Attachment K
Cell Sizing Worksheet

Appendix revised
to account for
Transfer Switch loading

By: H Robinson Date: _____

Check: _____ Date: _____

Cell Sizing Worksheet

Generation Date: 03/06/2008 10:51 am

Battery: 22

Lowest Expected Electrolyte Temp: 59 F		Minimum Cell Voltage: 1.88 VPC		Cell Mfg: EXIDE Cell Type: GN 23		Sized By:
(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity At T Min Rate Amps/Pos (RT)	(7) Required Section Size Positive Plates (3)/(6)
Section 1 - First 1 Periods Only - If A2 is greater than A1, go to Section A2.						
1	A1 = 372.77	A1 - A0 = 372.77	M1 = 1	T = M1 +...+ M1 = 1	89.76	4.15
					Sec 1 Total:	4.15
Section 3 - First 3 Periods Only - If A4 is greater than A3, go to Section A4.						
1	A1 = 372.77	A1 - A0 = 372.77	M1 = 1	T = M1 +...+ M3 = 21	71.72	5.20
2	A2 = 249.24	A2 - A1 = -123.53	M2 = 19	T = M2 +...+ M3 = 20	72.39	-1.71
3	A3 = 284.34	A3 - A2 = 35.1	M3 = 1	T = M3 +...+ M3 = 1	89.76	0.39
					Sec 3 Total:	3.88
Section 4 - First 4 Periods Only - If A5 is greater than A4, go to Section A5.						
1	A1 = 372.77	A1 - A0 = 372.77	M1 = 1	T = M1 +...+ M4 = 30	66.32	5.62
2	A2 = 249.24	A2 - A1 = -123.53	M2 = 19	T = M2 +...+ M4 = 29	66.82	-1.85
3	A3 = 284.34	A3 - A2 = 35.1	M3 = 1	T = M3 +...+ M4 = 10	79.98	0.44
4	A4 = 249.18	A4 - A3 = -35.17	M4 = 9	T = M4 +...+ M4 = 9	81.19	-0.43
					Sec 4 Total:	3.78
Section 6 - First 6 Periods Only - If A7 is greater than A6, go to Section A7.						
1	A1 = 372.77	A1 - A0 = 372.77	M1 = 1	T = M1 +...+ M6 = 90	46.09	8.09
2	A2 = 249.24	A2 - A1 = -123.53	M2 = 19	T = M2 +...+ M6 = 89	46.33	-2.67
3	A3 = 284.34	A3 - A2 = 35.1	M3 = 1	T = M3 +...+ M6 = 70	51.80	0.68
4	A4 = 249.18	A4 - A3 = -35.17	M4 = 9	T = M4 +...+ M6 = 69	52.09	-0.68
5	A5 = 248.43	A5 - A4 = -0.75	M5 = 30	T = M5 +...+ M6 = 60	54.71	-0.01
6	A6 = 248.85	A6 - A5 = 0.43	M6 = 30	T = M6 +...+ M6 = 30	66.32	0.01
					Sec 6 Total:	5.42
Section 8 - First 8 Periods Only - If A9 is greater than A8, go to Section A9.						
1	A1 = 372.77	A1 - A0 = 372.77	M1 = 1	T = M1 +...+ M8 = 120	40.65	9.17
2	A2 = 249.24	A2 - A1 = -123.53	M2 = 19	T = M2 +...+ M8 = 119	40.78	-3.03
3	A3 = 284.34	A3 - A2 = 35.1	M3 = 1	T = M3 +...+ M8 = 100	43.92	0.80
4	A4 = 249.18	A4 - A3 = -35.17	M4 = 9	T = M4 +...+ M8 = 99	44.12	-0.80
5	A5 = 248.43	A5 - A4 = -0.75	M5 = 30	T = M5 +...+ M8 = 90	46.09	-0.02
6	A6 = 248.85	A6 - A5 = 0.43	M6 = 30	T = M6 +...+ M8 = 60	54.71	0.01
7	A7 = 248.59	A7 - A6 = -0.27	M7 = 29	T = M7 +...+ M8 = 30	66.32	-0.00
8	A8 = 363.5	A8 - A7 = 114.92	M8 = 1	T = M8 +...+ M8 = 1	89.76	1.28
					Sec 8 Total:	7.41

Maximum Section Size (8) 7.42 + Random Section Size (9) 0.00 = Uncorrected Size - (US) (10) 7.42
US (11) 7.42 x Temp. Corr. (12) 1.118 x Design Margin (13) 1.00 x Aging Factor (14) 1.18 = (15) 9.75
When the cell size (15) is greater than the standard cell size, the next larger cell is required.
Required cell size (16) 10 Positive Plates. Therefore cell (17) _____ is required.

Attachment K
Cell Sizing Worksheet

Revised pages

By: Robert J. Keleher Date: 8/26/05

Check: [illegible] Date: 8-26-05

Cell Sizing Worksheet

Generation Date: 08/23/2005 08:19 pm

Battery: 22

Lowest Expected Electrolyte Temp: 60 F	Minimum Cell Voltage: 1.88 VPC	Cell Mfg: EXIDE Cell Type: GN 23	Sized By:

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity At T Min Rate Amps/Pos (RT)	(7) Required Section Size Positive Plates (3)/(6)
Section 1 - First 1 Periods Only - If A2 is greater than A1, go to Section A2.						
1	A1 = 283.31	A1 - A0 = 283.31	M1 = 1	T = M1 +...+ M1 = 1	91.48	3.10
					Sec 1 Total:	3.1
Section 3 - First 3 Periods Only - If A4 is greater than A3, go to Section A4.						
1	A1 = 283.31	A1 - A0 = 283.31	M1 = 1	T = M1 +...+ M3 = 21	73.20	3.87
2	A2 = 187.41	A2 - A1 = -95.9	M2 = 19	T = M2 +...+ M3 = 20	73.89	-1.30
3	A3 = 205.23	A3 - A2 = 17.82	M3 = 1	T = M3 +...+ M3 = 1	91.48	0.19
					Sec 3 Total:	2.76
Section 8 - First 8 Periods Only - If A9 is greater than A8, go to Section A9.						
1	A1 = 283.31	A1 - A0 = 283.31	M1 = 1	T = M1 +...+ M8 = 120	41.15	6.88
2	A2 = 187.41	A2 - A1 = -95.9	M2 = 19	T = M2 +...+ M8 = 119	41.29	-2.32
3	A3 = 205.23	A3 - A2 = 17.82	M3 = 1	T = M3 +...+ M8 = 100	44.55	0.40
4	A4 = 187.41	A4 - A3 = -17.82	M4 = 9	T = M4 +...+ M8 = 99	44.75	-0.40
5	A5 = 187.71	A5 - A4 = 0.3	M5 = 30	T = M5 +...+ M8 = 90	46.79	0.01
6	A6 = 187.82	A6 - A5 = 0.11	M6 = 30	T = M6 +...+ M8 = 60	55.70	0.00
7	A7 = 187.9	A7 - A6 = 0.08	M7 = 29	T = M7 +...+ M8 = 30	67.61	0.00
8	A8 = 288.98	A8 - A7 = 101.07	M8 = 1	T = M8 +...+ M8 = 1	91.48	1.10
					Sec 8 Total:	5.67

Maximum Section Size (8) 5.68 + Random Section Size (9) 0.00 = Uncorrected Size - (US) (10) 5.68
US (11) 5.68 x Temp. Corr. (12) 1.110 x Design Margin (13) 1.00 x Aging Factor (14) 1.11 = (15) 7.00
When the cell size (15) is greater than the standard cell size, the next larger cell is required.
Required cell size (16) 7 Positive Plates. Therefore cell (17) _____ is required.

Attachment L
Voltage Profile

Appendix revised
to account for
Transfer Switch loading

By: H Robinson Date: _____

Check: _____ Date: _____

Voltage Profile

Generation Date: 03/06/2008 10:51 am

E y: 22

Load (amperes)	Corrected Load (amps)	Time (min.)	AMP-HRS Removed	AMP-HR/ Pos Plt	AMPS/ Pos Plt	Cell Voltage (Volts)	Terminal Voltage (Volts)
372.77	490.11	1	8.17	0.74	44.56	* 1.975	114.57
249.24	327.70	2	13.63	1.24	29.79	* 2.000	116.00
249.24	327.70	3	19.09	1.74	29.79	2.000	116.00
249.24	327.70	4	24.55	2.23	29.79	2.000	116.00
249.24	327.70	5	30.01	2.73	29.79	2.000	115.98
249.24	327.70	6	35.48	3.23	29.79	1.998	115.91
249.24	327.70	7	40.94	3.72	29.79	1.997	115.84
249.24	327.70	8	46.40	4.22	29.79	1.996	115.76
249.24	327.70	9	51.86	4.71	29.79	1.995	115.69
249.24	327.70	10	57.32	5.21	29.79	1.993	115.61
249.24	327.70	11	62.78	5.71	29.79	* 1.992	115.54
249.24	327.70	12	68.25	6.20	29.79	1.991	115.47
249.24	327.70	13	73.71	6.70	29.79	1.990	115.41
249.24	327.70	14	79.17	7.20	29.79	1.989	115.36
249.24	327.70	15	84.63	7.69	29.79	* 1.988	115.32
249.24	327.70	16	90.09	8.19	29.79	1.988	115.28
249.24	327.70	17	95.55	8.69	29.79	1.987	115.24
249.24	327.70	18	101.02	9.18	29.79	1.986	115.20
249.24	327.70	19	106.48	9.68	29.79	1.986	115.17
249.24	327.70	20	111.94	10.18	29.79	1.985	115.15
284.34	373.84	21	118.17	10.74	33.99	* 1.977	114.66
249.18	327.61	22	123.63	11.24	29.78	* 1.984	115.10
249.18	327.61	23	129.09	11.74	29.78	* 1.984	115.08
249.18	327.61	24	134.55	12.23	29.78	* 1.984	115.06
249.18	327.61	25	140.01	12.73	29.78	1.983	115.02
249.18	327.61	26	145.47	13.22	29.78	1.983	114.99
249.18	327.61	27	150.93	13.72	29.78	1.982	114.97
249.18	327.61	28	156.39	14.22	29.78	1.982	114.93
249.18	327.61	29	161.85	14.71	29.78	1.981	114.88
249.18	327.61	30	167.31	15.21	29.78	1.980	114.84
248.43	326.63	31	172.75	15.70	29.69	1.979	114.79
248.43	326.63	32	178.20	16.20	29.69	1.978	114.74
248.43	326.63	33	183.64	16.69	29.69	1.977	114.67
248.43	326.63	34	189.09	17.19	29.69	1.976	114.61
248.43	326.63	35	194.53	17.68	29.69	1.974	114.48
248.43	326.63	36	199.97	18.18	29.69	1.973	114.43
248.43	326.63	37	205.42	18.67	29.69	1.972	114.38
248.43	326.63	38	210.86	19.17	29.69	1.971	114.33
248.43	326.63	39	216.31	19.66	29.69	* 1.970	114.28
248.43	326.63	40	221.75	20.16	29.69	* 1.969	114.23
248.43	326.63	41	227.19	20.65	29.69	* 1.969	114.17

'*' Denotes Extrapolated Data. Please Verify the Battery Characteristics Library.

Voltage Profile

Generation Date: 03/06/2008 10:51 am

Battery: 22

Load (amperes)	Corrected Load (amps)	Time (min.)	AMP-HRS Removed	AMP-HR/ Pos Plt	AMPS/ Pos Plt	Cell Voltage (Volts)	Terminal Voltage (Volts)
248.43	326.63	42	232.64	21.15	29.69	* 1.968	114.12
248.43	326.63	43	238.08	21.64	29.69	* 1.967	114.07
248.43	326.63	44	243.52	22.14	29.69	* 1.967	114.11
248.43	326.63	45	248.97	22.63	29.69	1.969	114.22
248.43	326.63	46	254.41	23.13	29.69	1.969	114.20
248.43	326.63	47	259.86	23.62	29.69	1.969	114.18
248.43	326.63	48	265.30	24.12	29.69	1.968	114.16
248.43	326.63	49	270.74	24.61	29.69	1.968	114.14
248.43	326.63	50	276.19	25.11	29.69	1.967	114.11
248.43	326.63	51	281.63	25.60	29.69	1.967	114.09
248.43	326.63	52	287.07	26.10	29.69	1.967	114.06
248.43	326.63	53	292.52	26.59	29.69	1.966	114.03
248.43	326.63	54	297.96	27.09	29.69	1.966	114.01
248.43	326.63	55	303.41	27.58	29.69	1.965	113.98
248.43	326.63	56	308.85	28.08	29.69	1.965	113.94
248.43	326.63	57	314.29	28.57	29.69	1.965	113.98
248.43	326.63	58	319.74	29.07	29.69	1.964	113.94
248.43	326.63	59	325.18	29.56	29.69	1.962	113.82
248.43	326.63	60	330.62	30.06	29.69	1.962	113.78
248.85	327.19	61	336.08	30.55	29.74	1.961	113.74
248.85	327.19	62	341.53	31.05	29.74	1.961	113.71
248.85	327.19	63	346.98	31.54	29.74	1.960	113.68
248.85	327.19	64	352.44	32.04	29.74	1.960	113.65
248.85	327.19	65	357.89	32.54	29.74	1.959	113.63
248.85	327.19	66	363.34	33.03	29.74	1.959	113.61
248.85	327.19	67	368.80	33.53	29.74	1.958	113.59
248.85	327.19	68	374.25	34.02	29.74	1.958	113.57
248.85	327.19	69	379.70	34.52	29.74	1.958	113.54
248.85	327.19	70	385.16	35.01	29.74	1.957	113.51
248.85	327.19	71	390.61	35.51	29.74	1.958	113.59
248.85	327.19	72	396.06	36.01	29.74	1.958	113.58
248.85	327.19	73	401.51	36.50	29.74	1.958	113.56
248.85	327.19	74	406.97	37.00	29.74	1.958	113.55
248.85	327.19	75	412.42	37.49	29.74	1.957	113.53
248.85	327.19	76	417.87	37.99	29.74	1.957	113.51
248.85	327.19	77	423.33	38.48	29.74	1.957	113.49
248.85	327.19	78	428.78	38.98	29.74	1.956	113.48
248.85	327.19	79	434.23	39.48	29.74	1.956	113.46
248.85	327.19	80	439.69	39.97	29.74	1.956	113.44
248.85	327.19	81	445.14	40.47	29.74	1.955	113.42
248.85	327.19	82	450.59	40.96	29.74	1.955	113.40

'*' Denotes Extrapolated Data. Please Verify the Battery Characteristics Library.

Voltage Profile

Generation Date: 03/06/2008 10:51 am

[illegible]y: 22

Load (amperes)	Corrected Load (amps)	Time (min.)	AMP-HRS Removed	AMP-HR/ Pos Plt	AMPS/ Pos Plt	Cell Voltage (Volts)	Terminal Voltage (Volts)
248.85	327.19	83	456.05	41.46	29.74	1.955	113.38
248.85	327.19	84	461.50	41.95	29.74	1.954	113.36
248.85	327.19	85	466.95	42.45	29.74	1.954	113.33
248.85	327.19	86	472.41	42.95	29.74	1.954	113.31
248.85	327.19	87	477.86	43.44	29.74	1.953	113.27
248.85	327.19	88	483.31	43.94	29.74	1.953	113.25
248.85	327.19	89	488.76	44.43	29.74	1.952	113.24
248.85	327.19	90	494.22	44.93	29.74	1.952	113.22
248.59	326.83	91	499.67	45.42	29.71	1.953	113.26
248.59	326.83	92	505.11	45.92	29.71	1.953	113.25
248.59	326.83	93	510.56	46.41	29.71	1.952	113.24
248.59	326.83	94	516.01	46.91	29.71	1.952	113.22
248.59	326.83	95	521.45	47.40	29.71	1.952	113.21
248.59	326.83	96	526.90	47.90	29.71	1.952	113.19
248.59	326.83	97	532.35	48.40	29.71	1.951	113.18
248.59	326.83	98	537.80	48.89	29.71	1.951	113.16
248.59	326.83	99	543.24	49.39	29.71	1.951	113.14
248.59	326.83	100	548.69	49.88	29.71	1.950	113.12
248.59	326.83	101	554.14	50.38	29.71	1.950	113.10
248.59	326.83	102	559.58	50.87	29.71	1.950	113.07
248.59	326.83	103	565.03	51.37	29.71	1.949	113.05
248.59	326.83	104	570.48	51.86	29.71	1.949	113.03
248.59	326.83	105	575.93	52.36	29.71	1.948	113.00
248.59	326.83	106	581.37	52.85	29.71	1.948	112.97
248.59	326.83	107	586.82	53.35	29.71	1.947	112.95
248.59	326.83	108	592.27	53.84	29.71	1.947	112.92
248.59	326.83	109	597.72	54.34	29.71	1.946	112.89
248.59	326.83	110	603.16	54.83	29.71	1.946	112.86
248.59	326.83	111	608.61	55.33	29.71	1.945	112.83
248.59	326.83	112	614.06	55.82	29.71	1.945	112.80
248.59	326.83	113	619.50	56.32	29.71	1.944	112.77
248.59	326.83	114	624.95	56.81	29.71	1.944	112.76
248.59	326.83	115	630.40	57.31	29.71	1.944	112.74
248.59	326.83	116	635.85	57.80	29.71	1.943	112.72
248.59	326.83	117	641.29	58.30	29.71	1.943	112.70
248.59	326.83	118	646.74	58.79	29.71	1.943	112.69
248.59	326.83	119	652.19	59.29	29.71	1.943	112.67
363.50	477.92	120	660.15	60.01	43.45	1.907	110.59

'*' Denotes Extrapolated Data. Please Verify the Battery Characteristics Library.

Attachment L
Voltage Profile

Revised page

By: Robert J. Fletcher Date: 8/26/05

Check: [signature] Date: 8-26-05

Voltage Profile

Generation Date: 08/23/2005 08:19 pm

Battery: 22

Load (amperes)	Corrected Load (amps)	Time (min.)	AMP-HRS Removed	AMP-HR/ Pos Plt	AMPS/ Pos Plt	Cell Voltage (Volts)	Terminal Voltage (Volts)
283.31	349.07	1	5.82	0.53	31.73	* 2.000	116.00
187.41	230.91	2	9.67	0.88	20.99	* 2.000	116.00
187.41	230.91	3	13.51	1.23	20.99	* 2.000	116.00
187.41	230.91	4	17.36	1.58	20.99	2.000	116.00
187.41	230.91	5	21.21	1.93	20.99	2.000	116.00
187.41	230.91	6	25.06	2.28	20.99	2.000	116.00
187.41	230.91	7	28.91	2.63	20.99	2.000	116.00
187.41	230.91	8	32.76	2.98	20.99	2.000	116.00
187.41	230.91	9	36.61	3.33	20.99	2.000	116.00
187.41	230.91	10	40.45	3.68	20.99	2.000	116.00
187.41	230.91	11	44.30	4.03	20.99	2.000	116.00
187.41	230.91	12	48.15	4.38	20.99	2.000	116.00
187.41	230.91	13	52.00	4.73	20.99	2.000	116.00
187.41	230.91	14	55.85	5.08	20.99	2.000	116.00
187.41	230.91	15	59.70	5.43	20.99	2.000	116.00
187.41	230.91	16	63.54	5.78	20.99	* 2.000	116.00
187.41	230.91	17	67.39	6.13	20.99	2.000	116.00
187.41	230.91	18	71.24	6.48	20.99	2.000	116.00
187.41	230.91	19	75.09	6.83	20.99	2.000	116.00
187.41	230.91	20	78.94	7.18	20.99	2.000	116.00
205.23	252.86	21	83.15	7.56	22.99	* 2.000	116.00
187.41	230.91	22	87.00	7.91	20.99	2.000	116.00
187.41	230.91	23	90.85	8.26	20.99	2.000	116.00
187.41	230.91	24	94.70	8.61	20.99	2.000	116.00
187.41	230.91	25	98.55	8.96	20.99	2.000	116.00
187.41	230.91	26	102.39	9.31	20.99	2.000	116.00
187.41	230.91	27	106.24	9.66	20.99	2.000	116.00
187.41	230.91	28	110.09	10.01	20.99	2.000	116.00
187.41	230.91	29	113.94	10.36	20.99	2.000	116.00
187.41	230.91	30	117.79	10.71	20.99	* 2.000	116.00
187.71	231.28	31	121.64	11.06	21.03	* 2.000	116.00
187.71	231.28	32	125.50	11.41	21.03	* 2.000	116.00
187.71	231.28	33	129.35	11.76	21.03	* 2.000	116.00
187.71	231.28	34	133.21	12.11	21.03	* 2.000	116.00
187.71	231.28	35	137.06	12.46	21.03	2.000	116.00
187.71	231.28	36	140.92	12.81	21.03	2.000	116.00
187.71	231.28	37	144.77	13.16	21.03	2.000	115.98
187.71	231.28	38	148.62	13.51	21.03	2.000	115.98
187.71	231.28	39	152.48	13.86	21.03	1.999	115.95
187.71	231.28	40	156.33	14.21	21.03	1.999	115.93
187.71	231.28	41	160.19	14.56	21.03	1.998	115.90

* Denotes Extrapolated Data. Please Verify the Battery Characteristics Library.

Voltage Profile

Generation Date: 08/23/2005 08:19 pm

Battery: 22

Load (amperes)	Corrected Load (amps)	Time (min.)	AMP-HRS Removed	AMP-HR/ Pos Plt	AMPS/ Pos Plt	Cell Voltage (Volts)	Terminal Voltage (Volts)
187.71	231.28	42	164.04	14.91	21.03	1.998	115.86
187.71	231.28	43	167.90	15.26	21.03	1.997	115.83
187.71	231.28	44	171.75	15.61	21.03	1.996	115.79
187.71	231.28	45	175.61	15.96	21.03	1.996	115.75
187.71	231.28	46	179.46	16.31	21.03	1.995	115.70
187.71	231.28	47	183.32	16.67	21.03	1.994	115.66
187.71	231.28	48	187.17	17.02	21.03	1.993	115.61
187.71	231.28	49	191.03	17.37	21.03	1.992	115.56
187.71	231.28	50	194.88	17.72	21.03	1.990	115.43
187.71	231.28	51	198.73	18.07	21.03	1.990	115.39
187.71	231.28	52	202.59	18.42	21.03	1.989	115.36
187.71	231.28	53	206.44	18.77	21.03	1.988	115.32
187.71	231.28	54	210.30	19.12	21.03	1.988	115.28
187.71	231.28	55	214.15	19.47	21.03	1.987	115.24
187.71	231.28	56	218.01	19.82	21.03	* 1.986	115.20
187.71	231.28	57	221.86	20.17	21.03	* 1.986	115.16
187.71	231.28	58	225.72	20.52	21.03	* 1.985	115.12
187.71	231.28	59	229.57	20.87	21.03	* 1.984	115.08
187.71	231.28	60	233.43	21.22	21.03	* 1.983	115.04
187.82	231.42	61	237.28	21.57	21.04	* 1.983	115.00
187.82	231.42	62	241.14	21.92	21.04	* 1.984	115.06
187.82	231.42	63	245.00	22.27	21.04	* 1.983	115.02
187.82	231.42	64	248.85	22.62	21.04	* 1.982	114.98
187.82	231.42	65	252.71	22.97	21.04	1.986	115.18
187.82	231.42	66	256.57	23.32	21.04	1.986	115.17
187.82	231.42	67	260.42	23.67	21.04	1.985	115.16
187.82	231.42	68	264.28	24.03	21.04	1.985	115.15
187.82	231.42	69	268.14	24.38	21.04	1.985	115.13
187.82	231.42	70	272.00	24.73	21.04	1.985	115.12
187.82	231.42	71	275.85	25.08	21.04	1.985	115.10
187.82	231.42	72	279.71	25.43	21.04	1.984	115.09
187.82	231.42	73	283.57	25.78	21.04	1.984	115.07
187.82	231.42	74	287.42	26.13	21.04	1.984	115.05
187.82	231.42	75	291.28	26.48	21.04	1.983	115.04
187.82	231.42	76	295.14	26.83	21.04	1.983	115.02
187.82	231.42	77	298.99	27.18	21.04	1.983	115.00
187.82	231.42	78	302.85	27.53	21.04	1.982	114.98
187.82	231.42	79	306.71	27.88	21.04	1.982	114.96
187.82	231.42	80	310.56	28.23	21.04	1.983	115.03
187.82	231.42	81	314.42	28.58	21.04	1.983	115.00
187.82	231.42	82	318.28	28.93	21.04	1.982	114.98

'*' Denotes Extrapolated Data. Please Verify the Battery Characteristics Library.

Voltage Profile

Generation Date: 08/23/2005 08:19 pm

Battery: 22

Load (amperes)	Corrected Load (amps)	Time (min.)	AMP-HRS Removed	AMP-HR/ Pos Plt	AMPS/ Pos Plt	Cell Voltage (Volts)	Terminal Voltage (Volts)
187.82	231.42	83	322.14	29.29	21.04	1.980	114.85
187.82	231.42	84	325.99	29.64	21.04	1.980	114.83
187.82	231.42	85	329.85	29.99	21.04	1.979	114.80
187.82	231.42	86	333.71	30.34	21.04	1.979	114.77
187.82	231.42	87	337.56	30.69	21.04	1.978	114.75
187.82	231.42	88	341.42	31.04	21.04	1.978	114.73
187.82	231.42	89	345.28	31.39	21.04	1.978	114.71
187.82	231.42	90	349.13	31.74	21.04	1.977	114.69
187.90	231.52	91	352.99	32.09	21.05	1.977	114.67
187.90	231.52	92	356.85	32.44	21.05	1.977	114.65
187.90	231.52	93	360.71	32.79	21.05	1.977	114.64
187.90	231.52	94	364.57	33.14	21.05	1.976	114.63
187.90	231.52	95	368.43	33.49	21.05	1.976	114.61
187.90	231.52	96	372.29	33.84	21.05	1.976	114.60
187.90	231.52	97	376.14	34.19	21.05	1.976	114.59
187.90	231.52	98	380.00	34.55	21.05	1.975	114.56
187.90	231.52	99	383.86	34.90	21.05	1.975	114.55
187.90	231.52	100	387.72	35.25	21.05	1.975	114.53
187.90	231.52	101	391.58	35.60	21.05	1.977	114.64
187.90	231.52	102	395.44	35.95	21.05	1.976	114.63
187.90	231.52	103	399.30	36.30	21.05	1.976	114.62
187.90	231.52	104	403.15	36.65	21.05	1.976	114.61
187.90	231.52	105	407.01	37.00	21.05	1.976	114.60
187.90	231.52	106	410.87	37.35	21.05	1.976	114.59
187.90	231.52	107	414.73	37.70	21.05	1.975	114.58
187.90	231.52	108	418.59	38.05	21.05	1.975	114.57
187.90	231.52	109	422.45	38.40	21.05	1.975	114.56
187.90	231.52	110	426.31	38.76	21.05	1.975	114.54
187.90	231.52	111	430.16	39.11	21.05	1.975	114.53
187.90	231.52	112	434.02	39.46	21.05	1.975	114.52
187.90	231.52	113	437.88	39.81	21.05	1.974	114.51
187.90	231.52	114	441.74	40.16	21.05	1.974	114.50
187.90	231.52	115	445.60	40.51	21.05	1.974	114.49
187.90	231.52	116	449.46	40.86	21.05	1.974	114.48
187.90	231.52	117	453.32	41.21	21.05	1.974	114.46
187.90	231.52	118	457.18	41.56	21.05	1.973	114.45
187.90	231.52	119	461.03	41.91	21.05	1.973	114.44
288.98	356.05	120	466.97	42.45	32.37	1.948	113.01

'*' Denotes Extrapolated Data. Please Verify the Battery Characteristics Library.

Attachment M
Load Profile Graph

Appendix revised
to account for
Transfer Switch loading

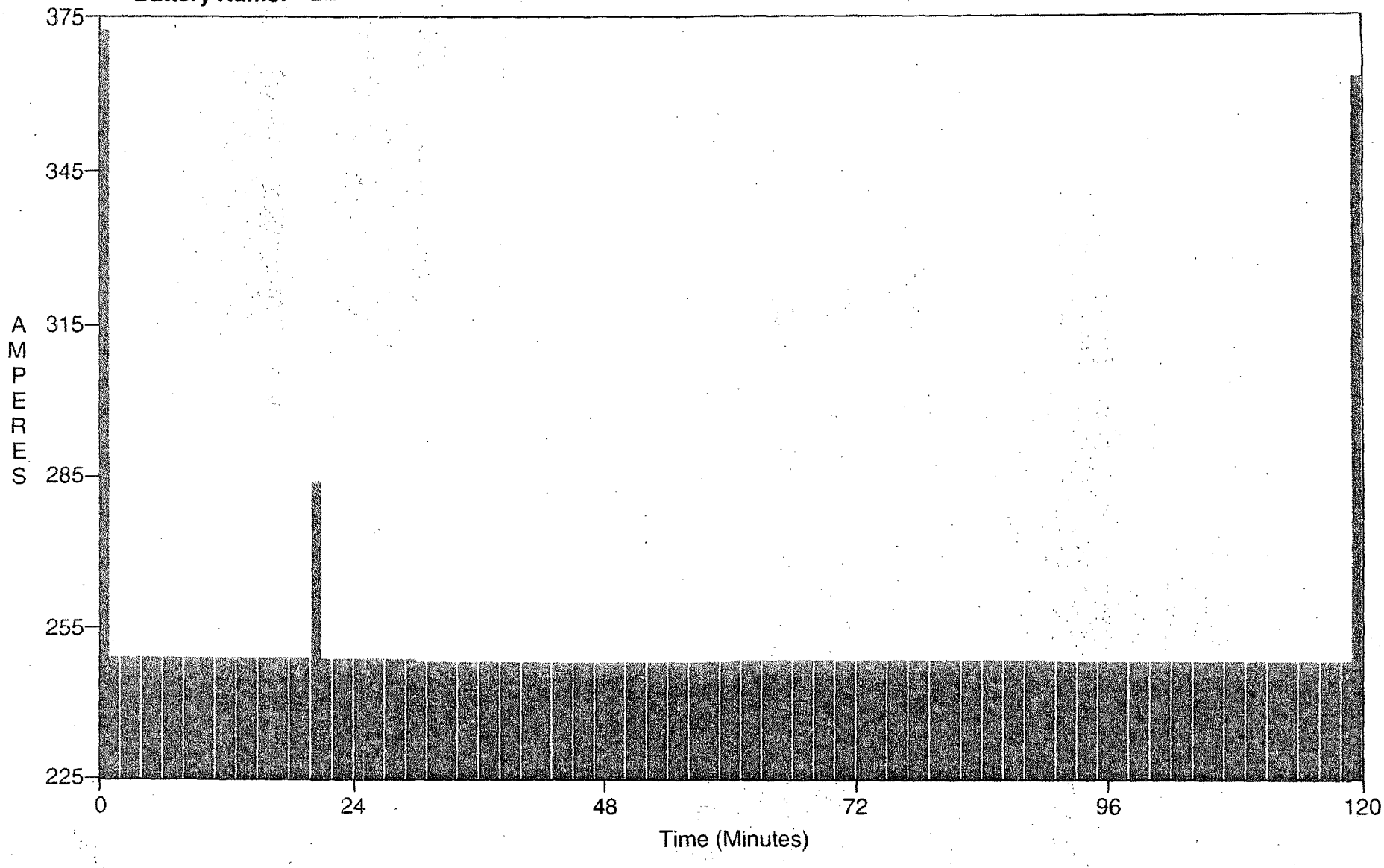
By: H Robinson Date: _____

Check: _____ Date: _____

LOAD PROFILE

Battery Name: 22

Generation Date: 03/06/2008 10:51 am



Attachment M
Load Profile Graph

Revised pages

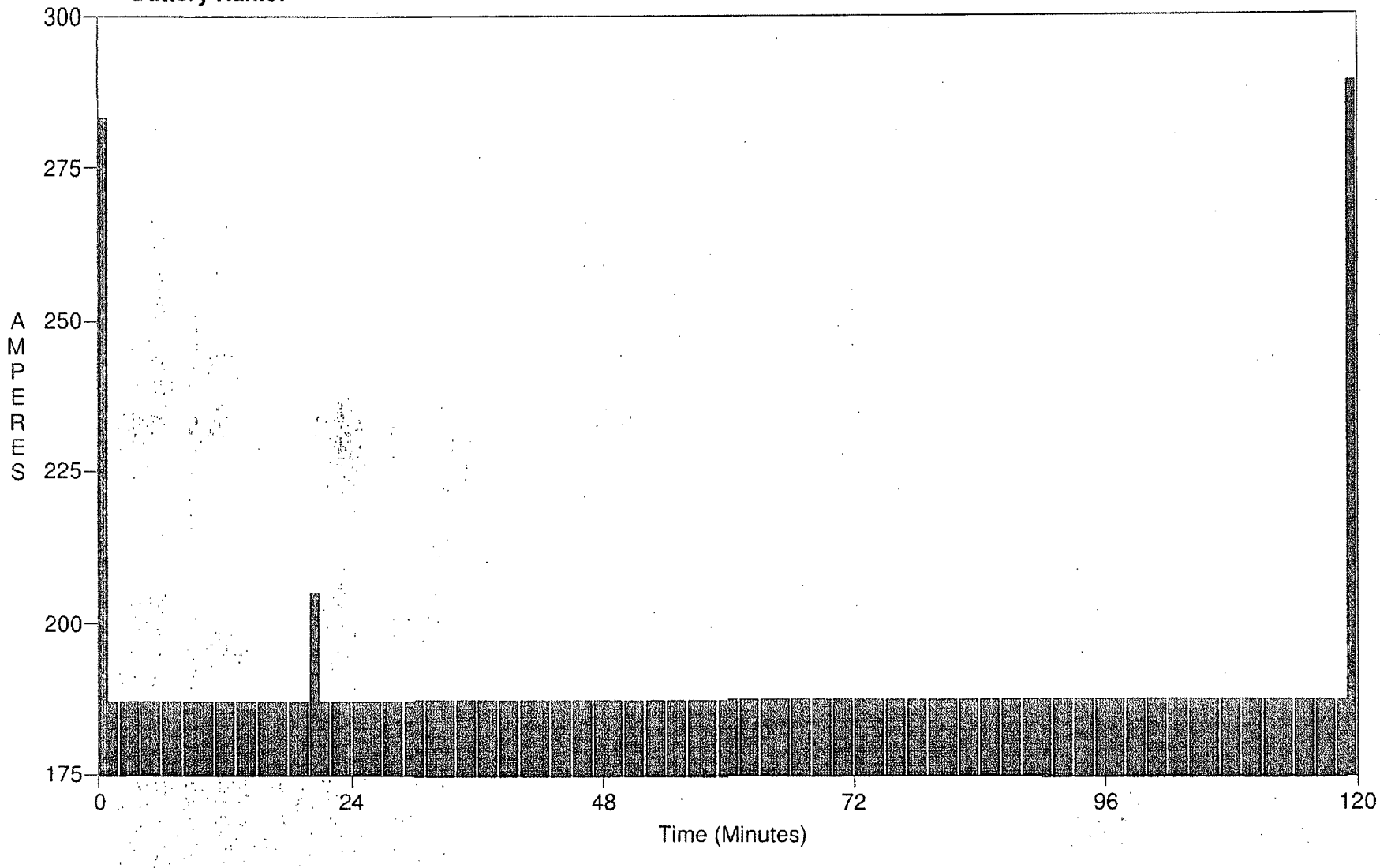
By: Robert J Fletcher Date: 8/26/05

Check: [signature] Date: 8-26-05

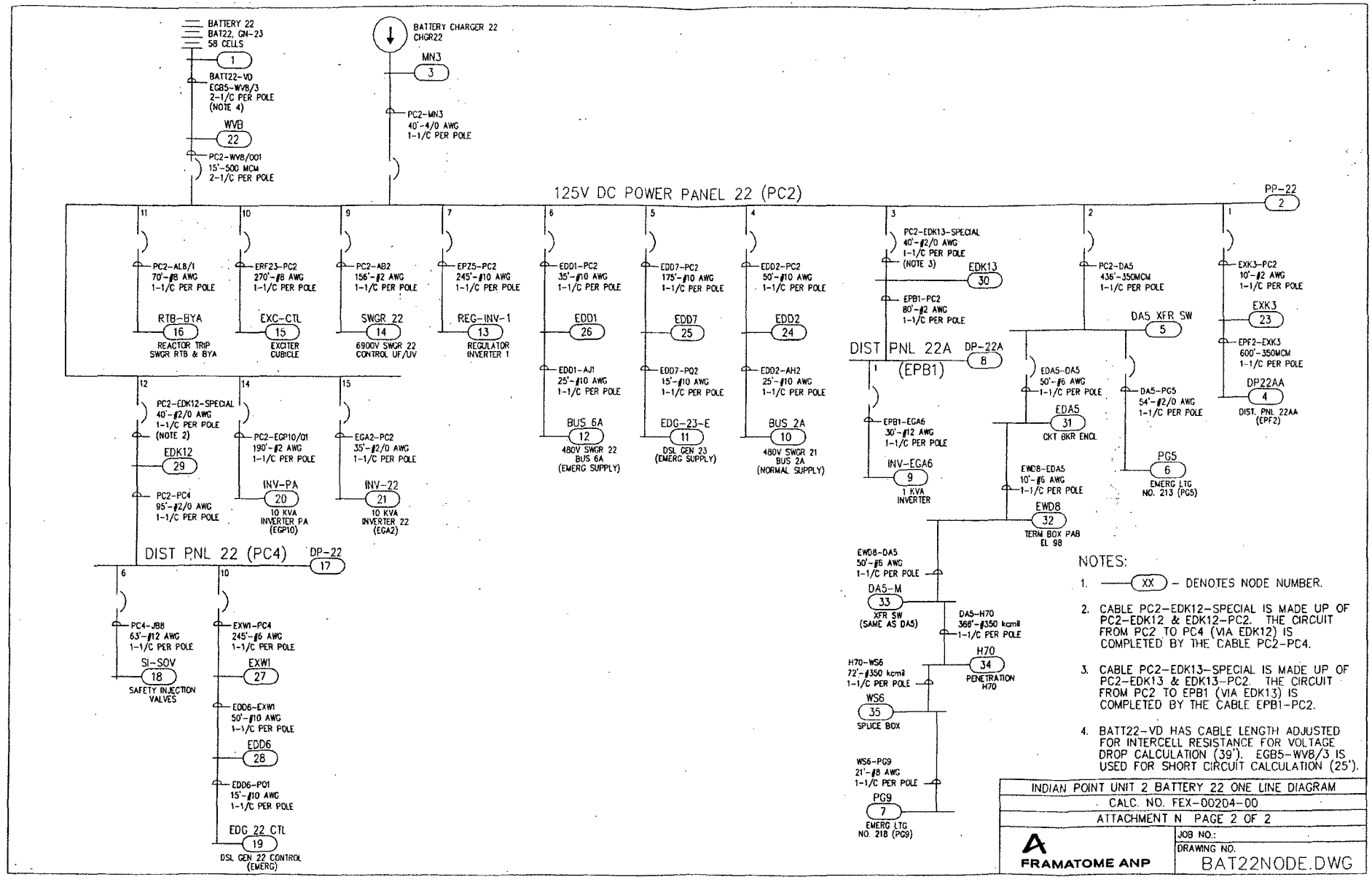
LOAD PROFILE

Battery Name: 22

Generation Date: 08/23/2005 08:19 pm



Attachment N
Battery 22 One Line Diagram


BATTERY 22
BAT22, GN-23
58 CELLS
1
BATT22-VD
EGB5-WV8/3
2-1/C PER POLE
(NOTE 4)
WV8
22
PC2-WV8/001
15'-500 MCM
2-1/C PER POLE
BATTERY CHARGER 22
CHGR22
MN3
3
PC2-MN3
40'-4/0 AWG
1-1/C PER POLE
125V DC POWER PANEL 22 (PC2)
PP-22
2
11
PC2-ALB/1
70'-#8 AWG
1-1/C PER POLE
RTB-BYA
16
REACTOR TRIP
SWGR RTB & BYA
10
ERF23-PC2
270'-#8 AWG
1-1/C PER POLE
EXC-CTL
15
EXCITER
CUBICLE
9
PC2-AB2
156'-#2 AWG
1-1/C PER POLE
SWGR 22
14
6900V SWGR 22
CONTROL UF/UV
7
EPZ5-PC2
245'-#10 AWG
1-1/C PER POLE
REG-INV-1
13
REGULATOR
INVERTER 1
6
EDD1-PC2
35'-#10 AWG
1-1/C PER POLE
EDD1
26
EDD1-AJ1
25'-#10 AWG
1-1/C PER POLE
BUS 6A
12
480V SWGR 22
BUS 6A
(EMERG SUPPLY)
5
EDD7-PC2
175'-#10 AWG
1-1/C PER POLE
EDD7
25
EDD7-PQ2
15'-#10 AWG
1-1/C PER POLE
EDG-23-E
11
DSL GEN 23
(EMERG SUPPLY)
4
EDD2-PC2
50'-#10 AWG
1-1/C PER POLE
EDD2
24
EDD2-AH2
25'-#10 AWG
1-1/C PER POLE
BUS 2A
10
480V SWGR 21
BUS 2A
(NORMAL SUPPLY)
3
PC2-EDK13-SPECIAL
40'-#2/0 AWG
1-1/C PER POLE
(NOTE 3)
EDK13
30
EPB1-PC2
80'-#2 AWG
1-1/C PER POLE
DIST PNL 22A
(EPB1)
DP-22A
8
1
EPB1-EGA6
30'-#12 AWG
1-1/C PER POLE
INV-EGA6
9
1 KVA
INVERTER
2
PC2-DA5
436'-350MCM
1-1/C PER POLE
DA5 XFR SW
5
EDA5-DA5
50'-#6 AWG
1-1/C PER POLE
EDA5
31
CKT BKR ENCL
DA5-PG5
54'-#2/0 AWG
1-1/C PER POLE
PG5
6
EMERG LTG
NO. 213 (PG5)
EWD8-EDA5
10'-#6 AWG
1-1/C PER POLE
EWD8
32
TERM BOX PAB
EL 98
1
EXK3-PC2
10'-#2 AWG
1-1/C PER POLE
EXK3
23
EPF2-EXK3
600'-350MCM
1-1/C PER POLE
DP22AA
4
DIST. PNL 22AA
(EPF2)
12
PC2-EDK12-SPECIAL
40'-#2/0 AWG
1-1/C PER POLE
(NOTE 2)
EDK12
29
PC2-PC4
95'-#2/0 AWG
1-1/C PER POLE
14
PC2-EGP10/01
190'-#2 AWG
1-1/C PER POLE
INV-PA
20
10 KVA
INVERTER PA
(EGP10)
15
EGA2-PC2
35'-#2/0 AWG
1-1/C PER POLE
INV-22
21
10 KVA
INVERTER 22
(EGA2)
DIST PNL 22 (PC4)
DP-22
17
6
PC4-JB8
63'-#12 AWG
1-1/C PER POLE
SI-SOV
18
SAFETY INJECTION
VALVES
10
EXW1-PC4
245'-#6 AWG
1-1/C PER POLE
EXW1
27
EDD6-EXW1
50'-#10 AWG
1-1/C PER POLE
EDD6
28
EDD6-PO1
15'-#10 AWG
1-1/C PER POLE
EDG 22 CTL
19
DSL GEN 22 CONTROL
(EMERG)
EWD8-DA5
50'-#6 AWG
1-1/C PER POLE
DA5-M
33
XFR SW
(SAME AS DA5)
DA5-H70
366'-#350 kcmil
1-1/C PER POLE
H70
34
PENETRATION
H70
H70-WS6
72'-#350 kcmil
1-1/C PER POLE
WS6
35
SPLICE BOX
WS6-PG9
21'-#8 AWG
1-1/C PER POLE
PG9
7
EMERG LTG
NO. 218 (PG9)
NOTES:
1. XX - DENOTES NODE NUMBER.
2. CABLE PC2-EDK12-SPECIAL IS MADE UP OF PC2-EDK12 & EDK12-PC2. THE CIRCUIT FROM PC2 TO PC4 (VIA EDK12) IS COMPLETED BY THE CABLE PC2-PC4.
3. CABLE PC2-EDK13-SPECIAL IS MADE UP OF PC2-EDK13 & EDK13-PC2. THE CIRCUIT FROM PC2 TO EPB1 (VIA EDK13) IS COMPLETED BY THE CABLE EPB1-PC2.
4. BATT22-VD HAS CABLE LENGTH ADJUSTED FOR INTERCELL RESISTANCE FOR VOLTAGE DROP CALCULATION (39'). EGB5-WV8/3 IS USED FOR SHORT CIRCUIT CALCULATION (25').
INDIAN POINT UNIT 2 BATTERY 22 ONE LINE DIAGRAM
CALC. NO. FEX-002D4-00
ATTACHMENT N PAGE 2 OF 2
FRAMATOME ANP
JOB NO.:
DRAWING NO.
BAT22NODE.DWG

Attachment O
Scenario Matrices

Battery 22 Composite

Battery	AC Source	DC Circuit	Location	Load Name	Load Type	Drwg (Subsection)	Description	I>0 Status	Time Step 01 0.00 00.0 - 0.00 01.9	Time Step 02 0.00 01.9 - 0.00 03.9	Time Step 03 0.00 03.9 - 0.00 03.9	Time Step 04 0.00 03.9 - 0.00 03.9	Time Step 05 0.00 03.9 - 0.00 04.9	Time Step 06 0.00 04.9 - 0.00 05.9	Time Step 07 0.00 05.9 - 0.00 06.9	Time Step 08 0.00 06.9 - 0.00 07.9	Time Step 09 0.00 07.9 - 0.00 08.9	Time Step 10 0.00 08.9 - 0.00 09.9	Time Step 11 0.00 09.9 - 0.00 10.9	Time Step 12 0.00 10.9 - 0.00 11.9	Time Step 13 0.00 11.9 - 0.00 12.9	Time Step 14 0.00 12.9 - 0.00 13.9	Time Step 15 0.00 13.9 - 0.00 14.9	Time Step 16 0.00 14.9 - 0.00 15.9	Time Step 17 0.00 15.9 - 0.00 16.9	Time Step 18 0.00 16.9 - 0.00 17.9	Time Step 19 0.00 17.9 - 0.00 18.9	Time Step 20 0.00 18.9 - 0.00 19.9	Time Step 21 0.00 19.9 - 0.00 20.9	Time Step 22 0.00 20.9 - 0.00 21.9	Time Step 23 0.00 21.9 - 0.00 22.9	Time Step 24 0.00 22.9 - 0.00 23.9	Time Step 25 0.00 23.9 - 0.00 24.9	Time Step 26 0.00 24.9 - 0.00 25.9	Time Step 27 0.00 25.9 - 0.00 26.9	Time Step 28 0.00 26.9 - 0.00 27.9	Time Step 29 0.00 27.9 - 0.00 28.9	Time Step 30 0.00 28.9 - 0.00 29.9
22	BUS 2A	PP22-4	Bus 2A-2GB	52/2AT5A	480v Bkr	9321-LL-3117 Sh 5	BUS TIE 2A-5A	Open																																
22	BUS 2A	PP22-4	Bus 2A-2GC	52/2ATDA	480v Bkr	9321-LL-3117 Sh 6	BUS TIE 2A-3A	Open																																
22	BUS 2A	PP22-4	Bus 2A-2HB	52/EG22	480v Bkr	9321-LL-3117 SH 8	EMERG DIESEL GEN 22	Open										X-Coil Energized	X-Coil & Close Coil Energized																				
22	BUS 2A	PP22-4	Bus 2A-2HC	52/MCC2A	480v Bkr	9321-LL-3117 SH 11	MCC 2NA	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GA	52/PSVZ	480v Bkr	8225149	SWT PNLT FOR PRESSURIZER HTR BKr GRP 22	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GH	52/MCC24A-MCC2N	480v Bkr	9321-LL-3117 SH 11	MCC 24 & 2NA	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GC	52/CC2	480v Bkr	8225150	COMPONENT COOLING PUMP 22	Closed	Trip Coil Energized																													X-Coil Energized	X-Coil & Close Coil Energized		
22	BUS 2A	PP22-4	Bus 2A-2GB	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GC	52/MC1	480v Bkr	8250467	AOD PWR SUPL MC 1&7 21	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2AA	52/SWZA	480v Bkr	8225147	SERVICE WATER PUMP & STRAINER 22	Closed	Trip Coil Energized															X-Coil Energized	X-Coil & Close Coil Energized														
22	BUS 2A	PP22-4	Bus 2A-2AB	52/SI2	480v Bkr	8225135	SAFETY INJECTION PUMP 22	Open	Trip Coil Voltage Analysis Only				X-Coil Energized	X-Coil & Close Coil Energized						X-Coil Energized	X-Coil & Close Coil Energized															Trip Coil Energized			
22	BUS 2A	PP22-4	Bus 2A-2AC	52/MCC10	480v Bkr	9321-LL-3117 SH 11	MCC 210	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2AA	52/SWP2	480v Bkr	8225141	SERVICE WATER PUMP 25 BKr FDR	Closed	Trip Coil Energized															X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only														
22	BUS 2A	PP22-4	Bus 2A-2GB	52/MCC3	480v Bkr	9321-LL-3117 SH 11	MCC 23	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GC	52/LTIN	480v Bkr	9321-LL-3117 SH 11	LIGHTING XFR BW 22 (NORM SUPL)	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GB	52/2A	480v Bkr	9321-LL-3117 SH 5	6 BKr SWGR BUS 2	Closed	Trip Coil Energized																															
22	BUS 2A	PP22-4	Bus 2A-2GC	52/CNV3	480v Bkr	8225152	CONTAINMENT RECIRC FAN 23	Closed	Trip Coil Energized																						X-Coil Energized	X-Coil & Close Coil Energized							
22	BUS 3	PP22-5	BUS 3-1	52/HDP21	6 Bkr Bkr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 3	PP22-5	BUS 3-1A	52/2SWV1	6 Bkr Bkr	9321-LL-3114 SH 20	SUS STA 2SWV3 XFMR	Closed																															
22	BUS 3	PP22-5	BUS 3-2	52/CWP28	6 Bkr Bkr	8231871	CIRC WTR PUMP 28	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 3	PP22-5	BUS 3-3	52/353	6 Bkr Bkr	9321-LL-3114 SH 10	STA SERVICE XFMR 3	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 3	PP22-5	BUS 3-4	52/RCP23	6 Bkr Bkr	9321-LL-3117 SH 7	REACTOR COOLING PUMP 23	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 3	PP22-5	BUS 3-5	52/UT3-5T6	6 Bkr Bkr	9321-LL-3114 S-1-3	BUS #3 - #5 T/E	Open		X-Coil Energized	X-Coil Energized Spring Charge Motor Invert	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running																								
22	BUS 3	PP22-5	BUS 3-7	52/UT3	6 Bkr Bkr	9321-LL-3114 S-1-2	UNIT AUX XFMR	Closed	Trip Coil Energized																															
22	BUS 4	PP22-6	BUS 4-10	52/CP23	6 Bkr Bkr	2321-LL-3114 SH 12	CONDENSATE PUMP 23	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 4	PP22-6	BUS 4-11	52/CWP24	6 Bkr Bkr	8231870	CIRC WTR PUMP 24	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 4	PP22-6	BUS 4-12	52/HDP22	6 Bkr Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 4	PP22-6	BUS 4-13	52/UT4-5T7	6 Bkr Bkr	9321-LL-3114 SH 5	BUS TIE 4 & 5	Open		X-Coil Energized	X-Coil Energized Spring Charge Motor Invert	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running																								
22	BUS 4	PP22-6	BUS 4-8	52/UT4	6 Bkr Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR	Closed	Trip Coil Energized																															
22	BUS 4	PP22-6	BUS 4-9	52/RCP22	6 Bkr Bkr	9321-LL-3114 SH 11	REACTOR COOLING PUMP 22	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 5	PP22-9	BUS 5-15	52/ST4	6 Bkr Bkr	9321-LL-3114 SH 6	STA AUX XFMR	Closed	Trip Coil Energized																															
22	BUS 5	PP22-9	BUS 5-16	52/CWP22	6 Bkr Bkr	8231869	CIRC WTR PUMP 22	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 5	PP22-9	BUS 5-17	52/SI2	6 Bkr Bkr	9321-LL-3114 SH 10	STA SERVICE XFMR 6	Closed																			Trip Coil Energized	Trip Coil Energized										
22	BUS 5	PP22-9	BUS 5-17A	52/GT2B	6 Bkr Bkr	9321-LL-3114 SH 18	GAS TURBINE GEN 1 & BUS 5 T/E	Open																															
22	N/A	PP22-14	N/A	EGP12	INV	9321-F-3250	10KVA STATIC INVERTER #4	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-15	N/A	EGA2	INV	4206402	10KVA STATIC INVERTER #2	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	CP22-5	DC DIST PNL 22A-1	EGA1	INV	4206401	1 KVA INVERTER	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	4P2-8400057	REGULATOR CUBICLE INVERTER #1	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PG8	PG8	EMERG LTG Pnl 213	EMG LTG	9321-F-3035	EMERG LTG PNL 213	Off	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PG8	PG8	EMERG LTG Pnl 213	EMG LTG	9321-F-3035	EMERG LTG PNL 213	Off	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-11	PP22-5B-2A-10-11	RTS-RTA	6 KRS	11Z6073	REACTOR TRIP SWGR RTB-SYA	Steady State	Trip Coils Energized																													

Battery 22 Composite

Battery	AC Bus/MCC	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	Time Step 20	Time Step 21	Time Step 22	Time Step 23	Time Step 24	Time Step 25.1	Time Step 26	Time Step 27	Comments	Automax Refs	Network Cons
								0.00.00.0 - 0.30.00.0	0.30.00.0 - 1.30.00.0	1.30.00.0 - 1.59.00.1	1.59.00.1 - 1.59.01.0	1.59.01.0 - 1.59.01.1	1.59.01.1 - 1.59.07.0	1.59.02.0 - 1.59.02.1	1.59.02.1 - 2.00.00.0			
22	BUS 2A	PP22-4	Bus 2A 209	52/2AT34	480v Bkr	9321-LL-3117 SH 3	BUS TIE 2A-5A									Breaker trips from UV on Buses 2A and 5A Relays 27-2A/X2, 27-2A/X12, 27-5A/X2, and 27-5A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-20C	52/2AT34	480v Bkr	9321-LL-3117 SH 9	BUS TIE 2A-3A									Breaker trips from UV Buses 2A and 3A Relays 27-2A/X2, 27-2A/X12, 27-5A/X2, and 27-5A/X12	9321-LL-3117 SH 2 9321-LL-3118 SH 2	
22	BUS 2A	PP22-4	Bus 2A-21B	52/EG2A	480v Bkr	9321-LL-3117 SH 8	EMERG DIESEL GEN 22			X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only					EDG Output Breaker Closes at t=10s		
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC8A	480v Bkr	9321-LL-3117 SH 11	MCC 28A									Breaker Trips on UV from 27-2A/X2 or 27-2A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A 22A	52/PBV2	480v Bkr	9220145	DIST PNL FOR PRESSURIZER HTR B-U GRP 22									Breaker Trips on UV from 27-2A/X2 or 27-2A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A,MCC24	480v Bkr	9321-LL-3117 SH 13	MCC 24 & 24A			X-Coil Energized	X-Coil & Close Coil Energized					Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A 22C	52/CC2	480v Bkr	9220150	COMPONENT COOLING PUMP 22									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13 Breaker Close at t=1.5s on LOOP with no SI No Closure Signal with SI	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-23B	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2 9321-LL-3117 SH 21A	
22	BUS 2A	PP22-4	Bus 2A-23C	52/MQ1	480v Bkr	9229007	ROD PWR SUPL MG SET 21									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24A	52/SWP2A	480v Bkr	9229147	SERVICE WATER PUMP 6 STRA NEA 22									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13 Either BW7 or BW9 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24B	52/SI2A	480v Bkr	9229136	SAFETY INJECTION PUMP 22									Breaker trips from UV from 27-2A/X3 or 27-2A/X13 Breaker Close at t=13s with SI Signal	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC10	480v Bkr	9321-LL-3117 SH 11	MCC 210									Breaker Trips on UV from 27-2A/X2 or 27-2A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25A	52/SWP2B	480v Bkr	9229141	SERVICE WATER PUMP 25 B-U FOR									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13 Either BW7 or BW9 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Bkr	9321-LL-3117 SH 11	MCC 23									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25C	52/LTIN	480v Bkr	9321-LL-3117 SH 11	LIGHTING AUX SW 22 (NORM SUPPL)									Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-26B	52/2A	480v Swgr	9321-LL-3117 SH 8	6.9KV SWGR BUS 2			X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only					Breaker trips after an unknown time delay Relays 62/2A and 62/12A	9321-LL-3117 SH 3A	Time Delay Unknown Conservatively modeled concurrent with max number of trip rates in the first minute
22	BUS 2A	PP22-4	Bus 2A-26C	52/CRF3	480v Bkr	9229152	CONTAINMENT RECIRC FAN 23									Breaker Trips on UV from 27-2A/X2 or 27-2A/X13 Breaker Close at t=30s with SI Signal	9321-LL-3117 SH 2	
22	BUS 3	PP22-9	Bus 3-3	52/HDP21	6.9kv Bkr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21									Breaker Trips on UV from 27-3A/2X	9321-LL-3123	30 second time delay to trip
22	BUS 3	PP22-9	Bus 3-1A	52/SWP1	6.9kv Bkr	9321-LL-3114 SH 20	SUS STA SERVS STAR									No UV Trip		
22	BUS 3	PP22-9	BUS 3-2	52/CWP2B	6.9kv Bkr	9229171	CIRC WTR PUMP 2B									Breaker Trips on UV from 27-3A/2X	9-129123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-3	52/SS2	6.9kv Bkr	9321-LL-3114 SH 19	STA SERVICE XFMR 3									Breaker Trips on UV from 27-3A/2X	9129123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-4	52/RCP23	6.9kv Bkr	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23									Breaker Trips on UV from 27-3A/2X	9129123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-5	52/UT4-5T6	6.9kv Bkr	9321-LL-3114 SH 3	BUS #3 - #5 TIE							A-Coil Energized	X-Coil Energized Spring Charge Motor Inhibit	Lockout Trips from 86/UT3 and 86/ST6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 3	PP22-9	BUS 3-7	52/UT3	6.9kv Bkr	9321-LL-3114 Sh 2	UNIT AUX XFMR									Lockout Trip from 86/UT3, 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-1C	52/CP23	6.9kv Bkr	9229141-3114 SH 12	CONDENSATE PUMP 23									Breaker Trips on UV from 27-4A/2X	9129124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1D	52/CWP2A	6.9kv Bkr	9229170	CIRC WTR PUMP 2A									Breaker Trips on UV from 27-4A/2X	9129124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1E	52/HDP22	6.9kv Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22									Breaker Trips on UV from 27-4A/2X	9229124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1J	52/UT4-5T6	6.9kv Bkr	9321-LL-3114 SH 3	BUS TIE 4 & 5									Lockout Trips from 86/UT4 and 86/ST6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 4	PP22-3	BUS 4-6	52/UT4	6.9kv Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR									Lockout Trip from 86/UT4, 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-9	52/RCP22	6.9kv Bkr	9321-LL-3114 SH 11	REACTOR COOLING PUMP 22									Breaker Trips on UV from 27-4A/2X	9229124	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-1E	52/ST6	6.9kv Bkr	9321-LL-3114 SH 5	STA AUX XFMR					X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only			Lockout Trip from 86/UST6 86/STP, 86/BU No UV Trip	9321-LL-3114 SH 18 9321-LL-3132 Sh 3 9321-LL-3132 Sh 4	
22	BUS 6	PP22-9	BUS 6-1F	52/CWP22	6.6kv Bkr	9229169	CIRC WTR PUMP 22									Breaker Trips on UV from 27-6A/2X	9129126	30 second time delay to trip
22	BUS 5	PP22-3	BUS 5-7	52/3S6	6.9kv Bkr	9321-LL-3114 SH 18	STA SERVICE XFMR 6					X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only			Breaker Trips on UV from 27-6A/2X	9129126	30 second time delay to trip
22	BUS 5	PP22-3	Bus 5-17A	52/GT24	6.9kv Bkr	9321-LL-3114 SH 18	GAS TURBINE GEN 1 & BUS 5 TIE					X-Coil Energized	X-Coil & Close Coil Energized			Lockout Trip from 86/UST6 No UV Trip	9321-LL-3114 SH 18	
22	N/A	PP22-14	N/A	EQP10	INV	9321-F-3220	10KVA STATIC INVERTER #A	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-15	N/A	EQP2	INV	A208002	10KVA STATIC INVERTER 22	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	CP22-1	DC DIST PNL 22A-1	EQ58	D/V	208002	1 KVA INVERTER	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	(P2--B-0000-7	REGULATOR CUBICLE INVERTER #1	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PG4	PG9	EMERG LTG PNL 21B	EVG LTG	9321-F-3035	EMERG LTG PNL 21A	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PG3	PG8	EMERG LTG PNL 21A	EMG LTG	9321-F-3035	EMERG LTG PNL 21B	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PV22-11	POWER PNL 22-11	MTR-BYA	4KV SWGR 4KRS	1124 073	REACTOR TRIP SWGR MTR BYA											

Battery 22 SBO

Battery	Alt. SA/GR	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	Pre-Status	Time Step 01 0 00 00 0 - 0 00 01 9	Time Step 02 0 00 01 0 - 0 00 30 9	Time Step 03 0 00 30 0 - 0 00 30 1	Time Step 04 0 00 30 1 - 0 00 31 0	Time Step 05 0 00 31 0 - 0 01 00 9	Time Step 06 0 01 00 0 - 0 30 00 0	Time Step 07 0 30 00 0 - 1 00 00 0	Time Step 08 0 30 00 0 - 0 58 00 9	Time Step 09 0 58 00 0 - 0 58 00 1	Time Step 10 0 58 00 1 - 0 59 01 0	Time Step 11 0 59 01 0 - 0 59 01 1	Time Step 12 0 59 01 1 - 0 59 02 0	Time Step 13 0 59 02 0 - 0 59 02 1	Time Step 14 0 59 02 1 - 1 00 00 0	Comments	Additional Refs	Setpoint Calc
22	BUS 2A	PP22-4	Bus 2A 2P9	52/2AT5A	480v Bkr	9321-LL-3117 SH 5	BUS TIE 2A-5A	Open															Breaker trips from UV on buses 2A and 5A Relays 27-2AX2, 27-2AX12, 27-5AX2, and 27-5AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-2P6	52/2AT3A	480v BH	9321-LL-3117 SH 5	BUS TIE 2A-3A	Open															Breaker trips from UV buses 2A and 3A Relays 27-2AX2, 27-2AX12, 27-3AX2, and 27-5AX12	9321-LL-3117 SH 2 9321-LL-3119 SH 2	
22	BUS 2A	PP22-4	Bus 2A-2H6	52/EG2A	480v Bkr	9321-LL-3117 SH 8	EMERG DIESEL GEN 22	Open									X-Coil Voltage Analyse Only	X-Coil & Close Coil Voltage Analyse Only					EDG Output Breaker Closes at t=10s		
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCCNA	480v Bkr	9321-LL-3117 SH 11	MCC 24A	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22A	52/PHU2	480v Bkr	8225145	DIST PNL FOR PRESSURIZER HTR BAI GRP 22	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A-MCC24	480v Bkr	9321-LL-3117 SH 11	MCC 24 & 24A	Closed	Trip Coil Energized								X-Coil Energized	X-Coil & Close Coil Energized					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22C	52/CC2	480v Bkr	8225160	COMPONENT COOLING PUMP 22	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX2 or 27-2AX12 Breaker Closes at t=18s on LOOP with No SI As Closure Signal with SI	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22D	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2 9321-LL-3117 SH 21B	
22	BUS 2A	PP22-4	Bus 2A-23C	52/MG1	480v Bkr	8253867	ROD PWR SUPLMG SET 21	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24A	52/SWP2A	480v Bkr	8225147	SERVICE WATER PUMP & STRAINER 22	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13 Either SW2 or SWS Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24B	52/SIA	480v Bkr	8225135	SAFETY INJECTION PUMP 22	Open	Trip Coil Voltage Analyse Only														Breaker trips from UV from 27-3AX3 or 27-3AX13 Breaker Closes at t=13s with SI Signal	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC10	480v Bkr	9321-LL-3117 SH 11	MCC 210	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25A	52/SWP8	480v Bkr	8225141	SERVICE WATER PUMP 25 BAI FSR	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13 Either SW2 or SWS Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Bkr	9321-LL-3117 SH 11	MCC 23	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25C	52/LTIN	480v Bkr	9321-LL-3117 SH 11	LIGHTING XFR E/N 22 (NORM SUPL)	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-26B	52/3A	480v Bkr	9321-LL-3117 SH 8	69kV EAGR BUS 2	Closed	Trip Coil Energized								7-Coil Voltage Analyse Only	X-Coil & Close Coil Voltage Analyse Only					Breaker trips after an unknown time delay Relays 62/2A and 62-1/2A	9321-LL-3117 SH 3A	Time Delay Unknown Conservatively modeled concurrent with max run time of trip coils at the first minute
22	BUS 2A	PP22-4	Bus 2A-26C	52/CBF3	480v Bkr	8225152	CONTAINMENT RECIRC FAN 23	Closed	Trip Coil Energized														Breaker Trips on UV from 27-2AX3 or 27-2AX13 Breaker Closes at t=32s with SI Signal	9321-LL-3117 SH 2	
22	BUS 3	PP22-9	BUS 3-1	52/HDP21	6.9kv Bkr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-3AX2X	8225173	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-1A	52/SSW3	6.9kv Bkr	9321-LL-3114 SH 20	SUB STA 22/SWS 4/MBR	Closed															No UV Trip		
22	BUS 3	PP22-9	BUS 3-2	52/CWP2A	6.9kv Bkr	8231671	CIRC WTR PUMP 2A	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-3AX2X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-3	52/SS3	6.9kv Bkr	9321-LL-3114 SH 16	STA SERVICE XFMR 3	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-3AX2X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-4	52/RCP22	6.9kv Bkr	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-3AX2X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-5	52/UT3-5T6	6.9kv Bkr	9321-LL-3114 SH 3	BUS #3 - #5 TIE	Open												X-Coil Energized	X-Coil Energized Spring Charge Motor (when	Lockout Trips from 86/UT3 and 86/ST6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 1	PP22-9	BUS 3-7	52/UT3	6.9kv Bkr	9321-LL-3114 SH 2	UNIT AUX XFMR	Closed	Trip Coil Energized														Lockout Trip from 86/UT3, 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-10	52/CP23	6.9kv Bkr	9321-LL-3114 SH 12	CONDENSATE PUMP 23	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-4P2X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-11	52/CWP24	6.9kv Bkr	8231670	CIRC WTR PUMP 24	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-4P2X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-12	52/HDP22	6.9kv Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-4P2X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-13	52/ST4-5T6	6.9kv Bkr	9321-LL-3114 SH 5	BUS TIE 4 & 5	Open															Lockout Trips from 86/UT4 and 86/ST6 No UV Trip	9321-LL-3114 Sh 17	
22	BUS 4	PP22-9	BUS 4-14	52/UT4	6.9kv Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR	Closed	Trip Coil Energized														Lockout Trip from 86/UT4, 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-15	52/RCP22	6.9kv Bkr	9321-LL-3114 SH 13	REACTOR COOLING PUMP 22	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-4P2X	8225124	30 second time delay to trip
22	BUS 5	PP22-9	BUS 5-16	52/ST5	6.9kv Bkr	9321-LL-3114 SH 16	STA AUX XFMR	Closed	Trip Coil Energized										X-Coil Voltage Analyse Only	X-Coil & Close Coil Voltage Analyse Only			Lockout Trip from 86/ST6, 86/STP, 86/STBU No UV Trip	9321-LL-3114 SH 18 9321-LL-3132 Sh 3 9321-LL-3132 Sh 4	
22	BUS 5	PP22-9	BUS 5-17	52/CWP22	6.9kv Bkr	8231669	CIRC WTR PUMP 22	Closed			Trip Coil Energized	Trip Coil Energized											Breaker Trips on UV from 27-5P2X	8225125	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-18	52/SS8	6.9kv Bkr	9321-LL-3114 SH 16	STA SERVICE XFMR 8	Closed			Trip Coil Energized	Trip Coil Energized							X-Coil Voltage Analyse Only	X-Coil & Close Coil Voltage Analyse Only			Breaker Trips on UV from 27-5P2X	8225125	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-17A	52/GT26	4.9kv Bkr	9321-LL-3114 SH 18	GAS TURBINE GEN 1 & BUS 6-17	Open											X-Coil Energized	X-Coil & Close Coil Energized			Lockout Trip from 86/GT6 No UV Trip	9321-LL-3114 SH 18	
22	N/A	PP22-14	N/A	EGF16	Inv	9321-L-3250	10KVA STATIC INVERTER HA	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-13	N/A	EGAD	Inv	A226620	10KVA STATIC INVERTER 2D	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	MCC22-3	DC 2-3ST PNL 22A-1	EGAE	Inv	226622	1 KVA INVERTER	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PCS	PCS	REGULATOR CUBICLE INVERTER #1	Inv	HP3-S400X57	REGULATOR CUBICLE INVERTER #1	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PCS	PCS	EMERG LTG PNL 216	EMG LTG	9321-F-3035	EMERG LTG PNL 216	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PCS	PCS	EMERG LTG PNL 215	EMG LTG	9321-F-3035	EMERG LTG PNL 215	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-11	PCWS + SWL PP 11	ATB-BYA	RA TRP BKRS	1106571	REACTOR TRIP SWSH RTB-BYA	Steady State	Trip Coil Energized																

Battery 22 LOOP Only

Battery	AC SWGR	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	NOR Status	Time Step 01 - 0 00 00.0 - 0 00 01.6	Time Step 02 - 0 00 01.6 - 0 00 02.0	Time Step 03 - 0 00 02.0 - 0 00 05.0	Time Step 04 - 0 00 05.0 - 0 00 18.6	Time Step 05 - 0 00 18.6 - 0 00 19.0	Time Step 06 - 0 00 19.0 - 0 00 31.0	Time Step 07 - 0 00 31.0 - 0 00 31.6	Time Step 08 - 0 00 31.6 - 0 00 19.0	Time Step 09 - 0 00 19.1 - 0 00 20.6	Time Step 10 - 0 00 20.6 - 0 00 25.6	Time Step 11 - 0 00 25.6 - 0 00 25.1	Time Step 12 - 0 00 25.1 - 0 00 26.0	Time Step 13 - 0 00 26.0 - 0 00 30.6	Time Step 14 - 0 00 30.6 - 0 00 30.1	Time Step 15 - 0 00 30.1 - 0 01 31.6	Time Step 16 - 0 01 30.6 - 0 01 00.0	Time Step 17 - 0 01 00.0 - 0 20 00.0	Time Step 18 - 0 20 00.0 - 0 20 01.0	Time Step 19 - 0 20 01.0 - 0 20 01.1	Time Step 20 - 0 20 01.1 - 0 21 00.0	Time Step 21 - 0 21 00.0 - 0 30 36.6	Time Step 22 - 0 30 00.0 - 1 00 00.0	Time Step 23 - 1 00 00.0 - 1 30 00.0	Time Step 24 - 1 30 00.0 - 1 58 00.0	Time Step 25 - 1 58 00.0 - 1 58 00.1	Time Step 26 - 1 58 00.1 - 1 58 01.0
22	BUS 2A	PP22-4	Bus 2A 26B	52/2A15A	480v Bkr	9321-LL-3117 SH 5	BUS TIE 2A 5A	Open																										
22	BUS 2A	PP22-4	Bus 2A-20C	52/2A12A	480v Bkr	9321-LL-3117 Sh 8	BUS TIE 2A-2A	Open																										
22	BUS 2A	PP22-4	Bus 2A-21B	52/EG2A	480v Bkr	9321-LL-3117 Sh 8	EMERG DIESEL GEN 22	Open					X-Coil Energizes	X-Coil & Close Coil Energized																		X-Coil Voltage Analyses Only	X-Coil & Close Coil Voltage Analyses Only
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC6A	480v Bkr	9321-LL-3117 SH 11	MCC 26A	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-22A	52/PSV2	480v Bkr	B229145	DIST PNL FOR PRESSURIZER HTR BAT GRP 22	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A-MCC24	480v Bkr	9321-LL-3117 SH 11	MCC 24 & 24A	Closed	Trip Coil Energized																								X-Coil Energized	X-Coil & Close Coil Energized
22	BUS 2A	PP22-4	Bus 2A-22C	52/CC2	480v Bkr	B229150	COMPONENT COOLING PUMP 22	Closed	Trip Coil Energized							X-Coil Energizes	X-Coil & Close Coil Energized																	
22	BUS 2A	PP22-4	Bus 2A-23B	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-23C	52/MG1	480v Bkr	B258867	ROD PWR SUPL MG SET 21	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-24A	52/SW2A	480v Bkr	B229147	SERVICE WATER PUMP & STRAINER 22	Closed	Trip Coil Energized											X-Coil Energizes	X-Coil & Close Coil Energized													
22	BUS 2A	PP22-4	Bus 2A-24B	52/SI2A	480v Bkr	B229135	SAFETY INJECTION PUMP 22	Open	Trip Coil Voltage Analyses Only																									
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC10	480v Bkr	9321-LL-3117 SH 11	MCC 210	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-25A	52/SWS2	480v Bkr	B229141	SERVICE WATER PUMP 29 BSF FOR	Closed	Trip Coil Energized											X-Coil Voltage Analyses Only	X-Coil Voltage Analyses Only													
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Bkr	9321 LL 3117 SH 11	MCC 23	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-25C	52/LTIN	480v Bkr	9321-LL-3117 SH 11	LIGHTING XFR SW 22 (NORM SUPL)	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-26B	52/2A	480v Bkr	9321-LL-3117 SH 8	6 KV SWGR BUS 2	Closed	Trip Coil Energized																								X-Coil Voltage Analyses Only	X Coil & Close Coil Voltage Analyses Only
22	BUS 2A	PP22-4	Bus 2A-29C	52/CRF2	480v Bkr	B229152	CONTAINMENT RECIRC FAN 23	Closed	Trip Coil Energized																									
22	BUS 3	PP22-8	BUS 3-1	52/HDP21	6 Kv Bkr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 3	PP22-8	BUS 3-1A	52/22RW3	6 Kv Bkr	9321-LL-3114 SH 20	SUS STA 22RW3 XFMR	Closed																									
22	BUS 3	PP22-8	BUS 3-2	52/CWP26	6 Kv Bkr	B231671	CIRC WTR PUMP 26	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 3	PP22-8	BUS 3-3	52/SS3	6 Kv Bkr	9321-LL-3114 Sh 10	STA SERVICE XRMR 3	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 3	PP22-8	BUS 3-4	52/RCP23	6 Kv Bkr	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 3	PP22-8	BUS 3-5	52/UT3-BTS	6 Kv Bkr	9321-LL-3114 SH 3	BUS #3 - #5 TIE	Open																									
22	BUS 3	PP22-8	BUS 3-7	52/UT3	6 Kv Bkr	9321-LL-3114 SH 2	UNIT AUX XFMR	Closed	Trip Coil Energized																									
22	BUS 4	PP22-8	BUS 4-10	52/CP23	6 Kv Bkr	9321-LL-3114 SH 12	CONDENSATE PUMP 23	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 4	PP22-8	BUS 4-11	52/CWP24	6 Kv Bkr	B231670	CIRC WTR PUMP 24	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 4	PP22-8	BUS 4-12	52/HDP22	6 Kv Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 4	PP22-8	BUS 4-13	52/UT4-BTS	6 Kv Bkr	9321-LL-3114 SH 5	BUS TIE 4 & 6	Open																									
22	BUS 4	PP22-8	BUS 4-8	52/UT4	6 Kv Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR	Closed	Trip Coil Energized																									
22	BUS 4	PP22-8	BUS 4-9	52/RCP22	6 Kv Bkr	9321-LL-3114 SH 13	REACTOR COOLING PUMP 22	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 6	PP22-8	BUS 6-15	52/ST6	6 Kv Bkr	9321-LL-3114 Sh 9	STA AUX XFMR	Closed	Trip Coil Energized														Trip Coil Energized	Trip Coil Energized									
22	BUS 6	PP22-8	BUS 6-16	52/CWP22	6 Kv Bkr	B231668	CIRC WTR PUMP 22	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 6	PP22-8	BUS 6-17	52/SS6	6 Kv Bkr	9321-LL-3114 Sh 10	STA SERVICE XRMR 6	Closed															Trip Coil Energized	Trip Coil Energized									
22	BUS 6	PP22-8	BUS 6-17A	52/GT25	6 Kv Bkr	9321-LL-3114 Sh 15	GAS TURBINE GEN 5 & BUS 6 TIE	Open																									
22	N/A	PP22-14	N/A	EQP10	INV	9321 F-3256	10kVA STATIC INVERTER 2A	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-15	N/A	EQA2	INV	A2E4502	INVERTER 2A	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	EP22-3	DC DIST PNL 22A-1	EQA6	INV	206000	1 KVA INVERTER	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
23	N/A	PP22-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	IPZ-B-000267	REGULATOR CUBICLE INVERTER #1	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PD5	PD5	EMERG LTG PNL 21A	EMG LTR	9321-F-3035	EMERG LTG PNL 21A	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PD5	PD5	EMERG LTG PNL 21B	EMG LTR	9321-F-3035	EMERG LTG PNL 21B	Off	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-11	POWER PNL 22-1	RTB-BYA	AUTMP BKR	1105273	REACTOR TRIP SWGR RTB-BYA	Steady State	Trip Coil Energize																									

Battery 22 LOOP Only

Battery	AC SWGR	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	Time Step 27 (1.59 01.0 - 1.59 01.1	Time Step 28 (1.59 01.1 - 1.59 02.0	Time Step 29 (1.59 02.0 - 1.59 02.1	Time Step 30 (1.59 02.1 - 2.00 00.0	Comments	Associated Relay	Setpoint Data
22	BUS 2A	PP22-4	Bus 2A-20D	52/2ATSA	480v Bkr	9321-LL-3117 SH 9	BUS TIE 2A-5A					Breaker trips from UV on Buses 2A and 5A. Relays 27-2AX2, 27-2AX12, 27-5AX2, and 27-5AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-20C	52/2ATSA	480v Bkr	9321-LL-3117 SH 9	BUS TIE 2A-3A					Breaker trips from UV Buses 2A and 3A. Relays 27-2AX2, 27-2AX12, 27-5AX2, and 27-5AX12	9321-LL-3117 SH 3 9321-LL-3118 SH 2	
22	BUS 2A	PP22-4	Bus 2A-21B	52/EG2A	480v Bkr	9321-LL-3117 SH 8	EMERG DIESEL GEN 22					EDG Output Breaker Closes at t=10s		
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC2A	480v Bkr	9321-LL-3117 SH 11	MCC 2BA					Breaker Trips on UV from 27-2AX12 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22A	52/PBU2	480v Bkr	8229145	DIST PNL FOR PRESSURIZER HTR BU GRP 22					Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A MCC24	480v Bkr	9321-LL-3117 SH 11	MCC 24 & 24A					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22C	52/CC2	480v Bkr	8229150	COMPONENT COOLING PUMP 22					Breaker Trips on UV from 27-2AX3 or 27-2AX13 Breaker Closes at t=15s on LOOP with No SI No Closure Signal with SI	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22G	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2 9321-LL-3117 SH 21B	
22	BUS 2A	PP22-4	Bus 2A-23C	52/MG1	480v Bkr	8253647	ROS PWR SUPL MG SET 21					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24A	52/SW2A	480v Bkr	8229147	SERVICE WATER PUMP & STRAINER 22					Breaker Trips on UV from 27-2AX3 or 27-2AX13 Either SW2 or SW5 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24B	52/SI2A	480v Bkr	8229139	SAFETY INJECTION PUMP 22					Breaker Trips from UV from 27-2AX3 or 27-2AX13 Breaker Close at t=15s with SI Signal	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC10	480v Bkr	9321-LL-3117 SH 11	MCC 210					Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-27A	52/SW5B	480v Bkr	8229141	SERVICE WATER PUMP 25 BU FOR					Breaker Trips on UV from 27-2AX3 or 27-2AX13 Either SW2 or SW5 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Bkr	9321-LL-3117 SH 11	MCC 23					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22C	52/LTTN	480v Bkr	9321-LL-3117 SH 11	LIGHTING XFR SW 22 (NORM SUPL)					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-26B	52/2A	480v Bkr	9321-LL-3117 SH 8	6 KV SWGR BUS 2					Breaker trips after an unknown time delay Relays 52/2A and 62-1/2A	9321-LL-3117 SH 2A	Time Delay Unknown Conservatively modeled concurrent with max number of trip coils in the first minute
22	BUS 2A	PP22-4	Bus 2A-26C	52/CRF3	480v Bkr	8229157	CONTAINMENT RECIRC FAN 23					Breaker Trips on UV from 27-2AX3 or 27-2AX13 Breaker Close at t=30s with SI Signal	9321-LL-3117 SH 2	
22	BUS 3	PP22-9	BUS 3-1	52/HDP21	6.9kv Bkr	9321-LL-3114 SH 8	HEAT DRAIN PUMP 21					Breaker Trips on UV from 27-3402X	8229123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-1A	52/22SWV3	6.9kv Bkr	9321-LL-3114 SH 20	SUB STA 22/SWV3 XFMR					No UV Trip		
22	BUS 3	PP22-9	BUS 3-2	52/CWP26	6.9kv Bkr	8231A71	CIRC WTR PUMP 26					Breaser Trips on UV from 27-3402X	8229123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-3	52/SF3	6.9kv Bkr	9321-LL-3114 SH 18	STA SERVICE XFMR 3					Breaser Trips on UV from 27-3402X	8229123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-4	52/RCP23	6.9kv Bkr	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23					Breaker Trips on UV from 27-3402X	8229123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-5	52/UT3-6TR	6.9kv Bkr	9321-LL-3114 SH 3	BUS #3 - #4 TIE			X-Coil Energized	X-Coil Energized Spring Charge Motor Inrush	Lockout Trips from 86UT3 and 86/6TR No UV Trip	9321-LL-3114 SH 17	
22	BUS 3	PP22-9	BUS 3-7	52/UT3	6.9kv Bkr	9321-LL-3114 SH 7	UNIT AUX XFMR					Lockout Trip from 86UT3, 86P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-10	52/CP23	6.9kv Bkr	9321-LL-3114 SH 12	CONDENSATE PUMP 23					Breaker Trips on UV from 27-4402X	8229124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-11	52/CWP24	6.9kv Bkr	8231B70	CIRC WTR PUMP 24					Breaker Trips on UV from 27-4402X	8229124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-12	52/HDP22	6.9kv Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22					Breaker Trips on UV from 27-4402X	8229124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-13	52/UT4-5T8	6.9kv Bkr	9321-LL-3114 SH 5	BUS TIE 4 & 6					Lockout Trips from 86UT4 and 86-5T6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 4	PP22-9	BUS 4-A	52/UT4	6.9kv Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR					Lockout Trip from 86UT4, 86P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-9	52/RCP22	6.9kv Bkr	9321-LL-3114 SH 11	REACTOR COOLING PUMP 22					Breaker Trips on UV from 27-4402X	8229124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-15	52/ST6	6.9kv Bkr	9321-LL-3114 SH 6	STA AUX XFMR	X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only			Lockout Trip from 86/ST6 and 86/ST4 No UV Trip	9321-LL-3114 SH 19 9321-LL-3130 SH 2 9321-LL-3130 SH 4	
22	BUS 4	PP22-9	BUS 4-16	52/CWP22	6.9kv Bkr	8231A8	CIRC WTR PUMP 22					Breaker Trips on UV from 27-4402X	8229135	30 second time delay to trip
22	BUS 5	PP22-9	BUS 5-17	52/SS6	6.9kv Bkr	9321-LL-3114 SH 16	STA SERVICE XFMR 6	X-Coil Voltage Analysis Only	X-Coil & Close Coil Voltage Analysis Only			Breaker Trips on UV from 27-5402X	8229135	30 second time delay to trip
22	BUS 5	PP22-9	BUS 5-17A	52/GT2B	6.9kv Bkr	9321-LL-3114 SH 19	GAS TURB NE GEN 1 & BUS 5 TIE	X-Coil Energized	X-Coil & Close Coil Energized			Lockout Trip from 86/ST6 No UV Trip	9321-LL-3114 SH 19	
22	N/A	PP22-14	N/A	EGP1E	INV	9321-F-3050	10KVA STATIC INVERTER PA	On DC	On DC	On DC	On DC			
22	N/A	PP22-15	N/A	EGA2	INV	A208572	10KVA STATIC INVERTER 22	On DC	On DC	On DC	On DC			
22	N/A	PP22-3	DC DIST PNL 22A-1	EGA6	INV	204906	1 KVA INVERTER	On DC	On DC	On DC	On DC			
22	N/A	PP22-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	#2-8-000007	REGULATOR CUBICLE INVERTER #1	On DC	On DC	On DC	On DC			
22	N/A	PP22	PP22	EMERG LTG PNL 21B	EMG LTG	9321-F-3035	EMERG LTG PNL 21B	On DC	On DC	On DC	On DC			
22	N/A	PP22	PP22	EMERG LTG PNL 21D	EMG LTG	9321-F-3035	EMERG LTG PNL 21D	On DC	On DC	On DC	On DC			
22	N/A	PP22-11	POWER PNL 22-11	RTB-BVA	RX TRP BKR	11QE072	REACTOR TRIP SWGR RTB-BVA							

Battery 22 LOCA Only

Battery	AC BAKuit	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	Init. Status	Time Step 01 0:00:00.0 - 0:00:01.0	Time Step 02 0:00:01.0 - 0:00:01.1	Time Step 03 0:00:01.1 - 0:00:02.0	Time Step 04 0:00:02.0 - 0:00:03.0	Time Step 05 0:00:03.0 - 0:00:03.1	Time Step 06 0:00:03.1 - 0:00:04.0	Time Step 07 0:00:04.0 - 0:00:05.0	Time Step 08 0:00:05.0 - 0:00:10.0	Time Step 09 0:00:10.0 - 0:00:15.0	Time Step 10 0:00:15.0 - 0:00:15.1	Time Step 11 0:00:15.1 - 0:00:16.9	Time Step 12 0:00:16.9 - 0:00:25.0	Time Step 13 0:00:25.0 - 0:00:25.1	Time Step 14 0:00:25.1 - 0:00:26.0	Time Step 15 0:00:26.0 - 0:01:00.0	Time Step 16 0:01:00.0 - 0:20:00.0	Time Step 17 0:20:00.0 - 0:20:01.0	Time Step 18 0:20:01.0 - 0:20:01.1	Time Step 19 0:20:01.1 - 0:21:00.0	Time Step 20 0:21:00.0 - 0:30:00.0	Time Step 21 0:30:00.0 - 1:00:00.0	Time Step 22 1:00:00.0 - 1:30:00.0	Time Step 23 1:30:00.0 - 1:59:00.0	Time Step 24 1:59:00.0 - 1:59:00.1	Time Step 25 1:59:00.1 - 2:00:00.0
22	BUS 2A	PP22-4	Bus 2A-20B	52/2ATSA	480v Bkr	9321-LL-3117 SH 5	BUS TIE 2A-6A	Open																										
22	BUS 2A	PP22-4	Bus 2A-20C	52/2AT3A	480v Bkr	9321-LL-3117 SH 9	BUS TIE 2A-3A	Open																										
22	BUS 2A	PP22-4	Bus 2A-21B	52/EG2A	480v Bkr	9321-LL-3117 SH 8	EMERG DIESEL GEN 22	Open																										
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC6A	480v Bkr	9321-LL-3117 SH 11	MCC 29A	Closed																										
22	BUS 2A	PP22-4	Bus 2A-22A	52/PBU2	480v Bkr	8225145	DIST PNL FOR PRESSURIZER HTR BU CRP 22	Closed																										
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A-MCC24	480v Bkr	9321-LL-3117 SH 11	MCC 24 & 24A	Closed																									X-Coil Energized	X-Coil & Close Coil Energized
22	BUS 2A	PP22-4	Bus 2A-22C	52/CO2	480v Bkr	8225150	COMPONENT COOLING PUMP 22	Closed																				X-Coil Energized	X-Coil & Close Coil Energized					
22	BUS 2A	PP22-4	Bus 2A-23B	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21	Closed																										
22	BUS 2A	PP22-4	Bus 2A-23C	52/MG1	480v Bkr	8253867	ROD PWR SUPL MG SET 21	Closed																										
22	BUS 2A	PP22-4	Bus 2A-24A	52/SW2A	480v Bkr	8225147	SERVICE WATER PUMP & STRAINR 22	Closed										X-Coil Energizes	X-Coil & Close Coil Energized														
22	BUS 2A	PP22-4	Bus 2A-24B	52/SI2A	480v Bkr	8225139	SAFETY INJECTION PUMP 22	Open					X-Coil Energized	X-Coil & Close Coil Energized													Trip Coil Energized							
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC1G	480v Bkr	9321-LL-3117 SH 11	MCC 21G	Closed																										
22	BUS 2A	PP22-4	Bus 2A-25A	52/SW5B	480v Bkr	8225141	SERVICE WATER PUMP 25 BU FDR	Closed										X-Coil Voltage Analyzer Only	X-Coil Voltage Analyzer Only														
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Bkr	9321-LL-3117 SH 11	MCC 23	Closed																										
22	BUS 2A	PP22-4	Bus 2A-25C	52/LT1N	480v Bkr	9321-LL-3117 SH 11	LIGHTING XFR EW 22 (NORM SUPL)	Closed																										
22	BUS 2A	PP22-4	Bus 2A-26B	52/2A	480v Bkr	9321-LL-3117 SH 6	6.9KV SWGR BUS 2	Closed																										
22	BUS 2A	PP22-4	Bus 2A-26C	52/CRF3	480v Bkr	8225152	CONTAINMENT RECIRC FAN 23	Closed															X-Coil Energizes	X-Coil & Close Coil Energized										
22	BUS 3	PP22-9	BUS 3-1	52/RDP21	6.9kv Bkr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21	Closed																										
22	BUS 3	PP22-9	BUS 3-1A	52/SWW3	6.9kv Bkr	9321-LL-3114 SH 20	SUB STA 22RW3 XFMR	Closed																										
22	BUS 3	PP22-9	BUS 3-2	52/CWP26	6.9kv Bkr	8231671	CIRC WTR PUMP 26	Closed																										
22	BUS 3	PP22-9	BUS 3-3	52/SS1	6.9kv Bkr	9321-LL-3114 SH 10	STA SERVICE XFMR 3	Closed																										
22	BUS 3	PP22-9	BUS 3-4	52/RCP23	6.9kv Bkr	9321-LL-3114 SH 7	REACTOR COOLANT PUMP 23	Closed																										
22	BUS 3	PP22-9	BUS 3-5	52/UT3-ST5	6.9kv Bkr	9321-LL-3114 SH 3	BUS #3 - #5 TIE	Open		X-Coil Energized	X-Coil Energized Spring Charge Motor Inrush	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running																		
22	BUS 3	PP22-9	BUS 3-7	52/UT3	6.9kv Bkr	9321-LL-3114 SH 2	UNIT AUX XFMR	Closed	Trip Coil Energized																										
22	BUS 4	PP22-9	BUS 4-1B	52/CP23	6.9kv Bkr	9321-LL-3114 SH 12	CONDENSATE PUMP 23	Closed																										
22	BUS 4	PP22-9	BUS 4-11	52/CWP24	6.9kv Bkr	8231670	CIRC WTR PUMP 24	Closed																										
22	BUS 4	PP22-9	BUS 4-12	52/RDP22	6.9kv Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22	Closed																										
22	BUS 4	PP22-9	BUS 4-13	52/UT4-ST6	6.9kv Bkr	9321-LL-3114 SH 5	BUS TIE 4 & 6	Open		X-Coil Energized	X-Coil Energized Spring Charge Motor Inrush	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running	Spring Charge Motor Running																		
22	BUS 4	PP22-9	BUS 4-8	52/UT4	6.9kv Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR	Closed	Trip Coil Energized																										
22	BUS 4	PP22-9	BUS 4-9	52/RCP22	6.9kv Bkr	9321-LL-3114 SH 11	REACTOR COOLING PUMP 22	Closed																										
22	BUS 6	PP22-9	BUS 6-16	52/ST6	6.9kv Bkr	9321-LL-3114 SH 5	STA AUX XFMR	Open																										
22	BUS 6	PP22-9	BUS 6-16	52/CWP-22	6.9kv Bkr	8231669	CIRC WTR PUMP 22	Closed																										
22	BUS 6	PP22-9	BUS 6-17	52/SS6	6.9kv Bkr	9321-LL-3114 SH 10	STA SERVICE XFMR 6	Closed																										
22	BUS 6	PP22-9	BUS 6-17A	52/GT2B	6.9kv Bkr	9321-LL-3114 SH 19	GAS TURBINE GEN 1 & BUS 6 TIE	Open																										
22	N/A	PP22-14	N/A	EGP10	INV	9321-F-3250	10KVA STATIC INVERTER PA	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-14	N/A	EGAD	INV	A295552	10KVA STATIC INVERTER 22	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	CP22-1	DC DIST PNL 22A-1	EDAB	INV	206400	1KVA INVERTER	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP37-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	IP2-B-005557	REGULATOR CUBICLE INVERTER #1	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PG5	PG5	EMERG LTG PNL 21B	EMG LTG	9321-F-3035	EMERG LTG PNL 21B	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PG5	PG5	EMERG LTG PNL 21B	EMG LTG	8231-F-0005	EMERG LTG PNL 21B	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-11	POWER PNL 22D-11	RTB-EVA	RX TRIP BKRS	1-OE672	REACTOR TRIP SWGR RTB-EVA	Steady State	Trip Coils Energize																										

Battery 22 LOCA Only

Battery	AC SWGR	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	Comments	Additional Info	Setpoint Data
22	BUS 2A	PP22-4	Bus 2A-20B	52/2A15A	480v Swr	9321-LL-3117 SH 6	BUS TIE 2A-5A	Breaker trips from UV on Buses 2A and 5A Relays 27-2A/X2, 27-2A/X12, 27-5A/X2, and 27-5A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-20C	52/2AT3A	480v Swr	9321-LL-3117 SH 9	BUS TIE 2A-3A	Breaker trips from UV Buses 2A and 3A Relays 27 2A/X2, 27-2A/X12, 27-6A/X2, and 27-5A/X12	9321-LL-3117 SH 2 9321-LL-3118 SH 2	
22	BUS 2A	PP22-4	Bus 2A-21B	52/E 52A	480v Swr	9321-LL-3117 SH 6	EMERG D ESEL GEN 22	EDG Output Breaker Closes at t=10s No Closure for LOCA Only event.		
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC6A	480v Swr	9321-LL 3117 SH 11	MCC 28A	Breaker Trips on UV from 27 2A/X2 or 27-2A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22A	52/PBU2	480v Swr	8225145	DIST PNL FOR PRESSURIZER HTR BAT GRP 22	Breaker Trips on UV from 27-2A/X2 or 27-2A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A-MCC24	480v Swr	9321-LL-3117 SH 11	MCC 24 & 24A	Breaker Trips on UV from 27-2A/X2 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22C	52/CCP	480v Swr	8225160	COMPONENT COOLING PUMP 22	Breaker Trips on UV from 27-2A/X2 or 27-2A/X12 Breaker Close at t=10s on LOOP with No SI No Closure Signal with SI	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-23B	52/MCC1	480v Swr	9321-LL-3117 SH 13	MCC 21	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2 9321-LL-3117 SH 2/8	
22	BUS 2A	PP22-4	Bus 2A-23C	52/MS1	480v Swr	8253887	ROD PWR SUPL MG SET 21	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24A	52/SW2A	480v Swr	8225147	SERVICE WATER PUMP & STRAINER 22	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13 Either SW2 or SW5 Closes at t=13s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24B	52/SIC4	480v Swr	8225135	SAFETY INJECTION PUMP 23	Breaker trips from UV from 27-2A/X3 or 27-2A/X13 Breaker Close at t=13s with SI Signal	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC10	480v Swr	9321-LL-3117 SH 11	MCC 210	Breaker Trips on UV from 27-2A/X2 or 27-2A/X12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25A	52/SW5B	480v Swr	8225141	SERVICE WATER PUMP 25 B/U FOR	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13 Either SW2 or SW5 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Swr	9321-LL-3117 SH 13	MCC 23	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25C	52/LTN	480v Swr	9321-LL-3117 SH 11	LIGHTING XFR SW 22 (NORM SUPL)	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-26B	52/2A	480v Swr	9321-LL-3117 SH 6	8 SKV SWGR BUS 2	Breaker trips after an unknown time delay Relays 62/2A and 62-12A	9321-LL-3117 SH 3A	Time Delay Unknown Conservatively modeled consumers with max number of trip coils in the first minute
22	BUS 2A	PP22-4	Bus 2A-26C	52/CBF3	460v Swr	8225152	CONTAINMENT RECIRC FAN 23	Breaker Trips on UV from 27-2A/X3 or 27-2A/X13 Breaker Close at t=35s with SI Signal	9321-LL-3117 SH 2	
22	BUS 3	PP22-9	BUS 3-1	52/HDP21	6.9kv Swr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21	Breaker Trips on UV from 27-3/62X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-1A	52/2SRW3	6.9kv Swr	9321-LL-3114 SH 22	SUB STA 22/RW3 XFMR	No UV Trip		
22	BUS 3	PP22-9	BUS 3-2	52/CWP2B	6.9kv Swr	8231671	CIRC WTR PUMP 2B	Breaker Trips on UV from 27-3/62Y	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-3	52/SS3	6.9kv Swr	9321-LL-3114 SH 10	STA SERVICE XFMR 3	Breaker Trips on UV from 27-3/62X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-4	52/RCP23	6.9kv Swr	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23	Breaker Trips on UV from 27-3/62X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-5	52/UT1-5T6	6.9kv Swr	9321-LL-3114 SH 9	BUS #3 - #5 TIE	Lockout Trips from 86/UT3 and 86/ST6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 3	PP22-9	BUS 3-7	52/UT3	6.9kv Swr	9321-LL-3114 SH 2	UNIT AUX XFMR	Lockout Trip from 86/UT3, 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-1C	52/CP23	6.9kv Swr	9321-LL-3114 SH 12	CONDENSATE PUMP 23	Breaker Trips on UV from 27-4/62X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1I	52/CWP2A	6.9kv Swr	8231670	CIRC WTR PUMP 2A	Breaker Trips on UV from 27-4/62X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1J	52/HDP22	6.9kv Swr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22	Breaker Trips on UV from 27-4/62X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1S	52/UT4-5T6	6.9kv Swr	9321-LL-3114 SH 5	BUS TIE 4 & 6	Lockout Trips from 86/UT4 and 86/ST6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 4	PP22-9	BUS 4-8	52/UT4	6.9kv Swr	9321-LL-3114 SH 4	UNIT AUX XFMR	Lockout Trip from 86/UT4, 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-9	52/RCP22	6.9kv Swr	9321-LL-3114 SH 11	REACTOR COOLING PUMP 22	Breaker Trips on UV from 27-4/62X	8225124	30 second time delay to trip
22	BUS 5	PP22-9	BUS 5-1S	52/ST6	6.9kv Swr	9321-LL-3114 SH 6	STA AUX XFMR	Lockout Trip from 86XST6, 86/STP, 86/STBU No UV Trip	9321-LL-3114 SH 18 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 5	PP22-9	BUS 5-1S	52/CWP22	6.9kv Swr	8231668	CIRC WTR PUMP 22	Breaker Trips on UV from 27-5/62X	8225125	30 second time delay to trip
22	BUS 5	PP22-9	BUS 5-1T	52/SS5	6.9kv Swr	9321-LL-3114 SH 16	STA SERVICE XFMR 5	Breaker Trips on UV from 27-5/62X	8225125	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-17A	52/GT2B	6.9kv Swr	9321-LL-3114 SH 19	GAS TURBINE GEN 2 & BUS 6 TIE	Lockout Trip from 86/A/B No UV Trip	9321-LL-3114 SH 18	
22	N/A	PP22-14	N/A	EGP10	INV	9321-F-3256	10KVA STATIC INVERTER PA			
22	N/A	PP22-15	N/A	EGA0	INV	A264132	10KVA STATIC INVERTER 22			
22	N/A	PP22-3	DC DIST PNL 22A-1	EGA6	INV	256600	1 KVA INVERTER			
22	N/A	PP22-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	PC-S-000057	REGULATOR CUBICLE INVERTER #1			
22	N/A	PC6	PC6	EMERG LTG PNL 21B	EMG LTG	9321-F-3035	EMERG LTG PNL 21B			
22	N/A	PC5	PC5	EMERG LTG PNL 21A	EMG LTG	9321-F-3036	EMERG LTG PNL 21A			
22	N/A	PP22-11	POWER PNL 22-11	52B-BYA	RX TRIP BKRS	1206073	REACTOR TRIP SWGR #1B-BYA			

Battery 22 LOOP SI

Battery	AC SWGR	DC Circuit	Location	Load Name	Load Type	Dwg (Schematic)	Description	NO- Status	Time Step 01 0 00 00 0 - 0 00 01 0	Time Step 02 0 00 01 0 - 0 00 02 0	Time Step 03 0 00 02 0 - 0 00 04 0	Time Step 04 0 00 04 0 - 0 00 13 0	Time Step 05 0 00 13 0 - 0 00 16 1	Time Step 06 0 00 16 1 - 0 00 11 0	Time Step 07 0 00 11 0 - 0 00 13 0	Time Step 08 0 00 13 0 - 0 00 13 1	Time Step 09 0 00 13 1 - 0 00 14 0	Time Step 10 0 00 14 0 - 0 00 25 0	Time Step 11 0 00 75 0 - 0 00 25 1	Time Step 12 0 00 25 1 - 0 00 25 2	Time Step 13 0 00 26 0 - 0 00 30 0	Time Step 14 0 00 30 0 - 0 00 30 1	Time Step 15 0 00 30 1 - 0 00 31 0	Time Step 16 0 00 31 0 - 0 00 35 0	Time Step 17 0 00 35 0 - 0 00 35 1	Time Step 18 0 00 35 1 - 0 00 36 0	Time Step 19 0 00 36 0 - 0 01 30 0	Time Step 20 0 01 00 0 - 2 30 00 0	Time Step 21 2 30 00 0 - 2 30 01 1	Time Step 22 2 30 01 1 - 2 30 01 1	Time Step 23 2 30 01 1 - 4 21 00 0	Time Step 24 4 21 00 0 - 4 30 00 0	Time Step 25 4 30 32 0 - 1 00 00 0	Time Step 26 1 00 00 0 - 1 30 00 0
22	BUS 2A	PP22-4	Bus 2A-20B	52/2A15A	480v Brk	9321-LL-3117 Sh 5	BUS TIE 2A-3A	Open																										
22	BUS 2A	PP22-4	Bus 2A-20C	52/2A13A	480v Brk	9321-LL-3117 SH 5	BUS TIE 2A-3A	Open																										
22	BUS 2A	PP22-4	Bus 2A 21B	52/EG2A	480v Brk	9321-LL-3117 Sh 8	EMERG DIESEL GEN 22	Open					X-Coil Energizes	X-Coil & Close Coil Energized																				
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC6A	480v Brk	9321-LL-3117 SH 11	MCC 26A	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-22A	52/PRV2	480v Brk	B225146	DIST PNL FOR PRESSURIZER HTR BAT GRP 22	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A-MCC24	480v Brk	9321-LL-3117 SH 11	MCC 24 & 24A	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-22C	52/CC2	480v Brk	B225150	COMPONENT COOLING PUMP 22	Closed	Trip Coil Energized																							X-Coil Energized	X-Coil & Close Coil Energized		
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC1	480v Brk	9321-LL-3117 Sh 11	MCC 21	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-23C	52/MG1	480v Brk	B253867	ROD PWR SUPL MG SET 21	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-24A	52/SW2A	480v Brk	B225147	SERVICE WATER PUMP & STRAINER 22	Closed	Trip Coil Energized										X-Coil Energizes	X-Coil & Close Coil Energized													
22	BUS 2A	PP22-4	Bus 2A-24B	52/SI2A	480v Brk	B225135	SAFETY INJECTION PUMP 22	Open	Trip Coil Voltage Analyses Only						X-Coil Energizes	X-Coil & Close Coil Energized												Trip Coil Energized					
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC1C	480v Brk	9321-LL-3117 Sh 11	MCC 21C	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-25A	52/SW5B	480v Brk	B225141	SERVICE WATER PUMP 25 BAY FOR	Closed	Trip Coil Energized										X-Coil Voltage Analyses Only	X-Coil Voltage Analyses Only													
22	BUS 2A	PP22-4	Bus 2A-25C	52/MCC3	480v Brk	9321-LL-3117 SH 11	MCC 23	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-25C	52/LTIN	480v Brk	9321-LL-3117 SH 11	LIGHTING XFR SW 22 (NORM SUPL)	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-26B	52/2A	480v Brk	9321-LL-3117 SH 8	6 9kV SWGR BUS 2	Closed	Trip Coil Energized																									
22	BUS 2A	PP22-4	Bus 2A-26C	52/CR2-3	480v Brk	B225153	CONTAINMENT RECIRC FAN 23	Closed	Trip Coil Energized																	X-Coil Energizes	X-Coil & Close Coil Energized					
22	BUS 3	PP22-6	BUS 3-1	52/HP21	6.9kv Brk	9321-LL-3114 Sh 9	HEAT DRAIN PUMP 21	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 3	PP22-6	BUS 3-1A	52/ZRW3	6.9kv Brk	9321-LL-3114 SH 20	SUB STA ZZRW3 XFMR	Closed																									
22	BUS 3	PP22-6	BUS 3-2	52/CWP26	6.9kv Brk	B231871	CIRC WTR PUMP 26	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 3	PP22-6	BUS 3-3	52/SS3	6.9kv Brk	9321-LL-3114 SH 13	STA SERVICE XFMR 3	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 3	PP22-6	BUS 3-4	52/RCP23	6.9kv Brk	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 3	PP22-6	BUS 3-5	52/UTA-STS	6.9kv Brk	9321-LL-3114 SH 3	BUS #3 - #5 TIE	Open																									
22	BUS 3	PP22-6	BUS 3-7	52/UT3	6.9kv Brk	9321-LL-3114 SH 2	UMT AUX XFMR	Closed	Trip Coil Energized																									
22	BUS 4	PP22-9	BUS 4-1B	52/CP23	6.9kv Brk	9321-LL-3114 SH 12	CONDENSATE PUMP 23	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 4	PP22-9	BUS 4-1*	52/CWP24	6.9kv Brk	B231870	CIRC WTR PUMP 24	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 4	PP22-9	BUS 4-1Z	52/HDR2	6.9kv Brk	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 4	PP22-9	BUS 4-1S	52/UT4-STS	6.9kv Brk	9321-LL-3114 SH 5	BUS TIE 4 & 6	Open																									
22	BUS 4	PP22-9	BUS 4-9	52/UT4	6.9kv Brk	9321-LL-3114 SH 4	UNIT AUX XFMR	Closed	Trip Coil Energized																									
22	BUS 4	PP22-9	BUS 4-6	52/RCP22	6.9kv Brk	9321-LL-3114 Sh 11	REACTOR COOLING PUMP 22	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 6	PP22-9	BUS 6-1S	52/ST6	6.9kv Brk	9321-LL-3114 SH 6	STA AUX XFMR	Closed	Trip Coil Energized																									
22	BUS 6	PP22-9	BUS 6-1B	52/CWP22	6.9kv Brk	B201868	CIRC WTR PUMP 22	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 6	PP22-9	BUS 6-1Z	52/SS6	6.9kv Brk	9321-LL-3114 SH 15	STA SERVICE XFMR 6	Closed													Trip Coil Energized	Trip Coil Energized											
22	BUS 6	PP22-9	BUS 6-17A	52/GT2	6.9kv Brk	9321-LL-3114 SH 15	GAS TURBINE GEN 1 BUS 6 TIE	Open																									
22	N/A	PP27-14	N/A	EGP12	INV	9321-F-3250	10KVA STATIC INVERTER PA	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP27-15	N/A	EGA2	INV	A2KM07	10KVA STATIC INVERTER 22	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-3	DC DIST PNL 22A-1	EGA6	INV	13M6/0	15 KVA Static Inv	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-7	N/A	REGULATOR CUBICLE #VERTER #1	INV	9321-S-709067	REGULATOR CUBICLE INVERTER #1	On	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP8	PP8	EMERG LTG PNL 218	EMG LTG	9321-L-3635	EMERG LTG PNL 218	Off	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PC6	PC6	EMERG LTG PNL 213	EMG LTG	9321-F-3634	EMERG LTG PNL 213	Off	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC	On DC
22	N/A	PP22-11	RECEPTACLE PNL 22-11	RTB-BYA	N/A TRIP Brk	1105073	REACTOR TRIP SWGR RTB-BYA	Steady State	Trip Coils Energize																									

Battery 22 LOOP SI

Battery	AC/ SWGR	DC Distrib	Location	Load Name	Load Type	Dwg (Schem #s)	Description	Time Step 27 (1.30.00.0 - 1.59.00.0	Time Step 28 (1.59.00.0 - 1.59.00.1	Time Step 29 (1.59.00.1 - 1.59.01.0	Time Step 30 (1.59.01.0 - 1.59.01.1	Time Step 31 (1.59.01.1 - 1.59.02.0	Time Step 32 (1.59.02.0 - 1.59.02.1	Time Step 33 (1.59.02.1 - 2.00.00.0	Comments	Additional Refs	Setpoint Data
22	BUS 2A	PP22-4	Bus 2A-2DB	52/2A7BA	480v Bkr	9321-LL-3117 SH 5	BUS TIE 2A-5A								Breaker trips from UV on Buses 2A and 5A Relays 27-2AX2, 27-2AX12, 27-5AX2, and 27-5AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-2DC	52/2A7BA	480v Bkr	9321-LL-3117 SH 9	BUS TIE 2A-3A								Breaker trips from UV Buses 2A and 3A Relays 27-2AX2, 27-2AX12, 27-3AX2, and 27-3AX12	9321-LL-3117 SH 2 9321-LL-3116 SH 2	
22	BUS 2A	PP22-4	Bus 2A-2B	52/EDG A	480v Bkr	9321-LL-3117 SH 8	EMERG DIESEL GEN 22		X-Coil Voltage Analyses Only	X Coil & Close Coil Voltage Analyses Only					EDG Output Breaker Closes at t=10s		
22	BUS 2A	PP22-4	Bus 2A-21C	52/MCC8A	480v Bkr	9321-LL-3117 SH 11	MCC 28A								Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22A	52/PSU2	480v Bkr	8225145	DIST PNL FOR PRESSURIZER HTR BAU GRP 22								Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22B	52/MCC24A-MCC24	480v Bkr	9321-LL-3117 SH 11	MCC 24 & 24A		X Coil Energized	X-Coil & Close Coil Energized					Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-22C	52/CC2	480v Bkr	8225150	COMPONENT COOLING PUMP 22								Breaker Trips on UV from 27-2AX2 or 27-2AX12 Breaker Close at t=19s on LOOP with No SI No Closure Signal with SI	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-23B	52/MCC1	480v Bkr	9321-LL-3117 SH 11	MCC 21								Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 3 9321-LL-3117 SH 21B	
22	BUS 2A	PP22-4	Bus 2A-23C	52/MG1	480v Bkr	8253867	ROD PWR SUPL MG SET 21								Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24A	52/SA2A	480v Bkr	8225147	SERVICE WATER PUMP & STRAINER 22								Breaker Trips on UV from 27-2AX3 or 27-2AX13 Either SW2 or SW5 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24B	52/SI2A	480v Bkr	8225138	SAFETY INJECTION PUMP 22								Breaker trips from UV from 27-3AX3 or 27-3AX13. Breaker Close at t=13s with SI Signal	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-24C	52/MCC10	480v Bkr	9321-LL-3117 SH 11	MCC 210								Breaker Trips on UV from 27-2AX2 or 27-2AX12	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25A	52/SW5B	480v Bkr	8225161	SERVICE WATER PUMP 25 B/U FOR								Breaker Trips on UV from 27-2AX3 or 27-2AX13 Either SW2 or SW5 Closes @ t=25s	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-25B	52/MCC3	480v Bkr	9321-LL-3117 SH 11	MCC 23								Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-26C	52/LTIN	480v Bkr	9321-LL-3117 SH 11	LIGHTING XFR SW 22 (NORM SUPL)								Breaker Trips on UV from 27-2AX3 or 27-2AX13	9321-LL-3117 SH 2	
22	BUS 2A	PP22-4	Bus 2A-26B	57/0A	480v Bkr	9321-LL-3117 SH 8	6 SKV SWGR BUS 2		X-Coil Voltage Analyses Only	X-Coil & Close Coil Voltage Analyses Only					Breaker trips after an unknown time delay Relays 62/2A and 62-1/2A	9321-LL-3117 SH 3A	Time Delay Unknown Conservatively recycled concurrent with max number of trip coils in the time module
22	BUS 2A	PP22-4	Bus 2A-26C	52/CRF3	480v Bkr	8225152	CONTAINMENT RECIRC FAN 23								Breaker Trips on UV from 27-2AX3 or 27-2AX13 Breaker Close at t=35s with SI Signal	9321-LL-3117 SH 2	
22	BUS 3	PP22-9	BUS 3-1	52/HDP21	6.9kv Bkr	9321-LL-3114 SH 9	HEAT DRAIN PUMP 21								Breaker Trips on UV from 27-3/52X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-1A	52/SSWXR	6.9kv Bkr	9321-LL-3114 SH 20	SUB STA 22KV3 XFMR								No UV Trip		
22	BUS 3	PP22-9	BUS 3-2	52/CWP26	6.9kv Bkr	8231673	CIRC WTR PUMP 26								Breaker Trips on UV from 27-3/52X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-3	57/6S3	6.9kv Bkr	9321-LL-3114 SH 10	STA SERVICE XFMR 3								Breaker Trips on UV from 27-3/52X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-4	52/RCP23	6.9kv Bkr	9321-LL-3114 SH 7	REACTOR COOLING PUMP 23								Breaker Trips on UV from 27-3/52X	8225123	30 second time delay to trip
22	BUS 3	PP22-9	BUS 3-5	52/UT3-5T6	6.9kv Bkr	9321-LL-3114 SH 3	BUS #3 - #5 TIE						X-Coil Energized	X-Coil Energized Spring Charge Motor Inrush	Lockout Trips from 86/UT3 and 86/ST6 No UV Trip	9321-LL-3114 SH 17	
22	BUS 3	PP22-9	BUS 3-7	52/UT3	6.5kv Bkr	9321-LL-3114 SH 2	UNIT AUX XFMR								Lockout Trip from 86/UT3 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-1B	52/CP23	6.9kv Bkr	9321-LL-3114 SH 12	CONDENSATE PUMP 23								Breaker Trips on UV from 27-4/52X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1C	52/CWP24	6.9kv Bkr	8231676	CIRC WTR PUMP 24								Breaker Trips on UV from 27-4/52X	8225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1D	52/HDP22	6.9kv Bkr	9321-LL-3114 SH 14	HEAT DRAIN PUMP 22								Breaker Trips from 86/UT4 and 86/ST6 No UV Trip	9225124	30 second time delay to trip
22	BUS 4	PP22-9	BUS 4-1E	52/UT4-5T6	6.9kv Bkr	9321-LL-3114 SH 5	BUS TIE 4 & 6								Lockout Trip from 86/ST6, 86/STP, 86/STBU No UV Trip	9321-LL-3114 SH 17 9321-LL-3114 SH 18 9321-LL-3132 SH 3 9321-LL-3132 SH 4	
22	BUS 4	PP22-9	BUS 4-6	52/UT4	6.9kv Bkr	9321-LL-3114 SH 4	UNIT AUX XFMR								Lockout Trip from 86/UT4 86/P, 86/BU No UV Trip	9321-LL-3114 SH 17 9321-LL-3130 SH 5 9321-LL-3130 SH 6	
22	BUS 4	PP22-9	BUS 4-9	52/RCP22	6.9kv Bkr	9321-LL-3114 SH 13	REACTOR COOLING PUMP 22								Breaker Trips on UV from 27-4/52X	8225124	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-1B	52/ST6	6.9kv Bkr	9321-LL-3114 SH 6	STA AUX XFMR				X-Coil Voltage Analyses Only	X-Coil & Close Coil Voltage Analyses Only			Lockout Trip from 86/ST6, 86/STP, 86/STBU No UV Trip	9321-LL-3114 SH 18 9321-LL-3132 SH 3 9321-LL-3132 SH 4	
22	BUS 6	PP22-9	BUS 6-1C	52/CWP22	6.9kv Bkr	8231669	CIRC WTR PUMP 22								Breaker Trips on UV from 27-6/52X	8225126	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-1D	52/6S6	6.9kv Bkr	9321-LL-3114 SH 15	STA SERVICE XFMR 6				X-Coil Voltage Analyses Only	X-Coil & Close Coil Voltage Analyses Only			Breaker Trips on UV from 27-6/52X	8225126	30 second time delay to trip
22	BUS 6	PP22-9	BUS 6-17A	52/GT6	6.9kv Bkr	9321-LL-3114 SH 16	GAS TURBINE GEN 3 & BUS 6 TF				X-Coil Energized	X-Coil & Close Coil Energized			Lockout Trip from 86/ST6 No UV Trip	9321 LL 3114 SH 18	
22	N/A	PP22-14	N/A	EGP10	INV	9321-F-3250	10KVA STATIC INVERTER PA	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-15	N/A	EGA2	INV	A258007	10KVA STATIC INVERTER 22	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	DP22-3	DC DIST PNL 22A-1	EG46	INV	206900	1 KVA INVERTER	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-7	N/A	REGULATOR CUBICLE INVERTER #1	INV	121-5-000557	REGULATOR CUBICLE INVERTER #1	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PGS	PGS	EMG HG LTG PNL 218	EMG LTG	9321-F-3035	EMERG LTG PNL 218	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PGS	PGS	EMG HG LTG PNL 213	EMG LTG	9321-F-3035	EMERG LTG PNL 213	On DC	On DC	On DC	On DC	On DC	On DC	On DC			
22	N/A	PP22-11	POWER PNL 22-11	RTB-5YA	RX TRF B-RR5	110E073	REACTOR TRIP SWGR STB-5YA										

Attachment P
Component Assumptions

Component ID	Component Class	Manufacture	Model	Assumptions
5	CC	WHSE	75DH500-CC	Current value from data sheet contained in Attachment T. Voltage values from data contained in Attachment Z.
10	FLDFLASH	ALCO	FIELD FLASH	Field flash current is limited by 4 25ohm resistors in parallel. This yields a resistance of 6.25 ohms. This resistance is in series with the 0.872 Ohm field. The total resistance is the 6.25 + 0.872 = 7.122 Ohms Max voltage assumed to be 10% above rated voltage.
13	INV	TOPAZ	1 KVA INVERTER	Minimum voltage assumed at 80% of rated. No cut sheet available. Assumed full load of 1KVA 80% effficiency at 125Vdc. Assumed max voltage of 140V based on other similar components.
23	RELAY	UNKNOWN	UV RELAY	Relay type is unknown. Assumed rated current, rated voltage, minimum voltage, and maximum voltage based on ABB Circuit Shield Relay.
28	X-COIL	WHSE	75DH500 Stored Energy	Current and voltage taken from DHP datasheet provided by Entergy. Datasheet is located in Attachment T.
29	TC	WHSE	75DH500-TC	Voltage and current values taken from DH-P data sheet provided by Indian Point 2.
35	LIGHT	UNKNOWN	INDICATING LIGHT	Assumed generic 4W indicating light load. Assumed max voltage 10% above rated voltage.
38	X-COIL	WHSE	75DH500 Solenoid Operated	Relay current assumed based on Westinghouse type SG relay. Operating voltage is taken from Attachment Z. Minimum and maximum voltage values based on DH operating voltages.
39	RELAY	UNKNOWN	Y- CUT-OFF RELAY(6.9kV)	Assumed relay to be Westinghouse type SG. Max voltage assumed 10% above rated.
42	RELAY	UNKNOWN	UNKNOWN	Unknown relay values are based on Westinghouse BFD relay.
43	SPGM	WHSE	M-SPRING CHARGING MTR (6.9kV)	Running current taken from 15kV DH-P Breaker data sheet located in Attachment T. Inrush current conservatively assumed to be 10 times the running current.
44	RELAY	UNKNOWN	MX-CHARGING MTR AUX RLY (6.9kV)	Assumed to be Westinghouse type SG. Max voltage assumed 10% above rated voltage.
45	RELAY	UNKNOWN	MR- MECH RELEASE RELAY (6.9kV)	Assumed to be Westinghouse type SG. Max voltage assumed 10% above rated voltage.
46	SOV	UNKNOWN	UNKNOWN	Assumed values based on generic ASCO solenoid values.
47	X-COIL	WHSE	X- CLOSING RELAY (0.48kV)	Assumed to be Westinghouse type SG. Max voltage assumed 10% above rated voltage.

Component ID	Component Class	Manufacture	Model	Assumptions
49	RELAY	AGASTAT	UNKNOWN	Assumed Agastat 7000 series characteristics.
50	RELAY	UNKNOWN	R- 52R, RESET Rx Trip Bkr	Assumed to be Westinghouse type SG. Max voltage assumed 10% above rated voltage.
51	RELAY	UNKNOWN	TD-53 TIME DELAY RELAY (6.9kV)	Assumed values based on Agastat 7000 series.
53	LIGHT	UNKNOWN	NE-2, NEON LAMP, 200 K OHM +/- 10% RES.	Assumed typical load of 4 W. Min voltage set to 0 for lights. Max voltage assumed to be 10% above rated voltage.
54	RELAY	WHSE	51N OVERCURRENT RELAY (6.9kV), TYPE CO	Assumed Minimum Voltage of 80% rated. Max voltage assumed 10% above rated voltage.
56	INV	SCI	10 KVA INV, SV12100/TS100NB/TS100MB	The minimum voltage for the inverter is 105 Vdc. Since the inverter is modeled as a node and no wiring or contacts exist between the node and the device, the minimum voltage of this component is reduced by 1 volt. DCSDM adds 1 volt to the acceptance criteria for the device. Rated current is taken from IP2 data provided in Attachment Y. Voltage at which the current readings are taken is used for the rated voltage (132Vdc).
57	RELAY	WHSE	CV	Assumed Minimum Voltage of 80% rated. Max voltage assumed 10% above rated voltage.
59	RELAY	WHSE	SG	Max voltage assumed to be 10% above rated voltage.
60	RELAY	WHSE	KF	Assumed Minimum Voltage of 80% rated. Max voltage assumed 10% above rated voltage.
61	RELAY	AGASTAT	2122DH39YC	Assumed Agastat 7000 series values.
63	RESISTOR	UNKNOWN	UNKNOWN	Assumed resistor Value of 2k Ohm. Max voltage assumed 10% above rated.
64	LOR	WHSE	86 LOCKOUT RELAY (0.48kV)	Assumed values based on Westinghouse WL Relay. Max voltage assumed 10% above rated.
65	METER	UNKNOWN	TIME METER	Assumed high impedance (Over 1M ohm) device. Max voltage assumed 10% above rated.
67	LIGHT	ALCO	NEON- BND-2R	Assumed typical light value of 4W. Max voltage assumed 10% above rated.
68	LIGHT	UNKNOWN	NEON	Assumed typical light value of 4 W. Max voltage assumed 10% above rated.
77	LOR	WHSE	TYPE WL	Max voltage assumed to be 10% above rated voltage.

Component ID	Component Class	Manufacture	Model	Assumptions
80	RELAY	WHSE	TYPE SG, 12V COIL, WITH 480 OHM VARIABLE RES.	Current based on 48 ohm coil resistance in series with a 480 ohm resistor. Max voltage assumed at 10% above rated voltage.
83	RELAY	UNKNOWN	PILOT WIRE RECIEVER RELAY	Unknown relay. Westinghouse BFD relay values used.
84	RELAY	WHSE	TYPE HCB, DIFF CURRENT RELAY	Rated current, rated voltage, minimum voltage assumed based on similar current relays. Max voltage assumed at 10% above rated voltage.
86	FIELD	UNKNOWN	FIELD FOR 1/30 HP MOTOR, LLV1 & LLV2	Field current based on 1/30 HP = 25 W which requires 0.2 Amps for the entire motor. Max voltage assumed 10% above rated voltage. Min voltage assumed 80% of rated voltage.
87	MOTOR	UNKNOWN	1/30 HP MOTOR, LLV1 & LLV2, (ASSUMED VALUE)	Field current based on 1/30 HP = 25 W which requires 0.2 Amps for the entire motor. Max voltage assumed 10% above rated voltage. Min voltage assumed at 80% of rated voltage.
88	RELAY	SCCA	MODEL 1080811, TIME DELAY	Voltage and current values based on Agastat time delay relays.
93	RELAY	UNKNOWN	UNKNOWN W/ DIODE IN PARRALLEL	Per Attachment X, Westinghouse BFD values are used for unknown relays.
94	RELAY	UNKNOWN	UNKNOWN TIME DELAY W/ DIODE IN PARRALLEL	Assumed values based on Agastat time delay relays
95	HORN	PANALARM	HORN FOR ANNUNCIATOR	Horn type assumed to be Panalarm type HSD. Rated voltage assumed to be 125 Vdc. Minimum voltage assumed at 80% of rated voltage. Maximum voltage assumed at 10% above rated voltage.
96	RESISTOR	UNKNOWN	RESISTOR - 800 OHM, 25 WATTS	Min voltage of 0 Vdc as this is a resistor. Max voltage assumed 10% above rated voltage.
97	LIGHT	UNKNOWN	LIGHT W/ 10000 OHM, 10 WATT RESISTOR	Assumed typical 4W indicating light. No minimum voltage requirement for lights. Max voltage assumed 10% above rated voltage.
98	SOV	UNKNOWN	SOV - OPERATES AS VLV CONTROLLER	Conservative values for current, minimum voltage, and maximum voltage assigned based on ASCO values.
98	SOV	UNKNOWN	SOV - OPERATES AS VLV CONTROLLER	Conservative values for current, minimum voltage, and maximum voltage assigned based on ASCO values.
99	FL SW	UNKNOWN	FLOW SWITCH	This is an Unknown relay. All values based on BFD relay type.
100	RELAY	GE	TYPE HGA	Minimum voltage assumed at 80% of rated voltage.

Component ID	Component Class	Manufacture	Model	Assumptions
103	LIGHT	UNKNOWN	LIGHT W/ 2500 OHM RESISTOR	Current based on resistor in series with light. No minimum voltage requirement for lights. Max voltage assumed 10% above rated voltage.
105	LIGHT	UNKNOWN	LIGHT W/200K OHM RES	Assumed typical indicating light load of 4W. No minimum voltage requirement for lights. Max voltage assumed 10% above rated voltage.
106	LIGHT	UNKNOWN	LIGHT W/400K OHM RES	Assumed typical indicating light load of 4W. No minimum voltage requirement for lights. Max voltage assumed 10% above rated voltage.
107	RELAY	UNKNOWN	1 PUSHBUTTON LT & 1 AUX RELAY	Assumed current, minimum voltage, and rated voltage. This is an Unknown relay. Maximum voltage assumed at 10% above rated voltage.
110	RELAY	SIEMENS	CODE 82E TYPE 3TH4	Assigned values as an unknown relay. Max voltage assumed at 10% above rated voltage.
111	LIGHT	UNKNOWN	3 TERM MONITORING/TEST LIGHT	Assumed typical indicating light. Assumed value of 4W with no minimum voltage. Max voltage assumed 10% above rated voltage.
112	SWITCH	ASCO	AUTO TRANSFER P/N 302A1264	Unknown values. Set current to 0 as these devices are not expected to operate during the event. Max voltage assumed 10% above rated voltage.
113	LIGHT	UNKNOWN	LIGHT WITH UNKNOWN RESISTOR	Unknown indicating light. Assumed value of 4W with no minimum voltage. Max voltage assumed 10% above rated voltage.
114	LOR	ELECTROSW	ER-LOR, T COIL	CONSERVATIVE PICKUP VOLTAGE (90V) USED. PICKUP VOLTAGE (MIN VOLT) CAN BE LOWER DEPENDING ON COIL TYPE USED.
119	CNTCR	WHSE	TYPE MLLO-2H	Assumed values based on type Westinghouse Type M and MME. Max voltage assumed to be 10% above rated voltage. Min voltage assumed at 80% rated voltage.
122	XFER SW	ASCO	TYPE BULLETIN 908, ASSUME 100 W AS LOAD	ASSUMED 100 WATTS AS LOAD. Max voltage assumed 10% above rated voltage.
123	RELAY	PANALARM	FLASHER RELAY, MODEL 50-F1	Max voltage assumed to be 10% above rated voltage. Min voltage assumed at 80% rated voltage.
125	PWR SUP	UNKNOWN	UNKNOWN	Unknown power supply. Current conservatively assumed as 1 amp. Min voltage assumed at 80% of rated voltage. Max voltage assumed 10% above rated voltage.
126	CC	GE	Close Solenoid AKR-4B-50, GE BREAKER	GE AKR 50 Values Used.
127	TC	GE	TC AKR-4B-50, GE BREAKER	GE AKR 50 Values Used.

Component ID	Component Class	Manufacture	Model	Assumptions
128	X-COIL	GE	X AKR-4B-50, GE BREAKER	GE AKR 50 Values Used.
129	W-COIL	GE	W AKR-4B-50, GE BREAKER	GE AKR 50 Values Used.
130	SPGM	GE	Motor AKR-4B-50, GE BREAKER	GE AKR 50 Values Used.
131	PANEL	GE	BATTERY LINE FILTER PANEL	Unknown device. Load current assumed at 1 amp. Minimum volage assumed at 80% of rated. Max voltage assumed at 10% above rated value.
135	ANNUN-Z	PANALARM	SERIES 10, MODEL 11, 44 POINT	19.4 watts per point max. Max voltage assumed 10% above rated value.
137	ANNUN-Z	PANALARM	SERIES 10, MODEL 11, 20 POINT	ASSUMED 19.4 WATTS PER POINT USING PANALARM SERIES 10 VALUES. Minimum voltage assumed at 80% of rated. Max voltage assumed 10% above rated value.
138	ANNUN	UNKNOWN	UNKNOWN ANNUNCIATOR	ASSUME 44 POINTS AT 19.4 WATTS PER POINT - USING PANALARM SERIES 10 VALUES. Max voltage assumed at 10% above rated voltage. Min voltage assumed at 80% rated voltage.
144	INV	UNKNOWN	GEN REG. INVERTER	Assumed values for MGE GZ Static Inverter. Information provided in Attachment T. The minimum voltage for the inverter is 105 Vdc. Since the inverter is modeled as a node and no wiring or contacts exist between the node and the device, the minimum voltage of this component is reduced by 1 volt. DCSDM adds 1 volt to the acceptance criteria.
145	FILTER	UNKNOWN	FILTER FOR GEN FF RELAYS	Load conservatively assumed as 0.1 amps. Min voltage assumed at 80% of rated voltage. Max voltage assumed 10% above rated voltage.
146	LED	UNKNOWN	LED	Per schematic (1986-M-03516), LED(s) is in series with a 620 ohm resistor and a relay (74T). These series loads will serve to decrease the actual current. Load current for this diode will be shown as 0. Relay will be conservativly assumed as the only load. Minimum and maximum voltage will be assumed as 0.
147	DIODE	UNKNOWN	ZENER DIODE 24V, 10W	Per schematic (1986-M-03516), diode is in series with a 620 ohm resistor and a relay (74T). These series loads will serve to decrease the actual current. Load current for this diode will be shown as 0. Relay will be conservativly assumed as the only load. Minimum and maximum voltage will be assumed as 0.

Component ID	Component Class	Manufacture	Model	Assumptions
153	RELAY	ABB	CAT. NO. 439U6345	MIN VOLTS ADJUSTABLE ASSUMED LOWEST 70% OR .7 OF RATED VOLTS.
178	SOV	ASCO	CAT. NO. LB-83146	(USED 8314 VALUES)
179	RELAY	AMERACE	CAT. NO. 7012PD	(AGASTAT VALUES)
180	RELAY	AMERACE	CAT. NO. E7022PE004	(AGASTAT VALUES)
183	SOV	VALCOR	CAT. NO. V526-xxxx-xx	Assumed values based on V709 Valcor series valve.
204	SOV	ASCO	CAT. NO. 8300C58RF	Values based on ASCO 8300 Series data.
206	SOV	ASCO	CAT. NO. HCX8262220	Min and Max voltages based on other ASCO valves with 120 VDC rated voltage. Rated load based on ASCO 8260 Series.
216	SOV	ASCO	CAT. NO. 8211D3	Min and Max voltages based on other ASCO valves with 120 VDC rated voltage.
218	SOV	ASCO	CAT. NO. NP8316A54E	Values based on NP8316 series SOV.
224	SOV	ASCO	CAT. NO. WJNP831666V	Data based on NP8316 series SOV.
225	SOV	ASCO	CAT. NO. WJNP8316E34V	Data based on NP8316 series SOV
236	SOV	ASCO	CAT. NO. NPK8316A74V	Data based on NP8316 series SOV.
239	SOV	ASCO	CAT. NO. FT8316E36	Min and Max voltages assumed based on conservative valuew for ASCO valves. Wattage rating based on 8316 valve type.
240	SOV	ASCO	CAT. NO. NPK8316A54V	Values based on NP8316 series SOV.
304	INV	SCI	INV 22	The minimum voltage for the inverter is 105 Vdc. Since the inverter is modeled as a node and no wiring or contacts exist between the node and the device, the minimum voltage of this component is reduced by 1 volt. DCSDM adds 1 volt to the acceptance criteria.
307	SOV	ROSS	SERIES 27	Maximum voltage assumed at 110% of rated voltage. Other information taken from Attachment Z.

N/A

Attachment R
References Report By Battery

By: Robert J Pileteri Date: 8/26/05

Check: [illegible] Date: 8-26-05

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	18	DATABASE	N/A	ECRIS DATA FILE DATA AS OF 7/24/2003	07/24/03
Comments: ECRIS Data from Excel file dated 7/24/03 provided to Framatome by IP2					
ENTERGY	935	MEMO	R MILICI TO J HAUSSER	LETTER FROM R. MILICI TO J. HAUSSER STATING VALUES FOR SEVERAL COMPONENTS	09-18-03
Comments:					
ENTERGY	11	ONE-LINE	A208501	ONE LINE DIAGRAM 125VDC FOR DIST PNL'S 21, 21A, 21B, 22, & 22A	35
Comments:					
ENTERGY	100	ONE-LINE	9321-F-3004	ONE LINE DIAGRAM 480V MOTOR CONTROL CENTER 21,22,23,25,25A	81
Comments:					
ENTERGY	103	ONE-LINE	9321-F-3008	SINGLE LINE DIA. 125V DC POWER PNLS 21,22,23&24	83
Comments:					
ENTERGY	346	ONE-LINE	A208088	ONE LINE DIAG. 480 V SWGR 21 & 22, BUS 2A,3A,5A&6A	38
Comments:					
ENTERGY	348	ONE-LINE	A208241	SINGLE LINE DIA. OF 480 VAC MCC 28A &211	23
Comments:					
ENTERGY	376	ONE-LINE	A231592	6900 VOLT AC ONE LINE DIAGRAM	18
Comments:					
ENTERGY	1	SCHEMATIC	206799	RCS OVERPRESSURIZATION SYS D.C. SCHEMATIC TRAIN A & B	5
Comments:					
ENTERGY	3	SCHEMATIC	A207325	SCHEMATIC DIAGRAM CH 1 & 2 LP STEAM DUMP SOVS 1206, 1207, 1208, 1209, 1210, 1211	4
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	4	SCHEMATIC	UNKNOWN	UNKNOWN SCHEMATIC	N/A
Comments:					
ENTERGY	5	SCHEMATIC	B207581	D/C OF EQUIPMENT FOR REPLACEMENT OF CONTROL VALVES TCV1104 & TCV1105	4
Comments:					
ENTERGY	9	SCHEMATIC	B208435	D/C OF CKT CHANGES FOR SG SAMPLE & BLOWDOWN ISOL VLVS (TMI - CONT/SO MODIF)	7
Comments:					
ENTERGY	21	SCHEMATIC	A209515	SD OF SAMP ISO SOL VLV SOV1523A-SOV1526A & BLOWDWN ISO SOL VLV SOV1314A-SOV1317A	12
Comments:					
ENTERGY	25	SCHEMATIC	B225185	ELEMENTARY WIRING DIAGRAM OF VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 94	1
Comments:					
ENTERGY	26	SCHEMATIC	B225191	ELEMENTARY WIRING DIAGRAM OF CONTROL VALVE TABLE SH 105	4
Comments:					
ENTERGY	27	SCHEMATIC	B225192	ELEMENTARY WIRING DIAGRAM OF CONTROL VALVE TABLE SH 106	5
Comments:					
ENTERGY	28	SCHEMATIC	B225193	ELEMENTARY WIRING DIAGRAM OF CONTROL VALVE TABLE SH 107	6
Comments:					
ENTERGY	31	SCHEMATIC	B225206	ELEMENTARY WIRING DIAGRAM OF REMOTE OPERATED VALVES SH 121	2
Comments:					
ENTERGY	32	SCHEMATIC	225209	ELEMENTARY WIRING DIAGRAM OF REMOTE OPERATED VALVES SH 124	5
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	33	SCHEMATIC	225242	ELEMENTARY WIEING DIAGRAM OF ANNUNCIATOR PNL "SB1F" SH 160	6
Comments:					
ENTERGY	37	SCHEMATIC	B235113	SCHEM DIAG AUX FEED PMP 22 STEAM SUPPLY ISOL VALVES (20/AFPSS1&2)	5
Comments:					
ENTERGY	55	SCHEMATIC	311906	SWD OF SOV 455C PRESSURIZER PORV PCV-455C	2
Comments:					
ENTERGY	58	SCHEMATIC	110E073 SH 9	INDIAN POINT STATION UNIT 2 REACTOR PROTECTION SYSTEM SCHEMATIC	9P
Comments:					
ENTERGY	59	SCHEMATIC	110E073 SH 11	INDIAN POINT STATION UNIT 2 REACTOR BREAKER SCHEMATIC	11U
Comments:					
ENTERGY	61	SCHEMATIC	322462	SCHEMATIC DIAGRAM OF IVSWS FLOW CONTROL VALVES SOV-7864, SOV-7865, SOV-7866 & SOV-7867	0
Comments:					
ENTERGY	62	SCHEMATIC	195B46	UNITED ENGRS & CONST INC CLASS III LTG SWGR	3B
Comments:					
ENTERGY	63	SCHEMATIC	195B47	UE&C INC CLASS III LTG SWGR	4D
Comments:					
ENTERGY	71	SCHEMATIC	1975M1487	OUTLINE 10 KVA INVERTER 129 VDC	C
Comments:					
ENTERGY	72	SCHEMATIC	1975M5611	SCHEMATIC INVERTER, 1PHASE, KVA, 1O, 60HZ,129VDC	B1
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	73	SCHEMATIC	1986M02277	SCHEMATIC DIAGRAM (HYDROGEN STATOR COOLING) SH. 5	8C
Comments:					
ENTERGY	74	SCHEMATIC	1986M03496	DE-EXC BREAKER CONTROL	1C
Comments:					
ENTERGY	75	SCHEMATIC	A241685	SCHEMATIC DIAGRAM OF SAFEGUARDS ACTUATION CABINETS E7, E8, F7, & F8	6
Comments:					
ENTERGY	76	SCHEMATIC	199B23	CON ED CO INDIAN POINT ISOLATION UNIT AND SAFEGUARDS ACTUATION SCHEMATIC	5L
Comments:					
ENTERGY	78	SCHEMATIC	204B70	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL. SWGR CONNECTION DIAGRAM	4
Comments:					
OBSOLETE SEE A242646					
ENTERGY	82	SCHEMATIC	204B74	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 9 & 10	5B
Comments:					
ENTERGY	84	SCHEMATIC	204B76	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 11 & 12	2A
Comments:					
ENTERGY	86	SCHEMATIC	204B78	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 24 & 25	5E
Comments:					
ENTERGY	87	SCHEMATIC	204B79	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 22 & 23	4
Comments:					
ENTERGY	177	SCHEMATIC	9321-LL-3114 SH 02	BREAKER 52/UT3 BUS #3 NORMAL FEED	11
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	178	SCHEMATIC	9321-LL-3114 SH 03	BREAKER 52/UT3-ST6 BUS #3 - #6 TIE	11
Comments:					
ENTERGY	179	SCHEMATIC	9321-LL-3114 SH 04	BREAKER 52/UT4 BUS #4 NORMAL FEED	10
Comments:					
ENTERGY	180	SCHEMATIC	9321-LL-3114 SH 05	BREAKER 52/UT4-ST6 BUS #4 - #6 TIE	11
Comments:					
ENTERGY	181	SCHEMATIC	9321-LL-3114 SH 06	BREAKER 52/ST6 BUS #6 NORMAL FEED	12
Comments:					
ENTERGY	182	SCHEMATIC	9321-LL-3114 SH 07	SCHEMATIC DIAGRAM BREAKER 52/RCP23 REACTOR COOLANT PUMP 23	15
Comments:					
ENTERGY	183	SCHEMATIC	9321-LL-3114 SH 09	BREAKER 52/HDP21 HEATER DRAIN PUMP 21	15
Comments:					
ENTERGY	184	SCHEMATIC	9321-LL-3114 SH 10	BREAKER 52/SS3 STATION SERVICE TRANSFORMER 3	8
Comments:					
ENTERGY	185	SCHEMATIC	9321-LL-3114 SH 11	BREAKER 52/RCP22 REACTOR COOLANT PUMP 22	16
Comments:					
ENTERGY	186	SCHEMATIC	9321-LL-3114 SH 12	BREAKER 52/CP23 CONDENSATE PUMP 23	13
Comments:					
ENTERGY	187	SCHEMATIC	9321-LL-3114 SH 14	BREAKER 52/HDP22 HEATER DRAIN PUMP 22	16
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	189	SCHEMATIC	9321-LL-3114 SH 17	6900V BUS 3, 4, & 6 LOCKOUT RELAYS (86/UT3, 86/UT4 & 86/ST6	7
Comments:					
ENTERGY	190	SCHEMATIC	9321-LL-3114 SH 19	BREAKER 52/GT26 GAS TURB. BUS 6 TIE	13
Comments:					
ENTERGY	192	SCHEMATIC	9321-LL-3117 SH 02	SCHEMATIC DIAGRAM 480V SWITCHGEAR 21 INTERLOCKING RELAYS	24
Comments:					
ENTERGY	194	SCHEMATIC	9321-LL-3117 SH 03A	480V BUS 2A - INTERLOCKING RELAYS	29
Comments:					
ENTERGY	198	SCHEMATIC	9321-LL-3117 SH 06	BREAKER 52/2A - STATION SERVICE TRANSFORMER 2-BUS 2A TIE	24
Comments:					
ENTERGY	200	SCHEMATIC	9321-LL-3117 SH 08	BREAKER 52/EG2A EMERGENCY GENERATOR 22	20
Comments:					
ENTERGY	203	SCHEMATIC	9321-LL-3117 SH 11	LTG. & MCC BREAKERS	16
Comments:					
ENTERGY	212	SCHEMATIC	9321-LL-3117 SH 22	480V BUS 5A & 6A UNDER VOLTAGE AUX. RELAYS	22
Comments:					
ENTERGY	213	SCHEMATIC	9321-LL-3117 SH 22A	480V BUS 6A UNDERVOLTAGE AUX. RELAYS	10
Comments:					
ENTERGY	216	SCHEMATIC	9321-LL-3118 SH 02	SCHEMATIC DIAGRAM 480V SWITCHGEAR 22 INTERLOCKING RELAYS	22
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	219	SCHEMATIC	9321-LL-3118 SH 03B	480V AC BUS 6A INTERLOCKING RELAYS	25
Comments:					
ENTERGY	220	SCHEMATIC	9321-LL-3118 SH 04	BREAKER 52/6A STATION SERVICE TRANSFORMER 6-BUS 6A TIE	24
Comments:					
ENTERGY	221	SCHEMATIC	9321-LL-3118 SH 05	BREAKER 52/3AT6A BUS 3A-6A TIE	14
Comments:					
ENTERGY	223	SCHEMATIC	9321-LL-3118 SH 07	BREAKER 52/EG3 EMERGENCY GENERATOR 23	19
Comments:					
ENTERGY	225	SCHEMATIC	9321-LL-3118 SH 09	BREAKER 52/MCC6B BUS 6A FEED TO MCC26B	11
Comments:					
ENTERGY	226	SCHEMATIC	9321-LL-3118 SH 10	LTG. & MCC BREAKERS	6
Comments:					
ENTERGY	232	SCHEMATIC	9321-LL-3118 SH 16	BREAKER 52/AF3 AUXILIARY FEEDWATER PUMP 23 SWITCHGEAR 22 UNIT 9C	30
Comments:					
ENTERGY	233	SCHEMATIC	9321-LL-3118 SH 18	BREAKER 52/TAO TURBINE AUXILIARY OIL PUMP	16
Comments:					
ENTERGY	236	SCHEMATIC	9321-LL-3118 SH 19B	SCHEM. DIAG. OF 125 V DC SUPPLY FOR UNIT 7 TO 13 SWGR 22	3
Comments:					
ENTERGY	237	SCHEMATIC	9321-LL-3118 SH 20	AUX. BFP 21 & 23 AUTO-START RELAYS	28
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	238	SCHEMATIC	9321-LL-3118 SH 20A	SCHEMATIC DIAGRAM AUX. B.F. PUMPS 21, 22 & 23 AND B.F.P. 22 AUTO-START	3
Comments:					
ENTERGY	242	SCHEMATIC	9321-LL-3130 SH 02B	SCHEMATIC DIAGRAM FOR TURBINE AUTO STOP TPIP SOLENOID & TRIP RELAYS	29
Comments:					
ENTERGY	243	SCHEMATIC	9321-LL-3130 SH 03	SCHEMATIC DIAGRAM LOAD LIMIT VALVE #1 CONTROLLER (LLV1)	17
Comments:					
ENTERGY	245	SCHEMATIC	9321-LL-3130 SH 05	GENERATOR PRIMARY LOCKOUT RELAY 86/P	29
Comments:					
ENTERGY	246	SCHEMATIC	9321-LL-3130 SH 06	SCHEMATIC DIAGRAM GENERATOR BACKUP LOCKOUT RELAY 86BU	37
Comments:					
ENTERGY	263	SCHEMATIC	9321-LL-3131 SH 11	AUX BOILER FEED PUMP 23 RECIRC VALVE (AFPR3)	7
Comments:					
ENTERGY	264	SCHEMATIC	9321-LL-3131 SH 11A	SCHEMATIC DIAGRAM FOR AUX BOILER FEED PUMP #23 RECIR VALVE (AFPR3)	3
Comments:					
ENTERGY	268	SCHEMATIC	9321-LL-3131 SH 25	CONTAINMENT RADIATION MONITOR ISOLATION VALVES	8
Comments:					
ENTERGY	271	SCHEMATIC	9321-LL-3131 SH 15A	SCHEMATIC DIAGRAM SERVICE WATER CONTROL VALVES	14
Comments:					
ENTERGY	272	SCHEMATIC	9321-LL-3131 SH 21	SCHEMATIC DIAGRAM MAIN STEAM ISOLATION VALVES	12
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	274	SCHEMATIC	9321-LL-3132 SH 02	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	8
Comments:					
ENTERGY	276	SCHEMATIC	9321-LL-3132 SH 04	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	9
Comments:					
ENTERGY	277	SCHEMATIC	9321-LL-3132 SH 05	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	10
Comments:					
ENTERGY	279	SCHEMATIC	9321-LL-3132 SH 07	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	17
Comments:					
ENTERGY	281	SCHEMATIC	9321-LL-3132 SH 09	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	16
Comments:					
ENTERGY	283	SCHEMATIC	9321-LL-3132 SH 11	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	15
Comments:					
ENTERGY	285	SCHEMATIC	9321-LL-3132 SH 13	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	6
Comments:					
ENTERGY	310	SCHEMATIC	9321-LL-3135 SH 01	SCHEMATIC DIAGRAM FIRST OUT FAF ANNUNCIATOR & FBF & FCF ANNUNCIATORS	12
Comments:					
ENTERGY	322	SCHEMATIC	9321-LL-3140 SH 12	BOILER FEED PUMP 22 TRUBINE TRIP AND RESET	29
Comments:					
ENTERGY	324	SCHEMATIC	9321-LL-3140 SH 14	BOILER FEED PUMP 22 TURBINE LOW PRESSURE STOP VALVE CONTROLLER (20/LP-SVC2)	10
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	325	SCHEMATIC	9321-LL-3140 SH 15	BOILER FEED PUMP 22 TURBINE HIGH PRESSURE STOP VALVE CONTROLLER (20HP-SVC2)	9
Comments:					
ENTERGY	326	SCHEMATIC	9321-LL-3140 SH 16	BOILER FEED PUMP 22 RECIRD. VALVE (BFPR2)	8
Comments:					
ENTERGY	340	SCHEMATIC	A206900	DIA OF CONN'S FOR STATIC INV 24 BAT CHARG 24 & 125 DC PWR PNL 214 & 125 DC DISTR PNL 2A	27
Comments:					
ENTERGY	363	SCHEMATIC	A208548	SHEM DIAG OF CONN FOR POST ACCIDENT SOV CONT	2
Comments:					
ENTERGY	366	SCHEMATIC	A208551	SCHEMATIC DIAGRAM OF CONN'S FOR POST ACCIDENT SOV CONTROL	2
Comments:					
ENTERGY	392	SCHEMATIC	B209521	SCHEMATIC D/C FOR MODIF OF CONTROL FOR SOV 955D	3
Comments:					
ENTERGY	393	SCHEMATIC	B209522	SCHEMATIC D/C FOR MODIF OF CONTROL FOR SOV 955E	3
Comments:					
ENTERGY	394	SCHEMATIC	B209523	SCHEMATIC D/C FOR MODIF OF CONTROL FOR SOV 955F	3
Comments:					
ENTERGY	395	SCHEMATIC	B209543	See Comment	5
Comments:					
Title illegible					
ENTERGY	396	SCHEMATIC	B209545	SCHEMATIC D/C FOR CONTROL OF SOV 5047 &	5
Comments:					
Rest of Title illegible					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	397	SCHEMATIC	B209546	SCHEMATIC D/C FOR CONTROL OF SOV 5048 & 110V 5052	5
Comments:					
ENTERGY	398	SCHEMATIC	B209547	SCHEMATIC D/C FOR CONTROL OF SOV 5049 & HCV 5053	5
Comments:					
ENTERGY	400	SCHEMATIC	B225122	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE AND UNDERFREQUENCY BUS #2 SH 16	4
Comments:					
ENTERGY	401	SCHEMATIC	B225123	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE AND UNDERFREQUENCY BUS #3 SH 17	3
Comments:					
ENTERGY	402	SCHEMATIC	B225124	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE AND UNDERFREQUENCY BUS #4 SH 18	2
Comments:					
ENTERGY	403	SCHEMATIC	B225125	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE BUS #5 & 6 SH 19	3
Comments:					
ENTERGY	406	SCHEMATIC	B225131	ELEMENTARY WIRING DIAGRAM FOR ROD POWER SUPPLY MG SET 22	6
Comments:					
ENTERGY	408	SCHEMATIC	B225132	ELEMENTARY WIRING DIAG OF CHARGING PMPS 21& 23 SH 26	11
Comments:					
ENTERGY	412	SCHEMATIC	B225135	ELEMENTARY WIRING DIAGRAM OF SAFETY INJECTION PUMP #22 SH 29	6
Comments:					
ENTERGY	414	SCHEMATIC	B225137	ELEMENTARY WIRING DIAGRAM OF RESIDUAL HEAT REMOVAL PUMPS #21 AND 22 SH 31	10
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	420	SCHEMATIC	B225141	ELEMENTARY WIRING DIAGRAM OF SERVICE WATER PUMP 25 SH 35	16
Comments:					
ENTERGY	421	SCHEMATIC	B225142	ELEMENTARY WIRING DIAGRAM OF RECIRCULATION PUMP #22 SH 36	5
Comments:					
ENTERGY	423	SCHEMATIC	B225143	ELEMENTARY WIRING DIAG OF CONT. RECIRC. FAN 21,22,25 SH 37	8
Comments:					
ENTERGY	424	SCHEMATIC	B225144	ELEMENTARY WIRING DIAGRAM FOR PRESS. HEATER CONTROL GROUP 24 SH 38	6
Comments:					
ENTERGY	425	SCHEMATIC	B225145	ELEM WIRING DIAG OF PRESSURIZER HTR BACK-UP GROUP 22	9
Comments:					
ENTERGY	426	SCHEMATIC	B225146	ELEMENTARY WIRING DIAGRAM OF CONT SPRAY PUMP #22 SH 40	9
Comments:					
ENTERGY	427	SCHEMATIC	B225147	ELEMENTARY WIRING DIAGRAM OF SERVICE WATER PUMP #22 SH 42	18
Comments:					
ENTERGY	429	SCHEMATIC	B225149	ELEMENTARY WIRING DIAGRAM OF SERVICE WATER PUMP #23 SH 44	23
Comments:					
ENTERGY	430	SCHEMATIC	B225150	ELEMENTARY WIRING DIAGRAM FOR COMPONENT COOLING PUMP #22 SH 45	10
Comments:					
ENTERGY	431	SCHEMATIC	B225151	ELEMENTARY WIRING DIAGRAM OF COMPONENT COOLING PUMP #23	14
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	432	SCHEMATIC	B225152	ELEMENTARY WIRING DIAGRAM OF CONTAINMENT RECIRD FAN #23 SH 47	7
Comments:					
ENTERGY	435	SCHEMATIC	B225173	ELEMENTARY DIAGRAM OF UNDER VOLTAGE REACTOR TRIP SH 70	4
Comments:					
ENTERGY	436	SCHEMATIC	B225181	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID SH 90	5
Comments:					
ENTERGY	437	SCHEMATIC	B225182	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID SH 91	6
Comments:					
ENTERGY	438	SCHEMATIC	B225183	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID SH 92	3
Comments:					
ENTERGY	439	SCHEMATIC	B225184	ELEMENTARY WIRING DIAGRAM OF PILOT SOLENOID & SOLENOID VALVE TABLES SH 93	3
Comments:					
ENTERGY	440	SCHEMATIC	B225186	ELEMENTARY WIRING DIAGRAM OF VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 95	2
Comments:					
ENTERGY	441	SCHEMATIC	B225187	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 96	10
Comments:					
ENTERGY	442	SCHEMATIC	B225189	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID VALVES SH 98	4
Comments:					
ENTERGY	443	SCHEMATIC	B225190	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 99	3
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	445	SCHEMATIC	B225207	ELEMENTARY WIRING DIAG OF REMOTE OPERATED VALVES SH 122	3
Comments:					
ENTERGY	446	SCHEMATIC	B225227	ELEMENTARY WIRING DIAGRAM OF RECIRC. SW & INDICATING LIGHTS SH 142	7
Comments:					
ENTERGY	447	SCHEMATIC	B225228	ELEMENTARY WIRING DIAGRAM OF RECIRC. SW & INDICATING LIGHTS SH 143	5
Comments:					
ENTERGY	448	SCHEMATIC	B225229	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 144	6
Comments:					
ENTERGY	449	SCHEMATIC	B225230	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 145	5
Comments:					
ENTERGY	450	SCHEMATIC	B225231	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 146	4
Comments:					
ENTERGY	451	SCHEMATIC	B225233	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 148	5
Comments:					
ENTERGY	452	SCHEMATIC	B225234	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 149	5
Comments:					
ENTERGY	454	SCHEMATIC	B226967	WIRING DIAG & SCHEM OF ISO SEAL WTR VLVS 3518 & 3519	7
Comments:					
ENTERGY	459	SCHEMATIC	B231669	SCHEM DIAG 6900V SWITCHGEAR #22 UNIT NO. 16 BREAKER 52/CWP 22 CIRC WATER PUMP #22	10
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	460	SCHEMATIC	B231670	SCHEM DIAG 6900V SWITCHGEAR #22 UNIT NO. 11 BREAKER 52/CWP 24 CIRC WATER PUMP #24	10
Comments:					
ENTERGY	461	SCHEMATIC	B231671	SCHEM DIAG 6900V SWITCHGEAR #22 UNIT #2 BREAKER 52/CWP 26 CIRC WATER PUMP #26	10
Comments:					
ENTERGY	464	SCHEMATIC	B253867	ELEMENTARY WIRING DIAGRAM ROD POWER SUPPLY MG SET 21	4
Comments:					
ENTERGY	490	SCHEMATIC	IP2-S-000089	SPRAY VALVE INDICATION PRESSURIZER SPRAY VALVES PCV-455A & PCV-455B INDIC	1
Comments:					
ENTERGY	493	SCHEMATIC	IP2-S-000092	S/D OF POST ACCIDENT SAMPLING VALVES SOV 5019, 5023	1
Comments: SEE 731 & 733 ALSO					
ENTERGY	497	SCHEMATIC	IP2-S-000285	D. C. SCHEMATIC FOR DIESEL GENERATORS 22	13
Comments:					
ENTERGY	498	SCHEMATIC	IP2-S-000286	D. C. SCHEMATIC FOR DIESEL GENERATORS 23	13
Comments:					
ENTERGY	499	SCHEMATIC	IP2-S-000329	480V BREAKERS MCC24A, MCC27A, MCC29A INDICATION	0
Comments:					
ENTERGY	504	SCHEMATIC	IP2-S-000358	DC MONITORING - SCHEMATIC FOR INSTALL OF BAT #22 U.V. RELAY	0
Comments:					
ENTERGY	508	SCHEMATIC	IP2-S-000365	SCHEMATIC DIAGRAM OF EDG 22 DC TRANSFER SWITCH CONTROL	4
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	509	SCHEMATIC	IP2-S-000366	SCHEMATIC DIAGRAM OF EDG 23 DC TRANSFER SWITCH CONTROL	4
Comments:					
ENTERGY	511	SCHEMATIC	IP2-S-000194	SWD-CONTROL & INDICATION SERVICE WATER PUMP 26	12
Comments:					
ENTERGY	528	SCHEMATIC	225026	SAFEGUARDS ACTUATION CONT ISOLATION VENT & SPRAY - TRAIN B CAB F7	5
Comments:					
WORK THIS WITH REFERENCE 834					
ENTERGY	533	SCHEMATIC	9321-LL-3114 SH 18	AUX LOCK-OUT RELAY 86X/ST6	7
Comments:					
ENTERGY	534	SCHEMATIC	9321-LL-3114 SH 20	BREAKER 52/SS22RW3 SUB. STA. 22RW3 TRANSFORMER	1
Comments:					
ENTERGY	593	SCHEMATIC	9321-LL-3135 SH 02	ANNUNCIATORS SCHEMATIC	11
Comments:					
ENTERGY	594	SCHEMATIC	9321-LL-3135 SH 03	FIRST-OUT ANNUNCIATOR ON "FAF" FLIGHT PANEL	19
Comments:					
ENTERGY	607	SCHEMATIC	306825	LOW VOLTAGE METAL ENCLOSED SWITCHGEAR DB-75 & DB-50 BREAKERS FIG #1 THRU #5	6
Comments:					
ENTERGY	612	SCHEMATIC	011D13784	OUTLINE 10 KVA INVERTER 105-140V DC	1
Comments:					
ENTERGY	629	SCHEMATIC	110E073 SH 10	REACTOR PROTECTION SYSTEM SCHEMATIC	5L
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	631	SCHEMATIC	110E073 SH 3	REACTOR PROTECTION SYSTEM SCHEMATIC	7E
Comments:					
ENTERGY	632	SCHEMATIC	110E073 SH 2	REACTOR PROTECTION SYSTEM SCHEMATIC	8L
Comments:					
ENTERGY	634	SCHEMATIC	110E073 SH 5	REACTOR PROTECTION SYSTEM SCHEMATIC	10N
Comments:					
ENTERGY	637	SCHEMATIC	110E073 SH 8	REACTOR PROTECTION SYSTEM SCHEMATIC	9H
Comments:					
ENTERGY	638	SCHEMATIC	A236330	OVER SPEED CONTROL SCHEMATIC VALVE CHANNEL	2
Comments:					
ENTERGY	639	SCHEMATIC	306965	INTERNAL WIRING DIAGRAM OF IEOPS PANEL OF CCR F9 PANEL	0
Comments:					
ENTERGY	643	SCHEMATIC	1981M598	INTERNAL WIRING DIAGRAM OF 125V DC, 50A, AUTO TRANSFER SWITCH FOR EDG'S 21, 22, 23	A2
Comments:					
ENTERGY	644	SCHEMATIC	59M196	SCHEMATIC EXCITER VOLTAGE REGULATOR REGULATOR (EDG 21, 22, 23)	Z6
Comments:					
ENTERGY	645	SCHEMATIC	A208540	D. C. SCHEMATIC (BREAKER CONTROL)	7
Comments:					
ENTERGY	651	SCHEMATIC	B225205	ELEMENTARY WIRING DIAGRAM OF REMOTE OPERATED VALVES	8
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	656	SCHEMATIC	307670	DIAGRAM OF INTERNAL CONN'S OF IEOPS AUX EQUIPMENT DRAWER CHANNEL B	0
Comments:					
ENTERGY	657	SCHEMATIC	B225208	ELEMENTRY DIAGRAM OF REMOTED OPERATED VALVES	4
Comments:					
ENTERGY	669	SCHEMATIC	A208425	D/C FOR CKT CHANGES FOR RCDT PMP DISCHARGE ISO VLV 1706	4
Comments:					
ENTERGY	671	SCHEMATIC	A208844	SCHEM DIAG FOR POST-ACCIDENT LIQUID SAMPLING MOV 959, 4395, 5132, 955B, 956F, 990B	7
Comments:					
ENTERGY	674	SCHEMATIC	9321-LL-3601 SH 03	SCHEMATIC DIAGRAM SOL OPERATED FEEDWATER SYSTEM BYPASS VALVES	10
Comments:					
ENTERGY	677	SCHEMATIC	B209518	SCHEMATIC D/C FOR MODIFICATION OF CONTROL FOR PRESS STEAM SP SAMPLING VALVE SOV951	2
Comments:					
ENTERGY	678	SCHEMATIC	B209519	SCHEMATIC D/C FOR MODIFICATION OF CONTROL FOR PRESS LIQUID SP SAMPLING VALVE SOV953	2
Comments:					
ENTERGY	679	SCHEMATIC	B209520	SCHEMATIC D/C FOR MODIFICATION OF CONTROL FOR SOV955C	2
Comments:					
ENTERGY	680	SCHEMATIC	B209864	SCHEMATIC D/C FOR PRT DRAIN VLV 523, RCDT DRAIN VLV LCV3401 & RCDP #21	6
Comments:					
ENTERGY	681	SCHEMATIC	225188	VALVE TABLE PILOT SOLENOID & SOLENOID VALVES	3
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	682	SCHEMATIC	225232	RECIRC. SW. #5 & INDICATING LIGHTS	7
Comments:					
ENTERGY	683	SCHEMATIC	B228092	ELEMENTRY WIRING DIAGRAM OF ANNUNCIATOR PANEL SGF	13
Comments:					
ENTERGY	684	SCHEMATIC	225018	SAFEGAURDS ACTUATION SCHEMES (TRAIN B ONLY)	10
Comments:					
ENTERGY	685	SCHEMATIC	208416	D/C OF CIRCUIT CHANGES FOR RC DT GAS ANALYZER ISOL VLV 1789	3
Comments:					
ENTERGY	686	SCHEMATIC	208417	D/C OF CIRCUIT CHANGES FOR RC DT GAS ANALYZER ISOL VLV 1788	3
Comments:					
ENTERGY	687	SCHEMATIC	208421	D/C OF CIRCUIT CHANGES FOR PRT GAS ANALYZER ISOL VLV 549	3
Comments:					
ENTERGY	688	SCHEMATIC	208419	D/C OF CIRCUIT CHANGES FOR PRT GAS ANALYZER ISOL VLV 548	4
Comments:					
ENTERGY	689	SCHEMATIC	303845	SWD OF GAS SAMPLINGVALVE 1600E (548 & 549), 1600F, 1600G (1286)	1
Comments:					
ENTERGY	690	SCHEMATIC	A207559	D/C OF ELECTRICAL SEPERATION OF AIR EJECTOR ISOL VALVES	9
Comments:					
ENTERGY	691	SCHEMATIC	1986M03456	ELEMENTRY DIAGRAM INVERTER	2E
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	692	SCHEMATIC	1986M03516	ELEMENTRY DIAGRAM HOT WATER ALARM	1A
Comments:					
ENTERGY	693	SCHEMATIC	1986M03453	ELEMENTRY DIAGRAM FIELD FLASHING CIRCUIT	2C
Comments:					
ENTERGY	694	SCHEMATIC	IP2--S-000054	GENEREX EXCITATION SYSTEM DE-EXCITATION BREAKER CONTROL	3
Comments:					
ENTERGY	695	SCHEMATIC	9321-LL-3114 SH 16	BREAKER 52/SS6 STATION SERVICE TRANSFORMER 6	9
Comments:					
ENTERGY	696	SCHEMATIC	300925	ELEMENTRY DIAGRAM OF SAFETY INJECTION PUMP 23	2
Comments:					
ENTERGY	697	SCHEMATIC	B209526	SCHEMATIC DC FOR ACCUMULATOR SAMPLE ISO VALVE SOV 956H	1
Comments:					
ENTERGY	698	SCHEMATIC	B209525	SCHEMATIC DC FOR ACCUMULATOR SAMPLE ISO VALVE SOV 956D	1
Comments:					
ENTERGY	699	SCHEMATIC	B209524	SCHEMATIC DC FOR ACCUMULATOR SAMPLE ISO VALVE SOV 956B	1
Comments:					
ENTERGY	700	SCHEMATIC	303686	SWD GAS SAMPLING VALVES 1600A (1788, 1789), 1600B (265)	1
Comments:					
ENTERGY	701	SCHEMATIC	304159	SWD GAS SAMPLING VALVES 1600H (1285), 1600J (1284, 1600K)	0
Comments:					

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ENTERGY	703	SCHEMATIC	241185	CONTROL ROOM PANEL "FB"	14
Comments:					
ENTERGY	704	SCHEMATIC	B261914	SCHEMATIC DIAGRAM OF CONTROL CKT. SOV459 ACTUATOR OF LETDOWN STOP VALVE LCV459	2
Comments:					
ENTERGY	710	SCHEMATIC	610F942	SUPERVISORY PANEL " SBR-1" WIRING DIAGRAM	4X
Comments:					
ENTERGY	714	SCHEMATIC	610F960	SUPERVISORY PANEL "SHR" WIRING DIAGRAM	4G
Comments:					
ENTERGY	716	SCHEMATIC	IP2-S-000006	INDIAN POINT #2 AUTO SEAL WATER VALVE #1413	2
Comments:					
ENTERGY	717	SCHEMATIC	IP2-S-000225	23 ACCUM DISCHARGE TO LOOP 23 COLD LEG STOP VALVE MOV-894C	2
Comments:					
ENTERGY	718	SCHEMATIC	IP2-S-000201	FLOW ISOLATION VALVE MOV-842	3
Comments:					
ENTERGY	719	SCHEMATIC	IP2-S-000226	21 ACCUM DISCHARGE TO LOOP 21 COLD LEG STOP VALVE MOV- 894A	2
Comments:					
ENTERGY	720	SCHEMATIC	IP2-S-000212	LOOP 21 HOT LEG SI LINE STOP VALVE MOV-856F	5
Comments:					
ENTERGY	721	SCHEMATIC	IP2-S-000198	RHR PUMPS DISCHARGE RESIDUAL HXS MOV-744	7
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	722	SCHEMATIC	IP2-S-000197	RESIDUAL PUMP SUCTION STOP VALVE TO SI PUMPS SUCTION MOV-1810	1
Comments:					
ENTERGY	723	SCHEMATIC	B207571	CONTROL AND INDICATION SOV-1430 AND PCV-1230 SJAE DISCHARGE ISOL VALVE	2
Comments:					
ENTERGY	727	SCHEMATIC	DMD 208436-AA	DC CKT FOR H2 RECOMB 21 & 22 ISOL VLV	0
Comments:					
ENTERGY	728	SCHEMATIC	DMD 208435-AF	DISCONNECT OF POWER SUP TO H2 ARR & H2 BRR RELAYS	0
Comments:					
ENTERGY	731	SCHEMATIC	DMD IP2--S-000092-AB	S/D OF POST ACC SAMPLE PNL SOV 5019 & SOV 5023	0
Comments:					
ENTERGY	733	SCHEMATIC	DMD IP2--S-000092-AC	S/D OF POST ACC SAMPLE PNL SOV 5019 & SOV 5023	0
Comments:					
ENTERGY	916	SCHEMATIC	B236062	SCHEMATIC WIRING DIAGRAM FOR MOTOR-GENERATOR SET NO. 21 - ROD CONTROL CONTROLMG SET	2
Comments:					
ENTERGY	939	SD	27.3	INDIAN POINT ENERGY CENTER, UNIT NO. 2, EMERGENCY DIESELS SYSTEM DESCRIPTION	7
Comments:					
NEC	14	STANDARD	Chapter 9 Table 8	CONDUCTOR PROPERIES	2002
Comments:					
ENTERGY	116	WD	9321-F-3153 SH 01	WIRING DIAGRAM 6900V SWITCHGEAR 22	21
Comments:					
ALSO KNOWN AS DWG A200925					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	117	WD	9321-F-3154 SH 02	WIRING DIAGRAM 6900V SWITCHGEAR 22	23
Comments:					
ALSO KNOWN AS DWG A200926					
ENTERGY	120	WD	9321-F-3165	WIRING DIAGRAM 480V SWITCHGEAR 21 UNITS 20, 21 & 22	17
Comments:					
ENTERGY	121	WD	9321-F-3166	WIRING DIAGRAM 480V SWITCHGEAR 21 UNITS 23, 24 AND 25	14
Comments:					
ALSO KNOWN AS DWG A200982					
ENTERGY	122	WD	9321-F-3167	WIRING DIAGRAM 480V SWITCHGEAR 21 UNIT 26	38
Comments:					
ENTERGY	126	WD	9321-F-3171	WIRING DIAGRAM 480V SWITCHGEAR 22 UNITS 10, 11 & 12	20
Comments:					
ENTERGY	127	WD	9321-F-3172	WIRING DIA 480V SWITCHGEAR 22 UNIT 13	13
Comments:					
ENTERGY	138	WD	9321-F-3225	WIRING DIAGRAM OF SUPERVISORY CONTROL PANEL - SB1 (SH. 1 OF 2)	32
Comments:					
ENTERGY	141	WD	9321-F-3250	WIRING DIAGRAM P.A. SYSTEM SH 03	21
Comments:					
ENTERGY	142	WD	9321-F-3268	WIRING DIAGRAM FLIGHT CONTROL PANEL FBF	36
Comments:					
ENTERGY	145	WD	9321-F-3281	WIRING DIAGRAM AUX RELAYS RACK G3	32
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	149	WD	9321-F-3303	UNKNOWN TITLE	UNKNOW
Comments:					
ENTERGY	150	WD	9321-F-3309	WIRING DIAGRAM AUXILIARY RELAYS RACK G-1 (FRONT)	21
Comments:					
ENTERGY	151	WD	9321-F-3310	WIRING DIAGRAM AUXILIARY RELAYS RACK G-2 (FRONT)	21
Comments:					
ENTERGY	337	WD	9321-F-3222	WIRING DIAGRAM REACTOR TRIP & MG SET BREAKERS	14
Comments:					
ALSO KNOWN AS A201243					
ENTERGY	338	WD	A206800	DIAG OF INT CONN'S OF RELAY PANEL (TRAIN B) FOR OVER PRESSURIZATION SYSTEM	1
Comments:					
ENTERGY	359	WD	A208508	WIRING DIAGRAM DIESEL GENERATOR #22	17
Comments:					
ENTERGY	360	WD	A208509	WIRING DIAGRAM DIESEL GENERATOR #23	16
Comments:					
ENTERGY	893	WD	300469	LOW VOLTAGE METAL ENCLOSED SWITCHGEAR DB-50 BREAKERS FIGURE # 7	5
Comments:					
ENTERGY	641	WD	9321-F-3223	WIRING DIAGRAM REDUNDANT OVER SPEED TURBINE TRIP	10
Comments:					
ALSO KNOWN AS DWG A201252					
ENTERGY	650	WD	A207577	INTERNAL DC WIRING DIAGRAM FOR DIESEL GEN'S 21, 22, 23	20
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	668	WD	A208429	D/C FOR CKT CHANGES FOR EXCESS LETDOWN HT EXCHANGE VALVES 793 & 796	2
Comments:					
ENTERGY	702	WD	A241184	CONTROL ROOM PANEL "FA"	12
Comments:					
ENTERGY	712	WD	A225564	INTERNAL WIRING DIAGRAM OF SUPERVOSORY PANEL "SJR"	13
Comments:					
ENTERGY	843	WD	9321-F-3270	WIRING DIAGRAM FLIGHT CONTROL PANEL FBR (JA7)	25
Comments:					
ENTERGY	851	WD	610F958	SUPERVISORY PANEL SHF-A WIRING DIAGRAM	4Q
Comments:					
ENTERGY	853	WD	9321-F-3267	WIRING DIAGRAM FLIGHT CONTROL PANEL FAR (JA8)	35
Comments:					
ENTERGY	854	WD	610F959	SUPERVISORY PANEL SHF-B WIRING DIAGRAM	4J
Comments:					
ENTERGY	855	WD	A208545	WIRING DIAGRAM OF SUPERVISORY PANEL SH	7
Comments:					
ENTERGY	860	WD	9321-F-3232	WIRING DIAGRAM OF SUPERVISORY CONTROL PANEL SH	26
Comments:					
ENTERGY	861	WD	9321-F-3233	WIRING DIAGRAM OF SUPERVISORY CONTROL PANEL SJ	48
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	863	WD	593F140	INDOOR METAL CLAD SWITCHGEAR 75 DH BREAKER CONN DIAG UNITS 5 & 6	3A
Comments:					
ENTERGY	864	WD	593F141	INDOOR METAL CLAD SWITCHGEAR 75 DH BREAKER CONN DIAG UNITS 7 & 8	4
Comments:					
ENTERGY	880	WD	A242121	PART OF PANEL FAR WIRING DIAGRAM	8
Comments:					
ENTERGY	882	WD	A242120	PART OF PANEL FAR WIRING DIAGRAM	21
Comments:					
ENTERGY	884	WD	A225577	SUPERVISORY PANEL SJF	22
Comments:					
ENTERGY	890	WD	A208505	WIRING DIAGRAM AUXILIARY RELAY RACK G1 REAR	7
Comments:					
ENTERGY	891	WD	225543	WIRING DIAGRAM OF SUPERVISORY PANEL SB1(F)-A	12
Comments:					
IS NEW BORDER FOR 610F940					
ENTERGY	892	WD	A208825	WIRING DIAG OF SUPERVISORY CONTROL PANEL SB1 SHEET 2 (JB8)	9
Comments:					
DWG SHOWS AS SHT 1					
ENTERGY	894	WD	615B440	SAFEGAURDS WIRING G1 & G2 (WIRE TABULATION SHEETS, SHEETS 1 TO 39)	J1
Comments:					
ENTERGY	896	WD	207B70	CONTROL STATION PS6 CONNECTION DIAGRAM SERVICE WATER PUMPS & CONTAINMENT AIR RECIRC FANS	0A
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	897	WD	A225544	INTERNAL WIRING DIAGRAM OF SUPERV PNL SBF1-B	19
Comments:					
ENTERGY	898	WD	A225584	INTRERNAL WIRING DIAGRAM OF FLIGHT PNL PART FBF-A	17
Comments:					
ENTERGY	899	WD	A225586	WIRING DIAG OF INT CONN'S OF PART OF FBF-B-PNL	8
Comments:					
ENTERGY	903	WD	225546	WIRING DIAGRAM OF SUPERVISORY PANEL SBF2-A	11
Comments:					
ENTERGY	905	WD	A208511	DC FOR 480VAC BUS SECT BKR'S 52/2A, 52/5A, 52/3A & 52/6A UNDERVOLTAGE TRIP - REMOTE RLY CAB'S	9
Comments:					
ENTERGY	911	WD	A208823	EXTERNAL DIAGRAM OF SUPERVISORY CONTROL PANEL SB2 (SHEET 3 OF 3)	16
Comments:					
ENTERGY	912	WD	204B37	WIRING DIAGRAM SUPERVISORY PNL SBF2-B	6AE
Comments:					
ALSO KNOWN AS 610F944					
ENTERGY	913	WD	A242646	LOW VOLTAGE METAL ENCL. SWGR. CONNECTION DIAGRAM	3
Comments:					
WAS 204B70					
ENTERGY	914	WD	A242647	LOW VOLTAGE METAL ENCL. SWGR. CONNECTION DIAGRAM	3
Comments:					
WAS 204B71					
ENTERGY	915	WD	311183	LOW VOLTAGE METAL ENCLOSED SWITCHGEAR BREAKER DB-50 FIGURE 8	1
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	917	WD	208824	WIRING DIAG OF SUPERV CONTROL PANEL SB1 SHEET 2	18
Comments:					
ENTERGY	918	WD	9321-F-3302	WIRING DIAG OF PROTECTION LOGIC RACK F-8	36
Comments:					
ENTERGY	919	WD	A208822	DIAG OF EXTERNAL CONNS FOR SUPERVISORY CONTROL PANEL SB2 (SH 2 OF 3)	16
Comments:					
ENTERGY	920	WD	9321-F-3288	WIRING DIAGRAM FOR PROTECTION LOGIC RACK E-7 CONNECTION OR RELAY SI-13X SPARE CONTACTS	41
Comments:					
ENTERGY	923	WD	A225579	WIRING DIAGRAM FLIGHT CONTROL PANEL FCR	5
Comments:					
ENTERGY	924	WD	A242119	PART OF PANEL FBR WIRING DIAG	7
Comments:					
ENTERGY	928	WD	208052	WIRING CONN DIAG OF ENGINE GEN SET FOR DIESEL GENS 21,22,23	9
Comments:					
ENTERGY	931	WD	59M194	AC CONTROL WIRING FOR EMERG DIESEL GENERATORS 21, 22, 23	Z5
Comments:					

N/A

Attachment R
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By: Robert J. Fletcher Date: 8/26/05

Check: [illegible] Date: 8-26-05

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	18	DATABASE	N/A	ECRIS DATA FILE DATA AS OF 7/24/2003	07/24/03
Comments: ECRIS Data from Excel file dated 7/24/03 provided to Framatome by IP2					
ENTERGY	935	MEMO	R MILICI TO J HAUSSER	LETTER FROM R. MILICI TO J. HAUSSER STATING VALUES FOR SEVERAL COMPONENTS	09-18-03
Comments:					
ENTERGY	11	ONE-LINE	A208501	ONE LINE DIAGRAM 125VDC FOR DIST PNL'S 21, 21A, 21B, 22, & 22A	35
Comments:					
ENTERGY	100	ONE-LINE	9321-F-3004	ONE LINE DIAGRAM 480V MOTOR CONTROL CENTER 21,22,23,25,25A	81
Comments:					
ENTERGY	103	ONE-LINE	9321-F-3008	SINGLE LINE DIA. 125V DC POWER PNLS 21,22,23&24	83
Comments:					
ENTERGY	346	ONE-LINE	A208088	ONE LINE DIAG. 480 V SWGR 21 & 22, BUS 2A,3A,5A&6A	38
Comments:					
ENTERGY	348	ONE-LINE	A208241	SINGLE LINE DIA. OF 480 VAC MCC 28A &211	23
Comments:					
ENTERGY	376	ONE-LINE	A231592	6900 VOLT AC ONE LINE DIAGRAM	18
Comments:					
ENTERGY	1	SCHEMATIC	206799	RCS OVERPRESSURIZATION SYS D.C. SCHEMATIC TRAIN A & B	5
Comments:					
ENTERGY	3	SCHEMATIC	A207325	SCHEMATIC DIAGRAM CH 1 & 2 LP STEAM DUMP SOVS 1206, 1207, 1208, 1209, 1210, 1211	4
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	4	SCHEMATIC	UNKNOWN	UNKNOWN SCHEMATIC	N/A
Comments:					
ENTERGY	5	SCHEMATIC	B207581	D/C OF EQUIPMENT FOR REPLACEMENT OF CONTROL VALVES TCV1104 & TCV1105	4
Comments:					
ENTERGY	9	SCHEMATIC	B208435	D/C OF CKT CHANGES FOR SG SAMPLE & BLOWDOWN ISOL VLVS (TMI - CONT/SO MODIF)	7
Comments:					
ENTERGY	21	SCHEMATIC	A209515	SD OF SAMP ISO SOL VLV SOV1523A-SOV1526A & BLOWDWN ISO SOL VLV SOV1314A-SOV1317A	12
Comments:					
ENTERGY	25	SCHEMATIC	B225185	ELEMENTARY WIRING DIAGRAM OF VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 94	1
Comments:					
ENTERGY	26	SCHEMATIC	B225191	ELEMENTARY WIRING DIAGRAM OF CONTROL VALVE TABLE SH 105	4
Comments:					
ENTERGY	27	SCHEMATIC	B225192	ELEMENTARY WIRING DIAGRAM OF CONTROL VALVE TABLE SH 106	5
Comments:					
ENTERGY	28	SCHEMATIC	B225193	ELEMENTARY WIRING DIAGRAM OF CONTROL VALVE TABLE SH 107	6
Comments:					
ENTERGY	31	SCHEMATIC	B225206	ELEMENTARY WIRING DIAGRAM OF REMOTE OPERATED VALVES SH 121	2
Comments:					
ENTERGY	32	SCHEMATIC	225209	ELEMENTARY WIRING DIAGRAM OF REMOTE OPERATED VALVES SH 124	5
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	33	SCHEMATIC	225242	ELEMENTARY WIEING DIAGRAM OF ANNUNCIATOR PNL "SB1F" SH 160	6
Comments:					
ENTERGY	37	SCHEMATIC	B235113	SCHEM DIAG AUX FEED PMP 22 STEAM SUPPLY ISOL VALVES (20/AFPSS1&2)	5
Comments:					
ENTERGY	55	SCHEMATIC	311906	SWD OF SOV 455C PRESSURIZER PORV PCV-455C	2
Comments:					
ENTERGY	58	SCHEMATIC	110E073 SH 9	INDIAN POINT STATION UNIT 2 REACTOR PROTECTION SYSTEM SCHEMATIC	9P
Comments:					
ENTERGY	59	SCHEMATIC	110E073 SH 11	INDIAN POINT STATION UNIT 2 REACTOR BREAKER SCHEMATIC	11U
Comments:					
ENTERGY	61	SCHEMATIC	322462	SCHEMATIC DIAGRAM OF IVSWS FLOW CONTROL VALVES SOV-7864, SOV-7865, SOV-7866 & SOV-7867	0
Comments:					
ENTERGY	62	SCHEMATIC	195B46	UNITED ENGRS & CONST INC CLASS III LTG SWGR	3B
Comments:					
ENTERGY	63	SCHEMATIC	195B47	UE&C INC CLASS III LTG SWGR	4D
Comments:					
ENTERGY	71	SCHEMATIC	1975M1487	OUTLINE 10 KVA INVERTER 129 VDC	C
Comments:					
ENTERGY	72	SCHEMATIC	1975M5611	SCHEMATIC INVERTER, 1PHASE, KVA, 1O, 60HZ,129VDC	B1
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	73	SCHEMATIC	1986M02277	SCHEMATIC DIAGRAM (HYDROGEN STATOR COOLING) SH. 5	8C
Comments:					
ENTERGY	74	SCHEMATIC	1986M03496	DE-EXC BREAKER CONTROL	1C
Comments:					
ENTERGY	75	SCHEMATIC	A241685	SCHEMATIC DIAGRAM OF SAFEGUARDS ACTUATION CABINETS E7, E8, F7, & F8	6
Comments:					
ENTERGY	76	SCHEMATIC	199B23	CON ED CO INDIAN POINT ISOLATION UNIT AND SAFEGUARDS ACTUATION SCHEMATIC	5L
Comments:					
ENTERGY	78	SCHEMATIC	204B70	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL. SWGR CONNECTION DIAGRAM	4
Comments:					
OBSOLETE SEE A242646					
ENTERGY	82	SCHEMATIC	204B74	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 9 & 10	5B
Comments:					
ENTERGY	84	SCHEMATIC	204B76	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 11 & 12	2A
Comments:					
ENTERGY	86	SCHEMATIC	204B78	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 24 & 25	5E
Comments:					
ENTERGY	87	SCHEMATIC	204B79	CON ED - INDIAN PT - UNIT 2 LOW VOLTAGE METAL ENCL SWGR UNITS 22 & 23	4
Comments:					
ENTERGY	177	SCHEMATIC	9321-LL-3114 SH 02	BREAKER 52/UT3 BUS #3 NORMAL FEED	11
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	178	SCHEMATIC	9321-LL-3114 SH 03	BREAKER 52/UT3-ST6 BUS #3 - #6 TIE	11
Comments:					
ENTERGY	179	SCHEMATIC	9321-LL-3114 SH 04	BREAKER 52/UT4 BUS #4 NORMAL FEED	10
Comments:					
ENTERGY	180	SCHEMATIC	9321-LL-3114 SH 05	BREAKER 52/UT4-ST6 BUS #4 - #6 TIE	11
Comments:					
ENTERGY	181	SCHEMATIC	9321-LL-3114 SH 06	BREAKER 52/ST6 BUS #6 NORMAL FEED	12
Comments:					
ENTERGY	182	SCHEMATIC	9321-LL-3114 SH 07	SCHEMATIC DIAGRAM BREAKER 52/RCP23 REACTOR COOLANT PUMP 23	15
Comments:					
ENTERGY	183	SCHEMATIC	9321-LL-3114 SH 09	BREAKER 52/HDP21 HEATER DRAIN PUMP 21	15
Comments:					
ENTERGY	184	SCHEMATIC	9321-LL-3114 SH 10	BREAKER 52/SS3 STATION SERVICE TRANSFORMER 3	8
Comments:					
ENTERGY	185	SCHEMATIC	9321-LL-3114 SH 11	BREAKER 52/RCP22 REACTOR COOLANT PUMP 22	16
Comments:					
ENTERGY	186	SCHEMATIC	9321-LL-3114 SH 12	BREAKER 52/CP23 CONDENSATE PUMP 23	13
Comments:					
ENTERGY	187	SCHEMATIC	9321-LL-3114 SH 14	BREAKER 52/HDP22 HEATER DRAIN PUMP 22	16
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	189	SCHEMATIC	9321-LL-3114 SH 17	6900V BUS 3, 4, & 6 LOCKOUT RELAYS (86/UT3, 86/UT4 & 86/ST6	7
Comments:					
ENTERGY	190	SCHEMATIC	9321-LL-3114 SH 19	BREAKER 52/GT26 GAS TURB. BUS 6 TIE	13
Comments:					
ENTERGY	192	SCHEMATIC	9321-LL-3117 SH 02	SCHEMATIC DIAGRAM 480V SWITCHGEAR 21 INTERLOCKING RELAYS	24
Comments:					
ENTERGY	194	SCHEMATIC	9321-LL-3117 SH 03A	480V BUS 2A - INTERLOCKING RELAYS	29
Comments:					
ENTERGY	198	SCHEMATIC	9321-LL-3117 SH 06	BREAKER 52/2A - STATION SERVICE TRANSFORMER 2-BUS 2A TIE	24
Comments:					
ENTERGY	200	SCHEMATIC	9321-LL-3117 SH 08	BREAKER 52/EG2A EMERGENCY GENERATOR 22	20
Comments:					
ENTERGY	203	SCHEMATIC	9321-LL-3117 SH 11	LTG. & MCC BREAKERS	16
Comments:					
ENTERGY	212	SCHEMATIC	9321-LL-3117 SH 22	480V BUS 5A & 6A UNDER VOLTAGE AUX. RELAYS	22
Comments:					
ENTERGY	213	SCHEMATIC	9321-LL-3117 SH 22A	480V BUS 6A UNDERVOLTAGE AUX. RELAYS	10
Comments:					
ENTERGY	216	SCHEMATIC	9321-LL-3118 SH 02	SCHEMATIC DIAGRAM 480V SWITCHGEAR 22 INTERLOCKING RELAYS	22
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	219	SCHEMATIC	9321-LL-3118 SH 03B	480V AC BUS 6A INTERLOCKING RELAYS	25
Comments:					
ENTERGY	220	SCHEMATIC	9321-LL-3118 SH 04	BREAKER 52/6A STATION SERVICE TRANSFORMER 6-BUS 6A TIE	24
Comments:					
ENTERGY	221	SCHEMATIC	9321-LL-3118 SH 05	BREAKER 52/3AT6A BUS 3A-6A TIE	14
Comments:					
ENTERGY	223	SCHEMATIC	9321-LL-3118 SH 07	BREAKER 52/EG3 EMERGENCY GENERATOR 23	19
Comments:					
ENTERGY	225	SCHEMATIC	9321-LL-3118 SH 09	BREAKER 52/MCC6B BUS 6A FEED TO MCC26B	11
Comments:					
ENTERGY	226	SCHEMATIC	9321-LL-3118 SH 10	LTG. & MCC BREAKERS	6
Comments:					
ENTERGY	232	SCHEMATIC	9321-LL-3118 SH 16	BREAKER 52/AF3 AUXILIARY FEEDWATER PUMP 23 SWITCHGEAR 22 UNIT 9C	30
Comments:					
ENTERGY	233	SCHEMATIC	9321-LL-3118 SH 18	BREAKER 52/TAO TURBINE AUXILIARY OIL PUMP	16
Comments:					
ENTERGY	236	SCHEMATIC	9321-LL-3118 SH 19B	SCHEM. DIAG. OF 125 V DC SUPPLY FOR UNIT 7 TO 13 SWGR 22	3
Comments:					
ENTERGY	237	SCHEMATIC	9321-LL-3118 SH 20	AUX. BFP 21 & 23 AUTO-START RELAYS	28
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	238	SCHEMATIC	9321-LL-3118 SH 20A	SCHEMATIC DIAGRAM AUX. B.F. PUMPS 21, 22 & 23 AND B.F.P. 22 AUTO-START	3
Comments:					
ENTERGY	242	SCHEMATIC	9321-LL-3130 SH 02B	SCHEMATIC DIAGRAM FOR TURBINE AUTO STOP TPIP SOLENOID & TRIP RELAYS	29
Comments:					
ENTERGY	243	SCHEMATIC	9321-LL-3130 SH 03	SCHEMATIC DIAGRAM LOAD LIMIT VALVE #1 CONTROLLER (LLV1)	17
Comments:					
ENTERGY	245	SCHEMATIC	9321-LL-3130 SH 05	GENERATOR PRIMARY LOCKOUT RELAY 86/P	29
Comments:					
ENTERGY	246	SCHEMATIC	9321-LL-3130 SH 06	SCHEMATIC DIAGRAM GENERATOR BACKUP LOCKOUT RELAY 86BU	37
Comments:					
ENTERGY	263	SCHEMATIC	9321-LL-3131 SH 11	AUX BOILER FEED PUMP 23 RECIRC VALVE (AFPR3)	7
Comments:					
ENTERGY	264	SCHEMATIC	9321-LL-3131 SH 11A	SCHEMATIC DIAGRAM FOR AUX BOILER FEED PUMP #23 RECIR VALVE (AFPR3)	3
Comments:					
ENTERGY	268	SCHEMATIC	9321-LL-3131 SH 25	CONTAINMENT RADIATION MONITOR ISOLATION VALVES	8
Comments:					
ENTERGY	271	SCHEMATIC	9321-LL-3131 SH 15A	SCHEMATIC DIAGRAM SERVICE WATER CONTROL VALVES	14
Comments:					
ENTERGY	272	SCHEMATIC	9321-LL-3131 SH 21	SCHEMATIC DIAGRAM MAIN STEAM ISOLATION VALVES	12
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	274	SCHEMATIC	9321-LL-3132 SH 02	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	8
Comments:					
ENTERGY	276	SCHEMATIC	9321-LL-3132 SH 04	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	9
Comments:					
ENTERGY	277	SCHEMATIC	9321-LL-3132 SH 05	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	10
Comments:					
ENTERGY	279	SCHEMATIC	9321-LL-3132 SH 07	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	17
Comments:					
ENTERGY	281	SCHEMATIC	9321-LL-3132 SH 09	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	16
Comments:					
ENTERGY	283	SCHEMATIC	9321-LL-3132 SH 11	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	15
Comments:					
ENTERGY	285	SCHEMATIC	9321-LL-3132 SH 13	SCHEMATIC DIAGRAM PILOT WIRE AND MISC. LOCK-OUT RELAYS	6
Comments:					
ENTERGY	310	SCHEMATIC	9321-LL-3135 SH 01	SCHEMATIC DIAGRAM FIRST OUT FAF ANNUNCIATOR & FBF & FCF ANNUNCIATORS	12
Comments:					
ENTERGY	322	SCHEMATIC	9321-LL-3140 SH 12	BOILER FEED PUMP 22 TRUBINE TRIP AND RESET	29
Comments:					
ENTERGY	324	SCHEMATIC	9321-LL-3140 SH 14	BOILER FEED PUMP 22 TURBINE LOW PRESSURE STOP VALVE CONTROLLER (20/LP-SVC2)	10
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	325	SCHEMATIC	9321-LL-3140 SH 15	BOILER FEED PUMP 22 TURBINE HIGH PRESSURE STOP VALVE CONTROLLER (20HP-SVC2)	9
Comments:					
ENTERGY	326	SCHEMATIC	9321-LL-3140 SH 16	BOILER FEED PUMP 22 RECIRD. VALVE (BFPR2)	8
Comments:					
ENTERGY	340	SCHEMATIC	A206900	DIA OF CONN'S FOR STATIC INV 24 BAT CHARG 24 & 125 DC PWR PNL 214 & 125 DC DISTR PNL 2A	27
Comments:					
ENTERGY	363	SCHEMATIC	A208548	SHEM DIAG OF CONN FOR POST ACCIDENT SOV CONT	2
Comments:					
ENTERGY	366	SCHEMATIC	A208551	SCHEMATIC DIAGRAM OF CONN'S FOR POST ACCIDENT SOV CONTROL	2
Comments:					
ENTERGY	392	SCHEMATIC	B209521	SCHEMATIC D/C FOR MODIF OF CONTROL FOR SOV 955D	3
Comments:					
ENTERGY	393	SCHEMATIC	B209522	SCHEMATIC D/C FOR MODIF OF CONTROL FOR SOV 955E	3
Comments:					
ENTERGY	394	SCHEMATIC	B209523	SCHEMATIC D/C FOR MODIF OF CONTROL FOR SOV 955F	3
Comments:					
ENTERGY	395	SCHEMATIC	B209543	See Comment	5
Comments:					
Title illegible					
ENTERGY	396	SCHEMATIC	B209545	SCHEMATIC D/C FOR CONTROL OF SOV 5047 &	5
Comments:					
Rest of Title illegible					

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ENTERGY	397	SCHEMATIC	B209546	SCHEMATIC D/C FOR CONTROL OF SOV 5048 & 110V 5052	5
Comments:					
ENTERGY	398	SCHEMATIC	B209547	SCHEMATIC D/C FOR CONTROL OF SOV 5049 & HCV 5053	5
Comments:					
ENTERGY	400	SCHEMATIC	B225122	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE AND UNDERFREQUENCY BUS #2 SH 16	4
Comments:					
ENTERGY	401	SCHEMATIC	B225123	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE AND UNDERFREQUENCY BUS #3 SH 17	3
Comments:					
ENTERGY	402	SCHEMATIC	B225124	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE AND UNDERFREQUENCY BUS #4 SH 18	2
Comments:					
ENTERGY	403	SCHEMATIC	B225125	ELEMENTARY WIRING DIAGRAM OF UNDERVOLTAGE BUS #5 & 6 SH 19	3
Comments:					
ENTERGY	406	SCHEMATIC	B225131	ELEMENTARY WIRING DIAGRAM FOR ROD POWER SUPPLY MG SET 22	6
Comments:					
ENTERGY	408	SCHEMATIC	B225132	ELEMENTARY WIRING DIAG OF CHARGING PMPS 21& 23 SH 26	11
Comments:					
ENTERGY	412	SCHEMATIC	B225135	ELEMENTARY WIRING DIAGRAM OF SAFETY INJECTION PUMP #22 SH 29	6
Comments:					
ENTERGY	414	SCHEMATIC	B225137	ELEMENTARY WIRING DIAGRAM OF RESIDUAL HEAT REMOVAL PUMPS #21 AND 22 SH 31	10
Comments:					

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ENTERGY	420	SCHEMATIC	B225141	ELEMENTARY WIRING DIAGRAM OF SERVICE WATER PUMP 25 SH 35	16
Comments:					
ENTERGY	421	SCHEMATIC	B225142	ELEMENTARY WIRING DIAGRAM OF RECIRCULATION PUMP #22 SH 36	5
Comments:					
ENTERGY	423	SCHEMATIC	B225143	ELEMENTARY WIRING DIAG OF CONT. RECIRC. FAN 21,22,25 SH 37	8
Comments:					
ENTERGY	424	SCHEMATIC	B225144	ELEMENTARY WIRING DIAGRAM FOR PRESS. HEATER CONTROL GROUP 24 SH 38	6
Comments:					
ENTERGY	425	SCHEMATIC	B225145	ELEM WIRING DIAG OF PRESSURIZER HTR BACK-UP GROUP 22	9
Comments:					
ENTERGY	426	SCHEMATIC	B225146	ELEMENTARY WIRING DIAGRAM OF CONT SPRAY PUMP #22 SH 40	9
Comments:					
ENTERGY	427	SCHEMATIC	B225147	ELEMENTARY WIRING DIAGRAM OF SERVICE WATER PUMP #22 SH 42	18
Comments:					
ENTERGY	429	SCHEMATIC	B225149	ELEMENTARY WIRING DIAGRAM OF SERVICE WATER PUMP #23 SH 44	23
Comments:					
ENTERGY	430	SCHEMATIC	B225150	ELEMENTARY WIRING DIAGRAM FOR COMPONENT COOLING PUMP #22 SH 45	10
Comments:					
ENTERGY	431	SCHEMATIC	B225151	ELEMENTARY WIRING DIAGRAM OF COMPONENT COOLING PUMP #23	14
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	432	SCHEMATIC	B225152	ELEMENTARY WIRING DIAGRAM OF CONTAINMENT RECIRD FAN #23 SH 47	7
Comments:					
ENTERGY	435	SCHEMATIC	B225173	ELEMENTARY DIAGRAM OF UNDER VOLTAGE REACTOR TRIP SH 70	4
Comments:					
ENTERGY	436	SCHEMATIC	B225181	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID SH 90	5
Comments:					
ENTERGY	437	SCHEMATIC	B225182	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID SH 91	6
Comments:					
ENTERGY	438	SCHEMATIC	B225183	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID SH 92	3
Comments:					
ENTERGY	439	SCHEMATIC	B225184	ELEMENTARY WIRING DIAGRAM OF PILOT SOLENOID & SOLENOID VALVE TABLES SH 93	3
Comments:					
ENTERGY	440	SCHEMATIC	B225186	ELEMENTARY WIRING DIAGRAM OF VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 95	2
Comments:					
ENTERGY	441	SCHEMATIC	B225187	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 96	10
Comments:					
ENTERGY	442	SCHEMATIC	B225189	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID VALVES SH 98	4
Comments:					
ENTERGY	443	SCHEMATIC	B225190	ELEMENTARY WIRING DIAGRAM VALVE TABLE PILOT SOLENOID & SOLENOID VALVES SH 99	3
Comments:					

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ENTERGY	445	SCHEMATIC	B225207	ELEMENTARY WIRING DIAG OF REMOTE OPERATED VALVES SH 122	3
Comments:					
ENTERGY	446	SCHEMATIC	B225227	ELEMENTARY WIRING DIAGRAM OF RECIRC. SW & INDICATING LIGHTS SH 142	7
Comments:					
ENTERGY	447	SCHEMATIC	B225228	ELEMENTARY WIRING DIAGRAM OF RECIRC. SW & INDICATING LIGHTS SH 143	5
Comments:					
ENTERGY	448	SCHEMATIC	B225229	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 144	6
Comments:					
ENTERGY	449	SCHEMATIC	B225230	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 145	5
Comments:					
ENTERGY	450	SCHEMATIC	B225231	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 146	4
Comments:					
ENTERGY	451	SCHEMATIC	B225233	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 148	5
Comments:					
ENTERGY	452	SCHEMATIC	B225234	ELEMENTARY WIRING DIAGRAM OF RECIRC SW & INDICATING LIGHTS SH 149	5
Comments:					
ENTERGY	454	SCHEMATIC	B226967	WIRING DIAG & SCHEM OF ISO SEAL WTR VLVS 3518 & 3519	7
Comments:					
ENTERGY	459	SCHEMATIC	B231669	SCHEM DIAG 6900V SWITCHGEAR #22 UNIT NO. 16 BREAKER 52/CWP 22 CIRC WATER PUMP #22	10
Comments:					

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ENTERGY	460	SCHEMATIC	B231670	SCHEM DIAG 6900V SWITCHGEAR #22 UNIT NO. 11 BREAKER 52/CWP 24 CIRC WATER PUMP #24	10
Comments:					
ENTERGY	461	SCHEMATIC	B231671	SCHEM DIAG 6900V SWITCHGEAR #22 UNIT #2 BREAKER 52/CWP 26 CIRC WATER PUMP #26	10
Comments:					
ENTERGY	464	SCHEMATIC	B253867	ELEMENTARY WIRING DIAGRAM ROD POWER SUPPLY MG SET 21	4
Comments:					
ENTERGY	490	SCHEMATIC	IP2-S-000089	SPRAY VALVE INDICATION PRESSURIZER SPRAY VALVES PCV-455A & PCV-455B INDIC	1
Comments:					
ENTERGY	493	SCHEMATIC	IP2-S-000092	S/D OF POST ACCIDENT SAMPLING VALVES SOV 5019, 5023	1
Comments: SEE 731 & 733 ALSO					
ENTERGY	497	SCHEMATIC	IP2-S-000285	D. C. SCHEMATIC FOR DIESEL GENERATORS 22	13
Comments:					
ENTERGY	498	SCHEMATIC	IP2-S-000286	D. C. SCHEMATIC FOR DIESEL GENERATORS 23	13
Comments:					
ENTERGY	499	SCHEMATIC	IP2-S-000329	480V BREAKERS MCC24A, MCC27A, MCC29A INDICATION	0
Comments:					
ENTERGY	504	SCHEMATIC	IP2-S-000358	DC MONITORING - SCHEMATIC FOR INSTALL OF BAT #22 U.V. RELAY	0
Comments:					
ENTERGY	508	SCHEMATIC	IP2-S-000365	SCHEMATIC DIAGRAM OF EDG 22 DC TRANSFER SWITCH CONTROL	4
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	509	SCHEMATIC	IP2-S-000366	SCHEMATIC DIAGRAM OF EDG 23 DC TRANSFER SWITCH CONTROL	4
Comments:					
ENTERGY	511	SCHEMATIC	IP2-S-000194	SWD-CONTROL & INDICATION SERVICE WATER PUMP 26	12
Comments:					
ENTERGY	528	SCHEMATIC	225026	SAFEGUARDS ACTUATION CONT ISOLATION VENT & SPRAY - TRAIN B CAB F7	5
Comments: WORK THIS WITH REFERENCE 834					
ENTERGY	533	SCHEMATIC	9321-LL-3114 SH 18	AUX LOCK-OUT RELAY 86X/ST6	7
Comments:					
ENTERGY	534	SCHEMATIC	9321-LL-3114 SH 20	BREAKER 52/SS22RW3 SUB. STA. 22RW3 TRANSFORMER	1
Comments:					
ENTERGY	593	SCHEMATIC	9321-LL-3135 SH 02	ANNUNCIATORS SCHEMATIC	11
Comments:					
ENTERGY	594	SCHEMATIC	9321-LL-3135 SH 03	FIRST-OUT ANNUNCIATOR ON "FAF" FLIGHT PANEL	19
Comments:					
ENTERGY	607	SCHEMATIC	306825	LOW VOLTAGE METAL ENCLOSED SWITCHGEAR DB-75 & DB-50 BREAKERS FIG #1 THRU #5	6
Comments:					
ENTERGY	612	SCHEMATIC	011D13784	OUTLINE 10 KVA INVERTER 105-140V DC	1
Comments:					
ENTERGY	629	SCHEMATIC	110E073 SH 10	REACTOR PROTECTION SYSTEM SCHEMATIC	5L
Comments:					

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ENTERGY	631	SCHEMATIC	110E073 SH 3	REACTOR PROTECTION SYSTEM SCHEMATIC	7E
Comments:					
ENTERGY	632	SCHEMATIC	110E073 SH 2	REACTOR PROTECTION SYSTEM SCHEMATIC	8L
Comments:					
ENTERGY	634	SCHEMATIC	110E073 SH 5	REACTOR PROTECTION SYSTEM SCHEMATIC	10N
Comments:					
ENTERGY	637	SCHEMATIC	110E073 SH 8	REACTOR PROTECTION SYSTEM SCHEMATIC	9H
Comments:					
ENTERGY	638	SCHEMATIC	A236330	OVER SPEED CONTROL SCHEMATIC VALVE CHANNEL	2
Comments:					
ENTERGY	639	SCHEMATIC	306965	INTERNAL WIRING DIAGRAM OF IEOPS PANEL OF CCR F9 PANEL	0
Comments:					
ENTERGY	643	SCHEMATIC	1981M598	INTERNAL WIRING DIAGRAM OF 125V DC, 50A, AUTO TRANSFER SWITCH FOR EDG'S 21, 22, 23	A2
Comments:					
ENTERGY	644	SCHEMATIC	59M196	SCHEMATIC EXCITER VOLTAGE REGULATOR REGULATOR (EDG 21, 22, 23)	Z6
Comments:					
ENTERGY	645	SCHEMATIC	A208540	D. C. SCHEMATIC (BREAKER CONTROL)	7
Comments:					
ENTERGY	651	SCHEMATIC	B225205	ELEMENTARY WIRING DIAGRAM OF REMOTE OPERATED VALVES	8
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	656	SCHEMATIC	307670	DIAGRAM OF INTERNAL CONN'S OF IEOPS AUX EQUIPMENT DRAWER CHANNEL B	0
Comments:					
ENTERGY	657	SCHEMATIC	B225208	ELEMENTRY DIAGRAM OF REMOTED OPERATED VALVES	4
Comments:					
ENTERGY	669	SCHEMATIC	A208425	D/C FOR CKT CHANGES FOR RCDT PMP DISCHARGE ISO VLV 1706	4
Comments:					
ENTERGY	671	SCHEMATIC	A208844	SCHEM DIAG FOR POST-ACCIDENT LIQUID SAMPLING MOV 959, 4395, 5132, 955B, 956F, 990B	7
Comments:					
ENTERGY	674	SCHEMATIC	9321-LL-3601 SH 03	SCHEMATIC DIAGRAM SOL OPERATED FEEDWATER SYSTEM BYPASS VALVES	10
Comments:					
ENTERGY	677	SCHEMATIC	B209518	SCHEMATIC D/C FOR MODIFICATION OF CONTROL FOR PRESS STEAM SP SAMPLING VALVE SOV951	2
Comments:					
ENTERGY	678	SCHEMATIC	B209519	SCHEMATIC D/C FOR MODIFICATION OF CONTROL FOR PRESS LIQUID SP SAMPLING VALVE SOV953	2
Comments:					
ENTERGY	679	SCHEMATIC	B209520	SCHEMATIC D/C FOR MODIFICATION OF CONTROL FOR SOV955C	2
Comments:					
ENTERGY	680	SCHEMATIC	B209864	SCHEMATIC D/C FOR PRT DRAIN VLV 523, RCDT DRAIN VLV LCV3401 & RCDP #21	6
Comments:					
ENTERGY	681	SCHEMATIC	225188	VALVE TABLE PILOT SOLENOID & SOLENOID VALVES	3
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	682	SCHEMATIC	225232	RECIRC. SW. #5 & INDICATING LIGHTS	7
Comments:					
ENTERGY	683	SCHEMATIC	B228092	ELEMENTRY WIRING DIAGRAM OF ANNUNCIATOR PANEL SGF	13
Comments:					
ENTERGY	684	SCHEMATIC	225018	SAFEGAURDS ACTUATION SCHEMES (TRAIN B ONLY)	10
Comments:					
ENTERGY	685	SCHEMATIC	208416	D/C OF CIRCUIT CHANGES FOR RC DT GAS ANALYZER ISOL VLV 1789	3
Comments:					
ENTERGY	686	SCHEMATIC	208417	D/C OF CIRCUIT CHANGES FOR RC DT GAS ANALYZER ISOL VLV 1788	3
Comments:					
ENTERGY	687	SCHEMATIC	208421	D/C OF CIRCUIT CHANGES FOR PRT GAS ANALYZER ISOL VLV 549	3
Comments:					
ENTERGY	688	SCHEMATIC	208419	D/C OF CIRCUIT CHANGES FOR PRT GAS ANALYZER ISOL VLV 548	4
Comments:					
ENTERGY	689	SCHEMATIC	303845	SWD OF GAS SAMPLINGVALVE 1600E (548 & 549), 1600F, 1600G (1286)	1
Comments:					
ENTERGY	690	SCHEMATIC	A207559	D/C OF ELECTRICAL SEPERATION OF AIR EJECTOR ISOL VALVES	9
Comments:					
ENTERGY	691	SCHEMATIC	1986M03456	ELEMENTRY DIAGRAM INVERTER	2E
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	692	SCHEMATIC	1986M03516	ELEMENTRY DIAGRAM HOT WATER ALARM	1A
Comments:					
ENTERGY	693	SCHEMATIC	1986M03453	ELEMENTRY DIAGRAM FIELD FLASHING CIRCUIT	2C
Comments:					
ENTERGY	694	SCHEMATIC	IP2–S-000054	GENEREX EXCITATION SYSTEM DE-EXCITATION BREAKER CONTROL	3
Comments:					
ENTERGY	695	SCHEMATIC	9321-LL-3114 SH 16	BREAKER 52/SS6 STATION SERVICE TRANSFORMER 6	9
Comments:					
ENTERGY	696	SCHEMATIC	300925	ELEMENTRY DIAGRAM OF SAFETY INJECTION PUMP 23	2
Comments:					
ENTERGY	697	SCHEMATIC	B209526	SCHEMATIC DC FOR ACCUMULATOR SAMPLE ISO VALVE SOV 956H	1
Comments:					
ENTERGY	698	SCHEMATIC	B209525	SCHEMATIC DC FOR ACCUMULATOR SAMPLE ISO VALVE SOV 956D	1
Comments:					
ENTERGY	699	SCHEMATIC	B209524	SCHEMATIC DC FOR ACCUMULATOR SAMPLE ISO VALVE SOV 956B	1
Comments:					
ENTERGY	700	SCHEMATIC	303686	SWD GAS SAMPLING VALVES 1600A (1788, 1789), 1600B (265)	1
Comments:					
ENTERGY	701	SCHEMATIC	304159	SWD GAS SAMPLING VALVES 1600H (1285), 1600J (1284, 1600K)	0
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	703	SCHEMATIC	241185	CONTROL ROOM PANEL "FB"	14
Comments:					
ENTERGY	704	SCHEMATIC	B261914	SCHEMATIC DIAGRAM OF CONTROL CKT. SOV459 ACTUATOR OF LETDOWN STOP VALVE LCV459	2
Comments:					
ENTERGY	710	SCHEMATIC	610F942	SUPERVISORY PANEL " SBR-1" WIRING DIAGRAM	4X
Comments:					
ENTERGY	714	SCHEMATIC	610F960	SUPERVISORY PANEL "SHR" WIRING DIAGRAM	4G
Comments:					
ENTERGY	716	SCHEMATIC	IP2-S-000006	INDIAN POINT #2 AUTO SEAL WATER VALVE #1413	2
Comments:					
ENTERGY	717	SCHEMATIC	IP2-S-000225	23 ACCUM DISCHARGE TO LOOP 23 COLD LEG STOP VALVE MOV-894C	2
Comments:					
ENTERGY	718	SCHEMATIC	IP2-S-000201	FLOW ISOLATION VALVE MOV-842	3
Comments:					
ENTERGY	719	SCHEMATIC	IP2-S-000226	21 ACCUM DISCHARGE TO LOOP 21 COLD LEG STOP VALVE MOV- 894A	2
Comments:					
ENTERGY	720	SCHEMATIC	IP2-S-000212	LOOP 21 HOT LEG SI LINE STOP VALVE MOV-856F	5
Comments:					
ENTERGY	721	SCHEMATIC	IP2-S-000198	RHR PUMPS DISCHARGE RESIDUAL HXS MOV-744	7
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	722	SCHEMATIC	IP2-S-000197	RESIDUAL PUMP SUCTION STOP VALVE TO SI PUMPS SUCTION MOV-1810	1
Comments:					
ENTERGY	723	SCHEMATIC	B207571	CONTROL AND INDICATION SOV-1430 AND PCV-1230 SJAE DISCHARGE ISOL VALVE	2
Comments:					
ENTERGY	727	SCHEMATIC	DMD 208436-AA	DC CKT FOR H2 RECOMB 21 & 22 ISOL VLV	0
Comments:					
ENTERGY	728	SCHEMATIC	DMD 208435-AF	DISCONNECT OF POWER SUP TO H2 ARR & H2 BRR RELAYS	0
Comments:					
ENTERGY	731	SCHEMATIC	DMD IP2--S-000092-AB	S/D OF POST ACC SAMPLE PNL SOV 5019 & SOV 5023	0
Comments:					
ENTERGY	733	SCHEMATIC	DMD IP2--S-000092-AC	S/D OF POST ACC SAMPLE PNL SOV 5019 & SOV 5023	0
Comments:					
ENTERGY	916	SCHEMATIC	B236062	SCHEMATIC WIRING DIAGRAM FOR MOTOR-GENERATOR SET NO. 21 - ROD CONTROL CONTROLMG SET	2
Comments:					
ENTERGY	939	SD	27.3	INDIAN POINT ENERGY CENTER, UNIT NO. 2, EMERGENCY DIESELS SYSTEM DESCRIPTION	7
Comments:					
NEC	14	STANDARD	Chapter 9 Table 8	CONDUCTOR PROPERIES	2002
Comments:					
ENTERGY	116	WD	9321-F-3153 SH 01	WIRING DIAGRAM 6900V SWITCHGEAR 22	21
Comments:					
ALSO KNOWN AS DWG A200925					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	117	WD	9321-F-3154 SH 02	WIRING DIAGRAM 6900V SWITCHGEAR 22	23
Comments:					
ALSO KNOWN AS DWG A200926					
ENTERGY	120	WD	9321-F-3165	WIRING DIAGRAM 480V SWITCHGEAR 21 UNITS 20, 21 & 22	17
Comments:					
ENTERGY	121	WD	9321-F-3166	WIRING DIAGRAM 480V SWITCHGEAR 21 UNITS 23, 24 AND 25	14
Comments:					
ALSO KNOWN AS DWG A200982					
ENTERGY	122	WD	9321-F-3167	WIRING DIAGRAM 480V SWITCHGEAR 21 UNIT 26	38
Comments:					
ENTERGY	126	WD	9321-F-3171	WIRING DIAGRAM 480V SWITCHGEAR 22 UNITS 10, 11 & 12	20
Comments:					
ENTERGY	127	WD	9321-F-3172	WIRING DIA 480V SWITCHGEAR 22 UNIT 13	13
Comments:					
ENTERGY	138	WD	9321-F-3225	WIRING DIAGRAM OF SUPERVISORY CONTROL PANEL - SB1 (SH. 1 OF 2)	32
Comments:					
ENTERGY	141	WD	9321-F-3250	WIRING DIAGRAM P.A. SYSTEM SH 03	21
Comments:					
ENTERGY	142	WD	9321-F-3268	WIRING DIAGRAM FLIGHT CONTROL PANEL FBF	36
Comments:					
ENTERGY	145	WD	9321-F-3281	WIRING DIAGRAM AUX RELAYS RACK G3	32
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	149	WD	9321-F-3303	UNKNOWN TITLE	UNKNOW
Comments:					
ENTERGY	150	WD	9321-F-3309	WIRING DIAGRAM AUXILIARY RELAYS RACK G-1 (FRONT)	21
Comments:					
ENTERGY	151	WD	9321-F-3310	WIRING DIAGRAM AUXILIARY RELAYS RACK G-2 (FRONT)	21
Comments:					
ENTERGY	337	WD	9321-F-3222	WIRING DIAGRAM REACTOR TRIP & MG SET BREAKERS	14
Comments:					
ALSO KNOWN AS A201243					
ENTERGY	338	WD	A206800	DIAG OF INT CONN'S OF RELAY PANEL (TRAIN B) FOR OVER PRESSURIZATION SYSTEM	1
Comments:					
ENTERGY	359	WD	A208508	WIRING DIAGRAM DIESEL GENERATOR #22	17
Comments:					
ENTERGY	360	WD	A208509	WIRING DIAGRAM DIESEL GENERATOR #23	16
Comments:					
ENTERGY	893	WD	300469	LOW VOLTAGE METAL ENCLOSED SWITCHGEAR DB-50 BREAKERS FIGURE # 7	5
Comments:					
ENTERGY	641	WD	9321-F-3223	WIRING DIAGRAM REDUNDANT OVER SPEED TURBINE TRIP	10
Comments:					
ALSO KNOWN AS DWG A201252					
ENTERGY	650	WD	A207577	INTERNAL DC WIRING DIAGRAM FOR DIESEL GEN'S 21, 22, 23	20
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	668	WD	A208429	D/C FOR CKT CHANGES FOR EXCESS LETDOWN HT EXCHANGE VALVES 793 & 796	2
Comments:					
ENTERGY	702	WD	A241184	CONTROL ROOM PANEL "FA"	12
Comments:					
ENTERGY	712	WD	A225564	INTERNAL WIRING DIAGRAM OF SUPERVOSORY PANEL "SJR"	13
Comments:					
ENTERGY	843	WD	9321-F-3270	WIRING DIAGRAM FLIGHT CONTROL PANEL FBR (JA7)	25
Comments:					
ENTERGY	851	WD	610F958	SUPERVISORY PANEL SHF-A WIRING DIAGRAM	4Q
Comments:					
ENTERGY	853	WD	9321-F-3267	WIRING DIAGRAM FLIGHT CONTROL PANEL FAR (JA8)	35
Comments:					
ENTERGY	854	WD	610F959	SUPERVISORY PANEL SHF-B WIRING DIAGRAM	4J
Comments:					
ENTERGY	855	WD	A208545	WIRING DIAGRAM OF SUPERVISORY PANEL SH	7
Comments:					
ENTERGY	860	WD	9321-F-3232	WIRING DIAGRAM OF SUPERVISORY CONTROL PANEL SH	26
Comments:					
ENTERGY	861	WD	9321-F-3233	WIRING DIAGRAM OF SUPERVISORY CONTROL PANEL SJ	48
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	863	WD	593F140	INDOOR METAL CLAD SWITCHGEAR 75 DH BREAKER CONN DIAG UNITS 5 & 6	3A
Comments:					
ENTERGY	864	WD	593F141	INDOOR METAL CLAD SWITCHGEAR 75 DH BREAKER CONN DIAG UNITS 7 & 8	4
Comments:					
ENTERGY	880	WD	A242121	PART OF PANEL FAR WIRING DIAGRAM	8
Comments:					
ENTERGY	882	WD	A242120	PART OF PANEL FAR WIRING DIAGRAM	21
Comments:					
ENTERGY	884	WD	A225577	SUPERVISORY PANEL SJF	22
Comments:					
ENTERGY	890	WD	A208505	WIRING DIAGRAM AUXILIARY RELAY RACK G1 REAR	7
Comments:					
ENTERGY	891	WD	225543	WIRING DIAGRAM OF SUPERVISORY PANEL SB1(F)-A	12
Comments:					
IS NEW BORDER FOR 610F940					
ENTERGY	892	WD	A208825	WIRING DIAG OF SUPERVISORY CONTROL PANEL SB1 SHEET 2 (JB8)	9
Comments:					
DWG SHOWS AS SHT 1					
ENTERGY	894	WD	615B440	SAFEGAURDS WIRING G1 & G2 (WIRE TABULATION SHEETS, SHEETS 1 TO 39)	J1
Comments:					
ENTERGY	896	WD	207B70	CONTROL STATION PS6 CONNECTION DIAGRAM SERVICE WATER PUMPS & CONTAINMENT AIR RECIRC FANS	0A
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	897	WD	A225544	INTERNAL WIRING DIAGRAM OF SUPERV PNL SBF1-B	19
Comments:					
ENTERGY	898	WD	A225584	INTRERNAL WIRING DIAGRAM OF FLIGHT PNL PART FBF-A	17
Comments:					
ENTERGY	899	WD	A225586	WIRING DIAG OF INT CONN'S OF PART OF FBF-B-PNL	8
Comments:					
ENTERGY	903	WD	225546	WIRING DIAGRAM OF SUPERVISORY PANEL SBF2-A	11
Comments:					
ENTERGY	905	WD	A208511	DC FOR 480VAC BUS SECT BKR'S 52/2A, 52/5A, 52/3A & 52/6A UNDERVOLTAGE TRIP - REMOTE RLY CAB'S	9
Comments:					
ENTERGY	911	WD	A208823	EXTERNAL DIAGRAM OF SUPERVISORY CONTROL PANEL SB2 (SHEET 3 OF 3)	16
Comments:					
ENTERGY	912	WD	204B37	WIRING DIAGRAM SUPERVISORY PNL SBF2-B	6AE
Comments:					
ALSO KNOWN AS 610F944					
ENTERGY	913	WD	A242646	LOW VOLTAGE METAL ENCL. SWGR. CONNECTION DIAGRAM	3
Comments:					
WAS 204B70					
ENTERGY	914	WD	A242647	LOW VOLTAGE METAL ENCL. SWGR. CONNECTION DIAGRAM	3
Comments:					
WAS 204B71					
ENTERGY	915	WD	311183	LOW VOLTAGE METAL ENCLOSED SWITCHGEAR BREAKER DB-50 FIGURE 8	1
Comments:					

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Mfgr	Ref ID	Class ID	Doc No	Title	Revision
ENTERGY	917	WD	208824	WIRING DIAG OF SUPERV CONTROL PANEL SB1 SHEET 2	18
Comments:					
ENTERGY	918	WD	9321-F-3302	WIRING DIAG OF PROTECTION LOGIC RACK F-8	36
Comments:					
ENTERGY	919	WD	A208822	DIAG OF EXTERNAL CONNS FOR SUPERVISORY CONTROL PANEL SB2 (SH 2 OF 3)	16
Comments:					
ENTERGY	920	WD	9321-F-3288	WIRING DIAGRAM FOR PROTECTION LOGIC RACK E-7 CONNECTION OR RELAY SI-13X SPARE CONTACTS	41
Comments:					
ENTERGY	923	WD	A225579	WIRING DIAGRAM FLIGHT CONTROL PANEL FCR	5
Comments:					
ENTERGY	924	WD	A242119	PART OF PANEL FBR WIRING DIAG	7
Comments:					
ENTERGY	928	WD	208052	WIRING CONN DIAG OF ENGINE GEN SET FOR DIESEL GENS 21,22,23	9
Comments:					
ENTERGY	931	WD	59M194	AC CONTROL WIRING FOR EMERG DIESEL GENERATORS 21, 22, 23	Z5
Comments:					

Attachment S
Component Data Sheets

ITEMS 6, 7, 30, 31

Control Voltages and Operating Currents

Electrically operated air circuit breakers should be operated from reliable sources of control power. Standard control voltages and ranges for electrically operated low voltage breakers are measured at the mechanism terminals for solenoid mechanisms given below:

Control Voltages

Direct Current			Alternating Current		
Standard Control Voltages	To Close	To Trip	Standard Control Voltages	To Close	To Trip
24	----------	14 to 30①	115	95 to 125	95 to 125
48	----------	28 to 60	230	190 to 250	190 to 250
125	90 to 130	70 to 140	460	380 to 500	380 to 500
250	180 to 260	140 to 280			

① 24-volt tripping is not recommended

Operating Currents

Type of Breaker	No. of Poles	Closing Current—Volts				Tripping Current—Volts					
		125 Dc	250 Dc	230 Ac	460 Ac	48 Dc	125 Dc	250 Dc	115 Ac	230 Ac	460 Ac
DB-15	2, 3	20	10	30	15	5	2	1	1	.5	.2
DB-25	2, 3	23	10	35	20	5	2	1	1	.5	.2
DB-50	2, 3	20	10	20	10	5	2	1	1	.5	.2
DB-75	2, 3	32	18	32	18	5	2	1	1	.5	.2
	2, 3	32	18	32	18	6	2	1	1	.5	.2

Control power for ac closing of low voltage breakers in metal-enclosed switchgear is usually taken from the bus or line-side of the breaker through current limiting fuses, or through standard fuses and current limiting resistors. When it is necessary to supply closing power through a control power transformer, a 3 Kva transformer is used for all breaker types and regardless of the number of breakers. For tripping power only, a 250 va control power transformer is adequate for all breaker ratings and regardless of the number of breakers.

Other Attachments

Control Relays

A control relay is normally supplied on each electrically operated type DB breaker. The function of the control relay is to close and open the closing solenoid circuit of the breaker during a closing operation, so that the heavy closing current does not pass through the control switch or other initiating device.

When the control switch of the breaker is closed, it energizes the control relay. A contact from the relay completes the closing solenoid circuit. When the breaker is closed, the breaker closing mechanism mechanically opens the relay contact which interrupts the closing current.

Alarm Switches

It may be desirable when a breaker trips on a fault or overload to ring an alarm of some type. Alarm switches are available on the type DB breaker that will close their contact when the breaker is tripped by the series current device but which is mechanically blocked from closing when the breaker is manually tripped or opened by the shunt trip device. Undervoltage tripping attachment, when supplied, can also operate an alarm.

Auxiliary Switches

Auxiliary switch circuits are available on the type DB breakers in groups of 4 or 8①. These switches are used to control indicating lamps, shunt trip coil circuits or other duties in automatic or manual control schemes.

The switches are contained in molded cases. A rotary design moving contact is used with a wiping action between contact surfaces. The contact faces are silverplated and are held against each other by auxiliary spring tension when they are engaged in the closed position.

Normally, the auxiliary switches have alternate make and break contact when the breaker is in the open or closed position. These can be changed, however, to give any combination of make and break contacts desired.

The auxiliary switch contacts have the following characteristics:

Contacts can carry 15 amperes continuously or 250 amperes for 3 seconds.

Interrupting Capacity:

Volts	Circuit	
	Non-Inductive	Inductive
125 Dc	11 Amperes	6.25 Amperes
250 Dc	2 Amperes	1.75 Amperes
115 Ac	75 Amperes	15 Amperes
460 Ac	25 Amperes	5 Amperes

Interlocks

Interlocks can also be supplied to prevent the operation of breakers under certain conditions. For example, two breakers may be interlocked so that only one may be closed at any one time but both may be open at any one time. Electric lockout attachments or key interlocks are recommended to perform these special functions. Key interlocks on drawout switchgear are so designed and mounted that the interlocking function will not be defeated by substitution of a different breaker in the cell. Mechanical interlocks are also available for non-drawout breakers.

Electric lockout attachments are available on the type DB breakers. The lockout prevents closing of the breaker by holding the breaker linkage in the trip-free position. Energizing the lockout coil frees the linkage and permits closing the breaker. After the breaker is closed, de-energizing the lockout coil does not cause tripping. Standard coil voltages are 48, 125 or 250 dc and 115 230 or 460 ac.

Mountings and Enclosures

Mountings

The type DB circuit breakers are available for dead front fixed mounting or for drawout mounting in individual enclosures or in metal enclosed switchgear assemblies.

Enclosures

Breakers applied in hazardous locations with explosive atmospheres or otherwise contaminated atmospheres, should be provided with proper enclosures to prevent explosions and to maintain proper breaker performance. Individual circuit breakers of the type DB can be supplied with enclosures as shown by the following table:

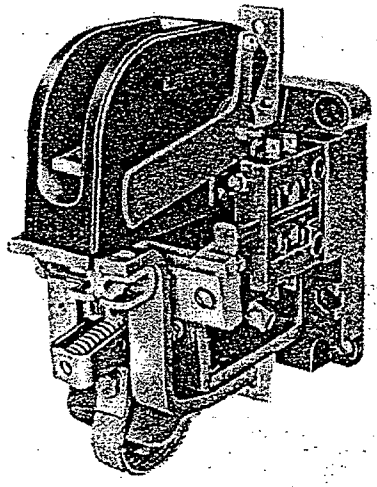
① Twelve auxiliary switch circuits are available on the types DB-50, 75 and 100 breakers.

Westinghouse Electric Corporation
Control Division
Asheville, NC 28813

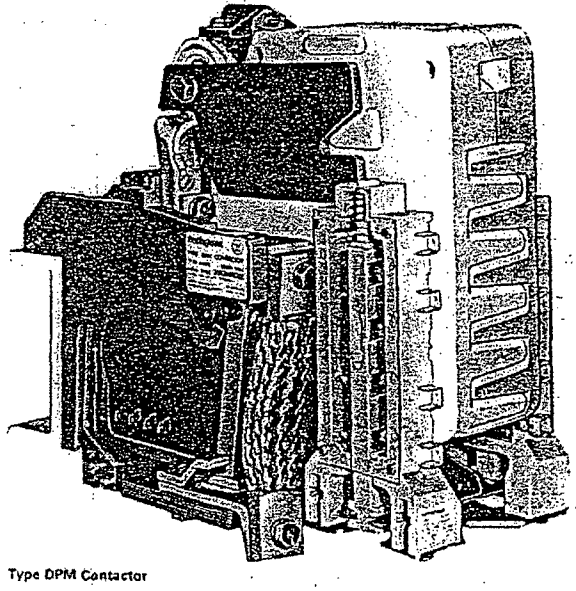
March 15, 1985
New information
Prices effective March 15, 1985, subject to change without notice.
Resale prices suggested only.
Selling Policy 2000
Manual ID: E, D, G/C, 100A

Type MME, MD, M 600 Volts, Max., 10 to 2500 Amperes
Type DPM 1000 Volt, 1250 Amperes
Type DPR 1000 Volt, 100 Amperes

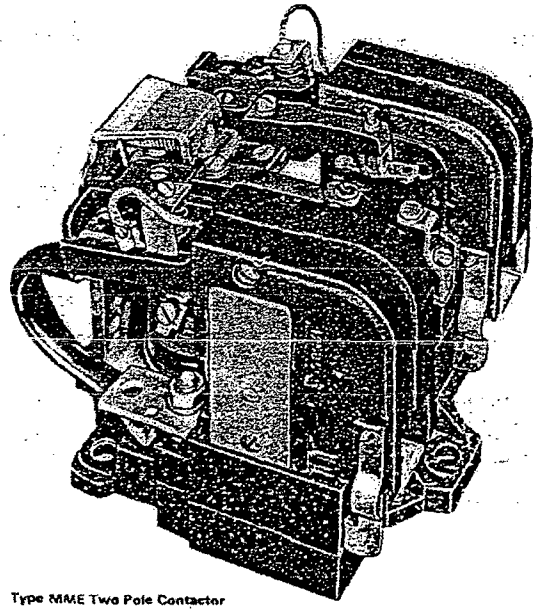
DC Industrial Control Components



Type MD510 Single Pole Contactor



Type DPM Contactor



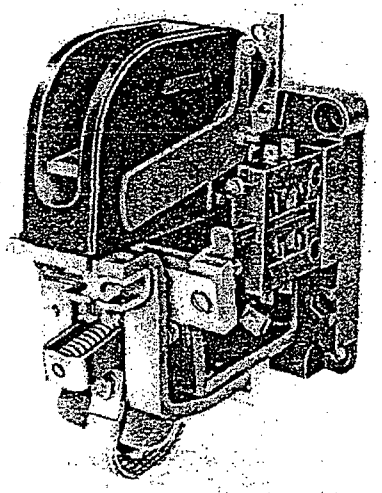
Type MME Two Pole Contactor

ITEM 9, 117, 118

Calculation FEX-00204-00
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Attachment S
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In this publication	Page
Type MME, MD, M Contactors	2-5
Type DPM Contactor	6-8
Type DPR Contactor	9
Renewal Parts Data	10
Technical Data	11

Dc Industrial Control Components
Type MME, MD, M Low Voltage Contactors



Single Pole, Type MD 510 with L64 Interlock

Features

1. Glass-polyester bases; non-tracking, extra strong (MD and MME).

2. Suitable for mounting on steel or panels of any material for maximum flexibility.

3. Front mounting and wiring for convenience of installation and service. Kit available for rear connection of Type MME 10-150 amp ratings. Rear connection Type M available for ratings of 300 amps and above.

4. Knife-edge bearings: Friction-free, guarantee precision operation with minimum wear.

5. Rapid arc quenching: Magnetic blowout prevents arc from concentrating at any point, prolongs life of contact tips, horns and arc box.

6. Easily accessible contact tips: Require only a screwdriver to remove and replace.

7. High contact pressure: Assures rapid opening of contacts, provides quick break action.

8. Vacuum-impregnated magnet coil: Keeps out moisture, dirt and metallic dust.

9. Designed in accordance with NEMA standards ICS 2-110.

10. Standard coils are rated 65, 115, 125, 230, 250 and 550 volt Dc.

11. Ac operation requires rectifier.
List Price Addition: $250

Ordering Information

1. Order by catalog number, and desired coil voltage. (Contactors with normally open and normally closed main contacts will be supplied with upper and lower coil blowouts and arc chutes.) Lower coil must be energized to completely seal the lower contacts. Contactors will not be supplied without operating coils installed.

2. When auxiliary contacts are required, specify number normally open and/or normally closed, or delayed break if required.

List Prices

Coil voltage must be specified separately. Standard voltages are 65, 115, 125, 230 and 550. Other voltages are available: **add 20%** of contactor list price.

Contactor Size	Open 8-Hr. Amp. Rating	Contact Arrangement	Type Contactor Identification (Less Coil)	List Price (With Coil)	Provision for Interlocks		Approx Net Wt. (lb)	Approximate Dimensions: Inches		
					Mechanical	Electrical		Front Connected		
								Width	Height	Depth
Front Connected										
0	10	1 NO	MME10-10	$ 268	Yes	4	8	3.18	7.56	6.81
		2 NO	MME20-10	420	Yes	2	10	5.53	6.75	6.81
		1 NO/1NC	MME11-10	440	Yes	4	12	3.67	12.44	6.81
		1 NC	MME01-10	400	Yes	2	10	3.67	9.47	6.81
1	25	1 NO	MME10-25	268	Yes	4	8	3.18	7.56	6.81
		2 NO	MME20-25	420	Yes	2	10	5.53	6.75	6.81
		1 NO/1NC	MME11-25	440	Yes	4	12	3.67	12.44	6.81
		1 NC	MME01-25	417	Yes	2	10	3.67	9.47	6.81
2	50	1 NO	MME10-50	268	Yes	4	8	3.18	7.56	6.81
		2 NO	MME20-50	420	Yes	2	10	5.53	6.75	6.81
		1 NO/1NC	MME11-50	440	Yes	4	12	3.67	12.44	6.81
		1 NC	MME01-50	434	Yes	2	10	3.67	9.47	6.81
3	100	1 NO	MME10-100	376	Yes	4	8	3.18	7.78	6.81
		2 NO	MME20-100	640	Yes	2	10	5.53	7.44	6.81
		1 NO/1NC	MME11-100	592	Yes	4	12	3.67	12.88	6.81
		1 NC	MME01-100	570	Yes	2	10	3.67	9.69	6.81
4	150	1 NO	MME10-150	452	Yes	4	8	3.18	7.78	6.81
		2 NO	MME20-150	820	Yes	2	10	5.53	7.44	6.81
		1 NO/1NC	MME11-150	616	Yes	4	12	3.67	12.88	6.81
		1 NC	MME01-150	596	Yes	2	10	3.67	9.69	6.81
5	300	1 NO	MD-510	748	Yes	2	34	5.5	13	12
		1 NC	MD-501	912	No	2	45	5.88	16.19	12
6	600	1 NO	MD-510	1256	Yes	2	71	6.63	16.81	14.38
		1 NC	MD-601	2096	No	2	103	9.5	20.38	14.75
7	900	1 NO	MD-710	1728	Yes	2	76	6.63	16.81	14.28
		1 NC	MD-701	2324	No	2	110	9.95	20.38	14.75
8	1350	1 NO	MD-810	2660	Yes	3	151	11	21	17
9	2500	1 NO	MD-910	4750	Yes	3	188	11	21	19

Dc Industrial Control Components
Type MME, MD, M Low Voltage Contactors

List Prices

Coil voltage must be specified separately. Standard voltages are 65, 115, 125, 230, 250 and 550. Other voltages are available, add 20% of contactor list price.

For rear connected application of Type MME contactors (10-150 amps), order rear connection kit style 2184A10G08 at $70 List. For field installation only.

Contactor Size	Open 8-Hr. Amp. Rating	Contact Arrangement	Type Contactor Identification (Less Coil)①	List Price (With Coil)	Provision for Interlocks: Mechanical	Provision for Interlocks: Electrical	Approx. Net Wt. (lb.)	Approximate Dimensions: Inches: Rear Connected: Width	Height	Depth
Rear Connected③	10-150		MME②							
5	300	1 NO	M-510	$ 840	Yes	2	34	7	17	12.5
		1 NC	M-501	1052	No	2	45	7	20	10.5
6	600	1 NO	M-510	1396	Yes	2	71	6¾	21	13
		1 NC	M-601	2236	No	2	103	9½	24	13
7	900	1 NO	M-710	1868	Yes	2	76	6¾	21	13
		1 NC	M-701	2464	No	2	110	9½	24	13
8	1350	1 NO	M-810	2800	Yes	4④	151	9½	24	15
9	2500	1 NO	M-910	4905	Yes	4④	220	9½	24	17

Auxiliary Contacts (Electrical Interlocks)

Auxiliary Contact Type	Contactor Size	Contact Arrangement ④	Number of Auxiliary Contacts	Auxiliary Contacts Factory Mounted: List Price	Auxiliary Contacts Unmounted Replacement Only⑤: Style Number	Auxiliary Contacts Unmounted Replacement Only⑤: List Price	Mounting and Operating Hardware for New Applications: Style Number ⑥	Mounting and Operating Hardware for New Applications: List Price
L46	All MME	NO-FC	1	$ 44	11A8713G09	$ 34	None Required.	$...
		NC-FC	1	44	11A8713G10	34	Integral to	..
		NC – FC – OB	1	44	487B878G01	40	Auxiliary	..
L66	All MME	DB – FC – L	1	44	659C301G04	34	None Required. In-	..
		DB – FC – R	1	44	659C301G05	34	tegral to Auxiliary	..
L 64	MO-301-401 MD 501 MD 601-701 MD 310-410-510 MD 610-710 MD 810 MD 910	NO-NC 2 NO 2 NC	1 1 1	132 132 132	843D943G04 843D943G05 843D943G06	66 66 66	2087A63G01 2087A63G02 2087A63G03 2087A63G04 2087A63G17 2087A63G05 2087A63G06	54 54 54 54 54 68 68
	MD 810	4 NO to 4 NC	2	264	Order 2, L64	132	2087A63G07	88
	MD 910	4 NO to 4 NC	2	264	Order 2, L64	132	2087A63G08	88
	MD 810	6 NO to 6 NC	3	396	Order 3, L64	198	2087A63G07	88
	MD 910	6 NO to 6 NC	3	396	Order 3, L64	198	2087A63G08	88
	MD 810-910⑦	2 NO to 2 NC	1	132	Order 1, L64	66	2087A63G09	68
	MD 810-910⑧	4 NO to 4 NC	2	264	Order 2, L64	132	2087A63G09	68
	MD 810-910⑦	2 NO to 2 NC	1	132	Order 1, L64	66	2087A63G10	40

Mechanical Interlocks, Unmounted

Type	Contactor: Type	Contactor: Size	Contacts	Style No.	List Price
M-25	MME	ALL	1 NO, 1 NO + 1 NC	878D400G01	$84
M-25	MD and MME	0 to 2	2 NO, 2 NO + 1 NC	878D401G01	84
M-27	MD	5	1 NO	25A1669G01	48
M-27	MD	6, 7	1 NO	25A1670G01	48
M-27	MD	8, 9	1 NO	25A1671G01	48

① Order M and MD contactors by type and style number. Order MME contactor by type identification only.
② Requires panel drilling.
③ For rear connected ratings 10A through 150A, order front connected MME contactor and rear connection kit style 2184A10G08 at $70 List from W35 warehouse. (Field installed only.)
④ NO – Normally Open, NC – Normally Closed, DB – Delayed Break, FC – Front Connected, L – Left Hand, R – Right Hand, OB – Outboard (for 1 Pole, Size 2 Frame).
⑤ Left hand mounting styles shown. For right hand mounting, reverse operating finger. Styles 2087A63G01 through 2087A63G06 only.
⑦ With one interlock mounted.
⑧ With two interlocks mounted.

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Dc Industrial Control Components
Type MME, MD, M Low Voltage Contactors

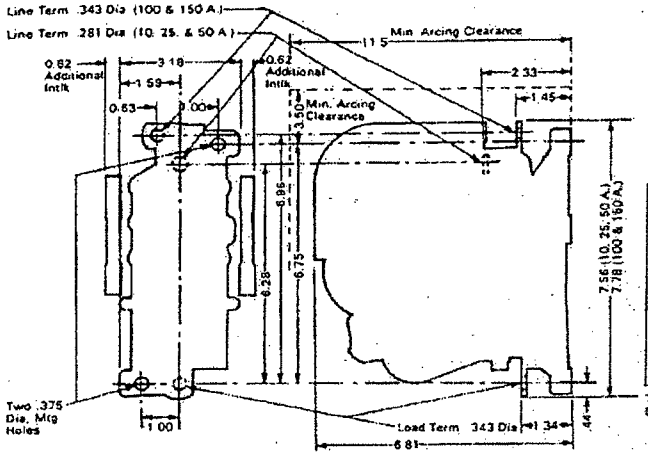
Comparison Chart

Front Connected MD and MMD			Rear Connected④ M and MM					
Open 8-Hr. Amp Rating	Contact Arrangement	Type	Contact Arrangement	Type	Conversion To New Type MME②⑤	MME Dimensions (In Inches) Height	Width	Depth
5	①	MD-000	....	....	Not Available	....	....	....
	1NC	MD-001	1NC	MD-001	MME-01-10	9.47	3.67	6.81
	1NO	MD-010	1NO	MD-010	MME-10-10	7.56	3.18	6.81
	2NO	MD-020	2NO	MD-020	MME-20-10	6.75	5.53	6.81
	1NO 1NC	MD-011	1NO 1NC	MD-011	MME-11-10	12.44	3.67	6.81
	1NO 1NC	MD-011			MME-11-10②			
	2NO 1NC	MD-021			11-10 plus 10-10③	12.44	7.35	6.81
	2NO 1NC②	MD-021			11-10 plus 10-10			
	2NO 2NC	MD-022	2NO 2NC	MD-022	11-10 plus 11-10③	12.44	7.84	6.81
5/25③	.....	.....	1NO 1NC	M-011	Not Available	....	....	....
	.....	.....	2NO 1NC	M-021	Not Available	....	....	....
10	1NC	MD-001	1NC	M-001	MME-01-10	9.47	3.67	6.81
	1NO	MD-010	1NO	M-010	MME-10-10	7.56	3.18	6.81
	2NO	MD-020	2NO	M-020	MME-20-10	6.75	5.53	6.81
	1NO 1NC	MD-011	1NO 1NC	M-011	MME-11-10	12.44	3.67	6.81
	1NO 1NC	MD-011			MME-11-10②			
	2NO 1NC②	MD-021	2NO 1NC②	M-021	11-10 plus 10-10			
	2NO 1NC	MD-021			11-10 plus 10-10③	12.44	7.35	6.81
	2NO 2NC	MD-022	2NO 2NC	M-022	11-10 plus 11-10③	12.44	7.84	6.81
10/25③	.....	....	1NO 1NC	M-011	Not Available	....	....	....
	.....	....	2NO 1NC	M-021	Not Available	....	....	....
25	1NC	MD-101	1NC	M-101	MME-01-25	9.47	3.67	6.81
	1NO	MD-110	1NO	M-110	MME-10-25	7.56	3.18	6.81
	2NO	MD-120	2NO	M-120	MME-20-25	6.75	5.53	6.81
	1NO 1NC	MD-111	1NO 1NC	M-111	MME-11-25	12.44	3.67	6.81
	1NO 1NC②	MD-111			MME-11-25			
	2NO 1NC	MD-121	2NO 1NC	M-121	11-25 plus 10-25③	12.44	7.35	6.81
	2NO 1NC②	MD-121			11-25 plus 10-25			
	2NO 2NC	MD-122	2NO 2NC	M-122	11-25 plus 11-25③	12.44	7.84	6.81
50	1NC	MD-201	1NC	M-201	MME-01-50	9.47	3.67	6.81
	1NO	MD-210	1NO	M-210	MME-10-50	7.56	3.18	6.81
	2NO	MD-220	2NO	M-220	MME-20-50	6.75	5.53	6.81
	1NO 1NC	MD-211	1NO 1NC	M-211	MME-11-50	12.44	3.67	6.81
	1NO 1NC②	MD-211			MME-11-50			
	2NO 1NC	MD-221	2NO 1NC	M-221	11-50 plus 10-50③	12.44	7.35	6.81
	2NO 1NC②	MD-221			11-50 plus 10-50			
	2NO 2NC	MD-222	2NO 2NC	M-222	11-50 plus 11-50③	12.44	7.84	6.81
100	1NC	MMD-301	1NC	MM-301	MME-01-100	9.69	3.67	6.81
	1NO	MMD-310	1NO	MM-310	MME-10-100	7.78	3.18	6.81
	2NO	MMD-320	2NO	MM-320	MME-20-100	6.75	5.53	6.81
	1NO 1NC②	MMD-311	1NO 1NC	MM-311	MME-11-100			
	1NO 1NC	MMD-311			MME-11-100	12.88	3.67	6.81
	2NO 1NC②	MMD-321	2NO 1NC	MM-321	MME-11-100 + 10-100			
	2NO 1NC	MMD-321			11-100 plus 10-100③	12.88	7.35	6.81
	2NO 2NC	MMD-322	2NO 2NC	MM-322	11-100 plus 11-100③	12.88	7.84	6.81
150	1NC	MMD-401	1NC	MM-401	MME-01-150	9.69	3.67	6.81
	1NO	MMD-410	1NO	MM-410	MME-10-150	7.78	3.18	6.81
	2NO	MMD-420	2NO	MM-420	MME-20-150	6.75	5.53	6.81
	1NO 1NC	MMD-411	1NO 1NC	MM-411	MME-11-150	12.88	3.67	6.81
	1NO 1NC②	MMD-411			MME-11-150			
	2NO 1NC	MMD-421	2NO 1NC	MM-421	11-150 plus 10-150③	12.88	7.35	6.81
	2NO 1NC②	MMD-421			11-150 plus 10-150			
	2NO 2NC	MMD-422	2NO 2NC	MM-422	11-150 plus 11-150③	12.88	7.84	6.81

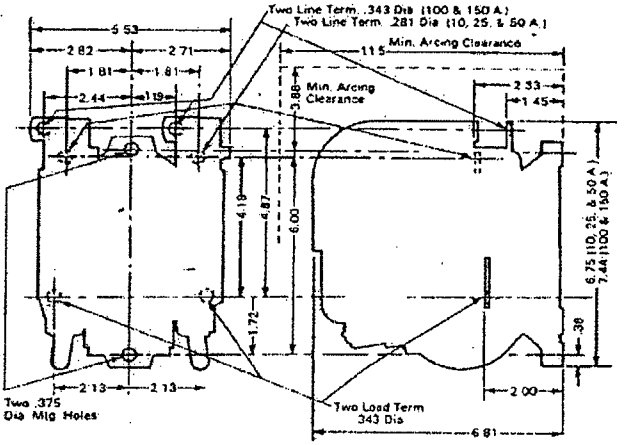
① No main contact.
② No blowout on normally closed contact replaced by MME with blowouts on all contacts.
③ Dual rating is for normally open and normally closed poles respectively.
④ All MME Contactors are provided with blowouts on all main poles.
⑤ When two contactors are used voltage of operating coil will be ½ line voltage and coils must be connected in series.
⑥ For rear connection use MME contactor listed and rear connection kit S# 2184A10G08.

Dc Industrial Control Components
Type MME, MD, M Low Voltage Contactors

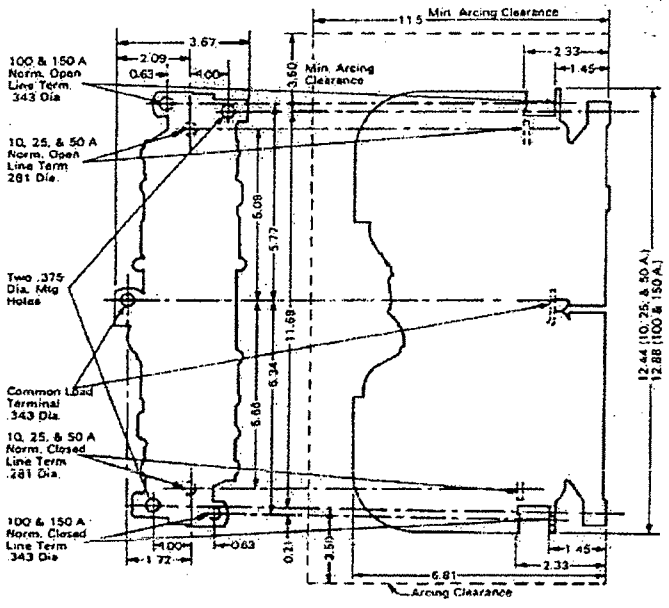
Dimensions in Inches
Not to be used for construction purposes unless approved.



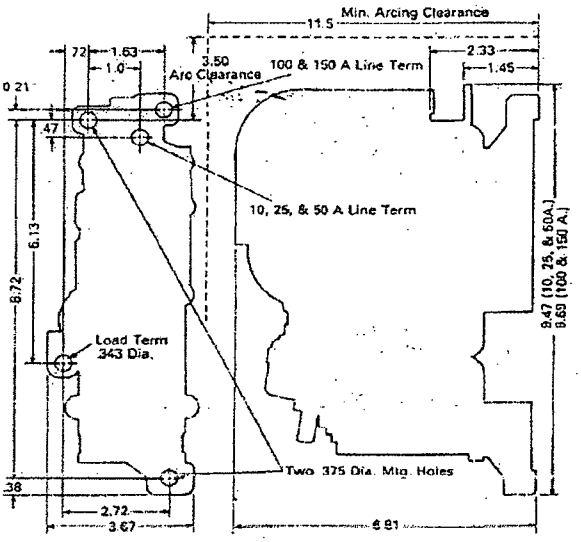
MME Single Pole Normally Open



MME Two Pole Normally Open



MME Single Pole-One Normally Open, One Normally Closed



MME-61 Single Pole Normally Closed

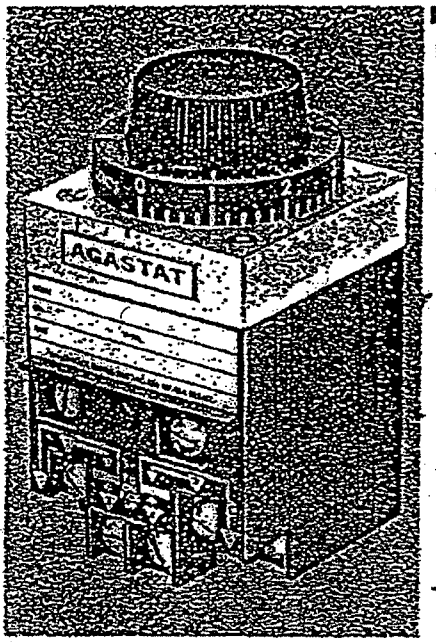
Type MME, MD and M Contactors

Contactor Type	Open 8 Hr. Rating	Contact Arrangement	% Coil Voltage		Coil Watts	600 Volt Interrupting Rating, Amps.	Coil Operating Time (MS)	
			Pick-up	Drop-out			Pick-up	Drop-out
MME, Size 0	10	1 NO 1 NC 2 NO 1 NO, 1 NC	80	50	19	100	10.0	5.5
MME Size 1	25	1 NO 1 NC 2 NO 1 NO, 1 NC	80	50	19	250	10.0	5.5
MME Size 2	50	1 NO 1 NC 2 NO 1 NO, 1 NC	80	50	19	400	10.0	5.5
MME Sizes 3, 4	100/150	1 NO 1 NC 2 NO 1 NO, 1 NC	80	50	35	1000	10.0	5.5
M-510, MD-510	300	1 NO	80	50	60	3000	160	75
M-501, MD-501	300	1 NC	80	50	180	3000	210	170
M-610, MD-610	600	1 NO	80	50	165	6000	210	90
M-601, MD-601	600	1 NC	80	50	410①	6000	150	85
M-710, MD-710	900	1 NO	80	50	165	9000	210	90
M-701, MD-701	900	1 NC	80	50	410①	9000	150	85
M-810, MD-810	1350	1 NO	80	50	500①	13500	170	110
M-910, MD-910	2500	1 NO	80	50	600①	25000	210	110

① Two coils total.

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AGASTAT®



timing relays 7000 series

UL

CSA

ITEM NOS. 19,27,49,158

FM APPROVED 179

54

The AGASTAT 7000 Series timing relay provides performance features never before available in an electropneumatic timer. It represents over 35 years of research and development by the acknowledged leader in this specialized field. Using advanced design concepts and custom-produced components, this new generation of timers offers circuit designers a degree of accuracy and versatility matched only by the most sophisticated electronic controls. In addition, their economy and reliability under severe operating conditions make them the preferred choice for demanding industrial applications where timing is a critical function.

A number of significant design improvements characterize the 7000 Series. These include:

OVERSIZE TIME-CALIBRATED ADJUSTMENT KNOBS — all ranges from milliseconds to 60 minutes are fully calibrated in linear increments. Large serrated knobs with high-resolution markings visible from all angles make this the most practical, easily-set timer available.

2-WAY MOUNTING — can be ordered for surface or panel mounting, with minimum hardware change. "All-angle" dial calibrations.

LONGEST TIME RANGES — standard ranges from milliseconds to 60 minutes, with outstanding repeatability at all points.

FRONT TERMINALS — easy-to-reach screw terminals, all on the face of the unit, clearly identified.

MODULAR ASSEMBLY — timing head, coil assembly and switchblock all individual modules, with coils and switches field-replaceable. Auxiliary switches can be added for greater switching flexibility.

CONTROL PRODUCTS DIVISION

Agastat timing relays 7000 series

design

Other manufacturers assemble timers using switches, solenoid coils or other parts originally designed for nontiming applications. Extensive research through the years has proven, however, that the proper balance of electrical, mechanical, and pneumatic forces required to produce a reliable timing instrument cannot be achieved in this manner. This is why every component of the AGASTAT timing relay has been expressly designed for its specific role in the overall timing function. These are the main components of the 7000 Series relays:

CALIBRATED TIMING HEAD uses no needle valve, recirculates air under controlled pressure through a variable orifice to provide linearly adjustable timing. Patented design provides instant recycling, easy adjustment and long service life under severe operating conditions.

PRECISION-WOUND POTTED COIL module supplies the initial motive force with minimum current drain. Total sealing without external leads eliminates moisture problems, gives maximum insulation value.

NEW SNAP-ACTION SWITCH ASSEMBLY — custom-designed over-center mechanism provides greater contact pressure up to transfer time for positive, no-flutter action. Standard switches are DPDT arrangement, with flexible beryllium copper blades and silver-cadmium oxide contacts. Special "timing-duty" design assures positive wiping action, sustained contact pressure and greater heat dissipation during long delay periods.

Each of these sub-assemblies forms a self-contained module which is then assembled at the factory with the other two to afford a wide choice of operating types, coil voltages, and timing ranges.

The modern squared design with front terminals and rear mounting permits the grouping of 7000 Series units side-by-side in minimum panel space. Auxiliary switches may be added in the base of the unit, without affecting the overall width or depth.

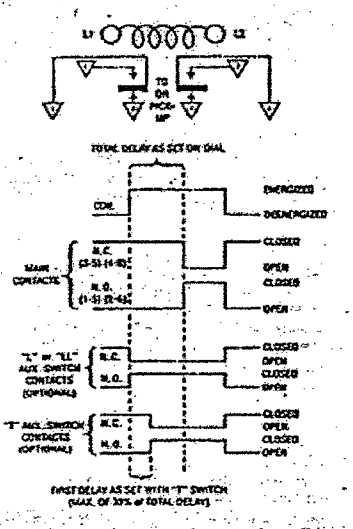
operation

Two basic operating types are available. "On-delay" models provide a delay period on energization, at the end of which the switch transfers the load from one set of contacts to another. De-energizing the unit during the delay period immediately recycles the unit, readying it for another full delay period on reenergization.

In "off-delay" models the switch transfers the load immediately upon energization, and the delay period does not begin until the unit is deenergized. At the end of the delay period the switch returns to its original position. Reenergizing the unit during the delay period immediately resets the timing, readying it for another full delay period on deenergization. No power is required during the timing period.

In addition to these basic operating types, "Double Head" models offer sequential delays on pull-in and drop-out in one unit, as described on page 3. With the addition of auxiliary switches the basic models provide two-step timing, pulse actuation for interlock circuits, or added circuit capacity.

On-Delay Models, 7012
(Delay on pick-up)



Applying continuous voltage to the coil (L1-L2) starts a time delay lasting for the preset time. During this period the normally closed contacts (3-5 and 4-6) remain closed. At the end of the delay period the normally closed contacts break and the normally open contacts (1-5 and 2-6) make. The contacts remain in this transferred position until the coil is deenergized, at which time the switch instantaneously returns to its original position.

Deenergizing the coil, either during or after the delay period, will recycle the unit within .050 second. It will then provide a full delay period upon reenergization, regardless of how often the coil voltage is interrupted before the unit has been permitted to "time-out" to its full delay setting.

Auxiliary Switch Options

To increase the versatility of the basic timer models, auxiliary switches may be added to either on-delay or off-delay types. They switch additional circuits, provide two-step timing action, or furnish electrical interlock for sustained coil energization from a momentary impulse, depending on the type selected and its adjustment. Because of their simple attachment and adjustment features, they can be installed at the factory or in the field, by any competent mechanic. All auxiliary switches are SPDT with UL listings of 10A @ 125, 250, or 480 VAC. A maximum of one Code T or two Code L auxiliary switches may be added to each relay.

Instant Transfer (Auxiliary Switch Code L, maximum of 2 per relay)
1. Energizing coil begins time delay and transfers auxiliary switch.
2. Main switch transfers after total preset delay.
3. Deenergizing coil resets both switches instantly.

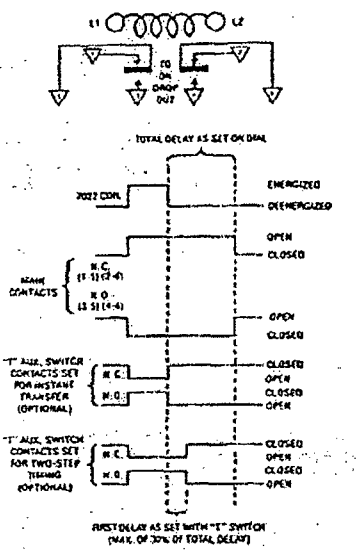
Auxiliary switch is non-adjustable.

Two-Step Timing (Auxiliary Switch Code T, maximum of 1 per relay)
1. Energizing coil begins time delay.
2. After first delay auxiliary switch transfers.
3. Main switch transfers after total preset delay.
4. Deenergizing coil resets both switches instantly.

First delay is independently adjustable, up to 30% of overall delay. (Recommended maximum 100 seconds). Repeat accuracy of the first delay is ± 15%.

operation

Off-Delay Models, 7022
(Delay on drop-out)



Applying voltage to the coil (for at least .050 second) will instantaneously transfer the switch, breaking the normally closed contacts (1-5 and 2-6), and making the normally open contacts (3-5 and 4-6). Contacts remain in this transferred position as long as the coil is energized. The time delay begins immediately upon deenergization. At the end of the delay period the switch returns to its normal position.

Reenergizing the coil during the delay period will immediately return the timing mechanism to a point where it will provide a full delay period upon subsequent deenergization. The switch remains in the transferred position.

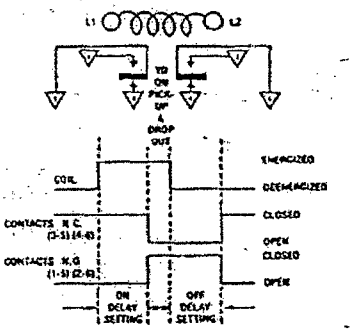
Auxiliary Switch Options

In these models the same auxiliary switch provides either two step timing or instant transfer action, depending on the adjustment of the actuator.

Two-Step Timing (Auxiliary Switch Code T, maximum of 1 per relay)
1. Energizing coil transfers main and auxiliary switches instantly.
2. Deenergizing coil begins time delay.
3. After first delay auxiliary switch transfers.
4. Main switch transfers after total preset delay. First delay is independently adjustable, up to 30% of overall delay. (Recommended maximum 100 seconds). Repeat accuracy of the first delay is ±15%.
5. When equipped with Code T Auxiliary Switch, the coil of Model 7022 must be energized for at least 0.100 second before initiating an off-delay.

Instant Transfer (Auxiliary Switch Code T, maximum of 1 per relay)
1. Energizing coil transfers main and auxiliary switches instantly.
2. Deenergizing coil resets auxiliary switch and begins time delay.
3. Main switch transfers after total preset delay. Auxiliary switch is factory adjusted to give instant transfer operation, but may be easily adjusted in the field to provide two-step timing.

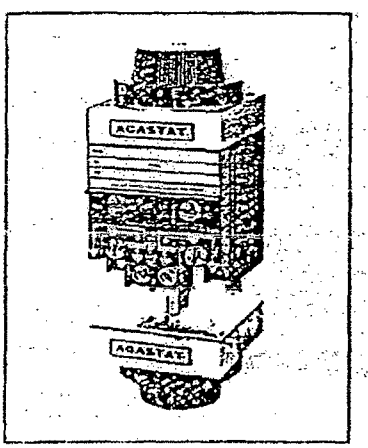
On-Delay, Off-Delay Models, 7032
(Double Head)



The Double Head model provides delayed switch transfer on energization of its coil, followed by delayed resetting upon coil deenergization. Each delay period is independently adjustable.

In new circuit designs or the improvement of existing controls now using two or more conventional timers, the Double Head unit offers distinct advantages.

Its compact design saves precious panel space, while the simplified wiring reduces costly interconnections.



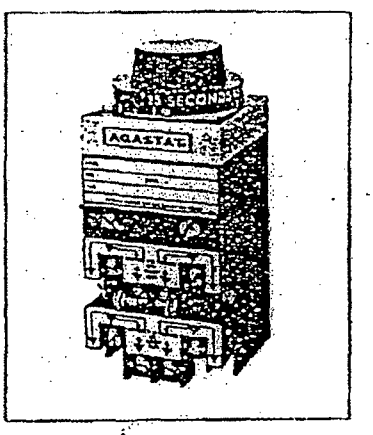
Four Pole Models, 7014, 7024

With the addition of an extra switch block at the bottom of the basic unit, this version of the 7000 Series offers four pole switch capacity with simultaneous timing or two-step timing. The two-step operation is achieved by factory adjustment to your specifications.

For two-step operation, a maximum timing ratio between upper and lower switches of 3:2 is recommended, with a minimum of 1:1. Once adjusted at the factory, this ratio remains constant regardless of changes in dial settings. (Ex: if upper switch transfer is set on dial at 60 sec., minimum time on lower switch should be 40 sec.)

This 7000 Series unit offers many of the performance features found in basic models in the series — voltage ranges, timing and switch capacities are virtually identical.

Four pole models add approximately 1¼" to the maximum height of the basic model, approximately ⅛" to the depth. They are designed for vertical operation only.



Timing Adjustment

The AGASTAT 7000 Series is the first electropneumatic timer to offer the ease of adjustment and resetting of a calibrated dial head. Discrete ranges covering a total span from .1 second to 60 minutes are available, as well as a cycle-calibrated range. (See table on page 4.) Each has its own calibrated, clearly identified dial.

Timing is set by simply turning the dial to the desired time value. In the zone of approximately 25° separating the high and low ends of timing ranges A, D, E, and K, instantaneous operation (no time delay) will occur. All other ranges produce an infinite time delay when the dial is set in this zone.

Agastat timing relays /OOO series

specifications

(All values shown are at nominal operating voltage and 77°F unless otherwise noted.)

Linear Timing Ranges

Time Range Code	Models 7012, 7022, 7024	*Models 7014 7032
A	.1 to 1 Sec.	.2 to 2 Sec.
B	.5 to 5 Sec.	.7 to 7 Sec.
C	1.5 to 15 Sec.	2 to 20 Sec.
D	5 to 50 Sec.	10 to 100 Sec.
E	20 to 200 Sec.	30 to 300 Sec.
F	1 to 10 Min.	1.5 to 15 Min.
H	3 to 30 Min.	3 to 30 Min.
I	6 to 60 Min.	Not avail.
J	3 to 120 Cycle	Not avail.
K	1 to 300 Sec.	Not avail.

Basic models are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

*Models 7014 and 7032 are available with letter-calibrated dials only. The upper end of the time ranges in these models may be twice the values shown.

Contact Ratings

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Contact Ratings as listed under the UL Component Recognition Program for 100,000 operations:

10 Amps, Resistive, 240 VAC
¼ Horsepower, 120 VAC/240 VAC
15 Amps, 30 VDC
5 Amps, General Purpose, 600 VAC
} Per Pole

All specifications listed here are for reference only, and are subject to continuing revision. Verified drawings are available on request. If your requirements cannot be met by the standard production units described here, they may be filled by one of the many non-standard models not shown here. Many of these unusual configurations are available on a shorter-delivery, lower-cost basis than a purely custom model. We welcome your inquiry.

Coil Data, 7012, 7022

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range* @ 60 Hz	Rated Voltage	Operating Voltage Range @ 50 Hz
7000	A	120	102-132	110	93.5-121
AC	B	240	204-264	220	187-242
	C	480	408-528		
	D	550	468-605		
	E	24	20.5-26.5		
	F			127	108-140
	G			240	204-264
	H	12	10.2-13.2		
	I	6	5.1-6.6		
	J	208	178-229		
	K	Dual Voltage Coil (Combines A&B)			
	L	Special AC Coils (L1, L2, etc.)			
7010	M	28	22.5-33.5		
DC	N	48	38.5-57.5		
	O	24	19.2-28.8		
	P	125	100-150		
	Q	12	9.6-14.4		
	R	60	48-74		
	S	250	200-300		
	T	550	440-660		
	U	16	12.8-19.2		
	V	32	25.6-38.4		
	W	96	76.8-115		
	Y	6	4.8-7.2		
	Z	220	176-264		
	X	Special DC Coils (X1, X2, etc.)			

All units draw approximately 8 watts power at rated voltage. Minimum operating voltages are based on vertically mounted 7012 units. 7012 horizontally mounted or 7022 vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

AC units drop out at approximately 50% of rated voltage. DC units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycles at voltages 10% above the listed maximums. (Intermittent duty = maximum 50% duty cycle and 30 minutes "on" time.)

*FOUR POLE MODELS:
Operational voltage range 90% to 110% for AC units; 85% to 120% for DC units.
*All units draw approximately 8 watts power at rated voltage.

Minimum operating voltages are based on vertically mounted 7014 (on-delay) units.

AC units drop out at approximately 50% of rated voltage. DC units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Intermittent duty — maximum 50% duty cycle and 30 minutes "on" time.)

Coils are rated 6 VAC through 550 VAC.

Repeat Accuracy

Repeat accuracy at any fixed temperature is defined as:

*The repeat accuracy deviation (A_R) of a time-delay relay is a measure of the maximum deviation in the time-delay that will be experienced in successive operations at any particular time setting of the relay and for any particular operating voltage or current.

Repeat accuracy is obtained from the following formula:

$$A_R = 100\frac{(T_1 - T_2)}{(T_1 + T_2)}$$

Where —
T_1 = Maximum time delay.
T_2 = Minimum time delay.

*NEMA part ICS 2-218 .07

For delays of 200 seconds or less:

7012*, 7022, 7024	±5%
7014*	±10%
7032	±15%

For delays greater than 200 seconds:

7012*, 7022, 7014*, 7024	±10%
7032	±15%

*The first time delay afforded by Model 7012 with H (3 to 30 min.) and I (6 to 60 min.) time ranges or Model 7014 with H time range will be approximately 15% longer than subsequent delays due to coil temperature rise.

specifications

Temperature Range

Operating temperature range is −20°F to 165°F. The maximum shift in the average of three consecutive time delays at 77°F is −20% at −20°F; +20% at 165°F.

The storage temperature is −67°F to 165°F.

Dielectric

Withstands 1500 volts RMS 60 Hz between terminals and ground; 1,000 volts RMS 60 Hz between non-connected terminals.

For dielectric specifications on hermetically sealed models, consult factory.

Insulation Resistance

500 Megohms with 500 VDC applied.

Mounting/Terminals

Normal mounting of the basic unit is in a vertical position, from the back of the panel. Four tapped holes are provided in the back plate of the unit, making it interchangeable with earlier AGASTAT timer models. A front mounting bracket is also supplied with each basic unit, for installation from the front of the panel. All units are calibrated for vertical operation. Basic models (7012, 7022) may also be horizontally mounted, and will be factory adjusted accordingly when *Accessory Y1 is specified in your order.*

Standard screw terminals (8-32 truss head screws supplied) are located on the front of the unit, with permanent schematic markings. Barrier isolation is designed to accommodate spade or ring tongue terminals, with spacing to meet all industrial control specifications.

The basic 7000 Series may also be panel-mounted, with the addition of a panelmount kit that includes all necessary hardware and faceplate. This offers the convenience of "out-front" adjustment, with large calibrated dial skirt knob. The modern faceplate and knob blend with advanced equipment and console designs, while the body of the unit and its wiring are protected behind the panel.

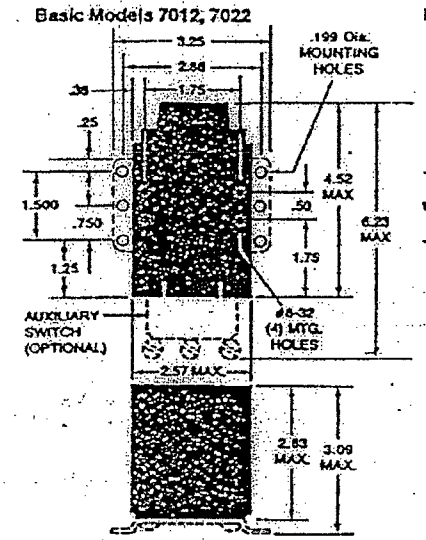
Other mounting options include plug-in styles and special configurations to meet unusual installation requirements. Your inquiries are invited.



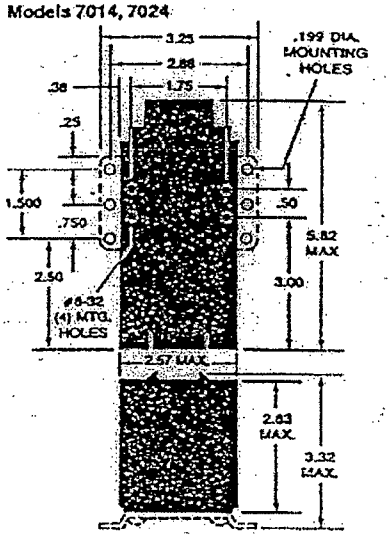
Panelmount Option "X"

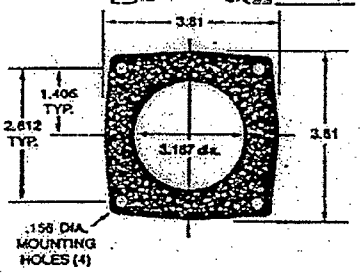
Dimensions

Basic Models 7012, 7022

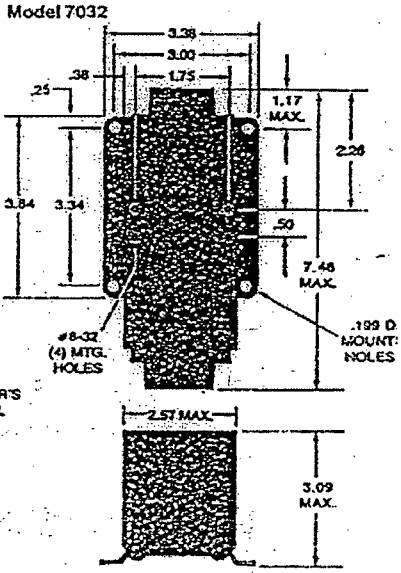


Models 7014, 7024

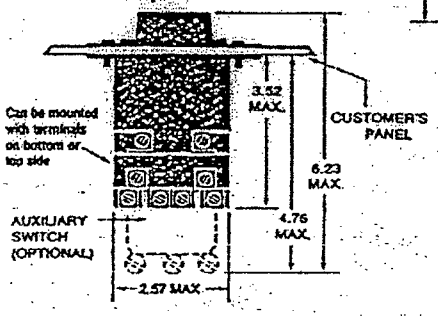




Model 7032



Panelmount Option "X"



UL Listed, CSA Certified, FM Approved

AGASTAT® 7000 Series basic models 7012, 7022, 7014 and 7024 are UL Listed under File No. E15631.

They are Canadian Standards Association (CSA) certified under File No. LR-29186; and they are approved by Factory Mutual Engineering Corporation: JI22089.

Approximate Weights

Models 7012, 7022	2.2 lbs.
7014, 7024	2.5 lbs.
7032	3.3 lbs.

Weight may vary slightly with coil voltage.

Agastat timing relays 7000 series

ordering information

ORDERING INFORMATION
Catalog Number Code

-70 | -1 | -2 | -A | -D | -GZ

AGASTAT® 7000 Series timing relay

Operation
1 - On-Delay
2 - Off-Delay
3 - On-Delay; Off-Delay (Double Head)

Contact Arrangement
2 — Double Pole, Double Throw
①⑧ 4 — Four Pole, Double Throw

Coil Voltage

A	120V 60 Hz 110 V 50 Hz
B	240 V 60 Hz 220 V 50 Hz
C	480 V 60 Hz
D	550V 60 Hz
E	24 V 60 Hz
F	127V 50 Hz
G	240 V 50 Hz
H	12V 60 Hz
I	6 V 60 Hz
J	208 V 60 Hz
K	Dual Voltage (combines A & B)
M	28 VDC
N	48 VDC
O	24 VDC
P	125 VDC
Q	12 VDC
R	60 VDC
S	250 VDC
T	550 VDC
U	16 VDC
V	32 VDC
W	96 VDC
Y	6 VDC
Z	220 VDC

Time Range
Models 7012, 7022, 7024

Code

A	.1 to 1 sec.
B	.5 to 5 sec.
C	1.5 to 15 sec.
D	5 to 50 sec.
E	20 to 200 sec.
F	1 to 10 min.
H	3 to 30 min.
I	6 to 60 min.
J	3 to 120 cyc.
K	1 to 300 sec.

③ Models 7014, 7032

For Model 7032 specify separate time range code for each head. Any two ranges may be selected.

Code

A	.2 to 2 sec.
B	.7 to 7 sec.
C	2 to 20 sec.
D	10 to 100 sec.
E	30 to 300 sec.
F	1.5 to 15 min.
H	3 to 30 min.

Factory Installed Options

②④ A1—Quick-Connect Terminals Single, Male, .250 ± .032
②④ A2—Quick-Connect Terminals Double, Male, .250 ± .032
②⑤⑥ B—Plug-In Connector, Male
①⑥ GZ—Total Enclosure with Bottom Connection
①②④ H—Herm. Sealed (Consult Factory)
① I1—Tamperproof Cover — Opaque black
① I2—Tamperproof Cover — Transparent
① K—Explosionproof enclosure
⑥ L—Auxiliary Switch One instantaneous Form C contact, (On-delay models only) Factory installed on Model 7014.
⑥ LL—Auxiliary Switch Two instantaneous Form C contacts, (On-delay models only) Factory installed on Model 7014.
②④⑥ M—Dustight
①②⑤⑥ P—Octal Plug Adapter
④⑥ S—Dial Stops — Specify minimum & maximum settings
⑥ T—Auxiliary Switch One Form C contact (timed on on-delay models; timed or instantaneous on off-delay models)
① W—Watertight Enclosure
②⑥ X—Panelmount Kit (Relay is calibrated for horizontal mounting)
② Y1—Factory calibration for Horizontal Mounting.
①②④⑥ Y2—Compensating Spring for 2-way mounting. Factory installed for vertical operation; remove for horizontal operation. (Not compatible with H,L,LL,M,P or T Options)

① Not suitable for Panelmounted models
② Not available on Four Pole models
③ Models 7014, and 7032 available with letter calibrated dials only. Upper end of time range may be twice the value shown.
④ Factory installed only
⑤ Not available if unit is equipped with L, LL or T Auxiliary Switch or any type of enclosure
⑥ Not available on On-Delay, Off-Delay (Double Head) models

▌= Revised Since Last Printing

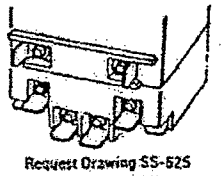
AGASTAT 7000 Series timing relays are also manufactured to MIL-SPEC requirements, and are QPL listed, conforming to requirements of MIL-C-2212E (SHIPS). Consult Control Products Division Regional Information Center for drawings and model number of available configurations.

E7000 Series models are available which conform to 10CFR50 Appendix B, and which have been tested to IEEE 323-1974 and IEEE 344-1975. Consult factory for details and special ordering information.

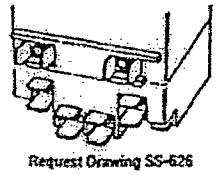
Options

Factory installed when ordered as part of the Catalog Number Code

A1 SINGLE — **QUICK-CONNECT TERMINALS** — DOUBLE **A2**

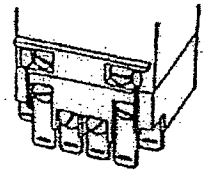


Request Drawing SS-525



Request Drawing SS-626

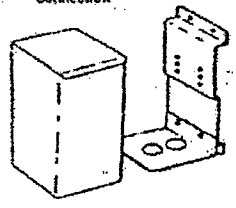
B PLUG-IN CONNECTORS



May be ordered separately as Catalog No. 700077 for 7012, 7022

Request Drawing SS-627

G2 TOTAL ENCLOSURE with Knockouts for Bottom Connection



May be ordered separately as Catalog No. 700042 for 7012, 7022, 7014, 7024

3.16" W. × 3.64" D. × 7.63" H.

Request drawing SS-633

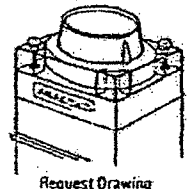
H HERMETICALLY SEALED ENCLOSURE



with Solder Hook Terminals
Consult Factory for connector styles available

Request drawing SS-526

L TAMPER-PROOF COVER



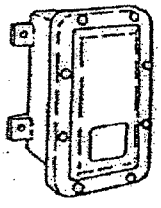
Request Drawing SS-634

May be ordered separately as Catalog No. 700((opaque black) o 700071 (transpar — for 7012, 702

Catalog No. 700((opaque black) o 700073 (transpar — for 7014, 702

Catalog No. 700((opaque black) o 700075 (transpar — for 7032

K6 EXPLOSIONPROOF ENCLOSURE

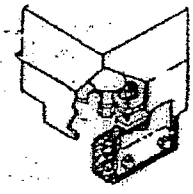


(Meets requirements for Class I, Groups C & D locations)
May be ordered separately as: Catalog No. 700034

Request drawing 32607-00

7.50" W. × 6.00" D. × 10.38" H.

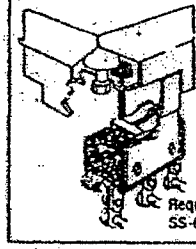
LE AUXILIARY SWITCH



May be ordered separately as Catalog No. 700047 — for 7012
Mounting hardware included.

Request Drawing SS-638

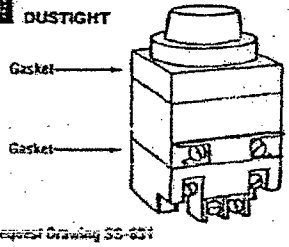
LE AUXILIARY SWITCH



May be ordered separately as Catalog No. 700048 — for 7012

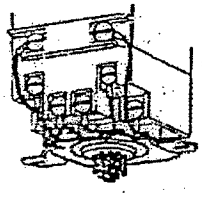
Request Drawing SS-621

M DUSTIGHT



Request Drawing SS-631

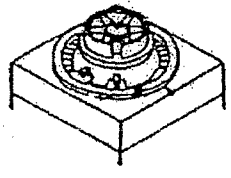
P OCTAL PLUG ADAPTER



May be ordered separately as Catalog No. 700097 — for 7012, 7022

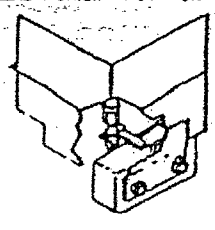
Request Drawing SS-630

S DIAL STOPS



Request Drawing SS-632

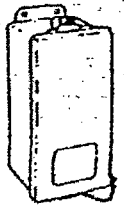
T2 AUXILIARY SWITCH



May be ordered separately as Catalog No. 703121 — for 7012, 7022, 7014, 7024
Mounting hardware included.

Request Drawing SS-641

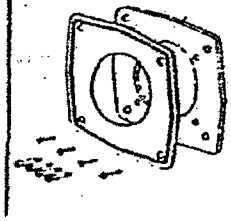
W4 WATERTIGHT ENCLOSURE (NEMA-4)



4.75" W. × 4.44" D. × 9.75" H.
May be ordered separately as Catalog No. 700099 for 7012, 7022, 7014, 7024
700088 for 7032

Request drawing SS-635

X PANELMOUNT KIT



Mounting hardware included.
May be ordered separately as Catalog No. 700041 — for 7012, 7022

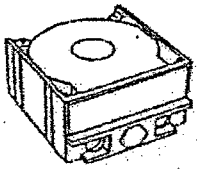
Request Drawing SS-583

Agastat timing relays 7000 series

accessories

order separately by Catalog Number

COIL ASSEMBLIES



AC ASSEMBLY
Catalog No. 7000*

DC ASSEMBLY
Catalog No. 7010*

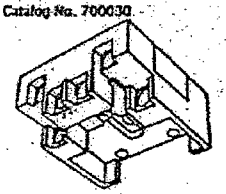
DC ASSEMBLY, 550 VDC
Catalog No. 7010-T

*Insert coil voltage code.
(See "Ordering Information")

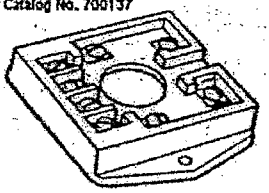
AC DUAL VOLTAGE COIL ASSEMBLY
Catalog No. 7000K



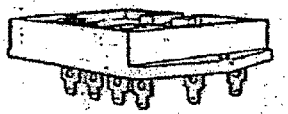
SWITCHBLOCK ASSEMBLY
Catalog No. 700030



PLUG-IN RECEPTACLE
Screw Terminals
Catalog No. 700137



PLUG-IN RECEPTACLE
Quick-connect Terminals
Catalog No. 700141



NOTE
Control Products Division of Amerace Corporation cannot recommend the use of its Products in the containment areas of Nuclear Power Generating Stations.

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CONTROL PRODUCTS DIVISION

Amerace Corporation, Control Products Division, 2330 Vauxhall Road, Union, New Jersey 07083 •
Telex 138 978

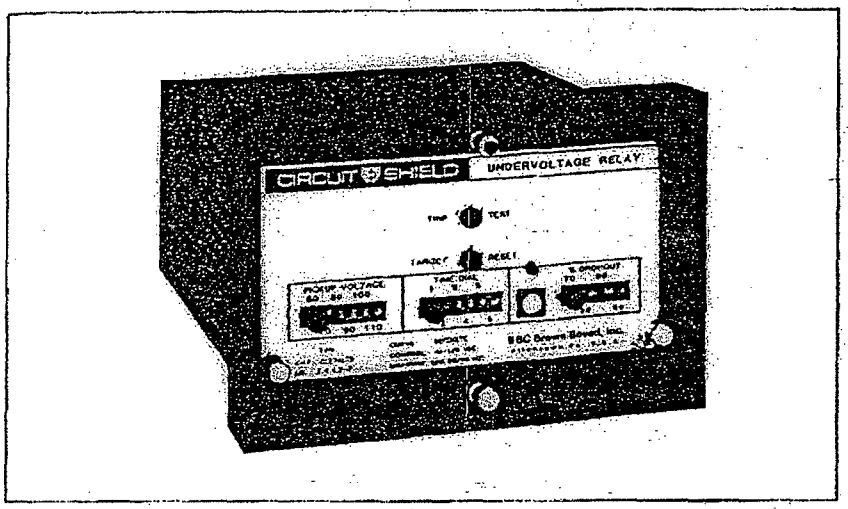
ITEM-62

September 1995
Supersedes Descriptive Bulletin 41-233S, pages 1-2, dated September 1990
Mailed to: E, D, C/41-2008

Highly Accurate
Device Number: 27 Undervoltage
Device Number: 59 Overvoltage

CIRCUIT SHIELD ®

Type 27N and 59N Undervoltage and Overvoltage Relay



Application

The Type 27N and Type 59N Voltage Relays provide a wide range of protective functions, including undervoltage protection of motors, overvoltage protection, and automatic bus transfer. The Type 27N and Type 59N relays are primarily designed for those applications where exceptional accuracy, exceptional repeatability, and long term stability are important. In addition, inherently high seismic and transient immunity allow the use of these relays in generating stations or substations where the performance of electromechanical or other types of static relays is marginal.

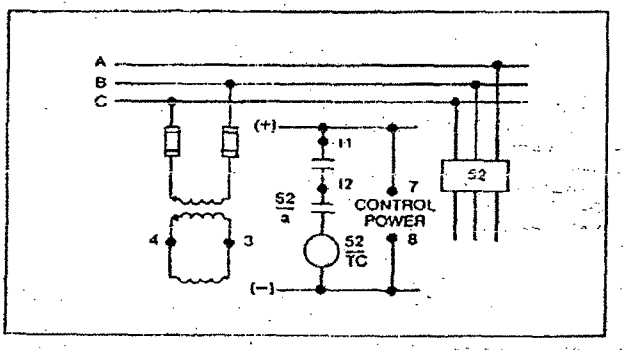
Both types have a dual nominal frequency rating of 50 or 60 Hz.

The unique design of the output circuit does not require seal-in contacts, allowing simplification of bus-transfer schemes. Operation indicators, however, are provided as standard features on all types.

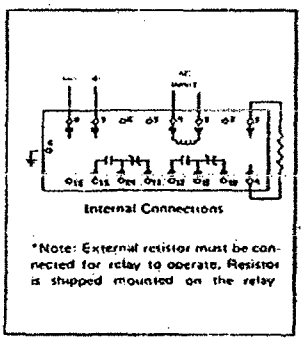
Harmonic distortion in the AC waveform can have a noticeable effect on the relay operating point and on measuring instruments used to set the relay. An internal harmonic filter module is available for those applications where waveform distortion is a factor.

Features

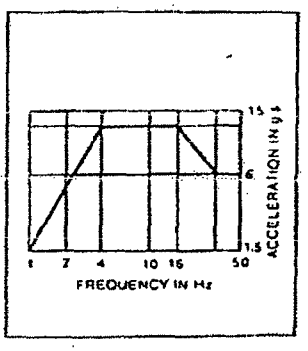
- Definite time or high speed
- Highly stable, accurate and repeatable characteristics
- Low burden
- UL recognized
- Seismic capability to 6g ZPA
- Transient immunity
- Drawout construction
- 2 year warranty



Typical Circuit Shield Voltage Relay Application



Internal Connections



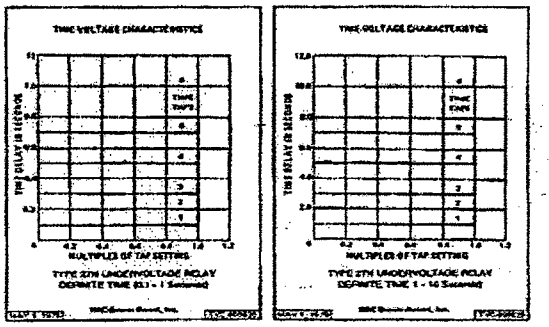
Typical Seismic Test Results

‹ ifications

Input Circuit Rating:	Type 27N 150 Vac Maximum Continuous Type 59N 160 Vac Maximum Continuous
Burden:	Less than 0.5 VA at 120 Vac
Frequency:	50/60 Hz.
Output Circuit:	Each contact at 125 Vdc: 30A Tripping Duty 5A Continuous 1A Break, Resistive 0.3A Break, Inductive.
Control Power:	Rated at 48/125, 250 Vdc at 0.05 ampere maximum.
Temperature:	ANSI range −20°C to +55°C Must operate −30°C to +70°C
Tolerances: (Without harmonic filter module, after 10 minute warm-up.)	Pickup and dropout settings with respect to printed dial markings (factory calibration) = ±2%. Pickup and dropout settings, repeatability at constant temperature and constant control voltage = ±0.1%. (See Note) Pickup and dropout settings, repeatability over DC control power range of 100-140 volts = ±0.1%. (See Note) Pickup and dropout settings, repeatability over temperature range: (See Note) −20°C to +55°C ±0.4% −20°C to +70°C ±0.7% 0°C to +40°C ±0.2% Note: The three tolerances shown should be considered independent and may be cumulative. Tolerances assume pure sine wave input signal. Time Delay Instantaneous model: 3 cycles or less operating time. Definite Time models (see appropriate curve). ±10% or ±20 milliseconds, whichever is greater.
Tolerances: (With harmonic filter module)	All ratings are the same except: Pickup and dropout settings, repeatability over temperature range: 0°C to +55°C ±0.75% +10°C to +40°C ±0.40% −20°C to +70°C ±1.50%
Reset Time:	Less than 2 cycles (Type 27N). Less than 3 cycles (Type 59N). (The relay resets when the input voltage goes above the pickup setting −27N, below the dropout setting −59N.)
Seismic Capability:	More than 6g ZPA either AXIS biaxial broadband multifrequency vibration without damage or malfunction ANSI/IEEE C37.98.
Transient Immunity:	More than 2500V, 1MHz bursts at 400 Hz repetition rate, continuous (ANSI C37.90.1 SWC); Fast transient test, EMI test.
Dielectric:	2000 Vac RMS 60 seconds all circuits to ground.
Weight:	Unboxed - 3.7 lbs. (1.7 kg) Boxed - 4.3 lbs. (2.0 kg) Volume - 0.26 cubic feet.

How To Specify

Voltage Relay shall be Asea Brown Boveri Type 27N, Type 59N or approved equal, draw-out case, capable of withstanding up to 6g ZPA seismic stress without damage or malfunction, at minimum voltage and time settings. A magnetic operation indicator shall be provided which retains position on loss of control power. Built-in means shall be provided to allow operational tests without additional equipment.



Note: Time delays associated with the time taps for the Type 59N Overvoltage Relay are identical to those of the Type 27N Undervoltage Relay, except the delay occurs on pickup; i.e., when voltage increases to above the pickup tap setting.

How To Order

For a complete listing of available versions of single and three phase voltage relays see TD 41-025.

Models are available for 48 to 250 Vdc control power, and 120 Vac potential transformers. For other control voltages contact the nearest ABB Representative.

To place an order, or for further information, contact the nearest ABB Representative.

Further Information

List Prices: PL 41-020
Technical Data: TD 41-025
Instruction Book IB 7.4.1.7-7
Other Protective Relays:
Application Selector Guide, TD 41-016

Printed in U.S.A.

September 1995
Supersedes Descriptive Bulletin 41-233S,
page 3, dated September 1990
Mailed to: E, D, C/41-200B

High Accuracy

CIRCUIT SHIELD ®

Type 27N and 59N Undervoltage and Overvoltage Relay

Single-Phase Undervoltage Relays

Type	Max. Voltage Rating	Pickup Tap Range	Dropout Curve	Time	Range	Output Contacts	Internal Connections	① Control Voltage	Catalog Number
27N See Note 1	150V 50/60 Hz	60-110V	Definite	0.1-1 sec.	70-99% of pickup adjustable	2-C	16D211N	48/125 Vdc	411T6175
								48/110 Vdc	411T6105
								220 Vdc	411T6125
								250 Vdc	411T6155
				1-10 sec.				48/125 Vdc	411T4175
								48/110 Vdc	411T4105
								220 Vdc	411T4125
								250 Vdc	411T4155
				0.1-1 sec.	30-60% of pickup adjustable			48/125 Vdc	411T6275
								48/110 Vdc	411T6205
								220 Vdc	411T6225
								250 Vdc	411T6255
				1-10 sec.				48/125 Vdc	411T4275
								48/110 Vdc	411T4205
								220 Vdc	411T4225
								250 Vdc	411T4255
			Inst.	—				48/125 Vdc	411T0275
								48/110 Vdc	411T0205
								220 Vdc	411T0225
								250 Vdc	411T0255
					70-99% of pickup adjustable			48/125 Vdc	411T0175
								48/110 Vdc	411T0105
								220 Vdc	411T0125
								250 Vdc	411T0155
		70-120V						48/125 Vdc	411T0375
								48/110 Vdc	411T0305
								220 Vdc	411T0325
								250 Vdc	411T0355

Single-Phase Overvoltage Relays

59N See Note 1	160V 50/60 Hz	100-150V	Definite	0.1-1 sec.	70-99% of pickup adjustable	2-C	16D211N	48/125 Vdc	411U6175
								48/110 Vdc	411U6105
								220 Vdc	411U6125
								250 Vdc	411U6155
				1-10 sec.				48/125 Vdc	411U4175
								48/110 Vdc	411U4105
								220 Vdc	411U4125
								250 Vdc	411U4155
			Inst.					48/125 Vdc	411U0175
								48/110 Vdc	411U0105
								220 Vdc	411U0125
								250 Vdc	411U0155

① For other control voltages contact nearest ABB Representative.

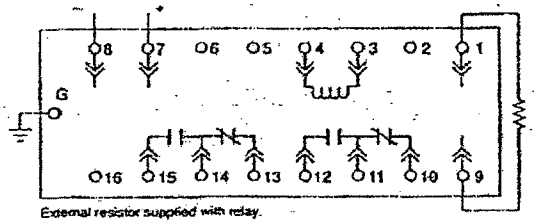
Note 1. Add suffix — HF to catalog number for harmonic filter module. Harmonic filter not available on instantaneous Type 27N relays.

To place an order, or for further information, contact the nearest ABB Representative.

Internal Connection Diagram

Note: Refer to Instruction Book IB 7.4.1.7-7 for contact logic data.
Instruction Book available upon request.

16D211N
Single-Phase Voltage Relays
Drawout Test Case



External resistor supplied with relay.

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 20 of 219

ABB Power T&D Company Inc.
Relay Division
4300 Coral Ridge Drive
Coral Springs, FL 33065
954-752-6700

ABB Power T&D Company Inc.
Relay Division
7036 Snowdrift Road, Suite 2
Allentown, PA 18106
610-395-7333

September 1995

INSTRUCTIONS

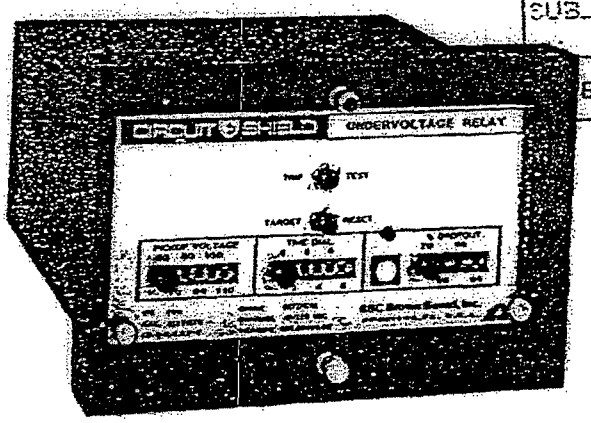
Single Phase Voltage Relays

Type 27N HIGH ACCURACY UNDERVOLTAGE RELAY

Type 59N HIGH ACCURACY OVERVOLTAGE RELAY

Type 27N	Catalog Series 211T	Standard Case
Type 27N	Catalog Series 411T	Test Case
Type 59N	Catalog Series 211U	Standard Case
Type 59N	Catalog Series 411U	Test Case

SHEET 21 OF 33
SUB Relay info
CK
E



ASEA BROWN BOVERI

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 22 of 219
SHEE
SUB.
BY –
DATE

SPECIFICATIONS

Input Circuit: Rating: type 27N 150v maximum continuous.
type 59N 160v maximum continuous.

Burden: less than 0.5 VA at 120 vac.

Frequency: 50/60 Hz.

Taps: available models include:
Type 27N: pickup - 60, 70, 80, 90, 100, 110 volts.
70, 80, 90, 100, 110, 120 volts.
dropout- 60, 70, 80, 90, 99 percent of pickup.
30, 40, 50, 60 percent of pickup.

Type 59N: pickup - 100, 110, 120, 130, 140, 150 volts.
dropout- 60, 70, 80, 90, 99 percent of pickup.

Operating Time: See Time-Voltage characteristic curves that follow.
Instantaneous models: 3 cycles or less.

Reset Time: 27N: less than 2 cycles; 59N: less than 3 cycles.
(Type 27N resets when input voltage goes above pickup setting.)
(Type 59N resets when input voltage goes below dropout setting.)

Output Circuit: Each contact

@ 120 vac	@ 125 vdc	@ 250 vdc	
30 amps.	30 amps.	30 amps.	tripping duty.
5 amps.	5 amps.	5 amps.	continuous.
3 amps.	1 amp.	0.3 amp.	break, resistive.
2 amps.	0.3 amp.	0.1 amp.	break, inductive.

Operating Temperature Range: -30 to +70 deg. C.

Control Power:

Models available for		Allowable variation:	
48/125 vdc @ 0.05 A max.	48 vdc nominal	38- 58 vdc
48/110 vdc @ 0.05 A max.	110 vdc	"	88-125 vdc
220 vdc @ 0.05 A max.	125 vdc	"	100-140 vdc
250 vdc @ 0.05 A max.	220 vdc	"	176-246 vdc
	250 vdc	"	200-280 vdc

Tolerances: (without harmonic filter option, after 10 minute warm-up)

Pickup and dropout settings with respect to printed dial markings (factory calibration) = +/- 2%.

Pickup and dropout settings, repeatability at constant temperature and constant control voltage = +/- 0.1%. (see note below)

Pickup and dropout settings, repeatability over "allowable" dc control power range: +/- 0.1%. (see note below)

Pickup and dropout settings, repeatability over temperature range:
-20 to +55°C +/- 0.4% -20 to +70°C +/-0.7%
0 to +40°C +/- 0.2% (see note below)

Note: the three tolerances shown should be considered independent and may be cumulative. Tolerances assume pure sine wave input signal.

Time Delay: Instantaneous models: 3 cycles or less.
Definite time models: +/- 10 percent or +/-20 millisecs. whichever is greater.

Harmonic Filter: (optional) All ratings are the same except:
Pickup and dropout settings, repeatability over temperature range:
0 to +55°C +/- 0.75% -20 to +70°C +/-1.5%
+10 to +40°C +/- 0.40%

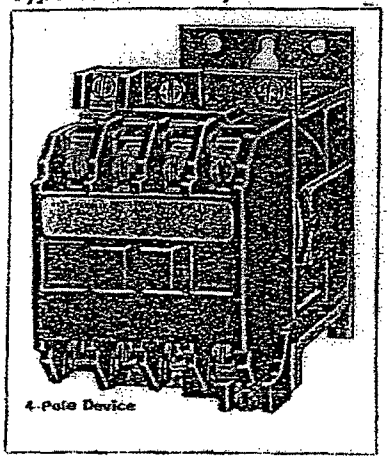
Dielectric Strength: 2000 vac, 50/60 Hz., 60 seconds, all circuits to ground.

Seismic Capability: More than 6g ZPA biaxial broadband multifrequency vibration without damage or malfunction. (ANSI C37.98-1978)

ITEM 24, 104

Westinghouse

Type BFD Dc Relay



4-Pole Device

Description

The Type BFD is a Dc operated relay, available in any combination of normally open and normally closed poles, from two to 12, with a maximum of 12 normally open or eight normally closed. Although the base plate is integral with the magnet, it is exactly the same size as the base plate on all other BF relays. All panel drillings are the same for either Ac or Dc relays.

Dc Ratings

Inductive Loads

Two poles in series: 2.2 amps at 125 volts, 1.1 amps at 250 volts.

Single pole: 1.1 amps at 125 volts, .55 at 250 volts.

Resistive Loads

Single pole: 3 amps at 125 volts, 1.5 amps at 250 volts.

Pick-up time: 25 to 40 milliseconds, depending on contact arrangement.

Drop-out time: 15 to 25 milliseconds, depending on contact arrangement.

Coil power: 12 watts, 250 volts maximum.

List Prices

Dc Devices, 250 Volts Maximum

Number of Poles	Contacts N. O.	Contacts N. C.	Catalog Number②	List Price
Universal Contact				
2	2	2	BFD22S	$19.00
3	3	3	BFD33S	21.00
4	4	4	BFD44S	23.00
5	5	5	BFD55S	27.00
6	6	4	BFD64S	27.00
6	6	6	BFD66S	31.00
8	8	4	BFD84S	31.00
Fixed Contact				
2	2	0	BFD20S	17.00
	1	1	BFD11S	17.00
	0	2	BFD02S	17.00
3	3	0	BFD30S	19.00
	2	1	BFD21S	19.00
	1	2	BFD12S	19.00
	0	3	BFD03S	19.00
4	4	0	BFD40S	21.00
	3	1	BFD31S	21.00
	2	2	use Universal 2-pole	
	1	3	BFD13S	21.00
	0	4	BFD04S	21.00
6	6	0	BFD60S	23.00
	5	1	BFD51S	23.00
	4	2	BFD42S	23.00
	3	3	use Universal 3-pole	
	2	4	BFD24S	23.00
	0	6	BFD06S	23.00
8	8	0	BFD80S	27.00
	7	1	BFD71S	27.00
	6	2	BFD62S	27.00
	5	3	BFD53S	27.00
	4	4	use Universal 4-pole	
	0	8	BFD08S	27.00
10	10	0	BFD100S	31.00
	8	2	BFD82S	31.00
	7	3	BFD73S	31.00
	6	4	use Universal 6-pole	
	5	5	use Universal 5-pole	
	4	6	BFD46S	31.00
	2	8	BFD28S	31.00
12	12	0	BFD120S	35.00
	8	4	use Universal 8-pole	
	7	5	BFD75S	35.00
	6	6	use Universal 6-pole	
	5	7	BFD57S	35.00
	4	8	BFD48S	35.00

All relays listed are available with dual tabs for AMP FASTON* Push-On terminals at no extra cost – order by description.

* Trademark of AMP Incorporated.

Enclosures

Description	Style Number	List Price
4- 8 Pole	503C573G01	$3.00
10-12 Pole	503C573G02	5.00

② Catalog numbers listed are for 120 volts Dc. For 240 volts, see Ordering Information.

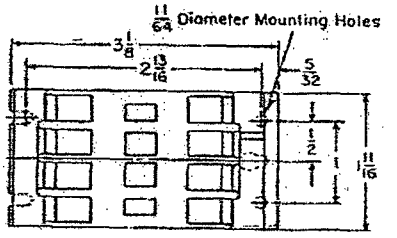
Ordering Information

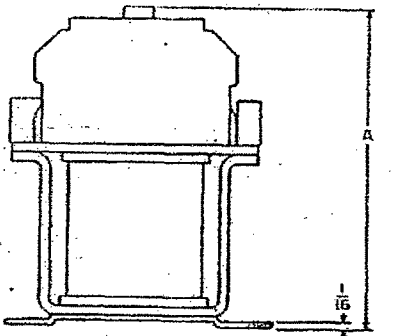
Order by catalog number

Devices listed have 120 volt Dc coils. For 240 volt Dc coil, substitute the letter T for the letter S in the catalog number. Replacement coils are listed on page 19.

Dimensions, Inches

Not to be used for construction purposes unless dimensions are approved.

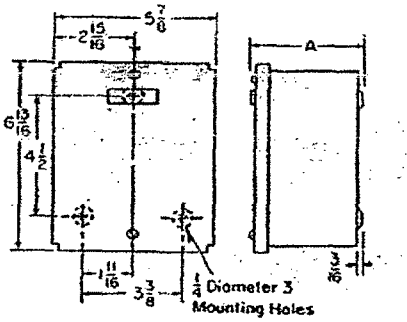




A= 4 Pole $4\frac{1}{32}$ A=8 Pole $4\frac{31}{32}$ A=12 Pole $5\frac{5}{8}$

NEMA 1 Enclosure

No. of Poles	Dimension "A"
4-8	5¼
12	6¾



Prices effective May 20, 1968; subject to change without notice.
Discount Symbol C-10
Selling Policy 7000

Industrial Control Relays
Ac and Dc

Type BFD Relay, 250 Volts Dc,
Fixed and Universal Contacts
Relay Replacement Parts

Replacement Parts
List Prices

Operating Coils, Types BF, BT Ac

Style Numbers		List Price
120, 60 Cycle 110, 50 Cycle	240, 60 Cycle 220, 50 Cycle	
2 to 12 Pole Relays and Off Delay BT Timers		
505C077G01	505C077G02	$5.00
On Delay BT Timer		
505C077G03	505C077G04	5.00

Operating Coils, Types BFD, BTD Dc

Volts	Cycles	Style Number	List Price
120	Dc	506C322G02	$7.00
240	Dc	506C322G01	7.00

Operating Coils, Type AM

Volts	Cycles	Style Number	List Price
120/110	60/50	1406 910	$16.50
240/220	60/50	1599 882	16.50
440	60	1406 934	16.50
550	60	1406 935	16.50

Operating Coils, Type AR Ac

Volts	Cycles	Style Number	List Price
12	60	176C663G06	$7.00
24	60	176C663G07	7.00
48	60	176C663G08	7.00
120	60	176C663G01	7.00
208	60	176C663G02	7.00
240	60	176C663G03	7.00
480	60	176C663G04	7.00
600	60	176C663G05	7.00

Operating Coils, Type AF Ac

Volts	Cycles	Style Numbers: 2 to 6 Pole and 7 Pole with 2 N.C.	Style Numbers: 7 to 10 Pole	List Price
120/110	60/50	314C894G06	314C895G01	$7.00
240/220	60/50	314C894G12	314C895G02	7.00
440	60	314C894G03	314C895G03	7.00
550	60	314C894G04	314C895G04	7.00

Operating Coils, Type Z

Ac, 60 Cycle Volts	Ac, 60 Cycle Style Number	Dc Volts	Dc Style Number	List Price
6	206B968G01	6	206B968G07	$6.00
12	206B968G02	12	206B968G08	6.00
24	206B968G03	24	206B968G09	5.00
115/120	206B968G04	120	206B968G10	5.00
220	206B968G05	...	.....	5.00

Replacement Contact Switch Unit Types AM and AMD

Type	Style Number	List Price
PF-SPDT	1625 900	$4.20

Replacement Type BT and Type BTD Relays

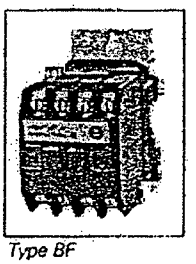
Description	Contacts: Timing N.O.	Timing N.C.	Instantaneous N.O.	Instantaneous N.C.	Catalog Number	List Price
Type BT Ac 300 Volt Maximum						
On Delay	1	1	1	1	BTC22F	$36.50
Off Delay	1	1	1	1	BTO22F	36.50
Type BTD Dc 250 Volt Maximum						
On Delay	1	1	1	1	BTDC22S	41.50
Off Delay	1	1	1	1	BTDO22S	41.50

Renewal Parts Kit for NH, NHF Relays Style No. 1739 593, consists of complete stationary and moving contact assembly, plus all mounting hardware for 1-pole only—list price $2.40 E-1 discount. (For E-1 discount see Renewal Parts Selling Policy 100 or Selling Policy 7000)

Prices effective May 20, 1968; subject to change without notice.
Discount Symbol E-1
Selling Policy 7000

Industrial Control Relays

Type BF, 300 Volts AC, Fixed Contacts
Type BFD, 250 Volts, DC, Fixed Contacts


Type BF


Type BFD

Type BF and BFD relays are compact industrial control relays ideally suited for machine tool and similar applications where size is a factor. Type BF is AC-operated, 300 volts, maximum, and the BFD is DC-operated, 250 volts. Fixed contact relays are available in any combination of NO and NC from two to twelve poles. The NO and NC contacts are electrically isolated and both can be used without regard to polarity.

BF and BFD relays have captive clamp terminals fully accessible from the front, a molded coil with low operating temperature, and silver alloy contacts suitable for low-voltage circuits. Overlap contacts are available. All contacts feature the exclusive knife-edge design which provides a "self-wiping" action on every closure.

Application Data

BF Relay Electrical Ratings

AC Rating - NEMA A300

	Maximum Current (Amps)			Maximum VA	
Volts	Cont.	Make	Break	Make	Break
120	10	60	6	7200	720
0	10	30	3	7200	720

Hp Ratings (UL-recognized)

	AC Volts	
Phase	115	230
1	⅙	½
3	—	1

DC Rating - NEMA P300

	Maximum Current (Amps)			Maximum VA
Volts	Cont.	Make	Break	Make or Break
125	5.0	1.1	1.1	138
250	5.0	0.55	0.55	138

Coil Power Requirements

AC: 72 VA open, 12 VA closed
DC: 12 watts, 250 volts max.

Resistive Rating

125-volts DC: 3 amps
250-volts DC: 1.5 amps

If a different coil voltage is required, select the catalog suffix letter from the Coil Voltage Table below and substitute it for the *last* letter in the catalog number.

Coil Voltage Table

BF Coils			BFD Coils	
Volts AC	Hz	Catalog Suffix	Volts DC	Catalog Suffix
12	60	H	6	C
24	60	I	12	D
48	60	J	24	L
110	60	V	48	M
208	60	K	95	B
240/220	60/50	G	130	U
440	60	C	240	T

11 Selection Guide

No. of Poles	Contacts N.O. (Form A)	Contacts N.C. (Form B)	BF 300 Volt AC Relays 120/60, 110/50 AC Coil WESCO Stock No.	Mfr. Catalog No.	List	WESCO Each	BFD 250 Volt DC Relays 120 Volt DC Coil WESCO Stock No.	Mfr. Catalog No.	List	WESCO Each
2	2	0	78-6678-27016	BF20F	$72.00	$58.18	78-6678-28528	BFD20S	$102.00	$82.42
	1	1	78-6678-26848	BF11F	72.00	58.18	78-6678-28645	BFD11S	102.00	82.42
	0	2	78-6678-26743	BF02F	72.00	58.18				
3	3	0	78-6678-27268	BF30F	84.00	67.87	78-6678-39360	BFD30S	114.00	92.11
	2	1	78-6678-27058	BF21F	84.00	67.87				
	1	2	78-6678-26911	BF12F	84.00	67.87				
	0	3	78-6678-13920	BF03F	84.00	67.87				
4	4	0	78-6678-27457	BF40F	96.00	77.57	78-6678-28591	BFD40S	126.00	101.81
	3	1	78-6678-27310	BF31F	96.00	77.57	78-6678-28646	BFD31S	126.00	101.81
	2	2	78-6678-17303	BF22F	84.00	67.87	78-6678-28549	BFD22S	114.00	92.11
	1	3	78-6678-26983	BF13F	96.00	77.57	78-6678-28521	BFD13S	126.00	101.81
	0	4	78-6678-26806	BF04F	96.00	77.57				
6	6	0	78-6678-27793	BF60F	108.00	87.26				
	5	1	78-6678-27688	BF51F	108.00	87.26				
	4	2	78-6678-27499	BF42F	108.00	87.26	78-6678-28607	BFD42S	138.00	111.50
	3	3	78-6678-27373	BF33F	96.00	77.57	78-6678-28570	BFD33S	126.00	101.81
	2	4	78-6678-27184	BF24F	108.00	87.26				
	0	6	78-6678-26828	BF06F	108.00	87.26				
8	8	0	78-6678-28045	BF80F	132.00	106.66	78-6678-28635	BFD80S	162.00	130.90
	7	1	78-6678-27940	BF71F	132.00	106.66				
	6	2	78-6678-27835	BF62F	132.00	106.66	78-6678-28634	BFD62S	162.00	130.90
	5	3	78-6678-27730	BF53F	132.00	106.66	78-6678-28633	BFD53S	162.00	130.90
	4	4	78-6678-17328	BF44F	108.00	87.26	78-6678-28612	BFD44S	138.00	111.50
	0	8	78-6678-26836	BF08F	132.00	106.66				
10	10	0	78-6678-28108	BF100F	156.00	126.05				
	8	2	78-6678-28066	BF82F	156.00	126.05				
	6	4	78-6678-27877	BF64F	132.00	106.66				
	5	5	78-6678-27751	BF55F	132.00	106.66	78-6678-28621	BFD55S	162.00	130.90
	4	6	78-6678-27604	BF46F	156.00	126.05				
12	12	0	78-6678-28129	BF120F	180.00	145.44				
	8	4	78-6678-28087	BF84F	156.00	126.05	78-6678-28636	BFD84S	186.00	150.29
	7	5	78-6678-28024	BF75F	180.00	145.44				
	6	6	78-6678-27898	BF66F	156.00	126.05	78-6678-28628	BFD66S	186.00	150.29
	5	7	78-6678-27770	BF57F	180.00	145.44				
	4	8	78-6678-27646	BF48F	180.00	145.44				

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 26 of 219

Westinghouse Electric Corporation Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

IPP-98-510
NSD-SAE-ESI-98-031
January 23, 1998

Mr. Patrick M. Duggan
Consolidated Edison Company
Indian Point Unit 2
Broadway and Bleakley Avenues
Buchanan, New York 10511

Consolidated Edison Company of New York, Inc.
Indian Point Unit 2
BFD RELAYS - PICKUP VOLTAGE

Dear Mr. Duggan,

In response to a request regarding the above subject, the following information is provided.

Per NEMA standard, the minimum pickup voltage for BFD relays is 80% of the rated voltage of 120 VDC or 96 VDC. In other words, the relays are expected to pick up and remain picked up at 96 VDC but not necessarily at voltages below this level.

In actual application, the minimum pickup voltage is likely to vary from relay to relay based on number of contacts, contact configuration (NO/NC) and manufacturing variances; however, only the above specification should be relied upon.

As noted previously, the BFD relay is a commercial product now manufactured by Cutler-Hammer. For safety related applications, Westinghouse NSD-RRS provides only NBFD relays that have been verified to meet this requirement.

Please let me know if you have any questions or comments. I may be reached at (412)374-4459.

Fax #011

Gene Strusser
724-275-3673
Ron Roby 3130

Sincerely,

Doug Holderbaum
Senior Engineer
Engineering Services Integration

dfh/kk

Westinghouse Electric Corporation Energy Systems

Nuclear Services Division
Box 355
Pittsburgh Pennsylvania 15230-0355

IPP-98-504
NSD-SAE-ESI-98-012
January 9, 1998

Mr. Patrick M. Duggan
Consolidated Edison Company
Indian Point Unit 2
Broadway and Bleakley Avenues
Buchanan, New York 10511

Consolidated Edison Company of New York, Inc.
Indian Point Unit 2
BFD RELAYS

Dear Pat,

In response to a request regarding the above subject, the following information is provided:

It is confirmed that BFD relays manufactured by Westinghouse were designed to conform to the requirements of NEMA Standard ICS 2-212.41 which specifies that the relay will drop out between 80% of rated voltage and 10% of rated voltage. For the BFD66S relay, this translates into a drop out range of between 12.0 VDC and 96 VDC for this 120 VDC rated coil.

The NEMA standard for maximum voltage of 110% of rated also applies to the BFD line. In the case of the BFD66S, this is 132 VDC.

Note that the BFD relay is a commercial product now manufactured by Cutler-Hammer. Only NBFD relays purchased from Westinghouse NSD-RRS as safety related items have been verified to meet these specifications as part of the commercial dedication process.

Sincerely,

Doug Holderbaum
Senior Engineer

dfh/kk

NX-20457-1

ITEM 26

Westinghouse Electric Corp.
Commercial Operations Division
Pittsburgh, Pennsylvania 15220

Designation	NBFD65NR — Style 9084A70G01
General Description	11 Pole, 125V DC Nuclear Control Relay Class 1E Qualified—Nuclear Safety Related

Mechanical Specifications

Pole Configuration	6 NO and 5 NC, 10 amp contacts (1 NC contact used for coil control)
Mounting	Same as Westinghouse NBFD relay family
Reduced Heating	Dual coil design reduces coil heating under continuous operating conditions
Reduced Coil Burden	Dual coil design minimizes operating coil load
Qualified Life	20 years in mild power system environments
Seismic	Improved seismic performance (greater than 2.0 ZPA)
Contact Life	100,000 operations - AC loads 15,000 operations - DC loads
Contact Terminals	Suitable for ring terminations

Electrical Specifications

Minimum Operating Voltage	100 VDC
Maximum Operating Voltage	145 VDC (continuous for 4 to 6 hours)
Average Operating Voltage	125 VDC (rated voltage)
Drop Out Voltage	Greater than 12.5 VDC
Pick Up Time	Less than 50 milli-seconds
Drop Out Time	Less than 20 milli-seconds
Coil Burden	Less than 9 watts
Contact Rating	10A thermal rating NEMA A300-7200 VA make/720 VA break @120 VDC NEMA P300-1.1 amp make/break @ 125 VDC

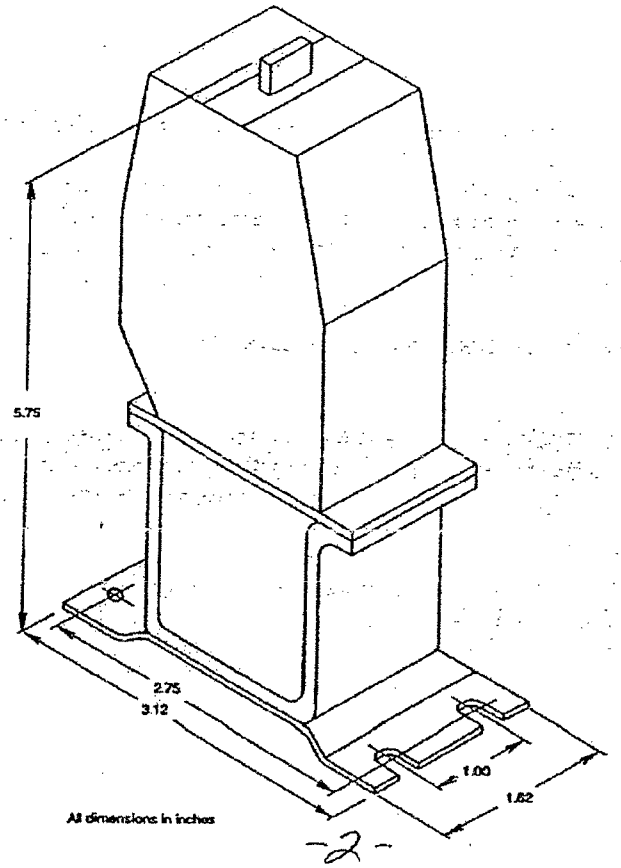
Environment

Operating Temperature	40 Degrees F to 130 Degrees F
Operating Relative Humidity	40% to 95%
Seismically Qualified	Greater than 2.0 ZPA

Applicable Standards

NEMA ICS 2-212
IEEE 323-1974
IEEE 344-1975

REV. 2 (TRF. 90-111)



-2-

Westinghouse Electric Corporation Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

IPP-98-510
NSD-SAE-ESI-98-031
January 23, 1998

Mr. Patrick M. Duggan
Consolidated Edison Company
Indian Point Unit 2
Broadway and Bleakley Avenues
Buchanan, New York 10511

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Fax Roll

Gene Stevenson
724-275-3673
Rm. Rdg 3130

Sincerely,

Doug Holderbaum
Senior Engineer
Engineering Services Integration

dfh/kk

Westinghouse Electric Corporation Energy Systems

Nuclear Services Division
Box 355
Pittsburgh Pennsylvania 15230-0355

IPP-98-504
NSD-SAE-ESI-98-012
January 9, 1998

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The NEMA standard for maximum voltage of 110% of rated also applies to the BFD line. In the case of the BFD66S, this is 132 VDC.

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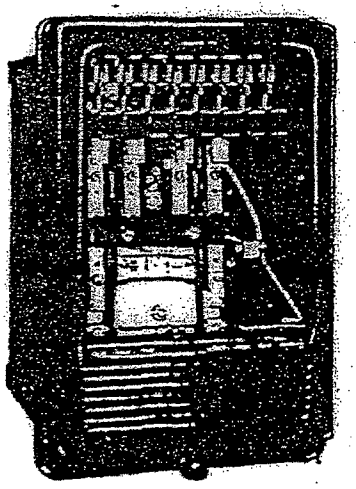
Sincerely,

Doug Holderbaum
Senior Engineer

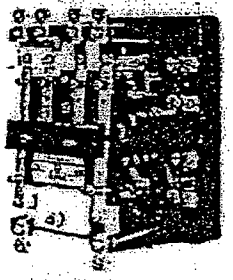
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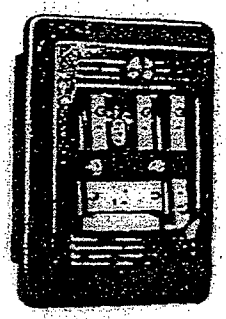
Type MG-6 Auxiliary Relays



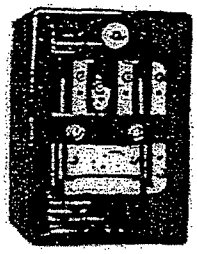
Flexitest® Semi-flush or Projection Mounting



Molded Base Without Cover



Molded Base with Cover Semi-Flush Mounting



Molded Base with Cover Projection Mounting

222.C-DC
(2)
A-10
(PG. 2 OF 3)

Application

Type MG-6 relays are for use in protective relaying or industrial control applications where electrically independent multiple contacts are required.

They have six contact circuits, each capable of carrying 12 amperes continuously or 30 amperes for one minute. The stationary contacts are readily reversible, providing make or break contact circuits as required.

Relays are available with either a self-reset armature (which resets when the operating coil is de-energized), or with a latch-type mechanism which holds the armature in closed position until the latch is tripped electrically or by hand.

In some MG-6 applications it is desirable to have the operating and/or reset coils de-energized automatically as soon as the relay has performed its function. When such is required, the operating coil circuit is interrupted by an additional cutoff contact contained in the relay. This contact is closed when the relay armature is open or unlatched. It opens when the armature is closed. The reset coil circuit can be interrupted by connecting the reset coil through one of the normally open contacts of the relay.

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Construction	3
Contact Arrangements	3
Contact Ratings	4
Operating Time	4
Reduced Operating Time	4
Positive Target Indication	4
Sheet Metal Enclosure	4
Electrical Characteristics	5
Coil Ratings	5
Internal Wiring	6 & 7

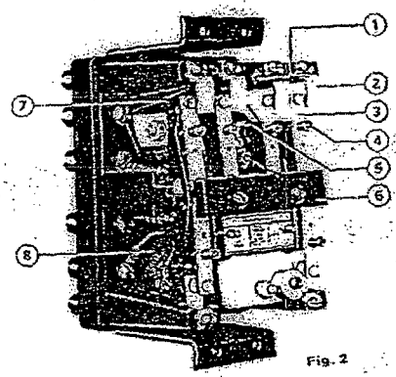


Fig. 2
Molded Base with Cover
Semi-Flush Mounting, Rear Connected

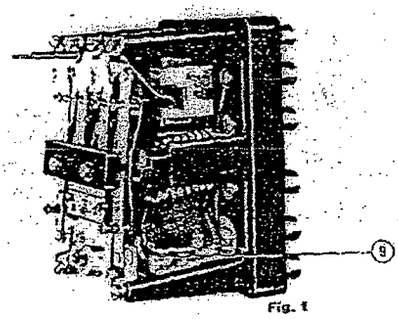


Fig. 1
Molded Base with Cover
Projection Mounting, Rear Connected

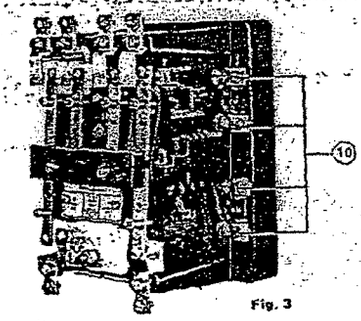


Fig. 3
Molded Base without Cover
Projection Mounting, Front Connected

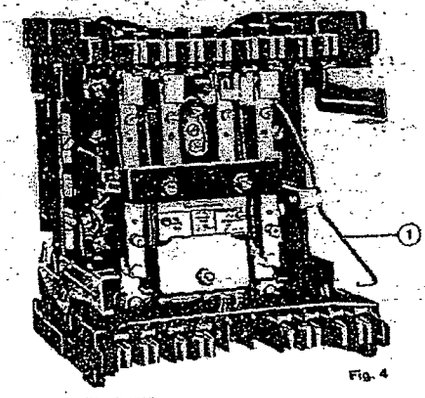


Fig. 4
Flexitest®
Semi-Flush or Projection Mounting

APPENDIX D
PAGE 29 OF 258

Flexitest manual reset lever is actuated by a push rod located outside at the bottom of the case.

(2) Stationary Contacts

Six in number, and electrically independent. They are made of pure silver, and are easily reversible.

(3) Moving Contacts

Also made of silver. They are mounted on a contact arm which provides adequate wipe action to assure positive contact between the moving and stationary contacts.

(4) Moving Contact Spring Assembly

Consists of a bushing, pin, and spring. Guides motion of the moving contact arm.

(5) Latch Screw Adjustment

(6) Adjusting Screw for Armature Spring Tension

(7) Reset Coil

[illegible] stationary contacts are easily reversed (by removing their retaining screws and reversing their position on the base) to obtain circuit opening operation.

Ac Operated Relays: Ac operated relays can have any or all stationary contacts reversed to provide contact opening ("break" or normally closed) operation.

Dc Operated Relays: Dc operated relays cannot have more than four contacts reversed, if normal contact pressure and travel are to be maintained. All six contacts can be reversed if additional armature spring tension is applied by adjustment of the screw shown in figure 1, reference 6.

Operating Coil Cutoff Contact

As shown in figures 1 and 12, MG-6 relays can be supplied with an additional auxiliary snap action contact which cuts off the relay operating coil when the armature closes. This snap action contact is also provided with a small permanent magnet which acts as an arc extinguisher, and provides a clean, fast break in the operating coil circuit, with minimum of arcing.

With this arrangement, faster relay operation may be obtained on dc by applying overvoltage to the operating coil. The cutoff contact will interrupt operating coil current using up to 4 times rated dc voltage. 24-volt and 48-volt dc ratings can be operated [illegible]

[illegible] and relays so ord[illegible] must specify the number of special "m[illegible] before-break" contacts desired.

To maintain the desirable amount of a[illegible] ture spring tension, it is preferable to [illegible] these special contact arrangements to:

(1) two special "break" contacts
(2) five special "make" contacts

The total number of contacts on the r[illegible] is limited to six. Increased armature sp[illegible] tension is required if the above arrangem[illegible] limits are exceeded. (a maximum of t[illegible] special "break" contacts can be used). Increased spring tension, however, creases the minimum pickup voltage of relay.

Figure 5 illustrates the location of the a[illegible] zable special "make-before-break" contr[illegible]

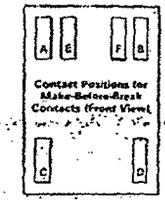


Fig. 5

Construction

(1) Reset Push Rod

Provides for manual reset of the armature. Extends through the cover of molded projection and semi-flush types.

Flexible manual reset lever is actuated by a push rod located outside, at the bottom of the case.

(2) Stationary Contacts

Six in number, and electrically independent. They are made of pure silver, and are easily reversible.

(3) Moving Contacts

Also made of silver. They are mounted on a contact arm which provides adequate wipe action to assure positive contact between the moving and stationary contacts.

(4) Moving Contact Spring Assembly

Consists of a bushing, pin, and spring. Guides motion of the moving contact arm.

(5) Latch Screw Adjustment

(6) Adjusting Screw for Armature Spring Tension

(7) Reset Coil

For intermittent duty only. When energized, the coil trips a latch to reset the armature.

(8) Operating Coil (Continuously Rated)

(9) Location of Optional Operating Coil Cutoff Contact

(10) External Wiring Connections

For molded base without cover only.

Contact Arrangements

Standard

All MG-6 relays are shipped from the factory with six circuit closing contacts, unless otherwise specified.

Non-Standard

The stationary contacts are easily reversed (by removing their retaining screws and reversing their position on the base) to obtain circuit opening operation.

Ac Operated Relays: Ac operated relays can have any or all stationary contacts reversed to provide contact opening ("break" or normally closed) operation.

Dc Operated Relays: Dc operated relays cannot have more than four contacts reversed, if normal contact pressure and travel are to be maintained. All six contacts can be reversed if additional armature spring tension is applied by adjustment of the screw shown in figure 1, reference 6.

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As shown in figures 1 and 12, MG-6 relays can be supplied with an additional auxiliary snap action contact which cuts off the relay operating coil when the armature closes. This snap action contact is also provided with a small permanent magnet which acts as an arc extinguisher, and provides a clean, fast break in the operating coil circuit, with minimum of arcing.

With this arrangement, faster relay operation may be obtained on dc by applying overvoltage to the operating coil. The cutoff contact will interrupt operating coil current using up to 4 times rated dc voltage. 24-volt and 48-volt dc ratings can be operated at 5 times rated voltage if the total number of relay operations is limited to 10,000 or less.

Operating time of relays with coil cutoff contact, with overvoltage applied, is as follows:

Multiples of Rated Dc Voltage Applied To Operating Coil	Time Required to Close "Make" Contact (60 Hertz Basis)
1	5.0 cycles
2	2.5 cycles
3	2.0 cycles
4	1.5 cycles

Special "Make-Before-Break" Arrangement

MG-6 contacts can also be arranged so one or more contacts close before the ot open, on the same relay.

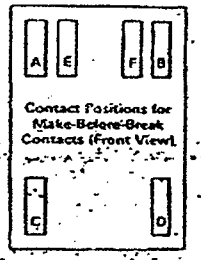
Such arrangements necessitate a sp armature assembly, and relays so ord must specify the number of special "m before-break" contacts desired.

To maintain the desirable amount of ar ture spring tension, it is preferable to these special contact arrangements to:

(1) two special "break" contacts
(2) five special "make" contacts

The total number of contacts on the r is limited to six. Increased armature sp tension is required if the above arranger limits are exceeded (a maximum of t special "break" contacts can be used). increased spring tension, however, creases the minimum pickup voltage of relay.

Figure 5 illustrates the location of the av ible special "make-before-break" contac



Contact Positions for Make-Before-Break Contacts (Front View)

Fig. 5

Number of Special Contacts	1	2	3	4
Special "Make" Positions				
	C	C	C	C
	..	D	D	D
	..	..	E	E
	..	..	..	F
	..	..	..	..
Special "Break" Positions				
	A	A	A	..
	..	B	B	..
	..	..	F	..

Example: If two special "make-bef break" contacts are required, the make c tacts are at positions C and D, and the b contacts at A and B.

Contact Ratings
Close and Carry

Each of the six relay contacts will carry 12 amperes continuously, and will close and carry 30 amperes for one minute.

Interrupting Ability
(Non-Inductive)

Control Circuit Voltage		Interrupting Rating, In Amperes	
Dc	60 Hertz	Single Contact	Two Series Contacts
12	---	30	30
24	---	15	30
32	---	10	20
48	---	8	16
125	---	3	6
250	---	1	2
---	115	30	30
---	230	20	30
---	460	15	30
---	575	10	20

Operating Time: 60 Hertz Base

Standard MG-6 operating time values are:

Pickup①

5 cycles (83 ms.) at dc rating
2 cycles (33 ms.) at ac rating

Dropout or Reset②

1.5 cycles (24 ms.) at dc rating
1.2 cycles (20 ms.) at ac rating

① Pickup time is the time required for the relay to close its make (or front contacts).

② Reset time is the time required for the relay to close its back contacts after the operating coil is de-energized.

Reduced Operating Time

1. Intermittent Duty

If faster operating time is required and intermittent application of energy is permissible, the MG-6 operating coil can be energized in either of the two following ways:

(a) Two times rated ac voltage yields 1 cycle operating time. The coil will safely withstand this voltage for over 2 minutes on 60 Hertz.

(b) Five times rated dc voltage yields slightly over 1 cycle operating time if there is not more than 1 circuit opening contact on the relay. The coil will withstand this voltage for 1 minute.

Trip Circuit Voltage, Volts Dc	Operating Coil Rating, Volts Dc	Current in Operating Coil, Amps Dc	Recommended Target Rating, Amps Dc
24	6	5.0	2.0
32	6	6.7	2.0
48	12	2.5	2.0
125	24	1.7	0.2
250	48	0.8	0.2

2. Continuous Duty

If faster operating time and continuous duty are required on dc applications, a low voltage coil with a series dropping resistor is used. The reduced inductance (flux build-up time) of the resistor-coil circuit results in an operating time of about 2 cycles. 10% of the control circuit voltage is applied across the coil and 90% across the resistor.

Trip Circuit Voltage, Volts Dc	Operating Coil Rating, Volts Dc	Series Resistors①		
		Ohms	Watts	Size
48	6	33.5	50	8¾"
125	12	180	71.4	8¾"
250	24	710	72.7	8¾"

① See Figure 9 for dimensions.

Because of the low ac impedance of the MG-6 relay with the armature open, as compared to the closed gap impedance, it is not advantageous to use a resistor in series with an ac coil of less than rated line voltage to obtain reduced operating time.

Positive Target Indication

Because MG-6 relays with rated control circuit voltage coils may draw insufficient current to operate protective relay targets, it is desirable to use a lower rated coil with a series resistor. (see figure 6) to draw sufficient trip circuit current to assure positive target indication.

The table below indicates ratings of resistors used with a 24-volt MG-6 operating coil and an 0.2 amp dc target.

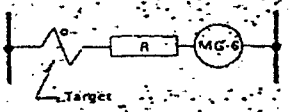


Fig. 6

Trip Circuit Voltage, Volts Dc	MG-6 Coil Rating, Volts Dc	Target Coil of Protective Relay, Amps Dc	Series Resistor①			Current in Target and MG-6 Coil Circuits, Amp Dc
			Ohms	Watts	Size	
48	24	0.2	67	6.5	3½"	.32
125	24	0.2	300	31	8¾"	.32
250	24	0.2	710	71	8¾"	.32

① See figures 8 and 9 for dimensions.

Sheet Metal Enclosure (NEMA 1)

For Front Connected Relays Without Cover

Figure 7 illustrates NEMA 1 sheet metal cabinet (style number 1164 761) in which a single unit, open-type MG-6 relay, either self-reset or electric and hand reset, can be mounted. The cabinet has a black enamel finish, and has ½" and ¾" knockouts for connection of external wiring.

Hardware for mounting the relay in the cabinet is supplied with the relay.

See Figure 15 for dimensions.

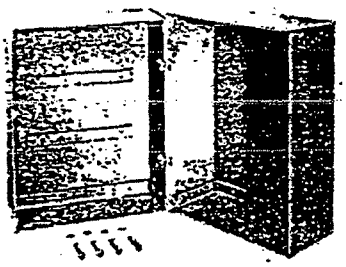


Fig. 7

Electrical Characteristics

Pickup Ratio

Relays will pickup at 80% of rating (both ac and dc).

Dropout Ratio

Dc relays will not dropout above 30% of rating.

Ac relays will not dropout above 50% of rating.

Coil Ratings

Operating Coil

Continuous: 110% of rated voltage
1 Minute on Dc: 500% of rated voltage
10 Minutes on Dc: 200% of rated voltage
2 Minutes on Ac: 200% of rated voltage

Reset Coil

5 Minute: 100% of rating

Coil Resistance (at 25°C) (± 10%)

Rating	Operating Coil Ohms	Operating Coil Closed Gap Impedance	Reset Coil Ohms
1 amp dc	4.8	....	....
2 amps dc	1.0	....	....
3 amps dc	.4	....	....
4 amps dc	.24	....	....
5 amps dc	.15	....	....
6 volts dc	4.8	....	.53
12 volts dc	19	....	2.12
24 volts dc	75	....	8.5
32 volts dc	132	....	13.9
48 volts dc	310	....	34
62.5 volts dc	530	....	56
125 volts dc	2000	....	222
250 volts dc	8200	....	890
115 volts, 60 hertz	19	354	91
208 volts, 60 hertz	67	1160	322
230 volts, 60 hertz	75	1410	364
460 volts, 60 hertz	305	5680	1445
575 volts, 60 hertz	495	8860	2208
115 volts, 50 hertz	26	....	138
230 volts, 50 hertz	105	....	550
460 volts, 50 hertz	465	....	2200
575 volts, 50 hertz	660	....	3550

Burden Data (at 25°C and Rated Voltage)

Hertz	Closed Gap Watts	Closed Gap Volt-Amperes	Open Gap Watts	Open Gap Volt-Amperes
Operating Coil				
25	6.8	23	19.6	53
50	9.8	31	17.4	78
60①	12	37	17.6	92
dc	7.8 watts cold		7.8 watts cold	
dc	6.5 watts hot		6.5 watts hot	
Reset Coil				
25	48	51.6	52	54
50	46	58.2	57	63.8
60①	84	104.5	96	112.8
dc	66 watts cold		68 watts cold	

① Rated voltage is 115 volts or multiples thereof.

External Resistors (With Mounting Bracket)

Fig. 8: 3½ inch

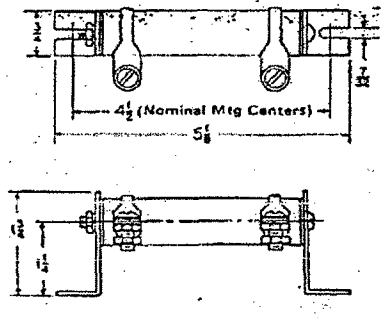
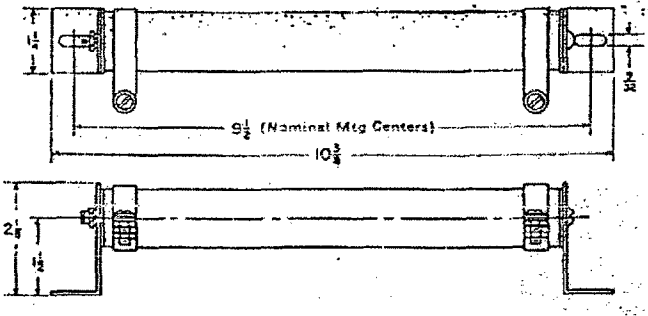


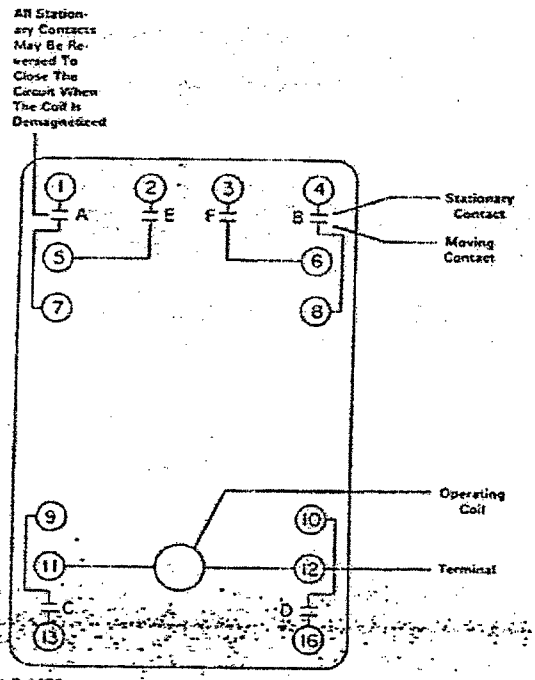
Fig. 9: 8½ inch



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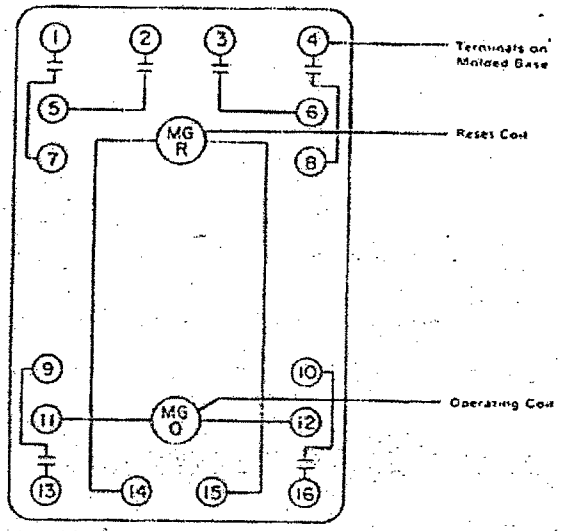
Internal Wiring: Front View (All Relays with Reversible Contacts, Make or Break)

Molded Base With or Without Cover
Fig. 10: Self-Reset



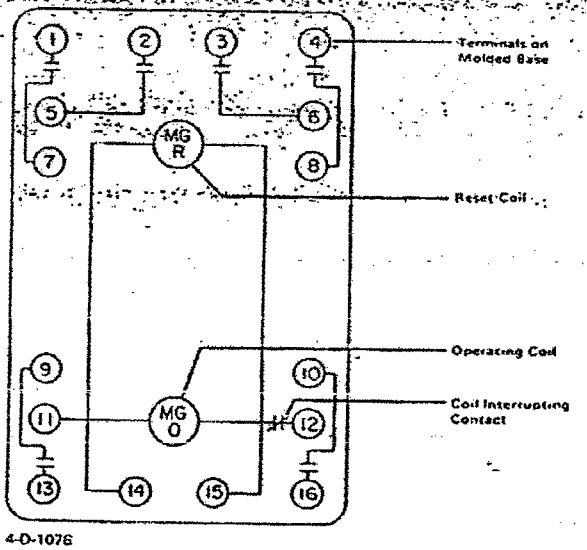
4-D-1072

Electric and Hand Reset
Fig. 11: Without Coil Cutoff Contact



4-D-1076 Sub. 4

Fig. 12: With Coil Cutoff Contact



4-D-1076

NC Contacts

No.	Position			
1	A			
2	A	B		
3	A	B	E	
4	A	B	E	F

Att. R 9
Page 7 of 8

Internal Wiring: Front View (All Relays with Reversible Contacts, Make or Break), Continued

Flexitest: FT-22 Case

Fig. 13: Self Reset

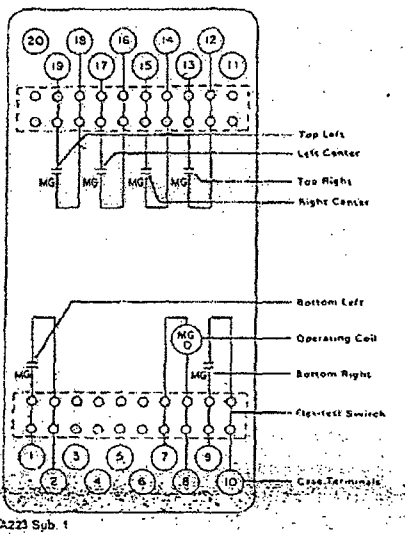


Fig. 14: Electric and Hand Reset

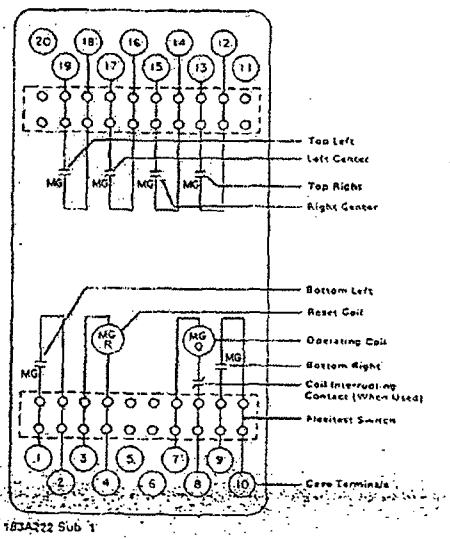
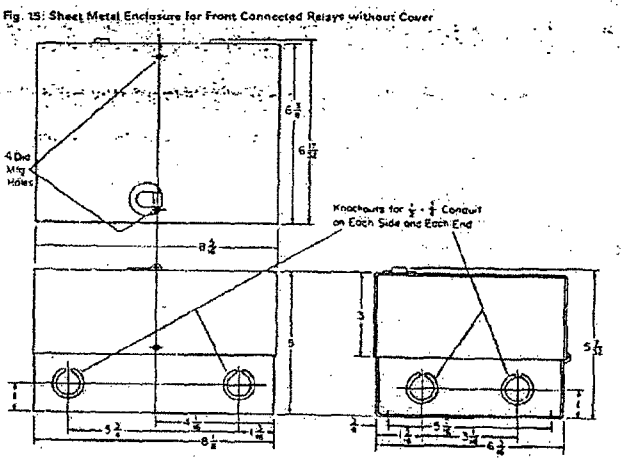


Fig. 15: Sheet Metal Enclosure for Front Connected Relays without Cover



Calculation FEX-00204-00
Rev. 0
Attachment S
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APPENDIX D
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Fig. 6. ← Target

Trip Circuit Voltage, Volts Dc	MG-6 Coil Rating, Volts Dc	Target Coil of Protective Relay, Amps Dc	Series Resistor® Ohms	Watts	Size	Current in Target and MG-6 Coil Circuits, Amp Dc
48	24	0.2	87	6.5	3¼"	32
125	24	0.2	300	31	8¼"	32
250	24	0.2	710	71	8¼"	32

® See figures 8 and 9 for dimensions.

Sheet Metal Enclosure (NEMA 1)

For Front Connected Relays Without Cover

Figure 7 illustrates NEMA 1 sheet metal cabinet (style number 1164 761) in which a single unit, open-type MG-6 relay, either self-reset or electric and hand reset, can be mounted. The cabinet has a black enamel finish, and has ½" and ¾" knockouts for connection of external wiring.

Hardware for mounting the relay in the cabinet is supplied with the relay.

See Figure 15 for dimensions.

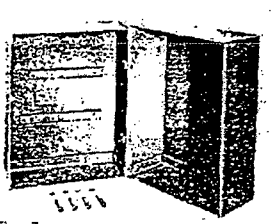


Fig. 7

APPENDIX D
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Shipping Weights and Carton Dimensions

Case Type	Weight, Lbs(kg) Net	Shipping	Domestic Shipping Carton Dimensions, Inches (cm)
Molded Base Without Cover	4 (1.8)	7 (3.2)	8½ x 9½ x 10 (21.6) x (24.1) x (25.4)
Molded Base With Cover	5 (2.3)	8 (3.6)	8½ x 9½ x 10 (21.6) x (24.1) x (25.4)
Flexitest FT-22	8 (3.6)	11 (5)	9 x 12 x 13 (22.9) x (30.5) x (33.0)

Further Information

Prices: Price List 41-020

Specifications and Ordering Information – Tech. Data 41-020

Dimensions: Flexitest, DB 41-075. Others, DB 41-075A

Instructions, Operation and Maintenance: IL 41-753.1

Renewal Parts: RPD 41-753A1

Other Protective Relays: Selector Guide 41-000

Westinghouse Electric Corporation
Relay-Instrument Division
Coral Springs, FL 33065

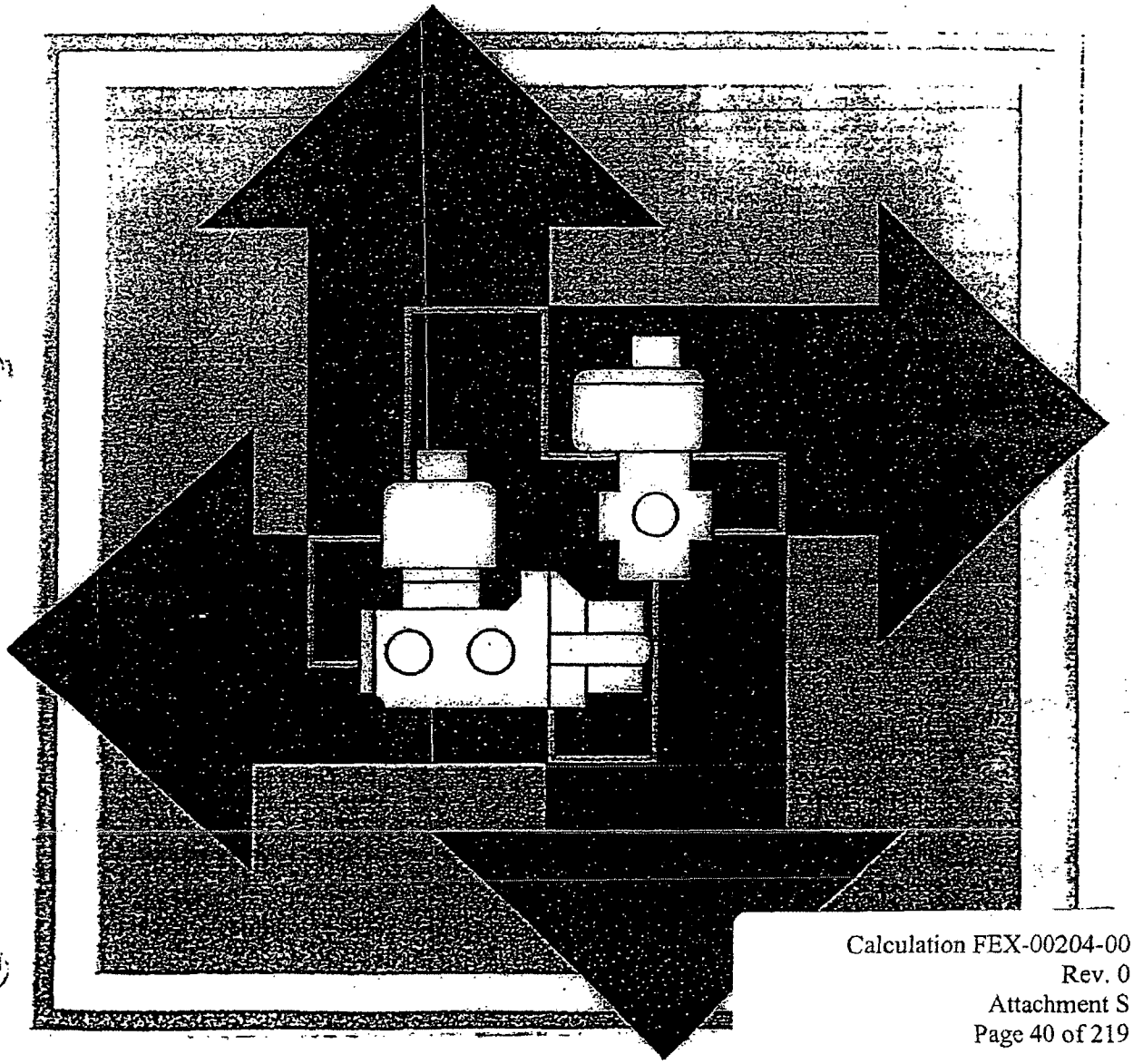
CATALOG NO. NP-1

ITEM-168, 163, 170, 166, 177, 175, 174, 165, 167, 161, 162, 169, 37, 3

ASCO®

3 AND 4 WAY SOLENOID VALVES

FOR PILOT CONTROL OF DIAPHRAGM & CYLINDER OPERATED VALVES USED IN NUCLEAR POWER PLANTS.



Automatic Switch Co. 50-56 Hanover Road, Florham Park, New Jersey 07932

Automatic Switch Co.

always pioneering in the design and development of solenoid operated valves — resulting in a line of solenoid valves that is recognized as the finest and most complete anywhere in the world.

This catalog lists special designs of three and four-way solenoid valves which are used primarily as pilot valves for handling oil free instrument air in nuclear power plants.

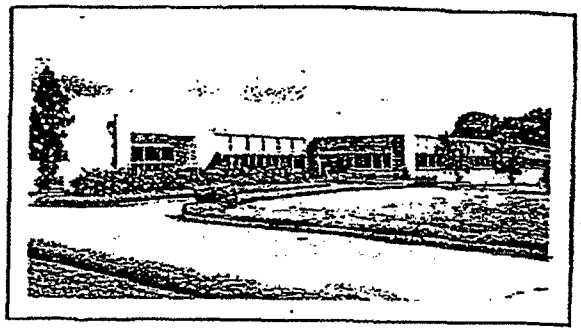
These valves are designed to meet the most stringent environmental conditions encountered in nuclear power generating applications and have been qualified to meet the specifications of the following IEEE Standards:

IEEE-323 — "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

IEEE-382 — "IEEE Trial-Use Guide for Type Test of Class 1 Electrical Valve Operators for Nuclear Power Generating Stations."

IEEE-344 — "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."

ASCO assures these requirements by maintaining an extensive In-House testing program which is supplemented by independent outside testing facilities.



Qualification consists of subjecting each valve to the following tests as required by the above noted IEEE Specifications:

A. Thermal Aging
B. Radiation Aging
C. Wear Aging
D. Vibration Endurance
E. Seismic Simulation
F. Design Basis Event
Loss-of-Coolant-Accident (LOCA)
Environmental Simulation

All Valves Are Supplied With The Following Special Features:

1. Class H coil insulation.
2. Elastomers (gaskets, o'rings, discs) to meet radiation and high temperature degradation effects.
3. Elimination of radiation and temperature affected materials.
4. Specially designed solenoid enclosures to withstand Loss-of-Coolant-Accident (LOCA) environment.
5. Modification to meet seismic loadings
6. Last-Chance Coarse Filter.

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3 Way Bulletin NP 8320	9 & 10
3 Way Bulletin NP 8321	11
3 Way Bulletin NP 8323	12
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Asco's Broad Range of Products	Inside Back Cover
Asco Manufacturing and Sales Organization	Back Cover

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Engineering Information

SOLENOID VALVES

ASCO three and four-way solenoid valves, designed and manufactured by the Automatic Switch Company of Florham Park, New Jersey, are widely used for pilot control of diaphragm and cylinder operated valves (and other applications) used in nuclear power plants.

Selection of the proper valve for a specific application is of paramount importance. This engineering information section describes three and four-way valve constructions, types of operation, and coil information.

I. Principle of Operation

A solenoid valve is a combination of two basic functional units, (1) a solenoid (electromagnet) with its plunger (or core); (2) a valve body containing an orifice in which a disc or plug is positioned to stop or allow flow. The valve is opened or closed by movement of the magnetic plunger (or core) which is drawn into the solenoid when the coil is energized.

ASCO solenoid valves are of a packless construction with an enclosed solenoid mounted directly on the valve body with the solenoid core attached to the valve stem. The core is enclosed and free to move in a permanently sealed tube inside the solenoid coil. This construction provides a compact, leak tight assembly, without the need of a stuffing box or sliding stem seal.

Direct Acting Valve
(Figs. 1A and 1B)

In a direct acting, fully automatic valve, the solenoid core is mechanically connected to the valve disc and directly opens or closes the orifice, depending upon whether the solenoid is energized or de-energized. Operation is not dependent upon line pressure or rate of flow, and valve will operate from zero PSI to its maximum rated pressure.

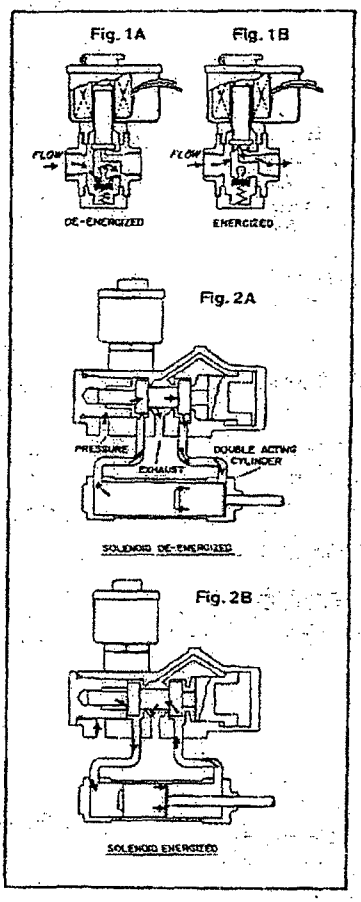
II. Types of Solenoid Valves

Three-Way Solenoid Valves
(Figs. 1A and 1B)

Three-way solenoid valves have three pipe connections and two orifices (one orifice is always open and one is always closed). These valves are commonly used to alternately apply pressure to and exhaust pressure from a diaphragm valve or single acting cylinder. They also may be used to select or divert flow.

Four-Way Solenoid Valves
(Figs. 2A and 2B)

Four-way solenoid valves are generally used to operate double acting cylinders. These valves have four pipe connections – one pressure, two cylinder, and one exhaust.



III. Solenoid Enclosure

All valves listed in the catalog are supplied with either watertight or combination explosion proof watertight solenoid enclosures to withstand the environmental conditions of IEEE Std 382 LOCA (Loss of Coolant Accident). Solenoid enclosures are deep-drawn steel equipped with a ½ threaded conduit hub.

The solenoid enclosure forms a magnetic path; therefore, do not remove as this will affect valve operation.

These enclosures meet the following NEMA solenoid enclosure requirements:

Watertight Nema Type 4 and 4X, (submersible) Nema Type 6; also meets Nema Type 3, 3S and 12.

Explosion-proof Nema Type 7C and 7D, Watertight Nema 4 and 4X; also meets Nema Type 3, 3S, 9E, 9F, 9G and 12.

IV. Solenoid Construction

Internal parts in contact with the fluid are made of non-magnetic 300 and magnetic 400 Series stainless steel. In A-C constructions only, the shading coil is normally copper except silver is used in stainless steel body valves. Other materials are available when required. No shading coil is used in D-C valves.

The core tube in ASCO valves is of 305 stainless steel and formed by deep drawing, eliminating silver brazed or welded joints otherwise necessary.

V. Maximum Operating Pressure Differential (M.O.P.D.)

The maximum operating pressure differential is the maximum differential pressure between the inlet and the outlet sides of the valve against which the solenoid can safely operate the valve. This is referred to as M.O.P.D. This pressure may be much less than the safe working pressure.

VI. Minimum Operating Pressure Differential

The minimum operating pressure differential is the lowest operating pressure differential required for dependable operation. For three and four-way pilot valves, the minimum operating pressure must be maintained throughout the operating cycle to insure complete transfer from one position to the other.

Note: Direct acting valves do not require a minimum pressure.

VII. Safe Working Pressure

Line or system working pressure to which the valve may be safely subjected. The proof pressure for any valve is five times the safe working pressure.

VIII. Ambient Temperature Limitations

Minimum Ambient Temperature

The nominal limitation of 32°F is advisable for any valve. The actual minimum ambient temperature permissible can be greatly affected by both application and valve construction.

Maximum Ambient Temperature

The nominal maximum ambient temperatures listed are based primarily on test conditions used by Underwriters' Laboratories in determining safe limits for coil insulation. They are determined under continuously energized conditions and with maximum fluid temperatures existing in the valve. In many applications, the specific conditions existing will permit use at considerably higher ambient temperatures. In addition, modifications to standard constructions are also available, which can extend the maximum ambient temperature limitation to 180°F or more. Consult Factory with your specific needs.

IX. Solenoid Coils

ASCO valves listed in this catalog are equipped with continuous duty, Class H coils. These can be energized continuously without danger of over heating or failure. Coils are provided with two coil leads which can be connected to any controlling device. For three-phase power systems, the two leads can be connected to any two of the three phases. All coils are constructed in accordance with Underwriters' Laboratories, NEMA, AIEE, and other industry standards. The coil insulation system and temperature limitations are shown below

Coil Operating Voltage Ranges

All coils are designed for industrial operating voltages and can be used on the following voltage ranges:

A-C		D-C	
Voltage Rating	Normal Operating Range	Battery Voltage Rating	Normal Operating Range
24	22- 24	6	5.1-6.3
120	110-120	12	10.2-12.6
		24	20-25
240	220-240	125	90-140
480	440-480	250	180-280

All ASCO valves are tested to operate at 15% under the nominal voltage and at maximum operating pressure differential, and are capable of operating for short periods at 10% over the nominal voltage. For wider voltage ranges than shown above, a different coil or insulation system must be used.

Power Consumption

Power consumption of solenoid valves may be determined from the rating in ASCO bulletins. For valves on A-C service, the watt rating, the volt-ampere "inrush" and the volt-ampere "holding" are given.

The volt-amp (VA) "inrush" is the high momentary surge of current which occurs at the moment an A-C solenoid is energized.

The volt-amp (VA) "holding" is the continuous rating after the initial "inrush."

The current rating for the "inrush" and "holding" may be determined by dividing the voltage into the volt-amp rating

$$\text{AMPS (INRUSH)} = \frac{\text{volt-amp inrush}}{\text{voltage}}$$

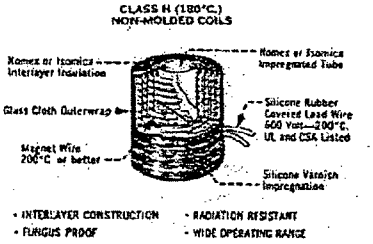
$$\text{AMPS (HOLDING)} = \frac{\text{volt-amp holding}}{\text{voltage}}$$

Valves supplied for D-C service have no "inrush" current, as in the case of A-C service. The amp rating can be determined by dividing the voltage into the D-C watt rating.

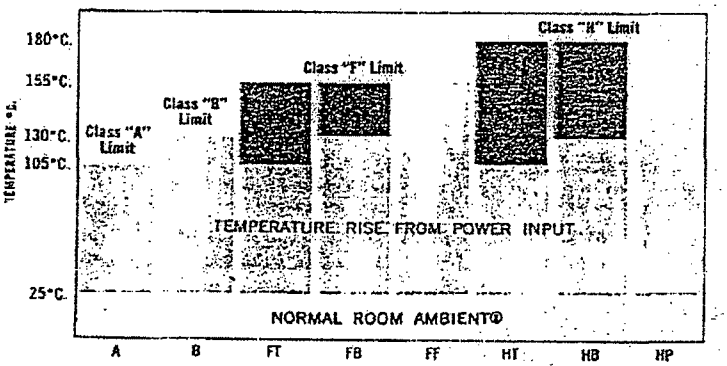
$$\text{AMPS} = \frac{\text{watts (D-C)}}{\text{voltage}}$$

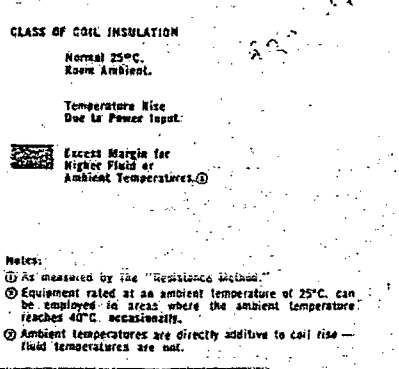
Note: (1) When a valve has been energized for a long period the solenoid enclosure becomes hot and cannot be touched by hand except for an instant. This is a perfectly safe operating temperature. Any excessive heating will be indicated by the smoking and burning odor of the coil insulation

(2) Valves for A-C service can be converted for use on other A-C voltages simply by changing the coil; similarly, D-C valves can be converted for other D-C voltages. When converting from A-C to D-C or vice versa, consult ASCO for instructions.



The following table illustrates the temperature parameters of ASCO Coils:
INDUSTRIAL TEMPERATURE LIMITATIONS① AND THERMAL CHARACTERISTICS OF ASCO SOLENOIDS AND COILS





Notes:
① As measured by the "Resistance Method."
② Equipment rated at an ambient temperature of 25°C. can be employed in areas where the ambient temperature reaches 40°C. occasionally.
③ Ambient temperatures are directly additive to coil rise — fluid temperatures are not.

Moderate Flow

3 WAY SOLENOID VALVES

For (oil free) Instrument Air
⅛", ¼", ⅜" and ½" N.P.T.

ASCO
Red-Hat

BULLETINS
206-380 208-448
206-381 208-266
206-832 210-036

General Description

These rugged forged brass, steel and stainless steel body valves are especially suited for heavy duty industrial applications.

Important: No minimum operating pressure is required.

Applications

They are primarily used as pilot operators on larger control valves in nuclear power plants.

These valves also may be used on:
- air vises
- compressors
- machine tools
- turbines

Specifications

Operation: Three types are available:
(a) Normally Closed
(b) Normally Open
(c) Universal

Pipe Sizes: ⅛", ¼", ⅜" and ½" N.P.T.

Valve Parts In Contact with Media:
Body — Brass, Steel or 304 s.s., as listed.

Disc — 303 s.s.

Core Tube — 305 s.s.

Core and Plugnut — 430F s.s.

Springs — 302 s.s. and 17-7 PH s.s.

Shading Coil — Copper for brass and steel valves; Silver for stainless steel valves.

Seats — Ethylene propylene or 303 s.s.

Gaskets — Ethylene Propylene

No aluminum parts.

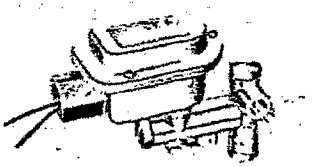
Solenoid Enclosures: Two types are available:
(a) Watertight (NEMA 4 and 6).
(b) Explosion-Proof and Watertight (NEMA 7C, 7D and 4).

Electrical: Standard Voltages:

24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).

6, 12, 24, 125, 250 volts, D-C (battery voltages).

Other voltages available when required.



Coils: Continuous Duty Class H.

Temperature: Fluid: To 180°F.

Ambient: Nominal Range, 32°F. to 140°F.

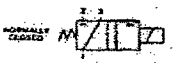
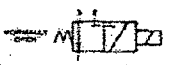
Installation: Valves must be mounted with solenoid vertical and upright.

Coarse Filter: Integral in valve inlet.

Optional Features:

- Junction box enclosure (AC watertight solenoid only)
- Manual operator
- ½" threaded conduit hub
- Screw terminal coils (AC watertight solenoid only)
- Viton elastomers

Specifications


AC Construction

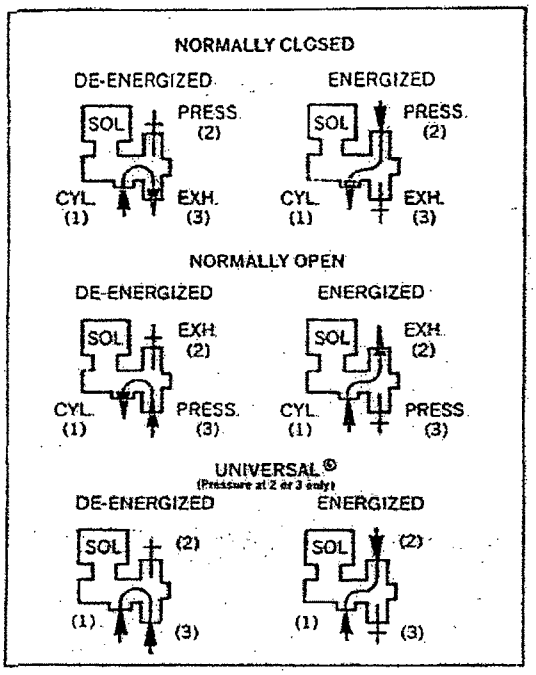
Pipe Size (Ins.)	Orifice Size (Ins.)	Maximum Operating Pressure Differential P.S.I. Normally Closed ② or Normally Open ③	Maximum Operating Pressure Differential P.S.I. Universal ④	Safe ⑤ Working Pressure (P.S.I.)	Max. ⑤ Fluid Temp. °F.	Cv ⑥ Flow Factor	Watertight Solenoid Enclosure Catalog Number	Explosion Proof — Watertight Solenoid Enclosure Catalog Number	Body Material	Watt Rating AC	Watt Rating DC	Approx. Shipping Weight (Lbs.)
② ⅛	⅛	200	100	600	180	.35	206-380-1	206-832-1	Brass	20	—	4
② ¼	⅛	200	100	600	180	.35	206-380-2	206-832-2	Brass	20	—	4
② ¼	¼	150	75	600	180	.45	206-380-3	206-832-3	Brass	20	—	4
② ⅜	⅜	200	100	600	180	.35	206-380-4	206-832-4	Brass	20	—	4
② ⅜	¼	150	75	600	180	.45	206-380-5	206-832-5	Brass	20	—	4
② ½	⅜	100	50	600	180	.75	206-380-6	206-832-6	Brass	20	—	4
② ½	½	100	50	600	180	.75	206-380-7	206-832-7	Brass	20	—	4
	⅜	200	100	1500	180	.35	208-266-1	210-036-1	Steel	20	—	6
	⅜	¼	150	75	1500	180	.45	208-266-2	210-036-2	Steel	20	—	6
	⅜	⅜	100	50	1500	180	.75	208-266-3	210-036-3	Steel	20	—	6
	½	⅜	100	50	1500	180	.75	208-266-4	210-036-4	Steel	20	—	6
	½	½	100	50	1500	180	.75	208-266-5	210-036-5	Stainless Steel	20	—	7

DC Construction

② ⅛	⅛	200	100	600	180	.35	—	206-381-1	Brass	—	35.1	7
② ¼	⅛	200	100	600	180	.35	—	206-381-2	Brass	—	35.1	7
② ¼	¼	150	75	600	180	.45	—	206-381-3	Brass	—	35.1	7
② ⅜	⅜	200	100	600	180	.35	—	206-381-4	Brass	—	35.1	7
② ⅜	¼	150	75	600	180	.45	—	206-381-5	Brass	—	35.1	7
② ½	⅜	125	60	600	180	.75	—	206-381-6	Brass	—	35.1	7
② ½	½	125	60	600	180	.75	—	206-381-7	Brass	—	35.1	7
	⅜	200	100	1500	180	.35	—	208-448-1	Steel	—	35.1	10
	⅜	¼	150	75	1500	180	.45	208-448-2	Steel	—	35.1	10
	½	⅜	125	60	1500	180	.75	208-448-3	Steel	—	35.1	10
	½	⅜	125	60	1500	180	.75	208-448-4	Steel	—	35.1	10
	½	½	125	60	1500	180	.75	208-448-5	Stainless Steel	—	35.1	10

Notes:
② For normally closed operation use catalog number Suffix "F"
③ For normally open operation use catalog number Suffix "G"
④ For universal operation use catalog number Suffix "U"
⑤ Maximum AC/DC continuous ambient 140°F
⑥ Resilient seats (Suffix "R") available — ⅛" orifice Cv = .25 ¼" orifice Cv = .39, ⅜" orifice Cv = .53
⑦ Coarse filter supplied at pressure connection 2 and 3 only

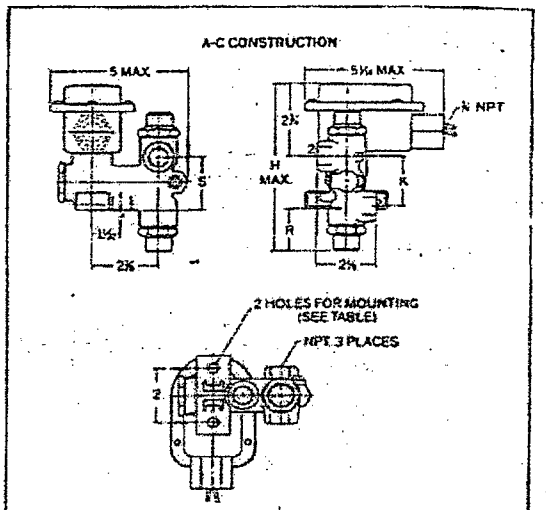
Flow Diagrams



Electrical Information

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.	
		A-C				
	D-C Watts	Watts	VA Holding	VA Inrush	A-C	D-C
H	35.1	20	41.5	195	102-005	208-452

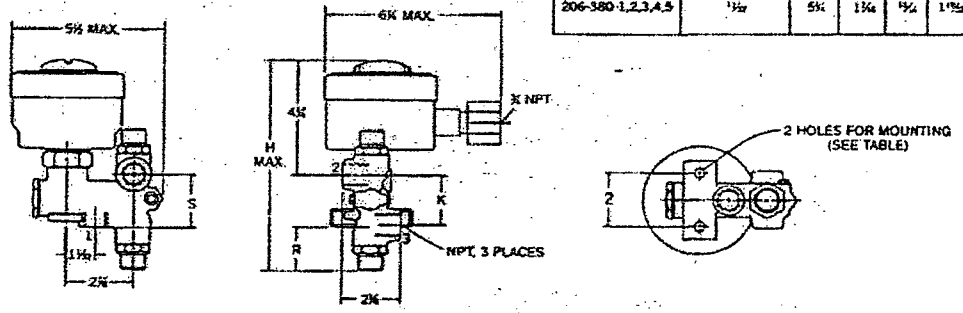
for K206-381-2RVF



CATALOG NUMBER	MOUNTING HOLE DIA.	H	K	R	S
206-266-1,2,3,4,5	⅜	6¾	1⅝	1⅝	2
206-380-6,7	11/32				
206-380-1,2,3,4,5	11/32	6¾	1¾	1¾	1 11/32

Dimensions (in inches)

Watertight Solenoid Shown. WP-EP Details On Request.



CATALOG NUMBER	MOUNTING HOLE DIA.	H	K	R	S
206-381-6,7	⅜	7 1/16	1⅝	1⅝	2
208-448-1,2,3,4,5					
206-381-1,2,3,4,5	11/32	6¾	1¾	1¾	1 11/32

High Flow

3 WAY SOLENOID VALVES

For (oil free) Instrument Air
⅜", ½", ¾" and 1" N.P.T.

ASCO
Red-Hat
BULLETIN
NP8316

General Description

These 3 way, internal piloted diaphragm valves have only four operating parts — a stainless steel core, two diaphragms and a disc holder.

Important: 10 p.s.i. minimum operating pressure differential required. Valve vents to "0" p.s.i.

Applications

Used primarily as pilot operators on larger control valves in nuclear power plants.

They are also used in applications, such as:

- pilots
- compressor unloaders
- cylinders
- turbines

Specifications

Operation: Normally closed and normally open, refer to flow diagrams.

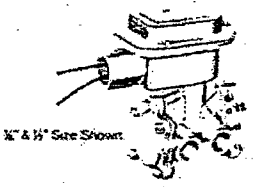
Pipe Sizes: ⅜", ½", ¾" and 1" N.P.T.

Valve Parts in Contact with Media:
Body — Brass.
Seals and Discs — Ethylene Propylene
Diaphragm Assembly — Ethylene propylene, Brass Trim.
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s
Springs — 302 s.s. and 17-7PH s.s.
Shading Coil — Copper.
Pilot Seat Cartridge — Brass
Disc Holder — Stainless steel.
No aluminum parts.

Solenoid Enclosures: Two types available:
(a) Watertight (NEMA 4 and 6).
(b) Explosion-Proof and Watertight (NEMA 7C, 7D and 4).

Electrical: Standard Voltages:
24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).
6, 12, 24, 125, 250 volts, D-C, (battery voltages).

Other voltages available when required.



Coil: Continuous Duty Class H.
Temperature: Fluid: To 180°F.
Ambient: Nominal Range, 32°F. to 140°F.
Mounting: Mountable in any position without affecting operation.
Coarse Filter: Integral in valve inlet.

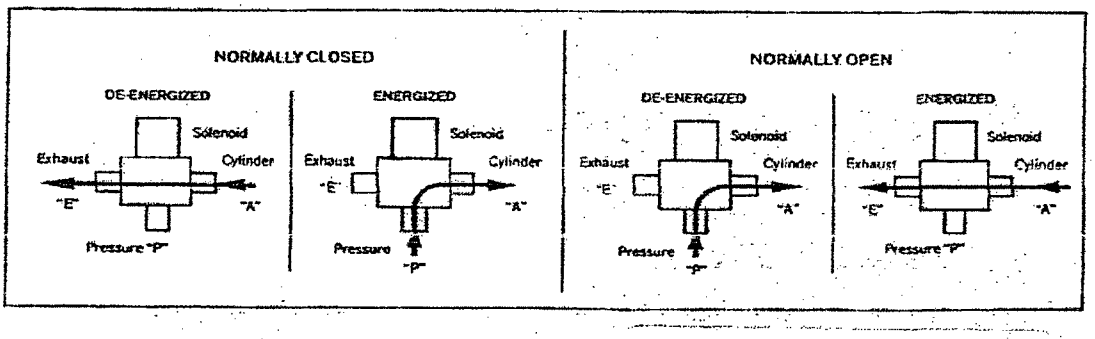
Optional Features:

- Junction Box Solenoid Enclosure (Watertight Solenoid only)
- Manual Operator
- ½" Threaded Conduit Hub
- Screw Terminal Coils (watertight solenoid only)
- Viton Elastomers

Specifications

Pipe Size (Ins.)	Orifice Size (Ins.)	Minimum Operating Pressure Differential (P.S.I.)	Maximum Operating Pressure Differential (P.S.I.) Air	Maximum Operating Pressure Differential (P.S.I.) A-C and D-C	Safe Working Pressure (P.S.I.)	Max. Fluid Temp. °F.	Cv Flow Factor	Watertight Solenoid Enclosure Catalog Number	Explosion-Proof — Watertight Solenoid Enclosure Catalog Number	Watt Rating A-C	Watt Rating D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.) WP	Approx. Shipping Weight (Lbs.) EP
Normally Closed Operation, Forged Brass Bodies														
⅜	⅜	10	175		250	180	3	NP8316S4E	NP8316S5E	10.5	17.4	H	5½	6¼
½	⅜	10	175		250	180	4	NP8316S6E	NP8316S5E	10.5	17.4	H	5½	6¼
¾	1⅛	10	175		250	180	5.5	NP8316A74E	NP8316A75E	10.5	17.4	H	5¼	6
1	1	10	175		250	180	13	NP8316E34E	NP8316E35E	10.5	17.4	H	9¼	10½
Normally Open Operation, Forged Brass Bodies														
⅜	⅜	10	175		250	180	3	NP8316S6E	NP8316S7E	10.5	17.4	H	5½	6¼
½	⅜	10	175		250	180	4	NP8316S6E	NP8316S7E	10.5	17.4	H	5½	6¼
¾	1⅛	10	175		250	180	5.5	NP8316A76E	NP8316A77E	10.5	17.4	H	9¼	6
1	1	10	175		250	180	13	NP8316E36E	NP8316E37E	10.5	17.4	H	9¼	10½

Flow Diagrams

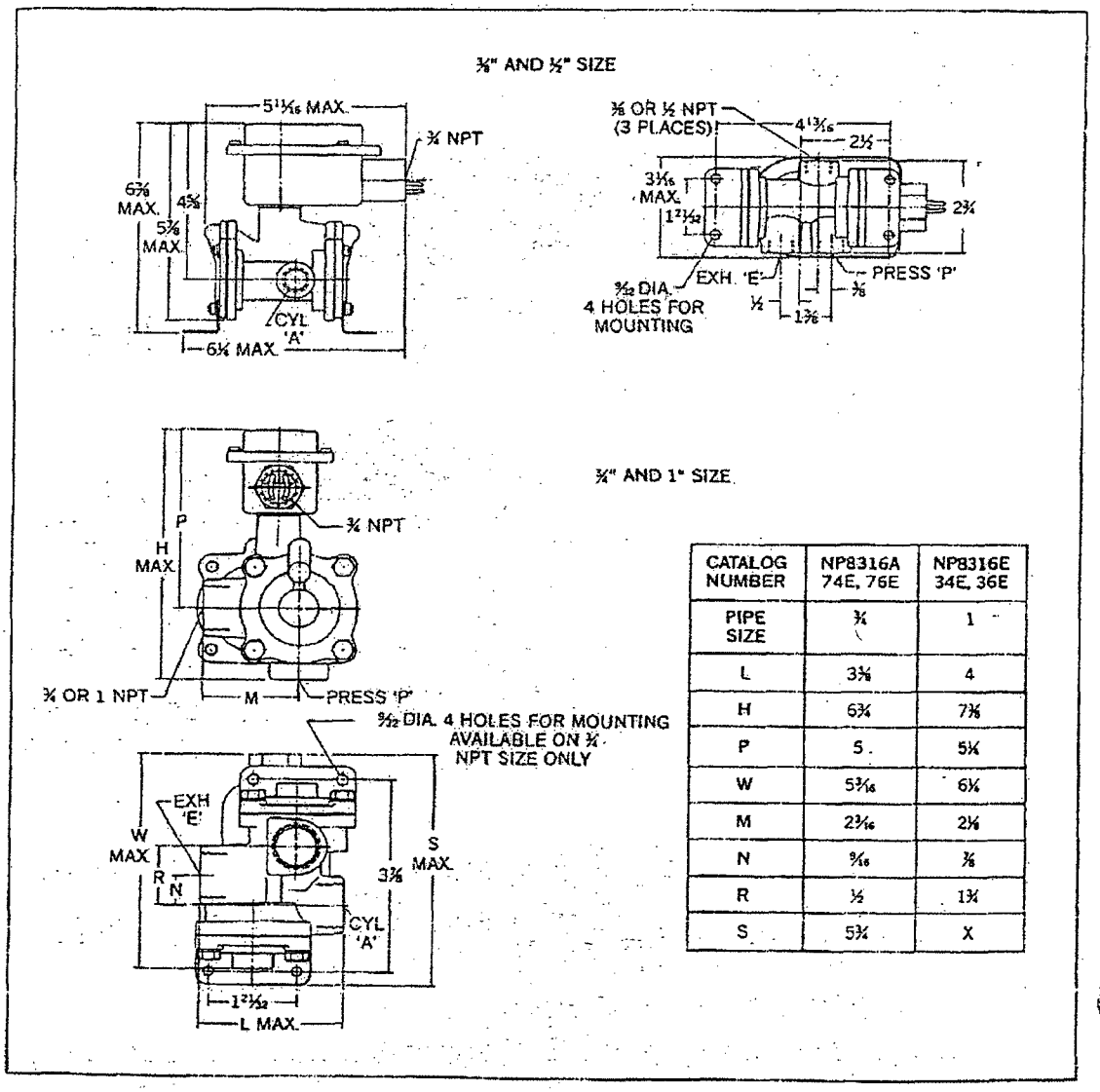


Electrical Information

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.	
		A-C				
	D-C Watts	Watts	VA Holding	VA Inrush	A-C	D-C
H	17.4	10.5	23	45	27-502	38-793

for NP8316SSV

Dimensions (in inches) Watertight Solenoid shown. WP-EP details on request.



CATALOG NUMBER	NP8316A 74E, 76E	NP8316E 34E, 36E
PIPE SIZE	¾	1
L	3⅜	4
H	6¾	7⅛
P	5	5¼
W	5 3/16	6¼
M	2 3/16	2¼
N	9/16	⅝
R	½	1¾
S	5¾	X

Miniature Size
3 WAY SOLENOID VALVES
For (oil free) Instrument Air ¼" N.P.T.

ASCO
Red-Hat
BULLETIN
NP8320

General Description
This compact design eliminates the orifice connection in the solenoid — all connections are in the valve body providing in-line piping.
This modern design concept with orifice and pipe connections in the body also permits coil replacement without opening pipe connections — now necessary on other 3 way valves.

Applications
These valves are commonly used to apply pressure to and vent pressure from cylinders and diaphragms or for selection and diversion of pressure.
They are primarily used as pilot operators on larger control valves in nuclear power plants.

Some typical applications are:
- automation
- pneumatic cylinders
- pilot operators
- air conditioning
- instrumentation
- air dryers
- compressors

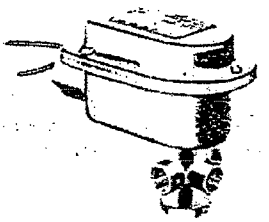
Specifications
Operation: Three types available:
(a) Normally Closed — applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized.
(b) Normally Open — applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized.
(c) Universal — for normally closed or normally open operation. Selection or diversion of pressure can be applied at 1, 2 or 3.

Pipe Size: ¼" N.P.T.

Valve Parts in Contact with Media:
Body — Brass or 303 s.s., as listed.
Seals and Discs — Ethylene propylene
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Core Spring — 302 s.s. and 17-7 PH s.s.
Shading Coil — Copper (brass body); Silver (stainless steel body).
Disc Holder — Stainless Steel.
Core Guide (A-C) — Brass.
No aluminum parts.

Solenoid Enclosures: Two types available:
(a) Watertight (NEMA 4 and 6).
(b) Explosion-Proof and Watertight (NEMA 7C, 7D and 4).

Electrical: Standard Voltages:
24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).



6, 12, 24, 125, 250 volts, D-C (battery voltages)
Other voltages available when required.
Coil: Continuous Duty Class H.
Temperature: Fluid: To 180°F
Ambient: Nominal Range, 32°F. to 140°F.
Installation: Mountable in any position without affecting operation.
Mounting: See dimension drawings.
Coarse Filter: Integral in valve inlet.

Optional Features:
- Junction Box Solenoid Enclosure (Watertight Solenoid only).
- Manual Operator
- ½" Threaded Conduit Hub
- Screw Terminal Coils. (Watertight Solenoid only).

Specifications • Brass Body

Pipe Size (ins.)	Orifice Size (ins.)	Maximum Operating Pressure Differential (P.S.I.) Air A-C	Air D-C	Safe Working Pressure (P.S.I.)	Max. Fluid Temp. °F	Cv Flow Factor	Watertight Solenoid Enclosure Catalog Number	Explosion-Proof — Watertight Solenoid Enclosure Catalog Number	Watt Rating A-C	Watt Rating D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.) WP	Approx. Shipping Weight (Lbs.) WP-EP
Universal Operation ① (Pressure at 2 or 1 only)													
¼	⅛	125	75	300	180	.09	NP8320A172E	NP8320A173E	10.5	17.4	H	1¾	2¾
	3/32	75	60	300	180	.15	NP8320A174E	NP8320A175E	10.5	17.4	H	1¾	2¾
	1/8	35	25	300	180	.31	NP8320A176E	NP8320A177E	10.5	17.4	H	1¾	2¾
	1/16	20	12	300	180	.38	NP8320A178E	NP8320A179E	10.5	17.4	H	1¾	2¾
Normally Closed Operation (Pressure at 2)													
¼	⅛	175	160	300	180	.09	NP8320A182E	NP8320A183E	10.5	17.4	H	1¾	2¾
	3/32	150	115	300	180	.15	NP8320A184E	NP8320A185E	10.5	17.4	H	1¾	2¾
	1/8	85	60	300	180	.31	NP8320A186E	NP8320A187E	10.5	17.4	H	1¾	2¾
	1/16	45	25	300	180	.38	NP8320A188E	NP8320A189E	10.5	17.4	H	1¾	2¾
Normally Open Operation (Pressure at 3)													
¼	⅛	175	135	300	180	.09	NP8320A192E	NP8320A193E	10.5	17.4	H	1¾	2¾
	3/32	140	100	300	180	.15	NP8320A194E	NP8320A195E	10.5	17.4	H	1¾	2¾
	1/8	70	55	300	180	.31	NP8320A196E	NP8320A197E	10.5	17.4	H	1¾	2¾
	1/16	40	30	300	180	.38	NP8320A198E	NP8320A199E	10.5	17.4	H	1¾	2¾

Specifications • Stainless Steel Body

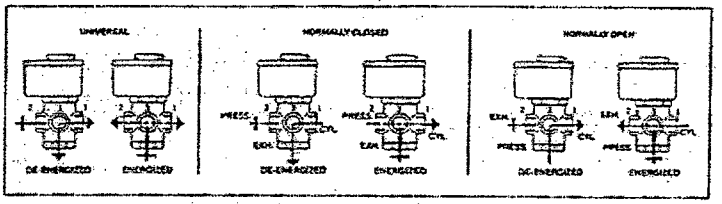
Pipe Size (in.)	Orifice Size (in.)	Maximum Operating Pressure Differential (P.S.I.) Air A-C	Air D-C	Safe Working Pressure (P.S.I.)	Max. Fluid Temp. °F.	Cv Flow Factor	Watertight Solenoid Enclosure Catalog Number	Explosion-Proof — Watertight Solenoid Enclosure Catalog Number	Watt Rating A-C	Watt Rating D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.) WP	Approx. Shipping Weight (Lbs.) EP
Universal Operation							*(Refer to Flow Diagram Below)						
¼	5/16	100	65	300	180	.09	NP832057E	NP832058E	10.5	17.4	H	1¼	2
	3/32	40	40	300	180	.15	NP832059E	NP832060E	10.5	17.4	H	1¾	2
	1/8	20	20	300	180	.31	NP832061E	NP832062E	10.5	17.4	H	1¾	2
Normally Closed Operation							*(Refer to Flow Diagram Below)						
¼	5/16	125	125	300	180	.09	NP832063E	NP832064E	10.5	17.4	H	1¼	2
	3/32	110	65	300	180	.15	NP832093E	NP832094E	10.5	17.4	H	1¾	2
	1/8	40	40	300	180	.31	NP832065E	NP832066E	10.5	17.4	H	1¾	2
Normally Open Operation							*(Refer to Flow Diagram Below)						
¼	5/16	125	125	300	180	.09	NP832067E	NP832068E	10.5	17.4	H	1¼	2
	3/32	110	65	300	180	.15	NP832095E	NP832096E	10.5	17.4	H	1¾	2
	1/8	40	40	300	180	.31	NP832069E	NP832070E	10.5	17.4	H	1¾	2

Notes: ① Coarse filter supplied at pressure connection 2 and 3 only

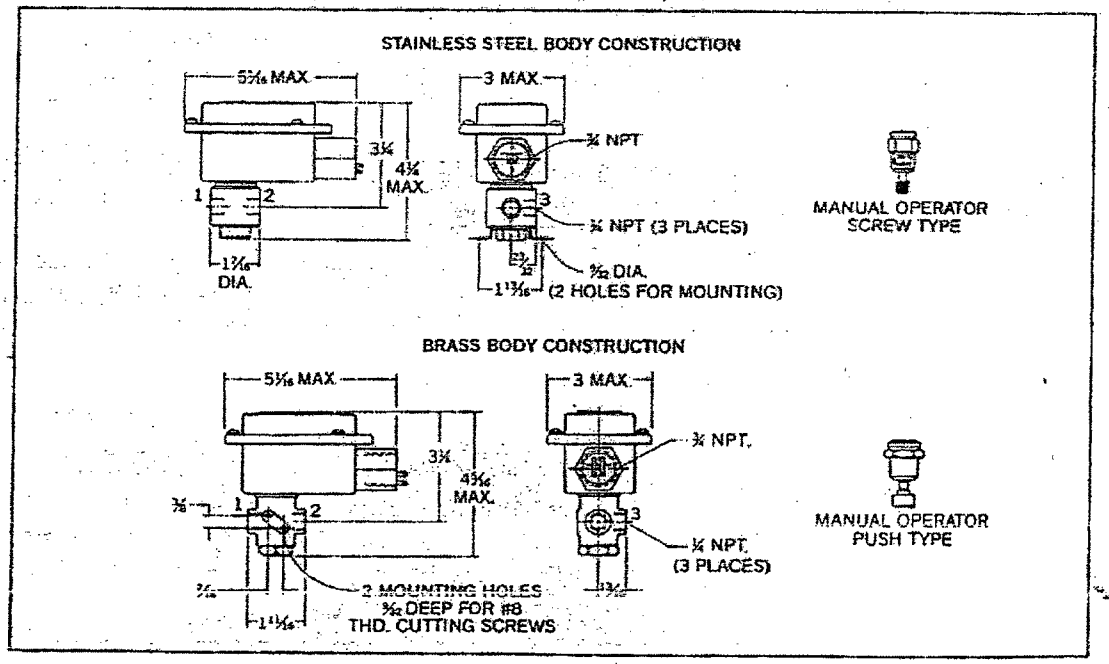
Electrical Information

Standard Coil and Class of Insulation	Watt Rating and Power Consumption D-C Watts	A-C Watts	A-C VA Holding	A-C VA Inrush	Spare Coil Part No. A-C	Spare Coil Part No. D-C
H	17.4	10.5	23	45	27-502	38-793

Flow Diagrams



Dimensions (in inches) Watertight Solenoid Shown. WP-EP Details On Request.



Quick Exhaust

3 WAY SOLENOID VALVES

For (oil free) Instrument Air • Normally Closed and Normally Open Operation ¼" and ⅜" N.P.T.

ASCO. Red-Hat®

BULLETIN NP8321

General Description

These internal pilot operated solenoid valves have an oversized exhaust orifice to provide fast venting of cylinders and diaphragms.

Important: 15 p.s.i. minimum operating pressure differential is required. Valve will vent to zero p.s.i.

Applications

Primarily used as pilot operators on larger control valves in nuclear power plants.

They are also used in applications, such as:

- cylinders
- clutches

Specifications

Operation: Two types available:

(a) Normally Closed — applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized.

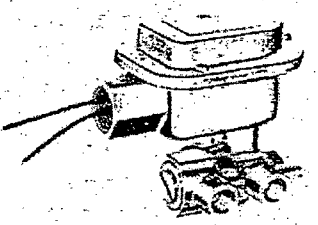
(b) Normally Open — applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized.

Pipe Sizes: ¼" and ⅜" N.P.T.

Valve Parts in Contact with Media:
Body — Brass.
Seals and Disc — Ethylene propylene.
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Springs — 302 s.s. and 17-7PH s.s.
Shading Coil — Copper.
Pilot Seat Cartridge — Brass.
Disc Holder — Stainless Steel.
Piston — 303 s.s.
No aluminum parts.

Solenoid Enclosures: Two types available:
(a) Watertight (NEMA 4 and 6).
(b) Explosion-Proof and Watertight (NEMA 7C, 7D and 4).

Electrical: Standard Voltages:
24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).
6, 12, 24, 125, 250 volts, D-C. (battery voltages).
Other voltages available when required.



Coil: Continuous Duty Class H.

Temperature: Fluid: 180°F.

Ambient: Nominal Range, 32°F. to 180°F.

Installation: Mountable in any position without affecting operation.

Coarse Filter: Integral in valve inlet.

Optional Features:

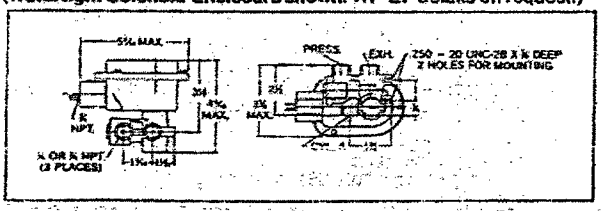
- Junction Box Solenoid Enclosure (Watertight Solenoid only)
- Manual Operator
- Screw Terminal Coils (Watertight Solenoid Only)
- Viton Elastomers
- ½" Threaded Conduit Hub

Specifications

Pipe Size (ins.)	Orifice Size (ins.) Pressure	Orifice Size (ins.) Exhaust	Operating Pressure Differential (P.S.I.) Minimum	Operating Pressure Differential (P.S.I.) Maximum Air	Operating Pressure Differential (P.S.I.) Maximum A-C and D-C	Safe Working Pressure (P.S.I.)	Max. Fluid Temp. °F.	Cv Flow Factor Pressure	Cv Flow Factor Exhaust	Watertight Solenoid Enclosure Catalog Number	Explosion-Proof and Watertight Solenoid Enclosure Catalog Number	Watt Rating A-C	Watt Rating D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.) WP	Approx. Shipping Weight (Lbs.) WP-EP
Normally Closed Operation																
¼	½	1½	15	150		200	180	.8	1.2	NP8321A1E	NP8321A5E	10.5	17.4	H	1¾	2½
⅜	½	1½	15	150		200	180	.8	1.2	NP8321A2E	NP8321A6E	10.5	17.4	H	1¾	2½
Normally Open Operation																
¼	½	1½	15	150		200	180	.8	1.2	NP8321A3E	NP8321A7E	10.5	17.4	H	1¾	2½
⅜	½	1½	15	150		200	180	.8	1.2	NP8321A4E	NP8321A8E	10.5	17.4	H	1¾	2½

Dimensions (in inches)

(Watertight Solenoid Enclosure shown. WP-EP details on request.)



Electrical Information

Standard Coil and Class of Insulation	Watt Rating and Power Consumption A-C Inrush Watts	A-C Holding Watts	D-C Watts	Spare Coil Part No. A-C	Spare Coil Part No. D-C
H	10.5	23	45	27 502	38-793

Redundant Control

3 WAY SOLENOID VALVES

For (oil free) Instrument Air
¼" N.P.T.

ASCO
Red-Hat
BULLETIN
NP8323

General Description

These direct acting solenoid valves have forged brass bodies and two solenoids suitable for any combination of A-C and D-C voltages.

Redundant Solenoid

Valve has two independent solenoids, each or both capable of operating valve when electric power is connected (energized). Valve will not shift to original position unless both solenoids are electrically disconnected (de-energized). This prevents valve from shifting in the event of a possible coil failure or failure of the normal electric power source.

Three way valve is supplied as standard but can also be used for 2 way operation (normally open or normally closed) merely by plugging one pipe connection.

Applications

To maintain uninterrupted control as long as either of two power sources is applied to valve. Primarily used as a pilot operator on larger control valves in nuclear power plants.

Specifications

Operation: (Refer to Flow Diagram).

Pipe Size: ¼" N.P.T.

Valve Parts in Contact with Media:

Body — Brass
Seals and Disc — Ethylene Propylene
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Core Spring — 302 s.s. and 17-7 PH s.s.
Shading Coil — Copper
Disc Holder — s.s.
No Aluminum Parts

Solenoid Enclosures: Two types available:

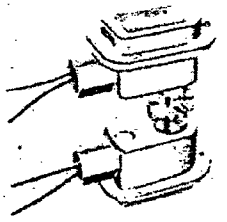
(a) Watertight (NEMA 4 and 6).

(b) Explosion-Proof and Watertight (NEMA 7C, 7D and 4).

Electrical: Standard Voltages:

24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).

6, 12, 24, 125, 250 volts, D-C. (battery voltages).



Coil: Continuous Duty Class H.
Temperature: Fluid: To 180°F.
Ambient: Nominal Range, 32°F. to 180°F.
Installation: Mountable in any position without affecting operation.
Coarse Filter: Integral in valve inlet.

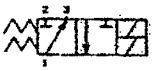
Optional Features:

- Junction Box Solenoid Enclosure (Watertight Solenoid Only)
- Screw Terminal Coils (Watertight Solenoid Only).
- Viton Elastomers.
- ½" Threaded Conduit Hub.

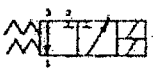
Specifications:

Pipe Size (In.)	Orifice Size (In.)	Air M.O.P.D. (P.S.I.) A-C	Air M.O.P.D. (P.S.I.) D-C	Safe Work. Press. (P.S.I.)	Max. Fluid Temp. °F.	Cv Flow Factor	Watertight Solenoid Enclosure: A-C - A-C Solenoids Catalog Number	Watertight Solenoid Enclosure: A-C - D-C Solenoids Catalog Number	Explosion Proof — Watertight Solenoid Enclosure: A-C - A-C Solenoids Catalog Number	Explosion Proof — Watertight Solenoid Enclosure: A-C - D-C Solenoids Catalog Number	Watt Rating: Solenoid A A-C	Watt Rating: Solenoid B A-C	Watt Rating: Solenoid B D-C	Approx. Shipping Weight (Lbs.): W.P. Encl.	Approx. Shipping Weight (Lbs.): EP-WP Encl.
Normally Closed Operation															
¼	5/16	125	125	500	180	.09	NP8323A19E	NP8323A35E	NP8323A20E	NP8323A36E	10.5	10.5	17.4	2¾	3½
	7/32	110	100	500	180	.15	NP8323A21E	NP8323A37E	NP8323A22E	NP8323A38E	10.5	10.5	17.4	2¾	3½
	⅛	40	40	500	180	.31	NP8323A23E	NP8323A39E	NP8323A24E	NP8323A40E	10.5	10.5	17.4	2¾	3½
Normally Open Operation															
¼	5/16	125	125	500	180	.09	NP8323A27E	NP8323A43E	NP8323A28E	NP8323A44E	10.5	10.5	17.4	2¾	3½
	7/32	110	100	500	180	.15	NP8323A29E	NP8323A45E	NP8323A30E	NP8323A46E	10.5	10.5	17.4	2¾	3½
	⅛	40	40	500	180	.31	NP8323A31E	NP8323A47E	NP8323A32E	NP8323A48E	10.5	10.5	17.4	2¾	3½

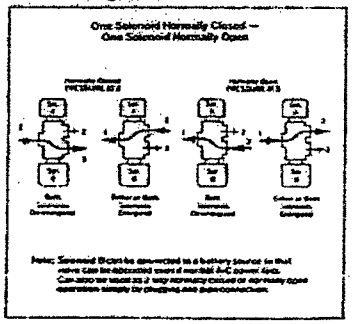
Normally Closed



Normally Open

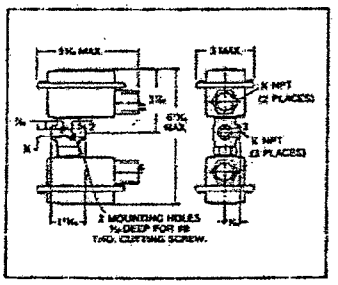


Flow Diagram



Dimensions (in inches)

(Watertight Solenoid Enclosure shown. WP-EP details on request.)



Electrical Information

Standard Coil and Class of Insulation	Watt Rating and Power Consumption: D-C Watts	A-C Watts	A-C VA Holding	A-C VA Inrush	Screw Coil Part No.: A-C	D-C
H	17.4	10.5	23	45	27-512	28-793

High Flow

4 WAY SOLENOID VALVES

2 Position Single and Dual Solenoids
For (oil free) Instrument Air ¼" to 1" N.P.T.

ASCO
Red-Hat
BULLETIN
NP8344

General Description

These are heavy duty two position 4 way valves with rugged forged brass bodies and poppet type seats and discs, providing tight seating.

The main valve discs are power driven in both directions by line pressure — no return springs.

Applications

Primarily used as pilot operators on larger control valves in nuclear power plants.

They are also used in applications such as:

- cylinders
- clutches

Specifications

Operation: Two types available:

(a) Single Solenoid — The valve changes position when the solenoid is energized; the valve returns to its original position when de-energized.

(b) Dual Solenoids — The valve changes position when one solenoid is energized. Valve will not return to its original position until opposite solenoid is energized. Solenoids may be energized momentarily or continuously.

Minimum on time of coil for dual solenoid valves is 0.3 second on air service.

Caution: Do not energize both solenoids simultaneously.

Pipe Sizes: ¼", ⅜", ½", ¾" and 1" N.P.T.

Valve Parts in Contact with Media:

Body — Brass.
Seals — Ethylene Propylene.
Discs — Viton
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Springs — 302 s.s. and 17-7PH s.s.
Shading Coil — Copper.
Pilot Seat Cartridge — Brass
Shaft Gasket — Lead/Clad. Copper.
No Aluminum Parts.

Solenoid Enclosures: Two types are available:

(a) Watertight (NEMA 4 and 6).

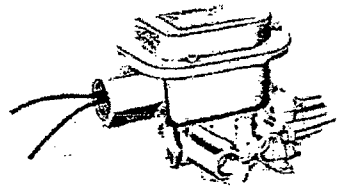
(b) Explosion-Proof — Watertight (NEMA 7C, 7D and 4)

Electrical: Standard Voltages:

24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).

6, 12, 24, 125, 250 volts, D-C, (battery voltages).

Other voltages available when required.



Coil: Continuous Duty Class H.

Temperature: Fluid: To 180°F.

Ambient: Nominal Range, 32°F. to 180°F.

Installation: Mountable in any position without affecting operation.

Coarse Filter: Integral in valve inlet.

Optional Features:

- Junction Box Solenoid Enclosure (Watertight Solenoid Only).
- Manual Operator
- ½" Threaded Conduit Hub
- Screw Terminal Coils (Watertight Solenoid Only).
- Viton Elastomers.

Specifications

Pipe Size (In.)	Orifice Size (In.)	Operating Pressure Differential (P.S.I.) Minimum	Maximum Air A-C	Maximum Air D-C	Safe Working Pressure (P.S.I.)	Max. Fluid Temp. °F.	Cv Flow Factor Press. to Cyl.	Cv Flow Factor Cyl. to Exh.	Watertight Solenoid Enclosure Catalog Number	Explosion-Proof — Watertight Solenoid Enclosure Catalog Number	Watt Rating A-C	Watt Rating D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.) NP	Approx. Shipping Weight (Lbs.) WP-EP
Single Solenoid															
¼	¼	10	125	125	450	180	.8	1	NP8344A70E	NP8344A71E	10.5	17.4	H	4¾	5¾
⅜	⅜	10	125	125	450	180	1.4	2.2	NP8344A72E	NP8344A73E	10.5	17.4	H	9¼	10
½	⅜	10	125	125	450	180	1.4	2.2	NP8344A74E	NP8344A75E	10.5	17.4	H	9¼	10
¾	½	10	125	125	300	180	5.2	5.6	NP8344A76E	NP8344A77E	10.5	17.4	H	18¾	18¾
1	½	10	125	125	300	180	5.2	5.6	NP8344A78E	NP8344A79E	10.5	17.4	H	18¾	18¾
Dual Solenoid															
¼	¼	10	350	125	450	180	.8	1	NP8344B45E	NP8344B58E	10.5	17.4	H	6¾	7
⅜	⅜	10	300	125	450	180	1.4	2.2	NP8344B50E	NP8344B62E	10.5	17.4	H	10	10¾
½	⅜	10	300	125	450	180	1.4	2.2	NP8344B52E	NP8344B64E	10.5	17.4	H	10	10¾
¾	½	10	300	125	300	180	5.2	5.6	NP8344B54E	NP8344B66E	10.5	17.4	H	19¾	20¾
1	½	10	300	125	300	180	5.2	5.6	NP8344B56E	NP8344B68E	10.5	17.4	H	19¾	20¾

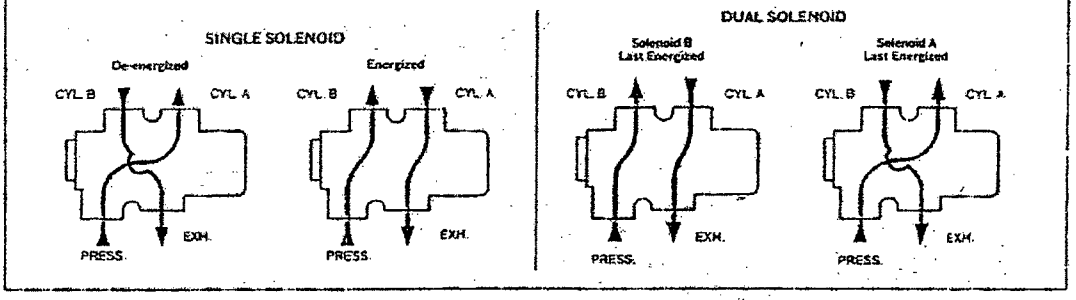
Electrical Information

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.	
	D-C Watts	A-C				
		Watts	VA Holding	VA Inrush	A-C	D-C
H	17.4	10.5	23	45	27-302	38-793

IMPORTANT:

The pressure and exhaust lines must be kept fully open and the minimum pressure differential must be maintained to insure proper operation of the valve. ASCO speed controls and other such components must be installed in the cylinder lines only.

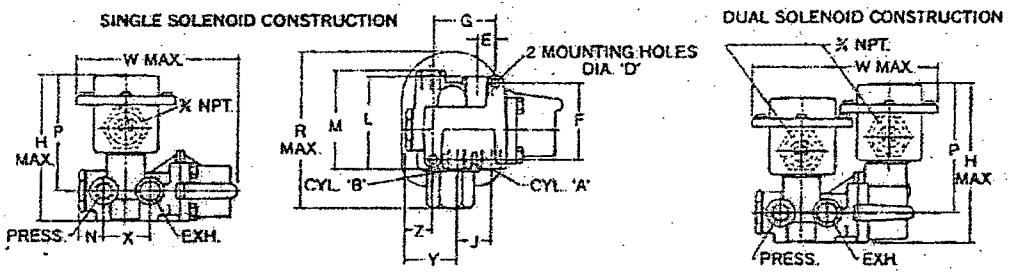
Flow Diagrams



Dimensions (A-C Only†) (in inches)

Watertight Solenoids shown. WP-EP details on request.

† D-C dimensions available on request.



CATALOG NUMBER	PIPE SIZE	DIA. D	E	F	G	H	J	L	M	N	P	R	W	X	Y	Z	EXH. PIPE SIZE (INS.)
NP8344A70E	¼	9/32	3/16	2 13/32	1 3/8	4 3/8	1 11/32	3 1/4	2 13/16	3/8	3 3/8	5 1/16	4 13/16	1 11/32	1 23/32	1 11/32	3/8
NP8344A72E NP8344A74E	⅜ or ½	11/32	¾	3 1/8	2 5/8	4 1/2	1 1/8	3 3/8	3 3/16	¾	3 1/2	5 1/16	6 1/4	1 1/8	1 15/16	1 3/16	½
NP8344A76E NP8344A78E	¾ or 1	11/32	1 11/32	3 13/16	3 3/8	5 1/16	2 11/32	4 3/8	4 1/16	1 3/16	3 13/16	5 1/16	8 3/16	2 3/8	2 3/8	1 11/32	1
NP8344B46E	¼	5/32	9/16	2 13/32	1 3/8	5 1/16	1 11/32	3 1/4	2 13/16	¾	4 1/16	6	5 1/16	1 13/32	1 23/32	3/16	⅜
NP8344B50E NP8344B52E	⅜ or ½	11/32	¾	3 1/8	2 5/8	5 3/16	1 1/2	3 3/4	3 3/16	¾	4 1/16	6 1/16	6 13/32	1 3/8	1 15/16	1 3/16	½
NP8344B54E NP8344B56E	¾ or 1	11/32	1 11/32	3 13/16	3 3/8	5 1/16	2 11/32	4 3/8	4 1/16	1 3/16	4 1/2	6 1/16	8 13/16	2 3/8	2 3/8	1 11/32	1

Midget

3 WAY SOLENOID VALVES

For (oil free) Instrument Air • ¼" N.P.T.

ASCO
Red-Hat
BULLETIN
NP8314

General Description

These midget brass body 3 way solenoid valves are ideally suited for piloting large valves.

Important: No minimum operating pressure required!

Specifications

Operation: Three types available:

(a) Normally Closed — applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized.
(b) Normally Open — applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized.
(c) Universal — for normally closed or normally open operation only.

Valve Parts in Contact with Fluid:

Body — Brass

Seats — All metal or combination metal and ethylene propylene.

Core Tube — 305 s.s.

Core and Plugnut — 430F s.s

Core Springs — 302 s.s. and 17-7PH s.s.

Shading Coil — Copper.

Elastomers: Ethylene Propylene (or Viton* when specified).

Process Fluid: Instrument quality air (must be free of petroleum based oils and compounds when ethylene propylene elastomers are used).

Coarse Filters: integral in valve inlet.

NO ALUMINUM PARTS.

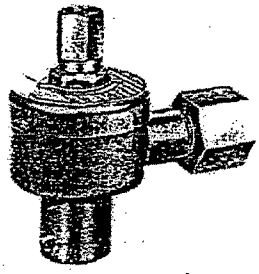
Solenoid Enclosures: Type 4 and 7 (C and D) - Combination Water-tight and Explosion-Proof. Also meets Types 3 and 9 (E, F and G).

Electrical: Standard Voltages:
24, 120, 240, 480 volts, AC, 60 Hz (or 110, 220 volts, AC, 50 Hz)
6, 12, 24, 125, 250 volts, DC, battery voltages.

Other voltages available when required.

Coil: Continuous Duty Class H.

*Ducon Co. trademark



Temperature: Fluid: To 180°F Maximum.
Ambient: Normal Range, 32°F. to 140°F.

Installation:
Dimensions — Refer to dimensions for envelope size and mounting.
Attitude — Valves may be mounted in any position.

Optional Features:

- ¼" threaded conduit hub
- Viton elastomers

Specifications

Pipe Size (ins.)	Orifice Size (ins.)	C_v Flow Factor	Maximum Operating Pressure Differential (psi) AC	Maximum Operating Pressure Differential (psi) DC	Types 4 & 7 (C & D) Watertight and Explosion-proof Solenoid Enclosure Catalog Number	Watt Rating/ Class of Coil Insulation AC	Watt Rating/ Class of Coil Insulation DC	Operation	List Price †
Combination Metal and Ethylene Propylene Seat ②									
¼"	3/64	0.04	150	70	NP8314C13E	11/H	17.4/H	⊙ Universal	$211.00
	5/32	0.15	80	35	NP8314C14E	11/H	17.4/H	⊙ Universal	$211.00
	3/64	0.04	175	120	NP8314C23E	11/H	17.4/H	Normally Closed	$211.00
	5/32	0.15	125	60	NP8314C25E	11/H	17.4/H	Normally Closed	$211.00
	3/64	0.04	175	175	NP8314C61E	11/H	17.4/H	Normally Open	$211.00
	5/32	0.15	175	70	NP8314C62E	11/H	17.4/H	Normally Open	$211.00
All Metal Seat Construction ②									
¼"	3/64	0.04	150	70	NP8314C13EL	11/H	17.4/H	⊙ Universal	$282.00
	5/32	0.11	80	35	NP8314C14EL	11/H	17.4/H	⊙ Universal	$282.00
	3/64	0.04	175	120	NP8314C23EL	11/H	17.4/H	Normally Closed	$282.00
	5/32	0.11	125	60	NP8314C25EL	11/H	17.4/H	Normally Closed	$282.00
	3/64	0.04	175	175	NP8314C61EL	11/H	17.4/H	Normally Open	$282.00
	5/32	0.11	175	70	NP8314C62EL	11/H	17.4/H	Normally Open	$282.00

NOTES: ② Pressures at 2 or 3 only.

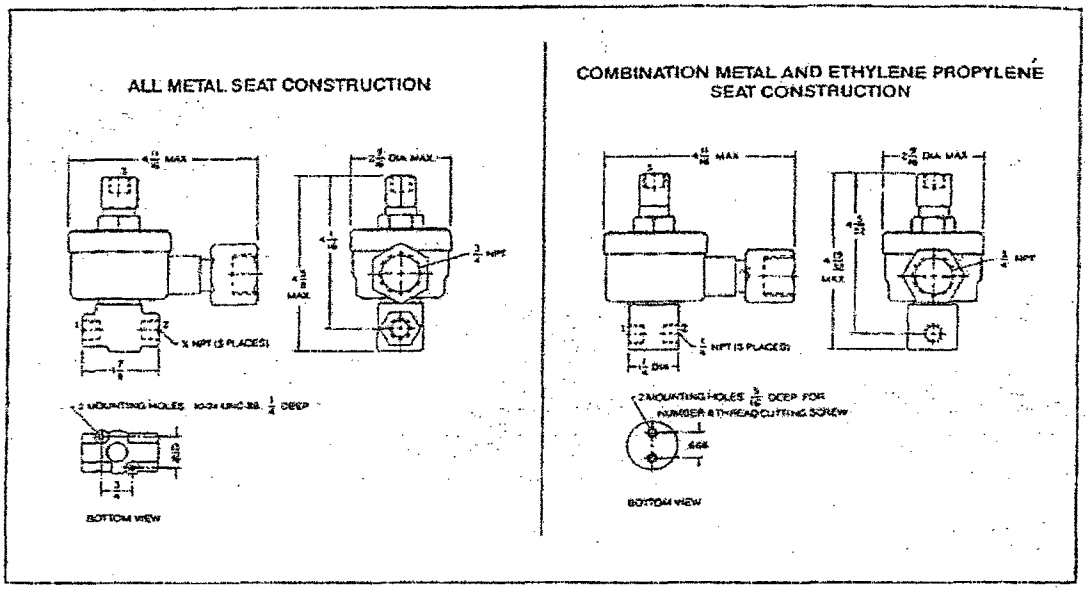
† Subject to change without notice.
Prices subject to Trade and Quantity Discounts.

③ For Viton construction replace catalog number suffix "E" with "V" (for example - NP8314C13V); for Viton elastomer in all metal construction replace catalog number suffix "EL" with "VL" (for example - NP8314C13VL). Add $7.75 List extra for Viton.

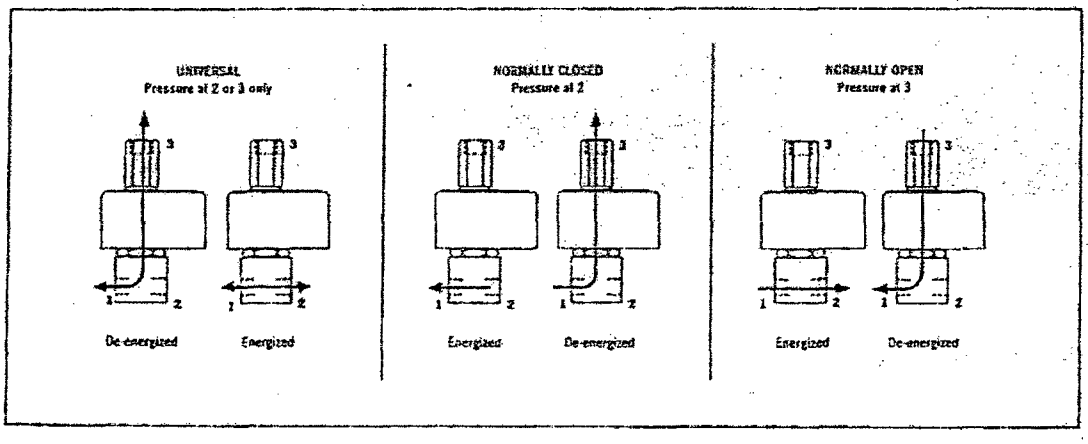
ELECTRICAL INFORMATION

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Space Coil Part No.	
		AC				
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC
H	12.4	11	21	42	27 502	220 339

DIMENSIONS (in inches)



FLOW DIAGRAMS



ASCO Valves

Automatic Switch Co. 50-56 Hanover Road, Florham Park, New Jersey 07932 Tel (201) 966-2000

PRINTED IN U.S.A. Rev 1/89

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Midget
3 WAY SOLENOID VALVES
for Air, Gas, Water and Light Hydraulic Oil
⅛" and ¼" N.P.T.

ITEM 178

ASCO Red-Hat
BULLETIN 8314

General Description
Midget brass body 3 way solenoid valves ideally suited for controlling single acting cylinders.

Important: No minimum operating pressure required!

Specifications
Operation: Three types available:

(a) Normally Closed — applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized.

(b) Normally Open — applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized.

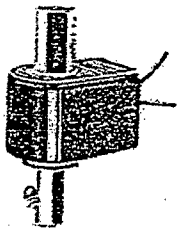
(c) Universal — for normally closed or normally open operation. Selection or diversion of pressure can be applied at 1, 2 or 3.

Pipe Sizes: ⅛" and ¼" N.P.T.

Valve Parts in Contact with Media:
Body — Brass.
Seals and Discs — Buna "N" and Nylon.
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Core Springs — 302 s.s. and 17-7PH s.s.
Shading Coil — Copper.
Core Guide — Acetal — all A-C valves and ⅛" orifice normally open D-C valves.

Solenoid Enclosures: Two types available:
(a) General Purpose (NEMA 1).
(b) Explosion-Proof and Watertight (NEMA 7C, 7D and 4).

Electrical: Standard Voltages:
24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).
6, 12, 24, 120, 240 volts, D-C
Other voltages available when required.



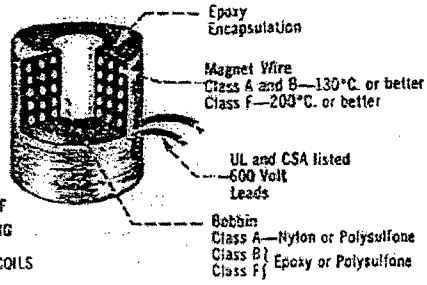
Coil: Continuous Duty Molded Class A.
Temperature: Fluid: To 200°F. Maximum.
Ambient: Nominal Range, 32°F. to 77°F.
Installation: Mountable in any position without affecting operation.
Mounting: See dimension drawings
Approvals: UL listed and CSA certified. Refer to page 6 for details.

SPECIFICATIONS

Pipe Size (Ins.)	Orifice Size (Ins.)	Minimum Operating Pressure Differential (P.S.I.) Air-Inert Gas A-C	Air-Inert Gas D-C	Water A-C	Water D-C	Light Hydraulic Oil @ 45 SSU A-C	Light Hydraulic Oil @ 45 SSU D-C	Safe Working Pressure (P.S.I.)	Max. A-C Fluid Temp. °F	Cv Flow Factor	General Purpose Solenoid Enclosure Catalog Number	General Purpose Solenoid Enclosure Optional Feature Ref.	Explosion-Proof and Watertight Solenoid Enclosure Catalog Number	Explosion-Proof and Watertight Solenoid Enclosure Optional Feature Ref.	Watt Rating A-C	Watt Rating D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.) GP	Approx. Shipping Weight (Lbs.) EP
Universal Operation																			
⅛	1/16	160	70	160	65	160	65	750	200	.04	8314C41	1	8314C10	11	11	11.2	A	1.2	2
	3/32	80	35	40	35	40	15	750	200	.15	8314C43	1	8314C11	11	11	11.2	A	1.2	2
	⅛	45	20	25	15	25	15	750	200	.25	8314C45	1	8314C12	11	11	11.2	A	1.2	2
¼	1/16	160	70	160	65	160	65	750	200	.04	8314C6	1	8314C13	11	11	11.2	A	1.2	2
	3/32	80	35	40	25	40	15	750	200	.15	8314C7	1	8314C14	11	11	11.2	A	1.2	2
	⅛	45	20	25	15	25	15	750	200	.25	8314C8	1	8314C15	11	11	11.2	A	1.2	2
Normally Closed Operation																			
⅛	1/16	230	120	230	140	230	135	750	200	.04	8314C31	1	8314C25	11	11	11.2	A	1.2	2
	3/32	125	60	100	70	100	30	750	200	.15	8314C32	1	8314C26	11	11	11.2	A	1.2	2
	⅛	75	30	60	40	60	25	750	200	.25	8314C33	1	8314C27	11	11	11.2	A	1.2	2
¼	1/16	230	120	230	140	230	135	750	200	.04	8314C34	1	8314C28	11	11	11.2	A	1.2	2
	3/32	125	60	100	70	100	30	750	200	.15	8314C35	1	8314C29	11	11	11.2	A	1.2	2
	⅛	75	30	60	40	60	25	750	200	.25	8314C36	1	8314C30	11	11	11.2	A	1.2	2
Normally Closed Operation — Air Only																			
⅛	1/16	230	—	—	—	—	—	750	200	.04	8314C39	1	—	—	11	—	A	1.2	2
	3/32	125	—	—	—	—	—	750	200	.15	8314C40	1	—	—	11	—	A	1.2	2
	⅛	75	—	—	—	—	—	750	200	.25	8314C21	1	—	—	11	—	A	1.2	2
¼	1/16	230	—	—	—	—	—	750	200	.04	8314C22	1	—	—	11	—	A	1.2	2
	3/32	125	—	—	—	—	—	750	200	.15	8314C23	1	—	—	11	—	A	1.2	2
	⅛	75	—	—	—	—	—	750	200	.25	8314C24	1	—	—	11	—	A	1.2	2
Normally Open Operation																			
⅛	1/16	300	200	300	300	300	120	750	200	.04	8314C49	1	8314C58	11	11	11.2	A	1.2	2
	3/32	175	70	175	90	175	45	750	200	.15	8314C59	1	8314C59	11	11	11.2	A	1.2	2
	⅛	90	40	90	45	90	25	750	200	.25	8314C51	1	8314C60	11	11	11.2	A	1.2	2
¼	1/16	300	200	300	300	300	120	750	200	.04	8314C52	1	8314C61	11	11	11.2	A	1.2	2
	3/32	175	70	175	90	175	45	750	200	.15	8314C53	1	8314C62	11	11	11.2	A	1.2	2
	⅛	90	40	90	45	90	25	750	200	.25	8314C54	1	8314C63	11	11	11.2	A	1.2	2

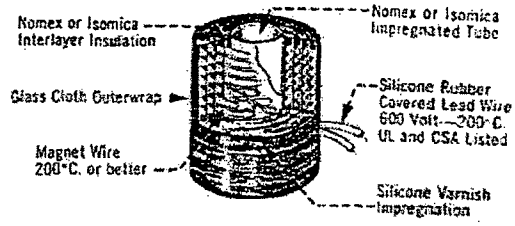
*Maximum D-C Fluid Temperature is 194°F

CLASS A
(105°C.), CLASS B (130°C.) AND
CLASS F (155°C.)
MOLDED COILS



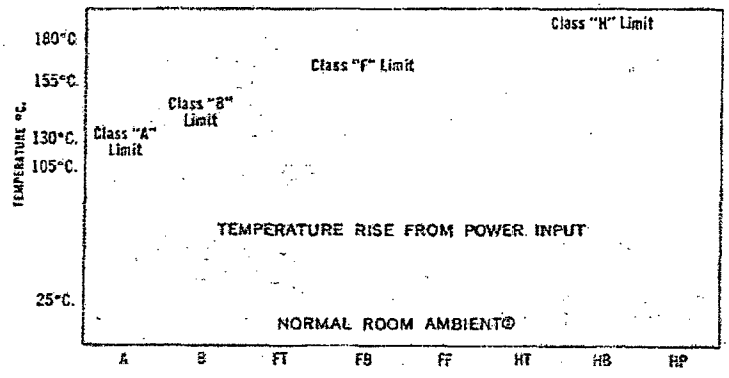
- FUNGUS PROOF
- MOISTURE PROOF
- WIDER OPERATING RANGE FOR CLASS B AND F COILS

CLASS H (180°C.)
NON-MOLDED COILS



- INTERLAYER CONSTRUCTION
- FUNGUS PROOF
- RADIATION RESISTANT
- WIDE OPERATING RANGE

The following table illustrates the temperature parameters of ASCO Coils:
INDUSTRIAL TEMPERATURE LIMITATIONS② AND THERMAL CHARACTERISTICS OF ASCO SOLENOIDS AND COILS



Notes:
① As measured by the "Resistance Method."
② Equipment rated at an ambient temperature of 25°C. can be employed in areas where the ambient temperature reaches 40°C. occasionally.
③ Ambient temperatures are directly additive to coil rise—fluid temperatures are not.

Coil Operating Voltage Ranges

All coils are designed for industrial operating voltages and can be used on the following voltage ranges:

A-C		D-C	
Nominal Voltage Rating	Normal Operating Range	Nominal Voltage Rating	Normal Operating Range
24	20- 24	6	5.1- 6.3
120	102-120	12	10.2-12.5
240	204-240	24	20-25
480	408-480	120	102-125
		240	204-252

Note: 125 volts, D-C and 250 volts, D-C are battery voltages and require special construction. Consult ASCO for details.

All ASCO valves are tested to operate at 15% under the nominal voltage and at maximum operating pressure differential, and are capable of operating for short periods at 10% over the nominal voltage. For wider voltage ranges than shown at left, a different coil or insulation system must be used.

Power Consumption

Power consumption of solenoid valves may be determined from the rating in ASCO bulletins. For valves on A-C service, the watt rating, the volt-ampere "inrush" and the volt-ampere "holding" are given.

The volt-amp (VA) "inrush" is the high momentary surge of current which occurs at the moment an A-C solenoid is energized.

The volt-amp (VA) "holding" is the continuous rating after the initial "inrush."

The current rating for the "inrush" and "holding" may be determined by dividing the voltage into the volt-amp rating.

$$\text{AMPS (INRUSH)} = \frac{\text{volt-amp "inrush"}}{\text{voltage}}$$

$$\text{AMPS (HOLDING)} = \frac{\text{volt-amp "holding"}}{\text{voltage}}$$

Valves supplied for D-C service have no "inrush" current, as in the case of A-C service. The amp rating can be determined by dividing the voltage into the D-C watt rating.

$$\text{AMPS} = \frac{\text{watts (D-C)}}{\text{voltage}}$$

Note: (1) When a valve has been energized for a long period the solenoid enclosure becomes hot and cannot be touched by hand except for an instant. This is a perfectly safe operating temperature. Any excessive heating will be indicated by the smoking and burning odor of the coil insulation.

(2) Valves for A-C service can be converted for use on other A-C voltages simply by changing the coil; similarly, D-C valves can be converted for other D-C voltages. When converting from A-C to D-C or vice versa, consult ASCO for instructions.

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Power Plant Service

3 WAY SOLENOID PILOT CONTROL VALVES

ITEM 159

Air Service — ¼", ⅜", ½" NPT

Red-Hat

BULLETINS

200-921	212-630
200-924	212-631
200-925	212-632
200-926	212-633

These rugged forged brass body valves are especially suited for heavy duty power plant applications.

Continuous duty Class H insulation high temperature coils are standard for both AC and DC constructions. When battery voltages are used, the 125 volt DC coil is designed to operate over a voltage range of 90-140 volts and the 250 volt DC coil will operate over a voltage range of 180-280 volts.

Important: No minimum operating pressure is required.

These valves are primarily used as pilot operators on large control valves in power plants. For nuclear power plant applications, refer to ASCO Catalog No. NP-1 for valves qualified to IEEE 323, IEEE 382 and IEEE 344 standards.

Operation: Three types available:

(a) Normally Closed — applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized.

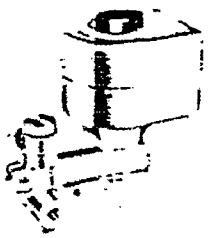
(b) Normally Open — applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized.

(c) Universal — for normally closed or normally open operation.

Pipe Sizes: ¼", ⅜" and ½" NPT

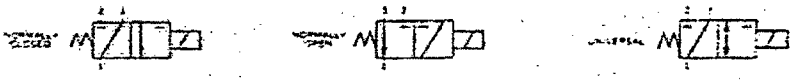
Valve Parts in Contact with Media:
Body — Forged Brass.
Disc — Metal (304 s.s.) or Resilient (Nylon).
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Springs — 302 s.s.
Shading Coil — Copper.
Seats — Metal (303 s.s.) or Resilient (Buna "N").
Gaskets — Buna "N".

Solenoid Enclosures: Two types are available:
(a) General Purpose Type 1



(b) Explosion-proof and Waterproof Types 4 & 7 (C&D)

Electrical: Standard Voltages: 24, 120, 240, 480 volts, AC, 60 Hz (or 50 Hz in 110 volt multiples).
6, 12, 24, 125, 250 volts, DC.
Coils: Continuous Duty Class H.
Temperature: Fluid to 160°F.
Ambient to 125°F.
Installation: Valves must be mounted with solenoid vertical and upright



— (Air Only) — Metal Seats and Discs; Resilient Seats Indicated by Catalog Number Suffix "R"

Pipe Size (Ins.)	Orifice Size (Ins.)	Maximum Operating Pressure Differential (P.S.I.) Normally Closed ① or Normally Open ②	Universal ③	Safe Working Pressure (P.S.I.)	Max. Fluid Temp. °F.	Cv Flow Factor	Type 1 General Purpose Solenoid Enclosure Catalog Number	List ④ Price	Types 4 & 7 (C & D) Explosion-Proof/ Watertight Solenoid Enclosure Catalog Number	List ④ Price	Spare Parts Kits Part Number	List ④ Price	Watt Rating	Approx. Shipping Wgt. GP	EP-WP
AC Construction															
¼	⅛	250	150	600	180	35	200-921-1	$189.00	200-924-1	$218.00	103-802	$40.50	20	3½	4
¼	⅛	250	150	600	180	25	200-921-1R	192.00	200-924-1R	222.00	208-169	47.50	20	3½	4
¼	¼	150	90	600	180	45	200-921-2	189.00	200-924-2	218.00	103-804	36.50	20	3½	4
¼	¼	150	75	600	180	39	200-921-2R	192.00	200-924-2R	222.00	208-749	47.50	20	3½	4
¼	¼	150	75	600	180	45	200-921-4	189.00	200-924-4	218.00	103-804	36.50	20	3½	4
¼	¼	150	75	600	180	39	200-921-4R	192.00	200-924-4R	222.00	208-749	47.50	20	3½	4
¼	⅜	120	60	600	180	75	200-925-1	244.00	200-926-1	274.00	103-807	53.50	20	4½	5
¼	⅜	120	60	600	180	53	200-925-1R	249.00	200-926-1R	279.00	162-753	59.00	20	4½	5
¼	⅜	120	60	600	180	75	200-925-2	244.00	200-926-2	274.00	103-807	53.50	20	4½	5
¼	⅜	120	60	600	180	53	200-925-2R	249.00	200-926-2R	279.00	162-753	59.00	20	4½	5
DC Construction															
¼	⅛	300	150	600	180	35	212-630-1	$307.00	212-631-1	$372.00	212-784	$53.50	35	5½	7
¼	⅛	300	150	600	180	25	212-630-1R	314.00	212-631-1R	375.00	212-786	75.50	35	6½	7
¼	¼	200	100	600	180	45	212-630-2	307.00	212-631-2	372.00	212-785	53.50	35	6½	7
¼	¼	200	100	600	180	39	212-630-2R	314.00	212-631-2R	375.00	212-787	75.50	35	6½	7
¼	⅜	300	150	600	180	35	212-630-3	307.00	212-631-3	372.00	212-784	53.50	35	6½	7
¼	⅜	300	150	600	180	25	212-630-3R	314.00	212-631-3R	375.00	212-786	75.50	35	6½	7
¼	⅜	200	100	600	180	45	212-630-4	307.00	212-631-4	372.00	212-785	53.50	35	6½	7
¼	⅜	200	100	600	180	39	212-630-4R	314.00	212-631-4R	375.00	212-787	75.50	35	6½	7
¼	½	125	60	600	180	75	212-632-1	372.00	212-633-1	439.00	212-780	68.50	35	8½	10
¼	½	125	60	600	180	53	212-632-1R	375.00	212-633-1R	442.00	212-781	87.00	35	8½	10
¼	½	125	60	600	180	75	212-632-2	372.00	212-633-2	439.00	212-780	68.50	35	8½	10
¼	½	125	50	600	180	53	212-632-2R	375.00	212-6[illegible]	[illegible]	[illegible]-781	87.00	35	8½	10

Notes: ①For Normally Closed Operation Use Catalog Number Suffix "1"
②For Normally Open Operation Use Catalog Number Suffix "2"
③For Universal Operation Use Catalog Number Suffix "3"
④List Prices subject to change without notice and subject to Trade and Quantity discounts

ITEM-160 172

ASCO Red-Hat

BULLETINS
8300, 8302,
8315

General Service
3 WAY SOLENOID VALVES
for Air, Gas, Water, Light Hydraulic Oil and Steam
⅛", ¼", ⅜" and ½" N.P.T.

General Description
These rugged forged brass, steel and stainless steel body valves are especially suited for heavy-duty industrial applications.

Important: No minimum operating pressure is required.

Applications
These valves may be used on:
- air vises
- machine tools
- compressors
- turbines

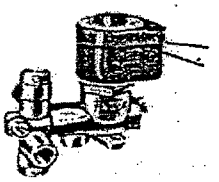
Specifications
Operation: Three types are available:
(a) Normally Closed
(b) Normally Open
(c) Universal

Pipe Sizes: ⅛", ¼", ⅜" and ½" N.P.T.

Valve Parts in Contact with Media:
Body — Brass, Steel or 304 s.s., as listed.
Disc — 303 s.s. (metal seated); Nylon (resilient seated).
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Springs — 302 s.s.
Shading Coil — Copper for brass and steel valves; Silver for stainless steel valves.
Seats — Buna "N," or 303 s.s., as listed.
Gaskets — Buna "N" for brass and steel valves; Teflon for stainless steel valves; Ethylene Propylene for steam valves.

Solenoid Enclosures: Two types are available:
(a) General Purpose (NEMA 1).
(b) Explosion-Proof and Watertight (NEMA 7C [except Steam Service], 7D and 4).

Electrical: Standard Voltages:
24, 120, 240, 480 volts, A-C, 60 Hz (or 50 Hz in 110 volt multiples).
6, 12, 24, 120, 240 volts, D-C.
Other voltages available when required.



Note: 125 volts, D-C, and 250 volts, D-C, are battery voltages applied in power plants. Special valves in both A-C and D-C construction are available for power plant applications, to act as pilots for control valves. Consult ASCO for listing.

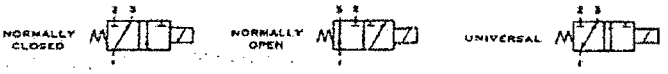
Coils: Continuous Duty Class H or Molded Class F, as listed.

Temperature: Fluid: To 400°F., as listed.

Ambient: Nominal Range, 32°F. to 77°F.

Installation: Valves must be mounted with solenoid vertical and upright

Approvals: CSA certified. Refer to page 6 for details.



SPECIFICATIONS

Pipe Size (Ins.)	Orifice Size (Ins.)	Maximum Operating Pressure Differential (P.S.I.) — Normally Closed or Normally Open: Air-Gas, Water, Light Hydraulic Oil A-C	Normally Closed or Normally Open: Air-Gas, Water, Light Hydraulic Oil D-C	Normally Closed or Normally Open: Steam A-C	Universal: Air-Gas, Water, Light Hydraulic Oil A-C	Universal: Air-Gas, Water, Light Hydraulic Oil D-C	Safe Working Pressure (P.S.I.)	Max. A-C Fluid Temp. °F.	Cv Flow Factor	General Purpose Solenoid Enclosure: Catalog Number	Optional Feature Ref.	Constr. Ref.	Explosion-Proof — Watertight Solenoid Enclosure: Catalog Number	Optional Feature Ref.	Watt Rating: A-C	Watt Rating: D-C	Class of Coil Insulation	Approx. Shipping Weight (Lbs.): GP	Approx. Shipping Weight (Lbs.): EP
Forged Brass Body, Metal Seats and Discs for General Service																				
⅛	⅛	550	250	—	300	125	600	200	.13	8300S55	I	1	8302G24	III	20	33	F	3½	4
	¼	250	125	—	150	60	600	200	.25	8300G3	I	1	8302G3	III	20	33	F	3½	4
¼	⅜	250	125	—	150	60	600	200	.35	8300G58	I	1	8302G25	III	20	33	F	3½	4
	¼	190	75	—	90	25	600	200	.45	8300A81	I	1	8302A81	III	20	33	F	3½	4
	½	250	—	—	120	—	600	200	.45	8300G51	II	1	8302G26	IV	28	—	H	3½	4
⅜	⅛	190	75	—	90	25	600	200	.45	8300A82	I	1	8302A82	III	20	33	F	3½	4
	½	250	—	—	120	—	600	200	.45	8300G9	II	1	8302G4	IV	28	—	H	3½	4
	⅜	120	40	—	60	20	600	200	.75	8300G64	I	2	8302G27	III	20	33	F	4½	5
	½	75	30	—	35	15	600	200	1.0	8300G72	I	2	8302G31	III	20	33	F	4½	5
½	⅜	120	40	—	60	20	600	200	.75	8300G68	I	2	8302G29	III	20	33	F	4½	5
	½	75	30	—	35	15	600	200	1.0	8300G76	I	2	8302G33	III	20	33	F	4½	5
Forged Brass Body, Buna "N" Seats and Nylon Discs for General Service																				
¼	⅜	250	125	—	150	60	600	150	.25	8300S8R	I	1	8302G25R	III	20	33	F	3½	4
	½	250	75	—	75	25	600	150	.35	8300A81R	I	1	8302A81R	III	20	33	F	3½	4
⅜	¼	150	75	—	75	25	600	150	.39	8300A82R	I	1	8302A82R	III	20	33	F	3½	4
	½	120	40	—	60	20	600	150	.53	8300G64R	I	2	8302G27R	III	20	33	F	4½	5
½	⅜	120	40	—	60	20	600	150	.53	8300G68R	I	2	8302G29R	III	20	33	F	4½	5
Forged Brass Body, Metal Seats and Discs for Steam Service																				
¼	¼	—	—	110	50	—	600	400	.45	831502	II	1	8315022	IV	15.4	—	H	3½	4
¾	½	—	—	110	50	—	600	400	.65	831503	II	1	8315023	IV	15.4	—	H	3½	4

SPECIFICATIONS (continued)

Pipe Size (Ins.)	Orifice Size (Ins.)	Maximum Operating Pressure Differential③ (P.S.I.) Normally Closed① or Normally Open② Air-Gas,⑥ Water, Light Hydraulic Oil A-C	Normally Closed① or Normally Open② Air-Gas,⑥ Water, Light Hydraulic Oil D-C	Normally Closed① or Normally Open② Steam A-C	Universal③ Air-Gas,⑥ Water, Light Hydraulic Oil A-C	Universal③ Air-Gas,⑥ Water, Light Hydraulic Oil D-C	Safe Working Pressure (P.S.I.)	Max.④ A-C Fluid Temp. °F.	Cv Flow Factor	General Purpose Solenoid Enclosure Catalog Number	General Purpose Solenoid Enclosure Optional Feature Ref.	General Purpose Solenoid Enclosure Constr. Ref.	Explosion Proof — Watertight Solenoid Enclosure Catalog Number	Explosion Proof — Watertight Solenoid Enclosure Optional Feature Ref.	Watt Rating A-C	Watt Rating D-C	Class of Coil⑤ Insulation	Approx. Shipping Weight (Lbs.) CP	Approx. Shipping Weight (Lbs.) EP
Steel Body, Metal Seats and Discs for Corrosive Service																			
⅜	⅜	250	100	—	125	50	1500	200	.35	8300832	I	3	8302B6	III	20	33	F	4½	5
	½	150	50	—	75	25	1500	200	.45	8300A83	I	3	8302A63	III	20	33	F	4½	5
	¼	175	—	—	85	—	1500	200	.45	8300841	II	3	8302846	IV	28	—	H	4½	5
	⅜	120	40	—	60	20	1500	200	.75	8300889	I	3	8302838	III	20	33	F	4½	5
	½	75	30	—	35	15	1500	200	1.0	8300897	I	3	8302842	III	20	33	F	4½	5
½	⅜	120	40	—	60	20	1500	200	.75	83008203	I	3	83028203	III	20	33	F	4½	5
	½	75	30	—	35	15	1500	200	1.0	83008204	I	3	83028204	III	20	33	F	4½	5
Stainless Steel Body, Metal Seats and Discs for Corrosive Service																			
½	⅜	120	40	—	60	20	1500	200	.75	83008403	I	3	83028403	III	20	33	F	5½	6
	½	75	30	—	35	15	1500	200	1.0	83008404	I	3	83028404	III	20	33	F	5½	6

Notes: ① For Normally Closed Operation, use catalog number suffix "F."
② For Normally Open Operation, use catalog number suffix "G."
③ For Universal Operation, use catalog number suffix "U."
④ Maximum D-C Fluid Temperature is 180°F.
⑤ For higher D-C rating valves, refer to Bulletin 8321.
⑥ D-C Coil supplied with Class H insulation.
⑦ Universal rating for steam service only.
⑧ Suitable for inert gases — for other gases refer to Selection Guide on pages 101-105.

ELECTRICAL INFORMATION

Standard Coil and Class of Insulation	Watt Rating and Power Consumption D-C Watts	A-C Watts	A-C VA Holding	A-C VA Inrush	Spare Coil Part No. A-C	Spare Coil Part No. D-C
F	—	20	41.5	195	93-257	—
H	33	—	—	—	—	98 824
H	—	28	57	250	102-005	—
H	—	15.4	27	145	102-005	—

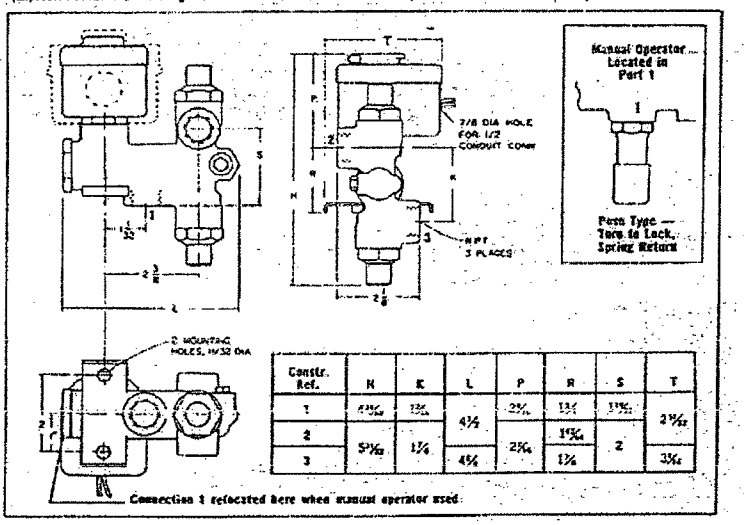
OPTIONAL FEATURE REFERENCE

Description and ordering information are located on pages 84-85

Optional Feature Ref.	Class H Hi-Temp. Coil	½" Conduit Adapter	½" Threaded Conduit Hub	Strain Relief Cord	Junction Box Solenoid Enclosure	Manual Operator
I	2F	9	10	11	12C	14
II	STD	9	10	11	—	14
III	2F	—	STD	—	—	14
IV	STD	—	STD	—	—	14

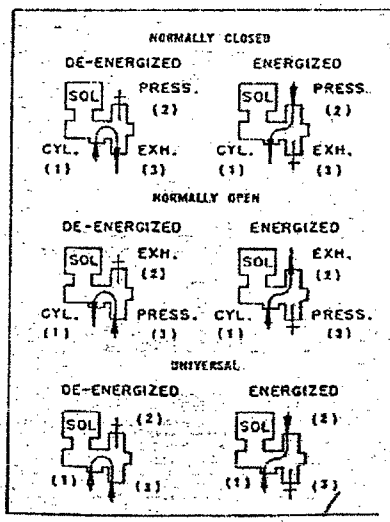
DIMENSIONS (in inches)

(Explosion Proof and Watertight Solenoid Enclosure shown dotted-in, details available on request.)

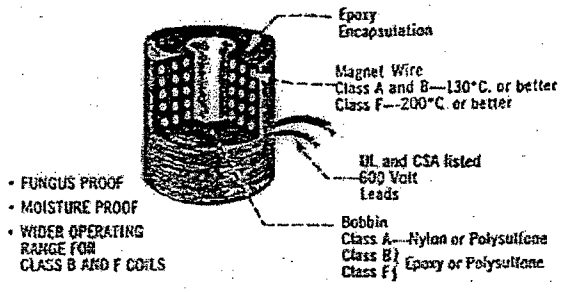


Constr. Ref.	N	K	L	P	R	S	T
1	4 15/16	1 3/16	4½	2 5/16	1 3/4	1 11/16	2 9/32
2	5 9/32	1¼	4 5/8	2 5/16	1 15/16	2	3 3/16
3					1¾		

FLOW DIAGRAMS

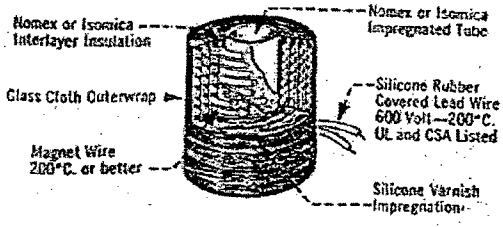


CLASS A
(105°C.), CLASS B (130°C.) AND
CLASS F (155°C.)
MOLDED COILS



- FUNGUS PROOF
- MOISTURE PROOF
- WIDER OPERATING RANGE FOR CLASS B AND F COILS

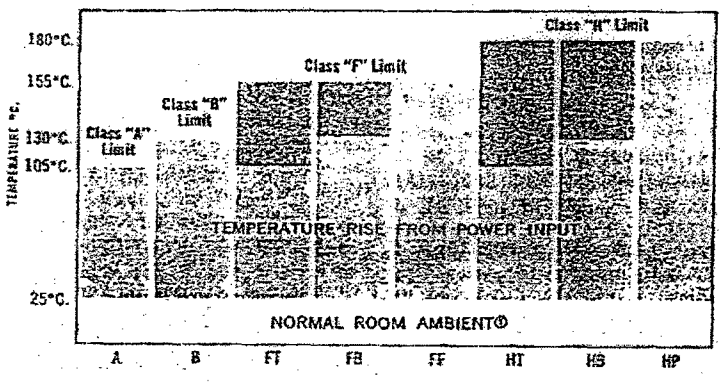
CLASS H (180°C.)
NON-MOLDED COILS



- INTERLAYER CONSTRUCTION
- FUNGUS PROOF
- RADIATION RESISTANT
- WIDE OPERATING RANGE

The following table illustrates the temperature parameters of ASCO Coils:

INDUSTRIAL TEMPERATURE LIMITATIONS① AND THERMAL CHARACTERISTICS OF ASCO SOLENOIDS AND COILS



CLASS OF COIL INSULATION

Normal 25°C. Room Ambient.

Temperature Rise Due to Power Input.

Excess Margin for Higher Fluid or Ambient Temperatures.②

Notes:
① As measured by the "Resistance Method."
② Equipment rated at an ambient temperature of 25°C. can be employed in areas where the ambient temperature reaches 40°C. occasionally.
③ Ambient temperatures are directly additive to coil rise—fluid temperatures are not.

Coil Operating Voltage Ranges

All coils are designed for industrial operating voltages and can be used on the following voltage ranges:

A-C		D-C	
Nominal Voltage Rating	Normal Operating Range	Nominal Voltage Rating	Normal Operating Range
24	20- 24	6	5.1- 6.3
120	102-120	12	10.2-12.6
240	204-240	24	20-25
480	408-480	120	102-126
		240	204-252

Note: 125 volts, D-C and 250 volts, D-C are battery voltages and require special construction. Consult ASCO for details.

All ASCO valves are tested to operate at 15% under the nominal voltage and at maximum operating pressure differential, and are capable of operating for short periods at 10% over the nominal voltage. For wider voltage ranges than shown at left, a different coil or insulation system must be used.

Power Consumption

Power consumption of solenoid valves may be determined from the rating in ASCO bulletins. For valves on A-C service, the watt rating, the volt-ampere "inrush" and the volt-ampere "holding" are given.

The volt-amp (VA) "inrush" is the high momentary surge of current which occurs at the moment an A-C solenoid is energized.

The volt-amp (VA) "holding" is the continuous rating after the initial "inrush."

The current rating for the "inrush" and "holding" may be determined by dividing the voltage into the volt-amp rating.

$$\text{AMPS (INRUSH)} = \frac{\text{volt-amp "inrush"}}{\text{voltage}}$$

$$\text{AMPS (HOLDING)} = \frac{\text{volt-amp "holding"}}{\text{voltage}}$$

Valves supplied for D-C service have no "inrush" current, as in the case of A-C service. The amp rating can be determined by dividing the voltage into the D-C watt rating.

$$\text{AMPS} = \frac{\text{watts (D-C)}}{\text{voltage}}$$

Note: (1) When a valve has been energized for a long period the solenoid enclosure becomes hot and cannot be touched by hand except for an instant. This is a perfectly safe operating temperature. Any excessive heating will be indicated by the smoking and burning odor of the coil insulation.

(2) Valves for A-C service can be converted for use on other A-C voltages simply by changing the coil; similarly, D-C valves can be converted for other D-C voltages. When converting from A-C to D-C or vice versa, consult ASCO for instructions.

ITEM- 173, 164, 176

sufficient for your requirements. The second column provides the desired solenoid option plus the higher temperature protection of a Class H coil.

For example, to select an 8262G2 valve with a Class H Open Frame Spade Terminal Solenoid, assuming the voltage to be 120 volts, AC, 60 Hz:

1. In the Specification Table for Series 8262, the Watt Rating/Class of Coil Insulation is 6.1/F for Catalog Number 8262G2.
2. Using Table 5, find the listing for "Open Frame Solenoid with Spade Terminal Coil" in the left column. Then find 6.1/F under AC coils in the next column. Reading horizontally across to the column headed "Class H Coil," you'll find the prefix "OFST." To order, specify Catalog Number OFST8262G2, 120/60. (Note: Always include the voltage and frequency.)

You'll find detailed information on available Red-Hat and Red-Hat II coil and enclosure options on the following pages.

TABLE 4 • Coil and Solenoid Enclosure Options for Red-Hat Valves

Coil Option Selected	Watt Rating/ Class of Coil Insulation AC	Watt Rating/ Class of Coil Insulation DC	Coil Option Only	Open Frame Solenoid Prefix "U"	Type 1 Splice Box Solenoid Enclosure Prefix "J"	Type 3R Rainproof Solenoid Enclosure Prefix "R"	Type 6 Submersible/ Watertight Splice Box Enclosure Prefix "WP"	Type 7 Explosion-proof Enclosure Prefix "EF"
No Coil Option Standard Valve Construction	13.8/F	15.3/F	—	U	J	R	WP	EF
	10.5/F 13.4/A 16.7/F 20.5/H	19.7/F 29.5/H	—	U	J	R	WP	EF
	15.4/F 15.4/H 20/F 20/H 26/H	16.8/F 36.2/H	—	U	J	R	WP	EF
	28.2/F 28.2/H		—	—	—	R	—	—
		14.9/8 30.6/H	—	—	—	—	—	EF
Class H Coils	10.5/F 15.4/F	16.8/F	HT	UHT	JHT	—	WPHT	EFHT
	28.2/F		HT	—	—	RHT	—	—
	16.7/F 20/F		HB	UHB	JHB	—	WPHB	EFHB
Dual Voltage Class F Coils	10.5/F 15.4/F		DF	UDF	JDF	RDF	WPDF	EFDF
	16.7/F 20/F		DP	UDP	JDP	RDP	WPDP	EFDP
Spade Terminal Class F Coils	10.5/F 15.4/F		—	USF	JSF	—	WPSF	—
	16.7/F 20/F		—	USP	JSP	—	WPSP	—
Screw Terminal Class F Coils	10.5/F 15.4/F		—	UKF	JKF	—	WPKF	—
	16.7/F 20/F		—	UKP	JKP	—	WPKP	—

TABLE 5 • Solenoid Options for Red-Hat II Valves

Solenoid Option Required	Watt Rating/ Class of Coil Insulation AC	Watt Rating/ Class of Coil Insulation DC	Class F Coil Prefix	Class H Coil Prefix
General Purpose Solenoid (Standard Valve Construction)	6.1/F 10.1/F	10.6/F 11.6/F	—	HT
	9.1/F 17.1/F	22.6/F	—	HB
Panel Mount Type 1 General Purpose Solenoid	6.1/F 10.1/F	10.6/F 11.6/F	GP	GPHT
	9.1/F 17.1/F	22.6/F	GP	GPHB
Type 7 Explosionproof Solenoid	6.1/F 10.1/F	10.6/F 11.6/F	EF	EFHT
	9.1/F 17.1/F	22.6/F	EF	EFHB
Panel Mount Type 7 Explosionproof Solenoid	6.1/F 10.1/F	10.6/F 11.6/F	EFP	EFPHT
	9.1/F 17.1/F	22.6/F	EFP	EFPHB
Open Frame Solenoid with Spade Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	OFSF	OFST
	9.1/F 17.1/F	22.6/F	OFSP	OFSS
Panel Mount Solenoid with Spade Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	OPSF	OPST
	9.1/F 17.1/F	22.6/F	OPSP	OPSS
Open Frame Solenoid with Screw Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	OFKF	OFKH
	9.1/F 17.1/F	22.6/F	OFKP	OFKB
Panel Mount Solenoid with Screw Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	OPKF	OPKH
	9.1/F 17.1/F	22.6/F	OPKP	OPKB
Junction Box with Spade Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	JSF	JST
	9.1/F 17.1/F	22.6/F	JSP	JSS
Panel Mount Junction Box with Spade Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	JPSF	JPST
	9.1/F 17.1/F	22.6/F	JPSP	JPSS

(continued)

TABLE 5 - (continued)

Solenoid Option Required	Watt Rating/ Class of Coil Insulation AC	DC	Class F Coil Prefix	Class H Coil Prefix
Junction Box with Screw Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	JKF	JKH
	9.1/F 17.1/F	22.6/F	JKP	JKB
Panel Mount Junction Box with Screw Terminal Coil	6.1/F 10.1/F	10.6/F 11.6/F	JPKF	JPKH
	9.1/F 17.1/F	22.6/F	JPKP	JPKB

Solenoid Option Required	Watt Rating/ Class of Coil Insulation AC	DC	Class F Coil Prefix	Class H Coil Prefix
DIN Connection Solenoid	6.1/F 10.1/F	10.6/F 11.6/F	SC	SU
	9.1/F 17.1/F	22.6/F	SD	SV
Panel Mount DIN Connection Solenoid	6.1/F 10.1/F	10.6/F 11.6/F	DPSC	DPSU
	9.1/F 17.1/F	22.6/F	DPSD	DPSV

Optional Electrical Features for Red-Hat® Solenoids

Class F High Temperature Molded Coils with ¼" Spade Terminals

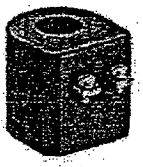


- Insulation system suitable for coil temperatures up to 155°C② For ambient temperature requirements, refer to specific Series and charts in Engineering Section beginning on page 97.
- Use with open frame solenoid, Type 1 splice box solenoid enclosure, or Type 6 Submersible and Watertight splice box solenoid enclosure
- Suitable for both 50 and 60 Hz①

Ordering Information: Depending on wattage, use catalog number prefix "SF" or "SP", plus appropriate solenoid option prefix (e.g., USF8210B54) and specify voltage.

Note: Spade terminal coils are not available above 250 volts, AC or DC.

Class F High Temperature Molded Coils with Screw Terminals

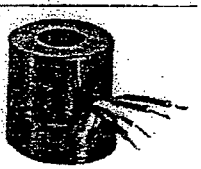


Same as above, except molded coils are provided with #6 screw terminals.

Ordering Information: Depending on wattage, use catalog number prefix "KF" or "KP", plus appropriate solenoid option prefix (e.g., WPKF8210B54) and specify voltage.

Note: Screw terminal coils are not available above 250 volts, AC or DC.

Class F High Temperature Dual Voltage Molded Coils with 18" Leads

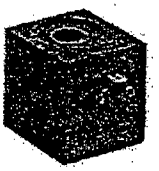


These Class F dual voltage molded coils provide versatility by allowing a valve to be energized from either one of two voltages.

- Insulation system suitable for coil temperatures up to 155°C② For ambient temperature requirements, refer to specific Series and charts in Engineering Section beginning on page 97.
- Suitable for 50 and 60 Hz①

Ordering Information: Depending on wattage, use catalog number prefix "DF" or "DP" (e.g., DF8210B54) and specify voltage.

Class F High Temperature Molded Coils with DIN Connections



These high temperature molded coils meet ISO 4400/DIN 43650 requirements.

- Insulation system suitable for coil temperatures up to 155°C② For ambient temperature requirements, refer to specific Series and charts in Engineering Section beginning on page 97.
- Suitable for 50 and 60 Hz①
- "Enclosure protection" with DIN connector equivalent to Types 1 and 4

Ordering Information: Depending on wattage, use catalog number prefix "SC" or "SD" (e.g., SC8210B54) and specify voltage.

Note: Optional DIN-type strain-relief connector kit includes a gasket and attaching screw. Outlet accommodates cables with O.D. of 0.310" to 0.400". Must be ordered separately as Kit No. K236034.

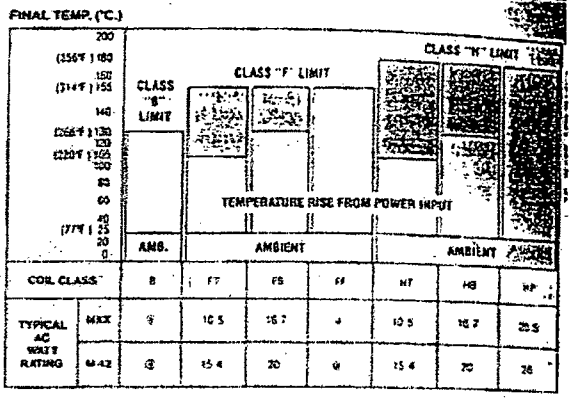
① ② See notes on page 17

INDUSTRIAL TEMPERATURE LIMITATIONS① AND THERMAL CHARACTERISTICS OF ASCO RED-HAT SOLENOIDS AND COILS

The typical watt ratings given show the relationship between different classes of coil insulation and the watt ratings to achieve higher temperature capabilities. The information contained in these tables applies only to non-explosionproof constructions ④.

② Excess margin for higher fluid or ambient temperature | Temperature rise due to power input | Listed ambient

① As measured by the "Resistance Method"
② Ambient temperatures are directly additive to coil rise—fluid temperature is not
③ Only available in sealed watt ratings. Consult ASCO when required.
④ Only available in M-5 and MUXX sampling sizes
⑤ Because of explosionproof codes and surface temperature limitations, the maximum listed ambients for specific valves should not be exceeded. Consult factory concerning explosionproof applications where higher than listed ambients are encountered.



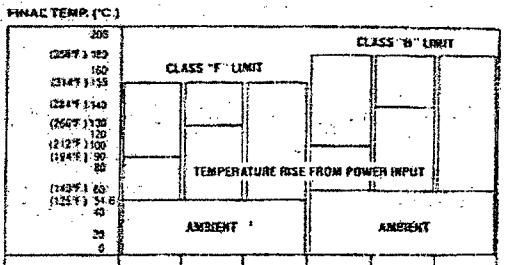
COIL CLASS		B	FT	FB	FF	HT	HB	HP
TYPICAL AC WATT RATING	MXX	③	10.5	15.7	④	10.5	15.7	25.5
	M-42	③	15.4	20	④	15.4	20	28

INDUSTRIAL TEMPERATURE LIMITATIONS⑥ AND THERMAL CHARACTERISTICS OF ASCO RED-HAT II SOLENOIDS AND COILS

The typical watt ratings given show the relationship between different classes of coil insulation and the watt ratings to achieve higher temperature capabilities. The information contained in these tables applies only to non-explosionproof constructions ④.

⑥ Excess margin for higher fluid or ambient temperature | Temperature rise due to power input | Listed ambient

Notes:
① As measured by the "Resistance Method"
② Ambient temperatures are directly additive to coil rise—fluid temperature is not
③ For M-6 50 Hz wattage values add 2 watts to the indicated values
④ To be determined
⑤ Because of explosionproof codes and surface temperature limitations, the maximum listed ambients for specific valves should not be exceeded. Consult factory concerning explosionproof applications where higher than listed ambients are encountered



COIL CLASS		FT	FB	FF	HT	HB	HP
TYPICAL AC WATTAGE RATING	M6	6.1	9.1③	④	6.1③	9.1③	④
	MXX	10.1	17.1	⑤	10.1	17.1	⑤

Coil Operating Voltage Ranges

All coils are designed for industrial operating voltages and can be used on the following voltage ranges:

AC		DC	
Nominal Voltage Rating	Normal Operating Range	Nominal Voltage Rating	Normal Operating Range
24	20- 24	6	5.1- 6.3
120	102-120	12	10.2-12.6
240	204-240	24	20-25
480	408-480	120	102-126
		240	204-252

Note: Special coils are required for battery charging circuits where wider voltage ranges are typically encountered. For these applications, special continuous duty Class H coils are available that will accommodate a voltage range equivalent to 12% over, 25% under nominal and a 60°C. (140°F.) ambient. Standard nominal voltages are 125 and 250 DC which translate to a voltage range of 90-140 and 180-280, respectively. Add prefix "HC" to the catalog number.

All ASCO valves are tested to operate at 15% under nominal voltage and at maximum operating pressure differential, and are capable of operating for short periods at 10% over nominal voltage. For wider voltage ranges than shown here, a different coil or insulation system must be used.

Power Consumption

Power consumption can be determined from the ratings shown on individual series pages. For AC valves, the watts, volt-ampere "inrush" (the high momentary surge occurring at coil energization) and volt-ampere "holding" (the continuous draw following inrush) are given.

The current rating for inrush and holding may be determined by dividing the voltage into the volt-amp rating:

$$\text{Inrush Amps} = \frac{\text{volt-amp inrush}}{\text{voltage}}$$

$$\text{Holding Amps} = \frac{\text{volt-amp holding}}{\text{voltage}}$$

DC valves have no inrush curren The amp rating can be determined dividing the voltage into the DC w rating:

$$\text{Amps} = \frac{\text{watts (DC)}}{\text{voltage}}$$

Notes:

(1) When a valve has been energiz for a long period, the solenoid l comes hot and can be touched hand for only an instant. This i perfectly safe operating temper ature. Any excessive heating wi be indicated by smoke and the odor of burning coil insulation.

(2) Valves for AC service can be co verted to other AC voltages sim by changing the coil. Similarly, DC valves can be converted to other DC voltages. But when co verting from AC to DC, or vice versa, consult your local ASCO sales office for instructions.

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

Descriptive Bulletin
41-817E

September, 1990
Supersedes Descriptive Bulletin 41-750A
pages 1-8, dated August, 1989
Mailed to: E, D, C/41-900A

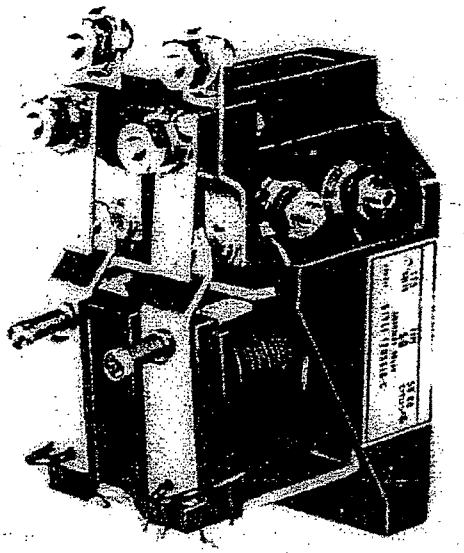
For Ac or Dc Voltage or Dc Current Operation
Device Number: 94X, Y, Z

Type SG Auxiliary Relays

Index

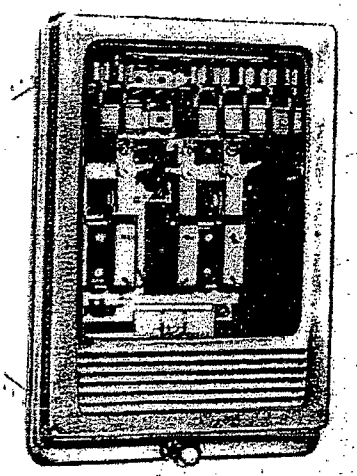
	Page
Construction, Operation	2
Operating Time	4
Burden Data	4
Contact Data	4
Coil Data	4
Time Delay Type	5
Internal Wiring	6, 7
External Capacitor Dimensions	8
External Resistor Dimensions	8

Molded Base, Front Connected



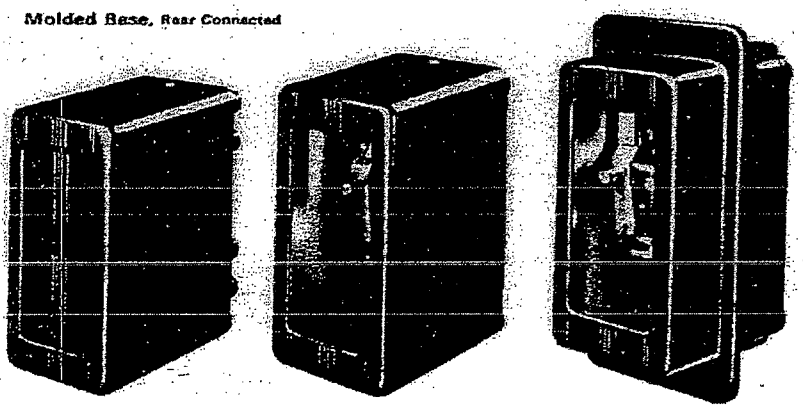
SG Open Type

Flexitest®



Projection or Semi-Flush Mounting

Molded Base, Rear Connected



Projection Mounting
Solid Cover

Projection Mounting
Glass Window Cover

Semi-Flush Mounting
Glass Window Cover Only

ABB

Application

The SG auxiliary relays are for use in miscellaneous automatic and remote control switching. It is suitable for many industrial applications. SG relays are supplied for use on the following voltages without an external resistor by the use of suitable coils. The standard coils are:

6, 12, 24, 48, 125, and 250 volts dc
115 and 230 volts, 25 hertz
115, 230, 440, and 575 volts, 50 and 60 hertz

External series resistors are used with the voltage rated dc relays, for higher control circuit voltages up to 600 volts dc. Relays having limited time-delay in operation are also available.

Construction and Operation

The SG relays are clapper-type devices designed to operate over a wide range of ac and dc voltages. When their coils are energized at or above pickup rating, the moving contacts on the armature block close and/or open with the two stationary contacts to complete the electrically independent contact circuits.

Closed types are supplied with two make and two break contacts. Open types (front connected) can be supplied with two make and two break contacts, or with only the two make contacts which can be reversed to provide one make, one break, or two break contact circuits.

Small coil springs on the moving contact arms provide adequate contact pressure, to assure positive contact action between the moving and stationary contacts.

Dc types have a bronze pin on the core which serves as a stop pin for the armature, and prevents magnetic seal-in of the armature due to residual magnetism. Ac types have a nonmagnetic washer at the base of the core assembly to prevent the armature from sticking in the closed-gap position. Copper shading rings are also provided on the core face of the ac types to prevent chattering of the armature.

All standard SG relays will pickup on 80% of rating, and will withstand 110% of rating continuously.

Contact Data

Both the moving and stationary contacts are made of pure silver. Each will close and carry 12 amperes continuously, or will carry 30 amperes for one minute.

Contact Legend

Dpst – double pole single throw
Dpdt – double pole double throw
cc – circuit closing
co – circuit opening

Basic SG Unit

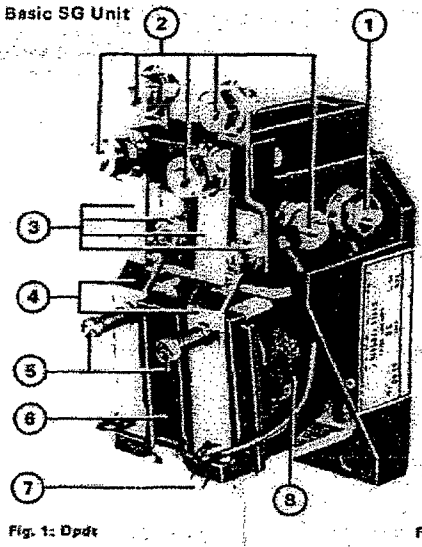


Fig. 1: Dpdt

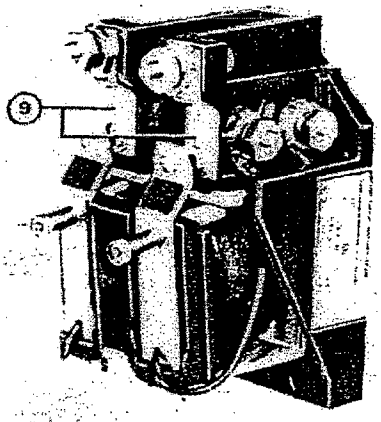


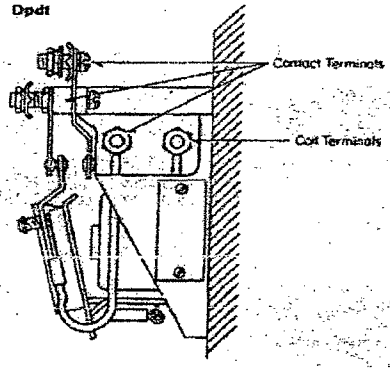
Fig. 2: Dpst Reversible

Dpdt Contacts (2 cc and 2 co) or Dpst Contacts (2 cc)

The design features illustrated in Figures 1 and 2 apply to all SG relays.

1. Terminals to Coil
2. Terminals to Contact Connections
3. Stationary Contacts
4. Moving Contacts
5. Contact Wipe Armature Spring
6. Armature Block
7. Armature Reset Spring
8. Coil
9. Reversible Stationary Contacts (Applies to Dpst only)

Dpdt



Dpst Reversible

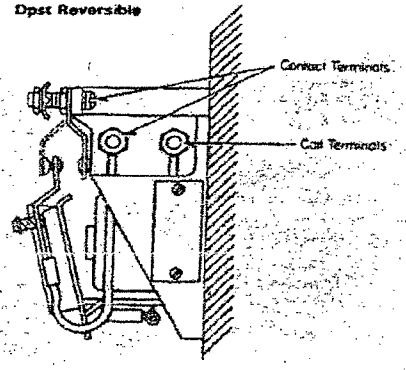


Figure 3: Contact Arrangements (Open Type)

SG in Molded Base With Cover Removed
Projection Mounting

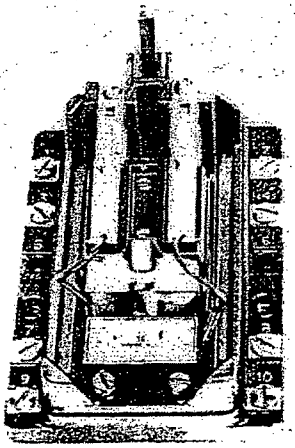


Fig. 4: Front Connected



Fig. 5: Glass Window Cover for Fig. 4

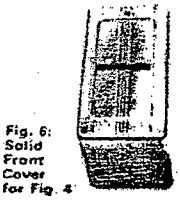


Fig. 6: Solid Front Cover for Fig. 4

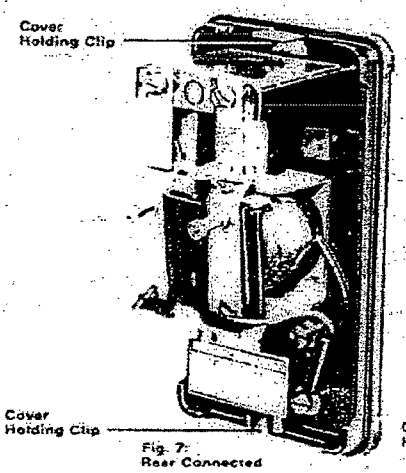


Fig. 7: Rear Connected

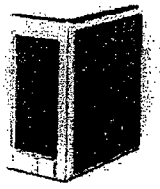


Fig. 8: Glass Window Cover for Fig. 7

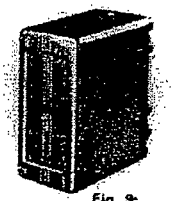


Fig. 9: Solid Front Cover for Fig. 7

SG in Molded Base With Cover
Semi-Flush Mounting

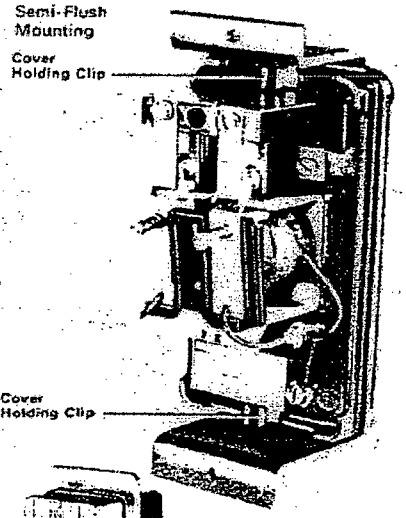


Fig. 10



Fig. 11: Glass Window Cover for Fig. 10

SG in Flexitest Case Dpdt Contacts
Projection or Semi-Flush Mounting

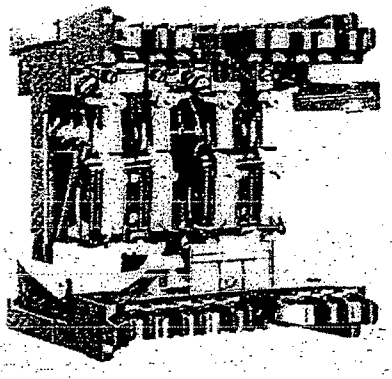


Fig. 12

Single Unit Type in FT-11 Case

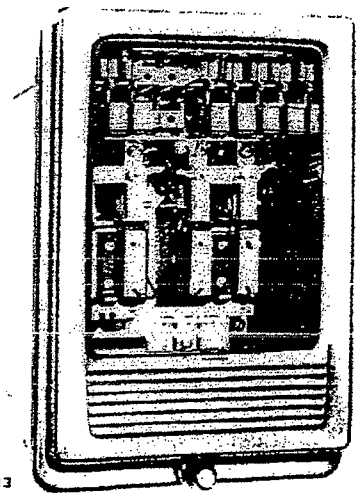


Fig. 13

Double Unit Type in FT-22 Case

SG Relay Characteristics
Relay Operating Time

Pickup
2 to 3 cycles on a 60 Hz base (.033 to .05 second) at dc rating.

1 to 2 cycles on a 60 Hz base (.016 to .033 second) at ac rating.

Dropout
Less than 1 cycle on a 60 Hz base on ac or dc.

Non-Adjustable Pickup and Dropout
Both pickup and dropout time values are non-adjustable.

Minimum Pickup
80% of ac or dc rating.

Maximum Dropout
30% of dc rating.
60% of ac rating.

Burden Data
Dc
Burden of dc operated SG relays is 3.5 watts at rated voltage or current.

Ac
Burden of ac, 50/60 hertz types is 10 volt-amperes at .55 power factor with the armature closed, or 16 volt-amperes at .45 power factor with the armature reset or open.

Contact Interrupting Ratings
Non-Inductive Circuits

Contact Circuit Voltage		Non-Inductive Interrupting Rating in Amperes		
Dc	Ac	Single Contact		Two Contacts in Series
		Ac	Dc	Dc
12	...	...	30	...
24	24	60	15	50
48	48	45	8	35
125	115	30	2.4	20
250	230	20	.75	2.5
...	460	15	.50	1.5
...	575	10	.25	.5

Inductive Circuits

Contact Circuit Voltage		Inductive Interrupting Rating in Amperes			
Dc	Ac	Single Contact		Two Contacts in Series	
		Ac	Dc	Ac	Dc
48	...	...	5	...	30
125	...	...	1	...	5
250	...	...	.2	...	.4
...	115	20	...	30	...
...	230	15	...	20	...
...	460	7.5	...	10	...
...	575	4.0	...	7.5	...

Coil Data
Dc

Rating Amps	Volts	Resistance: Ohms	1-Second Rating: Amps
1	...	2.5	35
2	...	0.7	55
3	...	0.33	85
4	...	0.2	110
5	...	0.1	185
...	6	12	...
...	12	48	...
...	24	185	...
...	32	294	...
...	48	725	...
...	62.5	1152	...
...	125	4650	...
...	250	17000	...

Ac, 50/60 Hertz

Rating: Volts	Resistance: Ohms	Closed Gap Impedance: Ohms
12	1.7	12.5
24	7.3	56
90	112	875
115	185	1320
208	630	4250
230	725	5300
275	1042	7500
460	2770	21000
575	4650	33000

SG Relays With Time Delay, Dc Operated

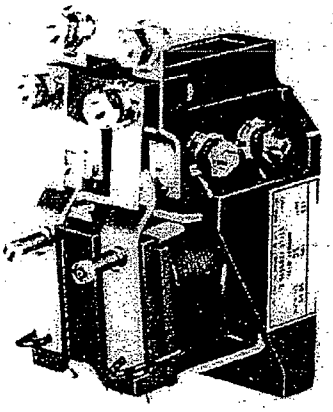


Fig. 14

Slug Type, Intermittent Duty

SG relays available with time delay have a special core and heavy copper ring (slug) which provide an additional time delay of 0.6 cycles (.01 second) on pickup, and 2½ cycles (.04 second) on dropout.

Induced current in the copper slug briefly retains the magnetic flux in the relay core, thereby creating the added 2½ cycles delay on dropout. Therefore, the total operating time of the relay on dc is 3 or 4 cycles for either pickup or dropout.

Use of the copper slug results in a reduction of available coil space, making the slug type SG suitable for intermittent duty only.

Additional Time Delay, Voltage Operated Types

Additional time delay on pickup or dropout can be obtained by the use of resistors and capacitors. When such are employed, the relays are continuously rated

Resistor-Capacitor Type, Continuous Duty

Typical Time Delay Values Using 125-Volt Relay Coil (with 125 Volts Dc Applied)

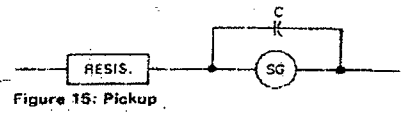


Figure 15: Pickup

Microfarads Across Coil (C)	Pickup Time Delay in Seconds Using Standard Core	
	500 Ohms (R)	1000 Ohms (R)
0	.045	.049
5	.047	.052
10	.049	.057
20	.054	.068

Dropout

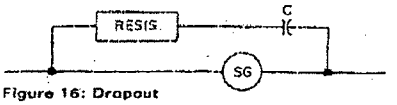


Figure 16: Dropout

Microfarads Across Coil (C)	Ohms (R)	Dropout Time Delay in Seconds, Standard Core
10	0	.081
10	1000	.080
10	3000	.075
10	5000	.070
10	7100	.054
20	0	.140
20	1000	.141
20	3000	.139
20	5000	.128
20	7100	.092

Capacitors and Resistors for Use With Time Delay Relays

Capacitors, Rated 1000 Vdc

Description	Style Number①
5 mfd	2898492H02
10 mfd	2898493H01
20 mfd	use two 2898493H01 in parallel

Resistors②

Description	Style Number③
500 ohms	184A369G10
1000 ohms	184A369G11
3000 ohms	184A369G12
5000 ohms	184A369G13
7100 ohms	184A369G14

① See figures 25 and 26 for dimensions.
② Style numbers include 3½-inch, two terminal resistor and mounting bracket.

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Internal Wiring for SG Relay With:

Molded Base, Open Type (Front Connected)
Dpdt Contacts: 2 cc and 2 co
(Top View)

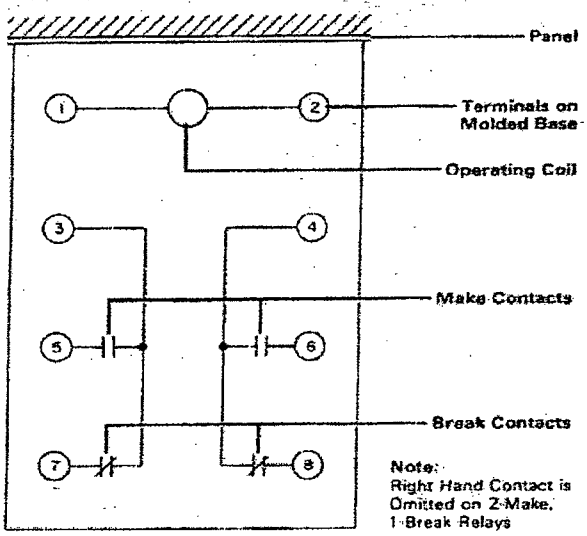


Figure 17 57D390

Molded Base, Open Type (Front Connected)
Dpdt Contacts: 2 cc and 2 co
(Top View)

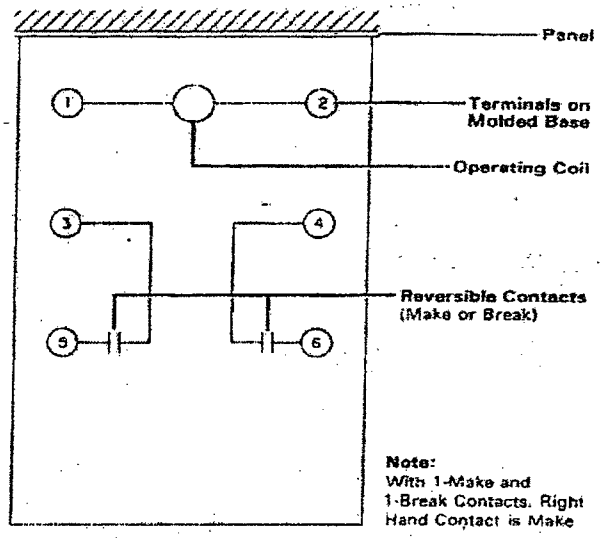


Figure 18 57D389

Molded Base With Cover (Rear Connected)
Dpdt Contacts: 2 cc and 2 co
(Rear View)

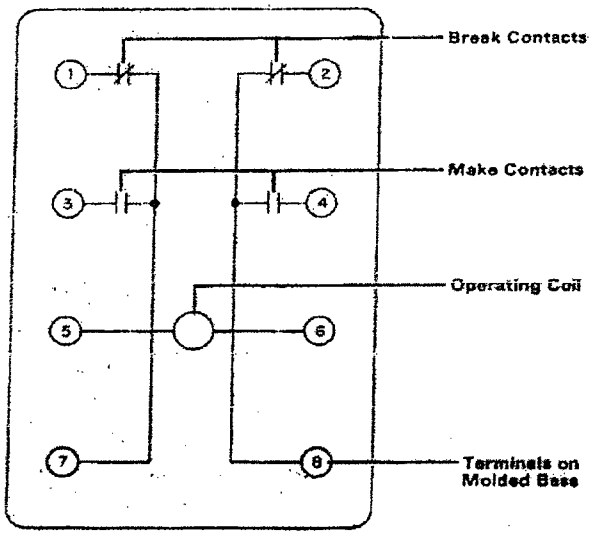


Figure 19

Molded Base With Cover (Front Connected)
Dpdt Contacts: 2 cc and 2 co
(Front View)

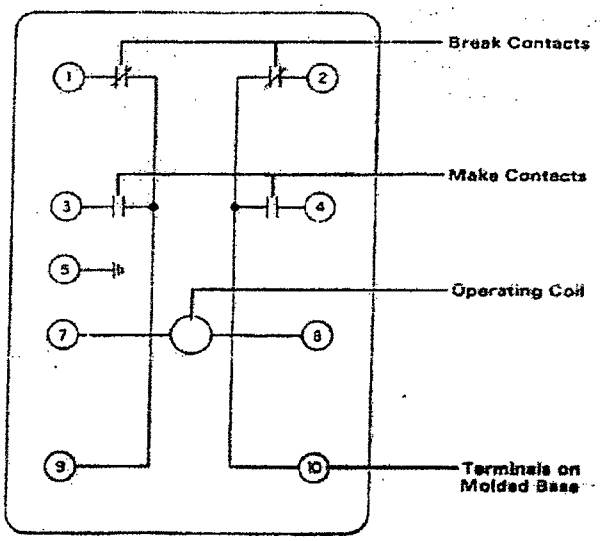


Figure 20 829A337

Calculation FEX-00204-00
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Internal Wiring for SG Relay With:

Flexitest Case (Front View)
Single Unit, 2 Make and 2 Break Contacts (FT-11 Case)

Current Operated

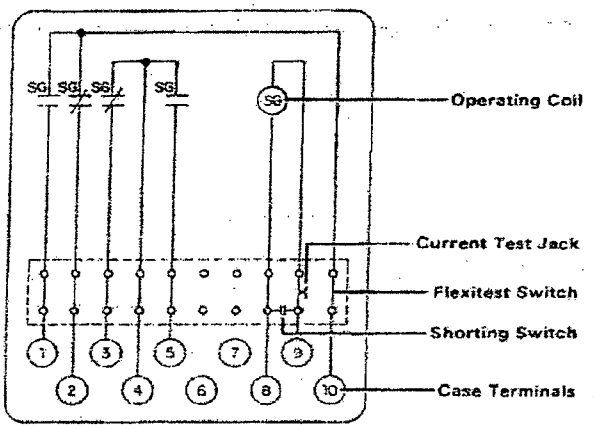


Figure 21 183A340

Voltage Operated

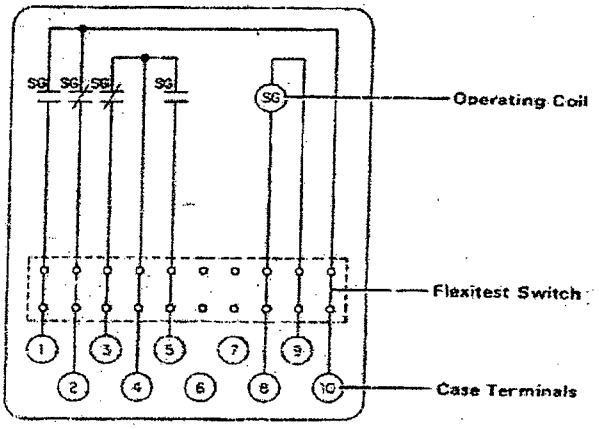


Figure 22 183A108

Two Units, Each With 2 Make and 2 Break Contacts (FT-22 Case)

Current Operated

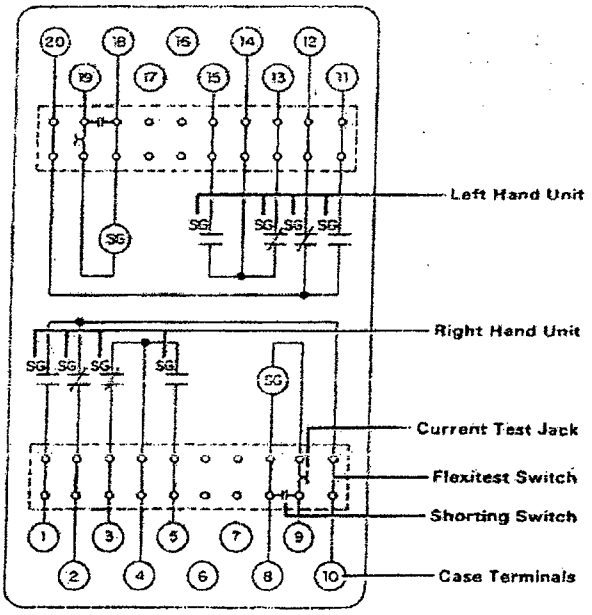


Figure 23 3512A58

Voltage Operated

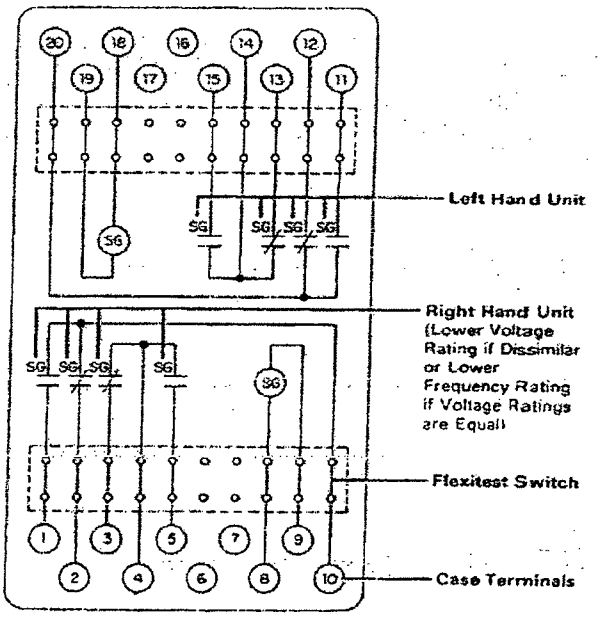


Figure 24 183A457

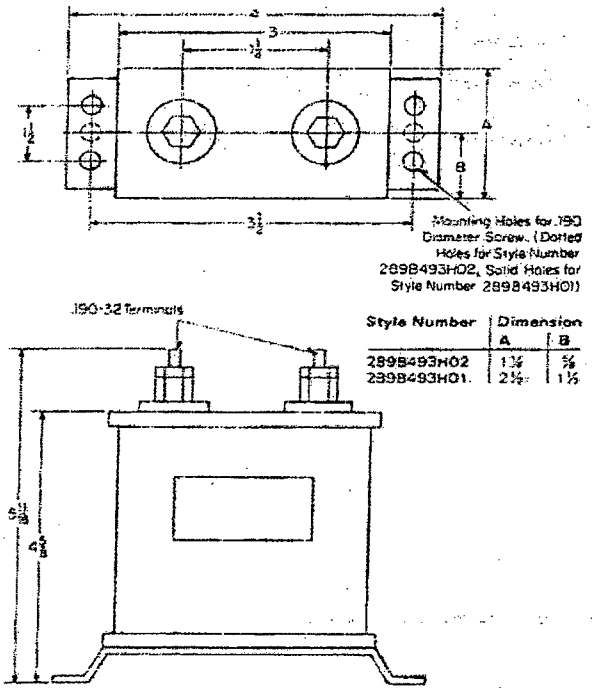
Shipping Weights and Carton Dimensions

Relay Case Type	Weight, Lbs: Approx. Net	Shipping	Domestic Shipping Carton Dimension: Inches
Molded Base			
Without Cover	½	1	8½ x 9½ x 10
With Cover	¾	2	8½ x 9½ x 10
Flexitest Case			
FT-11 (Single Unit)	6	9	9 x 9 x 10
FT-22 (Double Unit)	7	10	9 x 9 x 10

Further Information
List Prices: PL 41-020
Technical Data: TD 41-025
Instructions:
Type SG, IL 41-751
Flexitest, IL 41-751.1
Renewal Parts: RPD 41-989
Flexitest Case Dimensions: DB 41-076
Contactor Switches: DB 41-081
Other Protective Relays:
Application Selector Guide, TD 41-016

Accessory Dimensions (In Inches)

Capacitors



Style Number	Dimension A	B
2898493H02	1¾	⅝
2898493H01	2½	1⅛

Figure 25

External Resistors

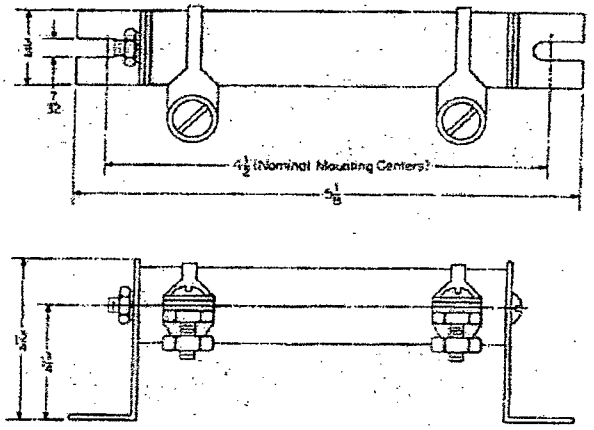


Figure 26

December, 1990
Supersedes TD 41-020, Type SG on pages 130 and 131, dated November, 1987
Mailed to: E, D, C/41-900A

For Ac or Dc Voltage or Dc Current Operation

Type SG Auxiliary Relays

Auxiliary, Ac Voltage, or Dc Voltage or Current
Non-Adjustable Pickup, Double Pole, Flexitest Case (Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data					
				Single Unit			Double Unit		
				Internal Schematic	Style Number	Case Size	Internal Schematic	Style Number	Case Size
SG	Dpdt-2 cc and 2 co	Dc	1 amp dc	183A340	1878 755	FT-11	3514A07	1955 556	FT-22
			2 amps dc		1878 756			1955 557	
Current or voltage			3 amps dc		1878 757			1955 558	
			4 amps dc		1878 758			1956 447	
Self-reset			5 amps dc		1878 759			1955 449	
			6 volts dc	183A108	1878 760		183A457	1955 560	
			12 volts dc		1878 761			1955 561	
			24 volts dc		1878 762			1955 562	
			32 volts dc		1878 763			1955 563	
			48 volts dc		1878 764			1955 564	
			62.5 volts dc		1878 765			1955 565	
			125 volts dc		1878 766Ⓓ			1955 566	
			250 volts dc		1878 767			1955 567	
		50/60	12 volts ac	183A108	1878 768		183A457	1955 568	
			24 volts ac		1878 769			1955 569	
			90 volts ac		1878 770			1955 570	
			115 volts ac		1878 771			1955 571	
			208 volts ac		1878 772			1955 572	
			230 volts ac		1878 773			1955 573	
			275 volts ac		1878 774			1955 574	
			460 volts ac		1878 775			1955 575	
			575 volts ac		1878 776			1955 576	

Non-Adjustable Pickup, Double Pole, Molded Case (Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data			
				Internal Schematic	Solid Projection Cover	Projection Glass Window Cover	Semi-Flush Glass Window Cover
					Style Number	Style Number	Style Number
Rear Connected							
SG	Dpdt: 2 cc and 2 co	Dc	1 amp dc	1D2102	1157 848	1162 959	1342 932
			2 amps dc		1729 023	1729 024	1729 025
Current or voltage			3 amps dc		1157 849	1162 960	1342 933
			4 amps dc		1956 249	1956 253	1956 257
Self-reset			5 amps dc		1157 850	1162 961	1342 934
			6 volts dc		1343 116	1340 082	1343 117
			12 volts dc		1155 686	1162 949	1343 118
			24 volts dc		1155 687	1162 950	1342 923
			32 volts dc		1729 011	1729 012	1729 013
			48 volts dc		1155 688	1162 951	1342 924Ⓓ
			62.5 volts dc		1729 017	1729 018	1729 019
			125 volts dc		1155 689Ⓓ	1162 952	1342 925Ⓓ
			250 volts dc		1343 088	1343 089	1343 090
		50/60	12 volts ac		1956 250	1956 254	1956 258
			24 volts ac		1878 284	1878 285	1878 286
			90 volts ac		1956 251	1956 255	1956 259
			115 volts ac		1155 693	1162 956	1342 929Ⓓ
			208 volts ac		1728 053	1728 054	1728 005
			230 volts ac		1155 694	1162 957	1342 930
			275 volts ac		1956 252	1956 256	1956 260
			460 volts ac		1155 695	1162 958	1342 931
			575 volts ac		1725 778	1725 799	1725 780

Ⓓ Denotes item available from stock

Auxiliary, Ac Voltage, or Dc Voltage or Current
Non-Adjustable Pickup, Double Pole, Molded Base Without Cover, Open Type
(Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data Without Cover	
				Internal Schematic	Style Number
Front Connected					
SG	Dpst-2 cc	Dc	1 amp dc	570389	1157 852
			2 amps dc		1729 026
Current or voltage			3 amps dc		1157 853
			4 amps dc		1956 261
Self-reset			5 amps dc		1157 854
			6 volts dc		1338 226
			12 volts dc		1059 230
			24 volts dc		1059 231
			32 volts dc		1729 014
			48 volts dc		1008 534
			62.5 volts dc		1729 020
			125 volts dc		1008 535Ⓢ
			250 volts dc		1337 424Ⓢ
		50/60	12 volts ac		1153 654
			24 volts ac		1337 364
			90 volts ac		1537 212
			115 volts ac		1008 539Ⓢ
			208 volts ac		1726 056
			230 volts ac		1008 540
			275 volts ac		1009 884
			460 volts ac		1009 541
			575 volts ac		1544 302

Non-Adjustable Pickup, Double Pole, Molded Base, With and Without Cover (Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data Without Cover (Open Type)		Solid Cover & Base (Front Conn.)	
				Internal Schematic	Style Number	Internal Schematic	Style Number
Front Connected							
SG	Dpdt-2 cc and 2 co	Dc	1 amp dc	570390	1875 946	629A337	293B254A09
			2 amps dc		1729 027		293B254A10
Current or voltage			3 amps dc		1875 947		293B254A11
			4 amps dc		1956 245		293B254A12
Self-reset			5 amps dc		1875 948		293B254A13
			6 volts dc		1340 727		293B254A14
			12 volts dc		1205 619		293B254A15
			24 volts dc		1205 620Ⓢ		293B254A16
			32 volts dc		1729 015		293B254A17
			48 volts dc		1205 612Ⓢ		293B254A18Ⓢ
			62.5 volts dc		1729 031		293B254A19
			125 volts dc		1161 540Ⓢ		293B254A20Ⓢ
			250 volts dc		1210 936Ⓢ		293B254A21Ⓢ
		50/60	12 volts ac		1956 248		293B254A22
			24 volts ac		1878 282		293B254A23
			90 volts ac		1956 247		293B254A25
			115 volts ac		1205 618Ⓢ		293B254A26Ⓢ
			208 volts ac		1726 057		293B254A27
			230 volts ac		1205 617Ⓢ		293B254A28
			275 volts ac		1958 248		293B254A29
			460 volts ac		1205 618Ⓢ		293B254A30
			575 volts ac		1725 781		293B254A31

Ⓢ Denotes item available from stock.

Auxiliary, Ac Voltage, or Dc Voltage or Current
Non-Adjustable Pickup, Double Pole, Molded Base, With Glass Window Cover
(Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data: With Glass Window Cover — Internal Schematic	Style Number
Front Connected					
SG Current or voltage Self-reset	Dpdt-2 cc and 2 co	Dc	1 amp dc	629A337	293B255A09
			2 amps dc		293B255A10
			3 amps dc		293B255A11
			4 amps dc		293B255A12
			5 amps dc		293B255A13
			6 volts dc		293B255A14
			12 volts dc		293B255A15
			24 volts dc		293B255A16
			32 volts dc		293B255A17
			48 volts dc		293B255A18③
			62.5 volts dc		293B255A19
			125 volts dc		293B255A20③
			250 volts dc		293B255A21
		50/60	12 volts ac		293B255A22
			24 volts ac		293B255A23
			90 volts ac		293B255A25
			115 volts ac		293B255A26③
			208 volts ac		293B255A27
			230 volts ac		293B255A28
			275 volts ac		293B255A29
			460 volts ac		293B255A30
			575 volts ac		293B255A31

Auxiliary Dc Voltage or Current, Non-Adjustable Pickup, With Copper Slug
For Time Delay Dropout, Intermittent Duty, Dc Operated (Device Number: 94X, Y, Z)

Type	Contacts	Rating	Relay Data: Molded Base With Solid Cover Projection Mounting — Internal Schematic	Style Number	Molded Base With Glass Window Cover: Semi-Flush Mounting — Internal Schematic	Style Number
Rear Connected						
SG Self-reset	Dpdt 2 cc and 2 co	1 amp dc	182A903	1961 590	1D2102	1961 593
		3 amps dc		1961 591		1961 594
		5 amps dc		1961 592		1961 595
		24 volts dc		1961 578		1961 582
		48 volts dc		1961 579		1961 583
		125 volts dc		1961 580		1961 584③
		250 volts dc		1961 581		1961 585

Type	Contacts	Rating	Relay Data: Molded Base Without Cover — Internal Schematic	Style Number	Molded Base With Solid Cover — Internal Schematic	Style Number	Molded Base With Glass Window Cover — Internal Schematic	Style Number
Front Connected								
SG Self-reset	Dpdt 2 cc and 2 co	1 amp dc	57D390	1961 596	629A337	293B257A09	629A337	293B256A09
		3 amps dc		1961 597		293B257A11		293B256A11
		5 amps dc		1961 598		293B257A12		293B256A12
		24 volts dc		1961 586		293B257A17		293B256A17
		48 volts dc		1961 587		293B257A18		293B256A18
		125 volts dc		1961 588		293B257A19		293B256A19
		250 volts dc		1961 589		293B257A20		293B256A20

③ Denotes item available from stock

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL 33065

Instruction Leaflet
41-751N

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Effective: September 1995
Supersedes I.L. 41-751M, Dated August 1980
(|) Denotes Change Since Previous Issue.

Type S
Auxiliary Relay

CAUTION

Before putting protective relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

1. APPLICATION

The relay is intended for use in the applications requiring:

(1) Increased current-carrying or interrupting capability in a contact (low current contact energizes the SG coil to close the high current contact).

(2) Circuit isolation.

(3) Contact conversion (for example, from a normally open to a normally closed condition), or

(4) Contact multiplication (from one contact input to two contact output).

The SG relay is available with 2 N.O. (normally-open) and 2 N.C. (normally-closed) contacts. They change condition when the coil is energized at a voltage level above pickup. The contacts are arranged in a 3-lead configuration with a "common" connected to a N.C. and a N.O. contact.

The relay can be supplied with suitable coils for use on the following voltages:

6, 12, 24, 48, 125 and 250 volts dc
115 and 230 volts - 25 hertz
115, 230, 440 and 575 volts - 50 or 60 hertz

By using a series resistor, each of the different voltage relays may be used on higher voltage systems provided the proper dielectric and safety considerations are observed.

2. CONSTRUCTION & OPERATION

The SG relays are clapper-type devices designed to operate over a wide range of ac and dc voltages. When their coils are energized at or above pickup rating, the moving contacts on the armature assembly, close and/or open with the two stationary contacts to activate the electrically independent contact circuits.

Closed types are supplied with two make and two break contacts. Open types (front connected) can be supplied with two make and two break contacts, or with only the two make contacts which can be reversed to provide one make, one break, or two break contact circuits. Contact gap and follow should be readjusted per Table 1 after contacts have been reversed. Adjustment is accomplished by bending the stationary contacts.

Small coil springs on the moving contact arms provide adequate contact pressure to assure positive contact action between the moving and stationary contacts.

Dc types have a bronze pin on the core which serves as a stop pin for the armature, and prevents magnetic seal-in of the armature due to residual magnetism. Ac types have a non-magnetic washer at the base of the core assembly to prevent the armature from sticking in the closed-gap position. Copper shading

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

Printed in U.S.A.

rings are also provided on the core face of the ac types to prevent chattering of the armature.

3. CHARACTERISTICS

All relays will pick up at 80% of the nameplate voltage rating or less. No adjustments are provided for varying the pickup. The armature will open at 30% or less on direct current and at 60% or less on alternating current.

4. INSTALLATION

Mount the relay with the base against a vertical plane and with the contacts at the top.

When sheet metal cabinets are ordered for open-type relays, the relays and cabinets are shipped separately. The relays can be assembled on the tapped mounting holes in the bottom of the case by means of the mounting screws which are provided. The cabinets have knockouts for conduit connections on top, bottom and sides.

5. BURDEN

The closed gap volt-ampere burden at rated voltage (60 hertz) is 10, at a power factor of approximately 50%. The open gap volt-ampere burden at rated voltage (60 hertz) is 16, at the same power factor. The watt consumption at rated dc voltage is 3.5.

6. CONTACTS

Each contact will carry 12 amperes continuous and 30 amperes for one minute.

The contact interrupting ratings are as follows: All values are non-inductive currents.

INTERRUPTING RATING IN AMPERES

Volts	dc 1 Contact	2 Contacts in Series	ac 1 Contact
24	15	50	50
48	8	35	45
115	2.4	20	30
230	0.75	2.5	20
550	0.25	0.5	10

OPERATING TIME

Pickup: .033 - .05 sec. at dc rating
.016 - .033 sec. at ac rating

Dropout: less than .016 sec. on dc or ac

COIL DATA - DC

Rating amps	Volts	Resistance: Ohms	1 Second Rating: amps
1	-	2.5	35
2	-	0.7	55
3	-	0.33	85
4	-	0.2	110
5	-	0.1	185
-	5	12	-
-	12	48	-
-	24	185	-
-	32	294	-
-	48	725	-
-	62.5	1152	-
-	125	4850	-
-	250	17000	-

TABLE 1:
CONTACT GAP AND FOLLOW ADJUSTMENT

Contact Arrange	Contact Gap	Make-Contact Follow
2M	5/32"	3/64"
2B	5/32"	-
SPDT	5/32"	3/64"
DPDT	1/8-9/64"	3/64"
Break Contact Follow		
	(1)	(2)
2M	-	-
2B	1/32-3/64"	0.020-0.031"
SPDT	3/64"	0.031"
DPDT	3/64"	0.031"

7. MAINTENANCE

All contacts should be cleaned periodically. A contact burnisher style 182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

8. REPAIR AND RENEWAL PARTS

Major repairs can be most satisfactorily done at the factory or ABB Service Shops. However, for customers equipped to do their own work, parts may be furnished on order. In ordering any part or requesting any other information, always give entire nameplate data.

Relays for use on ac are assembled with a thin bronze washer between the yoke and core. A brass screw holds the yoke and core together. This washer helps to reduce the residual magnetism after the relay is de-energized. In case the relay should be dismantled, it is important that this washer be replaced when re-assembling it.

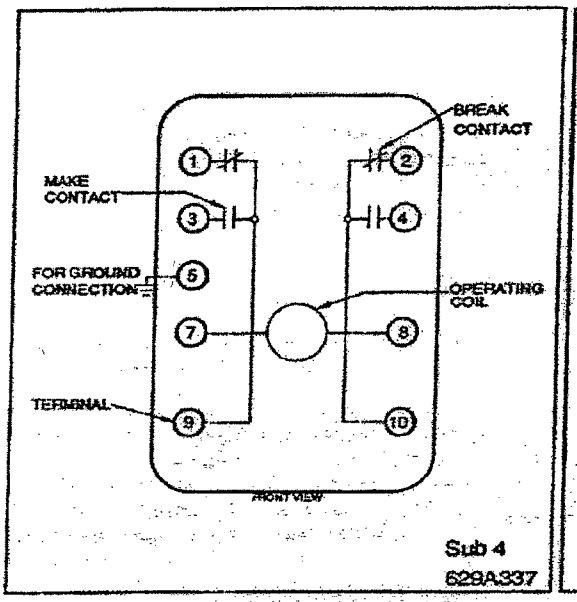


Figure 1. Internal Schematic for Type SG Relay in front connected case.

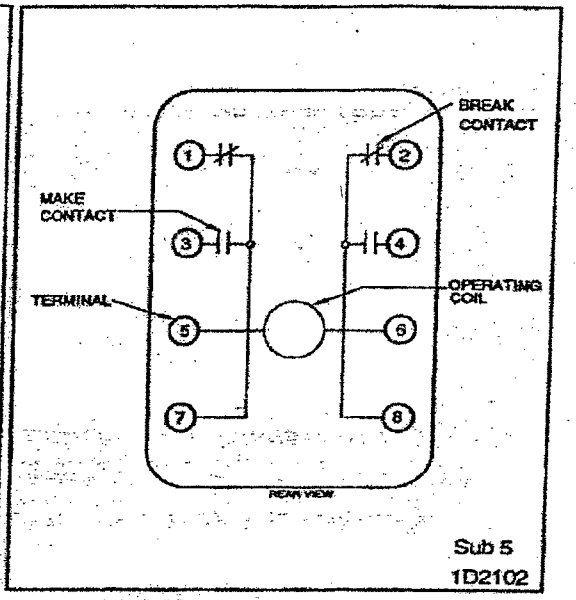


Figure 2. Internal Connections for Closed Type SG Relay.

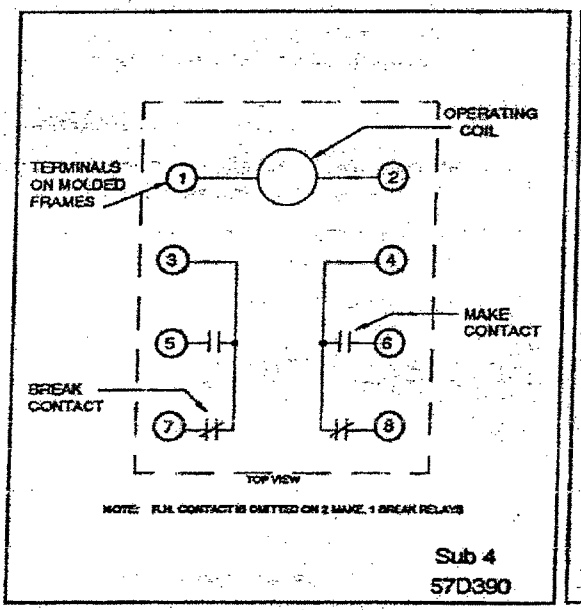


Figure 3. Internal Connections for 2-Make and 2-Break contact Open Type SG Relay.

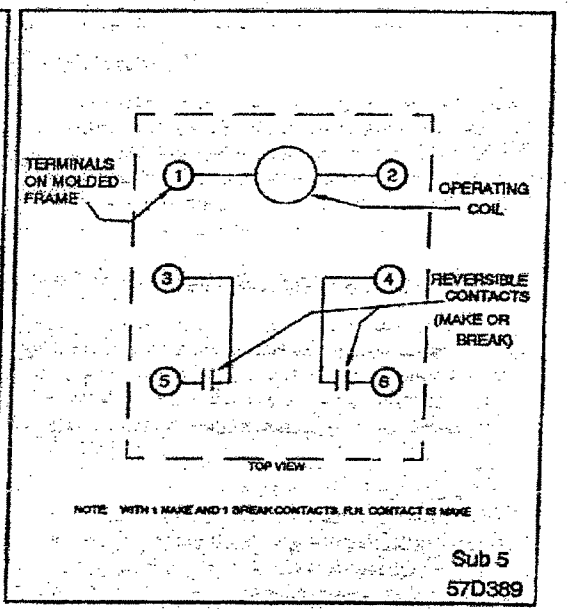


Figure 4. Internal Connections for Open Type SG Relay with Reversible Contacts.

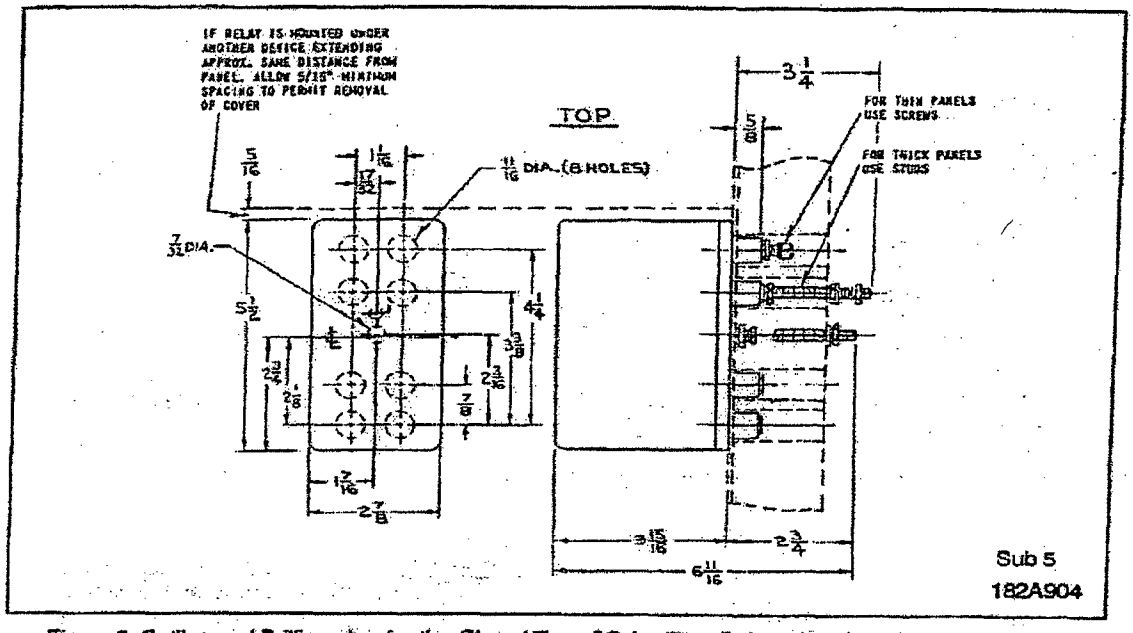


Figure 5. Outline and Drilling plan for the Closed Type SG Auxiliary Relay with 5/8 inch terminal studs.

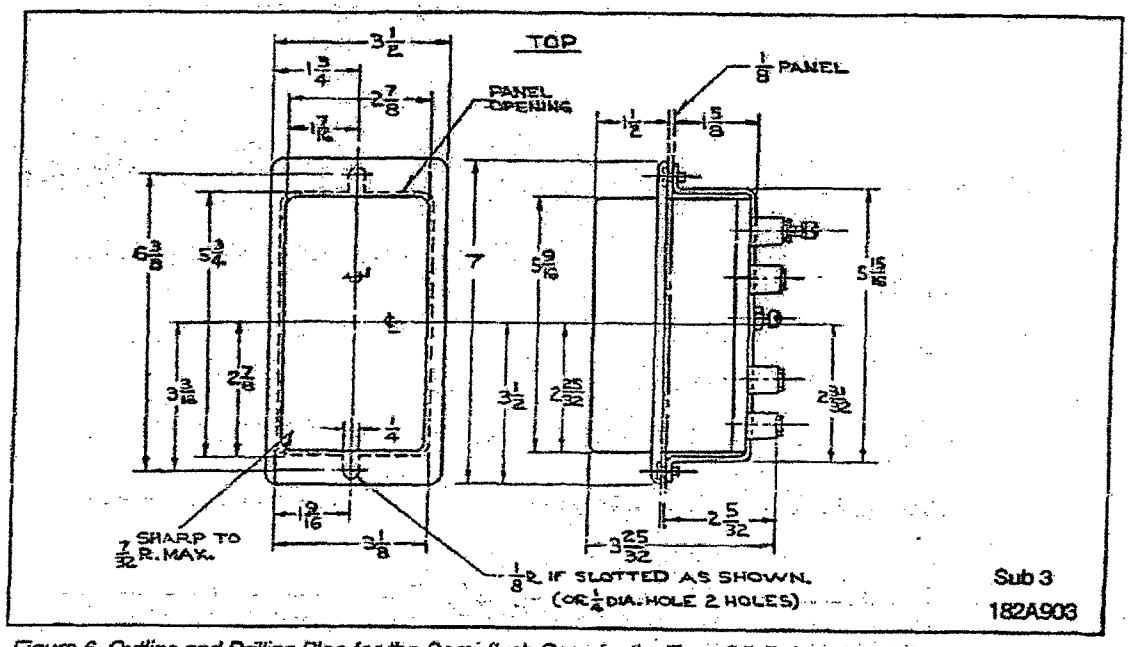


Figure 6. Outline and Drilling Plan for the Semi-flush Case for the Type SG Relay with 5/8 inch terminal studs.

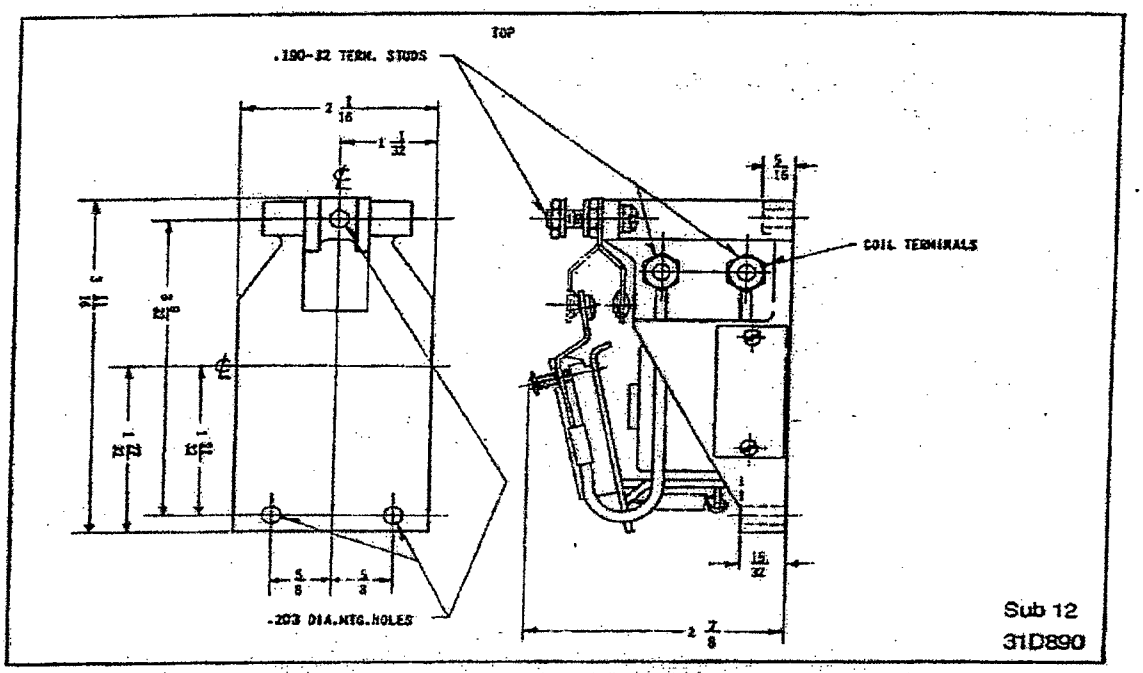


Figure 7. Outline and Drilling Plan for the Open Type SG Auxiliary Relay with Reversible Contacts.

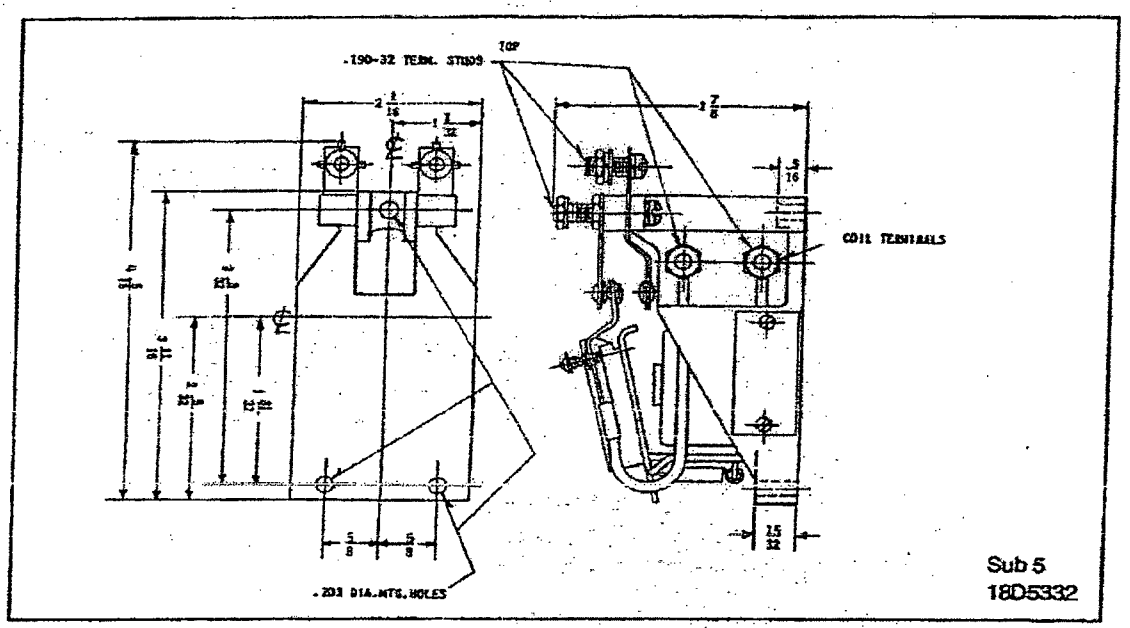


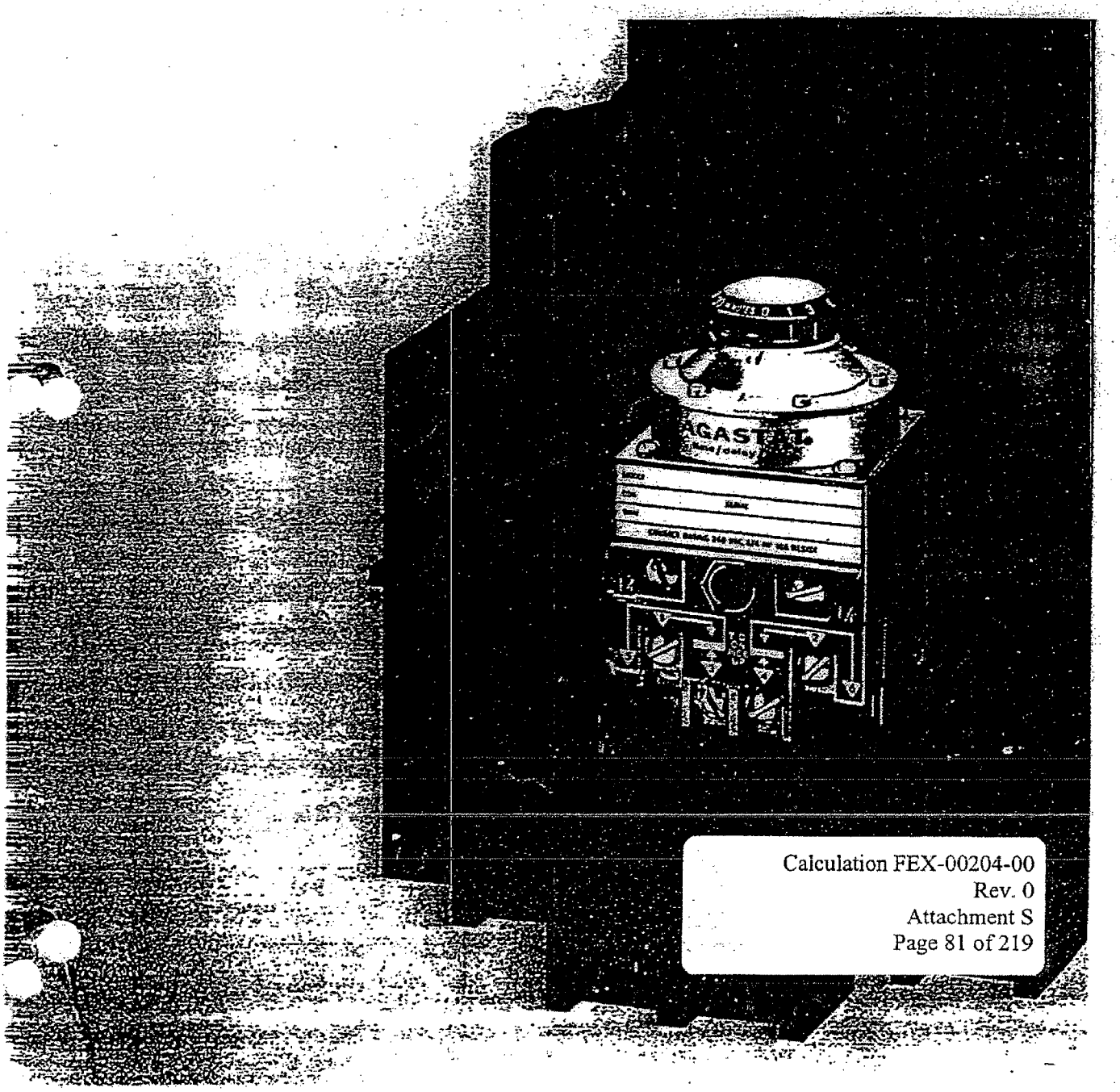
Figure 8. Outline and Drilling Plan for the 2-Make and 2-Break Contact Open Type SG Relay.

AGASTAT®

timing relays 2400 series

ITEM NOS. 48, 81 [redacted]

V0383 P1 R5



The AGASTAT® 2400 Series timing relay opens new areas of application potential for electropneumatic timing devices. It represents a significant advance in the state-of-the-art, the end product of many years of highly-specialized research and development by the acknowledged leader in this field. Imaginative design and modern materials combine to eliminate the problems circuit designers experienced with earlier pneumatic timers. Today, AGASTAT relays provide the versatility and reliability matched only by the most sophisticated electronic controls, with a bonus of economy and ruggedness which puts them in a class by themselves.

These outstanding features of the 2400 Series serve to illustrate its design superiority:

TIME-CALIBRATED ADJUSTMENT DIALS – all ranges from milliseconds to minutes, are fully calibrated in linear increments, for the most practical, precise adjustment ever available in electropneumatic timers.

LONGEST TIME RANGES – standard ranges from milliseconds to 60 minutes, with outstanding repeatibility at all points.

FRONT TERMINALS – easy-to-reach screw terminals, all on the face of the unit, clearly identified.

MODULAR ASSEMBLY – timing head, coil assembly and switchblock all individual modules, with coils and switches field-replaceable. Auxiliary switches easily added in the factory or the field.

Design

Other manufacturers assemble timers using switches, solenoid coils or other parts originally designed for non-timing applications. Extensive research through the years has proven, however, that the proper balance of electrical, mechanical, and pneumatic forces required to produce a reliable timing instrument cannot be achieved in this manner. This is why every component of the AGASTAT timing relay has been expressly designed for its specific role in the overall timing function. These are the main components of the 2400 Series relays:

CALIBRATED TIMING HEAD uses no needle valve, recirculates air under controlled pressure through a variable orifice to provide linearly adjustable timing. Patented design provides instant recycling, easy adjustment and long service life under severe operating conditions.

PRECISION-WOUND POTTED COIL module supplies the initial motive force with minimum current drain. Total sealing without external leads eliminates moisture problems, gives maximum insulation value.

NEW SNAP-ACTION SWITCH ASSEMBLY – custom-designed over-center mechanism provides greater contact pressure up to transfer time for positive, no-flutter action. Standard switches are DPDT arrangement, with flexible beryllium copper blades and silver-cadmium oxide contacts. Special "timing-duty" design assures positive wiping action, sustained contact pressure and greater heat dissipation during long delay periods. SPDT switches are also available.

Each of these sub-assemblies forms a self-contained module which is then assembled at the factory with the other two to afford a wide choice of operating types, coil voltages, and timing ranges.

The modern squared design with front terminals and rear mounting permits the grouping of 2400 Series units side-by-side in minimum panel space. Auxiliary switches may be added in the base of the unit, without affecting the overall width or depth.

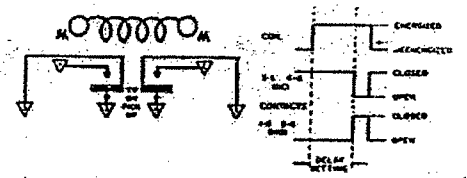
Operation

Two basic operating types are available. "ON-DELAY" models provide a delay period on energization, at the end of which the switch transfers the load from one set of contacts to another. Deenergizing the unit during the delay period immediately recycles the unit, readying it for another full delay period on reenergization.

In "OFF-DELAY" models the switch transfers the load immediately upon energization, and the delay period does not begin until the unit is deenergized. At the end of the delay period the switch returns to its original position. Reenergizing the unit during the delay period immediately recycles the unit, readying it for another full delay period on deenergization. No power is required during the timing period.

In addition to these basic operating types, "Double Head" models offer sequential delays on pull-in and drop-out in one unit, as described on page 3. With the addition of auxiliary switches the basic models provide two-step timing, pulse actuation for interlock circuits, or added circuit capacity.

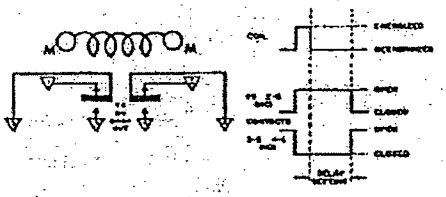
On-Delay Models (Delay on pick-up)



Applying a continuous voltage to the coil (M-M) starts a time delay lasting for the preset time. During this period the normally closed contacts (3-5 and 4-6) remain closed. At the end of the delay period the normally closed contacts break and the normally open contacts (1-5 and 2-6) make. The contacts remain in this transferred position until the coil is deenergized, at which time the switch instantaneously returns to its original position.

Deenergizing the coil, either during or after the delay period, will recycle the unit within .025 second. It will then provide a full delay period upon reenergization, regardless of how often the coil voltage is interrupted before the unit has been permitted to "time-out" to its full delay setting.

Off-Delay Models (Delay on drop-out)

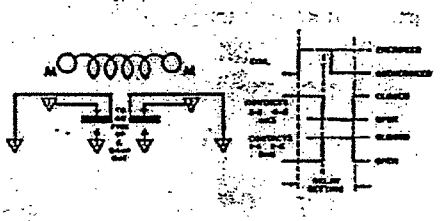


Applying voltage to the coil (for at least .050 second in AC units, .100 second in DC units for accuracy of timing) will instantaneously transfer the switch, breaking the normally closed contacts (1-5 and 2-6), and making the normally open contacts (3-5 and 4-6). Contacts remain in this transferred position as long as the coil is energized. The time delay begins immediately upon deenergization. At the end of the delay period the switch returns to its normal position.

Reenergizing the coil during the delay period will immediately return the timing mechanism to a point where it will provide a full delay period upon subsequent deenergization. The switch remains in the transferred position.

On-Delay, Off-Delay Models

(Double Head)

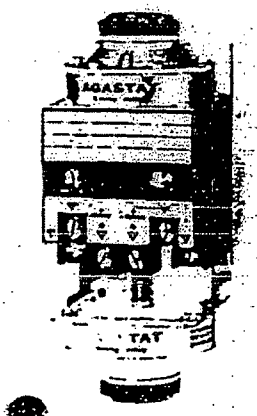


The Double Head model provides delayed switch transfer on energization of its coil, followed by delayed resetting upon coil deenergization. Each delay period is independently adjustable.

In new circuit designs or the improvement of existing controls now using two or more conventional timers, the Double Head unit offers distinct advantages.

Its compact design saves precious panel space, while the simplified wiring reduces costly interconnections.

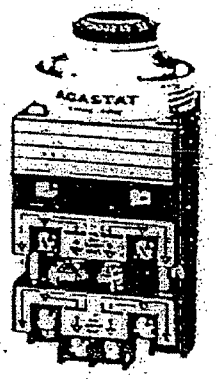
NOTE: Since On-Delay, Off-Delay models do not recycle instantly, successive energization and deenergization cycles of shorter duration than the time set on the upper head will eventually transfer the switch in the net "on" time. For normal "two-way" operation these models must remain energized and deenergized for at least as long as the time set on the upper and lower heads, respectively. Other circuits providing "two-way" action without this cumulative effect are available; consult factory for details.



Four Pole Models

With the addition of an extra switch block at the bottom of the basic unit, this version of the 2400 Series offers four pole switch capacity with simultaneous timing or two-step timing. The two-step operation is achieved by factory adjustment to your specifications.

For two-step operation, a maximum timing ratio between upper and lower switches of 3:1 is recommended. Once adjusted at the factory, this ratio remains constant regardless of changes in dial settings. (Ex: if upper switch transfer is set on dial at 60 sec., minimum time on lower switch should be 20 sec.)



This 2400 Series unit offers many of the performance features found in basic models in the series—voltage ranges, timing and switch capacities are virtually identical.

Four pole models add approximately 1¼" to the maximum height of the basic model, approximately 1/8" to the depth.

Timing Adjustment

The AGASTAT 2400 Series is the first electropneumatic timer to offer the ease of adjustment and resetting of a calibrated dial head. Discrete ranges covering a total span from .1 second to 60 minutes are available, as well as a cycle-calibrated range. (See table on page 4.) Each has its own calibrated, clearly identified dial. Timing is set by simply turning the dial (in either direction) to the desired time value. The standard head has no stops—it can safely be turned past the 360° point, although a "dead zone" of approximately 60° separates the high and low ends of each range.

Mounting/Terminals

Normal mounting of the basic unit is in a vertical position, from the back of the panel. Four tapped holes are provided in the back plate of the unit, making it interchangeable with earlier AGASTAT timer models. A front mounting bracket is also supplied with each basic unit, for installation from the front of the panel.

Standard screw terminals (8-32 truss head screws supplied) are located on the front of the unit, with permanent schematic markings. Barrier isolation is designed to accommodate spade or ring tongue terminals, with spacing to meet all industrial control specifications.

Basic models may also be horizontally mounted, and will be adjusted accordingly *when specified on your order.*

A horizontal panelmount style (Models 2452 and 2462) is also available, offering the convenience of "out-front" adjustment, with large calibrated faceplate and modern dial skirt knob. The modern bezel and knob blend with advanced equipment and console designs, while the body of the unit and its wiring are protected inside the cabinet. Faceplates are calibrated in all standard ranges.

Other mounting options include plug-in styles and special configurations to meet unusual installation requirements. Your inquiries are invited.

Agastat® timing relays 2400 series

Specifications (All values shown are at nominal operating voltage and 77°F unless otherwis

Linear Timing Ranges

A .1 to 1 Sec.	E 10 to 200 Sec.	I 2 to 60 Min.*
B .2 to 5 Sec.	F .5 to 10 Min.	J 3 to 120 Cyc.**
C .8 to 15 Sec.	G 1 to 20 Min.	K 1 to 300 Sec.
D 2.5 to 50 Sec.	H 1 to 30 Min.	

* Not available with time-calibrated dials in Models 2414, 2424, 2432.
**Not available in Models 2414, 2424, 2432.

All dial head units are furnished with dials calibrated in linear increments covering the range selected. In addition, time-calibrated ranges C through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

In addition to the dial head models above, the basic 2400 Series units are also available with needle valve adjustment. They are recommended only for applications where frequent readjustment of the delay period is not required, or where initial cost is a prime consideration. One timing range is offered:

Code N .2 to 180 sec.

Coil data, switch capacities and other performance specifications are identical with dial head models.

Contact Ratings

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Contact Ratings as listed under the UL Component Recognition Program:

120/240 VAC	½ H.P.
120/240 VAC	10 A. RES.
600 VAC	5 A.G.P.
30 VDC	15 A.G.P.

Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Maximum total loads for four pole units are twice the values given above.

All specifications listed here are for reference only, and are subject to continuing revision. Verified drawings are available on request. If your requirements cannot be met by the standard production units described here, they may be filled by one of the many non-standard models produced by us over the years. Many of these unusual configurations are available on a shorter-delivery, lower-cost basis than a purely custom model. We welcome your inquiry.

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400	A	120	102-132	110	93.5-121
	B	240	204-264	220	187-242
	C	480	408-528		
	D	550	468-605		
	E	24	20.5-26.5		
AC	F			127	108-140
	G			240	204-264
	H	12	10.2-13.2		
	I	6	5.1-6.6		
	J	208	178-229		
	K	Dual Voltage Coil (Combines A&B)			
	L	Special AC Coils (L1, L2, etc.)			
2410	M	28	22.5-33.5		
	N	48	38.5-57.5		
	O	24	19.2-28.8		
	P	120	96-144		
	Q	12	9.6-14.4		
DC	R	60	48-74		
	S	250	200-300		
	T	550	440-660		
	U	16	12.8-19.2		
	V	32	25.6-38.4		
	W	96	76.8-115		
	Y	6	4.8-7.2		
	Z	220	176-264		
	X	Special DC Coils (X1, X2, etc.)			

All units draw approximately 8 watts power at rated voltage. Minimum operating voltages are based on vertically mounted 2412 units. 2412 horizontally mounted or 2422 vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

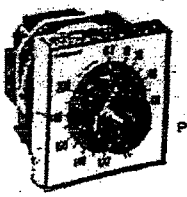
AC units drop out at approximately 50% of rated voltage. DC units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycles at voltages 10% above the listed maximums. (Intermittent duty = maximum 50% duty cycle and 30 minutes "on" time.)

Repeat Accuracy

For units set at 200 sec. or under—better than ±5% of preset adjustment. For longer time settings—better than ±10% of preset adjustment.

In 20, 30, and 60 minute delay on pull-in units the first delay will be approximately 20% longer than subsequent delays after coil warm-up.



Panelmount Style

d.)

Ambient Temperature Range

Rated performance over an ambient range of −67°F to 165°F. Temperature effect on preset delays will be less than ±10% between 0°F and 165°F.

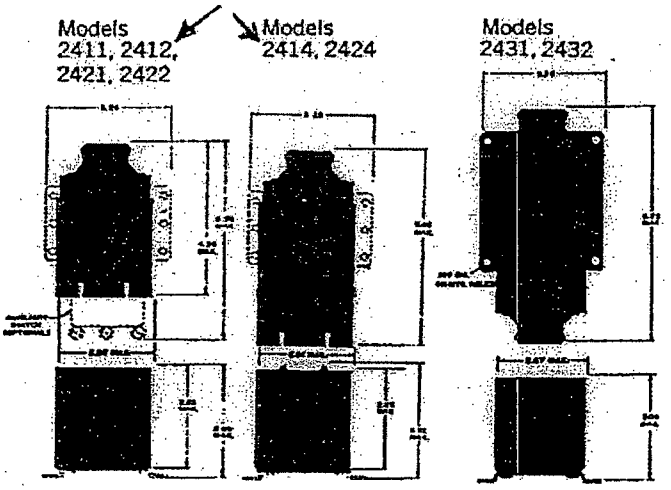
Dielectric

Withstands 1500 volts RMS 60 Hz between terminals and ground; 1,000 volts RMS 60 Hz between non-connected terminals.

Insulation Resistance

500 Megohms with 500 VDC applied.

Dimensions



UL Listed, FM and CSA Approved

Model 2412 and 2422 AGASTAT Timing Relays are listed under the Component Recognition Program of Underwriters' Laboratories, Inc. Also Factory Mutual and CSA approved. Request data on approval details.

Approximate Weights

Models 2411, 2412, 2421, 2422	1 lb. 13 ozs.
2414, 2424	1 lb. 15 ozs.
2432	3 lbs. 5 ozs.

Weight may vary slightly with coil voltage.

Auxiliary Switch Options

To increase the versatility of the basic timer models, auxiliary switches may be added to either on-delay or off-delay types. They switch additional circuits, provide two-step timing action, or furnish electrical interlock for sustained coil energization from a momentary impulse, depending on the type selected and its adjustment. Because of their simple attachment and adjustment features, they can be installed at the factory or in the field, by any competent mechanic. All auxiliary switches are SPDT with UL listings of 10A @ 125, 250, or 480 VAC. A maximum of one Code T or two Code L auxiliary switches may be added to each relay.

For On-Delay Models

Instant Transfer (Auxiliary Switch Code L)
1. Energizing coil begins time delay and instantly transfers auxiliary switch.
2. Main switch transfers after total preset delay.
3. Deenergizing coil resets both switches instantly.

Auxiliary switch is non-adjustable.

Two-Step Timing (Auxiliary Switch Code T)
1. Energizing coil begins time delay.
2. After first delay auxiliary switch transfers.
3. Main switch transfers after total preset delay.
4. Deenergizing coil resets both switches instantly.

First delay is independently adjustable, up to 50% of overall delay. (Recommended maximum 100 seconds)

For Off-Delay Models

In these models the same auxiliary switch provides either two step timing or instant transfer action, depending on the adjustment of the actuator.

Two-Step Timing (Auxiliary Switch Code T)
1. Energizing coil transfers main and auxiliary switches instantly.
2. Deenergizing coil begins time delay.
3. After first delay auxiliary switch transfers.
4. Main switch transfers after total preset delay.

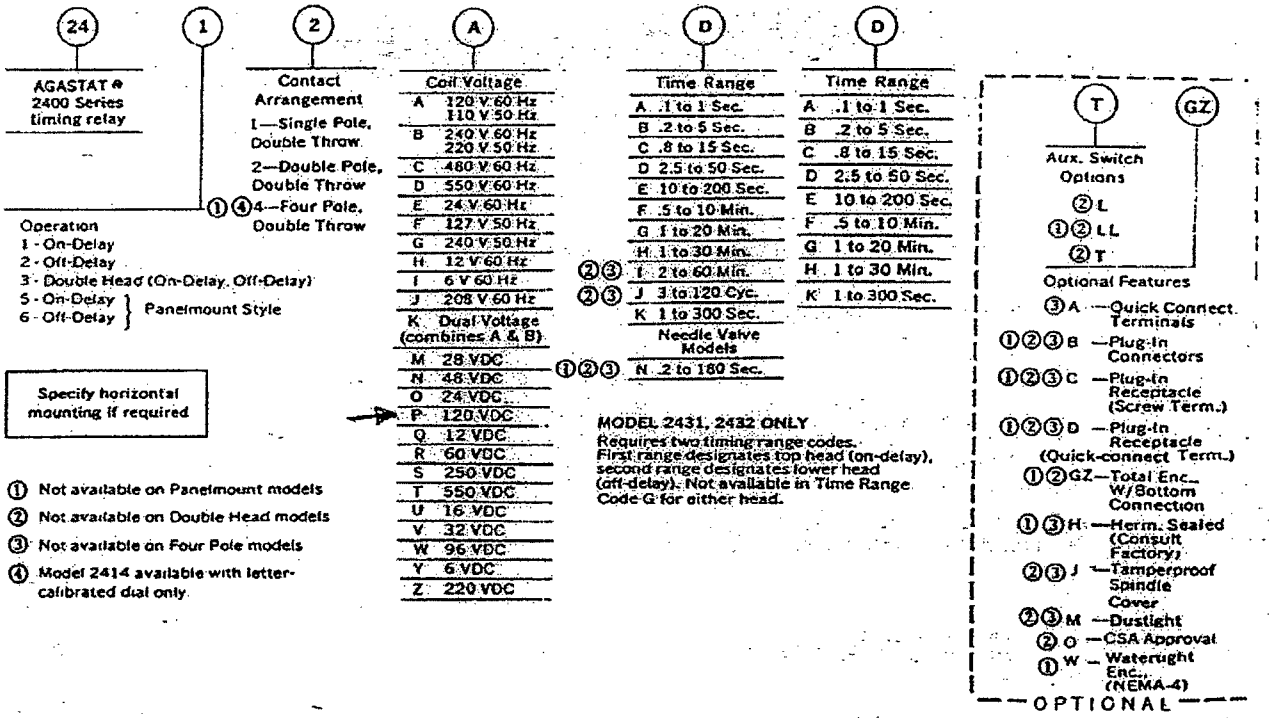
First delay is independently adjustable, up to 50% of overall delay. (Recommended maximum 100 seconds)

Instant Transfer (Auxiliary Switch Code T)
1. Energizing coil transfers main and auxiliary switches instantly.
2. Deenergizing coil instantly resets auxiliary switch and begins time delay.
3. Main switch transfers after total preset delay.

Auxiliary switch is factory adjusted to give instant transfer operation, but may be easily adjusted in the field to provide two-step timing.

Agastat® timing relays 2400 series

Model Number Code



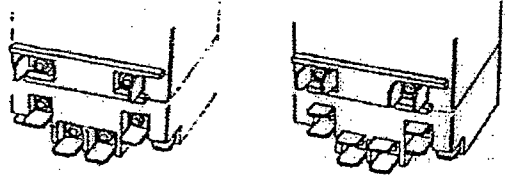
Calculation FEX-00204-00
Rev. 0
Attachment S
Page 86 of 219

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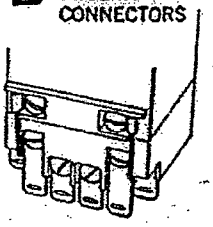
SR-2 April 1972 (supersedes July 1970) V0363 P7 R5

Accessories

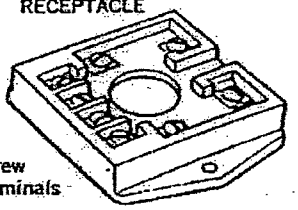
A1 SINGLE QUICK-CONNECT TERMINALS **A2** DOUBLE



B PLUG-IN CONNECTORS

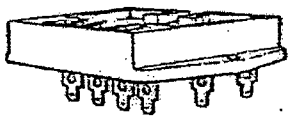


C PLUG-IN RECEPTACLE



Screw Terminals

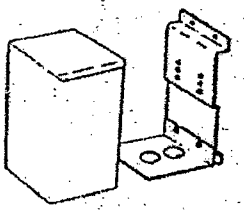
D PLUG-IN RECEPTACLE



Quick-Connect Terminals

GZ

TOTAL ENCLOSURE with Knockouts for Bottom Connection

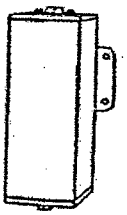


3.16" W. x 3.84" D. x 7.63" H.

H2

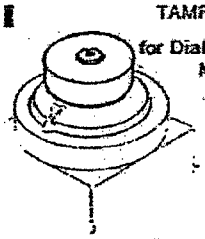
HERMETICALLY SEALED ENCLOSURE with Solder Hook Terminals

3.62" W. x 3.56" D. x 8.19" H.
Bracket: 5.12" W. x 2.75" H.

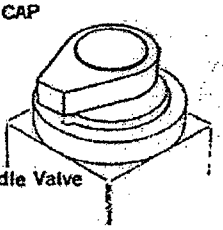


I TAMPER PROOF CAP

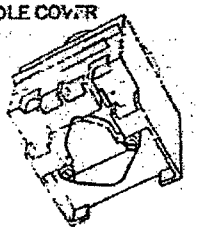
for Dial Head Models



for Needle Valve Models

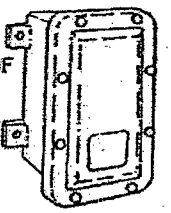


J SPINDLE COVER

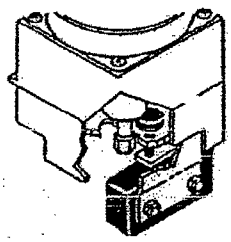


K EXPLOSION PROOF ENCLOSURE

(Meets requirements for Class I, Groups C & D locations.)

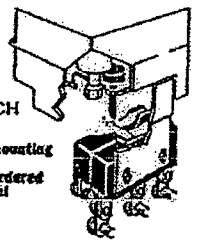


6.50" W. x 5.63" D. x 10.50" H.

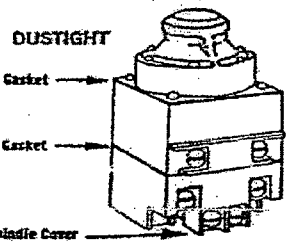


L **LL** AUXILIARY SWITCH KIT

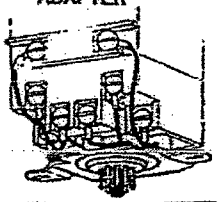
Includes all necessary mounting hardware. Factory-installed when ordered with unit as part of model number code.



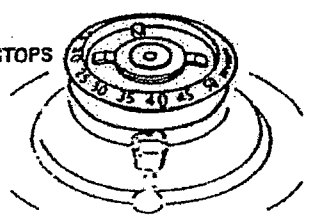
M DUSTIGHT



P OCTAL PLUG ADAPTER

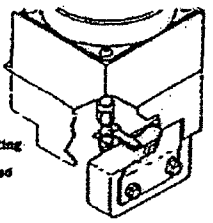


S STOPS

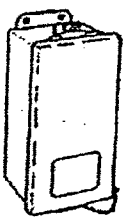


T AUXILIARY SWITCH KIT

Includes all necessary mounting hardware. Factory-installed when ordered with unit as part of model number code.



W WATERTIGHT ENCLOSURE (NEMA-4)



4.75" W. x 4.44" D. x 9.75" H.

Coil Data

Coil Part Number	Code Letter	Rated Voltage @ 60 Hz	Operating Voltage Range @ 60 Hz	Rated Voltage @ 50 Hz	Operating Voltage Range @ 50 Hz
2400—	A	120	102-132	110	93.5-121
	B	240	204-264	220	187-242
	C	480	408-528		
	D	550	468-605		
	E	24	20.5-26.5		
	F			127	108-140
	G			240	204-264
	H	12	10.2-13.2		
	I	6	5.1-6.6		
	J	208	178-229		
	K	DUAL VOLTAGE COIL (COMBINES A & B)			

AC

AC SPECIALS L1, L2, etc.

A C Coils (Part No — 2400 followed by dash and code letter above)

Coil Part Number	Code Letter	Rated Voltage	Operating Voltage Range D C
2410—	M	28	22.5-33.5
	N	48	38.5-57.5
	O	24	19.2-28.8
	P	120	96-144
	Q	12	9.6-14.4
	R	60	48-74
	S	250	200-300
	T	550	440-660
	U	16	12.8-19.2
	V	32	25.6-38.4
	W	96	76.8-115
	Y	6	4.8-7.2
	Z	220	176-264

DC

DC SPECIALS X1, X2 etc.

D C Coils (Part No — 2410 followed by dash and code letter above)

All units draw approximately 8 watts power at rated voltage.

Minimum operating voltages are based on vertically mounted 2412 (Type 1) units. 2412 horizontally mounted or 2422 (Type 2) vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately 5% lower than those listed.

A C units drop out at approximately 50% of rated voltage. D C units drop out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycle at voltages 10% above the listed maximums. (Intermittent duty —maximum 50% duty cycle and 30 minutes "on" time.)

AUXILIARY SWITCH ADJUSTMENT

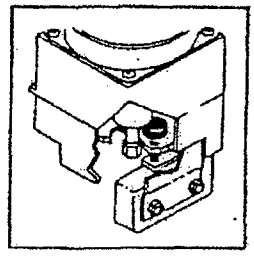
2412 SERIES

INSTANT TRANSFER AUX. SWITCH (CODE L)

Aux. switch should transfer immediately when relay coil is energized; and should reset shortly before solenoid core returns to its normal position, following deenergization. If it fails to reset before end of core's downward stroke, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.

TWO STEP AUX. SWITCH (CODE T)

Aux. switch contacts should transfer following first delay period after coil energization; and should reset shortly before core returns to its normal position, following coil deenergization. To increase first delay period, increase the distance between actuator screw head and arm by turning screw with a ¼" open-end wrench.*



Auxiliary Switch Code L

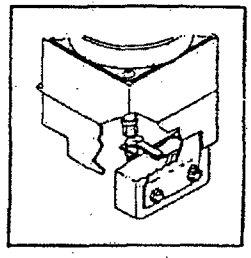
2422 SERIES

AUX. SWITCH (CODE T)— INSTANT TRANSFER SETTING

Aux. Switch should transfer immediately when relay coil is energized and should reset during initial motion of the spindle following de-energization. To adjust reset point of switch, turn the actuator screw with a ¼" open-end wrench.

AUX. SWITCH (CODE T) TWO STEP SETTING

Aux. Switch should transfer immediately when relay coil is energized, and should reset after the first delay period following de-energization. To increase first delay period, increase the distance between actuator screw head and arm by turning screw with a ¼" open-end wrench.*



Auxiliary Switch Code T

* First delay is independently adjustable but must be no more than 25% of overall delay.

TIMING RANGES

A	.1 to 1 sec.	G	1 to 20 min.
B	.2 to 5 sec.	H	1 to 30 min.
C	.6 to 15 sec.	I	2 to 60 min.
D	2.5 to 50 sec.	J	3 to 120 cyc.
E	10 to 200 sec.	K	1 to 300 sec.
F	.5 to 10 min.		

All dial head units are furnished with dials calibrated in linear increments covering the range selected. In addition, ranges C through K provide non-linear adjustment from .2 seconds to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable for the application should be selected.

In addition to the dial head models above, the 2400 Series are also available with needle valve adjustment. They are recommended only for applications where frequent readjustment of the delay period is not required, or where initial cost is a prime consideration. One timing range is offered:

N	.2 to 180 sec.

All needle valve models are factory adjusted to the delay specified; if no delay is specified, the unit is set for an approximate 10 seconds delay. To change this setting, turn the adjusting screw SLOWLY clockwise to increase the time delay, counterclockwise to decrease it, as indicated by the "increase" and "decrease" arrows on the timing head. CAUTION: Turn the screw only a fraction of a revolution before each timing check to avoid damaging the needle or orifice.

CONTACT RATINGS

Contact Capacity in Amperes (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 v 60 Hz	20.0	15.0
240 v 60 Hz	20.0	15.0
480 v 60 Hz	12.0	10.0

Inductive and capacitive loads should not have inrush currents that exceed five times normal operating load.

Contact rating is UL listed at 120/240 V.A.C., ¼ H.P., 10 A. Resistive; 600 V.A.C., 5A.; 30 V.D.C., 15A.

WARRANTY

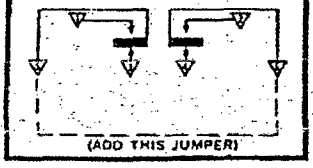
The AGASTAT timing relay is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. New parts will be furnished free of charge in exchange for parts which have proven defective. The furnishing of these parts shall constitute fulfillment of the Company's obligations and liabilities.

REPLACEMENT ASSEMBLIES

PART NO	
2412-30	DPDT Switchblock Assembly
2400 (AC)*	Coil Assembly, voltage as specified by code letter. (See Coil Data Chart)
2410 (DC)*	
2412-330	Auxiliary Switch Kit (Code L)
2412-121	Auxiliary Switch Kit (Code T)

* Specify with code letter

HOW TO CONVERT 2400 SERIES SWITCH FROM DPDT TO SPDT



AMERACE·ESNA
CORPORATION
AGASTAT DIVISION
1027 Newark Avenue

«Revised Since Last Printing

Printed in U.S.A.

2400 SERIES AGASTAT time/delay/relay

AUXILIARY SWITCH KITS

INSTALLATION and OPERATION INSTRUCTIONS

2412 SERIES (TYPE 1)

DELAY ON PULL-IN

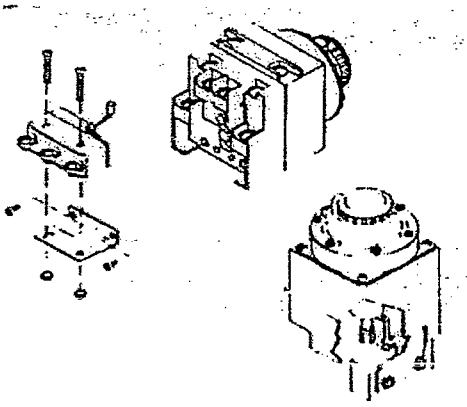
Two types of auxiliary switches are supplied for 2412 Series units. When the relay coil is energized, they provide either adjustable delayed transfer of the auxiliary contacts (two step timing), or instant transfer of the auxiliary contacts. In either type, the auxiliary switch transfer is followed by the normal delayed transfer of the main switch.

INSTALLING INSTANT TRANSFER AUXILIARY SWITCH (CODE L)

THIS KIT (PART 2412-120) CONTAINS:

(1) Snap-action switch with nylon-bumper actuator.
(2) 6-32 x 7/8" switch mounting screws and ELASTIC STOP nuts.
(2) 3-48 x 5/16" bracket mounting screws.
(1) Switch mounting bracket.
(1) Contact Identification Plate.

1. Apply contact identification plate over existing terminal markings on switch.
2. Attach the mounting bracket (without switch attached) to the bottom of the terminal block, using the two 3-48 screws.
3. Attach the switch to the bracket, using the two 6-32 screws and nuts. BE CAREFUL to avoid bending the timer switch blade when positioning the nylon bumper of the actuator against the underside of the solenoid core. Move switch slowly toward switch-block to slightly beyond the point at which it transfers. The adjustable switch mounting screw should now be at the bottom of the slot in the bracket.
4. TO CHECK FOR PROPER OPERATION:
   Aux. switch should transfer immediately when relay coil is energized, and should reset immediately following coil deenergization. If it fails to reset, loosen screw in slotted hole of mounting bracket and move switch closer to terminal block.



NOTE: These instructions apply only to units intended for vertical mounting. Auxiliary switches for horizontally mounted 2412 units must be installed at the factory.

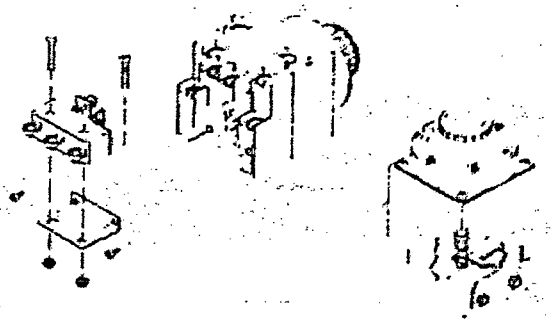
INSTALLING TWO STEP AUXILIARY SWITCH (CODE T)

THIS KIT (PART 2412-121) CONTAINS:

(1) Snap-action switch with adjustable se locking actuator.
(2) 6-32 x 7/8" switch mounting screws ar ELASTIC STOP nuts.
(2) 3-48 x 5/16" bracket mounting screws.
(1) Switch mounting bracket.
(1) Contact identification plate.

1. Apply contact identification plate over existi terminal markings on switch.
2. Attach the mounting bracket (without switc attached) to the bottom of the termin block, using the two 3-48 screws.
3. Be sure actuator screw is screwed into act ator arm as far as possible.
4. Attach the switch to the bracket, using th two 6-32 screws and nuts. The adjustab switch mounting screw should be at th bottom of the slot in the bracket for norm. operation.
5. Using 1/16" Allen wrench, turn actuat screw clockwise up against the end of spi dle collar, until auxiliary switch transfer This will provide a very short first del period before auxiliary switch transfer whe unit is energized. To increase first delay p riod, turn actuator screw clockwise, to d crease delay turn screw counterclockwise.

   TO CHECK FOR PROPER OPERATION: Aux liary switch contacts should transfer follo ing first delay period after relay coil energized. Auxiliary switch should res immediately, following coil deenergization. E SURE spindle reaches lower stop and rese main timer switch.



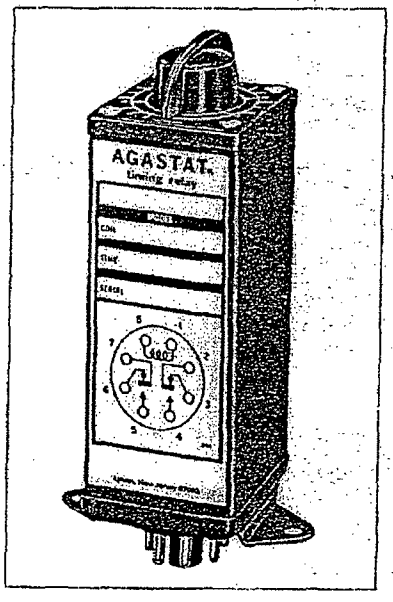
RECOMMENDED MAXIMUM AUXILIAR SWITCH DELAY IS 25% OF TOTAL DELA PERIOD, BUT NOT EXCEEDING 30 SEC ONDS.

ITEM 61

series 2100

miniature electropneumatic timing relay

AGASTAT® Series 2100 Miniature Timing Relays are available in both industrial and Mil-Spec configurations. They are time-tested, field-proven electrically actuated/pneumatically timed relays. In their space-saving and rugged construction they offer high accuracy, easy adjustment, either On-Delay or Off-Delay operation, and a wide selection of timing ranges and coil voltages.



Features

- High repeat accuracy over voltage and temperature extremes
- Instant recycling — easy linear adjustment
- Exclusive Dial Head adjustment — no needle valves
- Delay ranges from milliseconds to 3 minutes
- DPDT contacts
- Inherent transient immunity
- True 'Off-Delay' timing

Design

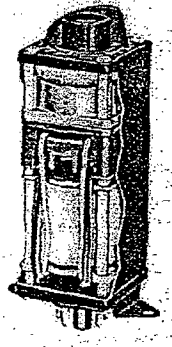
Sealed patented timing head circulates air under controlled pressure through a variable orifice to provide adjustable timing. Circular-path Dial Head principle replaces traditional needle valve.

Snap-action switch assembly provides sustained contact pressure during timing cycles. Special-design overcenter mechanism assures flutter-free load transfer after extended delay periods.

Precision-wound solenoid assembly supplies the basic motive force when the control circuit is closed.

Construction

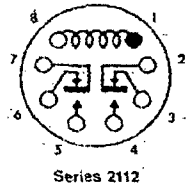
These assemblies are mounted in a rigid self-supporting framework within a steel enclosure. This rugged construction assures permanent alignment of all operating members, the key to this unit's long trouble-free operation.



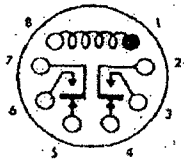
Operation

Series 2112 (On-Delay) - Applying a continuous rated voltage to the solenoid coil starts the preset time delay. At the end of the delay period the NC contacts break and the NO contacts make. Contacts remain in this position until the coil is de-energized, when the switch instantaneously returns to its original position. De-energizing the coil, either during or after the delay period, will immediately (within .025 sec.) recycle the unit. It will then provide another full delay period on re-energization.

Series 2122 (Off-Delay) — Applying a rated voltage to the coil for at least .075 sec. (for accurate timing) will instantaneously transfer the switch, breaking the NC contacts and making the NO contacts. Contacts remain in this position as long as the coil is energized. The preset time delay period begins as soon as the coil is de-energized, at the end of which the switch returns to its original position. No power is required during the timing period. Re-energizing the coil, either during or after the delay period, will immediately start a new cycle with full delay period.



Series 2112



Series 2122

Specifications

All values listed are at nominal operating voltage and 25°C, unless otherwise noted.

Operating Mode

Series 2112: On-Delay (Delay on Pull-in)
Series 2122: Off-Delay (Delay on Drop-out)

Timing Adjustment

All standard models offer easy linear adjustment over one of nine timing ranges, listed below. For applications requiring frequent readjustment, the external knob model with calibrated dial is recommended. For tamper-proof installation or where readjustment is infrequent, the internal key model may be preferred. This model requires removal of the cover plate for timing adjustment. Hermetically sealed models provide a slotted adjusting screw under the cap nut on the top cover.

Timing Ranges — Seconds

Code A	.03	to	.1
B	.1	to	.3
C	.15	to	1.0
D	.375	to	3.0
E	.750	to	10.0
F	1.0	to	30.0
G	2.0	to	60.0
H	5.0	to	120.0
J	5.0	to	180.0
K	1.5	to	30.0 Cyc.
L	3.0	to	120.0 Cyc.

Repeat Accuracy

NORMAL VERTICAL POSITION
@ 25°C . . . ± 5% @ 85°C . . . ±7%
@ −55°C . . . ±8%

The average time between −55°C and 85°C will be within ±20% of the average @ 25°C with a proportionally reduced effect at lesser extremes.

In extremely short delay settings an additional .008 sec. variation may result on AC models due to "half cycle" alternating current effect.

SETTING TOLERANCE
Factory time setting, when specified, subject to additional ± 5% tolerance.

series 2100

miniature electropneumatic timing relay

Position Sensitivity
HORIZONTAL POSITION
Approximately 5% increase from the initial time in the vertical position.
INVERTED POSITION
Approximately 10% increase from the initial time in the vertical position.

Reset Time
2112 Series .025 sec.
2122 Series .075 sec.

Relay Release Time
.025 sec. 2112 series

Relay Operate Time
.075 sec. 2122 series

Transients
Insensitive to transients of ± 1500V for 10 milliseconds.

Dielectric
1000V RMS @ 60 Hz between non-connected terminals.

Operating Voltage
Coil Data

Code	Nominal Operating Voltage†	Current at Rated Voltage Amps ± 10%	Resistance Ohms ± 10%
M	12 vdc	.400	30
N	28 vdc	.210	131
P	48 vdc	.096	500
R	110 vdc	.034	3200
S	120V 60 Hz (2112 Series)	.088	190
S	120V 60 Hz (2122 Series)	.067	285
T	240V 60 Hz	.049	765
U	115V 400 Hz	.038	2600
Y	125 vdc	.037	3380

†Consult factory for other voltages and frequencies.

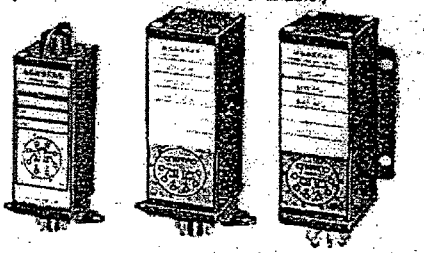
Contact Rating (DPDT Contacts)

	30 volts DC	110 volts DC	120 volts 60 Hz	120volts 400Hz	240 volts 60 Hz
Inductive	2 Amps	.75 Amps	3 Amps	2 Amps	1.5 Amps
Resistive	10 Amps	1 Amp	10 Amps	10 Amps	5 Amps

Inductive and capacitive loads should not have inrush currents that exceed 5 times normal operating load

Ambient Temperature Range
–55°C to 85°C
(Also available for higher temperature operation on special order.)

Mounting/Terminals
Chassis mounting tabs, octal plugs and external (–4) or internal (–5) adjustment. Panel mounting back plate, internal adjustment, and solder hook terminals (–9). (Front Screw Terminals also available.)



–4 –5 –9

Weight
Maximum, any unit . . . . . 17 ozs.

These are minimum standards; where more severe environmental conditions must be met, please consult the factory.

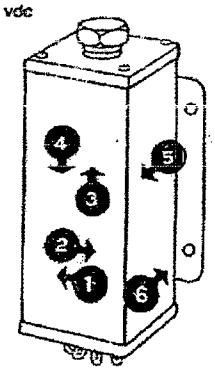
SPECIFICATIONS

The following specifications apply exclusively to MIL-SPEC and hermetically-sealed units.

SHOCK
Exceeds MIL-E-5272C, Proc. V
Contacts chatter-free . . . 30 g's
No structural damage . . . up to 75 g's

VIBRATION
10 g's 5 to 500 cycles in accordance with specification MIL-E-5272C-1, Procedure XII. Contacts — Chatter-free. Actual "g" forces with regard to Shock, Acceleration and Vibration are monitored on the relay.

INSULATION RESISTANCE
1000 Megohms minimum with 500 vdc applied



ACCELERATION
Withstands 10 g's Acceleration (position sensitive during timing).
The following g's may be applied in the direction indicated without contact opening:

Plane 1	2112 & 2122 units — 100 g's energized and deenergized
Plane 2	2112 & 2122 units — 100 g's energized and deenergized
Plane 3	2112 units — 60 g's energized and 100 g's deenergized 2122 units — 100 g's energized and 40 g's deenergized
Plane 4	2112 units — 100 g's energized and 20 g's deenergized 2122 units — 100 g's energized and deenergized
Plane 5	2112 & 2122 units — 100 g's energized and deenergized
Plane 6	2112 & 2122 units — 100 g's energized and deenergized

DIELECTRIC
In accordance with specification MIL-R-6106E (ASG). Also withstands 1,000 Volts RMS at 60 Hz between non-connected terminals.

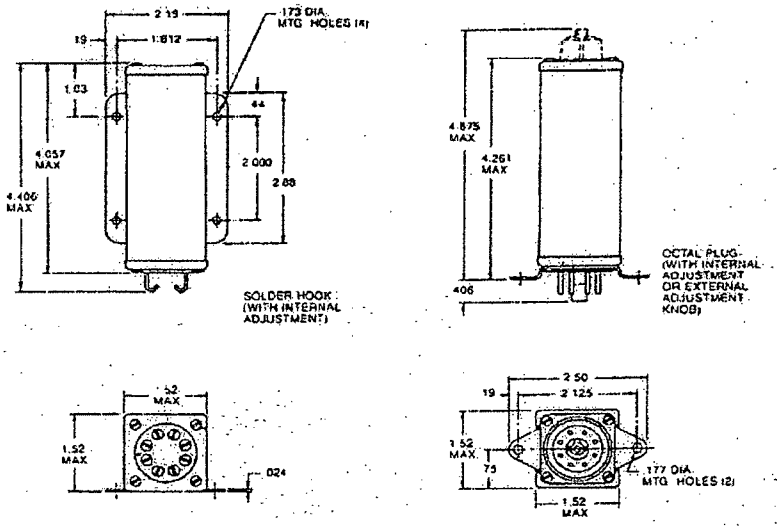
OTHER
AGASTAT® Miniature Timing Relays also conform to applicable MIL-Spec. requirements covering:

Moisture	Ozone
Humidity	Sunshine
Sand/Dust	Acoustic Noise
Salt Spray	Prolonged Storage

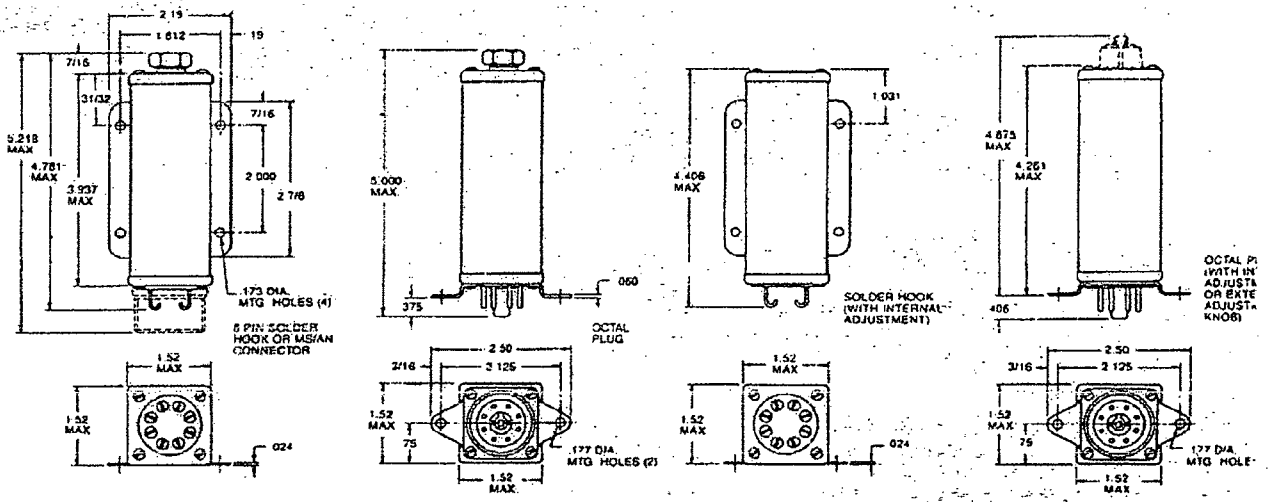
WARRANTY

This product is warranted against mechanical and electrical defects for a period of one year from date of shipment from factory if it has been installed and used in accordance with factory recommendations. Any field repairs or modifications to the original unit will void this warranty. Amerace Corporation's liability is limited to replacement of parts proved defective in workmanship or materials. (W-AB1)

DIMENSIONS — INDUSTRIAL MODELS
(inches)



DIMENSIONS — MIL-SPEC & HERMETICALLY SEALED MODELS
(inches)



PANEL MOUNT
—H1, —H3

CHASSIS MOUNT
—H2

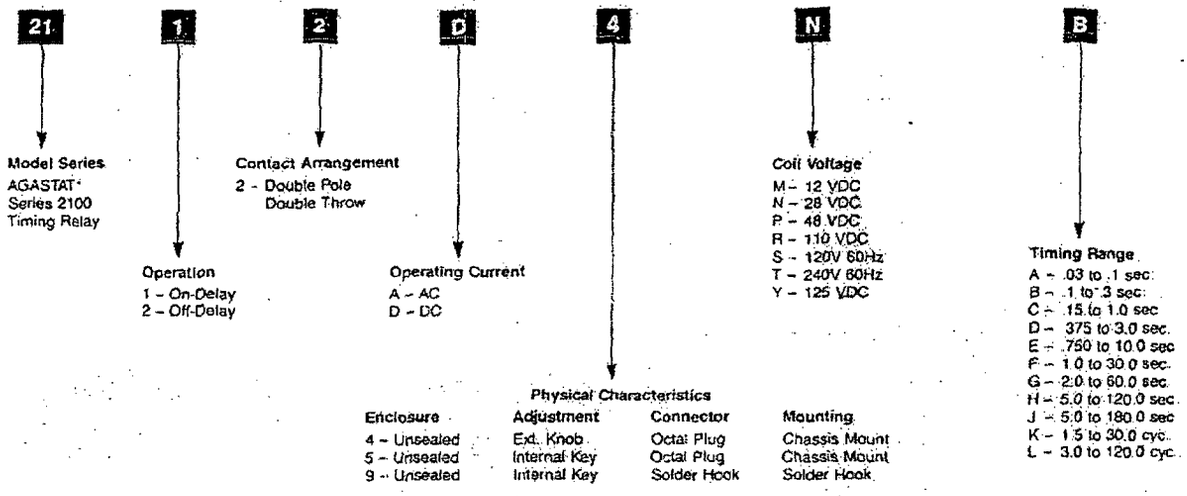
PANEL MOUNT
—9M

CHASSIS MOUNT
—4M, —5M

BASIC ENCLOSURE DIMENSIONS, AS WELL AS MOUNTING BRACKETS AND SOLDER HOOK HEADERS, ARE IDENTICAL IN ALL MODELS

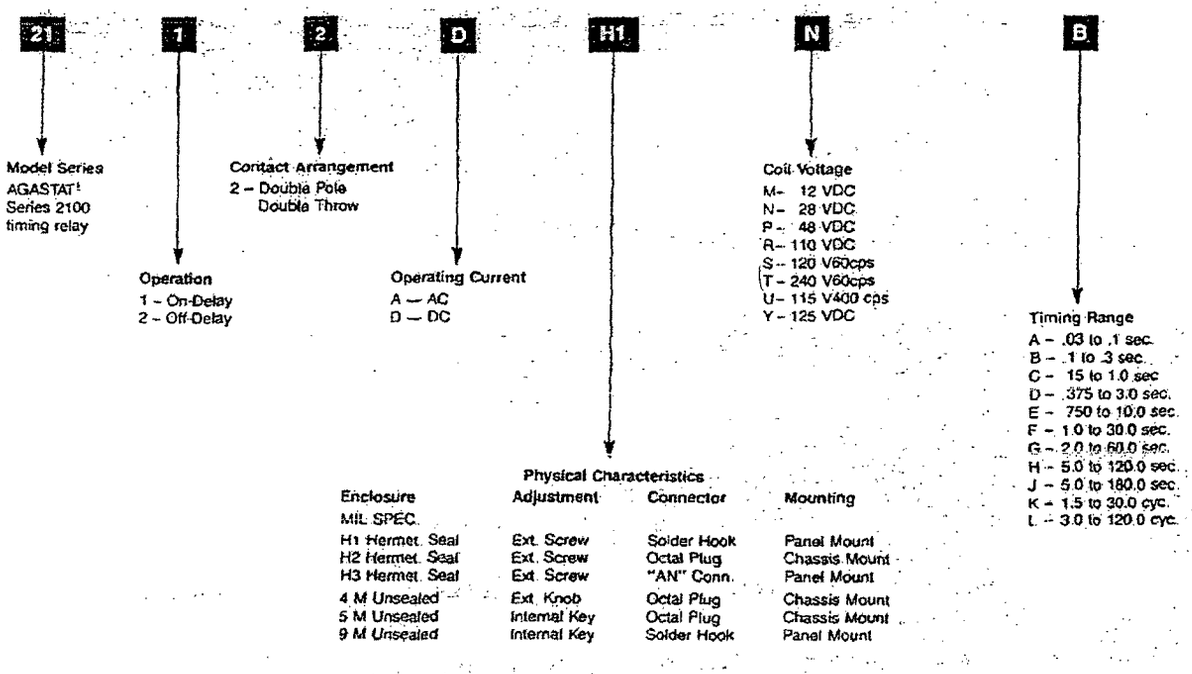
ORDERING INFORMATION — INDUSTRIAL MODELS

Catalog Number Code



ORDERING INFORMATION — MIL-SPEC & HERMETICALLY SEALED MODELS

Catalog Number Code



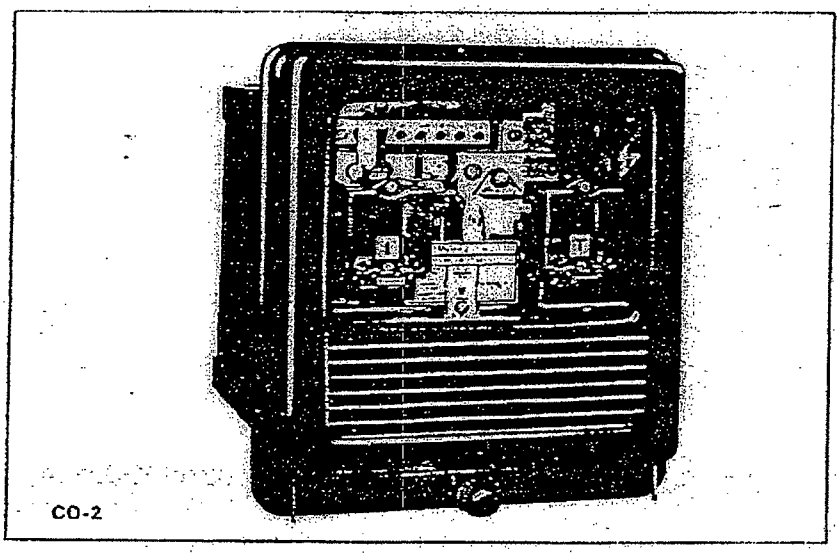
ITEM - 54

Westinghouse Electric Corporation
Relay and Telecommunications Div
Coral Springs, FL 33065

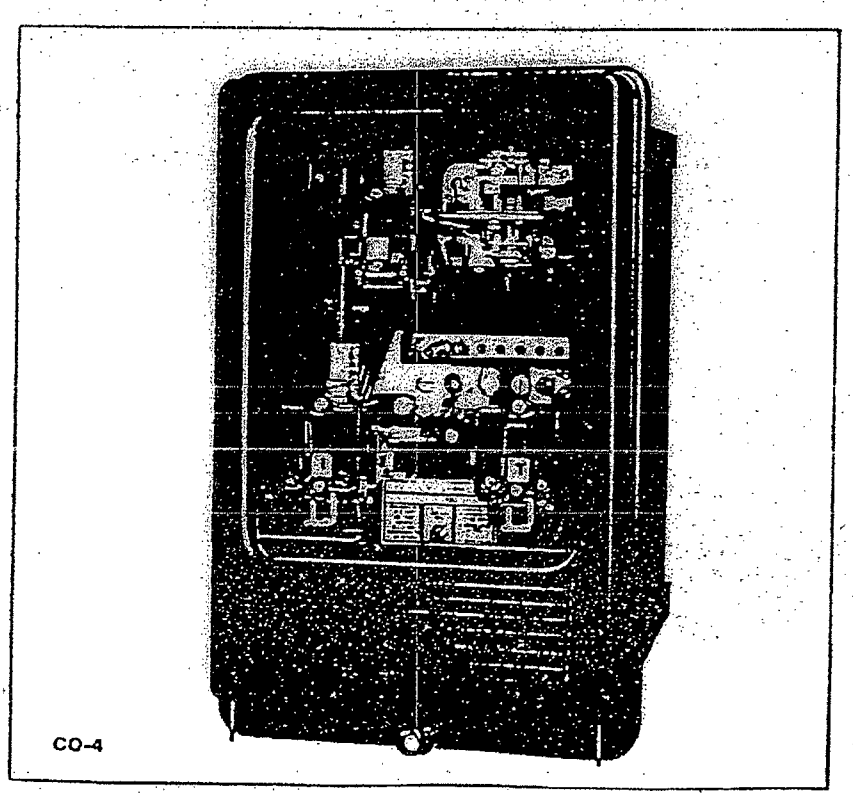
November, 1988
Supersedes DB 41-100A dated February, 1987
Mailed to: E, D, C/41-200A

Non-directional, Single Phase, Adjustable Time Delay

Overcurrent Relay
Type CO



CO-2



CO-4

Application

Westinghouse CO relays, a complete co dinated line, assure accurate and relia primary or backup protection against ph or ground faults. They provide the ba bone of any protective relaying syst from generator to load.

For selective coordination between rela seven different time curve characterist are available. All are designed to oper faster at higher fault currents.

Each type has a wide range of current s settings and time dial positions.

Properly applied, CO relays will prov maximum service continuity by tripping fewest possible circuit breakers required disconnect a faulted section.

For fast clearing of heavy faults, CO rel can be equipped with adjustable instan neous overcurrent units.

Where cold load pickup presents a probl due to heavy inrush currents to devi such as refrigerators, water heaters, e type CO relays can be equipped with hi dropout instantaneous trip units (IT which will provide instantaneous trip p tection for the protective line when ini load current is dropped to 90% of the I unit setting.

When ac current is necessary in the contr trip circuit, the indicating contactor swi (ICS) dc unit is replaced by the type A indicating contactor switch sealed-in u The ACS unit is similar in construction the IIT unit, and has an adjustable range .25 to .9 amperes ac.

Both non-torque and torque controlled c signs are available.

Advantages

Low burden, high thermal capacity, n ligible temperature error.

Accurate pickup, continuous "between ta adjustment.

Simplified settings, ease of accessibil lower maintenance cost.

Space saving Flexitest® universal cas for semi-flush or projection mounting.

Device Number: 51

Selector Guide

Relay Type	Time Curve	Comparative Operating Time①	Basic Application
CO-2	Short	0.47 Sec.	Differential protection of bus or generators where restraint windings are not required. Straight overcurrent protection where short operating time is necessary for system stability.
CO-4	Long (step)	25 Sec.	Designed primarily to provide effective relay coordination with the selective trip characteristics of Westinghouse DS breakers. Step-time operating characteristic coordinates with selective trip curve of DS breaker and associated fuses.
CO-5	Long	25 Sec.	Motor protection. Long time setting (150% of full load) prevents tripping due to motor starting currents, and allows motor to carry moderate overloads for safe periods. Inverse characteristic provides faster tripping at higher overloads.
CO-6	Definite	2 Sec.	For use where generating capacity and fault currents vary over a wide range. Relay has fixed operating time (per time dial setting) from approximately 10 to 20 times tap current, thus providing definite selective operation for sequential tripping.
CO-7	Moderately Inverse	2.48 Sec.	Overcurrent phase and/or ground fault detection on transmission or feeder lines where moderate changes in generating capacity occur, or on parallel lines where one line may be called on to carry both loads. Relay approaches definite time characteristics at high currents, allowing wide changes in fault current magnitude with little change in operating time.
CO-8	Inverse	2.52 Sec.	Phase and/or ground fault detection of subtransmission lines or feeders. Also supplied as primary protection or back-up for other relays. Wide range in time lever settings and slope of curves facilitate coordination and assure selective operation. Degree of inverseness required is determined by fault current magnitude, operating time desired, and the characteristics of nearby relays on the system.
CO-9	Very Inverse	1.53 Sec.	
CO-11	Extremely Inverse	0.8 Sec.	Used on feeder circuit breakers which must coordinate with main and branch line sectionalizing fuses. Also used where long time delay is required for light overload, such as where feeder is energized after extended outage.

① Values shown are with a 10 time dial setting, and with 10 times tap value current applied.

Factors to Consider in Selecting Proper Relay Type

Apparatus or Circuit to be Protected: In general, the application will indicate the use of a specific relay. Short-time relays act fast to avoid equipment damage. Long-time relays hold off tripping on heavy initial overloads or more extended moderate overloads.

At higher fault currents, definite-time and moderately inverse relays maintain constant operating time, despite variation in connected generation and fault currents. Inverse and extremely inverse relays operate respectively faster on higher fault currents.

Selective Operation, Sequential Tripping: To maintain maximum continuity of service, as small a section as possible should be removed from a system during a fault. A common method is to set each successive relay, progressing from the generator, to operate 0.3 second sooner (exclusive of circuit breaker operating time) so that the relay nearest the fault will operate first to remove the faulted section. See figure 1.

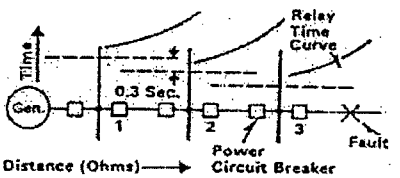


Fig. 1

Coordination With Adjacent Relays: To assure selective operation, relays in all sections of the protected line should have similar operating curves. Otherwise, curves may intercept, resulting in incorrect relay operation. See figure 2.

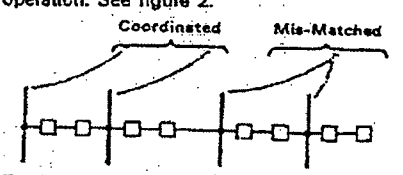


Fig. 2

Relay Tap Range: Magnitude of fault current available at a given location is usually determined by system studies. Tap range selection depends on the fault current as seen by the relay, which is determined by the current transformer ratio and its operating characteristics under fault conditions.

Ac or Dc Trip Circuit: Where a dc control source (24 to 250 volts) is available, circuit closing relays are used. If dc is not available, circuit opening relays are used with

Construction and Operation, Continued

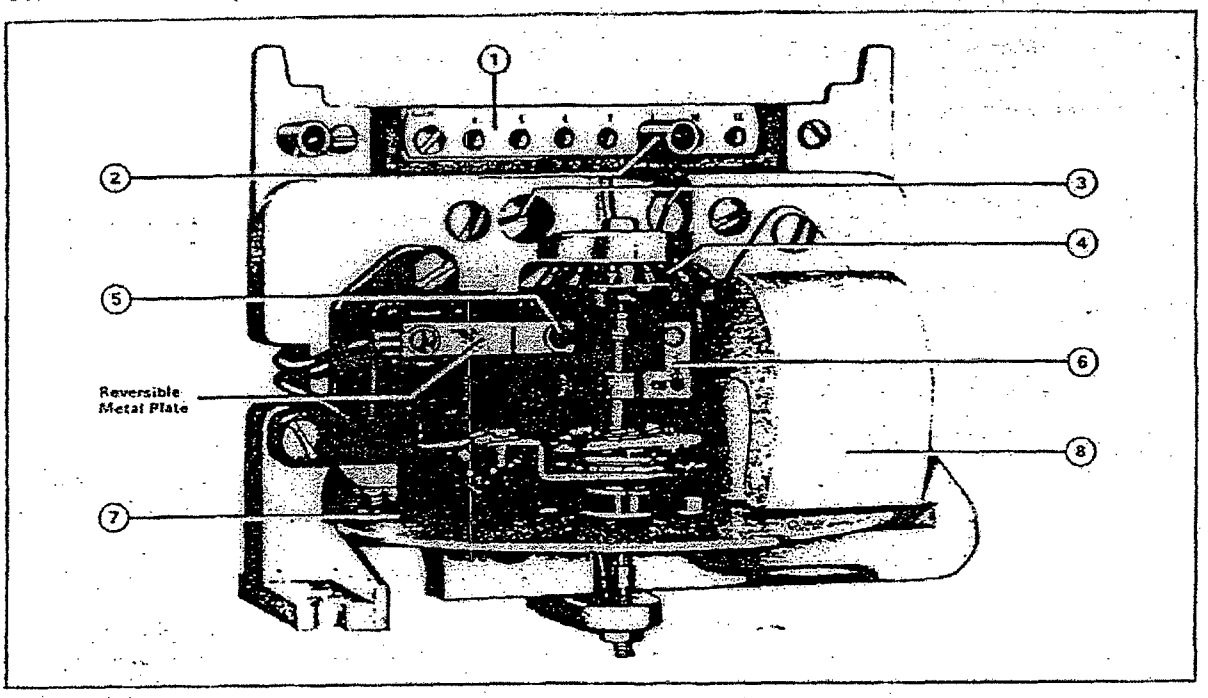


Fig. 4

Time Delay Overcurrent Unit (CO)

On CO-4, CO-5, CO-6, CO-7, CO-8, and CO-9 relays a main tapped coil is placed in the center leg of an "E" type laminated magnetic structure. Flux produced by this coil returns through the two outer legs of the electromagnet. A shading coil on the left leg of the electromagnet creates an out-of-phase flux which reacts with the main coil flux in the electromagnets air gap to cause disc rotation in the contact closing direction.

CO-2 and CO-11 electromagnets are similar in construction, except that both outer legs have windings to produce the necessary out-of-phase fluxes required for contact closing rotational torque.

(1) Tap Block

Indicates minimum current required to just close the relay contacts.

(2) Tap Screw

The tap screw is used to select the desired tap setting.

(3) Magnetic Plugs

May be screwed in or out of the magnetic circuit to control saturation and adjust calibration at high currents. A damping magnet and spring adjustment permits calibration at low currents.

(4) Time Dial

Indicates initial position of the moving contact over a 270° range. Indexes from ½ (minimum time) to 11 (maximum time).

(5) Stationary Contact

Made of pure silver. Will close 30 amperes at 250 volts dc. Has sufficient wipe to assure positive contact. In fast breaker reclosing schemes which require quick-opening relay contacts, the metal plate is reversed, holding the stationary contact fixed against the back-stop. On double-trip relays, adjustment of ¼" contact follow (or wipe) is obtained by use of a vernier adjusting screw on the stationary contact plate.

(6) Moving Contact

Also made of pure silver, the moving contact is clamped to the insulated section of the disc shaft. Electrical connection is made from the moving contact through a spiral spring to the spring adjuster frame, then to the relay terminal. Moving contacts will close 30 amperes at 250 volts dc.

(7) Induction Disc

Spiral shaped to compensate for the spring windup which occurs throughout the moving contact travel. Provides accurate pickup at any disc position. A spring adjuster is provided to permit in-between tap pickup adjustment when desired.

(8) Damping Magnet

Made of high strength Alnico. Controls relay operating time at low current values. A keeper screw permits micrometer adjustment of the damping magnet without shifting the location of the magnet, and allows the relay to be accurately calibrated at low currents.

Indicating Contactor Switch (ICS)
(Partially Disassembled)

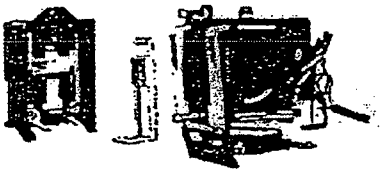


Fig. 5

The dc operated Indicating Contactor Switch has a clapper type magnetic armature to which leaf-spring contacts are attached.

When the switch is energized, the moving contacts bridge the stationary contacts, completing the trip circuit. The ICS contacts are connected in parallel with the main relay contacts, relieving them of carrying heavy trip currents.

During operation, two fingers on the armature deflect a spring, which allows the operation indicator target to drop. The target is orange color and readily visible.

Taps on the front of the unit provide connection for either 0.2 (left) or 2.0 (right) amperes dc pickup operation.

When using a 125 or 250 volt dc auxiliary WL auxiliary relay, the 0.2 ampere tap is recommended. The 2.0 ampere tap is used on 24 or 48 volt dc circuits.

Indicating Instantaneous Trip(IIT)

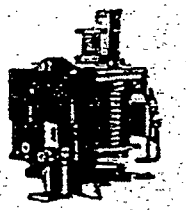


Fig. 6

Used for high speed protection against heavy fault currents. Construction is similar to that of the Indicating Contactor Switch, except that it is ac operated, and adjustable over a range of 1 to 4 times minimum pickup. Variable pickup is obtained by a core screw adjustment on the top of the unit.

When the IIT is energized above pickup setting, the target drops. Operating time is approximately one-half cycle above 250% of setting.

The IIT unit has a calibrated scale on which are marked the four divisional points of pickup range.

De-ion® Contactor Switch (CS)

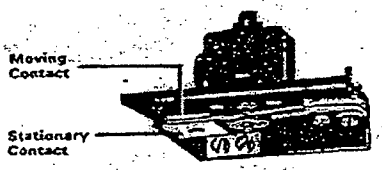


Fig. 7

Used in circuit opening type CO relays as shown schematically in figures 10 and 11. This scheme is applied where ac trip coils are used on the circuit breakers, energized by the line current transformers. When the CS coils energized by a small transformer located within the relay case, its normally closed contacts open to remove the by-pass around the breaker trip coil, thus tripping the breaker.

The CS switch will pick up at 4 amperes ac and will safely by-pass 100 amperes ac through its contacts.

High Dropout Instantaneous Unit (ITH)

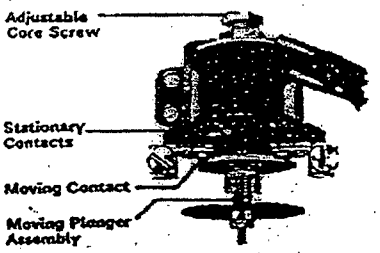


Fig. 8

The ITH unit is a solenoid operated device with an adjustable core screw which adjusts the ac current pickup of the device over a 2 to 1 range.

When the ITH coil is energized above pickup setting, the moving plunger assembly moves upward, carrying the silver disc which bridges three conical-shaped stationary contacts. The device opens its contacts when the coil current is reduced to 80% of its pickup value.

Operating range of the ITH unit can be increased to a 4 to 1 ratio, or four times the minimum pickup setting obtainable, by lowering the plunger after the core screw has been set at its maximum rated position.

If the plunger is lowered to increase the pickup current value, then at 300% of minimum trip the dropout ratio is 60% of the pickup current. At 400% of minimum trip the dropout ratio is 45% of the pickup current.

Operating speed of the ITH unit over nominal range (60 cycle base) is as follows:

at 200% of trip setting: less than 1 cycle
at 500% of trip setting: ½ cycle
at 1000% of trip setting: ¼ cycle

ACS Unit



Fig. 9

Operating Range	.25 to .9 amps ac
Burden	.73 ohms ac
Coil Rating:	
Continuous	.25 amp
1-Second	7.0 amps

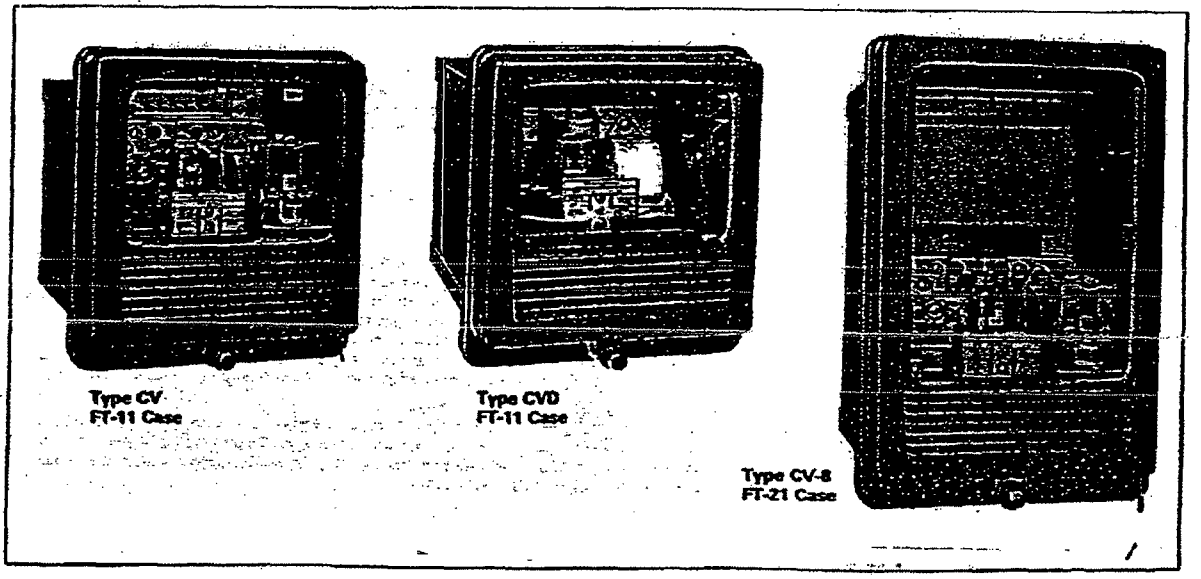
Westinghouse Electric Corporation
Relay and Telecommunications Division
Coral Springs, FL 33065

November, 1987
Supersedes DB 41-200
dated July, 1978
Mailed to: E, D, C/41-100A

For Under and/or
Overvoltage Protection

Voltage Relays Types CV, CVD, CV-8

ITEM 57



Application

Low Voltage Protection

A low voltage condition will prevent motors from reaching their rated speed on starting or cause them to lose speed and draw heavy overload current. While overload relays will eventually detect this condition, the motor should be quickly disconnected when severe low voltage conditions exist. Where continuous operation is essential, such as station auxiliary service or continuous manufacturing processes, the CV relay is used for alarm purposes only.

Voltage Transfer Schemes

When alternate sources of power exist, such as double-ended transformer units, the CV relay can be applied to initiate switching of the station bus to the alternate source.

The CVD relay is used in control circuits to initiate switching when the line voltage increases or decreases beyond a predetermined value.

CV-21 to CV-27 relays are frequency compensated, and maintain a fixed pickup voltage over a wide range of frequency. They are used in hydro machines.

Timing Applications

The CV relay has an accurate operating time characteristic over a wide range of time dial positions and minimum operating voltages. It is frequently used where specific time intervals are required after application of normal voltage or the increase or decrease from normal voltage.

Induction Motor Undervoltage Protection

During transistory faults, such as lightning strokes, an overhead line may be momentarily de-energized while the fault arc is being extinguished. During this period it is desirable to prevent disconnection of the motor load, and realize maximum benefit from fast reclosing schemes. Time delay CV relays are used to keep the motor load in service.

Ground Fault Protection of Ac Generator Windings

The single unit CV-8 relay provides effective ground fault protection for generator stator windings. It is relatively insensitive to third harmonic (180 hertz) voltage, and will not operate for third harmonic load unbalance which normally flows in the generator neutral. The CV-8 has a 60-hertz pickup voltage of 8% of rating, and provides good sensitivity for light ground faults in the machine.

Features

Low burden due to high efficiency of "E" type electromagnet.

Small size FT-11 case permits optimum use of panel space.

Frequency compensated designs having a variation in pickup of less than 5% over the frequency range of 30 to 90 hertz, applied on hydro operation.

Variety of designs available including units with single, double, or single-pole double-throw contacts with dc or ac seal-in units or instantaneous voltage units.

Harmonically restrained CV-8 relay provides excellent ground fault detection of generator stator windings.

Device Numbers

CV-1, CV-2, CV-21, CV-22	27
CV-4, CV-5, CV-24, CV-25	59
CV-6, CV-7, CV-26, CV-27	27 or 59
CV-8	59N
CVD	27 or 59

Operation and Construction

1 Mounting Frame

Solid one-piece die-cast aluminum. Assures accurate and permanent alignment of all components.

2 Left Stationary Contact

Has supporting plate which is reversible to eliminate wipe when used in quick opening applications with high speed reclosers.

3 Right Stationary Contact

On CV-6, 7, 26, and 27 relays, the left (front) stationary contact is closed at tap value voltage, and the right (back) contact will close at a lower voltage which is within 5% of this value.

4 Time Dial

Indicates initial position of the moving contact. It is indexed from position ½ (minimum time) to 11 (maximum time). See time curves, pages 4 and 5.

5 Damping Magnet

High strength Alnico. Used for damping the induction disc.

CV-1, 2, 4, 5, 6, 7

These relays consist of a voltage unit employing the electromagnetic induction disc construction (as shown in figure 1), and an Indicating Contactor Switch unit (ICS). See Performance Data 41-100.

The voltage unit consists of an "E" shaped laminated core which has a main tapped coil and a shading coil on one of the outer legs to shift the flux out of phase.

In operation, the out-of-phase flux interacts with the main coil flux to create a torque on the disc. Rotation of the disc is opposed by a spiral spring which resets the contacts and disc to their normal position when the applied voltage falls below the tap setting value. The voltage values indicated by the tap plate are the minimum voltages required to close the relay contacts.

On overvoltage relays types CV-4 and CV-5, the contacts close at tap value or above. On undervoltage types CV-1 and CV-2, the contacts open at tap value or above. On the over and undervoltage types CV-6 and CV-7, the tap value is the voltage at which the relay's front contact closes. The back contact will close within 5% of this value.

CV-8

The CV-8 uses the same basic induction

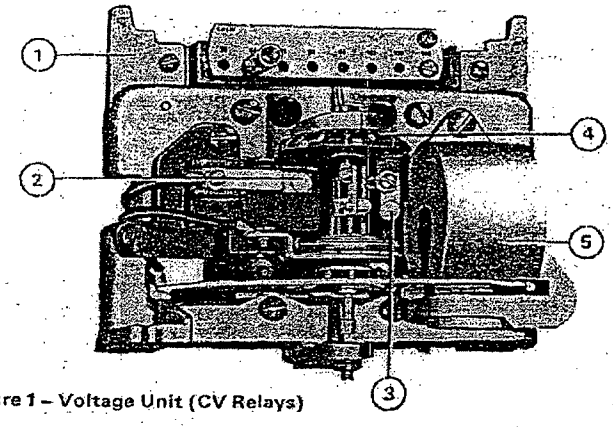


Figure 1 – Voltage Unit (CV Relays)

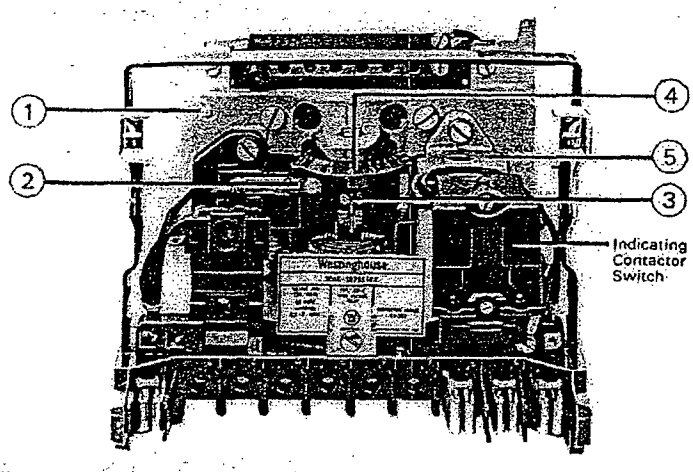


Figure 2 – Type CV-4 Relay – Front View, Chassis

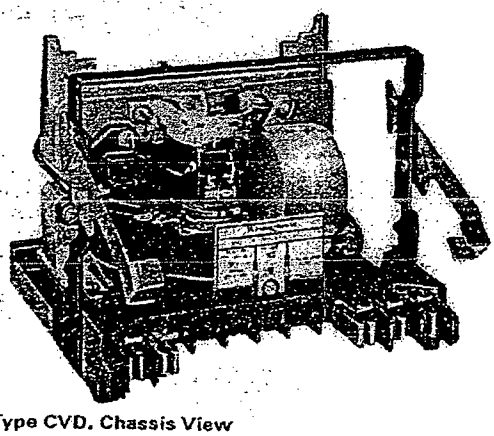


Figure 3 – Type CVD, Chassis View

disc voltage unit and Indicating Contactor Switch as types CV-1 to CV-7, but in addition includes a built-in capacitor connected in series with the electromagnet coil to filter out third harmonic voltage.

It is designed for low pickup value (8% of continuous voltage rating) in generator ground fault detection schemes. Additional data on this application is given on page 6.

CV-21, 22, 24, 25, 26, 27
These relays employ the same basic induction disc voltage unit and Indicating Contactor Switch and operate similar to types CV-1 to CV-7, except that they include a frequency compensating resistor connected in the outer leg coil circuit of the "E" type electromagnet. The compensating resistor enables them to maintain their 60 cycle pickup voltage and/or dropout values within 5% over a variable input frequency of from 30 to 90 hertz.

Their contact arrangements and characteristic curves are the same as those for the comparable CV-1 to CV-7 types.

CVD (Fig. 3)
Type CVD incorporates the same basic electromagnetic induction disc voltage unit used in the CV-1 to CV-7 types, but is constructed to operate essentially as a contact making voltmeter, with high and low voltage contacts, which are independently adjustable over a calibrated scale.

Upon application of voltage to the relay, the disc moves to a position in its travel that corresponds to the applied voltage, and remains in this position until the applied voltage changes. It then moves to a position corresponding to the new voltage value. Since the movement of the disc from one position to another is under the control of the restraining spring and the damping magnet, the relay has inverse timing characteristics. The greater the change in applied voltage, the faster the relay disc and moving contact will travel.

ICS, ACS, and IIV Units
ICS: The Indicating Contactor Switch is a dc current operated device having a magnetic armature to which leaf-spring contacts are attached. When energized at pickup value, the moving contacts bridge the stationary contacts and seal in around the main relay contacts, relieving them of carrying heavy trip currents. The switch has a target which indicates completion of the trip circuit.

ACS: Similar to the ICS unit, except that it is ac current operated.

IIV: Also similar to the ICS unit, except that it is ac voltage operated

Refer to Performance Data 41-100 for further details.

.2A → [SEE ITEM 7* *]

Contact Arrangements Available

Relay	Contacts	De-energized Position①	Energized Position①
Undervoltage CV-1, CV-2, CV-21, CV-22	Spst, dpst	Left contact closed	Left contact open at tap value or above
Overvoltage CV-4, CV-5, CV-24, CV-25	Spst, dpst	Left contact open	Left contact closed at tap value or above
Under or Overvoltage CV-6, CV-7, CV-26, CV-27	Spdt	Left contact open Right contact closed	Left contact closes at tap value or above Right contact closes below tap value
Low Pickup Overvoltage CV-8	Spst, dpst	Left contact open	Left contact closed at minimum pickup or above
Harmonic Filter CV-8	Spdt	Left contact open Right contact closed	Left contact closed at minimum pickup or above Right contact open
Over and Undervoltage CVD	Spdt	Left contact closed Right contact open	Left contact opens at low voltage setting Right contact closes at high voltage setting

① Front view

Thermal Capacities and Burden Data (60 Hertz)

Tap Value: Volts			Volt-Amperes ⑤	Power Factor Angle①	Watts
120 Volts Nominal	240 Volts Nominal	480 Volts Nominal			
CV-1, 2, 4, 5, 6, 7④					
55	110	220	10.0	67°	3.8
64	128	256	7.0	69°	2.8
70	140	280	5.8	70°	2.0
82	164	328	4.0	71°	1.3
93	186	372	3.1	72°	1.0
105	210	420	2.4	73°	.7
120	240	480	1.8	74°	.5
140	280	560	1.3	75°	.3
CV-21, 22, 24, 25, 26, 27④					
55	110	...	14.4	64°	6.3
64	128	...	10.4	66°	4.2
70	140	...	8.3	67°	3.3
82	164	...	6.0	68°	2.2
93	186	...	4.7	69°	1.6
105	210	...	3.6	70°	1.3
120	240	...	2.8	71°	.9
140	280	...	2.0	72°	.6

Voltage Rating	Maximum Continuous Voltage	Volt-Amperes ⑤	Power Factor Angle	Watts
CV-8⑦				
67	67	30.0	70°⑥	10.0
199	199	30.0	70°⑥	10.0
CVD				
30-120	132	7.85	70°①	2.67
40-160	176	7.85	70°①	2.67
80-320	352	7.85	70°①	2.67
105-135	148	16.5	78°①	3.52
210-270	296	16.5	78°①	3.52

② At nominal rating.
③ Degrees current lags voltage.
④ Maximum continuous voltage is 110% of nominal or tap voltage, whichever is higher.
⑤ At maximum continuous voltage.
⑥ Degrees current leads voltage.
⑦ Minimum pickup is 8% of continuous rating

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Time Curves, 60 Hertz

Undervoltage

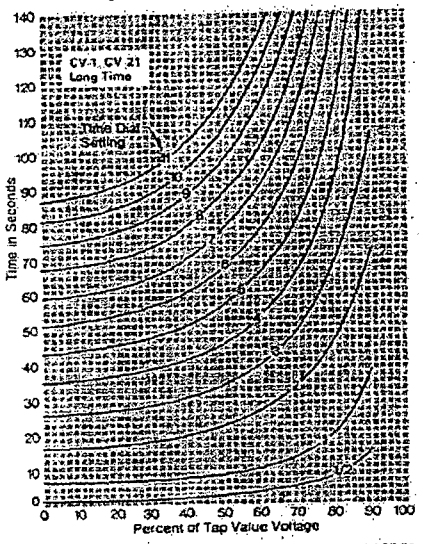


Figure 4 418251

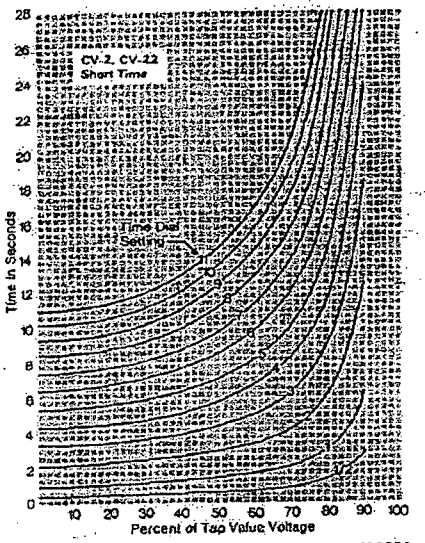


Figure 5 418250

Overvoltage

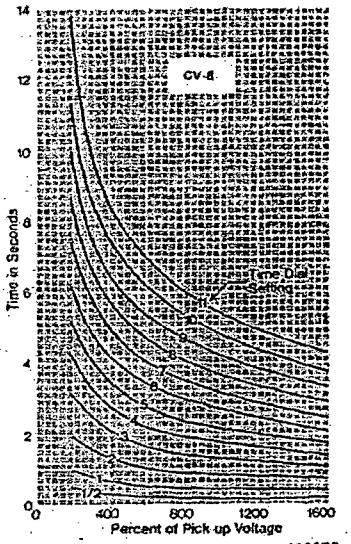


Figure 6 418252

Overvoltage

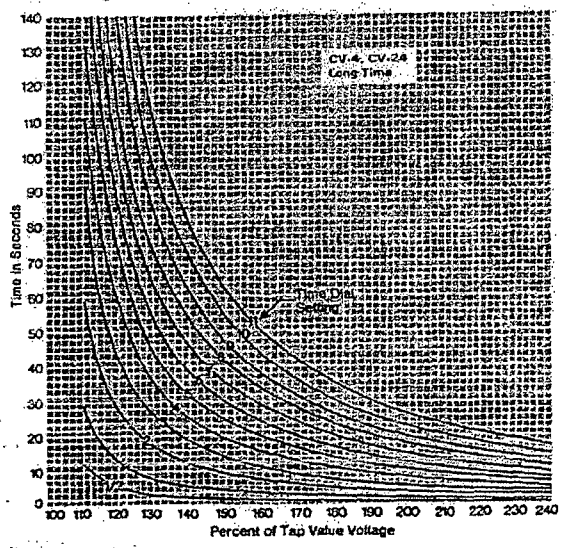


Figure 7 406C881

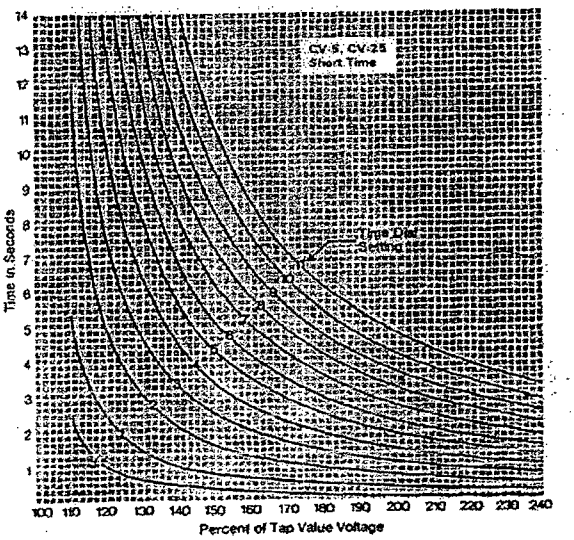
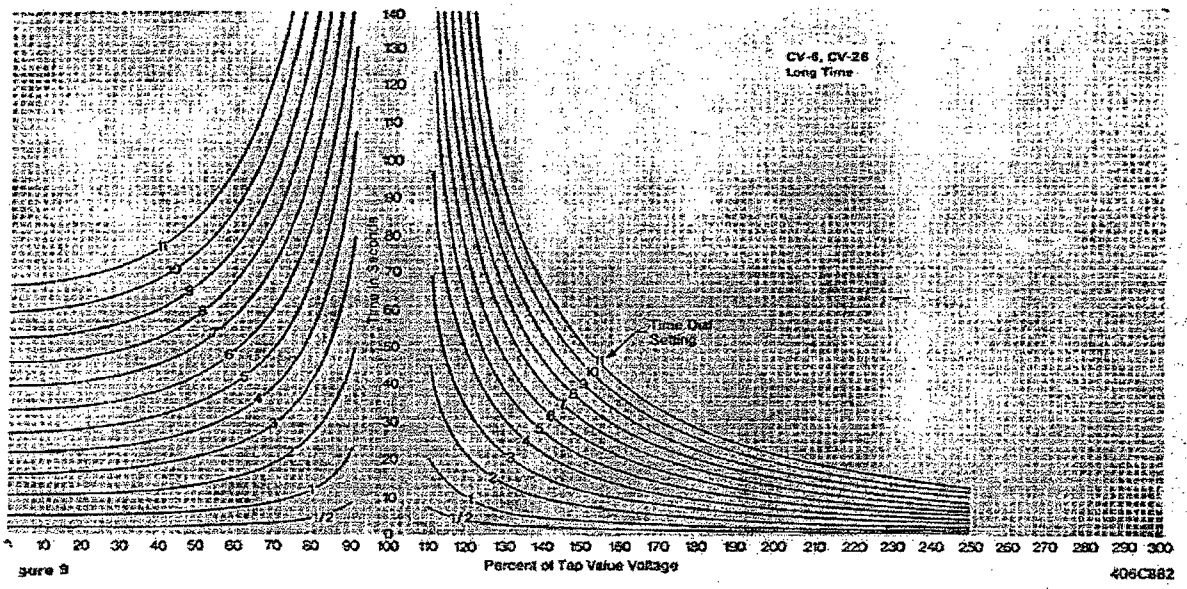


Figure 8 406C884

Under or Overvoltage①



sure 9

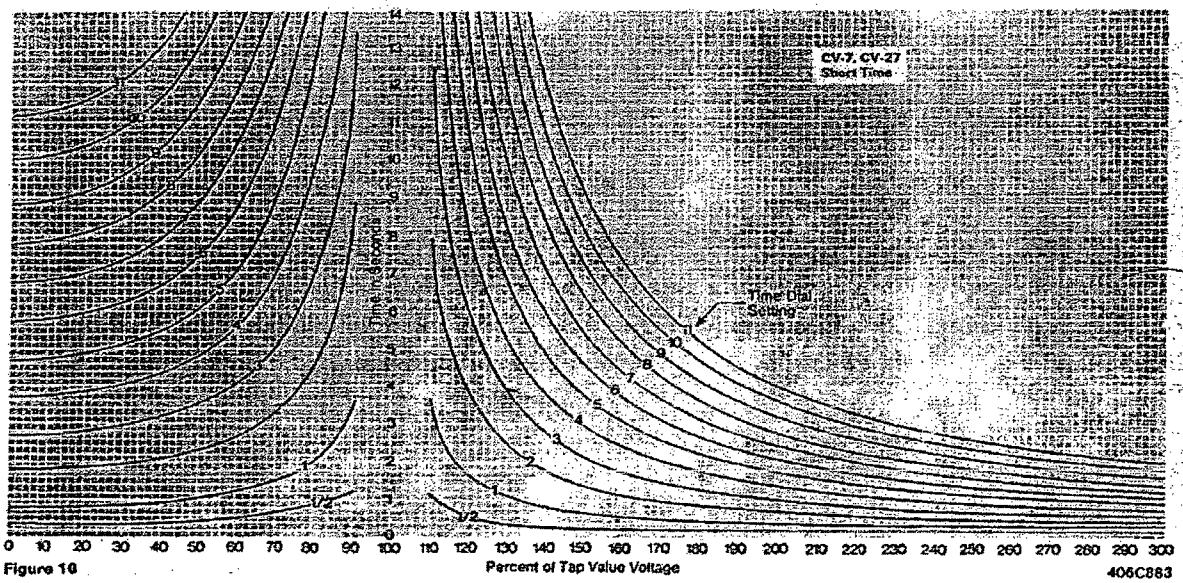


Figure 10

① Operating time between adjacent curves can be obtained by a continuous time dial adjustment.

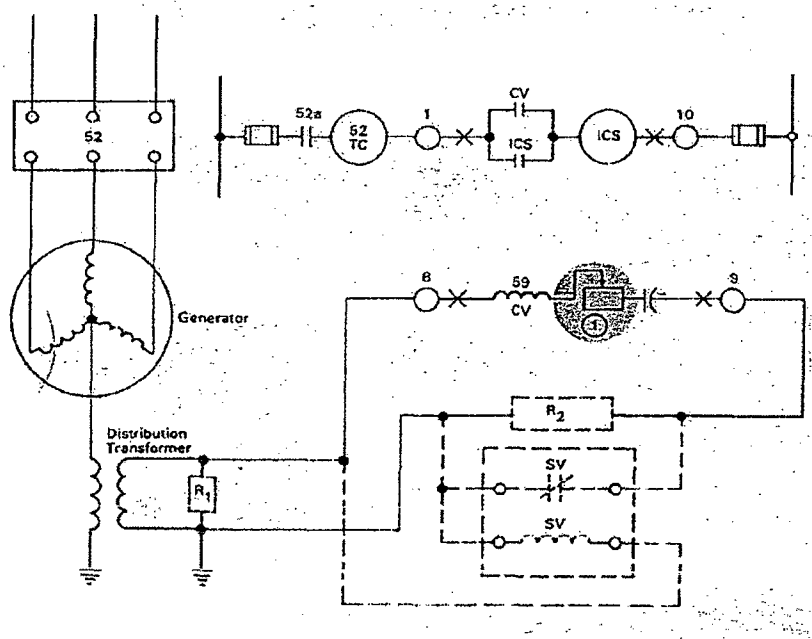
Generator Ground Protection (Type CV-8)

Typical Application of Low Pickup Overvoltage Relay (Ground Fault Protection of Ac Generator Windings)

The generator neutral is grounded through a distribution transformer. The primary of the transformer is rated for generator line-to-line voltage, secondary for 120 or 240 volts. A CV-8 low pickup relay is used to detect ground fault in the generator winding. The relay contains a tuned filter circuit which offers high impedance to 180 hertz voltage (third harmonic) and low impedance to 60 hertz voltage.

The 67 volt CV-8 relay can withstand 67 volts continuously and 140 volts for 2 minutes. If the relay is to be used for an alarm or a timing function where the above values are exceeded, it is advisable to use the 199 volt CV relay. If however, a more sensitive pickup is required, a 67 volt relay may be used in conjunction with one SV relay and an external resistor as shown dotted on figure 10. Using a 70-160 volt SV relay and a 375 ohm, 8½-inch external resistor, the combination is rated at 160 volts continuous. R_2 resistor assembly is style number 1956 449. At 70 volts, the SV relay picks up, opening its contact, and inserting the resistor in series with the type CV-8 relay, thus reducing the voltage impressed across the CV-8 coil.

Due to the high impedance of the CV-8 during generator warm-up or reduced frequency operation, an additional adjustable SV relay rated 7-16 volts, 60 hertz is used to back up the CV-8. The SV is set to initiate tripping. With a 7 volt, 60 hertz setting, it will operate at 2 volts, 15 hertz or 3.5 volts at 30 hertz. During 60 hertz operation, the SV relay is disconnected by a 52b contact. A third harmonic filter circuit is not required with the SV because of the low values of third harmonic present during reduced frequency operation.



① Also available in adjustable range:
5.4 to 20.0 volts (67 volts continuous)
16.0 to 40.0 volts (199 volts continuous)

Figure 11

Device Number Chart

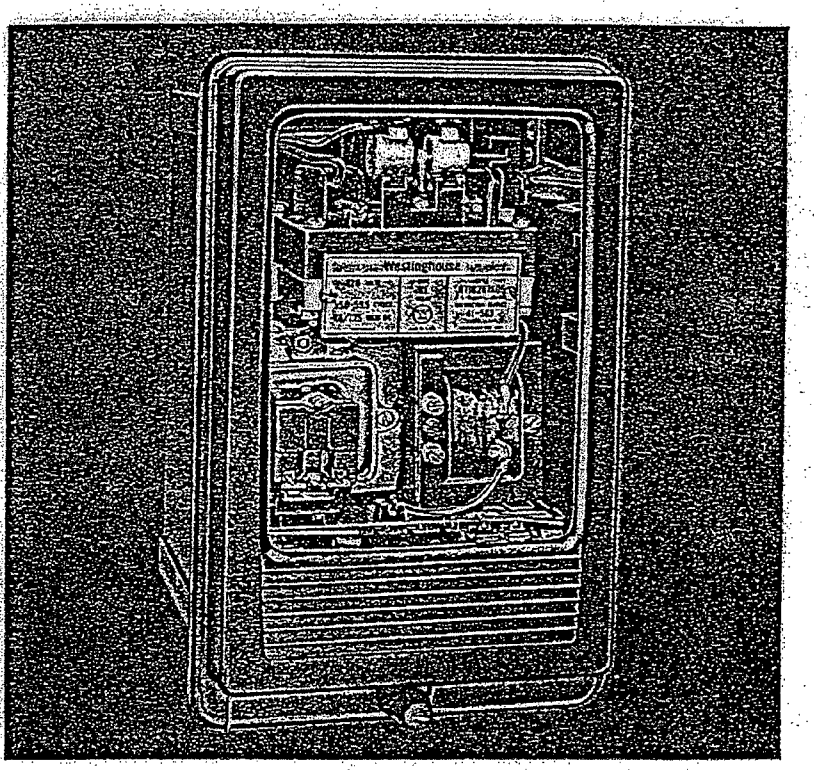
52 – Power Circuit Breaker
52a – Breaker Auxiliary Contact
52TC – Breaker Trip Coil
59 – Non-Directional Voltage Relay Type CV-8
ICS – Indicating Contactor Switch
R_1 – Resistor Supplied by Customer
R_2 – Voltage Drop Resistor
SV – Voltage Relay (see DB 41-765)

Calculation FEX-00204-00
Rev. 0
Attachment S
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Westinghouse

Type KF High-Speed Underfrequency Relay

With Solid State Timing



Application

The KF relay provides high-speed sensing of underfrequency conditions during system disturbances.

Usual applications of the relay involve selective dropping of the system load based on the frequency decrement.

It is particularly applicable for relatively isolated areas where a severe overload (i.e., greater than 50%) could occur due to a tie-line trip.

The relay can be applied to control voltage regulator tap changing mechanisms during low frequency operation.

Speed of operation of the relay is inversely proportional to the decrease of system frequency.

A minimum delay of 6 cycles is required since a sudden shift in the voltage phase angle during a fault will appear as a rapid change in frequency to underfrequency relays.

Features

Solid state timing is available to provide a wider range of time delay adjustment (6-30 cycles on a 60 hertz base). A 100 ms time delay on trip prevents undesirable operation due to other system transient conditions or voltage dips.

Individual settings for frequency, time delay, and Indicating Contactor Switch pickup make the relay suitable over a variety of applications.

Operable over a temperature range of −20°C to +60°C.

Operable over a voltage range of 70 to 110% of rated voltage.

Will not false trip on energization or de-energization.

A high-speed cylinder unit in conjunction with a time-delay-on-pickup telephone-type relay provides secure system frequency detection.

Device Number: 81

June, 1973
Supersedes DB 41-503 dated November, 1968
E. D. C/2017/08

Westinghouse

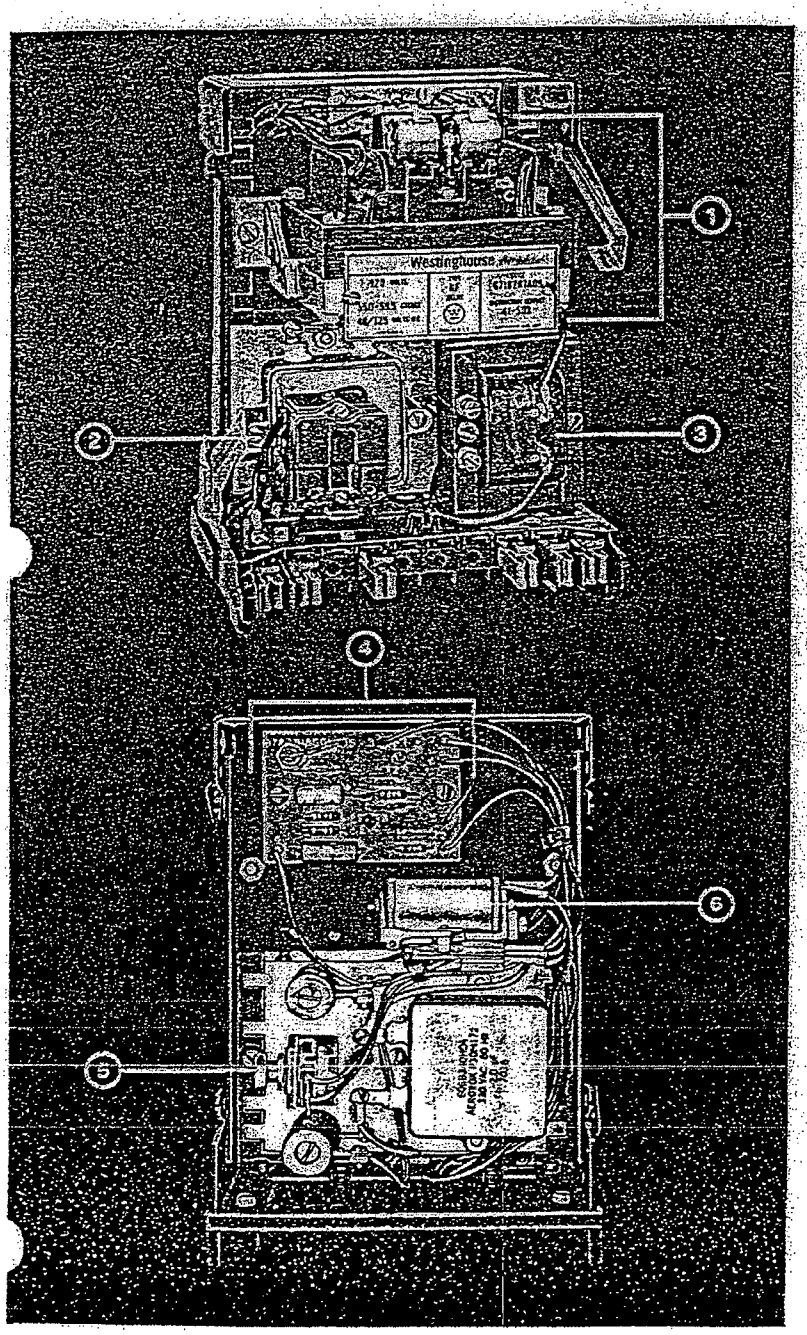


Figure 1 Upper View

Figure 2 Lower View

Construction

1 Induction Cylinder Unit

Has positive contact opening torque at normal frequency.

2 Indicating Contactor Switch (ICS)

Taps provided for 0.2 or 2.0 amps dc pickup operation. For breaker trip circuits or for operation of a type WL lockout relay, the 2.0 amp tap is used. When the current is low, as when using an SG or MG-6 multi-contact auxiliary relay, the 0.2 amp tap is recommended.

The ICS has 6.5 ohms resistance on the 0.2 amp tap, and 0.15 ohms on the 2.0 amp tap.

3 Frequency Adjusting Reactor

Has adjustments for setting the relay to trip at the desired frequency. The minimum trip frequency can be varied over the operating range of 55-59.5 hertz. The standard 60 hertz KF relay is shipped adjusted for contact closing at 59.5 hertz, unless otherwise specified.

A locking feature is provided to prevent an accidental change in the setting.

4 Solid State Timing Circuit

5 Timer Adjustment

Also provided with a locking feature for prevention of accidental setting change.

6 Telephone Relay (T)

Provides 6 cycle delay only on non-adjustable KF. 6-30 cycle adjustable delay is accomplished with a rheostat connected to static timing circuit. See no. 5 above.

Contacts work against gravity.

The telephone relay and the cylinder unit have mechanical spring restraint. This combined with the solid state timing circuit make the relay virtually immune to accidental panel shock.

Type KF High-Speed Underfrequency Relay

With Solid State Timing

Operation

When the applied source frequency drops below the setting of the relay, the cylinder unit will close, energizing the solid-state timing circuit. At this point, the telephone relay is picked up and sets up tripping. The Indicating Contactor Switch (ICS) is also picked up, and will provide trip indication.

The timer will reset when the cylinder unit resets; de-energizing the telephone relay.

The time-delay unit's operation can be selected from one of three types available:

(1) Ac operation, non-adjustable (6 cycles)

(2) Ac operation, adjustable (6-30 cycles)

(3) Dc operation, adjustable (6-30 cycles)

Characteristics

Ratings

The KF relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz.

Adjustable range of frequency is 55-59.5 hertz for the 60 hertz relay, and 44-49.5 hertz for the 50 hertz relay.

Continuous rating – 110% of rated voltage.

Trip Circuit

The main contacts will close 30 amperes at 250 volts dc, and the seal-in contacts of the ICS will safely carry this long enough to trip a circuit breaker.

Trip Circuit Constants

Indicating Contactor Switch (ICS)
6.5 ohms resistance on the 0.2 amp tap.
0.15 ohms resistance on the 2.0 amp tap.

Burden

12.8 volt-amperes at 120 volts, 60 hertz.
13.4 volt-amperes at 120 volts, 50 hertz.

Timing Circuit Selection

A choice of ac or dc time delay is available. For example, where adjustable time delay is required, a KF relay with the auxiliary time delay relay energized from the tripping battery is available. The ac time delay type utilizes a full-wave bridge rectifier.

By using ac for timing circuit, the following advantage is obtained:

A single style relay is applicable for all tripping battery ratings.

A minimum delay of 6-cycles is required unless the trip circuit is supervised by another device which will be open during faults. Unbalanced faults can cause a sudden shift in the voltage phase angle, producing an apparent rapid change in frequency. The cylinder unit closes momentarily, but will not produce tripping when used with a 6-cycle telephone unit delay.

Where the relay and motor load can be readily isolated, such as a station tapped off a tie line, use a type KO-1 current detector relay, 0.5-2 amperes to supervise the KF trip circuit. Energize the KO-1 relay with one phase of the station supply current so it will reset when the station is de-energized, otherwise the motor inertia may maintain sufficient voltage to operate the KF relay and lock out the expendable feeders. KF relays with time delays as long as 30 cycles have operated for this cause. During actual underfrequency conditions, if the station load is too low to operate the KO-1 relay, no purpose is served in tripping any of its feeders.

While long delays are desirable for security, care must be exercised in load-saving applications to insure that load shedding has been completed before the frequency drops more than 3 cycles (i.e., 57 hertz on 60 hertz system). Otherwise, generation may be curtailed due to plant auxiliary motor trouble. Figure 8 shows the KF rate-of-change of frequency. With a 6-cycle delay relay set for 59.5 hertz, for example, breaker trip coil energization occurs at 0.6 cycle below "trip" frequency (59.5−0.6=58.9 hertz) for a decay rate of 2.5 Hertz per second. This rate corresponds to about 30% overload, assuming an inertia constant of H=3.

After the first priority load has been shed the decay rate will diminish. Even so, unless the overload is quite small, a 30-cycle delay is excessive if three graded frequency priorities are to be accommodated without allowing the system frequency to dip below 57 hertz on a 60-hertz system.

Westinghouse

Internal Wiring (Front View) 120 Volt, FT-21 Case
55-59.5 Hertz Adjustable Frequency Range, Spdt Contacts

With Ac Operated Auxiliary
Time Delay Unit

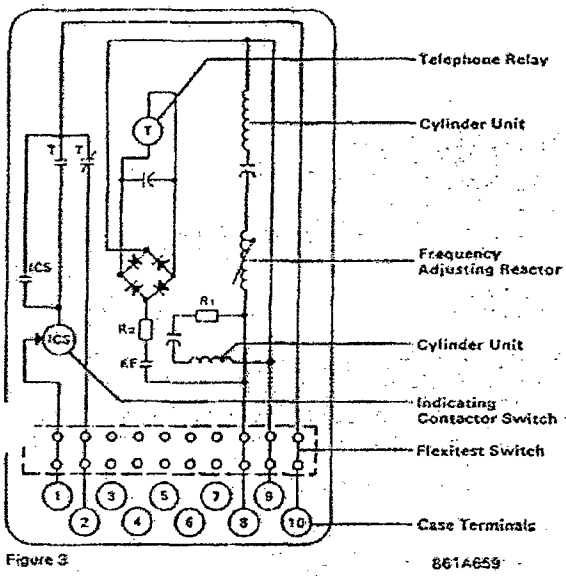


Figure 3 861A659

With Ac Operated Adjustable
Auxiliary Time Delay Unit

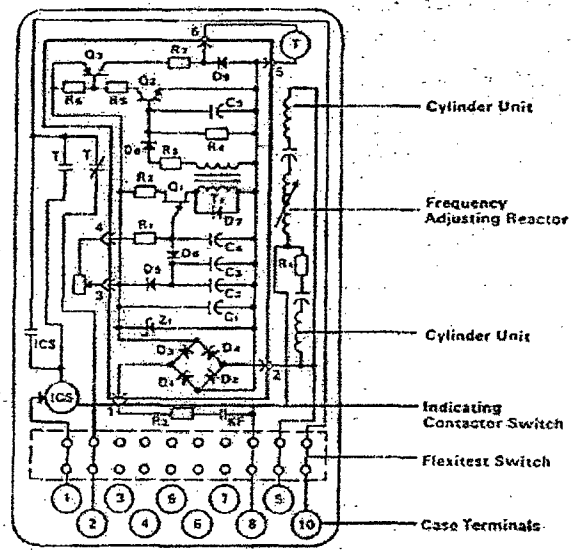


Figure 5 862A525 Sub. 2

With Dc Operated Adjustable
Auxiliary Time Delay Unit

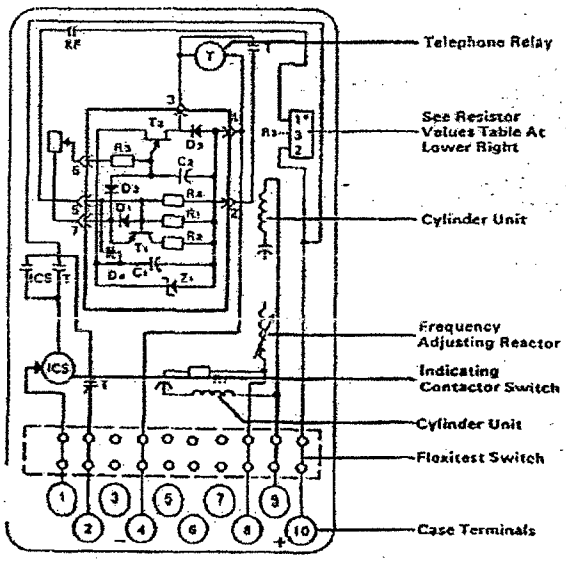


Figure 4

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 108 of 219

Relay Rating	Trip Voltage	Lead Position	Resistance Value
48/125	48	3	420 Ohms
	125	2	2000 Ohms

849A318 Sub. 7

Type KF
High-Speed
Underfrequency Relay

With Solid State Timing

Characteristic Curves (60 Hertz)

Temperature

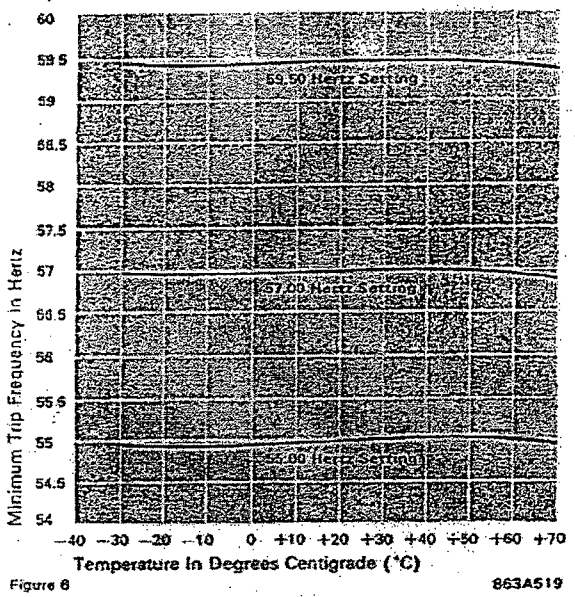


Figure 6 863A519

Voltage

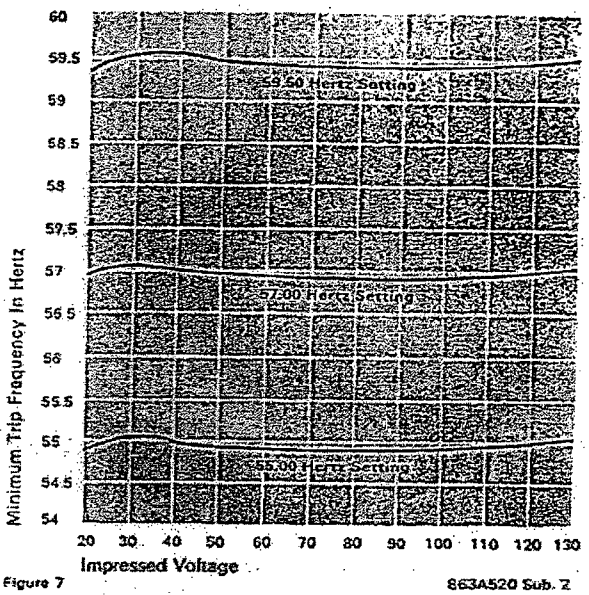


Figure 7 863A520 Sub. 2

Rate Of Change

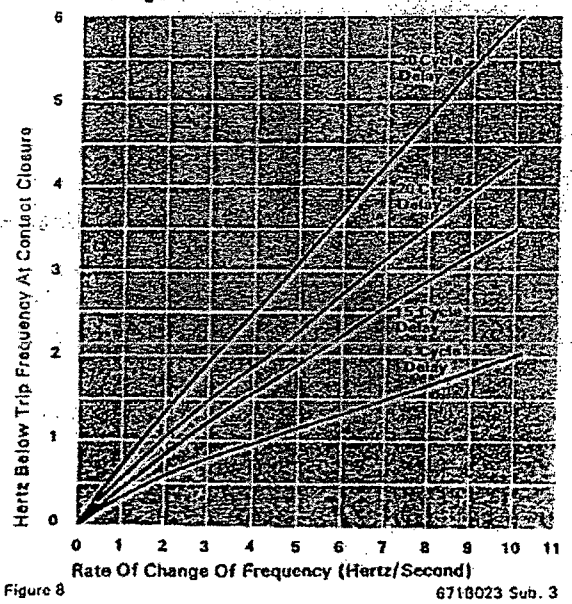


Figure 8 6718023 Sub. 3

Warm-Up

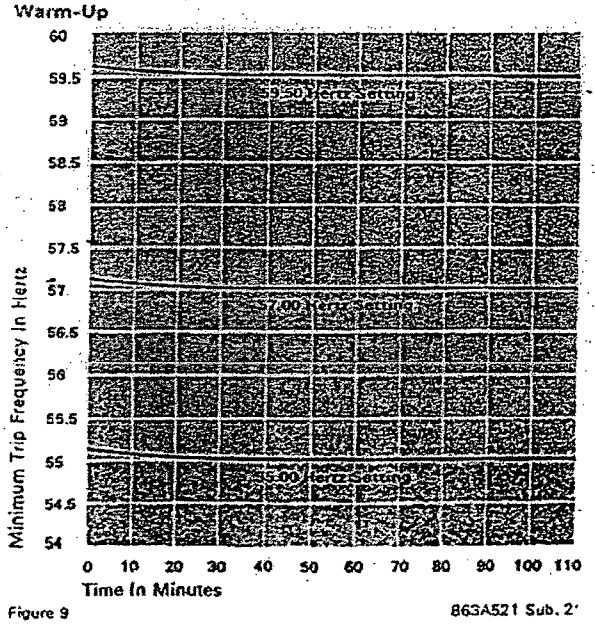


Figure 9 863A521 Sub. 2

Con' 67-77

Westinghouse Electric Corporation
Switchgear Division
East Pittsburgh, Pa. 15112

Technic
34-222
Page 1

25

2320-DC

January 16, 1980
Supersedes PL 34-222
dated May 5, 1977

Mailed to: E, D, C/1977/PL

Circuit Breaker Tripping, Control

Switches
Type WL, Type WLM
Auxiliary

Type WL Switches - For ordering information see page 2.

Table 1: Style Numbers With Coils ①

Assembly Style Number	No. of Stages	Switch, Less Coil	Coil Rating - Volts Dc	Approx. Shipping Wt., Lbs.	Assembly Style Number	No. of Stages	Switch, Less Coil	Coil Rating - Volts Dc	Approx. Shipping Wt., Lbs.
300P685G01②	5	422D949G04	250	8	300P757G01	8	422D949G06	125	10
300P686G01②	6	422D949G05	250	9	300P758G01①	10	422D949G07	125	11
300P687G01②	8	422D949G06	250	10	300P759G01	6	422D949G12	125	9
300P688G01②	10	422D949G07	250	11	300P760G01①	10	422D949G14	125	11
300P689G01②	6	422D949G12	250	9	300P761G01	4	422D949G23	125	7.5
300P690G01②	10	422D949G14	250	11	300P762G01①	6	422D949G25	125	9
300P691G01	6	422D949G19	③	9	300P763G01①—	10	422D949G27	125	11
300P692G01	8	422D949G26	④	10	300P764G01①	6	422D949G30	125	9
300P693G01	10	422D949G27	④	11	300P765G01①	10	422D949G32	125	11
300P694G01	6	422D949G45	⑤	9	300P766G01①	8	422D949G35	125	10
300P695G01	8	422D949G52	⑤	10	300P767G01①	10	422D949G36	125	11
300P696G01	10	422D949G53	⑤	11	300P768G01①	10	422D949G39	125	11
300P697G01	8	422D949G06	⑥	10	300P769G01①	10	422D949G53	125	11
599G01	8	422D949G08	48	10	300P770G01①	10	422D949G65	125	11
55G01①	5	422D949G04	125	8	300P771G01①	5	422D949G18	250	8
56G01①	6	422D949G05	125	9					

This table constitutes the most frequently used combinations and is given for convenience in ordering a single assembly style. ① Stock item. ② Connect coil contact and first stage contact in series for coil cutoff contact. ③ Operates on circuit breaker capacitor trip. ④ Coil good for 110 volt, 60 cycles or 24 volt dc.

Table 2: With Oval Handle for 6 inch Panel Mounting

No. of Stages	Style Numbers Without Coils: Modern Handle — Non-Trip By Handle	Modern Handle — Trip By Handle	Heavy-Duty Handle — Non-Trip By Handle	Heavy-Duty Handle — Trip By Handle	Approx. Ship. Wt., Lbs.	Rotor Contacts: A = Contact Open in Reset, Closed in Trip Position. B = Contact Closed in Reset, Open in Trip Position. Coil	1-2 ⑦	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20
2	422D949G01	422D950G01	422D948G08	422D950G08	6½	B	A	A								
3	422D949G02	422D950G02	422D949G09	422D950G09	7	B	A	A	A							
4	422D949G03	422D950G03	422D949G10	422D950G10	7½	B	A	A	A	A						
5	422D948G04	422D950G04	422D948G11	422D950G11	8	B	A	A	A	A	A					
6	422D949G05	422D950G05	422D949G12	422D950G12	9	B	A	A	A	A	A	A				
8	422D949G08	422D950G06	422D949G13	422D950G13	10	B	A	A	A	A	A	A	A	A		
10	422D949G07	422D950G07	422D949G14	422D950G14	11	B	A	A	A	A	A	A	A	A	A	A
2	422D949G15	422D950G15	422D949G41	422D950G41	6½	B	B	A								
3	422D949G16	422D950G16	422D949G42	422D950G42	7	B	B	A	A							
4	422D949G17	422D950G17	422D949G43	422D950G43	7½	B	B	A	A	A						
5	422D949G18	422D950G18	422D949G44	422D950G44	8	B	B	A	A	A	A					
6	422D949G19	422D950G19	422D949G45	422D950G45	9	B	B	A	A	A	A	A				
8	422D949G20	422D950G20	422D949G46	422D950G46	10	B	B	A	A	A	A	A	A	A		
10	422D949G21	422D950G21	422D949G47	422D950G47	11	B	B	A	A	A	A	A	A	A	A	A
3	422D949G22	422D950G22	422D949G48	422D950G48	7	B	B	B	A							
4	422D949G23	422D950G23	422D949G49	422D950G49	7½	B	B	B	A	A						
5	422D949G24	422D950G24	422D949G50	422D950G50	8	B	B	B	A	A	A					
6	422D949G25	422D950G25	422D949G51	422D950G51	9	B	B	B	A	A	A	A				
8	422D949G26	422D950G26	422D949G52	422D950G52	10	B	B	B	A	A	A	A	A	A		
10	422D949G27	422D950G27	422D949G53	422D950G53	11	B	B	B	A	A	A	A	A	A	A	A
4	422D949G28	422D950G28	422D949G54	422D950G54	7½	B	B	B	B	A						
5	422D949G29	422D950G29	422D949G55	422D950G55	8	B	B	B	B	A	A					
6	422D949G30	422D950G30	422D949G56	422D950G56	9	B	B	B	B	A	A	A				
8	422D949G31	422D950G31	422D949G57	422D950G57	10	B	B	B	B	A	A	A	A	A		
10	422D949G32	422D950G32	422D949G58	422D950G58	11	B	B	B	B	A	A	A	A	A	A	A
5	422D949G33	422D950G33	422D949G59	422D950G59	8	B	B	B	B	B	A					
6	422D949G34	422D950G34	422D949G60	422D950G60	9	B	B	B	B	B	A	A				
8	422D949G35	422D950G35	422D949G61	422D950G61	10	B	B	B	B	B	A	A	A	A		
10	422D949G36	422D950G36	422D949G62	422D950G62	11	B	B	B	B	B	A	A	A	A	A	A
	422D949G37	422D950G37	422D949G63	422D950G63	9	B	B	B	B	B	B	A				
	422D949G38	422D950G38	422D948G64	422D950G64	10	B	B	B	B	B	B	A	A	A		
10	422D949G39	422D950G39	422D949G65	422D950G65	11	B	B	B	B	B	B	A	A	A	A	A

⑦ On 250 volts dc control circuits this contact must be connected in series with co

Further Information
Price List 34-009

202245

echnical Data

25

A-17
(PG. 2 OF 2)

ype WL Switches, Continued
able 3: Two Units Geared to a Common
andle

tage①	Stage②
1	16
2	17
3	18
4	19
5	20

Additions and Modifications②

Capacitor
Diode-Resistor Assembly
Target
Resistor Assembly (One Resistor)
Special Nameplate Marking
Tumble Pin Key Lock
Bevel Geared Assy.
Coil Omission

able 4: Characteristics – Coil Selection for Relay Switch
ime From Energization of Coil to Positive Contact Closing – Seconds
he coils marked (①) are considered standard for the operating voltage as indicated and will e included with the switch if the style of the coil is not specified when the switch is ordered. In ny case, the operating voltage must be given. These coils should not be used for 5 ampere eries trip operation from secondary of current transformers, as the burden is too great.

Direct Current							Alternating Current – 60 Cycles*				
Coil Style Number	Ohms Resistance	Minimum Trip Dc Volts	Control Voltage – Dc 24	48	125	250	Coil Style Number	Ohms Impedance (Not Tripped)	Minimum Trip Ac Volts	Control Voltage – Ac 110	220
			Time in Seconds							Time in Seconds	
767 374	.73	8.7	① .018	....	....	....	767 374	6.2	50	① .016	....
452 325	2.68	17.1	....	.016	....	....	452 325	21.0	95	.019	.016
760 254	4.05	21.4	....	① .017	....	....	760 254	30.0	115	....	.018
476 372	6.2	27.0	....	.019	.013	....	476 372	43.0	135	....	① .017
1043 450	8.6	31.0	....	....	.014	....	1043 450	52.0	155	....	018
477 879	12.2	33.0	....	....	.014	....	477 879	97.0	200	....	....
807 530	18.5	44.0	....	....	.016	....	807 530	140.0	243	....	....
[illegible]	28.0	54.0	....	....	① .017	.014	807 531	208.0	297	....	....
	45.5	70.0	....	....	.018	.015					
	53.0	84.0	....	....	....	① .016					
3[illegible] .43	104.0	111.0	....	....	....	.017					

* Time may vary slightly for Ac tripping depending on point of Ac cycle at which coil is energized.

Type WLM Switches

Single Units Stages②	Geared Units Stages②
1	11
2	12
3	13
4	14
5	15
6	16
7	17
8	18
9	19
10	20

Auxiliary Switches

No. of Stages	Indoor With Cover Style Number②	Indoor Without Cover Style Number②	Outdoor Weatherproof Style Number②
2	676 957	591 815③	599 938
2	--- ---	591 816	--- ---
4	676 960①	591 818③	599 939
4	--- ---	591 819	--- ---
6	676 963	591 821③	599 940
6	--- ---	591 822	--- ---
10	678 966	591 824③	599 941
10	--- ---	591 825	--- ---

① Refer to Westinghouse.
② Stock item.
③ Without operating lever, mounting bracket, or cover.

Ordering Information

Prices include switch and coil in all cases. Select switch style number from table 1 and coil style number from table 4 unless it is convenient to order complete assembly style from table 2, which lists the most frequently used combinations.

Operating voltage should always be specified. Heavy-duty handle switches can be mounted on panels up to 2 inches thick by changing the mounting screw length. Modern handle switches for other than ¼ inch panels are available on special order.

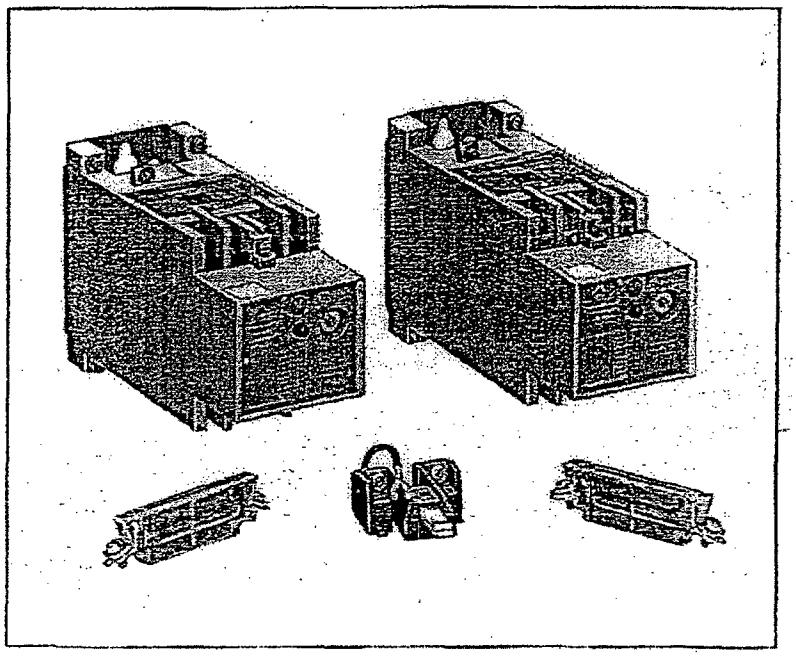
Special WL switches can be supplied on special order to handle more than 10 circuits up to a maximum of 20.

For information on direct current applications refer to Descriptive Bulletin 34-252.

For special switches, refer to Westinghouse.

Printed in U.S.A.

Westinghouse Electric Corporation
Switchgear Division
[illegible] Pittsburgh, Pa., U.S.A. 15112



Bulletin 700-RTC

- Timing Functions
  - 8 ON-Delay
  - 8 OFF-Delay
- Timing Ranges
  - Seconds: 0.05...2, 0.2...8, 0.4...30, 2...120
  - Minutes: 0.015...1, 0.06...4, 0.25...16 and 1...64
- AC, 50/60 Hz or DC
- 600V AC Maximum
- 300V DC Maximum
- Relays with Fixed Time Delay
- Sealed Contacts
- Harsh Environments
- Hazardous Locations Class I, Div. 2, Groups A, B, C and D

TABLE OF CONTENTS

Description	Page	Description	Page
Product Selection	9-192	Specifications	9-195
Accessories	9-194	Approximate Dimensions	9-195

Description

Bulletin 700-RTC Fixed Time timing relays are designed for applications requiring a specific time delay and in which inadvertent timing changes must be avoided. They offer the reliability and accuracy of a fixed solid-state along with the contact isolation of electromechanical relays.

Bulletin 700-RTC timing relays are available with up to 2 timed and 2 instantaneous contacts in various N.O. and N.C. combinations. The 16-position switch provides the selection of 8 timing ranges in either the On-Delay or Off-Delay mode. An LED indicator (Off, Flashing for timing, or On for delay completed) indicates timer operating status.

Bulletin 700-RTC timers have a self-contained adjustment potentiometer. Bulletin 700-RTCR timers have provision for a remote adjustment potentiometer for 24V only.

Bulletin 700-RTC and -RTCR Timing Relays – Timing ranges are 0.05...2, 0.2...8, 0.4...30, and 2...120 seconds and 0.01...1, 0.06...4, 0.25...16, and 1...64 minutes.

The fixed time delay is factory-set at a value within ±5% of time stated on the nameplate. The operating mode is either On-Delay or Off-Delay, not convertible. Relays are supplied with up to two timed contacts and two instantaneous contacts, and are also available without provision for instantaneous contacts.

The N.O. and N.C. contact cartridges are designed to be changed or added in the field. A relay can be easily modified to have any combination of N.O. and N.C. contacts, limited to 2 timed and 2 instantaneous contacts. The unused spaces are filled with removable "dummy cartridges".

Conformity to Standards:
NEMA B600
NEMA P300

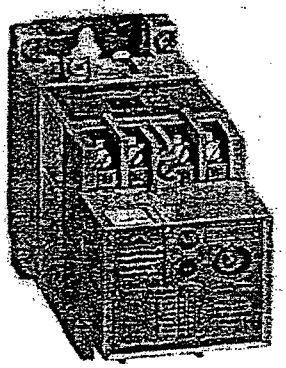
Approvals:
CSA Certified
File LR11924
UL File E10314,
Guide, NOIV

Your order must include:
- Cat. No. of the relay selected.
- Coil voltage suffix code.
- If required, Cat. No. of any accessories.

Bulletin 700-RTC
Solid-State Timing Relays
Product Selection

Bulletin 700-RTC Relay – Relays with Provision for Instantaneous Contacts

Relays listed below have slots for two timed contacts and two instantaneous contacts. Unused slots are equipped with removable dummy cartridges.



Number of Contact Cartridges					Open Type Without Enclosure
Total	Instantaneous		Timed		Cat. No.
	N.O.	N.C.	N.O.	N.C.	
0	0	0	0	0	700-RTC00000⊗
1	0	0	1	0	700-RTC00100⊗
	0	0	0	1	700-RTC00010⊗
2	0	0	2	0	700-RTC00200⊗
	1	0	1	0	700-RTC10100⊗
	0	1	1	0	700-RTC01100⊗
	0	0	1	1	700-RTC00110⊗
	1	0	0	1	700-RTC10010⊗
	0	1	0	1	700-RTC01010⊗
	0	0	0	2	700-RTC00020⊗
3	1	0	2	0	700-RTC10200⊗
	2	0	1	0	700-RTC20100⊗
	0	1	2	0	700-RTC01200⊗
	1	1	1	0	700-RTC11100⊗
	1	0	1	1	700-RTC10110⊗
	2	0	0	1	700-RTC20010⊗
	0	2	1	0	700-RTC02100⊗
	0	1	1	1	700-RTC01110⊗
	1	1	0	1	700-RTC11010⊗
	1	0	0	2	700-RTC10020⊗
	0	2	0	1	700-RTC02010⊗
	0	1	0	2	700-RTC01020⊗
4	2	0	2	0	700-RTC20200⊗
	1	1	2	0	700-RTC11200⊗
	2	0	1	1	700-RTC20110⊗
	0	2	2	0	700-RTC02200⊗
	1	1	1	1	700-RTC11110⊗
	2	0	0	2	700-RTC20020⊗
	1	1	0	2	700-RTC11020⊗
	0	2	1	1	700-RTC02110⊗
	0	2	0	2	700-RTC02020⊗

⊗ Voltage Suffix Code
The Cat. No. as listed is not complete. Select a voltage suffix code from the table below to complete the Cat. No. Example: Cat. No. 700-RTC00100⊗ becomes Cat. No. 700-RTC00100U24. For other voltages consult your local Allen-Bradley Sales Office.

Voltage	24V DC 24V AC, 50/60 Hz	120V DC 110/120V AC, 50/60 Hz	240V DC 220/240V AC, 50/60 Hz
Coil Code	U24	U1	U2

Contact Cartridges

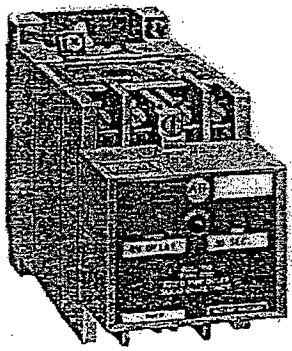
Description	Contacts	Cat. No.
Timed and Instantaneous	N.C. (Grey)	700-CRT5
	N.C. (Orange)	700-CRT6



Remote Potentiometer Provision (for Bulletin 700-RTCR Relays, 24V AC, 50–60 Hz, or 24V DC Only)
To order a Bulletin 700- RTC relay with remote potentiometer provision, add an "R" after the letters RTC of the selected Cat. No. from the above table and a "U24" coil code to the Cat. No. Example: 700-RTCR00000U24. Order potentiometer separately from page 9-194.

Bulletin 700-RTC Relays with Fixed Time Delay— Relays with Provision for Instantaneous Contacts

Relays listed below have slots for two timed and two instantaneous contacts. Unused slots are equipped with removable dummy cartridges.



Number of Contact Cartridges					Open Type Without Enclosure
Total	Timed		Instantaneous		Cat. No.
	N.O.	N.C.	N.O.	N.C.	
0	0	0	0	0	700-RTC00●⊗
1	1	0	0	0	700-RTC10●⊗
	0	1	0	0	700-RTC20●⊗
2	2	0	0	0	700-RTC40●⊗
	1	0	1	0	700-RTC11●⊗
	1	0	0	1	700-RTC12●⊗
	1	1	0	0	700-RTC30●⊗
	0	1	1	0	700-RTC21●⊗
	0	1	0	1	700-RTC22●⊗
	0	2	0	0	700-RTC50●⊗
3	2	0	1	0	700-RTC41●⊗
	1	0	2	0	700-RTC14●⊗
	2	0	0	1	700-RTC42●⊗
	1	0	1	1	700-RTC13●⊗
	1	1	1	0	700-RTC31●⊗
	0	1	2	0	700-RTC24●⊗
	1	0	0	2	700-RTC15●⊗
	1	1	0	1	700-RTC32●⊗
	0	1	1	1	700-RTC23●⊗
	0	2	1	0	700-RTC51●⊗
	0	1	0	2	700-RTC25●⊗
	0	2	0	1	700-RTC52●⊗
4	2	0	2	0	700-RTC44●⊗
	2	0	1	1	700-RTC43●⊗
	1	1	2	0	700-RTC34●⊗
	2	0	0	2	700-RTC45●⊗
	1	1	1	1	700-RTC33●⊗
	0	2	2	0	700-RTC54●⊗
	1	1	0	2	700-RTC35●⊗
	0	2	1	1	700-RTC53●⊗
	0	2	0	2	700-RTC55●⊗

● Replace the ● in the Cat. No. with the appropriate letter and numbers to indicate the operating mode and the fixed time delay value. Refer to operating mode table.

Digit	Operating Mode	Fixed Time Delay
S Z	On-Delay – Sec. Off-Delay – Sec.	Seconds – Two digits indicating the fixed time delay in seconds. Three digits indicating the fixed time delay (first digit indicates seconds, next two digits indicate 1/100 seconds).
Y I	On-Delay – Min. Off-Delay – Min.	Minutes – Two digits indicating the fixed time delay in minutes. Three digits indicating the fixed time delay (first digit indicates minutes, next two digits indicate 1/100 minutes).

Examples: Cat. No. 700-RTC00Y20⊗U1 is for a relay without contact cartridges. "Y20" indicates an On-Delay timer with a 20 minute fixed time delay. This is a "standard relay." You would order the contact cartridges separately. Cat. No. 700-RTC42S02⊗U1 is for a relay with 2 N.O. cartridges in the timed position and 1 N.C. cartridge in the instantaneous position. "S02" indicates an On-Delay timer with a 2 second fixed time delay.

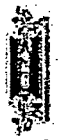
⊗ Voltage Suffix Code

The Cat. No. as listed is not complete. To complete the Cat. No., add a coil code selected from the table below.

Voltage	24V DC—24V AC, 50/60 Hz	120V DC—110/120V AC, 50/60 Hz	240V DC—220/240V AC, 50/60 Hz
Coil Code	U24	U1	U2

Solid-State Timing Relays

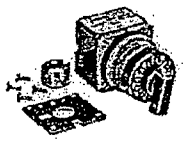
Accessories


Cat. No. 700-CRT5


Cat. No. 700-CRT6


Cat. No. 700-CR9

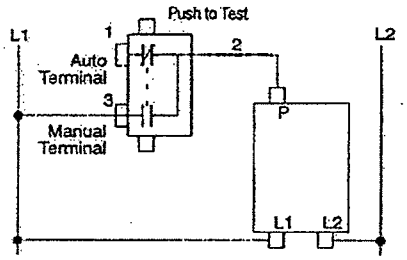
Description	Cartridge Type	Color	Cat. No.
Contact Cartridges – These cartridges are used to add contacts to timing relays having unused slots. The N.O., N.C., and "Dummy" cartridges are interchangeable and can be used in timed or instantaneous contact slots. "Dummy" cartridges should be placed in unused cartridge slots to guard against entrance of foreign material.	Normally Open	Grey	700-CRT5
	Normally Closed	Orange	700-CRT6
	"Dummy" Cartridge	Black	700-CR9


Cat. No. 800MR-N37

External Potentiometer – The potentiometer units listed are recommended for timers with remote potentiometer provision. Refer to catalog section on Bulletin 800T or 800M for general construction features.	Oiltight ❶	800T-U90
	Small Oiltight – Round ❷❸	800MR-N37
Connection Cable – Use shielded twisted pair cable, maximum of 50 feet. Recommended cable (or equivalent): UL style 2517, having two #18 stranded conductors with aluminum mylar foil shield and #20 drain wire. Rated 150°C, FR-1, 300 volts.	Small Oiltight – Square ❷❸	800MS-N37
ATTENTION – If the recommended potentiometer and cable are not used, be certain that the potentiometer and cable wiring (R1-R2 circuit in Figure 3) is insulated from ground and circuit common for 300V RMS or greater.		

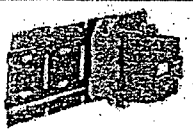


Manual Actuator – Used to energize the timing relay initiate circuit manually. Field installed. — 700-N7





NEMA Type 1 Enclosure – Suitable for Bulletin 700-RTC timing relays. — 700-N31



Universal Mounting Strips – These strips are easily cut to the required length and bolted, riveted or spotwelded in place. Relays are installed adjacent to one another on the mounting strip with the captive mounting screws provided. 5 strips/package.

Relays Per Strip	Pkg. Qty.	
4	5	700-MP4
8	5	700-MP8
12	5	700-MP12
16	5	700-MP16

❶ Legend plate, Cat. No. 800T-X609, must be specified when ordering.
❷ Add suitable 400 KΩ potentiometer.
❸ Does not include legend plate. Refer to page 10-289.
❹ Does not include legend plate. Contact your local Allen-Bradley Sales Office.

Voltage and Power Requirements

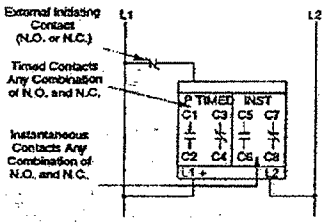
AC Voltage +10% –15% 50/60 Hz	Total Power Required	Initiate Terminal (P) Power	Maximum Allowable Leakage Current	Coil Code
24V AC	8 VA	4 VA	10 mA	U24
110/120V AC	9 VA	4 VA	2.4 mA	U1
220/240V AC	11 VA	5 VA	2.4 mA	U2

DC Voltage +10% –20%	Total Power Required	Initiate Terminal (P) Power	Maximum Allowable Leakage Current	Coil Code
24V DC	10 W	5 W	10 mA	U24
120V DC	11 W	5 W	2.4 mA	U1
240V DC	12 W	5 W	2.4 mA	U2

Type	700-RTC
Contact Rating (See page 9-12)	NEMA B600 600V AC, 5A NEMA P300 300V DC, 5A
Contact Arrangement	1...4 poles. Max. of 2 timed and 2 instantaneous. Available in any combination of N.O. and N.C. contacts
Contact Material	W (tungsten in a controlled gas atmosphere)
Operating Mode	Convertible to On-Delay or Off-Delay
Timing Range	0.05...64 min.
Reset Time	25 ms
Repeat Accuracy	±1% (or ±50 ms) at constant voltage and temperature
Mounting	Panel or Strip Mount
Surge Suppression	Not required. Timers have internal suppression
UL Listed	Suitable for use in Class I, Division 2, Groups A, B, C, and D
Maximum Allowable Leakage Current	24V AC/DC 10 mA 110/120V AC, 220/240V AC, 120/240V DC 2.4 mA
Ambient Temperature ❶ Operating: Storage:	 –20...+60°C (–4...+140°F) –20...+60°C (–4...+140°F)

❶ Continuous duty units placed close to each other (3 in a row) have a temperature range of –20...+45°C (–4...+113°F) or should have air circulated around the units.

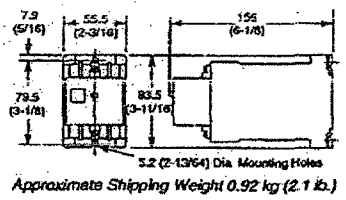
Typical Wiring Diagram



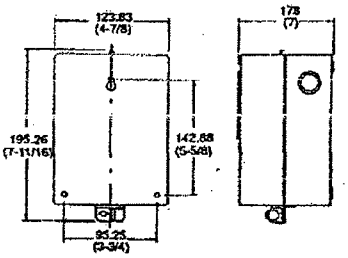
Calculation FEX-00204-00
Rev. 0
Attachment S
Page 116 of 219

Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



Approximate Shipping Weight 0.92 kg (2.1 lb.)



NEMA Type 1 Enclosure for RTC Relays
Approximate Shipping Weight 1.26 kg (2.8 lb.)

FEATURES AND GENERAL SPECIFICATIONS **Series 70**

Outstanding Features

ITEM 70

1. Logic circuitry solid state, no moving parts.
2. High voltage (125V DC) signal contact option provided for 12 volt logic systems. Note: This is not to be utilized where intrinsically safe operation is contemplated.
3. No false tripping. Power supply and each input circuit protected by filter networks.
4. De-rated components to assure long life.
5. Extra Long Life Lamps.
6. Operation from either normally open or normally closed signal contacts (via switch) without substituting plug-in modules.
7. Sequence option switch on some plug-in modules for operating flexibility.
8. Full operational test for maximum security of monitoring.
9. All logic supplied on printed circuit plug-in boards. Material: glass epoxy (G10), grade FR-4, flame retardant; meets MIL-P-13949E.
10. Five basic cabinet styles offered as part of standard line. Plug-in modules are identical.
11. Remote logic system capabilities.
12. Many plug-in cards have as an option integrally mounted LED status indicators. Consult factory for additional information.

General Specifications and Operating Details

Annunciators are subject to the same considerations as other electrical equipment regarding: (1) Environment, (2) Power Source, (3) Physical Mounting, (4) Function, and (5) General Specifications.

POWER REQUIREMENTS

3 watts per point, typical.

LOGIC VOLTAGE

Standard 12V DC with 6.3 volt lamps, signal contact 12V DC or optional 125V DC.
Optional 24V DC with 24 volt lamps and signal contacts.

SIGNAL INPUT VOLTAGE

12V DC, 24V DC or 125V DC (12 and 125V DC signal input not available with 24V logic; meets IEEE Standard 472-1974 Surge Withstand Capability Test)

12V Signal Contact Inputs (Not available with 24V logic)

Input current: 1.3ma max.
(Thru signal contact)
Series resistance: 8k ohm max.
(Maximum resistance of wiring and contact to be recognized as a closed contact.)
Shunt resistance: 68K ohm min.
(Minimum resistance in parallel to signal input to be recognized as an open contact.)
Response time: 11 ms. min., 14 ms. nom., 24 ms. max.
(Minimum length of time signal must be present at input to guarantee a lock-in alarm.)
Discrimination time: 5ms. typ. 10ms. max.
(Minimum time difference between input signals to guarantee that only the initial input signal will cause a first out alert condition; for sequential alarm points only.)
Input step function: ≤ 2.5V DC
≥ 7.5V DC
(Voltage levels required at input terminals when step function voltage input signals used.)

24V Signal Contact Inputs

Input current:	1.3ma. max.
Series resistance:	20K ohm max.
Shunt resistance:	120K ohm min.
Response time:	6ms. min., 10ms. nom., 27ms. max.
Discrimination time:	5ms. typ. 15ms. max.
Input step function:	≤ 10V DC ≥ 18V DC

125V Signal Contact Inputs (Not available with 24V Logic) Systems specified for 125V signal contacts are equipped with 75K ohm resistors mounted in the chassis

Input current:	2ma. max.
Series resistance:	100K ohm max.
Shunt resistance:	1.5meg. ohm min.
Response time:	9ms. min., 15ms. nom., 32ms. max.
Discrimination time:	5ms. typ. 15ms. max.

OUTPUTS

Visual lamp indication on lamp panel display, from point modules normally two 1-watt lamps in parallel per point. Audible tone output from remote Panatone horn, driven by flasher/horn module, with internal volume control.
Sound level: 72 to 90dB @ 10'
Optional auxiliary relay contact output. Contact rated 5 amps at 120/60V AC or 1 amp at 125V DC resistive.

HUMIDITY

Relative humidity: (non condensing) 0 to 95%

TEMPERATURE RANGE

Operative Limits
Minimum 0 degrees Celsius (32 degrees Fahrenheit)
Maximum 50 degrees Celsius (122 degrees Fahrenheit)
Storage Limits
Minimum -40 degrees Celsius (-40 degrees Fahrenheit)
Maximum 70 degrees Celsius (158 degrees Fahrenheit)

MOUNTING

Standard cabinets furnished with clamps for flush panel mounting. Panastat annunciators are not position sensitive and can be mounted in sloping panels. Surface mounted cabinets and door panels are available in weather-tight designs.

MAIN SUPPLY INPUT VOLTAGES

Standard: 120V 50-60Hz AC, 125V DC
Optional: 24V DC or AC, 48V DC or AC, 240V AC, 250V DC. All AC power supplies are designed for 50-60Hz operation.
Meets IEEE Standard 472-1974 Surge Withstand Capability Test

ITEM-73

INDUSTRIAL RELAYS

A1, B1, B58, 10, 119, 215

GENERAL PURPOSE SCREW MOUNTED RELAYS

5- TO 15-AMP MIDGET

6 AMP TYPES



A1XCX



B58XEX

Types A1, B1 & B58 relays have 300-volt electrical spacing and contact ratings of 6 amps, non-inductive—widely used in control circuits and for operating small auxiliary equipment.

COILS: For any single voltage up to 240V/60Hz or 125 Vdc

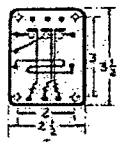
CONTACT RATING:

Load	24V	120V	240V
AC	6A	6	3
DC	6A	0.5	—

GENERAL SPECIFICATIONS:

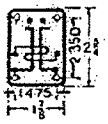
U.L. Listed: File No. E7104
Insulation: 300 V
Terminals: #6-32 front studs

SERIES A1



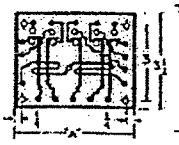
Relay	Contacts	Term.
A1CXX	3 SB NO	8
A1BAX	3 SB 2 NO 1 DT	9
A1ABX	3 SB 1 NO 2 DT	10
A1XCX	3 SB DT	11

SERIES B1



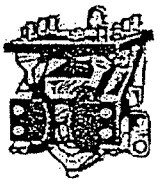
Relay	Contacts	Term.
B1HXX	1 DB NO	4
B1XHX	1 DB DT	6
B1XAX	1 SB DT	5
B1XXH	1 DB NC	4
B1BXX	2 SB NO	6
B1AXA	2 SB 1 NO 1 NC	6
B1XXB	2 SB NC	6
B1XBX	2 SB DT	8

SERIES B58



Relay	Contacts	Term.	"A" Dim.
B58DXX	4 SB NO(4)	10	3
B58XDX	4 SB DT (4)	14	3
B58EXX	5 SB NO(5)	12	3½
B58XEX	5 SB DT (5)	17	3¼
B58FXX	6 SB NO(6)	14	4
B58XFX	6 SB DT (6)	20	4

5 AMP TYPES



Type 119XBX is a 5-amp rated, DPDT unit that is a U.L. Listed Component: File No. E13224. Contact rating is 5 amps, non-inductive or 1/8 HP motor load (80% PF) at 120 Vac.

Designed for quantity production, standard relays with 120V, 60-hertz coils are normally carried in stock. Special modifications are available to quantity users.

10 AMP TYPES



10XBX

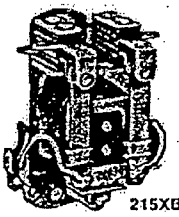
Type 10XBX is a 10-amp rated DPDT unit using the same coils as types A1, B1, & B58 on the left column. Voltages up to 240V/60Hz or 125Vdc.

CONTACT RATING:

Load	24V	120V	240V
AC	10A	10A	5A
DC	10A	0.5A	—

Larger coils for greater sensitivity, extra power, or to meet military shock and vibration requirements can also be furnished. Quotations upon request. Advise quantity and complete specifications.

15 AMP TYPES



215XBX

Type 215 Relays are 15-amp units with SPDT (215XAX) or DPDT (215XBX) contacts. Coils available up to 240V/60Hz or up to 125Vdc.

CONTACT RATING:

Load	24V	120V
AC	15A	13A
DC	15A	0.25A

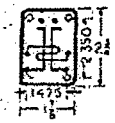
GENERAL SPECIFICATIONS:

Insulation: Meets requirements for 150V relays.
Terminals: Solder tab with 3/32" holes for up to #14 AWG wires.

CONTROL RELAYS • *Standard Midget Relays*



B1XBX



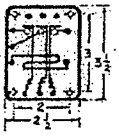
Relay	Contacts	Term
B1HXX	1 DB NO	4
B1XHX	1 DB DT	6
B1XAX	1 SB DT	5
B1XXH	1 DB NC	4
B1BXX	2 SB NO	6
B1AXA	2 SB 1 NO 1 NC	6
B1XXB	2 SB NC	6
B1X8X	2 SB DT	8

Recommended Enclosures: H6 sheet metal housing. G10 glass cover. B1 black plastic "snap-on" covers can also be furnished if the relay base is provided with ball catches. Order as one unit by specifying "B1" as a suffix to the relay type.

U.L. Listed: E7104 (White card)



A1XCX



Relay	Contacts	Term
A1CXX	3 SB NO	8
A1BAX	3 SB 2 NO 1 DT	9
A1ABX	3 SB 1 NO 2 DT	10
A1XCX	3 SB DT	11

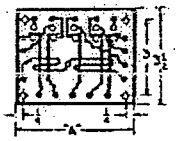
The above table includes only basic combinations of N.O. and D.T. contacts. N.C. contacts can be substituted for N.C. contacts at no increase in price.

Recommended enclosures: H6 sheet metal housing. G10 glass cover.

U.L. Listed: E7104 (White card)



B58XEX



Relay	Contacts	Term.	"A" Dim.
B58DXX	4 SB NO(4)	10	3
B58XDX	4 SB DT(4)	14	3
B58EXX	5 SB NO(5)	12	3½
B58XEX	5 SB DT(5)	17	3½
B58FXX	6 SB NO(6)	14	4
B58XFX	6 SB DT(6)	20	4

The above table includes only relays with 4, 5 or 6 identical contacts — all normally open or all double-throw. Combinations are also available, and the price can be estimated by interpolation. Normally-closed can be substituted for normally-open contacts at no increase in price. Specify number of each.

Recommended Enclosures:

H3—Sheet metal housing.
G6—Molded glass cover.

Struthers-Dunn Midget Relays are recognized throughout industry as a standard of quality and dependability for control circuit applications and for operating small auxiliary equipment such as motors, heaters, lights, etc., within their contact rating.

Contact Arrangements can be furnished as required. Only the more popular combinations are listed. A single magnet frame will operate up to 3 contacts. Four-, five- and six-pole combinations consist of two magnet frames on a common insulated base with properly selected coils in series, so as to function as a single relay.

Contact Ratings

Volts	24	115	230
AC AMPS	6	6	3
DC AMPS	6	0.5	—

The above ratings apply to open-mounted relays, and are based on continuous non-inductive resistance type loads. Inrush on motor or lamp loads should not exceed 20 amperes.

Insulation is in accordance with Underwriters Laboratories requirements for 300 volts.

Coils can be furnished for any single voltage up to 230 volts, 60 hertz AC, or 125 volts DC. Complete coil data and popular ratings are listed on the following page. Series coils are available for currents up to 30 amperes.

Terminals are #6-32 front connected studs complete with wiring hardware.

All models C.S.A. listed.

CONTROL RELAYS • *High Current Midget Relays*

Frame 18 High-Current Midget relays are essentially standard Midgets with larger contacts and a high rating, for controlling larger auxiliary loads, and match standard Midgets in size and appearance.

Contact Arrangements are available up to two-pole, double-throw as listed.

Contact Ratings

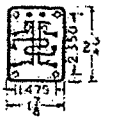
Volts	24	48	115
AC AMPS	15	15	15
DC AMPS	15	5	0.5

Other Parts, including base, terminals, magnetic assembly and coil are identical to those used on standard "Midgets."

Recommended Enclosures:

H6—sheet metal housing.
H4—weatherproof housing.
G10—*molded glass cover*
B1—black plastic snap-on cover (not recommended when relay contacts carry more than 10 amperes).

Relay	Contacts	Term.
18HXX	1 DB NO	4
18XHX	1 DB DT	6
16XXH	1 DB NC	4
18AXX	1 SB NO	4
18XAX	1 SB DT	5
18XXA	1 SB NC	4
18BXX	2 SB NO	6
18AXA	2 SB 1 NO 1 NC	6
18XXB	2 SB NC	6
18AAX	2 SB 1 NO 1 DT	7
18XAA	2 SB 1 DT 1 NC	7
18XBX	2 SB DT	8





18BXX

COILS AVAILABLE

Common 60 Hertz AC Ratings			
Voltage	Current in Amperes		Coil Gauge
	Inrush	Steady	
6	1.7	1.1	#360-24
12	0.925	0.525	#360-28
24	0.430	0.245	#360-31
115	0.082	0.046	#360-38
230	0.043	0.023	#360-41

Inrush values are taken with armature open and coil cold. Steady current values are with armatures closed and coils hot. Approximate steady power consumption is 5 to 6 volt-amperes

Common DC Ratings		
Voltage	Current in Amps.	Coil (Gauge)
6	0.495	#360-29
12	0.240	#360-32
24	0.130	#360-35
32	0.090	#360-36
48	0.058	#360-38
115	0.024	#360-42
125	0.020	#7556-42

Power Consumption—Approximately 3 watts

Coil Data			
Coil Block Number and Wire Gauge	Turns of Wire (Approx.)	Resistance DC Ohms	Impedance 60 Hz Ohms (Approx.)
#360-24	250	1.2	5
#360-25	350	2.1	10
#360-26	400	3.2	13
#360-27	475	4.8	19
#360-28	510	5.6	23
#360-29	645	9.5	37
#360-30	1000	19	81
#360-31	1100	25	98
#360-32	1400	40	162
#360-33	2050	77	319
#360-34	2500	121	500
#360-35	2600	145	542
#360-36	3800	308	1384
#360-37	4700	430	1810
#360-38	5400	625	2500
#360-39	7000	1100	4545
#360-40	9000	1640	6851
#360-41	10500	2350	10000
#360-42	13600	3550	15555
#7556-42	16800	5100	—

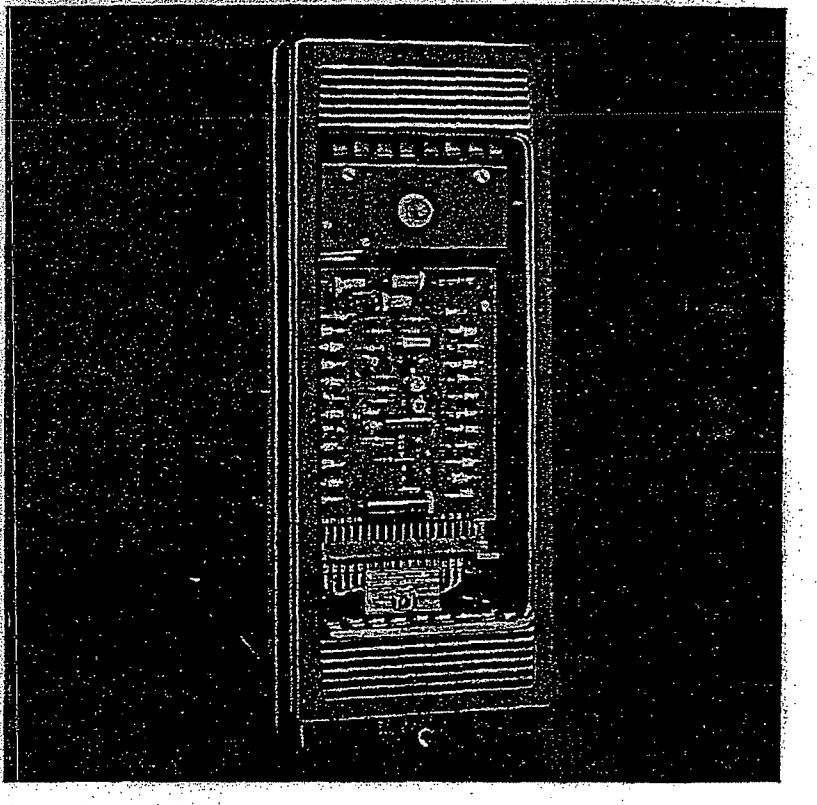
Attn: Tony Rocco

Westinghouse

ITEM 73

Type SA-1 Solid State Generator Relay

For Differential Protection of Ac Generators, Motors, and Shunt Reactors



Application

The Westinghouse SA-1 relay is a solid state, three-phase, high-speed type used for differential protection of ac generators, motors, and shunt reactors.

When equal currents flow into and out of the protected apparatus, differential current does not flow into the operating circuit of the relay unless it is "error" current due to unequal current transformer performance. However, the relay has a variable percentage operating characteristic, and requires a larger amount of operating current at higher values of restraint, or through current, than during light internal faults, thus accommodating increased amounts of current transformer error during heavy external faults.

The variable percentage characteristic of the relay provides high sensitivity during light internal faults, and avoids incorrect relay operation during heavy external faults.

Minimum pickup of the SA-1 relay is .14 amperes. As indicated in figures 2 and 5, it operates at 5% unbalance (.25 amperes) with 5 amperes of restraint current. At 60 amperes of restraint current, 50% unbalance or 30 amperes of differential current is required to initiate operation.

Device Number: 87

Features

Solid State Design: This relay has all solid state components mounted on a plug-in printed circuit board which is accessible from the front of the relay.

Utilizes Time Proven Components and Circuits: A successful field installation for over 2 years following 2 years of extensive laboratory and field tests insures the reliability of this design.

High Speed Tripping: Operating time of 1½ cycles over a wide range of trip conditions provides secure, rapid trip initiation for internal faults.

Variable Percentage Characteristic: The proportional increase in the current required to operate the relay is greater than that of the fault current. This protects against incorrect operation due to unequal current transformer performance during heavy external faults while providing sensitive protection during light internal faults.

Simple to Apply: No settings are required when placing the SA-1 in service.

Compact Design: One polyphase relay mounted in an FT-32 case provides complete differential protection for ac generators, motors and shunt reactors. The FT case matches other protective relays used to protect the machines.

Self Protected from Surges: Built in surge protection guards against surges on the external ac and dc circuits.

Indicating Lamp: An indicating light, turned on when the relay operates, remains lit until its circuit is interrupted by a microswitch. The microswitch is reset by a lever which is accessible without removing the relay cover.

Current Transformer Selection

Current transformer ohmic burden should not exceed $\frac{N_p V_{CL}}{133}$ and the burden factor (BF) should not have a ratio greater than the two current transformers on the same primary phase.

Legend:

N_p = proportion of total number of current transformer turns being used

V_{CL} = current transformer, 10L voltage accuracy class

$$BF = \frac{1000 R_B}{N_p V_{CL}}$$

R_B = burden resistance, excluding current transformer winding resistance

Example:

Assume a 10L200, 600/5 multi-ratio current transformer is being used on the 400/5 tap

$$N_p = \frac{400}{600} = 0.67$$

$V_{CL} = 200$

Burden on the current transformer should not exceed:

$$\frac{N_p V_{CL}}{133} = \frac{(0.67)\ 200}{133} = 1.0 \text{ ohm}$$

Assuming a burden resistance (R_B) of 0.5 ohms, the burden factor (BF) is:

$$BF = \frac{1000\ R_B}{N_p V_{CL}} = \frac{(1000)\ 0.5}{(0.67)\ 200} = 3.8$$

Then, the other set of current transformers may have a burden factor (BF) as great as 2 x 3.8=7.6, or as low as ½ or 3.8=1.9. If the other set of current transformers also has a burden of 0.5 ohms, a 10L100, 10L200, C-100, C200 or C400 rating would be satisfactory, since the burden factors are 7.6, 3.8, and 1.9 respectively.

When calculating the burden, use the one-way lead burden.

October, 1970
Supersedes DB 41-331, (SA-1) dated January, 1967
E, D. C/2015/DB

Westinghouse

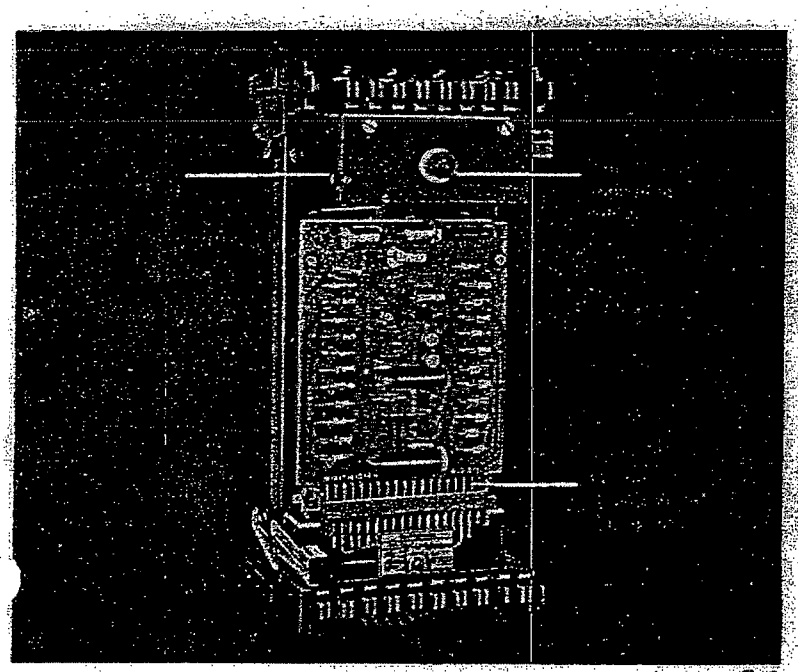


Fig. 1

Construction

The SA-1 relay consists of a restraint circuit, an operating circuit, filter and sensing circuit, amplifier circuit, and a trip and indicating circuit.

Restraint Circuit

The restraint circuit of each phase consists of a transformer with tapped primary winding, a resistor, and a full wave rectifier bridge. Outputs of the rectifiers on all three phases are connected in parallel, to provide a maximum voltage network. Thus the voltage applied to the filter and sensing circuit is proportional to the phase current of greatest magnitude.

Operating Circuit

The operating circuit of each phase consists of a transformer, resistor, and full-wave rectifier bridge. Output of the rectifier on all three phases is connected in parallel to provide a maximum voltage network. The voltage applied to the filter and sensing circuit is proportional to the phase current of the greatest magnitude.

Filter and Sensing Circuit

Consists of resistors and capacitors as shown in figure 6. The output of this circuit appears across resistor R_3, and is applied to the amplifier circuit.

Characteristic Curves

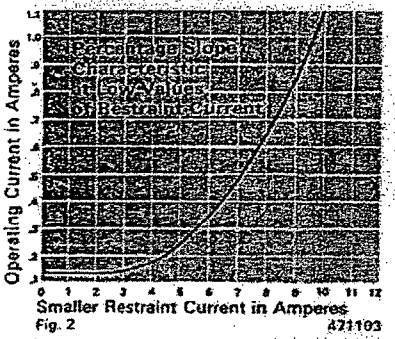


Fig. 2 471103

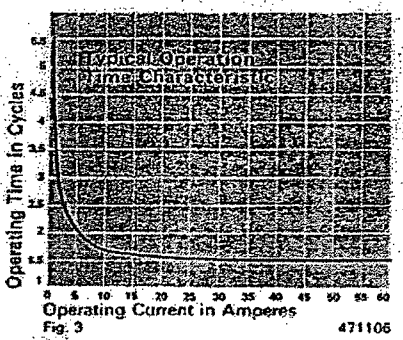


Fig. 3 471106

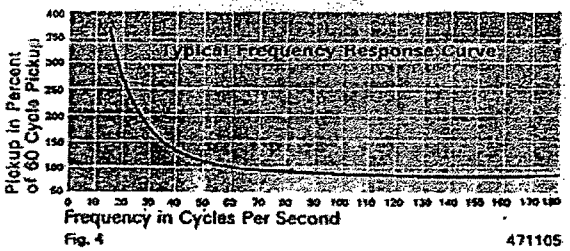


Fig. 4 471105

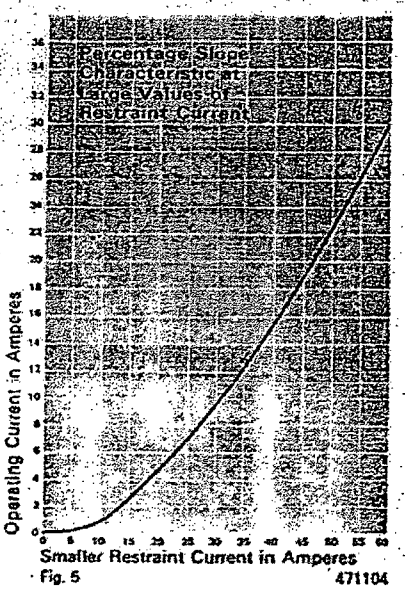


Fig. 5 471104

Type SA-1
Solid State Generator Relay

For Differential Protection
of Ac Generators, Motors,
and Shunt Reactors

Amplifier Circuit

Consists of a two-transistor amplifier, T_1 and T_2 (figure 6), which controls the operation of the relaxation oscillator.

The sensing circuit is connected to the amplifier circuit so that it receives the difference in voltage between the restraint and operating filter circuits. Consequently, the polarity input voltage to the amplifier depends upon the relative magnitude of the voltages across the operating and restraint filters. To trigger the amplifier, the voltage of the operating filter must be greater than the output voltage of the restraint filter.

Trip Circuit

The trip circuit is a thyristor (SCR-1 in figure 6) which consists of an anode, cathode, and gate.

The anode is connected to the positive side of the dc supply, and the cathode is connected to the negative side of the dc supply, through the breaker trip coil. The gate of the thyristor is connected to the output of the amplifier circuit through a pulse transformer. When gate current does not flow, the thyristor acts as an open circuit to the breaker trip coil circuit.

The presence of gate current in the thyristor connects the breaker trip coil to the dc supply.

Indicating Circuit

Consists of a lamp which is connected across the dc supply through a silicon controlled rectifier and resistor. When the amplifier circuit is triggered due to secondary fault current being applied to the relay, the lamp is energized and remains lighted until its circuit is interrupted by operation of the micro-type reset switch.

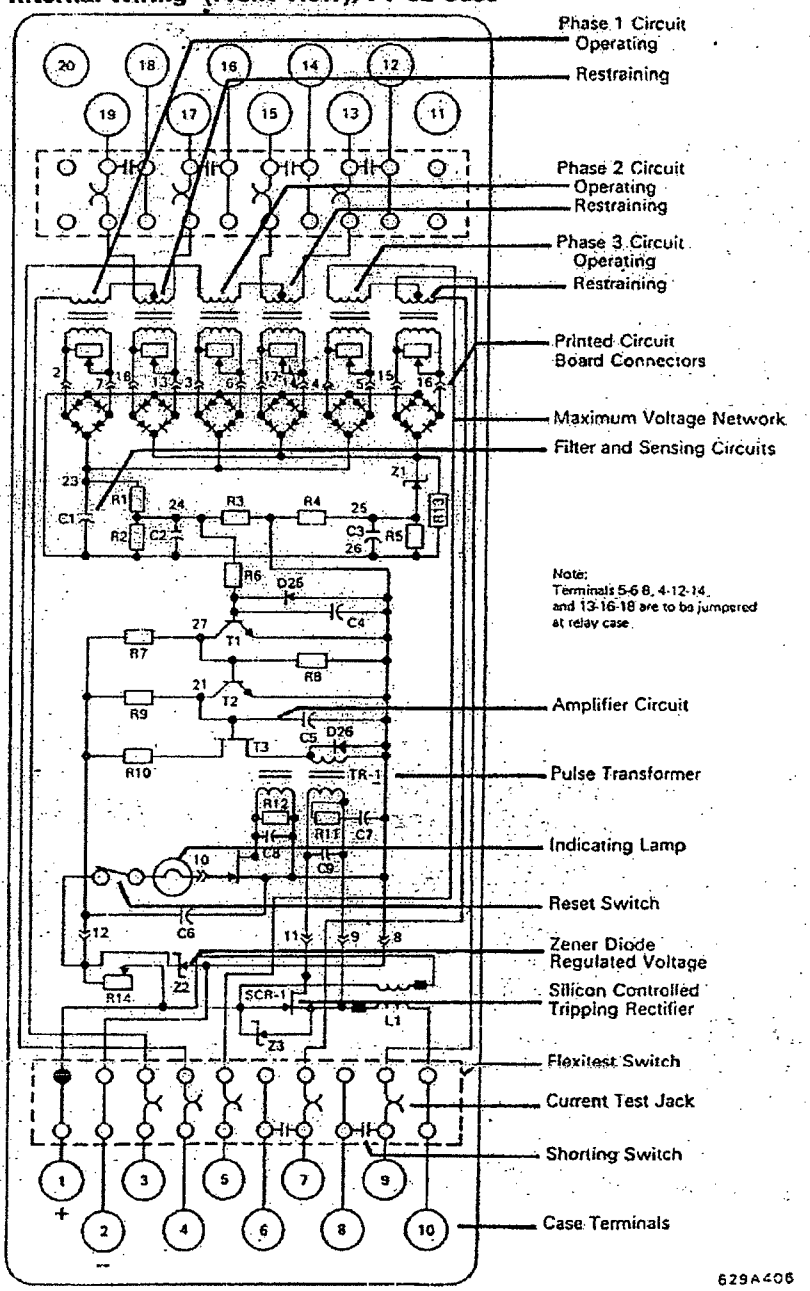
Operation

(See Figure 7)

During external faults, current flows through the primary winding of the restraint transformers and induces a secondary voltage which appears on the restraint side of the sensing circuit. If the two sets of primary currents do not have equal performance, then the difference or error current will flow out of the midtap of the restraint transformer, through the primary of the operating transformer to induce a secondary voltage which appears on the operating side of the sensing circuit.

However, with proper selection of current transformers, sufficient restraint voltage will exist to prevent triggering of the amplifier.

Internal Wiring (Front View), FT-32 Case



Type SA-1
Solid State Generator Relay

or Differential Protection
of Ac Generators, Motors,
and Shunt Reactors

Characteristics

Percentage Slope Curves

(See Figures 2 and 5)

Due to the variable percentage slope characteristic of the relay, high sensitivity is provided for light internal faults, and low sensitivity exists during heavy external faults, when current transformer performance may cause flow of a false differential current.

At 5 amperes restraint current, the relay operates at .25 ampere, or 5% unbalance. With 60 amperes restraint current, the relay requires 30 amperes to operate, or 50% unbalance. Thus, with 60 amperes through fault current flowing, the output of the main current transformers may vary considerably without causing incorrect relay operation.

Minimum Pickup

.14 ampere.

Operating Time

See figure 3.

Frequency Response

See figure 4.

Burden and Thermal Ratings

Each Restraint Circuit

Burden is 0.25 volt-amperes at 5 amperes.

Continuous rating is 20 amperes.

One-second rating is 300 amperes.

Operating Circuit

Burden of the operating circuit on each current transformer is variable because of the saturating transformer.

Burden is 0.37 volt-amperes at 0.5 amperes, and 170 volt-amperes at 60 amperes.

Continuous rating is 10 amperes.

One-second rating is 200 amperes.

Amplifier Circuit

Dc burden on station battery is:

Volts	Milliamperes	Watts
48 dc	60	2.9
125 dc	55	6.9

Settings

No settings are required, since neither the operating nor restraint transformers have taps.

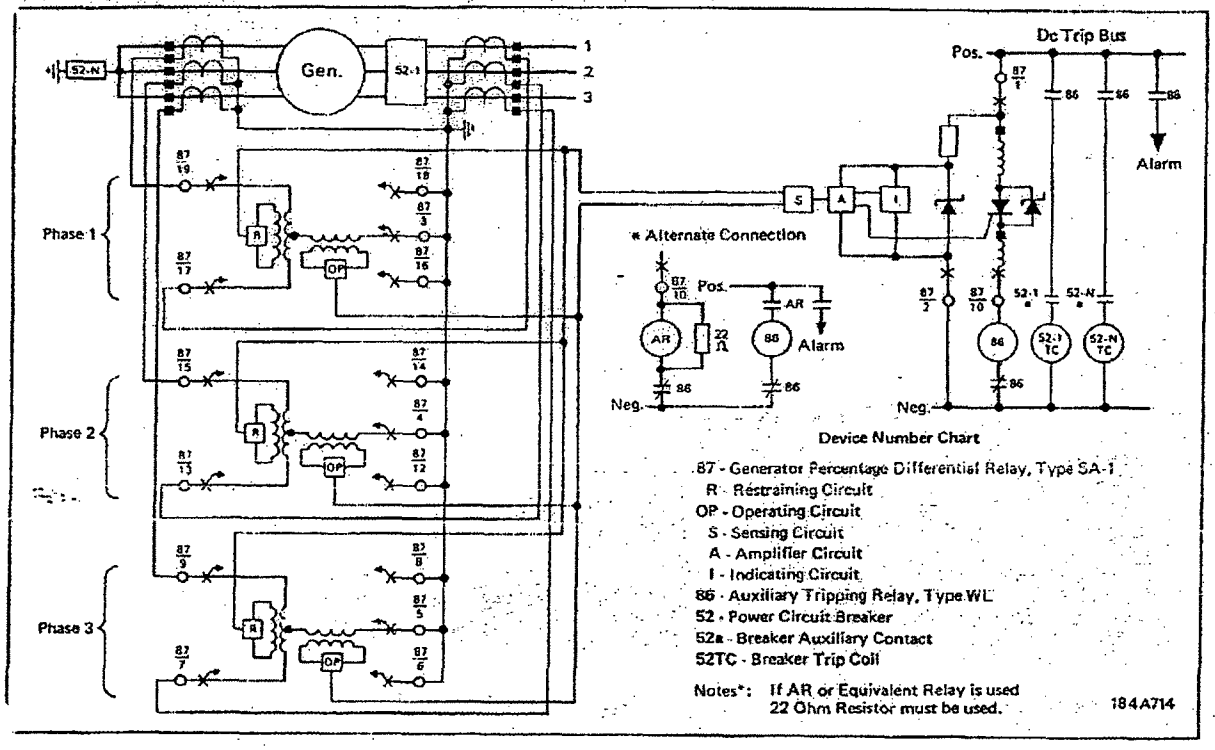
Shipping Weights and Carton Dimensions

Relay Type	Flexitest® Case Type	Weight, Lbs: Approx. Net	Weight, Lbs: Approx. Shipping	Domestic Shipping Carton Dimensions: Inches
SA-1	FT-32	15	19	13 x 13 x 21

Further Information

Prices and Style Numbers: PL 41-020
Instructions: IL 41-348.1
Case Dimensions: DB 41-075
Other Protective Relays: SG 41-000

External Wiring



Westinghouse Electric Corporation
Relay-Instrument Division: Newark Plant, Newark, N. J. 07101
Printed in USA

Type CHC

Instantaneous Overcurrent Relays

ITEM 78

DESCRIPTION

The CHC relays are cup-type, high speed, sensitive, overcurrent fault detector relays. These relays may be set to pick up below full load current and operate continuously in the picked-up position. The cup unit circuits are designed to prevent contact welding.

The CHC11A relay is a complete three-phase and ground, multicontact, high speed nondirectional overcurrent relay. The relay consists of an induction cup unit for multiphase faults and a small hinged armature unit for ground faults. Two targets and four electrically separate contacts are available. Three are normally open with a fourth that is field selectable either normally open or closed. An external reactor is supplied with the relay to reduce dropout time of hinged armature unit when applied in breaker failure schemes. Note that use of the reactor will increase pickup of ground fault unit approximately 40 percent.

The CHC15A consists of two cup units. The top unit is used for ground fault detection, with the bottom unit for phase fault detection. Also included in the relay are two targets and four electrically separate contacts; these are normally open with a fourth contact that is field selectable either normally open or closed.

The CHC21A and CHC21C relays consist of an induction cup unit that is responsive to both phase and ground currents, and a telephone type auxiliary relay that provides four or five electrically separate contact circuits. Two of these contact circuits have targets wired in series. The CHC21A auxiliary relay has three normally open contacts and a fourth contact that is field selectable normally open or closed. The CHC21C has an additional normally open contact.

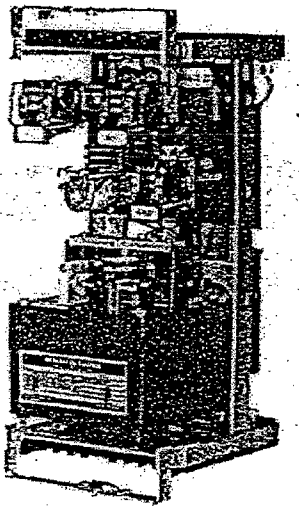
APPLICATION

The CHC11, CHC15, and CHC21 relays may be applied wherever a high-speed fault detector is required. However because it has four or five electrically separate contacts and can be operated continuously in the picked up position, it is particularly well suited for applications as a fault detector in circuit breaker failure schemes. In these schemes, the CHC11, CHC15, and CHC21 relays are used to detect the failed circuit breaker and to select the back up breakers to be tripped in order to isolate the fault.

The CHC12 relay is designed as a current fault detector in conjunction with distance relays to prevent tripping of the circuit breaker or operation of the associated timer because of loss of relay potential supply for reasons other than a system fault. This can occur because of (1) short circuits or open circuits involving the potential supply, (2) from switching (with certain configurations of power circuits) or (3) because of the use of line-side potential supply for the relay. In the latter instance the fault detector protects the associated timer against possible burnout when the breaker is open, and avoids false retripping of the breaker at the instant of reclosure.

RATINGS

The pickup of the cup units and the hinged armature units are continuously adjustable over their entire range.



(Photo 6035502)

Fig. 1. CHC11A fault detector relay (out of case)

The auxiliary telephone relay used in these relays is continuously rated at the nameplate dc voltage for the relay. The contacts can carry three amperes continuously or 30 amperes for two seconds. The current interrupting capabilities are shown in Table I.

The contacts of the cup unit and the hinged armature unit are capable of interrupting the auxiliary telephone unit current.

TABLE I— Auxiliary Telephone Relay Interruping Capabilities

Volts (Dc)	Inductive (Amp)	Non-Inductive (Amp)
48	1.0	3
125	0.5	1.5
250	0.25	1.0

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 125 of 219

REFERENCES:
Dimensions ..... Section 14 (7380)
How to Order ..... Section 1 (7210)
Prices ..... Handbook Section 7212
Instruction Books ..... Section 20 (7206)
Target and Contact Data ..... Section 14 (7381)
Relay Standards ..... Section 14 (7382)
Renewal Parts Information ..... Section 21 (7399)

Type CHC

Instantaneous Overcurrent Relays

SELECTION GUIDE

3 PHASE PROTECTION

Frequency (Hz)	Phase Current (Amps)	Continuous Rating (Amps)	Target and Seal-in (Amps)	Contacts	Model Number	Case Size	Approx. Wt. in Lb. (kg) Net	Ship
60	1-4	5	0.2	1 N.O.	12CHCT2A29A	S2	20 (9.1)	25 (11.3)
	1-4		1.0		A25A			
	1-4		2.0		A28A			
	2-8		0.2		A10A			
	2-8		1.0		A2A			
	2-8		2.0		A1A			
	4-16		1.0		A7A			
	10-40		1.0		A12A			
50	2-8		1.0		A13A			

3 PHASE AND GROUND PROTECTION

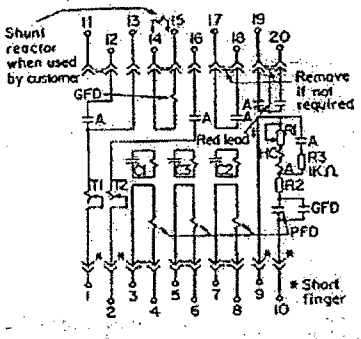
Frequency (Hz)	Phase Current (Amps)	Ground Current (Amps)①	Continuous Rating (Amps) Phase Unit	Continuous Rating (Amps) Ground Unit	Aux. Dc (Volts)	Two Targets (Amps)	Contacts	Model Number	Case Size	Approx. Wt. in Lb. (kg) Net	Ship
60	1-4	0.5-2.0	4		125	0.2/2.0	4 N.O. or 3 N.O. & 1 N.C.	12CHC11A29A	M2	25 (11.3)	31 (14.1)
	1-4	0.5-2.0	4		220			A52A			
	1-4	1-4	4		48			A33A			
	2-8	0.5-2.0	5		48			A25A			
	2-8	0.5-2.0	5		125			A21A			
	2-8	0.5-2.0	5		250			A26A			
	2-8	1-4	5		48			A28A			
	2-8	1-4	5		125			A22A			
	2-8	1-4	5		250			A23A			
	2-8	2-8	5		48			A34A			
	2-8	2-8	5		125			A24A			
	2-8	2-8	5		250			A27A			
	2-8	4-16	5		125			A30A			
	2-8	10-40	5		125			A31A			
	2-8	20-80	5		125			A32A			
	4-16	4-16	5		125			A46A			
	20-80	2-8	5		48			A35A			
50	2-8	0.5-2.0	5		125			A38A			
	2-8	1-4	5		125			A37A			
	2-8	1-4	5		250			A36A			
60	1-4	0.5-2.0	4.0	2.5	125	1.0	4 N.O. or 3 N.O. & 1 N.C.	12CHC15A3A	M2	25 (11.3)	31 (14.1)
	2-8	0.5-2.0	5.0	2.5	48	0.2		A7A			
	2-8	0.5-2.0	5.0	2.5	125	0.2		A2A			
	2-8	0.5-2.0	5.0	2.5	125	1.0		A1A			
	2-8	0.5-2.0	5.0	2.5	250	1.0		A4A			
	2-8	1-4	5.0	5.0	48	1.0		A9A			
	2-8	1-4	5.0	5.0	125	0.2		A8A			
	2-8	1-4	5.0	5.0	125	1.0		A5A			
	4-16	2-8	5.0	5.0	125	1.0		A6A			
	4-16	4-16	5.0	5.0	125	1.0		A10A			

3 PHASE AND GROUND PROTECTION

Frequency (Hz)	Phase Current (Amps)	Ground Current (Amps)①	Continuous Rating (Amps) Phase Unit	Continuous Rating (Amps) Ground Unit	Aux. Dc (Volts)	Two Targets (Amps)	Contacts	Model Number	Case Size	Approx. Wt. in Lb. (kg) Net	Ship
60	2-8	0.5-2.0	10	2.4	48	0.2/2.0	4 N.O. or 3 N.O. & 1 N.C.	12CHC21A3A	M2	22 (10)	27 (12.2)
		0.5-2.0		2.4	110			A6A			
		0.5-2.0		2.4	125			A1A			
		0.5-2.0		2.4	220			A8A			
		0.5-2.0		2.4	250			A4A			
		1-4		4.8	48			A5A			
		1-4		4.8	110			A7A			
		1-4		4.8	125			A2A			
60	2-8	0.5-2.0	10	1	125	0.2/2.0	5 N.O. or 4 N.O. & 1 N.C.	12CHC21C1A	M2	22 (10)	27 (12.2)
		1-4		2	48			C4A			
		1-4		2	125			C2A			
		2-8		4	125			C3A			

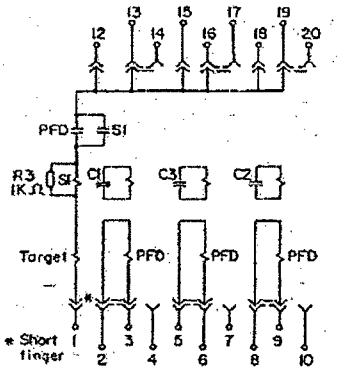
① The ground unit is a separate hinged-armature device in the CHC11A and a separate induction cup unit for the CHC15A. The CHC15A. The CHC21A & 21C each use a single induction cup which responds to all phase and ground faults, therefore the phase and ground pickup adjustments are interdependent.

CONNECTION DIAGRAMS



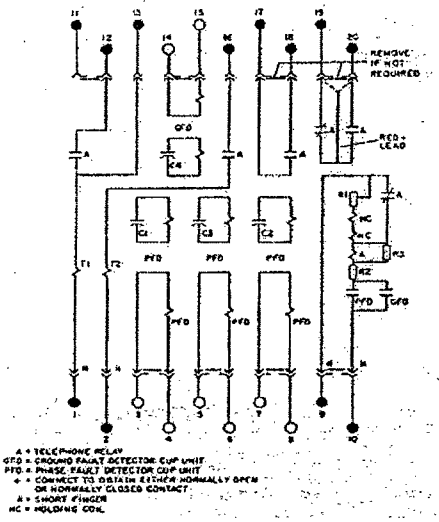
(Dwg. 178A9066)

Fig. 2. Internal connections for CHC11A, front view



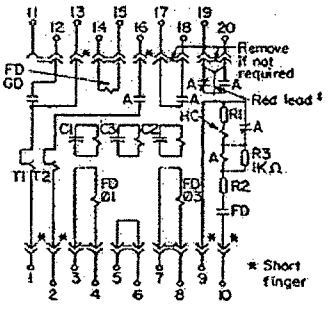
(Dwg. 148A3956)

Fig. 3. Internal connections for CHC12A, front view



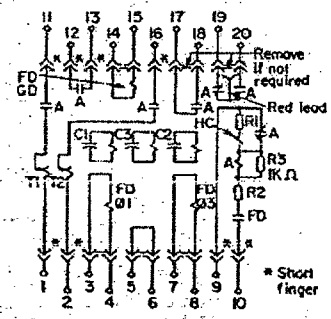
(Dwg. 178A7060)

Fig. 5. Internal connections for CHC15A, front view



(Dwg. 227A7097)

Fig. 6. Internal connections for CHC21A, front view



(Dwg. 246A2266)

Fig. 7. Internal connections for CHC21C, front view

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 127 of 219

Type CO Overcurrent Relays

Non-directional, Single Phase, Adjustable Time Delay

Indicating Contactor Switch (ICS)
(Partially Disassembled)

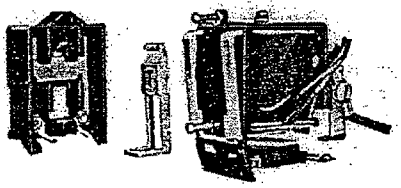


Fig. 5

The dc operated Indicating Contactor Switch has a clapper type magnetic armature to which leaf-spring contacts are attached.

When the switch is energized, the moving contacts bridge the stationary contacts, completing the trip circuit. The ICS contacts are connected in parallel with the main relay contacts, relieving them of carrying heavy trip currents.

During operation, two fingers on the armature deflect a spring, which allows the operation indicator target to drop. The target is orange color and readily visible.

Taps on the front of the unit provide connection for either 0.2 (left) or 2.0 (right) amperes dc pickup operation.

When using a 125 or 250 volt dc auxiliary WL auxiliary relay, the 0.2 ampere tap is recommended. The 2.0 ampere tap is used on 24 or 48 volt dc circuits.

Indicating Instantaneous Trip(IIT)

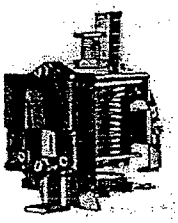


Fig. 6

Used for high speed protection against heavy fault currents. Construction is similar to that of the Indicating Contactor Switch, except that it is ac operated, and adjustable over a range of 1 to 4 times minimum pickup. Variable pickup is obtained by a core screw adjustment on the top of the unit.

When the IIT is energized above pickup setting, the target drops. Operating time is approximately one-half cycle above 250% of setting.

The IIT unit has a calibrated scale on which are marked the four divisional points of pickup range.

De-ion® Contactor Switch (CS)

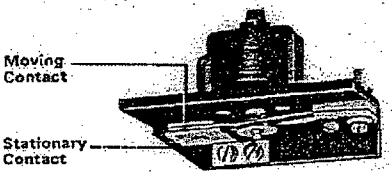


Fig. 7

Used in circuit opening type CO relays as shown schematically in figures 12 and 13. This scheme is applied where ac trip coils are used on the circuit breakers, energized by the line current transformers. When the CS coil is energized by a small transformer located within the relay case, its normally closed contacts open to remove the by-pass around the breaker trip coil, thus tripping the breaker.

The CS switch will pick up at 4 amperes ac and will safely by-pass 100 amperes ac through its contacts.

High Dropout Instantaneous Unit (ITH)

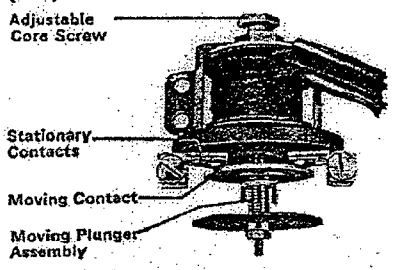


Fig. 8

The ITH unit is a solenoid operated device with an adjustable core screw which adjusts the ac current pickup of the device over a 2 to 1 range.

When the ITH coil is energized above pickup setting, the moving plunger assembly moves upward, carrying the silver disc which bridges three conical-shaped stationary contacts. The device opens its contacts when the coil current is reduced to 90% of its pickup value.

Operating range of the ITH unit can be increased to a 4 to 1 ratio, or four times the minimum pickup setting obtainable, by lowering the plunger after the core screw has been set at its maximum rated position.

If the plunger is lowered to increase the pickup current value, then at 300% of minimum trip the dropout ratio is 60% of the pickup current. At 400% of minimum trip the dropout ratio is 45% of the pickup current.

Operating speed of the ITH unit over nominal range (60 cycle base) is as follows:

at 200% of trip setting: less than 1 cycle
at 500% of trip setting: ½ cycle
at 1000% of trip setting: ¼ cycle

ACS Unit

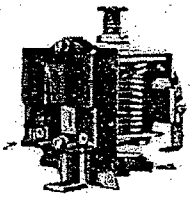


Fig. 9

Operating Range	.25 to .9 amps ac
Burden	.73 ohms ac
Coil Rating:	
Continuous	.25 amp
1-Second	7.0 amps

PANALARM DIVISION

ANNUNCIATOR ENGINEERING DATA

ANNUNCIATOR COMPONENT	POWER CONSUMPTION				CONTACT CAPACITY*
	VOLTAGE	STAND-BY	MAXIMUM	MINIMUM	
Self-Policing Plug-Ins	120 AC 125 DC	6.5 VA 3.7 Watts	8.5 VA 7.4 Watts	0 0	2.0 amps 0.5 amps
No-Drain Plug-Ins	120 AC 125 DC	0 0	7.2 VA 4.3 watts	0 0	2.0 amps 0.5 amps
Flashers, All Models	120 AC 125 DC	0 0	2.7 VA 5.0 Watts	0 0	1200 watts lamp load** 500 watts lamp load**
Auxiliary Relays	120 AC 125 DC	0 0	5.0 VA 3.5 Watts	0 0	10.0 amps 2.0 amps
Backlighted Nameplates 2¼" x 2¾" 1" x 1½"	 Any Any	 0 0	 12.0 Watts 3.0 Watts	 0 0	 — —
Bullseye Lamps	Any	0	3.0 Watts	0	—
Pushbuttons Models SW-102, SW-302	 120 AC 125 DC	 — —	 — —	 — —	 6.0 amps 1.1 amps
Model SI-11	120 AC 125 DC	— —	— —	— —	20.0 amps 10.0 amps
Models 51-PB, 51-PB41 Models ACS-PB, ACS-PB41	120 AC 125 DC	— —	— —	— —	6.0 amps 2.0 amps
Horn Model HSA Model HSD	 120 AC 125 DC	 0 0	 20.0 VA 13.0 Watts	 0 0	 — —

*All contact ratings are for non-inductive loads at 120/60 for AC applications and at 125 volts for DC applications.

**The number of lamps handled by one flasher is a function of this rating and lamp wattage. Consider total wattage of maximum number of lamps flashing at any one time. Where lamp load exceeds flasher contact rating, an auxiliary flasher relay is required, not an additional flasher.

In most cases, plug-in relays are designed for use on either 50 or 60 cycles. Nameplates so designate, for example 120/50-60. Flashers must be ordered for exact frequency however.

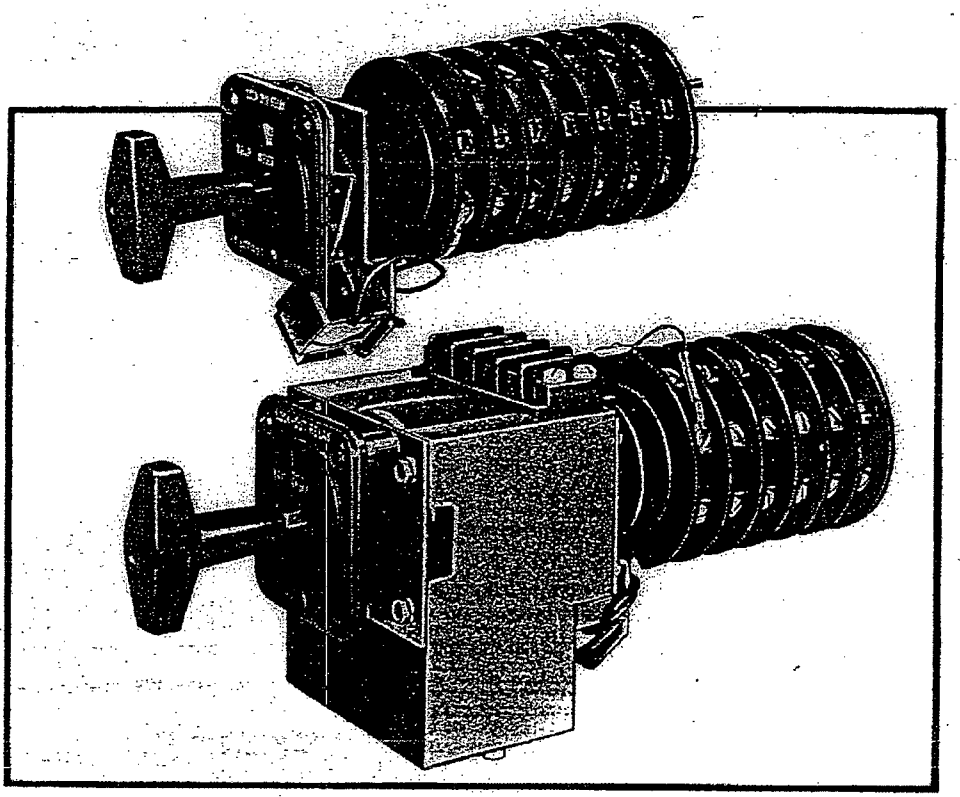
ITEM

Technical Publication
LOR-1

Effective April 15, 1987

HIGH SPEED MULTI-CONTACT LOCK-OUT RELAYS

FOR POWER INDUSTRY APPLICATIONS



ELECTROSWITCH
UNIT OF ELECTRO SWITCH CORP.

180 King Avenue, Weymouth, Massachusetts 02188
Telephone: 617/335/5200
FAX: 617/335/4253

HIGH SPEED
MULTI-CONTACT LOCK-OUT RELAYS
FOR POWER INDUSTRY APPLICATIONS

ELECTROSWITCH
Weymouth, Massachusetts

ABSTRACT

The series 24 Lock-out Relays are high-speed (eight milliseconds) control relays used primarily as auxiliary relays in applications requiring many contacts (up to forty). The LOR is an electric-trip and manual-reset device. The LOR/ER is an electric-trip and either manual or electric-reset. The LOR/SR is an electric-trip and self-reset device. All units have mechanical position indicator targets. They are qualified to ESC-STD-1000 which includes aging and seismic vibration requirements to ANSI/IEEE 323-1984 and ANSI/IEEE-344-1975 for class IE uses in nuclear power generating stations. The testing also satisfies ANSI/IEEE C37.90-1978 and ANSI/IEEE C37.98-1978.

INTRODUCTION

Lock-out Relays of various types are often used in the electrical power industry. These auxiliary relays are electric-trip, manual or electric reset control relays for the purpose of tripping and locking out circuit breakers or other devices automatically when a fault or other predetermined condition exists. The lock-out relays are generally used in conjunction with differential relays to protect transformers, buses, and rotating machinery in various electrical systems.

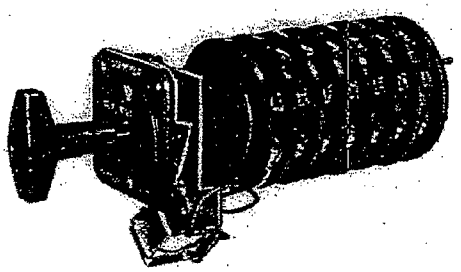


Fig. 1. Series 24 LOR Manual-reset Lock-out Relay

Initial Release - September 15, 1977
Revised - January 3, 1980
Added LOR/SR - February 1, 1983
Revised - March 15, 1985
Revised - April 15, 1987

Lock-out Relays of known types often have ten or more NO and NC contacts. The relays can be programmed to change sequences such as shutting down a faulty pump and then initiating the action to start-up a standby pump or bypassing a faulty circuit by opening and closing breakers.

Known relays of this type are normally latched in the RESET position and trip-out to a TRIP position when commanded. There are then manual-reset, electric-reset, and self-reset versions to get back to the RESET position.

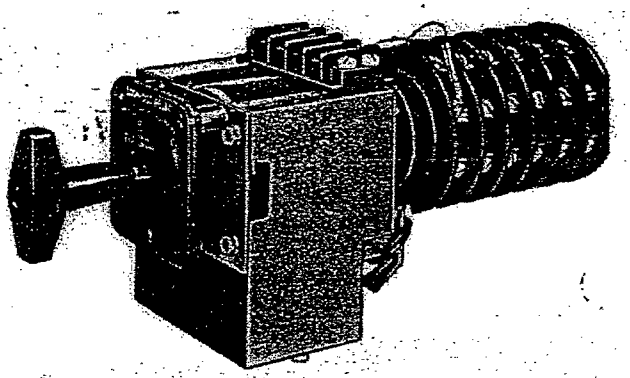


Fig. 2. Series 24 LOR/ER Electric-reset Lock-out Relay and LOR/SR Self-reset Lock-out Relay

High-speed, rugged, multi-contact units are needed. This paper describes a family of Lock-out relays with up to forty contacts that operate as quickly as eight milliseconds and are seismic shockproof.

BASIC CIRCUIT OPERATION

The control of the Lock-out Relays for operation as a relay requires no special wiring. They only require a NO contact (S1) to command the LOR to TRIP and the electric-reset LOR/ER needs an additional NO contact (S2) to initiate the command for RESET. The choice of S1 should take in consideration the burden data of trip coil, LOR/T, since S1 will "make" this current. This circuit is self-interrupting with the LOR contacts so S1 need not be concerned with the "break" of the TRIP circuit. On the electric-reset LOR S2 needs to make only the K1 relay circuit so the burden of LOR/R does not effect S2. Any pilot duty device is acceptable for both S1 and S2.

Manual-reset LOR Circuit

The LOR schematic is shown on Fig. 3.

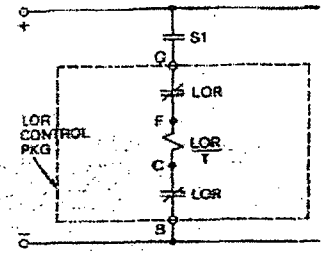


Fig. 3. Manual-reset LOR Control Circuit (shown in RESET position)

The standard station control bus voltage is used. The LOR, as shown, is in the RESET position. The LOR/T coil form represents the linear solenoid that releases a trigger that locks the LOR in the RESET position when the trigger is activated. The mechanical design is described later under THE ELECTRO-MECHANICAL DRIVE.

The LOR contacts shown are normally closed in the reset position. They are within the LOR control package. G and B are tie points to connect the LOR to the control circuit. C and F are internal connection points shown for information.

To command the Lock-out Relay to TRIP, S1 is closed. This completes a circuit across the LOR trigger solenoid, which operates, causing the device to snap to the TRIP position. It locks into this position and remains there indefinitely. When this happens, the LOR contacts open thereby removing the control circuit from the bus.

The unit will stay locked-out in the TRIP position until manually reset. S1 may be any kind of auxiliary contact -- from a breaker, a protective relay, or from another auxiliary device like a relay. The condition of the Lock-out Relay is visible by the handle location and a mechanical target within the nameplate (Black for RESET, Orange for TRIP).

Electric-reset LOR/ER Circuit

The LOR/ER schematic is shown on Fig. 4.

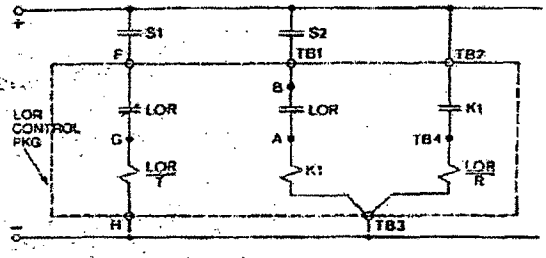


Fig. 4. Electric-reset LOR/ER Control Circuit (shown in the RESET position)

The electric-reset Lock-out Relay operates from the control bus voltage like the manual-reset version. The LOR/ER, as shown, is in the RESET POSITION. The LOR/T coil form is the same linear solenoid that is used in the manual-reset LOR, and controls the trigger that locks the LOR/ER in the RESET position. The LOR/R coil form represents the rotary solenoid that is used to reset the LOR/ER electrically. K1 is a relay used to control the rotary solenoid. This enables S2 to be a low level contact. It controls only the K1 relay coil. The K1 contact operates the high current rotary solenoid. TB1, TB2, TB3 are terminal block contacts, and F and H are LOR tie points -- all are for connection to the control bus. G, B, and TB4 are internal tie points shown for information.

The command of the LOR/ER to the TRIP position is the same as with the manual-reset LOR which was previously described. When tripped, the NC LOR contact in the LOR/T circuit opens removing LOR/T solenoid from the circuit. When this happens, the LOR NO contact in the K1 relay circuit closes enabling this circuit to be used.

To command the LOR/ER to reset, S2 is closed. This completes the circuit to the K1 relay and it operates, closing contact K1. This completes the circuit to the LOR/R rotary solenoid and it indexes to the RESET position. When this happens, the NO LOR contact opens. This opens the circuit on the K1 relay coil. K1 relay drops out opening contact K1 that opens the rotary solenoid LOR/R circuit. At the same time the NC LOR contact, in the linear solenoid LOR/T circuit, closes, setting up the LOR/ER for the next TRIP command.

S1 and S2 should be momentary contacts and should not stay closed. If both contacts are closed at the same time, a "pumping" action will result with the LOR/ER indexing back and forth between the RESET and TRIP positions.

The handle and target indicators are the same on the standard electric-reset LOR/ER as the manual reset LOR. The handle on the high-speed LOR/ER is not an indicator and remains in the vertical position and the target must be manually reset (see page 9).

Self-reset LOR/SR Circuits

The self-reset Lock-out Relay operates from the control bus voltage like the LOR and LOR/ER. The LOR/SR, as shown in Fig. 5 and 6, is in the RESET position. The LOR/T coil is the same linear solenoid that is used in all LOR's, and controls the trigger that locks the LOR/SR in the RESET position. The LOR/R is the same rotary solenoid used in the LOR/ER and is used to electrically reset the LOR/SR. K1 and K2 are two relays with NO contacts used in the control circuit. B-A is a NO contact and E-F-G is a form C contact -- both in the control circuit. F-G is NC in the reset position while F-E is NO. TB1, TB2, TB3, and TB4 are terminal block connection points for the user. R1 and R2 make up a bridge circuit

on both the INSTANTANEOUS RESET and the TIME DELAY RESET units. In addition the TIME DELAY RESET version has an additional 1E-1F normally open (NO) contact to isolate the K2 coil plus the time delay circuit consisting of R1 and C1-C2-C3-C4 which are wired in parallel. D1 protects the capacitors from a possible incorrect polarity hookup.

The INSTANTANEOUS RESET version of the LOR/SR will reset itself within 80 milliseconds after the fault has cleared itself (S1 opens). This circuit is illustrated in Fig. 5.

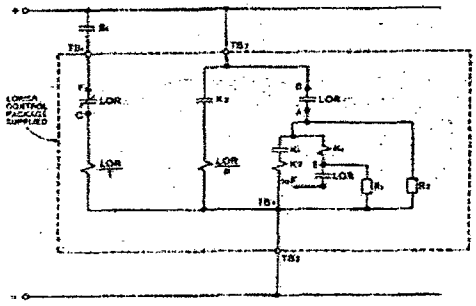


Fig. 5. Instantaneous-reset circuit for the self-reset (shown in RESET position) Lock-out Relay

The LOR/SR trips in the same manner as the manual-reset LOR. With S1 closed (simulating the commanded or fault condition) B-A contact closes and E-F contact closes. In this manner E-F and A-B are both connected to the (+) bus so the K1 coil sees no voltage difference and cannot operate. Therefore, the LOR/SR will not reset and may remain in the TRIP position indefinitely while the R1R2 bridge draws only enough milliamps to maintain the voltage balance of the bridge -- and well below the dropout current of any 0.2 amp. target relays that may be part of the circuit.

When S1 opens (indicating the fault or predetermined condition has cleared), the R1R2 bridge becomes unbalanced since the E-F contact, although closed, is in the S1 contact circuit. K1 operates, closing contact K1 and K2 operates, closing contact K2 and the rotary solenoid LOR/R operates and indexes to the RESET position completing the cycle.

Contact E-F, and A-B then open dropping out relays K1 and K2 (and their contacts). Contact F-G closes setting up LOR/SR for the next command.

The TIME DELAY SELF-RESET (shown in RESET position) version of the LOR/SR, illustrated in Fig. 6, operates in the same manner as the instantaneous reset version except the R3-C1-C2-C3-C4 circuit causes a time delay of from 300 to 600 milliseconds from the time S1 opens until the LOR/SR contacts reclose.

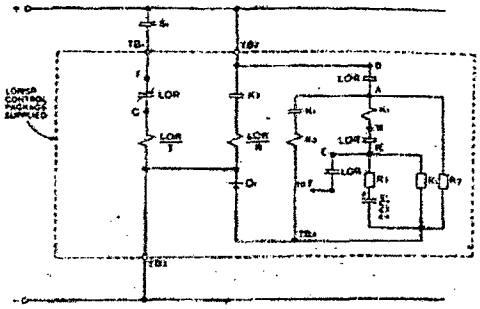


Fig. 6. Time-delay self-reset circuit for the LOR/SR

Operating Voltage

The LOR, LOR/ER, and LOR/SR Lock-out Relays are direct current actuated auxiliary relays. Because they are only actuated for short periods of time and are self-interrupting, they may be subjected to maximum design voltage indefinitely without exceeding 50°C temperature rise in ambient conditions as high as 55°C. This is using class 105 insulation and the applied thermocouple method of temperature determination.

The Lock-out Relays operate reliably over the full voltage ranges described in ANSI/IEEE C37.90-1978, the "Standard for Relays and Relay Systems Associated with Electric Power Apparatus."

These ratings are shown on Table I.

TABLE I
Coil Operating Range

COIL	NOMINAL VOLTAGE	NORMAL VOLTAGE OPERATING RANGE
A,B	24VDC	19.2 to 28VDC
C	48 VDC	38.4 to 56VDC
D,E,G	125VDC	100 to 140VDC
F,H	250VDC	200 to 280VDC

The trip and reset solenoid coils provide reliable operation over a wide latitude of operating conditions. Trip coils A, B, C, D, E, and F have substantial overlapping voltage ranges enabling some "custom-fitting" depending on desired speed versus current burden. Trip coils G and H have controlled threshold voltage levels to insure that the unit will not trip at half-voltage. G and H coils are useful where cummulative stray voltages due to capacitive and other effects might be impressed on the LOR coil causing occasional nuisance trips.

The full voltage ranges are shown on Tables II and III.

The Threshold Voltage shown is the minimum level that can produce a TRIP operation. This is not a reliable operation and this voltage level should not be normally used. The normal operation should be within the limits of the Operating Range.

The Operating Range represents the design limits for reliable operation. Safety factors are included so operation can occur above and below the indicated range as previously explained.

TABLE II

Trip Coil Voltage Data

COIL	NOMINAL VOLTAGE	THRESHOLD VOLTAGE	OPERATING RANGE
A	24VDC	6VDC	10 - 40VDC
B	24VDC	9VDC	18 - 50VDC
C	48VDC	12VDC	24 - 70VDC
D	125VDC	16VDC	30 - 140VDC
E	125VDC	23VDC	45 - 140VDC
F	250VDC	33VDC	70 - 280VDC
G	125VDC	70VDC	90 - 140VDC
H	250VDC	140VDC	180 - 280VDC

TABLE III

Reset Coil Voltage Data

COIL	NOMINAL VOLTAGE	OPERATING RANGE
A	24VDC	19.2 to 28VDC
C	48VDC	38.4 to 57.6VDC
D	125VDC	100 to 150VDC
F	250VDC	200 to 275VDC

Coil Burden Data

The LOR, LOR/ER, and LOR/SR solenoid coil burden data is outlined in Table IV.

As previously explained, the control bus needs to be able to supply the burden detailed in Table IV but does not need to interrupt it -- the units are self-interrupting. The reset coil is hard wired to the control bus so the actuating means (S2 on Fig.4) is not subjected to the burden (only the K1 coil burden at less than 1 ampere. S1 controlling the trip coil does "make" and carry the trip coil current.

TABLE IV

Coil Burden Data

COIL	COIL CIRCUIT VOLTS	TRIP COIL		RESET COIL	
		COIL CIRCUIT DC OHMS @25°C	BURDEN (AMPS) AT RATED VOLTAGE	COIL CIRCUIT DC OHMS @25°C	BURDEN (AMPS) AT RATED VOLTAGE
A	24VDC	3.3	7.3	.7	33.8
B	24VDC	7.7	3.1	—	—
C	48VDC	13.0	3.7	3.0	15.9
D	125VDC	27.0	4.6	12.4	10.1
E	125VDC	50.0	2.5	—	—
F	250VDC	104.0	2.4	80.6	3.1
G	125VDC	27.0	4.6	—	—
H	250VDC	104.0	2.4	—	—

Trip Coil Current - Voltage Characteristics

The trip coils may be used over a wide range of voltage levels as previously described. To aid in this selection Fig. 7 graphs the voltage/current characteristics of the trip coils. These values are the same for the manual-reset LOR, the electric-reset LOR/ER, and the self-reset LOR/SR Lock-out Relays. Fig. 7 is used with the Response Time graph of Fig. 8. Target selection data is detailed on Table V and VI and Fig. 9 to 12.

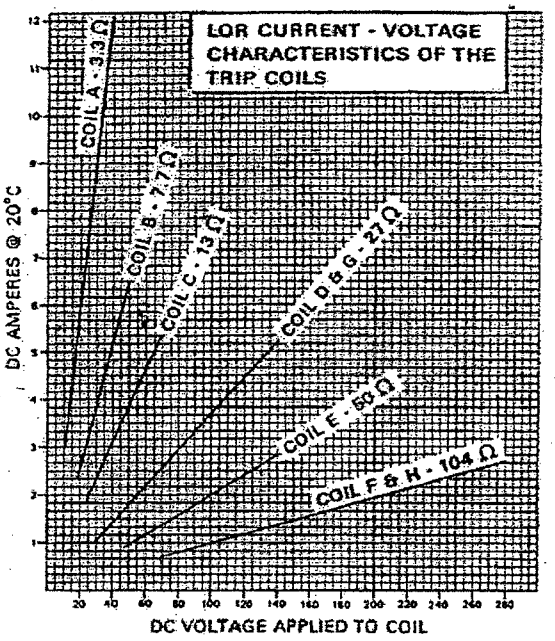


Fig. 7. Trip Solenoid Coil Burden Data

TABLE V

LOR Trip Coil Selection for Positive Target Operation

Operating DC Volts	LOR Trip Coils to Use .2A Target	2A Target
24	A,B,C	
48	B,C,D,E	
100	D,E,F	
125	D,E,F,G	D
140	D,E,F	D
190	F	D
250	F,H	D

TABLE VI

Minimum Required DC Voltage for Positive Target Operation with Manual-Reset LOR

LOR TRIP COIL	no additional circuitry (Target) .2A	1.6A	2A	2A Target resistor (Rp) in parallel 250Ohms	500ohms	2A Target R-C Circuit 40 Ω 1670	20 MFD	2A Target Series Resistor (Rs) 7 Ohms	12.3 Ohms	16.7 Ohms
A										90
B	12	12	42						99	
C								95		
D	24	48	115		80	94	102			
E				75	105					
F	48	150		70	125					
G	90									
H	180									

Response Time - Trip Solenoid

Fig. 8 shows the high-speed response of the Lock-out Relays. The values given are total response to close NO contacts. The values are for ten deck LOR's and eight deck LOR/ER's and LOR/SR's. There is very little difference in smaller units. The response time of the trip coil of the high-speed electric-reset Lockout-relays is the same as the manual-reset LOR's.

Response Time - Reset Solenoid

The reset time of the electric-reset LOR/ER Lock-out Relays is generally not an important applications consideration so a graph has not been prepared. The response is approximately fifty milliseconds at rated voltage for all coils. The reset times of the self-reset LOR/SR is described on page 3.

Target used with Lock-out Relays

All the Lock-out Relays have a mechanical target as part of the nameplate -- Black for RESET and Orange for TRIP. This indicates the condition of the LOR. The target resets when the LOR resets (with the exception of the high-speed trip electric-reset LOR/ER and self-reset LOR/SR where the memory target is manually reset).

External targets may also be used in conjunction with the LOR's to show the condition of the devices that are being controlled. The most common .2A targets operate satisfactorily with any LOR. .6A targets are also generally satisfactory. 2A targets need special attention. Selection of LOR trip coils are shown in Table V with minimum required DC voltages for positive target operation shown on Table VI.

2A targets are generally slow acting. The response time of the LOR's is generally too fast for them to respond. From Tables V and VI it is seen that only trip coil D will respond and only at 118VDC or more. In order to use 2A targets at lower voltages suggested circuits have been developed. The standard circuit with no additional circuitry is shown on Fig. 9 for comparison. Fig. 10 to 12 are shown as suggested solutions. Table VI shows the minimum voltages to apply with these circuits to get positive 2A target operation.

These circuits were developed using target relays with coil characteristics shown on Table VII.

TABLE VII

Target Relay Coil Characteristics

Tests based on following Target coil characteristics	TARGET .2A	.6A	2A
Coil resistance (ohms)	8.15	.71	.195
Pull-in current (amps)	.15	.45	1.75

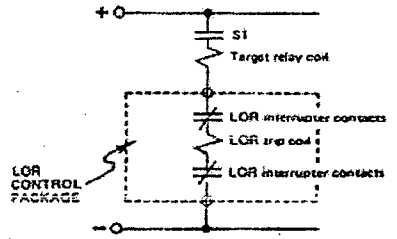


Fig. 9. Typical LOR trip circuit with target relay coil in series with LOR coil

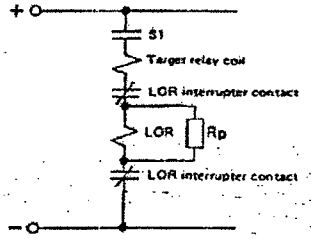


Fig. 10. LOR trip circuit with resistor (Rp) in parallel with LOR trip coil (not supplied with LOR -- see Table VI for recommended values)

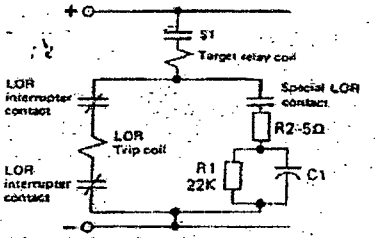


Fig. 11. LOR trip circuit with RC network -- momentarily connected with LOR coil increasing current in 2A target. C1 discharges through R1 when LOR is reset. See Table VI for recommended values of C1. Order special LOR

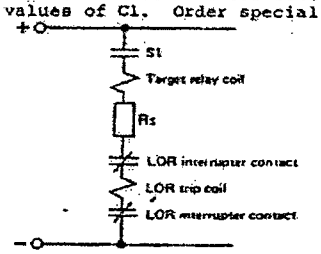


Fig. 12. LOR trip circuit with series resistor (Rs) chosen to reduce trip coil wattage. Value chosen to obtain 5 amperes for 5 milliseconds or longer through target relay coil. See Table VI for recommended values

Transient Protection

The LOR, LOR/ER, and LOR/SR Lock-out Relays are designed and tested to operate reliably in a normal power industry environment. This includes being subjected to transients on the control bus up to 3.5KV. Since the LOR is normally isolated from the

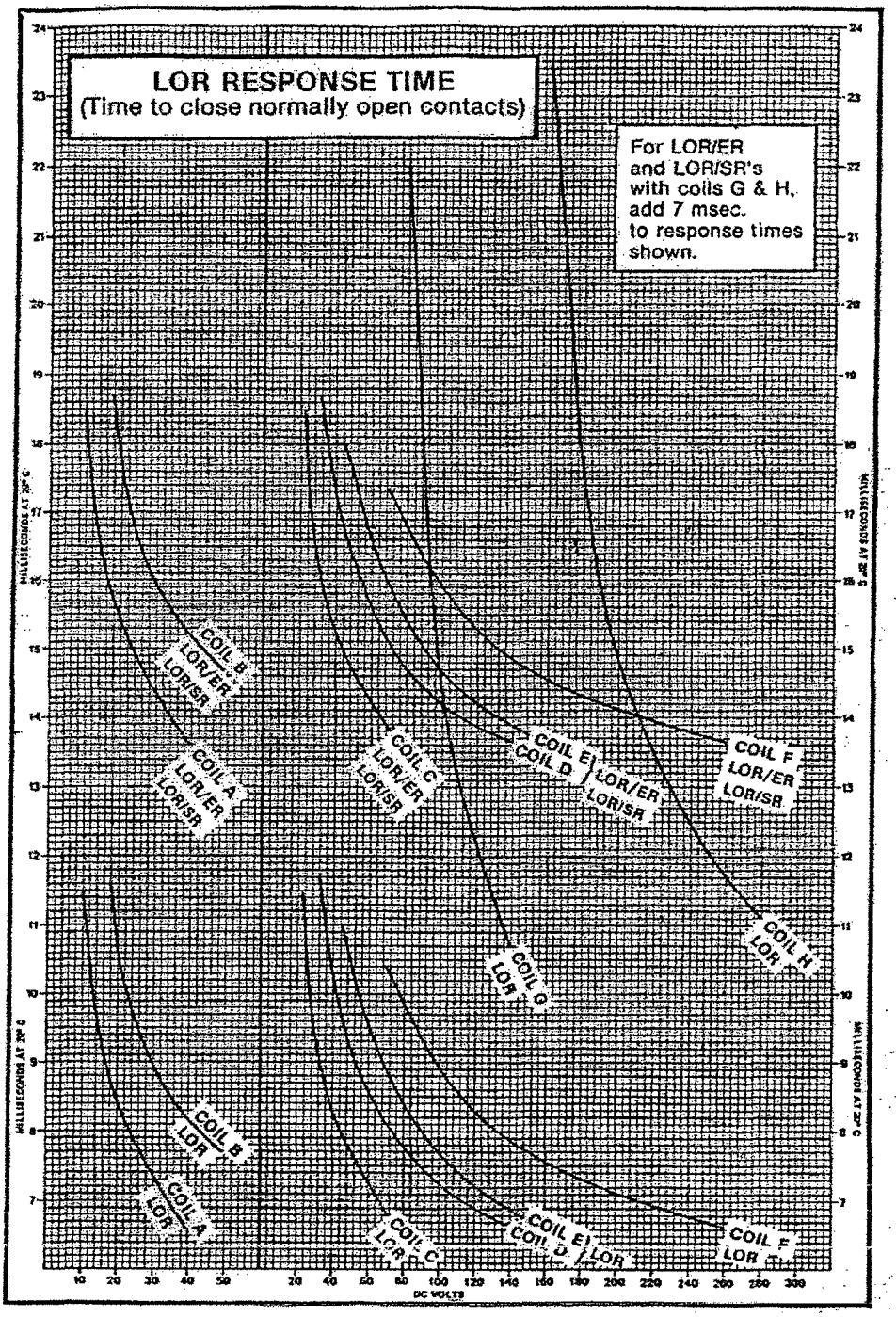


Fig. 8. LOR/ER, and LOR/SR Lock-out Relay Response Times (10 deck LOR, 8 deck LOR/ER, or LOR/SR). For high speed LOR/ER or LOR/SR's, use LOR response times.

bus, it will experience transients only if they occur in the operating mode. This precludes the possibility of a detrimental, accumulating affect over the life of the unit. As such, no transient protection is needed.

Because of the nature of the operation of the solenoid coils, the LOR does generate transients that may be of interest to the user. These transients are less than 2KV and generally in the 1.5KV to 1.8KV range.

BASIC RELAY CONTACTS

The LOR, LOR/ER, and LOR/SR Lock-out Relay contacts operate on the original, reliable principle of knife switches -- double sided, double-wiping, spring wiper blades closing on both sides of a terminal. To provide a closed contact, two terminals are bridged or shunted. Fig. 13 shows this contacting arrangement.

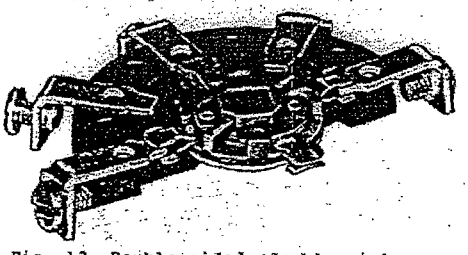


Fig. 13. Double-sided, double wiping knife-type contact configuration

Contact Materials

The wiper blades are made from a phosphor-bronze alloy that combines superior spring qualities with good electrical conductivity. This material and blade design has been proven by extensive laboratory testing as well as more than thirty years of field use and experience. Initially used in rugged naval ship applications, it is also used in industrial applications such as railroad locomotives and earth moving equipment. It has been used for more than thirty years in power industry applications, as well.

The blade assembly is shock-proof and virtually bounce-proof. This makes it ideal for high-speed, quick-make, quick-break devices like the LOR, LOR/ER, and LOR/SR.

The blades are formed, assembled, and riveted nearly closed. The gap is machine adjusted to provide a uniform high pressure. The gap does not change with time and use. Normal use tends to improve the contact surfaces due to the rubbing action. This provides a burnishing as well as cleaning action.

The contact surface conductivity is enhanced by a silver overlay stripe that lasts the life of the unit. This ensures a good contact even in those cases where the LOR, LOR/ER, and LOR/SR is not operated for long periods of time.

The terminals are made of electrically and environmentally compatible copper material with a silver overlay stripe at the contact area plus an overall silver plate to ensure a lastingly good contact surface for customer wiring purposes. Similarly, the terminal screws are made from silver-plated brass.

Number of Decks Available

Table VIII shows the maximum number of decks and contacts available for reliable operation:

TABLE VIII
MAXIMUM DECKS AVAILABLE

LOR TYPE	MAXIMUM DECKS	MAXIMUM CONTACTS
LOR	10	40
LOR/ER-HI SPEED TRIP	10	40
LOR/ER-STD SPEED TRIP	8	32
LOR/SR INSTANT RESET	8	32
LOR/SR TIME DELAY RESET	7	28

Contact Deck Arrangement

The blade and terminal configuration enables the use of multi-contacts in the same deck, and simple stacking procedures enable the fabrication of many independent contacts in one relay. Specifically, two NO contacts and two NC contacts are provided in each deck, and up to ten decks can be stacked, resulting in a relay with up to forty contacts (twenty NO and twenty NC). The deck arrangement is illustrated in Fig. 14.

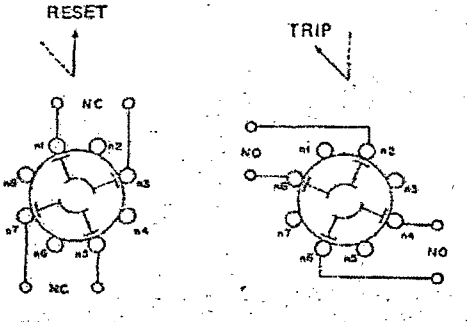


Fig. 14. Basic LOR Deck Layout.

The illustration of Fig. 14 is for the first deck. For multideck units the second digit of the terminal number is the same as shown but the first digit changes to denote the deck number. As an example, terminal 82 is in the eighth deck, directly under terminal 12 and used together with terminal 88.

Contact Charts

The previous illustration shows how the LOR's are constructed and is shown as information for the user. Traditional contact charts are normally used, as shown on Fig. 15.

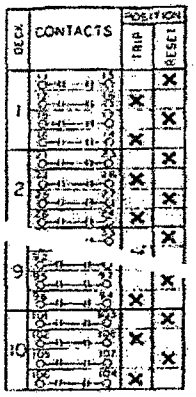


Fig. 15. LOR, LOR/ER, and LOR/SR, Lock-out Relay Contact Chart

Contact Ratings

The LOR, LOR/ER, and LOR/SR Lock-out Relays have been tested to many different circuit conditions. The interrupting ratings are based on 10,000 operations of life, using suddenly applied and removed rated voltage, with no extensive burning of contacts. Inductive ratings are based on tests using standard inductance L/R=0.04 for DC and cosθ=0.4 for AC. The Interrupting Rating Column headed "double contacts" means contacts in series. Short time, and continuous ratings are based on temperature rise in contact members and supporting parts not exceeding 50°C above ambient.

Allowable Variation From Rated Voltage

The relay contacts are not sensitive to normal variations in voltage. The interrupting capacity is important as indicated in Table IX. Variations of plus and minus twenty percent in rated voltage need not be considered as long as the interrupting current is not exceeded.

TABLE IX

Contact Ratings for
Series 24 LOR, LOR/ER, and LOR/SR
Lock-out Relays

CONTACT CIRCUIT VOLTS	INTERRUPTING RATING (AMPS) RESISTIVE SINGLE CONTACT	INDUCTIVE SINGLE CONTACT	SHORT TIME RATING (AMPS*)	CONTINUOUS RATING (AMPS)
125VDC	3	1	60	30
250VDC	2	½	60	30
120VAC	20	15	60	30
240VAC	15	5	60	30
480VAC	10	5	60	30
600VAC	6	5	60	30

*Short time current is for one minute

THE ELECTROMECHANICAL DRIVE

The switching portion of the Lock-out Relay is the field proven series 24 Instrument and Control Switch. In this application it is a two position device -- TRIP and RESET. There is a powerful coil spring mechanism to drive it from the RESET position to the TRIP position. The device is held in the RESET position by a trigger locking mechanism. This is actuated by a small linear solenoid for electric tripping. The LOR is manually reset by rotating the handle against the coil springs. The LOR/ER is either manually reset or electrically reset utilizing a separate rotary solenoid mechanism. The LOR/SR is self-resetting when the tripping condition has been removed. These mechanisms are described below.

The TRIP Mechanism (Patent No. 3649793)

Industry requirements for Lock-out Relays include:

- high-speed
- seismic shock-proof
- multiple contacts

To get the multi-contact feature and maintain positive and rugged action, heavy spring action is required. This requires a locking mechanism to hold a spring wind-up of forty inch pounds of torque. To get high-speed release a solenoid is needed. Ordinarily a large solenoid is required to do this. Large solenoids are inherently slow so a small linear solenoid is used to release the latch. By nature small solenoids do not develop much torque so a mechanical advantage is needed.

The trigger mechanism was invented to provide the mechanical advantage. One pound of force from the linear solenoid releases the latch that locks the device against forty inch pounds of torque. The trigger uses the principle of coincident radii of two rollers -- one cannot roll without the other. The two rollers are shown in Fig. 16.

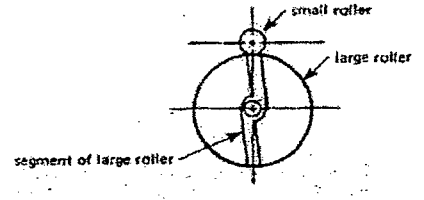


Fig. 16. Relationship of two rollers with coincident radii

The relationship of roller sizes is to get the mechanical advantage needed. Since only a small part of the larger roller is needed, a segment was cut out to reduce size and inertia.

Fig. 17 shows the small roller, large roller segment, and their relationships with the linear solenoid and the relay operating shaft.

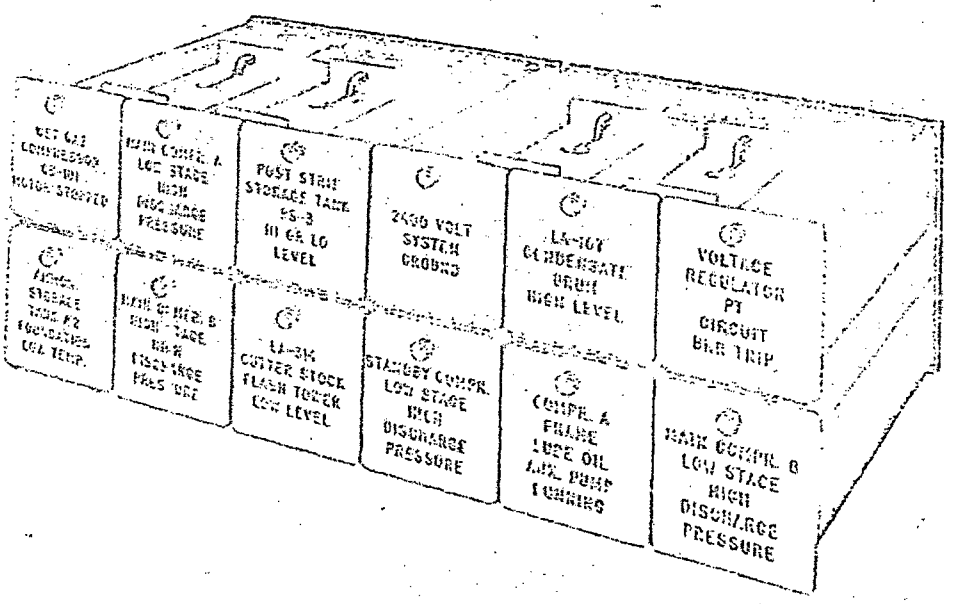
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INSTRUCTION MANUAL FOR

DE-LINE

SERIES 10, MODELS 11 AND 12



INDEX:

I. Cabinet Installation Instructions
II. Plug-In Installation Instructions
III. External Electrical Connections
IV. Check-Out Procedure
V. Trouble-Shooting Techniques
VI. Design Specifications
VII. Lamp Specifications
VIII. Outline Drawings
IX. Drawings Specific to Furnished Equipment

CANADIAN

FAIRBANKS DIVISION

The quickest and easiest method of determining whether the fault lies in the annunciator or in the external connections is to:

1. ISOLATE THE ANNUNCIATOR by disconnecting all of the external devices.
2. Connect a duplicate set of external devices as shown on the general electrical diagram and test out annunciator system (refer to Section IV).
3. If annunciator system performs as shown on the "Sequence Summary Chart", the fault of the erratic operation lies in the external devices or in their connections.

B. Burned Out Lamps:
To test, operate lamp test pushbutton or operational test pushbutton and all lamps should come on steady bright or flashing, depending on the type of test sequence supplied. (With some type of plug-ins, an audible test will occur simultaneously.)

C. Defective Audible Signal:
Simplest procedure for testing a defective audible signal is to disconnect it from the annunciator system and connect it to an external power supply. With some types of plug-ins, operation of the silence pushbutton may give an audible test. (Refer to the general electrical diagram.)

D. Checking Plug-In or Plug-Ins:
1. A faulty plug-in could give rise to any of the following abnormal operations:
   a. Lamps will remain off in the *alarm* or *silence* condition.
   b. Lamps will be steady bright instead of flashing in the *alarm* condition or continue to flash in the *silence* condition or may give any other abnormal indication.
   c. The audible signal will not sound in the *alarm* condition or cannot be silenced after an alarm.

2. TO TEST: Interchange the damaged plug-in with a plug-in that is operating satisfactorily from another position.
   a. The damaged plug-in would give the same erratic operation in the new position. In other words, the trouble will follow the plug-in regardless of what position it is put in.
   b. The good plug-in will operate satisfactorily in the position the damaged plug-in was originally in.

E. Checking Flasher:
1. A damaged flasher could cause any one of the following troubles:
   a. The lights will remain steady bright or off in the alarm condition.
   b. The horn will sound continuously in the NORMAL or SILENCE condition.

2. TO TEST: Simulate an abnormal condition of one of the trouble contacts and check respective alarm station for a flashing indication. If light remains steady bright or is off, flasher is defective.

3. IMPORTANT: Use only one flasher with one common set of external devices such as horns, pushbuttons, etc. SCAM flashers are designed so as to home into the same position at all times; and since the flashers are not synchronized this homing feature could cause the switches to overlap and, thus, make it impossible to silence the audible signal.

In the event that none of the steps listed above is of any assistance in locating the cause of the trouble, please get in touch with the factory or local representative for further instructions. Before doing so, however, note what the abnormal operation is, PREFERABLY IN CHART FORM, as shown in the Alarm Sequence Chart of the general electrical diagram.

Under no circumstances should the internal wiring of the chassis be tampered with or the plug-in cans be opened up without factory authorization. Tampering with the plug-ins or chassis wiring will void the guarantee made on the equipment.

VI. DESIGN SPECIFICATIONS

A. Design Voltage:
1. 120 volts, 60 cycles.
2. 125 VDC.
3. Special as specified.

B. Coil Characteristics:
1. Pull-in Voltage: 75% or less of design voltage.
2. Drop-out Voltage: 65% or less of design voltage.
3. Coil Resistance: ±5% of nominal coil resistance corrected to 20°C.

4. Operation: Continuous duty.
5. Temperature Rise: Will not exceed 40° Centigrade enclosed in a can (excluding the heating effect of external devices such as lamps, resistors, etc.)
6. Operating Time. 5 to 12 milliseconds.
7. Surge Coil Current:
   a. 192 MA for 120/60 VAC relays.
   b. Not applicable to DC units.
8. Operating Coil Current:
   a. 19.2 MA for 120/60 VAC relays.
   b. 14.7 MA for 125 VDC relays.
9. Power Consumption:
   a. 1.7 watts for 120/60 VAC relays.
   b. 1.8 watts for 125 VDC relays.

2 TIMES 2 RELAYS

C. Contact Ratings:
   1. Make or break contact rating:
      a. 2 amps non-inductive load: design AC voltage.
      b. 65 watts non-inductive load at design DC voltage.
   2. Continuous Current Carrying Capacity: 2 amps.
   3. Material: 99.7% fine silver.
   4. Contact Resistance: .050 ohms at 15 grams pressure.
   5. Contact Conductivity: 98 MHO.

D. General Characteristics:
   1. Will give a minimum of 1,000,000 operations.
   2. Will operate in any position.
   3. Voltage breakdown: Will withstand 1500 volts RMS to ground for one minute.

VII. LAMP SPECIFICATIONS

	3 Watt	6 Watt
Type	3S6/5 Double contact 3S6/5 Screw Base	6S6 Double contact 6S6 Screw Base
Voltage	130	130
Cold Resistance	450 ohms	200 ohms
Hot Resistance (120V)	5800 ohms	2600 ohms
Inrush Current @ 120V	.275 amp	.600 amp
Nominal Current @ 120V	.022 amp	.050 amp

2 BULBS X 6W

Operating Voltage	Approximate Life, Hours	% Light Output	Power Consumption	
			3 Watt	6 Watt
145	390	145	3.5	7.1
140	600	130	3.3	6.7
135	950	114	3.2	6.4
130	1,500	100	3.0	6.0
125	2,550	85	2.8	5.6
120	4,500	75	2.6	5.3
115	7,500	65	2.5	5.0
110	12,650	55	2.3	4.6
105	22,500	45	2.2	4.4

PANALARM®

ANNUNCIATOR ENGINEERING DATA

ANNUNCIATOR COMPONENT	POWER CONSUMPTION				CONTACT CAPACITY*
	VOLTAGE	STAND-BY	MAXIMUM	MINIMUM	
Self-Policing Plug-ins	120 AC 125 DC	6.5 VA 3.7 Watts	8.5 VA 7.4 Watts	0 0	2.0 amps 0.5 amps
No-Drain Plug-ins	120 AC 125 DC	0 0	7.2 VA 4.3 watts	0 0	2.0 amps 0.5 amps
Flashers, All Models	120 AC 125 DC	0 0	2.7 VA 5.0 Watts	0 0	1200 watts lamp load** 500 watts lamp load**
Auxiliary Relays (Model ACS-X1)	120 AC 125 DC	0 0	5.0 VA 3.5 Watts	0 0	10.0 amps 1.0 amps
Backlighted Nameplates 2 Lamps Per Point 1 Lamp Per Point	 Any Any	 0 0	 6.0 Watts 3.0 Watts	 0 0	 — —
Bullseye Lamps	Any	0	3.0 Watts	0	—
Pushbuttons Models SW-102, SW-302	120 AC 125 DC	— —	— —	— —	6.0 amps 1.1 amps
Model SI-11	120 AC 125 DC	— —	— —	— —	20.0 amps 10.0 amps
Models 51-PB, 51-PB41 Models ACS-PB, ACS-PB41	120 AC 125 DC	— —	— —	— —	6.0 amps 2.0 amps
Horn Model HSA Model HSD	120 AC 125 DC	0 0	20.0 VA 13.0 Watts	0 0	— —

*All contact ratings are for non-inductive loads at 120/60 for AC applications and at 125 volts for DC applications.

**The number of lamps handled by one flasher is a function of this rating and lamp wattage. Consider total wattage of maximum number of lamps flashing at any one time. Where lamp load exceeds flasher contact rating, an auxiliary flasher relay is required, not an additional flasher.

In most cases, plug-in relays are designed for use on either 50 or 60 cycles. Nameplates so designate, for example 120/50-60. Flashers must be ordered for exact frequency however.

INSTRUCTIONS

ITEM 100

GEI-10190G

SUPERSEDES GEI-10190F

D-C AUXILIARY RELAYS

TYPE HGA

SHEET 5 OF 33
SUB K Relay
BY CK
DATE

DESCRIPTION

INTRODUCTION

The Type HGA relays included in these instructions are double-pole, hinge-type relays suitable for application wherever a low-energy device with time-delay dropout is required. Table I lists the differences between the relays covered by these instructions.

CHARACTERISTICS

* TABLE I

RELAY	Type of Connection	Contact Arrangement		+Approx. Time Delay Cycles	
		N. O.	N. C.	P. U.	D. O.
HGA17A	BACK	2	1	‡	15
HGA17B	FRONT	2	1	‡	15
HGA17C	FRONT	2	1	‡	15
HGA17D	FRONT	2	2	3.5	‡
HGA17E	FRONT	0	2	3	15
HGA17F	BACK	0	2	3	15
HGA17H	BACK	2	2	3.5	‡

+ At rated voltage and on a 60 cycle basis
‡ No factory calibration made

All of these relays have a cover with the exception of the HGA17B relay.

RATINGS

The relays are available for continuous operation at all standard DC voltage ratings up to 250 volts. They can also be supplied with a rectifier for use in AC circuits at 115 and 230 volts.

The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for one minute. The interrupting ratings (non-inductive circuits) for the various voltages are listed in Table II.

TABLE II

VOLTS	Interrupt (single break) (Amps)	
	HGA17A, HGA17B HGA17C	HGA17D, HGA17E HGA17F, HGA17H
115 AC	20	30
230 AC	10	20
24 DC	3	20
48 DC	1.5	10
125 DC	0.6	3
250 DC	0.25	0.75

BURDENS

The burdens of the coils for the Type HGA relays are listed in Table III.

TABLE III

Coil Ratings (Volts)	Coil Resistance (Ohms)	Cold Watts	‡ Volt Amperes
250 DC	8700	7.2	———
125 DC	2200	7.1	———
48 DC	338	6.8	———
32 DC	146	7.0	———
24 DC	86	6.7	———
12 DC	21.5	6.7	———
115 AC	———	———	11
230 AC	———	———	22

‡ Includes burden of rectifier and resistor when used.

* Denotes change since superseded issue.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONSTRUCTION

The relays covered by these instructions are of the same basic construction. The contact circuits are closed or opened by moving contact arms, controlled by a hinge-type armature, which in turn is actuated by an operating coil and restrained by an adjustable control spring. The length of contact gap is adjustable by means of screw contacts and locknuts in the front fixed-contact positions. The armature gap and back-contact wipe can be controlled by the screws and locknuts located on the moving-contact arms. This latter feature makes it possible to reduce the pick-up energy to a relatively low value. Because of this, it is necessary to back off the front left stationary-contact screw to insure sufficient contact pressure on the remaining normally-closed contact. The coil is wound on a copper spool which also acts as a damping ring and provides a time delay on pickup and dropout.

INSTALLATION

LOCATION AND MOUNTING

The relays should be installed in a location that is clean, dry, and free from excessive vibration. It should be mounted on a vertical surface by means of the steel mounting strap on the back of the molded compound base. Care should be taken to allow sufficient clearance in front of the relay to remove the cover, if one is included.

* The outline and panel drilling diagrams are shown in Figs. 4 to 8. The outlines of the external resistor and external rectifiers used with AC relays are shown in Figs. 9, 10 and 11.

CONNECTIONS

The internal connection diagrams are shown in Figs. 2 and 3. The external connection diagram showing the use of a rectifier with AC relays is shown in Fig. 1.

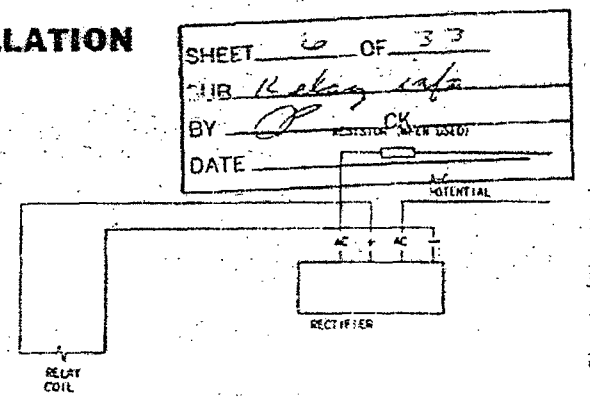


Fig. 1 (418A820-1)

* Fig. 1 External Wiring Diagram For AC Operated HGA17 Relays

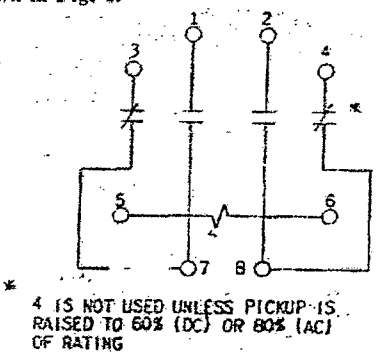


Fig. 2 (8077058-19)

Fig. 2 Internal Connection Diagram For HGA17A, HGA17B, HGA17C, HGA17D, And HGA17H Relays (Back View)

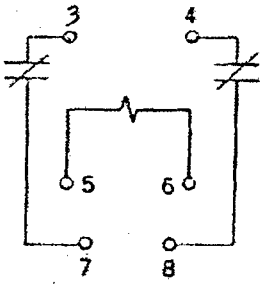


Fig. 3 (10HA8559-1)

Fig. 3 Internal Connection Diagram For HGA17E And HGA17F Relays (Back View)

MAINTENANCE

PERIODIC TESTING

Auxiliary relay equipment should be checked for operation at regular intervals, preferably at the same time that the associated protective devices are inspected. The relays should be checked for pick-up and drop-out values and time settings. These settings should not require readjustment, but if changes are necessary the points discussed under ADJUSTMENTS AND INSPECTION should be observed.

CONTACT CLEANING

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughtened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact.

Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing.

The burnishing tool described is included in the standard relay tool kit obtainable from the factory.

ADJUSTMENTS AND INSPECTION

Relay types HGA17A, HGA17B, and HGA17C have been adjusted at the factory to pick up at 30 per cent of rating for DC relays and 40 per cent of rating for AC relays. Relay types HGA17D, HGA17E, HGA17F, and HGA17H have been adjusted to pick up at approximately 60 per cent of rating for DC relays and 80 per cent of rating for AC relays. These values may be affected by the adjustment of time delay but will be approximately equal to the values given above.

The relays adjusted for the 60 per cent pickup are set so as to produce contact pressure and wipe on two normally-closed contacts. As shipped from the factory, all relays having low (30 per cent) pickup are provided with one normally-closed contact circuit. The left-hand (front view) screw contact is backed out of engagement with its moving contact. This is necessary since the low control-spring tension used on these relays is not great enough to give sufficient pressure on two normally-closed contacts. The low control-spring tension is necessary to facilitate the adjustment of time delay on dropout, as described in the following paragraphs.

As shipped from the factory, all relays, have been adjusted for the approximate time delay as listed in Table I. This time delay feature results from the damping effect of the copper spool. It may be adjusted over a small range by regulating the tension in the control spring. This of course affects the pick-up adjustment.

The minimum recommended contact wipe is one turn of the screw in the moving contactarm. To set the wipe, close the armature by hand and adjust the screws so that they are just touching the contact carrier. Then back off each screw one full turn, and lock in place with the locknut. The minimum recommended contact gap is 3-1/2 turns of the fixed contact screw. To adjust, turn both screws in until the normally-open contacts just make. Then back off each screw 3-1/2 turns and lock in position with the locknut. Lower contact gaps are permissible in special applications but the interrupting capacities listed in TABLE II will not apply. These ratings are for the minimum recommended gap settings previously mentioned.

The pick-up value is adjusted by means of the control spring located at the lower end of the armature. The control spring should be in the front hole of the spring post for relays adjusted for 30-40 per cent pickup and in the rear hole for relays adjusted for 60-80 per cent pickup.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken, or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required and describing the parts by catalogue numbers as shown in Renewal Parts Bulletin No. GEF-2623.

Type HGA

Hinged-armature Auxiliary Rela

For the Performance of Auxiliary Functions in Ac and Dc Circuits

APPLICATIONS

The Type HGA hinged armature auxiliary relays are designed to provide additional contacts, higher contact carrying and interrupting ratings, timing, interlocking, electrical separation, or other auxiliary functions.

Where more than two circuits are to be controlled, the coils of two or more relays may be connected either in parallel on ac or in series or parallel on dc to obtain the desired results.

GENERAL-PURPOSE RELAYS

Standard Pickup: The HGA11 is the standard auxiliary relay which is instantaneous in operation and is used for auxiliary functions where intentional delays of over 1¼ to 2 cycles are not required and where standard pickup values, as listed in the table, are satisfactory.

The contact arrangement for each relay (or unit) is double-pole, double-throw (2 normally open, 2 normally closed).

Low Pick-up: The HGA14 relay has been designed with a shorter armature gap which is obtained by the setting of an adjustable back contact. This construction allows a lower pickup value than normal and a faster pickup time. Also relays are available for tripping duty and target operation with pickup times of ½ cycle on a 60-cycle basis, and are intermittently rated.

The contact arrangement is one single-pole, double-throw contact and one normally open contact for each relay (or unit). The second normally closed contact is not used with the low pickup setting. This second contact can be used if the wipe is restored to normal and the control spring tension increased thus raising the pickup toward the 80 percent (60 percent dc cold) level which would apply with standard gap relays.

AC UNDERVOLTAGE

Low Dropout. The Type HGA14BH(-)A relay is a three-phase residual voltage relay with low dropout. A primary application is as on automatic throwover schemes where induction motors are the principal load.

TIME-DELAY RELAYS

Fixed-time Dropout. The HGA17 is designed to provide a time-delay dropout of approximately 15 cycles (60-cycle basis). The delay is obtained by momentarily sustaining the magnetic flux at the relay pole face by means of induced currents in a copper ring which acts as a shorted one-turn coil. A small delay in pickup time is also obtained since the induced currents also tend to retard the buildup of the relay magnetic field. Operating times are measured at or from rated voltage or amperes for pickup and dropout times respectively.

Adjustable-time Pickup: The HGA14D has a resistor-capacitor timing circuit with the resistor being adjustable to vary the charging time of the capacitor which is connected across the relay operating coil.

Contact arrangement for the fixed-time dropout (HGA17) is one single-pole, double-throw contact and one normally open contact per relay (or unit).

RELAY CHARACTERISTICS

Voltage or Current Pickup Values. The values listed in the table below apply as indicated for all relays.

Relay	Pickup Classification	Percentage of Rated Volts or Amps			
		Pickup Value		Dropout Value	
		Ac	Dc	Ac	Dc
HGA11	Standard	80%	80%	40-50%	2-10%
HGA14	Low	40%	40%	20-30%	2-10%
HGA17A,B,C	Time	30-40%	20-30%	2-10%	2-10%
HGA17D,H	Time	80% Max.	60% Max.	5-15%	2-10%

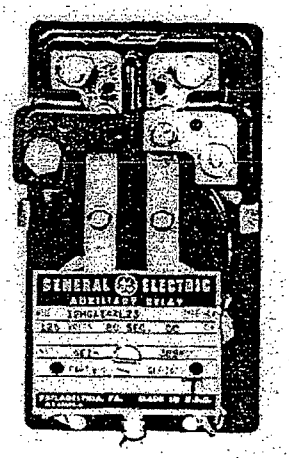
CONTACT RATINGS

Standard Pickup Relays—Type HGA11

The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for one minute.

Interrupting Ratings of Contacts in Amperes

Contact-circuit Volts		Single Break	Double Break
Ac	Dc		
NONINDUCTIVE CIRCUITS			
...	6-32	15	30
...	48	8	16
...	125	2	3
...	250	0.3	0.4
115	...	30	30
230	...	20	30
INDUCTIVE CIRCUITS			
...	6-32	5	10
...	48	3	6
...	125	1	1.5
...	250	0.25	0.3
115	...	10	20
230	...	6	10



(Photo 8043229)

Fig. 1. Type HGA14AL connected relay with cover

Low Pickup Relays—Types HGA14, HGA17

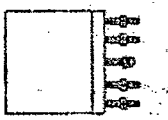
The current closing ratings of the contacts is 30 amperes. The current carrying rating is 12 amperes continuously or 30 amperes for one minute. The interrupting ratings (noninductive circuits) for the various voltages are as follows:

Contact-circuit Volts		Single Break
Ac	Dc	
NONINDUCTIVE CIRCUITS		
...	6-32	10
...	48	5
...	125	0.6
...	250	0.25
115	...	20
230	...	10
INDUCTIVE CIRCUITS		
...	6-32	5
...	48	3
...	125	0.5
...	250	0.2
115	...	10
230	...	5

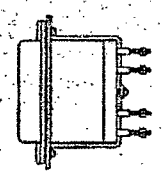
REFERENCES:
Dimensions.....Section 14 (7380)
How to Order.....Section 1 (7210)
Prices.....Handbook Section 7212
Instruction Books.....Section 20 (7206)
Target and Contact Data.....Section 14 (7381)
Relay Standards.....Section 14 (7382)
Renewal Parts Information...Section 21 (7399)

Type HGA

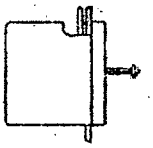
Hinged-armature Auxiliary Relays



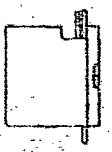
BC surface mounting with cover



BC semi-flush mounting with cover



FC surface mounting with cover



FC surface mounting with cover with provisions for front mounting

SELECTION GUIDE—MOLDED CASE RELAYS

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Contact	Pickup Time (Cycles)	Model Number: Surface Mounted Back Connected with Studs and Solid Cover③	Semi-flush Mounted Back Connected with Studs and Cover with Glass Window	Surface Mounted Front Connected with Solid Cover ③	Surface Mounted Front Connected with Solid Cover and Provision for Front Mounting	Approx Wt in lb (kg): Net	Ship.
General-Purpose Relays										
TYPE HGA STANDARD PICKUP										
DIRECT CURRENT										
6	10		2 N.O. 2 N.C.	Approx 2	12HGA11A58	12HGA11A58F	12HGA11J58	12HGA11S58	2 (0.9)	3 (1.4)
12	40				A57	A57F	J57	S57		
24	160				A56	A56F	J56	S56		
32	250				A55	A55F	J55	S55		
48	512				A54	A54F	J54	S54		
62.5	830				A53	A53F	J53	S53		
110	2460				A60	A60F	J60	S60		
125	3650				A52	A52F	J52	S52		
220	9600				A59	A59F	J59	S59		
250	15500				A51	A51F	J51	S51		
ALTERNATING CURRENT—60 HERTZ										
115	90.5	1000	Same as Dc	Approx 2	12HGA11A70	12HGA11A70F	12HGA11J70	12HGA11S70	2 (0.9)	3 (1.4)
230	367	3960			A71	A71F	J71	S71		
ALTERNATING CURRENT—50 HERTZ										
115	98.5	830	Same as Dc	Approx 2	12HGA11A74	12HGA11A74F	12HGA11J74	12HGA11S74	2 (0.9)	3 (1.4)
230	512	4270			A75	A75F	J75	S75		
TYPE HGA LOW PICKUP (40% of Rating for AC or 30% of Rating for DC)										
DIRECT CURRENT										
6	10		2 N.O. 1 N.C.	Approx 1	12HGA14A58	12HGA14A58F	12HGA14F58	—	2 (0.9)	3 (1.4)
12	40				A57	A57F	F57	—		
24	160				A56	A56F	F56	—		
32	250				A55	A55F	F55	—		
48	512				A54	A54F	F54	—		
62.5	830				A53	A53F	F53	—		
110	2460				A60	A60F	F60	—		
125	3650				A52	A52F	F52	—		
220	9600				A59	A59F	F59	—		
250	15500				A51	A51F	F51	—		
ALTERNATING CURRENT—60 HERTZ										
115	90.5	1000	Same as Dc	Approx 1	12HGA14A70	12HGAT4A70F	12HGA14F70	—	2 (0.9)	3 (1.4)
230	376	3960			A71	A71F	F71	—		
ALTERNATING CURRENT—50 HERTZ										
115	98.5	830	Same as Dc	Approx 2	12HGA14A74	12HGA14A74F	12HGA14F74	—	2 (0.9)	3 (1.4)
230	512	4270			A75	A75F	F75	—		

① Within plus or minus 10 percent.

(Continued on page 8-22)

② The ac impedence for the standard gap relays with armature in dropped position is 1/2 of listed value.

③ To obtain glass in cover of HGA relays, add suffix "G" to Model. Example: Model 12HGA11A58G.

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MOLDED CASE RELAYS (Cont'd)

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Contact	Pickup Time (Cycles)	Model Number: Surface Back Connected with Cover and Studs③	Model Number: Semi-flush Back Connected with cover	Model Number: Front Connected with Cover (No Studs)③	Approx Wt in lb (kg): Net	Approx Wt in lb (kg): Ship
TIME DELAY—Fixed Time (15 Cycles Dropout) (Copper Slugged Coil)									
DIRECT CURRENT									
12	24.5		2 N.O. 1 N.C.	Approx 2	12HGA17A57	12HGA17A57F	12HGA17C57	2 (0.9)	3 (1.4)
24	98				A56	A56F	C56		
32	153				A55	A55F	C55		
48	375				A54	A54F	C54		
62.5	585				A53	A53F	C53		
110	1700				A70	A70F	C70		
125	2280				A52	A52F	C52		
220	10300				A68	A68F	C68		
250	10300				A51	A51F	C51		
ALTERNATING CURRENT—50/60 HERTZ									
115	1700		Same as Dc	Approx 2	12HGA17A63④ A64⑤	12HGA17A63F④ A64F⑤	12HGA17C63④ C64④	4 (1.8)	5 (2.3)
230	1700								

FIXED TIME PICKUP WITH APPROX 15-CYCLE DELAY ON DROPOUT

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Pickup Volts	Contact	Pickup Time (Cycles)	Model Number: Surface Back Connected with Cover and Studs③	Model Number: Semi-flush Back Connected with cover	Model Number: Front Connected with Cover (No Studs)③	Approx Wt in lb (kg): Net	Approx Wt in lb (kg): Ship
DIRECT CURRENT										
12	24.4		80%	2 N.O. 2 N.C.	3.5	12HGA17H57	12HGA17H57F	12HGA17D57	2 (0.9)	3 (1.4)
24	98					H56	H56F	D56		
32	153					H55	H55F	D55		
48	375					H54	H54F	D54		
62.5	585					H53	H53F	D53		
110	1700					H70	H70F	D70		
125	2280					H52	H52F	D52		
220	10300					H68	H68F	D68		
250	10300					H51	H51F	D51		
ALTERNATING CURRENT 50/60 HERTZ										
115	1700		80%	Same as Dc	3.5	12HGA17H63③ H64④	12HGA17H63F③ H64F④	12HGA17D63④ D64④	4 (1.8)	5 (2.3)
230	1700									

MOLDED CASE TRIPPING RELAYS—1/2 Cycle or Less (For tripping two breakers)

Volts Dc (intermittent)	Pickup Volts	Contact	Back Connected with Cover③: For 3—2-amp Targets	For 3—1-amp Targets	For 3—0.6-amp Targets	For 3—0.2-amp Targets	For Carrier GCX or GCY	Approx Wt lb (kg): Net	Approx Wt lb (kg): Ship
24	80% or Less	2 N.O. 1 N.C.	12HGA14AM5	12HGA14AM10	12HGA14AM15	12HGA14AM20	.....	2 (0.9)	3 (1.4)
32			AM4	AM9	AM14	AM19	.....		
48			AM3	AM8	AM13	AM18	12HGA14AM28		
125			AM2	AM7	AM12	AM17	AM26		
250			AM1	AM6	AM11	AM16	AM25		
			Front Connected with Cover③						
24			12HGA14AL5	12HGA14AL10	12HGA14AL15	12HGA14AL20	12HGA14AL29		
32			.....	AL9	.....	AL19	.....		
48			AL3	AL8	AL13	AL18	AL28		
125			AL2	AL7	AL12	AL17	AL26		
250			AL1	AL6	AL11	AL16	AL25		

MOLDED CASE—Adjustable Time Delay on Pickup

Volts Dc	Pickup Volts	Contact	Pickup Time (Cycles)	Back Conn③ with Cover	Approx Wt lb: Net	Approx Wt lb: Ship
48	15 or Less	2 N.O. 1 N.C.	2- 4	12HGA14BT	8 (3.6)	12 (5.4)
125	61-67		2- 6	D2		
125	30-35		1- 3	D3		
125	65-70		4-24	D7		
125	65-70		2-12	D6		
250	65-70		1- 6	D4		
250	65-70		1-12	D5		

① Within plus or minus 10 percent.
② The ac impedance for the standard gap relays with armature in dropped position is 1/2 of listed value.
③ To obtain glass in cover of HGA relays add suffix "G" to Model. Example: Model 12HGA17H57G.
④ External rectifier and resistor included as required.
⑤ External capacitor(s) included as required.

Note: Any back-connected HGA Relay with molded case can be furnished for semi-flush mounting. Add "F" to regular model number when ordering. Example: 12HGA11A52F. Cover will have glass windows.

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Relay Standards

INTRODUCTION

All General Electric protective relays in this handbook, unless otherwise noted, are designed and manufactured in accordance with the ANSI/IEEE standard C37.90 that applies to protective relays. To better understand the application, design, rating and selection of protective relays, certain parts of the American National Standard (ANSI) and IEEE standard will be summarized for easy reference. This summary should help guide the relay engineer regarding service conditions, standard ratings and other application requirements, but is not intended as a substitute for a reference to the complete standard.

REFERENCE STANDARD

ANSI/IEEE C37.90 - 1978 "Standards for Relays and Relay Systems"

Scope and Limitations

The standards and references that follow apply primarily to relays and relay systems used to control power switchgear.

What is a Relay?

A relay is "an electrical device designed to respond to input conditions in a prescribed manner, and after specified conditions are met, to cause contact operation or similar abrupt change in associated electric control circuits."

Usual Service Conditions:

Relays must be suitable for operation under the following:

(a) The ambient temperature of the air immediately around the relay case or other enclosure shall be within the limits of −20C to +55C.

(b) The altitude shall not exceed 5000 ft (1500 meters).

Ratings

(a) Standard current and voltage ratings— The standard current and voltage ratings for relays shall be as follows:

Voltage (V)		Current (A)
Ac (rms)	Dc	Ac (rms)
120	24	1
240	48	5
480	125	
	250	

CONTENTS

	Applicable Standard
Usual Service Conditions	ANSI/IEEE C37.90-1978 Standards for Relays and Relay systems
Ratings—Current and Voltage	ANSI/IEEE C37.90-1978
Maximum design for all relays	
Ac and dc auxiliary relays	
Make and carry rating for tripping contacts	
Tripping contacts duty cycle	
Dielectric tests by manufacturer	ANSI/IEEE C37.90-1978
Dielectric tests by user	ANSI/IEEE C37.90-1978
Surge Withstand Capability (SWC)	ANSI/IEEE C37.90-1978, and C37.90a
Fast Transient Test	GE in-house test (IEEE standard under preparation)
Radio Frequency Interference (RFI)	GE in-house test (IEEE standard under preparation)
Seismic Qualifications - Class IE Equipment for Nuclear Power Generating Stations	IEEE 323-1974, Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations
Seismic testing of protective and auxiliary relays	Formerly IEEE 501, now IEEE C37.98 Seismic Testing of Relays
Electric Power System Device Function numbers	ANSI C37.2

(b) Allowable variation from rated voltage — Protective relays which are designed to be energized continuously with ac voltage shall operate without damage at rated frequency with voltage not more than 10 percent above rated voltage, but not necessarily in accordance with temperature rise limits established for operation at rated voltage.

(c) Maximum design voltage or current— The maximum design voltage or current for all relays, other than voltage-operated auxiliary relays, shall be equal to the rated voltage or current of the relay. This is the highest rms alternating or direct voltage or current at which the relay is designed to be energized continuously without exceeding the allowable temperature rise for the class of insulation (Many GE relays are designed to continuously carry current in excess of the rated current).

For dc auxiliary relays, relay power supply, or auxiliary relay circuits with dc voltage ratings, the maximum design voltage shall be as shown in Table 1.

The maximum design voltage for ac auxiliary relays shall be 110 percent of rated voltage.

(d) Range of operating voltage for auxiliary relays — dc auxiliary relays, which may be continuously energized for indefinite periods, dc power supplies, and auxiliary relay circuits with dc voltage ratings, shall be able to withstand the maximum design voltage without exceeding the allowable temperature rise. These relays shall operate successfully over a range from 80 percent of rated voltage to the maximum design voltage. Ac auxiliary relays shall be able to withstand 110 percent of rated voltage without exceeding the allowable temperature rise. These relays shall operate successfully over a range from 85-110 percent of rated voltage.

Table 1

Rated Volts	Maximum Design Volts
24	28
48	56
125	140 ←
250	280

(e) Make and Carry Ratings for Tripping Contacts (revised 1978) — a tripping contact is designed for the purpose of energizing a power circuit breaker trip coil.

The contact shall make and carry 30 amperes for at least 2000 operations in a prescribed duty cycle.

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 149 of 219

Dielectric Tests

General—Dielectric tests between circuits, and dielectric tests between circuits and relay frame, shall be considered as routine tests. Dielectric tests across open contacts shall be considered as design tests. Dielectric tests are not required across contacts with surge-suppression components, nor across solid-state output circuits; when these are used, the Surge Withstand Capability (SWC) test should be substituted for the dielectric test.

Standard Test Voltage — Relays rated 600 volts and below shall withstand for one minute a low-frequency alternating-current voltage test of twice rated voltage plus 1000 volts with a minimum of 1500 volts.

Duration of Test Voltage

The test voltage for all relays shall be applied continuously for a period of 60 seconds.

As an alternate, to be made at the point of manufacture only, it is permissible to test any relay for one second at a value of 20 percent higher than the standard 60 second test voltage.

Dielectric Tests by Users

Dielectric tests, in accordance with the standard, may be made by the user on new relays only, to determine whether specifications are fulfilled. New relays are defined as those which have not been in service and are not more than one year old from date of shipment and have been suitably stored to prevent deterioration.

Additional dielectric tests may be made, using 75 percent of the standard test voltage, at the point of installation to determine the practicality of placing or continuing the device or equipment in service.

Points of Application of Voltage

The test voltage of insulation to ground and between circuits shall be applied successively between each electric circuit and all other electric circuits, and between each electric circuit and the metal frame of the relay. The test voltage across open contacts shall be applied to the relay terminals which connect to the contacts.

Surge Withstand Capability (SWC) Tests

The surge withstand capability (SWC) is a design test for relay systems and, in particular, static relays.

The purpose of this test is to apply to the terminals of the relay system a standardized test wave shape that is representative of surges observed and measured in actual installations. In order to pass this test, relay systems must be able to withstand the applied surge without damage to components and without operating incorrectly.

Surge Withstand Capability (SWC) Wave Shape and Characteristics

The SWC test wave is an oscillatory wave, with a frequency range of 1.0 MHz to 1.5 MHz, voltage range of 2.5 kV to 3.0 kV crest value of the first half cycle peak, and envelope decaying to 50 percent of the crest value of the first peak in not less than 6 μs from the start of the wave. The source impedance of the surge generator used to produce the test wave shall be 150 ohms $\pm$ 5 percent. The test wave to be applied to test specimen at a repetitive rate of not less than 50 tests per second for a period of not less than 2.0 seconds.

NOTE: (1) All voltage and time values refer to the open circuit condition of the surge generator.
(2) Time period and repetition rate have been chosen to cover equipment which is used on 50 Hertz as well as 60 Hertz systems. The SWC test shall be applied to the relay as specified in ANSI C37.90.

FAST TRANSIENT TEST

(Ref. W. C. Kotheimer and L. L. Mankoff, Protection of Relays from Their Electrical Environment - Georgia Tech Relay Conference, 1977)

The Fast Transient test simulates the surges due to the interruption of inductive devices such as auxiliary relay coils, alarm bell coils, solenoids, etc. These surges are localized in effect, being attenuated by a few tens of feet of circuit from the source. Laboratory experiments show, however, that this surge presents a very real hazard to solid state equipment in the circuit close to it, possibly causing false operation or damage to semiconductor devices.

This "fast transient," produced by interrupting the current through an auxiliary relay coil or a breaker trip coil, has rise times in the 5-nanosecond range and power in the tens of kilowatts range. When subjected to such a transient, many semiconductor devices can be degraded such that failure may occur at a later time.

All new relay designs are subjected to this "fast transient" as a design-proof test. It was found that relays which survive the SWC test may fail the "fast transient" test.

(Recommend Guide Form Specification)

"The test shall be the application for two seconds of at least 60 pulses per second at each polarity from a surge generator having a source impedance of about 75 ohms resistance.

"When measured open circuit, the surge generator shall produce pulses having a rise time of 5 nanoseconds or less to a peak value of $\pm$3000 volts. The test voltage shall be applied to the relay as specified in ANSI C37.90 for the SWC test."

RADIO FREQUENCY INTERFERENCE (RFI)

Approximate Frequencies below 550 Mhz used by Electric Utilities in the USA

Freq. Band Mhz	Notes
27	Citizens Band, Class D
37	
47-48	
158-173	
216-220	
220-225	Citizens Band, Class E
450-470	Citizens Band, Class A
470-512	Land Mobile

A study has indicated that the possibility of misoperation of a protective or control device to radiated electromagnetic interference is a function of the following:

1. Field intensity and frequency of radiation.
2. Sensitivity of the affected circuitry to radiation.
3. Coupling efficiency resulting from device construction, lead configuration, etc.

An in-house test to check the security of static relays against false tripping is now used.

(Recommended Guide Form Specification)

"The relay shall not be damaged nor exhibit spurious output when subjected to a radio frequency susceptibility test, over a frequency range of 25 - 500 megahertz with a field strength measured at the front face of the relay, of 7.0 volts per meter. For these tests the relay is energized and connected for normal operation."

STANDARD FOR QUALIFYING CLASS 1E EQUIPMENT FOR NUCLEAR POWER GENERATION STATIONS① IEEE323-1974—A Guide for the Qualification of Class 1E

Class 1E - The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, or are otherwise essential in preventing significant release of radioactive material to the environment.

Testing - Outline of procedures which can be used to seismically qualify equipment by test.

Proof Testing - To qualify equipment for a particular application.

Fragility Testing - To qualify equipment by determining its ultimate capability.

SEISMIC TESTING OF RELAYS① IEEE C37.98 (Formerly IEEE-501)—

standard to establish procedures for determining the seismic capabilities of protective and auxiliary relays by fragility and testing.

In order to define the conditions for fragility testing of relays, parameters in three separate areas must be specified.

(a) Electrical settings and inputs to the relay.

(b) The change in state deviation in operating characteristics or other change of performance which constitutes failure.

(c) The seismic vibration environment to be imposed during test.

Typical Fragility Test

Tests are conducted with biaxial multi-frequency broadband vibrations applied to the shaker table. The standard response spectrum (SRS) of the vibrational stimulus (See Figure 1) is plotted as a percentage of the Zero Period Acceleration (ZPA). The 1.0 Hz point is 25% of the ZPA, the 4.0 to 16.0 HZ band is 250% of the ZPA and 33.0 HZ and above is equal to the ZPA. The range of maximum amplification of acceleration, 4.0 to 16.0 HZ, has been designed to most realistically match the range of peak acceleration input to the relays by equipments and panels on which they are mounted.

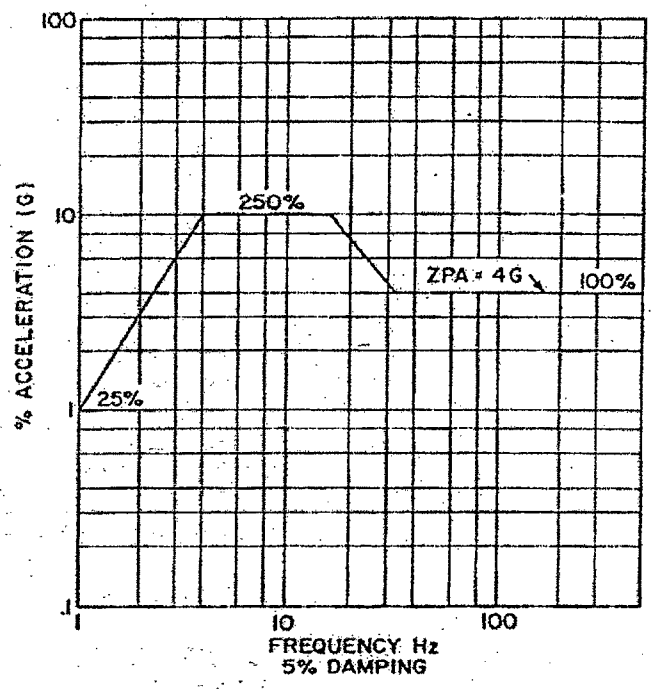


Fig. 1. Multi-frequency broad-band standard response spectrum shape (SRS) for relay with ZPA level of 4 Gs

The stimulus is increased in amplitude until failure occurs (per Item b, above) or the limits of the shaker table are reached. The fragility level of a relay or device is defined as the maximum ZPA level, expressed in Gs, that can be applied without causing failure.

① Relays for Class 1E duty are tested and qualified on a selective basis only. For information on specific relay types contact your local General Electric sales office.

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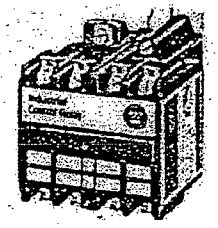
376 INDUSTRIAL CONTROL RELAYS

Types AR 600 Volt Ac, ARD 600 Volt Dc, Convertible Contacts

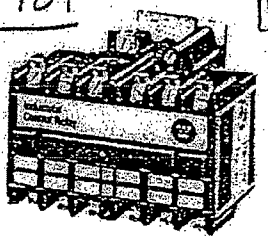
SHEET 29 OF 33
SUB Relay Index
DATE 4

ITEM 109

DESCRIPTION



AR 4 Pole



AR 6 Pole

Application
AR/ARD relays are designed for use on machine tools, process lines, conveyors, and similar automatic and semi-automatic equipment.

AR/ARD relays are electro-mechanical convertible contact relays. AR relays are Ac devices, and the ARD is for Dc applications.

Description
Available in either 4 or 6-pole configurations, AR relays are easily converted to 8 or 10 poles simply by adding a 4-pole deck. In addition, mechanical latch and pneumatic or solid state timer attachments are available for use with 4 and 6-pole relays.

Contacts are convertible from either NO to NC to provide any combination desired, up to a maximum of 10, except that for the ARD, the number of NC poles cannot exceed four in any pole configuration. Wide spacing of contacts simplifies installation, contact testing, and maintenance. Contacts are electrically and mechanically isolated from each other. Overlap contacts are also available in one or two sets. These contacts should be mounted in the center pole positions. Ac and Dc contact cartridges should not be used in the same relay.

APPLICATION DATA

Contact Ratings

600 Volt Ac Cartridges NEMA A600

Volts	Cont Current	Max. Current		Max. VA	
		Make	Break	Make	Break
120	10	60	6	7200	720
240	10	30	3	7200	720
480	10	15	1.5	7200	720
600	10	12	1.2	7200	720

Dc Cartridges NEMA P600

Volts	Cont. Current	Max. Current	Max. VA
		Make or Break	Make or Break
125	5	1.1	138
250	5	.55	138
600	5	.23	138

Resistive Load
125V Dc: 3.0 amps
250V Dc: 1.5 amps

Coil Power Requirements
Ac: 96 VA open, 14 VA close
Dc: 14 watts open, 250 volts max.

ORDERING INFORMATION

- Order by catalog number. AR relays listed have 120/110 volt, 60/50 Hz coils, and ARD relays have 120 volt Dc coils.
- If a different coil voltage is required, select the catalog letter from the Coil Voltage Table below and substitute it for the SHADED letter in the catalog number.
- AR and ARD relays listed are supplied with NO contacts which are easily converted to NC. If both NO and NC poles are required, order by catalog number. Example: 4 pole relay with 1 NO and 3 NC contacts, order AR413A. Add $12 list per relay.
- SCREW Terminals – For ring-type connectors, add Suffix R to the catalog number. Example: AR420AR. No additional charge.
- OVERLAP Contacts – Overlap contacts for AR and ARD relays are designed so that a normally open contact closes before the corresponding normally closed contact opens. Overlap contacts come in NO/NC sets of two cartridges. Add catalog letter Suffix S to the catalog number. Example: AR420AS. Specify the number of sets required: S for one set and S2 for two sets. Add $12 list per relay.

Coil Voltage Table

AR Coils			ARD Coils	
Volts Ac	Hz	Catalog Suffix	Volts Dc	Catalog Suffix
12	60	F	12	D
24	60	I	24	I
48	60	G	48	M
110	60	V	95	B
208	60	B	130	U
240/220	60/50	W	240	T
277	60	C		
440/380	60/50	H		
480/440	60/50	X		
550	60	D		
600/550	60/50	E		

LIST PRICES AND CATALOG NUMBERS

AR/ARD Relays

Number of Pole Spaces	Contacts NO	NC	Blank Cavities	AR 600 Volt Ac Relays 120/60, 110/50 Ac Coil Catalog Number	List Price	ARD 600 Volt Dc Relays 120 Volt Dc Coil Catalog Number	List Price
4	0	0	4	AR4A	$ 48	ARD4S	$108
	2	0	2	AR420A	72	ARD420S	132
	4	0	0	AR440A	96	ARD440S	156
6	0	0	6	AR6A	48	ARD6S	108
	4	0	2	AR640A	96	ARD640S	156
	6	0	0	AR660A	120	ARD660S	180
8[1]	6	0	2	AR860A	120	ARD860S	180
	8	0	0	AR880A	144	ARD880S	204
10[1]	10	0	0	AR10100A	168	ARD10100S	228

Contact Cartridges

Type Terminal	Standard Contact Cartridges[2] Catalog Number	List Price	Overlap Contact Cartridges[3] Catalog Number	List Price
600 Volt Ac Cartridges				
With Clamp Terminals	ARC	$12	AROC	$24
With Screw Terminals	ARCR	12	AROCR	24
600 Volt Dc Cartridges				
With Clamp Terminals	ARDC	12	ARDOC	24
With Screw Terminals	ARDCR	12	ARDOCR	24

[2] Standard cartridges are sold in cartons of 4 cartridges. Catalog number and list price are for single cartridge
[3] Overlap contact cartridges are sold in sets of 2 cartridges. Catalog number and list price are for sets of 2
[1] Will not accept top mounted latch or timers

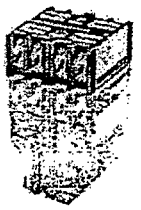
FURTHER INFORMATION

Discount C10-S12
UL File No. E19223
CSA File No. LR39402-6, LR54517, a

INDUSTRIAL CONTROL RELAYS
Types AR 600 Volt Ac, ARD 600 Volt Dc
Convertible Contacts

ACCESSORIES

Four Pole Top Deck Adder



- Increases contact capacity from four/six poles to eight/ten poles.
- Mounts on top of basic relay using three screws.
- Will not interfere with wiring, testing or converting cartridges.
- Screw terminals for ring connectors available; to order add Suffix R to catalog number of adder.

List Prices

No. of Pole Spaces	Contacts N.O.	Contacts N.C.	Blank Cavities	Catalog Number	List Price
With 600 Volt Ac Cartridges					
4	2	0	2	ARA20	$24
	4	0	0	ARA40	48
With 600 Volt Dc Cartridges					
4	2	0	2	ARDA20	24
	4	0	0	ARDA40	48

ARML Permanent Magnet Latch

For AR/ARD Relays



By energizing the relay coil, the latch attachment "sets" (when the base relay's armature/crossbar assembly has closed) holding the relay "On", even after the relay coil has been de-energized. The clearing coil on the latch is energized to release the armature/crossbar assembly.

- Field mountable to four and six pole.
- Latch plunger is adjustable.

Mounting Strip for AR/ARD

No. of Relays		Catalog Number	List Price
4 Pole	6 Pole		
4	2	ARMS4	$12.86

ARPT Pneumatic Timer

For AR Relays



- Includes 1 N.O. and 1 N.C. non-convertible timed contacts
- Mounts on basic four or six pole AR Relay. Not for use on Dc.
- Field convertible between On Delay and Off Delay.
- Repeatability accuracy: ±15%

List Prices

Timing Range Seconds	Catalog Number	List Price
2-20	ARPT-20	$168
4-60	ARPT-60	168
20-200	ARPT-200	168

Contact Ratings: NEMA A600

Ac Volts	Normal Load Break (Amps.)	Inrush and Interrupting Capacity (Amps.)
120	6.0	60
240	3.0	30
480	1.5	15
600	1.2	12

- Latch coil continuously rated.
- Unlatching power requirement:
  Open Gap: 24 VA
  Closed Gap: 7 VA
  Burden: 4 Watts Ac, 6 Watts Dc

List Prices – Permanent Magnet Latch

For Ac Control Circuits

Operating Volts	Coil Hz	Catalog Number	List Price
24	60	ARMLJ	$84
48	60	ARMLG	84
120	60/50	ARMLA	84
240	60/50	ARMLW	84
220	60	ARMLB	84

For Dc Control Circuits

Coil Volts	Catalog Number	List Price
24	ARMLL	$111
48	ARMLM	111
120	ARMLS	111
240	ARMLT	111

ART Solid State Timer



- Mounts on basic four or six pole relay using two screws
- Has one N.O. Solid State Contact.
- On Delay or Off Delay applications
- Will switch 120 volt Ac and Dc coils
- ARTD is field convertible to 24 or 48 volts Dc

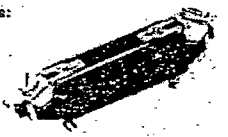
List Prices

Voltage	Time Delay, Seconds	Catalog Numbers On Delay	Catalog Numbers On Delay	List Price
Ac	1-30	ART-ON	ART-OF	$288
Ac	30-60	ART-ONB	ART-OFB	288
Dc	1-30	ARTD ON	ARTD OF	288

Electrical Ratings
Input: 120 Volts Ac, ±10%, 50/60 Hz;
120, 48, 24 Volts Dc, ±10%
Power Required: Ac, Dc: 2 VA max.
Contact Ratings: Ac, .2 amps inductive (1.3 amps max. inrush.)
Dc, will switch 4, 8, and 10 pole ARD relays:
48 Volts Dc, .25 amp.
24 Volts Dc, .5 amp.
Repeatability: Ac ±2% with 10% voltage variation, ±7.5% with 15°C temperature variation;
Dc, ±1% with 10% voltage variation, and 15°C temperature variation
Ambient Temp. Range: −20°C to +70°C
Duty Cycle: Ac, Dc: 150 Operations/minute max.
Reset Time: ART and ARTD
On Delay: ART, 50 ms Max; ARTD, 100 ms independent of time setting and duty cycle.
Off Delay: Instantaneous

ARSS Surge Suppressor

For AR Relays:



- Mounts in contact cavity of AR relays
- Limits high transient voltages resulting from de-energizing relay coil or other electro-mechanical devices.
- Protects sensitive instruments and solid state devices.
- 120 Volts Ac max. Not for use on Dc.
- For noise suppression, see Cat. No. SS-56 starter mounted surge suppressor, p. 313.

Catalog Number: ARSS; List Price: $24

FURTHER INFORMATION

IL 14510, IL 14485: ART, ARTD
IL 14846: ARPT
Renewal Parts, Page 545
Enclosures, Page 375
UL File No. E19223
CSA File No. LR39402-6, LR54517, and LR54520

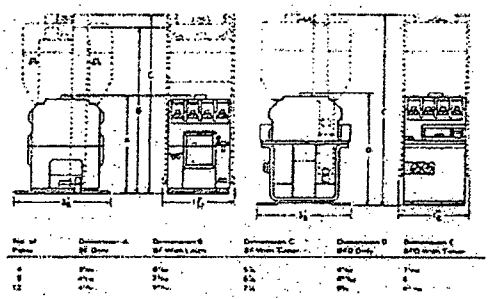
INDUSTRIAL CONTROL RELAYS
Dimensions and Weights

SHEET 30 OF 33
BY IEC Control Relays CK
DATE

DIMENSIONS

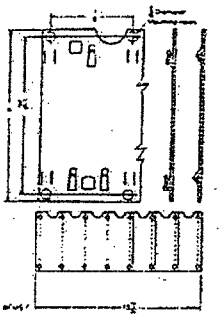
In Inches *Not to be used for construction purposes unless approved.*

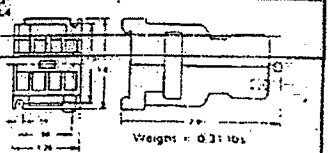
BF Relay With Permanent Magnet Latch and Solid State Timer



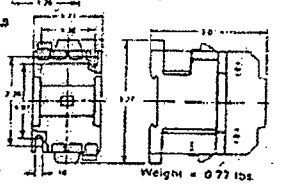
BFD Relay With Solid State Timer

BF Mounting Strip Dimensions, Inches

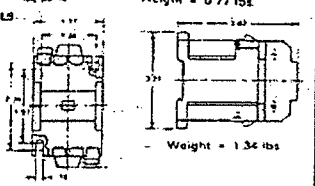




DSL9

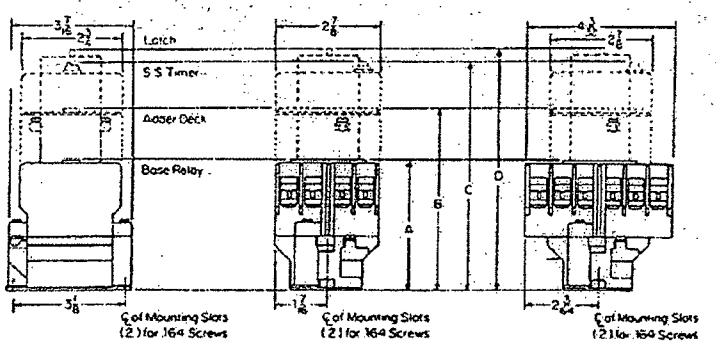


DGSL9



AR/ARD Relays and Accessories

4 and 6 Pole Relays with 4 Pole Adder, Solid State Timer and Mechanical Latch



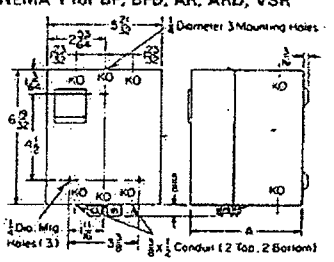
End View, 4 and 6 Poles — Side View, 4 Pole — Side View, 6 Pole

Description	Dimen.	AR	ARD
4, 6 Pole Relays	A =	3 1/16	4 3/8
Relay Adder	B =	4 15/16	6

Description	Dimen.	AR	ARD
Relay w/Timer	C =	6	7 1/16
Relay w/Latch	D =	6 29/64	7 29/64

Auxiliary Devices	Dimensions H	W	D	Weight Lbs
SF, SV	2.05	1.77	1.38	0.20
ZE, ZA	1.89	1.77	2.12	0.22

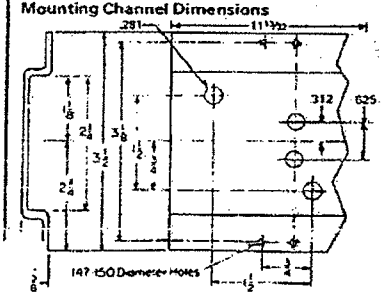
Enclosures
NEMA 1 for BF, BFD, AR, ARD, VSR



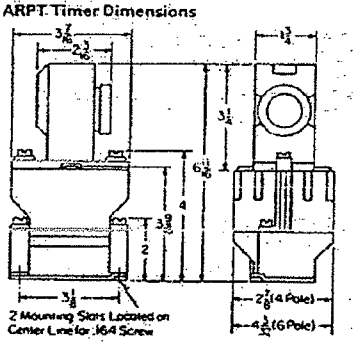
Relays w/o Attachments	Poles	Dim. "A" NEMA 1
BF, AR, ARD, VSR	All	5 11/32
BFD	4-8	5 11/32
BFD	10, 12	7 25/32

Relays w/ Attachments	Poles	Dim. "A" NEMA 1
BF, AR, ARD	All	7 25/32

Mounting Channel Dimensions



ARPT Timer Dimensions



Electrical Components Division
September 1989

ABB

ASEA BROWN BOVERI

ABB Impell Corporation

Record of Conversation

File:0017-00258.010

xx Telephone Meeting Copy: Other

To: Valerie Amerson From: Robert Fletcher 7-7-93

Company: Westinghouse Phone No: (412) 937-6148 Date: 7-7-93

Subject: ARD Relay- DC Application

Summary of Conversation:

I called Valerie to determine what the dropout voltage is for Westinghouse ARD relays for 125V DC systems. She said that the relays are at 120V nominal , require 80% (96 volts) to pick up and will drop out at 50% (60 volts) or less.

0017-258-T053

Control Relays

ITEM 110

3TH4 Fixed Contacts Type



3TH4840-0AK6 3TH4022-0BB4

Ordering Information

- Determine the number of contacts, AC or DC, then select Catalog Number.
- Complete Catalog Number by adding Coil suffix from table below.
- Replacement Parts see page 882

3TH40	2	2	0	A	KS

Relay Type
2 NO
2 NC
Terminals
AC
Coil
Voltage 120V AC

Relays With Screw Terminals for DIN Rail and Screw Mounting

AC Operation

No of Contacts	Code	Contact Type NO	Contact Type NC	Early Make NO	Late Break NC	Catalog No (Coil Suffix required from table below)	Price $
Relay With 4 Fixed Contacts							
4	40E	4	—	—	—	3TH4040-0A††	94.
	31E	3	1	—	—	3TH4031-0A††	94.
	22E	2	2	—	—	3TH4022-0A††	94.
	13E	1	3	—	—	3TH4013-0A††	94.
	04E	—	4	—	—	3TH4004-0A††	94.
	Relay With 4 Contacts, Early Make/Late Break						
	31E.U	2	1	1	1	3TH4095-0A††	90.
	22E.U	1	1	1	1	3TH4096-0A††	133.
	22E.2U	—	—	2	2	3TH4092-0A††	172.
Relay With 8 Fixed Contacts							
8	80E	8	—	—	—	3TH4280-0A††	155.
	71E	7	1	—	—	3TH4271-0A††	156.
	62E	6	2	—	—	3TH4262-0A††	156.
	53E	5	3	—	—	3TH4253-0A††	156.
	44E	4	4	—	—	3TH4244-0A††	156.
	Relay With 8 Contacts, Early Make/Late Break						
	44E.U	3	3	1	1	3TH4293-0A††	195.
Relay With 10 Fixed Contacts							
10	100E	10	—	—	—	3TH4310-0A††	187.
	91E	9	1	—	—	3TH4391-0A††	187.
	82E	8	2	—	—	3TH4382-0A††	187.
	73E	7	3	—	—	3TH4373-0A††	187.
	64E	6	4	—	—	3TH4364-0A††	187.
	55E	5	5	—	—	3TH4355-0A††	187.
	Relay With 10 Contacts With Early Make/Late Break						
	55E.U	4	4	1	1	3TH4394-0A††	222.
Mechanically Latched Relay With 9 Contacts							
9	54	5	4	—	—	3TH4454-0A††	252.

DC Operation

No of Contacts	Code	Contact Type NO	Contact Type NC	Early Make NO	Late Break NC	Catalog No (Coil Suffix required from table below)	Price $
Relay With 4 Fixed Contacts							
4	40E	4	—	—	—	3TH4040-0B††	152.
	31E	3	1	—	—	3TH4031-0B††	152.
	22E	2	2	—	—	3TH4022-0B††	152.
	13E	1	3	—	—	3TH4013-0B††	152.
	04E	—	4	—	—	3TH4004-0B††	152.
	Relay With 4 Contacts, Early Make/Late Break						
	31E.U	2	—	1	1	3TH4095-0B††	191.
	22E.U	1	1	1	1	3TH4096-0B††	191.
	22E.2U	—	—	2	2	3TH4092-0B††	232.
Relay With 8 Fixed Contacts							
8	80E	8	—	—	—	3TH4280-0B††	211.
	71E	7	1	—	—	3TH4271-0B††	211.
	62E	6	2	—	—	3TH4262-0B††	211.
	53E	5	3	—	—	3TH4253-0B††	237.
	44E	4	4	—	—	3TH4244-0B††	237.
	Relay With 8 Contacts, Early Make/Late Break						
	44E.U	3	3	1	1	3TH4293-0B††	258.
Relay With 10 Fixed Contacts							
10	100E	10	—	—	—	3TH4310-0B††	242.
	91E	9	1	—	—	3TH4391-0B††	242.
	82E	8	2	—	—	3TH4382-0B††	242.
	73E	7	3	—	—	3TH4373-0B††	242.
	64E	6	4	—	—	3TH4364-0B††	242.
	55E	5	5	—	—	3TH4355-0B††	242.
	Relay With 10 Contacts With Early Make/Late Break						
	55E.U	4	4	1	1	3TH4394-0B††	281.
Mechanically Latched Relay With 9 Contacts							
9	54	5	4	—	—	3TH4454-0B††	307.

Coil Suffix

AC Volts 50/60Hz							
Z4	T10/120	T13/208	220/277	208	220/240	380/480	500/600
C2	K6	M1	U1	M2	P6	Q0	S0

Coil Suffix

DC Volts				
L2	24	48	T25	240
A4	B4	W4	G4	G8

10

NEED PART

Logic Control

603

ITEM 116

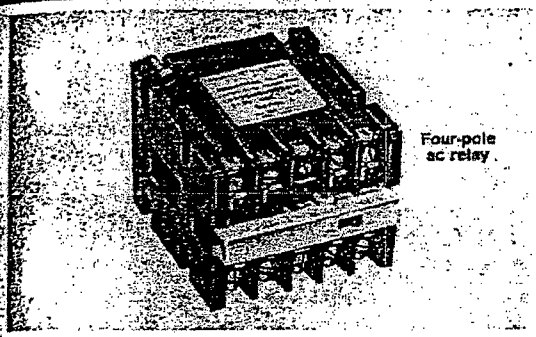
July, 1979

D-5, D-5H, D-5K

INDUSTRIAL RELAYS

300 Volts 10 Amperes Continuous 50/60 Hertz

CR120A RELAYS



Four-pole ac relay

Basic two- and four-pole relays and two- and four-pole adders, which may be combined with a four-pole relay for a maximum of twelve poles, are available. Pneumatic time-delay relays are available with two time-delay contacts (time setting of 0.2 to 60 seconds) and as many as four instantaneous contacts. Transistorized time-delay relays have two timing contacts (available in four time ranges to 180 seconds). Latched forms may be selected with two through eight poles.

All forms of the 300-volt industrial relay have compatible design—height for all forms is 2 ¼ inches. The width varies, depending on the form and number of poles desired.

APPLICATION

The multi-circuit, 300-volt industrial relays are especially suited for panel applications. They are available as relays and latched or time-delay relays.

FEATURES

- **Saves Space**—standard four-pole or four-pole relay with four-pole adder requires only 5 ⅜ square inches of panel mounting space. Standard panel enclosures can be used.
- **Saves Money**—sides of the relays act as a wiring trough to save the cost of mounting a separate trough.
- **Self-cleaning Contacts**—contacts close with a self-cleaning, scrubbing motion forcing aside contaminants which might accumulate on the contact tips and cause a failure.

PRICING INFORMATION

CR120A, CR120AD

Forms listed in table include clamp-type terminals and convertible contacts. Devices listed with four or fewer normally closed contacts may be converted to a maximum of four normally closed.

Forms listed with five through eight normally closed contacts may be converted to a minimum of five normally closed.

Number of Poles			Ac Relays	List Price,	Dc Relays	List Price,
Total	NO	NC	Catalog Number	GO-10G	Catalog Number①	GO-10G
2	2	0	CR120A020**AA	$ 48	CR120AD020**AA	$ 72
	1	1	A011**AA	56	AD011**AA	80
	0	2	A002**AA	56	AD002**AA	80
3	3	0	CR120A030**AA	56	CR120AD030**AA	80
	2	1	A021**AA	64	AD021**AA	88
	1	2	A012**AA	64	AD012**AA	88
	0	3	A003**AA	64	AD003**AA	88
4	4	0	CR120A040**AA	64	CR120AD040**AA	88
	3	1	A031**AA	72	AD031**AA	96
	2	2	A022**AA	72	AD022**AA	96
	1	3	A013**AA	72	AD013**AA	96
	0	4	A004**AA	72	AD004**AA	96
6	6	0	CR120A060**AA	80	CR120AD060**AA	104
	5	1	A051**AA	88	AD051**AA	112
	4	2	A042**AA	88	AD042**AA	112
	3	3	A033**AA	88	AD033**AA	112
	2	4	A024**AA	88	AD024**AA	112
	1	5	A015**AA	88	AD015**AA	112
	0	6	A006**AA	88	AD006**AA	112
8	8	0	CR120A080**AA	96	CR120AD080**AA	120
	7	1	A071**AA	104	AD071**AA	128
	6	2	A062**AA	104	AD062**AA	128
	5	3	A053**AA	104	AD053**AA	128
	4	4	A044**AA	104	AD044**AA	128
	3	5	A035**AA	104	AD035**AA	128
	2	6	A091**AA	104	AD091**AA	128
	1	7	A092**AA	104	AD092**AA	128
	0	8	A093**AA	104	AD093**AA	128
10	10	0	CR120A342**	112	.....	...
12	12	0	CR120A330**	128	.....	...

** Insert coil number from suffix table to complete catalog number.
① Coils on dc forms are not field replaceable.

ORDERING DIRECTIONS

Specify by complete catalog number, including coil suffix in place of **.

Example: For a six-pole relay (four NO poles and two NC poles) with clamp-type terminals, convertible contacts, and coil to operate on 230 volts, 60 hertz . . . Order: CR120A04203AA complete relay @ $88.00 or a CR120A04003AA relay @ $64.00 plus a CR120X3A adder @ $16.00 for customer mounting.

NOTE: Relays are available with quick-connect terminals and with fixed contacts. Refer to nearest GE sales office for complete information.

** COIL SUFFIX TABLE—Ac and Dc

(Use where ** appears in catalog number)

Ac—Use with ac forms only

Frequency	24V	110V	115V	120V	220V	230V
60 Hz	24	...	02	22	...	03
50 Hz	26	07	...	...	08	...

Dc—Use with dc forms only

	12V	24V	28V	48V	125V	250V
Dc	44	48	49	47	41	42

PRICING INFORMATION

Overlapping Contact Forms—Ac

(Clamp type terminals)

Contact Arrangement	Catalog Number	List Price, GO-10G
2NO-2NC②	CR120 A288**	$108
3NO-3NC②	A294**	102
3NO-1NC③	A297**	85
5NO-1NC②	A299**	162
7NO-1NC②	A284**	118

** Insert coil number from suffix table to complete catalog number.
② Total of 2NO-2NC contacts overlap.
③ Total of 1NO-1NC contacts overlap.

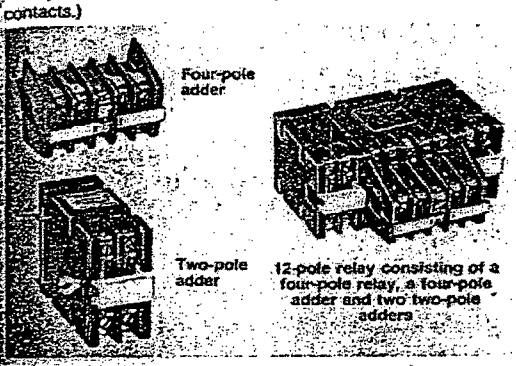
REFERENCES:
Descriptive bulletin GEA-7901
Renewal parts GEF-4247
Competitive comparison GIZ-2522

REFERENCES:
Instructions:
GEH-2466 (CR120A), GEH-2467 (CR120C)
GEH-2468 (CR122A), GEH-2525 (CR122AT)

PRICING INFORMATION—Accessories

Two-pole and Four-pole Adders

May be added to four-pole relays to form 6-, 8-, 10- or 12-pole forms (Any combination must not exceed four normally closed contacts.)



Number of Poles			Convertible Contacts	
Total	NO	NC	Clamp Type Terminals Catalog Number	List Price, GO-10G
2	2①	0①	CR120 X1A	$16.00
	1	1	X2A	16.00
	0②	2①	X3A	16.00
4	4	0	CR120 X1C	44.00
	3	1	X2C	44.00
	2	2	X3C	44.00
	1	3	X4C	44.00
	0	4	X5C	52.00

① For mounting on right-hand side—contact arrangement is reversed when mounted on left side. Example: CR120X1A becomes two NC when mounted on left. One may be mounted on each side of a four-pole relay.

Surge Suppression Kit

The surge suppression kit for the 300-volt industrial relay snaps in instantly and requires absolutely no wiring. The kit contains the RC circuit which absorbs energy surges that appear on the line.

Catalog Number	List Price, GO-10G
CR120 X57A	$11.80
CR120 X62A③	11.80
CR120 X103A (For single coil)③	11.80
CR120 X104A (For 2 coils-use for latch)③	11.80

② Use with four-pole top adder.
③ These and the CR120X57A and X62A are for 115 volts, 60 hertz coils.

Indicating Light Kits

Rating	Catalog Number	List Price, GO-10G
115 Volt	CR120 X37A	$5.60
230 Volt	CR120 X47A	5.60

For use with four-pole adder only

115 Volt	CR120 X59A	$5.60

Dummy Relays

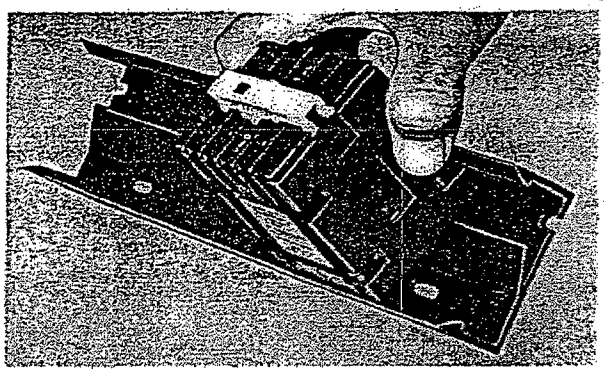
Description	Catalog Number	List Price GO-10G
2-pole body	CR120 X29A	$7.00
4-pole body	X30A	8.00

July, 1979

INDUSTRIAL RELAYS

300 Volts 10 Amperes Continuous 50/60 Hertz

D-5, D-5H, D-5K



600-VOLT FORMS

Special forms of the CR120A relay are offered for use on 600-volt applications. Refer to nearest General Electric sales office, or GE franchised distributor for complete information.

COIL DATA (All forms except transistorized timer)

Type of Data	60 Hz	50 Hz	Dc
Inrush Voltamperes	40	35	...
Sealed Voltamperes	8	7	...
Sealed Watts (Max.)	4	4	7.5

PRICING INFORMATION—Accessories

Trough Accessories

Description	Catalog Number Black	Catalog Number White	List Price GO-10G
Trough cover (6 ft long)			
1½ in. space	CR120 X15A	CR120 X18A	$10.80
2 in. space	X16A	X19A	14.00
2½ in. space	X17A	X20A	18.00
3 in. space	X41A	X42A	20.00
Retaining shield (6 ft long)			
For direct mounting forms	CR120 X14A	CR120 X24A	19.20
For mounting track forms	X52A		19.20
Bracket kit (package of 8)			
For direct mounting forms	CR120 X13A		4.00 per pkg.
For mounting track forms	X53A		4.00 per pkg.

Mounting Track

Length	Catalog Number	List Price GO-10G
3 ft.	CR120 X36A (includes 2 brkts)①	$ 7.20
6 ft.	CR120 X35A (includes 4 brkts)①	14.40

① Extra brackets furnished in kit form, package of 8.

CR120 X48A **$1.60/pkg., GO-10G**

NOTE: Mounting track maximum ambient is 60 C.

Panel Filler

Designed for use where a complete or partial row is left blank. Is 72 inches long, and may be cut to length.

CR120 X28A ..... **$48.00 each, GO-10G**

NEMA Type 1 Enclosures

Description	Catalog Number	List Price GO-10G
For 6- through 12-pole relay, 4- through 8-pole latch	CR120 X21A	$12
For timers (all forms)	CR120 X22A	12
For 2-pole relay, 4-pole relay	CR120 X23A	12

CONTACT RATINGS

10 Amperes Maximum Continuous
(All forms except transistorized timer)

Max. Ac Voltage	Max. Make Amperes	Max. Make Volt-amperes	Max. Break Amperes	Max. Break Volt-amperes	Dc Volts	1-Pole 125	1-Pole 250	2-Pole in Series 125	2-Pole in Series 250	3-Pole in Series 125	3-Pole in Series 250
300 Volts	60	7200	6	720	Amperes (NO or NC)						
					Inductive	1.0	0.3	2.5	1.0	5.0	2.0
					Non-inductive	2.0	0.5	10.0	1.0	10.0	10.0

REFERENCE:
Descriptive bulletin GEA-7901

Bob Brenenstuhl

G.E. - E.D. & C.S.
1639 Route 10 East
Parsippany, N.J. 07054

PHONE: (201)292-7251 FAX: (201)292-7256
DIAL-COMM: 8*269-7251 FAX: 8*269-7256

TO: Peter Djurdjevic, Con-Edison

DATE: December 29, 1997

RE: CR120AD Relays

Peter:

I was able to find out that the relay's coil will pick-up at 70% of the coil voltage. I am still checking to find out at what % the coil will drop-out.

Thanks,

Bob Brenenstuhl

Bob Brenenstuhl
Sales Engineer

MECHANICALLY HELD TRANSFER SWITCHES

FOR LIGHTING AND MIXED LOADS — 100 AMPERE SIZE ONLY
VERTICAL POLE ARRANGEMENTS

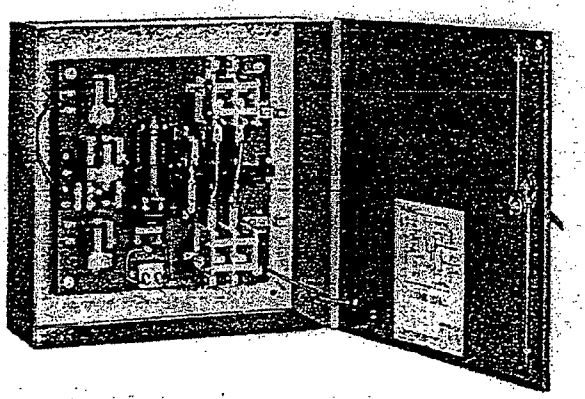


Figure 31. Bulletin 908 in NEMA 1 cabinet, with engine start contact and test button.

ELECTRICAL SPECIFICATIONS

- RATED IN AMPERES FOR NONINDUCTIVE LOAD TO 250 VOLTS MAXIMUM.
- 100 AMPERE SIZE ONLY.
- SUITABLE FOR TUNGSTEN LAMP, FLUORESCENT, AND ALL OTHER TYPES OF LIGHTING LOADS.
- NO DERATING WHEN USED ON HIGH IN-RUSH LOADS SUCH AS COLD TUNGSTEN LAMPS.
- INTERRUPTING CAPACITY 150% OF RATED CURRENT.
- SUPERVISORY RELAY PROTECTION AVAILABLE ON ALL SWITCHES.
- AVAILABLE WITH ACCESSORIES FOR ANY APPLICATION.

See Bulletin 905, Page 28, for 30-200 ampere sizes.
See Bulletin 907, Page 44, for 300 and 400 ampere sizes.

Application

Bulletin 908 Transfer Switches are fundamentally the same in physical arrangement as the Bulletin 905 Switches fully described on Page 26. They are intended to serve the same applications: the automatic transfer of resistance and all types of lighting loads.

The wide demand for these switches and the essential features which differentiate them from the Bulletin 905 types are the factors which have influenced this continued separate listing.

Construction

As illustrated in the photograph the pole arrangement of Bulletin 908 Switches is identical with that of the Bulletin 905 types. The same unique operating mechanism fully described in Engineering Data, Section B is used. The mechanical designs of bearings, shaft, drive levers and other parts, however, are based on the design of the larger sizes — 150 amperes and above. These features allow greater adaptability of these switches to unusual environmental conditions. They were "born" as the result of a requirement for transfer switches to operate under severe field conditions.

The 100 ampere rating adds a popular size to the broad range of switches listed in Bulletin 905.

Mixed Loads

Bulletin 908 Switches are used primarily for all types of noninductive loads such as resistance loads and lighting loads on alternating current service. If the switches will not be required to interrupt more than 150% of their rating they can be used on mixed loads consisting of motors, lighting and heater loads. Refer to Page 19 for further information on mixed loads.

Low Temperature Rise

The high thermal capacity built into the switch contacts, the use of silver contacting surfaces, and the absence of heat from the operating mechanism result in temperature rises so low that unventilated cabinets can be used. No derating is necessary for enclosed switches or for high inrush loads.

Enclosures

Bulletin 908 Transfer Switches are listed open type front connected and enclosed types. The list prices apply to enclosures of the NEMA 1 type. These sheet steel enclosures are for surface mounting. Standard hardware consists of a vault handle with single or 3 point catch as determined by the dimensions and the number of doors.

Enclosures for flush mounting, and hazardous locations are available along with weather resistant, dust-tight or watertight enclosures. Prices will be furnished on request.

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1959
Reissued 1965

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 161 of 219

Section 1

BULLETIN 908

MECHANICALLY HELD TRANSFER SWITCHES

FOR LIGHTING AND MIXED LOADS — 100 AMPERE SIZE ONLY
VERTICAL POLE ARRANGEMENTS

CATALOG NUMBERS** FOR 100 AMPERES, OPEN OR ENCLOSED, TO 250 VOLTS

Poles	Normal Service and Relay Protection*†	Type	A-C NORMAL WITH A-C Emergency Catalog No.	A-C NORMAL WITH D-C Emergency Catalog No.	D-C NORMAL WITH A-C Emergency Catalog No.	D-C NORMAL WITH D-C Emergency Catalog No.
2	*Form A Feeder Failure Protection	Open	90801	90811	90821	90831
		Enclosed	90802C	90812C	90822C	90832C
	†Form B Full Protection, 2-Wire, A-C or D-C, 1ø 3-Wire or 4-Wire D-C Solid Neutral	Open	90803	90813	90823	90833
		Enclosed	90804C	90814C	90824C	90834C
3	*Form C Feeder Failure Protection	Open	90805	90815	90825	90835
		Enclosed	90806C	90816C	90826C	90836C
	†Form D Full Protection, 1ø 3-Wire or 3-Wire D-C	Open	90807	90817	90827	90837
		Enclosed	90808C	90818C	90828C	90838C
	†Form E Full Protection, 3ø 3-Wire or 3ø 4-Wire Solid Neutral	Open	90809			
		Enclosed	90810C			
4	*Form F Feeder Failure Protection	Open	90839			
		Enclosed	90840C			
	†Form G Full Protection 2ø 4-Wire	Open	90841			
		Enclosed	90842C			
	†Form H Full Protection ø2 5-Wire, Solid Neutral	Open	90843			
		Enclosed	90844C			

Combinations of Polyphase A-C Normal with D-C Emergency or the reverse, usually require special pole combinations. Prices and recommendations on request. For evaluation of inductive load, refer to Page 19. See Bulletin 905, Page 28, for 30-200 ampere sizes. See Bulletin 907, Page 44, for 300 and 400 ampere sizes

WHEN ORDERING

Specify catalog number, normal and emergency source voltage and frequency, accessories by number, and type of cabinet if other than NEMA 1.

NOTES

*Feeder failure protection (listed as Forms A, C, and F) provides load transfer to emergency on complete feeder failure only, or when voltage fails completely across the lines to which the relay is connected, and returns the load to normal when normal voltage is restored to the lines across which the relay is connected. Feeder failure relay protection does not provide against partial loss of voltage or phase failure.

†Full relay protection (listed as Forms B, D, E, G and H) means that transfer to the emergency source will be effected when voltage on any phase drops to 70% or less. Retransfer to the normal will be made when all phase voltages are 90% or more. On single phase or D-C 3 wire systems, normal source voltage is supervised across the live lines.

Refer to Page 18 for discussion on relay protection. Solid neutral should not be used unless both sources are A-C or both D-C.

STANDARD DATA

Standard Voltages: 110 to 120 or 208 to 240 volts, 25, or 60 cycles; 115 or 230 volts D-C.

Standard Panels: Front connected, live back ebony asbestos.

Standard Cabinets: NEMA 1 for surface mounting, hinged doors.

Solderless lugs furnished as standard.

Enclosed ratings are continuous and the same as open type.

ADDITIONAL FEATURES

Special Voltages and Frequencies: Available on request. Consult factory for prices.

Back Connected Panels.**

Available with multiple poles, poles of different capacities, and with neutral connection. Combinations of polyphase A-C normal with D-C emergency, or the reverse, usually require special pole combinations. Prices and recommendations on request. See Page 18 for discussion.

** FOR PRICES, refer to separate Price List, Pub. 775.

DIMENSIONS AND WEIGHTS*

Poles	Form	A-C NORMAL TO A-C EMERGENCY Open Type W	H	D	Wt.	Enclosed Type W	H	D	Wt.	A-C NORMAL TO D-C EMERGENCY Open Type W	H	D	Wt.	Enclosed Type W	H	D	Wt.	D-C NORMAL TO D-C EMERGENCY Open Type W	H	D	Wt.	Enclosed Type W	H	D	Wt.
2	A	17	18	5¾	50	21	25	8	115	18	20	5¾	53	22	27	8	130	18	22	5¾	56	22	29	8	145
	B	17	18	5¾	54	21	25	8	120	18	20	5¾	56	22	27	8	135	18	22	5¾	60	22	29	8	150
3	C	19	18	5¾	56	23	25	8	130	21	20	5¾	65	25	27	8	148	21	22	5¾	70	25	29	8	168
	D	19	18	5¾	50	23	25	8	135	21	20	5¾	72	25	27	8	155	21	22	5¾	77	25	29	8	175
	E	21	18	5¾	65	25	25	8	145	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	F	21	18	5¾	73	25	25	8	140																
	G	23	18	5¾	80	27	25	8	148																
	H	23	18	5¾	82	27	25	8	150																

Full gutters allowed only on top, right and bottom 1" gutter on left side. These gutter spaces are based on nonlooping of cables within the enclosure. Where cables must be looped within the enclosure, oversize cabinets are available at extra cost. Please consult Factory for complete information.

NOTE: Catalog dimensions may change due to addition of accessories. Certified dimensions will be furnished upon request.

*W—Width; H—Height; D—Depth; Wt.—Weight. All weights are approximate shipping weights in pounds. All dimensions are in inches.

Open type panels assembled into enclosures furnished by others require the use of panel standoff bushings to provide required creepage distances to ground or to switch live parts. Standoff bushings are available at the factory. For angle iron mounting of open type, check with factory on required panel size.

ASCO Control ELECTROMAGNETIC - ELECTRONIC

ASCO

Automatic Switch Co. HANOVER ROAD, FLORHAM PARK, NEW JERSEY 07932 Telephone: Area Code 201 • 377-4600

Printed in U.S.A. 1959 Reissued 1965

MECHANICALLY HELD TRANSFER SWITCHES

FOR LIGHTING AND MIXED LOADS — 100 AMPERE SIZE ONLY
VERTICAL POLE ARRANGEMENTS

ACCESSORY FEATURES

Please order all accessories by suffix number.

FOR PRICES, refer to separate Price List, Publication 775.

SUFFIX	FEATURE
1A.	Time Delay (Nonadjustable)—1 Second Maximum.
B.	Time Delay (Nonadjustable)—3 Seconds Maximum.
C.	Time Delay (Nonadjustable)—6 Seconds Maximum.
	An Automatic Transfer Switch with this feature will ignore harmless momentary power dips and outages, but transfer the load to the emergency source if an outage is sustained.
2A.	Adjustable Time Delay on retransfer to normal (air diaphragm type - 2 minutes max.).
B.	Adjustable Time Delay on transfer to emergency (air diaphragm type - 2 minutes max.).
C.	Adjustable Time Delay on engine starting (air diaphragm type - 2 minutes max.).
3A.	Adjustable Time Delay on retransfer to normal (motor driven type - 0 to 30 minutes adjustable in 1 minute increments).
B.	Adjustable Time Delay on transfer to emergency (motor driven type - 0 to 30 minutes adjustable in 1 minute increments).
C.	Adjustable Time Delay on retransfer to normal with 5 minute unloaded running time of standby-plant (motor driven type - minimum setting for retransfer is 2 minutes, maximum is 25 minutes, unloaded running time is fixed at 5 minutes).
	NOTES: *Accessories 2A, 2B, & 3A, 3B are used for delayed retransfer to normal and delayed transfer to emergency to allow voltage stabilization before the selected source assumes load.*
	When delayed engine starting and delayed transfer to emergency are required, Accessory 1 or Accessory 2C must be used with Accessory 2B or 3B.
	Means for instantaneous retransfer to normal in event of emergency source failure are always furnished with Accessories 2A, 3A, and 3C.
4.	Close Differential Relay protection on normal. Add following extras to listed full protection forms:
A.	1 Phase, 2 or 3 wire, Forms B and D.
B.	3 Phase, 3 or 4 wire, Form E.
C.	2 Phase, 4 wire, Form G.
D.	2 Phase, 5 wire, Form H.
	Relays are factory set for 95% pickup, 90% dropout, unless otherwise specified. Relays are adjustable in the field for dropout.
5.	Test Switch, to be mounted on cabinet or switch panel as specified.
	Provides for test operation of emergency plant and transfer switch.
6A.	Push Button Reset to normal including mounted push button (also includes auxiliary contact).
	Used when automatic retransfer to normal not required.
B.	Push Button to by-pass Accessories 2A, 3A, or 3C.
	Provides manual means for retransfer to normal without waiting for completion of time delay period.
7.	Auxiliary Contact to close when normal fails (pilot contact to initiate starting controls on engine).
	When this contact is furnished, voltage frequency relay on transfer to emergency is also included. Engine Starting Contacts initiate cranking of stand-by automatic engine generator sets. Voltage frequency sensitive relay prevents transfer until electric plant voltage and frequency are normal.
8.	Auxiliary Contact to open when normal fails (pilot contact to initiate starting controls on engine).
	When this contact is furnished, voltage frequency relay on transfer to emergency is also included. Engine Starting Contacts initiate cranking of stand-by automatic engine generator sets. Voltage frequency sensitive relay prevents transfer until electric plant voltage and frequency are normal.
9A.	Mounted Pilot Light for indicating switch in normal position (includes fuses and auxiliary contact).
B.	Mounted Pilot Light for indicating switch in emergency position (includes fuses and auxiliary contact).
10A.	Battery Charger for 12 volt battery.
B.	Battery Charger for 24 volt battery.
C.	Battery Charger for 32 volt battery.
	An ASCO Battery Charger operating from the normal supply keeps starting batteries fully charged, ready for starting the engine. Charger can be placed on the Transfer Switch panel, making a neat "one package" arrangement. Charging Rate: 0.05 to 2.0 Amperes.
11A.	Exerciser for exercising plant only. Exercises for 15 minutes every 168 hours.
B.	Exerciser connected to function like Accessory 5. Exercises for 15 minutes every 168 hours.
12.	Four Position Selector Switch.
	Permits selection of one of four operating positions marked "Hand Crank," "Stop," "Automatic," "Engine Test." Hand Crank position disables automatic starting circuit to permit manual starting at engine. Accessories 5 and 16 combined with the engine test switch generally supplied on the generator set are preferred to Accessory 12.
14A.	Auxiliary contact on main shaft (closed on normal).
B.	Auxiliary contact on main shaft (closed on emergency).
15.	Automatic Engine Starting Controls—Bulletin 1025-134 in separate enclosure. See Bulletin 1025-134.
16.	Disconnect Switch in series with Accessory 7.
17.	Automatic Transfer Switch arranged for use with Area Protection System. (See Publication 682 for descriptive information).

NOTE: Catalog dimensions may change due to addition of accessories. Certified dimensions will be furnished upon request. Refer to Page 25 for a discussion of accessories.

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ASCO Control
ELECTROMAGNETIC • ELECTRONIC
ASCO
Automatic Switch Co. HANOVER ROAD, FLORHAM PARK, NEW JERSEY 07932
Telephone: Area Code 201 • 377-4300

Section 1

BULLETIN 908

MECHANICALLY HELD TRANSFER SWITCHES

FOR LIGHTING AND MIXED LOADS — 100 AMPERE SIZE ONLY

VERTICAL POLE ARRANGEMENTS

Electrical Connections

Bulletin 908 Switches, like all ASCO Transfer Switches, are factory wired, adjusted and tested. Installation requires merely the connection of normal, emergency and load conductors and the connection of small conductors to the remotely located indication light, if used.

Internal switch wiring is identical with Bulletin 905 Switches (refer to Page 31). Solderless lugs are furnished on all sizes.

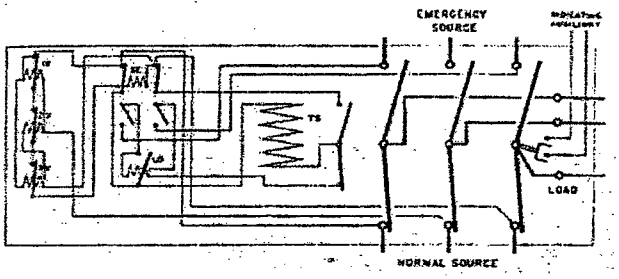


Figure 32. Circuits shown with normal source energized.

ASCO TRANSFER SWITCHES FOR ANY APPLICATION

The standard listing of ASCO Bulletin 908 Transfer Switches together with the accessories will satisfy any commercial or industrial requirement. ASCO Transfer Switches are available for the following special service applications:

High Shock — High Short Circuit Capacity

Switches are available in sizes from 50 to 600 amperes to 240 volts D-C, 450 volts A-C for marine service. Switches can be furnished open or with drip proof or water tight enclosures.

Marine Duty

Sizes from 30 to 2000 amperes A-C and D-C with all required features conform to AIEE #45 Marine Rules, USCG and American Bureau Shipping Regulations.

RETMA Standards

ASCO Automatic Transfer Switches conform to RETMA standards for microwave communications.

ASCO Transfer Switches are also available with complete starting controls for electric plants. Starting controls can be specified as single crank arrangements or for repeated cranking.

Alternating type transfer switches can be supplied. These are especially suitable for installations utilizing three electric plants as the sole sources of supply. Each plant is automatically started and operated for a definite time as the source of supply. The idle plants act as standby to the running plant. Starting of the plants, automatic transfer and automatic alternating of the plants are controlled entirely by ASCO Starting Panels and ASCO Automatic Transfer Switches. The broad range of ASCO Electromagnetic Control, from ASCO Solenoid Valves, ASCO Battery Chargers and ASCO Solenoids to ASCO Transfer Switches and accessories are utilized for these installations.

Please refer to Pages 17 and 18 for description of other useful arrangements of ASCO Transfer Switches.

SUGGESTED SPECIFICATION FOR BULLETIN 908 MECHANICALLY HELD TRANSFER SWITCHES

1. An Automatic Transfer Switch shall be provided . . . poles for a normal source of . . . volts . . . phase . . . cycles and an emergency source of . . . volts . . . phase . . . cycles to transfer the load circuits to the emergency source when any phase of the normal drops below 70%, and to automatically retransfer the load circuits to the normal source when all phases are 90% or more. An auxiliary contact shall close an indicating circuit when the load circuits are connected to the emergency source.
2. The transfer switch shall have adequate capacity for total load of . . . amperes, consisting of approximately . . . % tungsten lamp load and . . . % motor and other loads.
3. The transfer switch shall be a double throw switch operated by a single coil mechanism momentarily energized. The switch shall be inherently interlocked mechanically and electrically. Operating current for transfer shall be obtained from the same source to which the load is to be transferred. Failure of any coil or disarrangement of any part shall not permit a neutral position. The switch shall be positively locked mechanically on either source without the use of hooks, latches, semi-permanent magnets or springs. Main contacts shall be silver to silver, brazed to copper. All poles shall be protected by arc barriers and arc chutes.
4. Switches and accessory devices shall be the approved equal of ASCO Bulletin 908, 100 Ampere rating, open or enclosed.

ASCO Control ELECTROMAGNETIC • ELECTRONIC
ASCO
Automatic Switch Co. HANOVER ROAD, FLORHAM PARK, NEW JERSEY 07932
Telephone: Area Code 201 • 377-4500
Printed in U.S.A. 1959 Reissued 1965

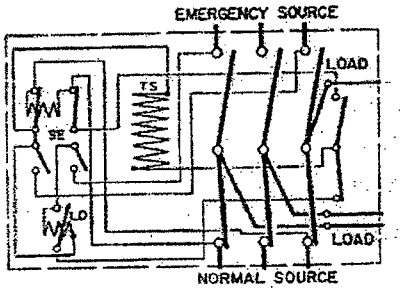


Figure 13. Form C Feeder Failure Protection . . . transfers on complete feeder failure.

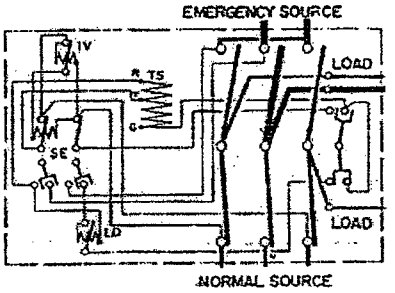


Figure 14. Single phase 3 wire normal to 2 wire D-C emergency, with Form D relay protection. Transfer occurs when voltage across live normal lines drops to 70%. One pole and common load wire must have double capacity.

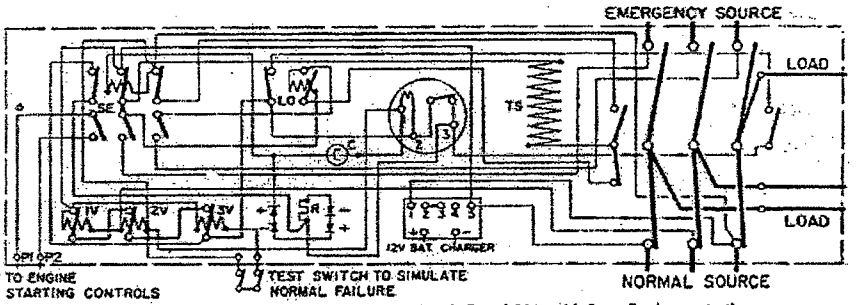


Figure 15. 3 phase 3 wire with accessories 1, 3A, 5, 7 and 10A, with Form E relay protection for use with automatically started stand-by plants.

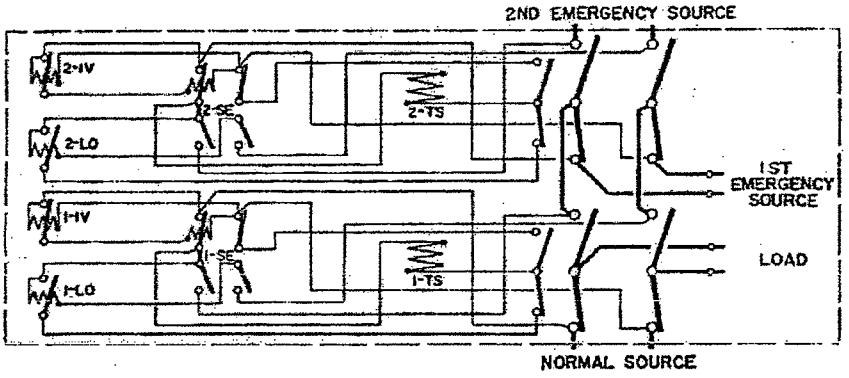


Figure 16. 3 source arrangement with Form B relay protection.

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Calculation FEX-00204-00
Rev. 0
Attachment S
Page 165 of 219

Type AKR Breakers

Accessories

Shunt Trip

Offers remote electrical tripping of breaker. Usually controlled by a switch or pushbutton. It may also be used in conjunction with protective relays for automatic tripping.

The shunt trip coil is rated for intermittent duty. When factory installed it is supplied with a cutoff switch which automatically removes control power following a breaker trip.

Selective Trip (Type EC-1)

Applied to circuit breakers in series so that only the breaker nearest the overcurrent fault opens. Allows for added system coordination.

Undervoltage Trip (UV)

Protects against harmful drops in line voltage by automatically tripping the breaker. This device is set to pickup at approximately 85% of bus voltage and drop out between 30% and 60%.

The UV device is also available with an optional static time-delay unit. This offers a field adjustable 2 to 6 second delay between under-voltage fault and breaker trip to prevent potential nuisance tripping due to momentary loss of voltage.

The time-delay unit is mounted external to the breaker. It is rated 125 or 250 V. DC or 208/240 VAC, 50 or 60 Hz. For any other AC source voltage, a control power transformer with a 240 volt secondary rated at least 100 VA is required.

Key Interlock Provision

Prevents operation of a remote function unless the breaker has been tripped. Provision is made to accept a lock assembly furnished by purchaser (GEE or Kirk).

Auxiliary Switch

Used for remote indication of breaker main contact position. Available in groupings of four contacts (two stages) or ten contacts (five stages). Each stage is composed of one "a" Type (N.O.) contact and one "b" Type (N.C.) contact. All contacts feature rugged double break construction.

Reverse Current Device

Used with D-c breakers. Designed to trip the breaker if current reverses direction.

Neutral Connector

For use in general-purpose enclosures, provides termination for system neutral.

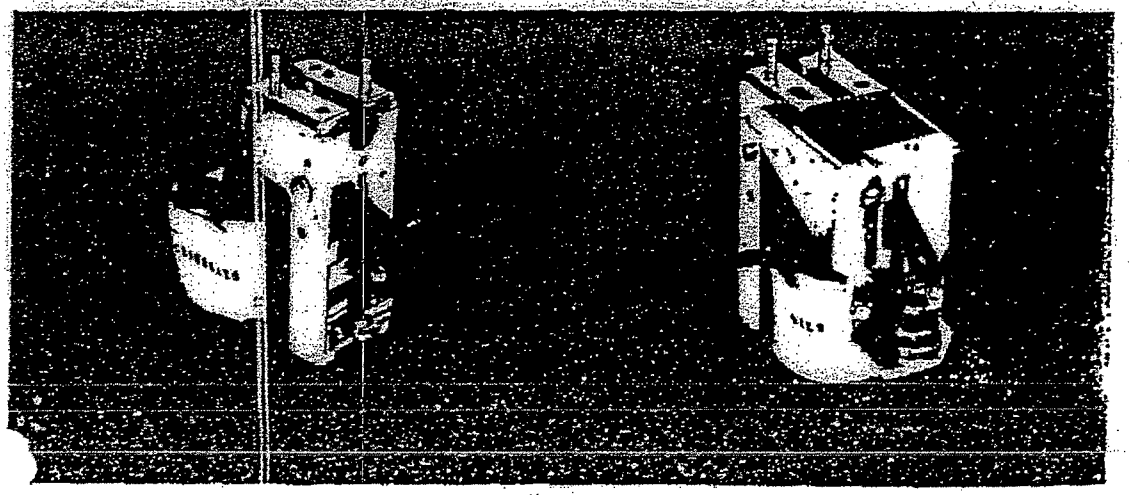
CONTROL VOLTAGE			Shunt Trip Amperes	
Nominal		Operating Range	Inrush	Sustained
Dc	48	28-56	4.5	4.5
	125	70-140	1.8	1.8
	250	140-280	1.0	1.0
60 Hz. Ac	120	104-127	12.3	10.8
	208	175-225	3.2	2.6
	240	208-254	3.9	3.4
	480	416-508	6.4	3.1
	575	475-625	2.8	2.5

Control Voltage		UV Coil Amperes Inrush	UV Coil Amperes Sustained
Dc	48	0.20	0.20
	125	0.07	0.07
	250	0.04	0.04
60 Hz. Ac	120	0.66	0.24
	208	0.51	0.17
	240	0.37	0.12
	480	0.23	0.08
50 Hz. Ac	120	0.75	0.25
	208	0.30	0.10
	240	0.34	0.11
	480	0.20	0.07

Breaker Main Contacts	Auxiliary Switch Position "a" Contact	Auxiliary Switch Position "b" Contact
Open or Tripped	Open	Closed
Closed	Closed	Open

Control Voltage		Auxiliary Switch Interrupting Ratings (Amperes) Non-Inductive	Auxiliary Switch Interrupting Ratings (Amperes) Inductive
Dc	125	11 ①	6.3 ①
	250	2	1.8 ①
Ac	115	75 ①	50 ①
	240	50 ①	25 ①
	480	25 ①	12 ①

① Limited to 20A continuous rating of switch on all breakers and to 5A continuous rating of #16 wire on drawout breakers



Operations Counter

A 5-digit, non-resettable counter actuated by the breaker cam shaft. Mounts on breaker.

Bell Alarm With Lockout

The bell alarm operates one "a" and one "b" contact; or, two "a's" or two "b's". It is activated when the breaker is tripped by any means (automatic) other than the manual trip button or the shunt trip device.

The contacts may be used for remote indication of an automatic trip.

The lockout feature is available to mechanically lock the breaker "open" when the device is activated. "Reset" is accomplished through operation of the manual trip button or shunt trip device.

The bell alarm is available without the lockout feature when so specified.

Electric Lockout

The electric lockout device provides a means of electrically interlocking breakers so that two cannot be closed at the same time. This electromechanical device consists of a coil whose winding must be energized to close the breaker. Once the breaker is closed, loss of voltage will not trip the breaker. A bypass interlock is provided for initial startup. Refer to the UV device for ratings and coil characteristics.

Auxiliary switches for cross-interlocking breakers must be ordered separately.

Remote Close Solenoid for Manually-Operated AKR-30, 50, AKRT-50 Breakers

Provides a means to electrically close the above breakers from a remote location. May be controlled by a switch or pushbutton for five-cycle closing. Breaker must be charged locally. Available ratings:

Closing Mechanism Operating Amperes

Breaker Frame	120 Volt, 60 Hz (Operating Range 104-127 VAC)			240 Volt, 60 Hz (Operating Range 208-254 VAC)			125 Volt, Dc (Operating Range 100-140 VDC)			250 Volt, Dc (Operating Range 200-280 VDC)		
	Inrush	Sustained	Recommended Fuse Size	Inrush	Sustained	Recommended Fuse Size	Inrush	Sustained	Recommended Fuse Size	Inrush	Sustained	Recommended Fuse Size
KR-30 KR-50 AKRT-50	25	5	6	12	3	6	27	5	6	13	3	6
AKR-75 AKP-100	25	8.1	10	12	3.5	10	27	7	10	13	3.2	10
AK-25	153	78	30	38	28	15	44	44	10	24	24	6
AK-50 AKT-50 AK-75	9	4	6	4	2.8	6	30	4	6	15	2	8
AK-100	9	4	10	4	3.2	10	30	5	10	15	2.5	10

Control Voltage		Bell Alarm Contact Ratings (amperes)	
		Inrush	Continuous
Dc	125	2.5	2.5
	250	0.9	0.9
60 Hz Ac	120	30	10
	240	15	5
	480	7	3



Bell Alarm Device with Lockout

Table 32.1
Charging and Closing Operating Currents

Nominal Control Voltage	Freq. Hz	Voltage Range	Min. (Volts) Pick-up	Anti-pump Relay "E" Rated Amps		Min. (Volts) Pick-up	Control Relay "K" Rated Amps		Min. (Volts) Pick-up	Closing Solenoid Rated Amps		Fuse Selection
				Inrush Open	Sealed Closed		Inrush Open	Sealed Closed		Inrush Open	Sealed Closed	
48V	DC	38-56	38	.063	.063	30	4.1	4.1	38	95	95	20A
125V	DC	100-140	85	.024	.024	90	1.05	1.05	100	43.6	43.6	10A
250V	DC	200-280	170	.015	.015	180	.53	.53	200	23.9	23.9	6A
120V	60	104-127	95	.090	.052	95	1.0	.14	98	153	78.4	30A
120V	50			.090	.052		1.0	.15		142	63.4	30A
120V	25			.047	.032		6.85	1.27		70.6	45.5	15A
208V	60	180-220	175	.050	.029	175	.45	.063	177	90.8	37.4	15A
208V	50			.050	.029		.55	.083		103	46.9	15A
208V	25			.032	.018		3.88	.76		45.3	27.3	10A
240V	60	208-254	190	.064	.036	190	.50	.07	196	67.5	27.6	15A
240V	50			.064	.036		.50	.08		74.8	30.3	15A
240V	25			.035	.023		3.42	.64		43.1	23.5	6A

Table 32.2
Shunt Trip and Undervoltage Device Operating Currents

Nominal Control Voltage	Frequency Hz	Shunt Trip Operating Voltage Range		Shunt Trip Current (Amps) Inrush Open	Shunt Trip Current (Amps) Sealed Closed	Undervoltage Operating Voltage Range	Undervoltage Current (Amps) Inrush Open	Undervoltage Current (Amps) Sealed Closed
24	DC	14	30	8.3	8.3	Pickup at 85% of Nominal Control Voltage, Dropout at 30-60% of Nominal Control Voltage	.38	.38
48	DC	28	60	4.5	4.5		.19	.19
125	DC	70	140	2.0	2.0		.08	.08
250	DC	140	280	1.0	1.0		.04	.04
70	50	59	132	—	—		N/A	N/A
120	60	95	127	12.3	10.8		.65	.24
120	50	95	127	7.6	6.7		.75	.25
208	60	175	220	3.2	2.6		.51	.17
208	50	175	220	3.8	3.1		.30	.10
240	60	190	254	3.9	3.4		.37	.12
240	50	190	254	4.7	4.1		.34	.11
240	40	190	254	5.8	5.1		N/A	N/A
380	50	315	410	2.9	2.6		.22	.08
480	60	380	508	3.4	3.1		.23	.08
480	50	380	508	7.5	7.3		.17	.06
575	60	475	625	2.8	2.5		.16	.06
575	50	475	625	5.1	4.7		.14	.06

Table 33.1
Coil Resistance — DC Ohms @ 25°C

Nominal Control Voltage	Frequency Hz	Anti-Pump Relay "E"	Control Relay "K"	Shunt Trip	Undervoltage	Closing Solenoid
24V	DC	N/A	N/A	3	64	N/A
48V	DC	802	12	11	240	.49
125V	DC	5000	119	64	1600	2.76
250V	DC	18400	476	260	6700	10.50
120V	60	450	54	3.9	25.4	.248
120V	50	450	75	7.15	33	.316
208V	60	1450	216	25.4	64	.825
208V	50	1450	300	25.4	146	.825
240V	60	1450	300	25.4	100	.930
240V	50	1450	300	25.4	146	1.27
380V	50	N/A	N/A	64	370	3.17
480V	60	N/A	N/A	64	370	4.10
480V	50	N/A	N/A	32	580	5.10
575V	60	N/A	N/A	100	580	5.85
575V	50	N/A	N/A	64	918	8.00

Electrical Characteristics
AKR-30 / 50 / T50

Table 34.1
Charging and Closing Operating Currents

Nominal Control Voltage	Freq. Hz	Voltage Range	Motor Current (Amps)		Anti-pump Relay "W"			Control Relay "X"			Closing Solenoid			Fuse Selection	Charging Time (Sec.)
			Inrush	Sustained	Min. (Volts) Pick-up	Rated Amps Inrush Open	Rated Amps Sealed Closed	Min. (Volts) Pick-up	Rated Amps Inrush Open	Rated Amps Sealed Closed	Min. (Volts) Pick-up	Rated Amps Inrush Open	Rated Amps Sealed Closed		
48V	DC	38-56	40	10	38	.063	.063	30	4.1	4.1	38	3.58	3.58	15A	1.5
125V	DC	100-140	27	5	85	.024	.024	90	1.05	1.05	100	1.75	1.75	6A	1.0
250V	DC	200-280	13	3	170	.015	.015	180	.53	.53	200	.88	.88	6A	1.0
120V	60	104-127	25	5	95	.090	.052	95	1.0	.14	98	2.6	.35	6A	0.9
120V	50					.090	.052		1.0	.15		2.2	.29	6A	0.9
120V	25					.047	.032		6.85	1.27		1.1	.17	6A	0.9
208V	60	180-220	15	3.5	175	.050	.029	175	.45	.063	177	1.5	.19	6A	0.9
208V	50					.050	.029		.55	.083		1.2	.16	6A	0.9
208V	25					.032	.018		3.86	.76		.60	.08	6A	0.9
250V	60	208-254	12	3	190	.064	.036	190	.50	.07	196	1.3	.17	6A	0.9
250V	50					.064	.036		.50	.08		1.1	.15	6A	0.9
250V	25					.035	.023		3.42	.54		.54	.08	6A	0.9

Table 34.2
Shunt Trip and Undervoltage Device Operating Currents

Nominal Control Voltage	Frequency Hz	Shunt Trip				Undervoltage		
		Operating Voltage Range		Current (Amps) Inrush Open	Current (Amps) Sealed Closed	Operating Voltage Range	Current (Amps) Inrush Open	Current (Amps) Sealed Closed
24	DC	14	30	8.3	8.3	Pickup at 80% of Nominal Control Voltage Drop out at 30-60% of Nominal Control Voltage	.38	.38
48	DC	28	60	4.5	4.5		.19	.19
125	DC	70	140	2.0	2.0		.08	.08
250	DC	140	280	1.0	1.0		.04	.04
70	60	59	132	—	—		N/A	N/A
120	60	95	127	12.3	10.8		.66	.24
120	50	95	127	7.6	6.7		.75	.25
120	25	95	127	4.7	4.1		.31	.10
208	60	175	220	3.2	2.6		.51	.17
208	50	175	220	3.8	3.1		.30	.10
208	25	175	220	2.1	1.9		.14	.05
240	60	190	254	3.9	3.4		.37	.12
240	50	190	254	4.7	4.1		.34	.11
240	40	190	254	5.8	5.1		N/A	N/A
240	25	190	254	2.1	1.9		.16	.06
380	50	315	410	2.9	2.6		.22	.08
480	60	380	508	3.4	3.1		.23	.08
480	50	380	508	7.5	7.3		.17	.06
480	25	380	508	3.5	3.3		.11	.05
575	60	475	625	2.8	2.5		.16	.06
575	50	475	625	5.1	4.7		.14	.06
575	25	475	625	3.1	3.0		.10	.05

Table 35.1
Coil Resistance — DC Ohms @ 25°C

Nominal Control Voltage	Frequency Hz	Anti-Pump Relay "W"	Control Relay "X"	Shunt Trip	Undervoltage
24V	DC	N/A	N/A	3	64
48V	DC	802	12	11	240
125V	DC	5000	119	64	1600
250V	DC	16400	476	260	6700
120V	60	450	54	3.9	25.4
120V	50	450	75	7.15	33
120V	25	1450	75	25.4	146
208V	60	1450	216	25.4	64
208V	50	1450	300	25.4	146
208V	25	3900	300	64	580
240V	60	1450	300	25.4	100
240V	50	1450	300	25.4	146
240V	25	6000	300	64	580
380V	50	N/A	N/A	64	370
480V	60	N/A	N/A	64	370
480V	50	N/A	N/A	32	580
480V	25	N/A	N/A	100	1600
575V	60	N/A	N/A	100	580
575V	50	N/A	N/A	64	918
575V	25	N/A	N/A	146	3200

Table 35.2
Remote Close Solenoid Ratings

Control Voltage		Amperes	
		Inrush	Sustained
Dc	48	2.7	0.58
	125	1.3	0.32
	250	0.68	0.15
60 Hz Ac	120	2	0.4
	240	1	0.2

Electrical Characteristics
AKR-75 / 100

Table 36.1
Charging and Closing Operating Currents

Nominal Control Voltage	Freq. Hz	Voltage Range	Motor Current (Amps)		Anti-Pump Relay "W"			Control Relay "X"			Closing Solenoid			Fuse Selection	Charging Time (Sec.)
			Inrush	Sustained	Min. (Volts) Pick-up	Rated Amps Inrush Open	Rated Amps Sealed Closed	Min. (Volts) Pick-up	Rated Amps Inrush Open	Rated Amps Sealed Closed	Min. (Volts) Pick-up	Rated Amps Inrush Open	Rated Amps Sealed Closed		
48V	DC	38–56	22	16.5	38	.063	.063	30	4.1	4.1	38	2.7	2.7	20A	2.0
125V	DC	100–140	25	7	85	.024	.024	90	1.05	1.05	100	1.3	1.3	20A	1.7
250V	DC	200–280	13	3.2	170	.015	.015	180	.53	.53	200	.68	.68	20A	1.7
120V	60	104–127	25	8.1	95	.090	.052	95	1.0	1.4	98	2.6	.35	20A	1.5
120V	50					.090	.052		1.0	.15		2.2	.29	20A	1.5
120V	25					.047	.032		6.65	1.27		1.1	.17	20A	1.5
208V	60	180–220	10.3	3.5	175	.050	.029	175	.45	.063	177	1.5	.19	20A	1.7
208V	50					.050	.029		.55	.063		1.2	.16	20A	1.7
208V	25					.032	.018		3.85	.76		.60	.08	20A	1.7
250V	60	208–254	11.7	3.5	190	.064	.036	190	.50	.07	196	1.3	.17	20A	1.3
250V	50					.064	.036		.50	.06		1.1	.15	20A	1.3
250V	25					.035	.023		3.42	.64		.54	.08	20A	1.3

Table 36.2
Shunt Trip and Undervoltage Device Operating Currents

Nominal Control Voltage	Frequency Hz	Shunt Trip				Undervoltage		
		Operating Voltage Range		Current (Amps)		Operating Voltage Range	Current (Amps)	
				Inrush Open	Sealed Closed		Inrush Open	Sealed Closed
24	DC	14	30	8.3	8.3	Pickup at 80% of Nominal Control Voltage Drop out at 30-60% of Nominal Control Voltage	.38	.38
48	DC	28	60	4.5	4.5		.19	.19
125	DC	70	140	2.0	2.0		.08	.08
250	DC	140	280	1.0	1.0		.04	.04
70	60	59	132	—	—		N/A	N/A
120	60	95	127	12.3	10.8		.66	.24
120	50	95	127	7.6	6.7		.75	.25
120	25	95	127	4.7	4.1		.31	.10
208	60	175	220	3.2	2.6		.51	.17
208	50	175	220	3.8	3.1		.30	.10
208	25	175	220	2.1	1.9		.14	.05
240	60	190	254	3.9	3.4		.37	.12
240	50	190	254	4.7	4.1		.34	.11
240	40	190	254	5.8	5.1		N/A	N/A
240	25	190	254	2.1	1.9		.16	.06
380	50	315	410	2.9	2.6		.22	.08
480	60	380	508	3.4	3.1		.23	.08
480	50	380	508	7.5	7.3		.17	.06
480	25	380	508	3.5	3.3		.11	.05
575	60	475	625	2.8	2.5		.16	.06
575	50	475	625	5.1	4.7		.14	.06
575	25	475	625	3.1	3.0		.10	.05

Table 37.1
Coil Resistance — DC Ohms @ 25°C

Nominal Control Voltage	Frequency Hz	Anti-Pump Relay "W"	Control Relay "X"	Shunt Trip	Undervoltage
24V	DC	N/A	N/A	3	64
48V	DC	802	12	11	240
125V	DC	5000	119	64	1600
250V	DC	16400	476	260	6700
120V	60	450	54	3.9	25.4
120V	50	450	75	7.15	33
120V	25	1450	75	25.4	146
208V	60	1450	216	25.4	64
208V	50	1450	300	25.4	146
208V	25	3900	300	64	580
240V	60	1450	300	25.4	100
240V	50	1450	300	25.4	146
240V	25	6000	300	64	580
380V	50	N/A	N/A	64	370
480V	60	N/A	N/A	64	370
480V	50	N/A	N/A	92	580
480V	25	N/A	N/A	100	1600
575V	60	N/A	N/A	100	580
575V	50	N/A	N/A	64	918
575V	25	N/A	N/A	146	3200

Table 37.2 Electrical Characteristics —
AKR-30S / 30, 50, 75, 100

Bell Alarm Contact Ratings			
Control Voltage		Rating (Amperes)	
		Inrush	Continuous
dc	125	2.5	2.5
	250	0.9	0.9
60 Hz ac	120	30	10
	240	15	5
	480	7	3
Auxiliary Switch Control Ratings ①			
Control Voltage		Rating (Amperes)	
		Non-Inductive	Inductive
dc	48	25	—
	125	11	6.3
	250	2	1.8
60 Hz ac	115	75	50
	240	50	25
	480	25	12
Auxiliary Switch Contact Sequence			
CB Main Contacts		"A" Contact	"B" Contact
Open or Tripped		Open	Closed
Closed		Closed	Open

① Limited to 20A continuous ratings of switch on all breakers and to 15A continuous rating of #16 wire on draw out breakers.

ITEM 153, 154 + 155

IB 7.5.1.7-4
Issue 8

INSTRUCTIONS

DC Control Circuit Monitoring Relays

CIRCUIT SHIELD ®

TYPE 27S DC UNDERVOLTAGE RELAY

TYPE 27B BATTERY GROUND DETECTOR RELAY

TYPE 74 TRIP CIRCUIT SUPERVISION RELAY



Type 27S

ASEA BROWN BOVERI

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INTRODUCTION

These instructions contain the information required to properly install, operate, and test the ABB Circuit-Shield™ Type 27S DC Undervoltage Relay, the Type 27B Battery Ground Detector Relay, and the Type 74 Trip Circuit Supervision Relay.

Each relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at terminals on the rear of the case that are clearly numbered.

Relays of the 439 catalog series are similar to relays of the 239 series. Both series provide the same basic functions and are of totally drawout construction; however, the 439 series relays provide integral test facilities.

Settings are made on the front panel of the relay, behind a removable clear plastic cover. The target indicator is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing. Wiring for the 439 series units is different than for the 239 series.

2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.

3. High voltage insulation tests are not recommended. See the section on testing for additional information.

4. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

5. Follow test instructions to verify that the relay is in proper working order.

CAUTION: *since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competant technicians familiar with good safety practices should service these devices.*

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:
The outline dimensions and panel drilling and cutout information is given in Fig. 1.

Connections:

Internal connections for each relay are shown in Figure 2. 439 series units are preferred for new applications due to the improved test features of the relays.

Connections for a typical dc control bus monitoring scheme using the Types 27B and 27S (439 series units) are shown in Figure 3.

Connections for typical trip circuit supervising schemes using the Type 74 are shown in Figures 4a and 4b.

DC must be connected in the proper polarity as shown in the diagrams.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

3. SETTINGS

Type 74 Trip Circuit Supervision Relay:

No settings are required for this relay.

Type 27B Battery Ground Relay:

The 27B relay is provided with a continuously adjustable dial for selecting the sensitivity of the detection of grounds. The dial is labelled SENSITIVITY. In the MAX position (fully clockwise) the relay has its highest sensitivity to grounds on the dc bus. The MIN position (fully CCW) provides the least sensitivity. See Fig. 5 for the characteristic. In general the MAX position should be used; however, if nuisance alarms are experienced, the sensitivity can be backed off as needed for the particular system.

Type 27S DC Undervoltage Relay:

The DROPOUT dial is used to select the dc voltage level at which the relay will operate. The dial is continuously adjustable over the range of approximately 0.7 to 1.15 times the rated voltage. An internal adjustment (see acceptance testing) allows setting the differential between the operate and reset voltages, and has a range of approximately 0.5-4 percent of the setting.

An uncalibrated TIME DELAY adjustment is provided. This screwdriver adjustment has a range of approximately 0.1 to 2 seconds. This delay on dropout is provided to allow the relay to ignore any momentary drop in voltage level.

4. INDICATORS

Indicators are provided to assist in testing and to give operating personnel information on the status of the relay:

Type 74 Trip Circuit Supervision Relay:

Three light emitting diodes and a target are provided. When trip circuit conditions are normal, one of the yellow led's and the green led will be lit. The target can be reset by depressing the TARGET RESET button. The yellow led labelled "A" will be on when the circuit breaker is closed. The yellow led labelled "B" will be on when the circuit breaker is open. Should a problem occur with the trip coil circuit, or with the dc supply, the led's will go off, and the target will be set simultaneously with the operation of the relay's output contacts. The target can not be reset until normal system conditions are restored.

Type 27B Battery Ground Relay:

Two red led's are provided. The led labelled Ground-on-Positive will light when there is a ground on the positive dc bus which is sufficient to cause the 27B relay to operate. The led indication is simultaneous with the transfer of the output contacts (terminals 10-11-12 on 439 series units). For grounds on the negative bus the led labelled Ground-on-Negative will light, and the other set of output contacts will transfer (terminals 13-14-15 on 439 series units). Upon removal of the ground condition the relay contacts will be self-resetting and the led will go out.

INDICATORS (cont.)

Type 27S DC Undervoltage Relay:

One led and a target are provided. The green led will be on when a dc voltage above the reset voltage is applied to the relay. The target can be reset by pushing the TARGET RESET pushbutton. Should the dc voltage level fall below the dropout setting of the relay, the led will go off. If the voltage does not return above the reset setting by the end of the time delay period, the output contacts will transfer and the target will be set. The target can not be reset until the voltage returns to normal.

APPLICATION DATA

Type 74 Trip Circuit Supervision Relay:

The ABB Circuit-Shield™ Type 74 is used to monitor the integrity of a circuit breaker's trip coil and associated wiring. The relay may be connected to monitor the trip circuit with the breaker in both the open and closed positions (Figure 4a), or just for the closed position (Figure 4b).

The relay will alarm for an open trip circuit and for a loss of dc control voltage. It will also alarm if a trip signal is received but the breaker fails to operate.

Trip circuit continuity is measured by passing a small current through the trip coil circuit. Breaker auxiliary contacts are used to indicate to the relay whether the breaker is in the open or closed position..

The operating time of the relay is approximately 400 milliseconds to prevent nuisance alarms on breaker operation or dc control power transfer.

Type 27B Battery Ground Relay:

The ABB Type 27B relay is used to detect grounds on the normally ungrounded dc control power bus, and to indicate whether the ground is on the positive or negative conductor. This is accomplished by measuring the difference in potential between ground and the midpoint voltage. A midpoint is established within the relay by two 30 kilohm resistors connected between positive and negative and grounded at the centerpoint between them.

A sensitivity adjustment is provided on the front panel of the relay. For a 125vdc system, a fault resistance from the positive or negative conductor to ground of 70 kilohms or less can be detected with the relay set for maximum sensitivity. Refer to Figure 5 for the typical range of sensitivity provided.

When a ground is alarmed, action should be taken to locate and remove the ground in order to preserve the reliability of the control power system.

The Type 27B has been qualified for class 1E nuclear service.

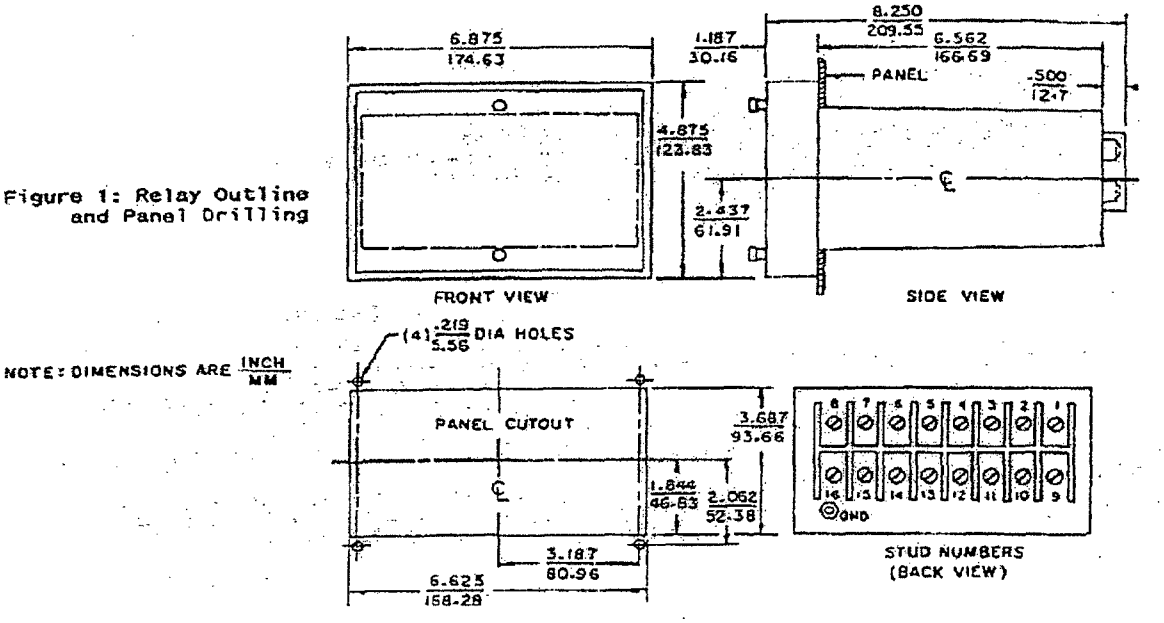
Type 27S DC Undervoltage Relay:

The ABB Circuit-Shield Type 27S, catalog series 439U/239U is an accurate, self-powered relay for monitoring dc control power busses. It may be used to alarm an undervoltage condition, or to initiate transfer to an alternate supply. The dropout voltage of the relay is continuously adjustable from 70 to 115 percent of its nominal dc rating. Reset is adjustable from approximately 0.5 to 4 percent higher than the dropout voltage.

A time delay on dropout is provided to override momentary conditions, and standard units have an adjustment range of approximately 0.1-2 seconds.

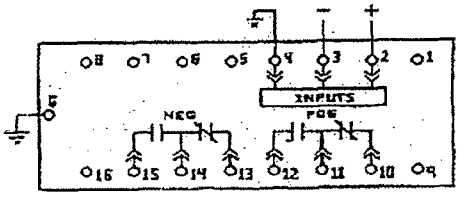
The Type 27S employs a latching relay in its output stage to provide a long-life, as compared to relays where the coil is continuously energized. The Type 27S relay has been qualified for a 40 year life per IEEE-323 for class 1E nuclear service.

Figure 1: Relay Outline and Panel Drilling

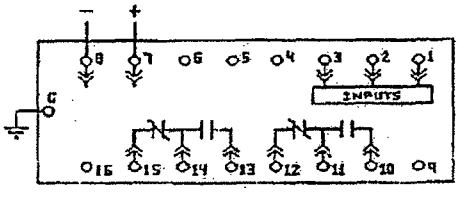


Calculation FEX-00204-00
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Attachment S
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16D439C Type 27B
Battery Ground Relay
Drawout Test Case



16D439A Type 74
Trip Circuit Supervision Relay
Drawout Test Case



16D439B Type 27S
DC Undervoltage Relay
Drawout Test Case

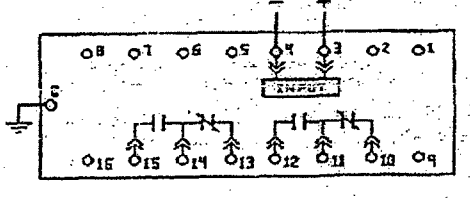


Figure 2: Internal Connections 439 Series Units

Notes:

1. For 239 Series Units refer to page 15.
2. Type 27B contacts shown in the "normal" (non-alarm) state.
   Type 27S contacts shown in the undervoltage state.
   Type 74 contacts shown in the trip-coil-open state (alarm).

SPECIFICATIONS:

Type 27B Battery Ground Relay:

Input Circuit Rating:	100-140 Vdc (125vdc nominal unit) 88-125 Vdc (110vdc nominal unit) 38- 58 Vdc (48vdc nominal unit)
Input Circuit Burden:	50 ma. maximum.
Output Contact Ratings:	see page 7.
Operating Temperature Range:	-30 to +70 degrees C.
Dielectric:	2000 Vac rms, 1 minute, all circuits to ground, with ground connection removed from terminal 9.

Type 27S DC Undervoltage Relay:

Input Circuit Rating:	150 Vdc max. continuous (125vdc nominal unit) 135 Vdc max. continuous (110vdc nominal unit) 60 Vdc max. continuous (48vdc nominal unit)
Input Circuit Burden:	50 ma. max. (125vdc or 110vdc rated units) 60 ma. max. (48vdc rated unit)
Dropout Voltage:	adjustable 0.7 - 1.15 times nominal rating.
Pickup/Dropout Ratio:	adjustable 0.5 - 4% of dropout setting.
Operating Time:	standard units adjustable approximately 0.1 - 2 seconds.
Output Contact Ratings:	see page 7
Operating Temperature Range:	-30 to +70 degrees C.
Tolerances:	accuracy with respect to printed dial markings: +/-10%. repeatability after calibration to a particular operating setting: better than +/-0.25%. variation of dropout setting with temperature variation -20 to +70° C with respect to 25° C value: +/-2%. variation of time delay setting with temperature variation -20 to +70° C with respect to 25° C value: +/-7%.
Dielectric:	2000 Vac rms, 1 minute, all circuits to ground, with ground connection removed from terminal 9.

Type 74 Trip Circuit Supervision Relay:

Input Circuit Rating:	140 Vdc max. continuous (125vdc nominal unit) 125 Vdc max. continuous (110vdc nominal unit)
Input Circuit Burden:	25 ma. maximum (supervising current through the trip circuit).
Control Power Drain:	20 ma. maximum (current into terminals 7 & 8).
Operating Time:	approximately 400 milliseconds.
Dropout Voltage:	approximately 30 Vdc on loss of dc control voltage.
Output Contact Ratings:	see below.
Operating Temperature Range:	-30 to +70 degrees C.
Dielectric:	2000 Vac rms, 1 minute, all circuits to ground.

Contact Ratings - Types 27B, 27S, 74:

Each contact:	at 125 Vdc	at 120 Vac
Tripping	30 A	30 A
Continuous	5 A	5 A
Break	0.3 A	2 A

SUMMARY OF COMMON UNITS - 439 Series

Type	Control Voltage Rating[2]	Internal Connections	Catalog Numbers[1]
27B	125 Vdc	16D439C	439G0045
	110 Vdc		439G0005
	48 Vdc		439G0035
27S	125 Vdc	16D439B	439U6345
	110 Vdc		439U6305
	48 Vdc		439U6335
74	125 Vdc	16D439A	439S0045
	110 Vdc		439S0005
	48 Vdc		439S0035

Notes:

1. See page 15 for units of catalog series 239 which are obsolete. 439 series units have improved testing features and should be specified for new applications.
2. Consult factory for availability of control voltage ratings not listed.

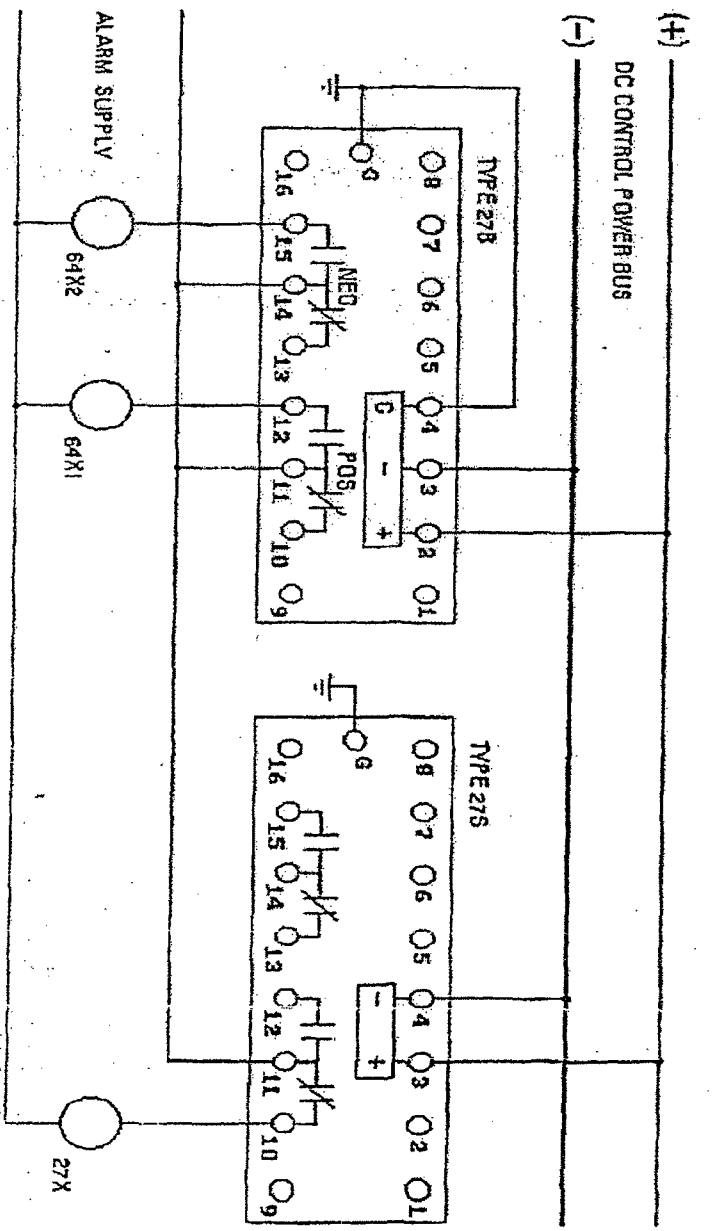


Figure 3: Typical Connections for Type 27B Battery Ground Relay and Type 27S DC Undervoltage Relay

Legend: 64X1 - annunciator, alarm for ground on positive.
64X2 - annunciator, alarm for ground on negative.
27X - annunciator, alarm for low dc voltage.

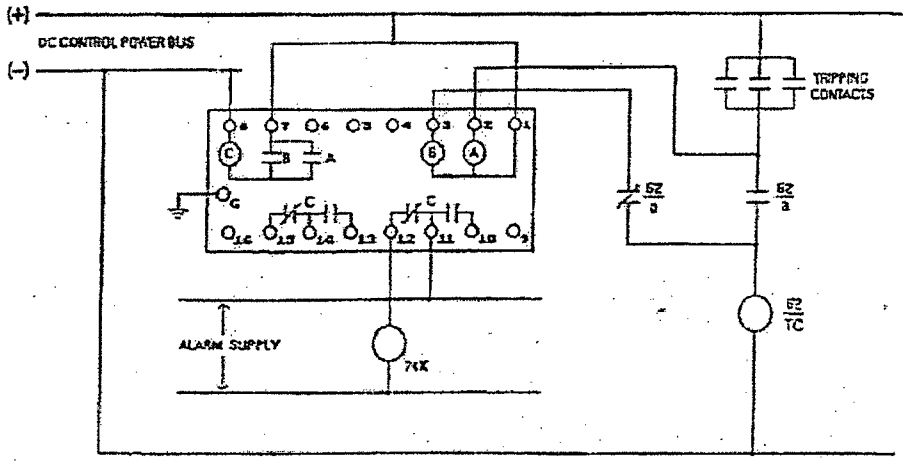


Figure 4a: Typical Connections for Type 74 Supervising Trip Circuit for Circuit Breaker in both the Open and Closed Positions.

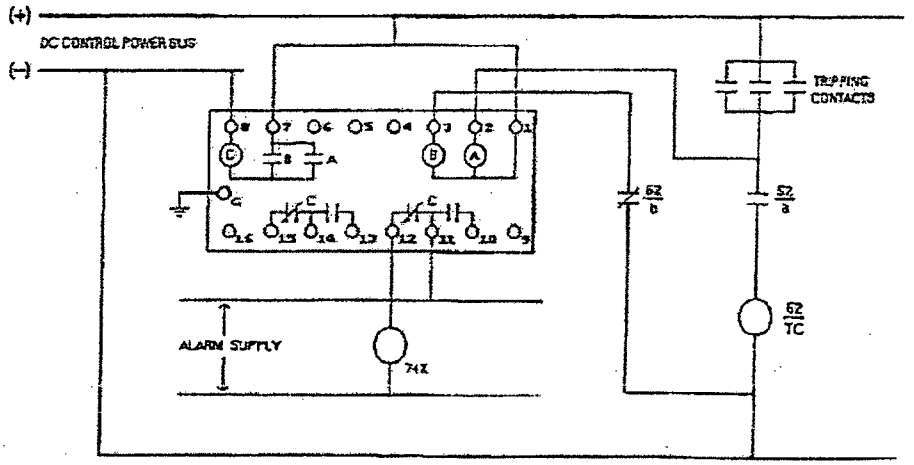


Figure 4b: Typical Connections for Type 74 Supervising Trip Circuit for Circuit Breaker in the Closed Position only.

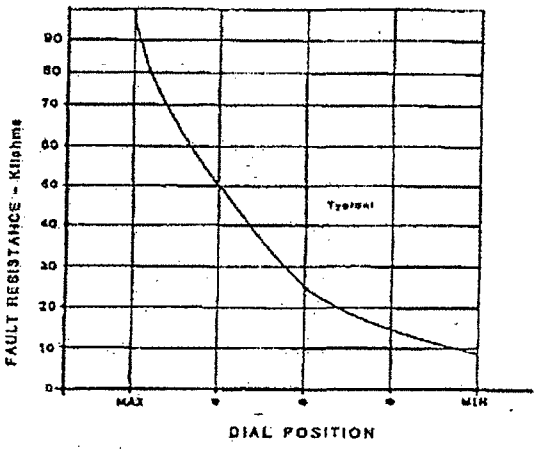


Figure 5: Sensitivity Characteristic

Type 278 Battery Ground Relay

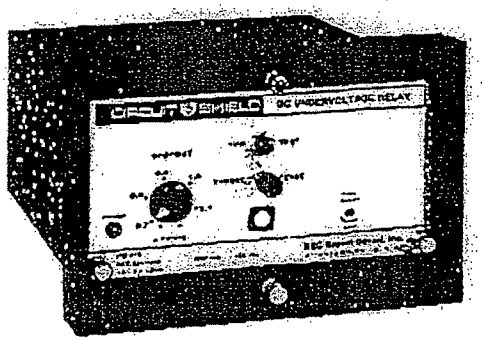


Figure 6a: Type 27S

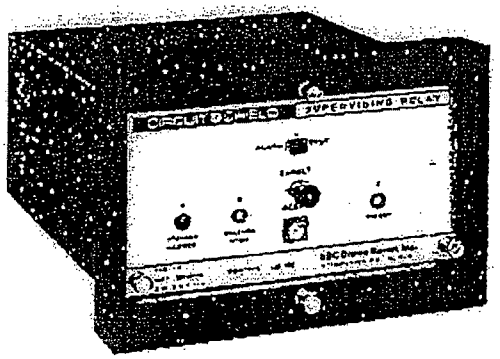


Figure 6c: Type 74

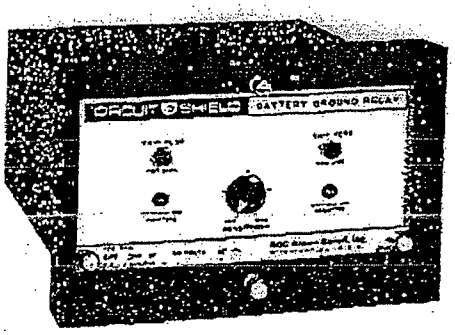
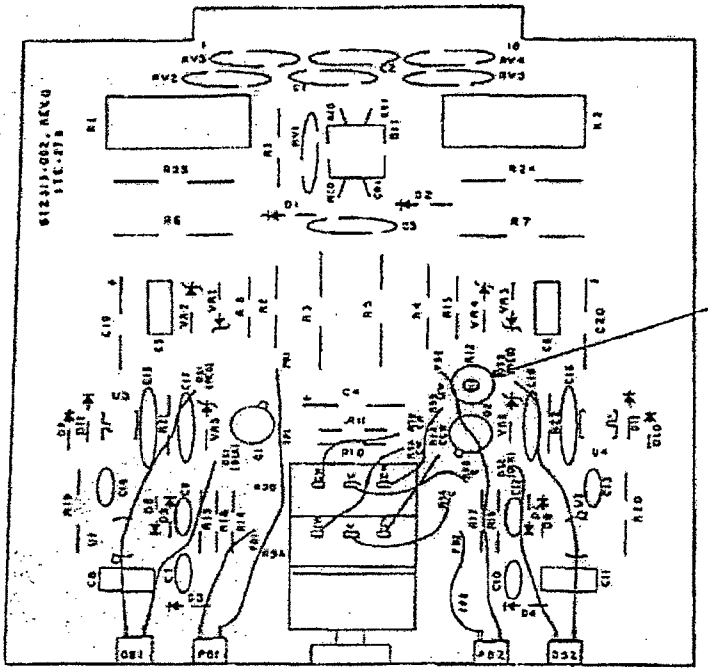
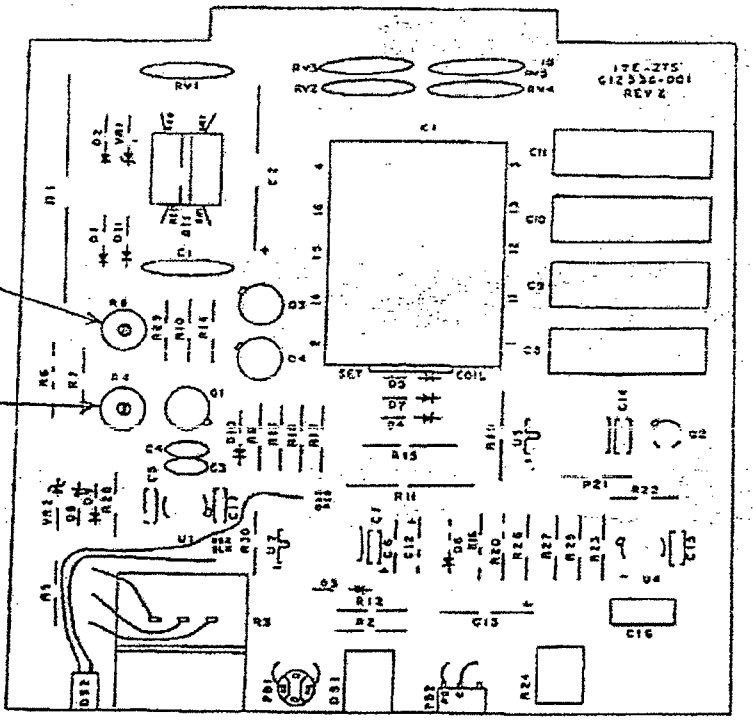


Figure 6b: Type 278



Typical Printed Circuit Board Layout - Type 27B

Potentiometer R12 Balance Adjustment



Typical Printed Circuit Board Layout - Type 27S

Potentiometer R8 Dropout Adjustment

Potentiometer R4 Pickup/Dropout Ratio Adjustment

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram can be provided on request. Renewal parts will be quoted by the factory on request.

The earlier versions of these relays, catalog series 239 are now obsolete and have been superseded by catalog series 439 units which have improved testing features. See page 15 for information on the 239 series.

439 Series Units:

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The drawout assembly is identified by the catalog number stamped on the front panel and the serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

A test plug assembly, catalog 400X0002 is available for use with the 439 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if tests are run with the main circuit energized.

The built-in test feature is provided as a convenient functional test of the relay and its associated trip or alarm circuit. Pushing the TEST button will cause the relay to pick up, time-out, and operate. The button must be held down long enough for the relay's timing circuit to time-out.

Type 27B: Two test buttons are provided, one to simulate a ground on the positive conductor, and the other for a ground on the negative. When the button is pressed, the associated red led should light and the associated output contacts transfer. If both test buttons are depressed simultaneously no operation will occur.

Type 27S: The built-in test simulates an undervoltage condition. When the test button is pressed, the green led should go out, and after the time delay, the target should show and the output contacts transfer.

Type 74: The built-in test simulates a trip circuit failure. When the test button is pressed, the led's should go out, the target should show, and the output contacts should transfer.

4. ACCEPTANCE TESTS

Type 27B Battery Ground Relay:
A typical acceptance test circuit is shown in Figure 7. A resistor substitution box or potentiometer can be used to simulate the fault resistance to ground - R1 in the figure.

With rated dc voltage applied, test resistor R1 at maximum resistance, and the SENSITIVITY dial set to minimum, actuate the built-in test button for the positive side. Observe that the positive side led lights and contacts 11-12 transfer. Repeat for the negative side test button, and observe that the negative side led lights, and contacts 14-15 close.

With rated dc voltage applied, S1a closed, S1b open, and the SENSITIVITY dial set to MAX, reduce resistance R1 until the relay operates. The red led that indicates a ground on positive should light and contacts 11-12 should close. R1 should be between 70 and 120 kilohms.

Return R1 to its maximum value. Open S1a and close S1b. Reduce the resistance of R1 until the relay operates. The red led that indicates a ground on negative should light and contacts 14-15 should close. Again, R1 should be between 70 and 120 kilohm.

The internal balance adjustment, R12, can be used to equalize the Pos. side and Neg. side sensitivities if desired. See circuit board layout on page 11.

Type 27S DC Undervoltage Relay:
A typical acceptance and calibration test circuit is shown in Figure 8. A stable, adjustable, filtered dc power supply is needed as the test source.

Observing the green led pickup indicator on the front panel, raise and lower the dc source voltage slowly to determine the dropout and pickup voltages. The tolerance on the front panel DROPOUT voltage dial is +/-10%. Should the dial calibration be out of tolerance, internal calibration potentiometer R4 can be readjusted as necessary to improve its accuracy for the particular setting to be used in the application.

The voltage difference between the pickup and dropout points can be adjusted using internal calibration potentiometer R8. (See page 11 for the circuit board layout.)

To adjust the operating time of the relay, set the dc source voltage to a value above pickup. Then actuate switch S1. The relay will time out and operate. Read the operating time on the timer. The time delay potentiometer (screwdriver adjustment) on the front panel can be used to obtain the desired time delay (adjustment range 0.1-2.0 seconds +/-20%).

With the dc source voltage above pickup, actuate the TRIP TEST button and observe that the relay times out and transfers its contacts.

Proper operation of the green led pickup indicator and the operation target should be observed during the above tests.

Type 74 Trip Circuit Supervision Relay:
A typical acceptance test circuit is shown in Figure 9. Switch S1 is single-pole double-throw. Contact 52a is used to simulate the breaker 52/a contact, and S1b the breaker 52/b contact. Switch S2 simulates an open trip circuit or loss of dc control voltage.

Apply rated dc control voltage and close S2. With S1a closed, S1b open, the led indicators labelled "A" and "C" should be on. Contacts 11-12 and 14-15 should be open. Actuate the TARGET RESET.

Open S1a, close S1b. Led's "B" and "C" should be on and contacts 11-12 and 14-15 should have remained open with no momentary closure.

Open switch S2. All led's should go out and contacts 11-12 and 14-15 should close. The target should set to orange.

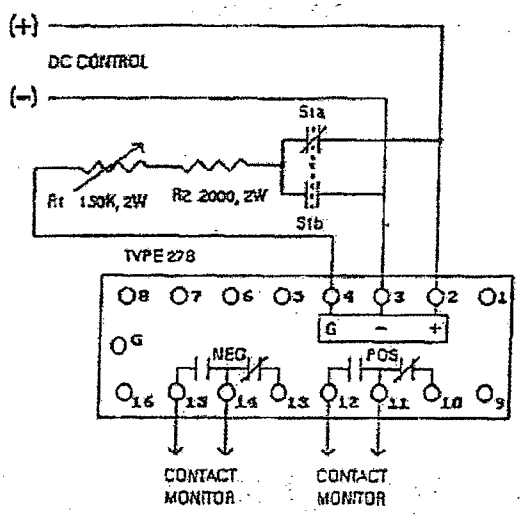


Figure 7: Typical Test Circuit Type 27B

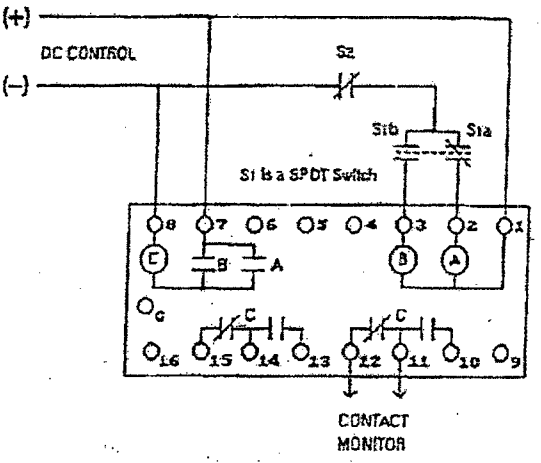


Figure 9: Typical Test Circuit Type 74

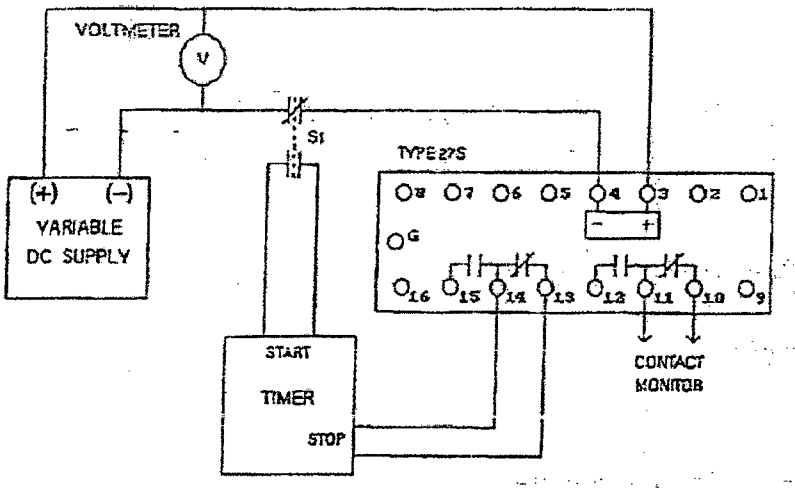


Figure 8: Typical Test Circuit - Type 27S

5. CATALOG SERIES 239 UNITS (obsolete)

Catalog Numbers 239Gxxxx, 239Sxxxx, 239Uxxxx:

Catalog series 239 has been superseded by units of the 439 series due to the improved test features provided. Units with a catalog number 239xxxxx which is identical (except for the first digit) to those listed on page 7 have the same electrical characteristics as the 439 series described in this instruction book; but the connections are different: the internal connection diagrams are given below in Figure 10.

The test procedures given for the 439 series units may be used for these relays if the test circuit connections are revised as required for the internal connections shown below.

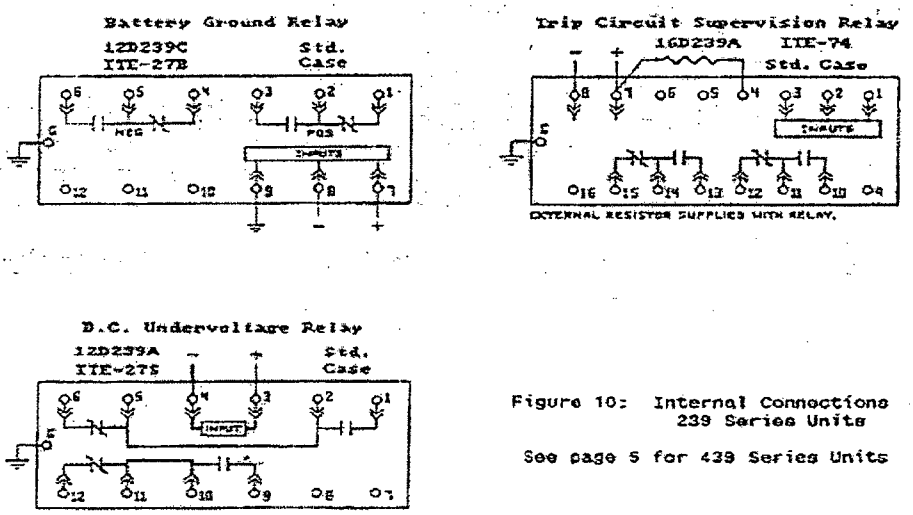


Figure 10: Internal Connections
239 Series Units

See page 5 for 439 Series Units

Type 27S Catalog Numbers 239Kxxx5, 239Lxxx5:

Relays with catalog numbers of this form are early versions of the Type 27S DC Undervoltage Relay, and were designed primarily for go/no-go monitoring of control voltage conditions. Type 27S relays of catalog series 439U and 239U are significantly more accurate than these relays and the 439U series is recommended as a replacement (wiring changes will be required). Internal connection diagram 12D239A shown above applies to the 239K and 239L series relays.

Type 27B Catalog Numbers 23900505:

A Type 27B relay with catalog number 23900605 is an early version of the Type 27B. The 439G0045 is recommended as a replacement (wiring changes will be required). Internal connection diagram 12D239C shown above applies to the 23900505 relay.

ASEA BROWN BOVERI

ABB Power T&D Company Inc.
Protective Relay Division
7036 Snowdrift Rd.
Allentown, PA 18106
215-395-7333 Fax 215-395-1055

Issue B (9/91)
Supersedes Issue A

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, or maintenance. Should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Asea Brown Boveri.

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

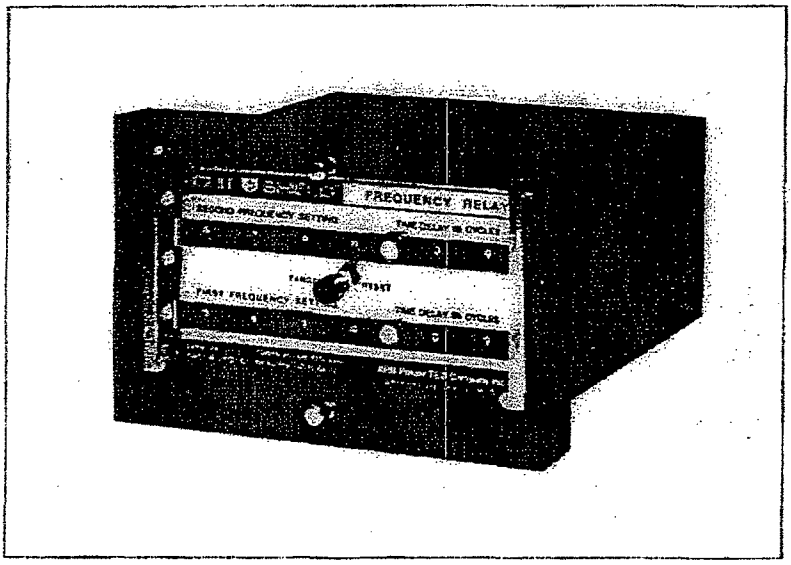
ITEM 156 & 157

September 1995
Supersedes Descriptive Bulletin 41-530S,
pages 1-2, dated November 1990
Mailed to: E, D, C/41-500B

Device Number: 81

CIRCUIT SHIELD ®

Type 81 One and Two Step Frequency Relays



Features

- High accuracy
- Easy to set
- Low burden
- High seismic capability - 6g ZPA
- Transient immunity
- Available in one stage or two stage models
- 2 year warranty
- UL Recognized

Application

The Type 81 Frequency Relay is a reliable solid state relay designed to provide accurate detection of abnormal frequency conditions on electrical power systems. The Type 81 is available in one stage and two stage models. Single step models are provided with means to select either underfrequency or overfrequency operation. Two stage models may be set up for either two steps of underfrequency detection, two steps of overfrequency detection or for overfrequency and underfrequency protection.

The relay has operating characteristics which make it ideal for application on closely coordinated system load shedding programs. The accuracy and stability of the relay characteristics permits settings much closer to system frequency, and closer steps between settings of relays in a load shedding program, than possible with electromechanical relays.

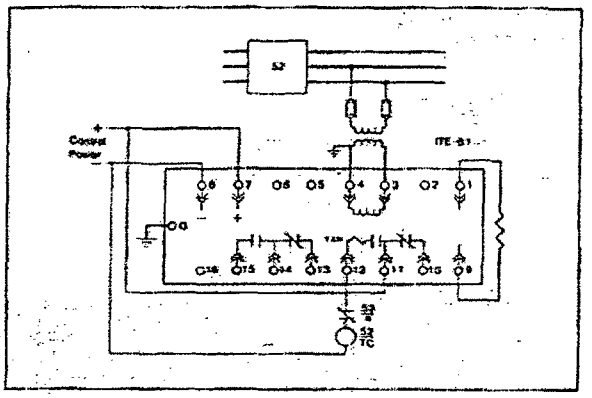
Another application is typical to large industrial plants which have some local generation. Normally, they depend on a tie line with a utility for some portion of their power needs. If the tie breaker at the utility end should open, the generator in the plant would be overloaded especially if it also attempts to pick up utility load tapped on the tie line. This overload causes and underfrequency condition on the industrial system. The Type 81 can be used to open the tie to the utility system and drop non-essential load. Essential loads can be maintained to the limit of the generator capability.

In OSG applications, typical protection includes a two step Type 81 providing an under and overfrequency window and a Type 27/59 providing an under and overvoltage window.

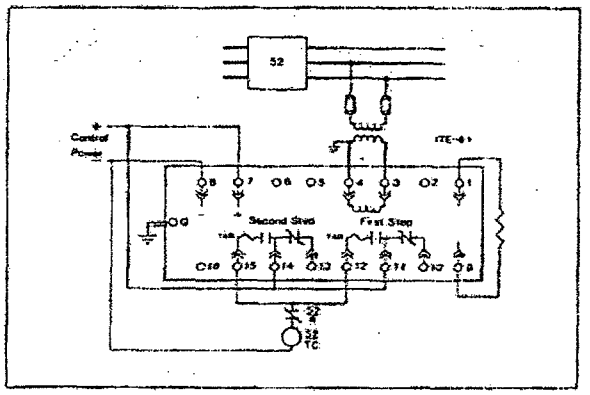
The relay uses digital counting techniques to provide an accurate measure of frequency. The time base measurement is provided by an extremely stable crystal oscillator reference. The set point accuracy is 0.008 Hz. The relay is provided with TRIP POINT and TIME DELAY settings. These settings are easily made on the front panel of the relay. For underfrequency operation the time delay period begins when the relay has counted three consecutive cycles below the trip frequency. The time delay counter will be fully reset if one cycle occurs above the trip frequency.

Specifications

Operating Range:	Models available for: 45 - 52 Hz 54 - 63 Hz
Input Circuit Rating:	60-140 Vac
Undervoltage Cutoff Function:	Adjustable 60 - 100 volts Factory set at 60 volts
Burden:	0.7 VA
Control Power:	Models available for: 48/125 Vdc @ 0.07A, 48/110 Vdc @ 0.07A. 24/32, Vdc @ 0.11A, 110/220 Vdc @ 0.07A. 250 Vdc @ 0.08A
Operating Time:	Adjustable 1 - 99 cycles (must have 3 consecutive incorrect cycles before timing begins)
Output Contacts:	2 Form C contacts (for 1 step unit) 1 Form C contact for each step (for 2 step unit)
Output Circuit Rating:	@ 125 Vdc 30A tripping 5A continuous 1A opening resistive 0.3A opening inductive
Series Target Coil Rating:	30 Amp Tripping (1 Amp minimum trip circuit current required to set targets). For trip circuit currents below 1 Amp, .25 Amps minimum, add "-ST" to catalog number for sensitive target coil.
Temperature:	Minus 20 to Plus 70°C
Seismic Capability:	More than 6g ZPA biaxial multi-frequency vibration without damage or malfunction. (ANSI/IEEE C37.98)
Transient Immunity:	More than 3000 V, 1 MHz bursts at 60 Hz repetition rate, continuous (ANSI C37.90a - 1974); fast transient test; EMI immunity.
Dielectric:	2000 Vac RMS, 60 seconds all circuits to ground
Weight:	1 Step Unboxed - 3.7 lbs (1.7 Kg) Boxed - 4.3 lbs (2.0 Kg) 2 Step Unboxed - 3.9 lbs (1.8 Kg) Boxed - 4.6 lbs (2.1 Kg)
Volume:	0.26 cubic feet



Typical Connections—1 Step Relay



Typical Connections—2 Step Relay

How to Specify

Frequency Relay shall be Asea Brown Boveri Type 81 or approved equal. Relay operating point shall be settable in 0.05 Hz increments. Time delay shall be adjustable in 1 cycle increments. Relay shall be capable of withstanding 6g ZPA seismic stress without malfunctions. Operation indicator shall be provided. An undervoltage cutoff function shall be provided to block operation for low line voltage conditions.

How to Order

For a complete listing of available frequency relays, see TD 41-025.

To place an order, or for further information, contact your nearest ABB Representative.

Further Information

List Prices: PL 41-020
Technical Data: TD 41-025
Instruction Book: IB 7.4.1.7-5
Other Protective Relays:
Application Selector Guide, TD 41-016

Printed in U.S.A.
September 1995

June, 1994
Supersedes Descriptive Bulletin 41-530S, Page 3,
dated November, 1990
Mailed to: E, D, C/41-500B

CIRCUIT SHIELD ®

Type 81 One and Two Step Frequency Relays

Type	Max. Voltage Rating	Number of Steps	Frequency Range	Operating Time	Output Contacts	Internal Connections	① Control Voltage	Catalog Number
81	140V	1	63-54 Hz	1-99 Cycles	2-C	16D422A	48/125 Vdc	422B1275
							48/110 Vdc	422B1205
							24/32 Vdc	422B1295
							250 Vdc	422B1255
			52-45 Hz				48/125 Vdc	422D1275
							48/110 Vdc	422D1205
							24/32 Vdc	422D1295
							250 Vdc	422D1255
		2	63-54 Hz		1-C for each step	16D422B	48/125 Vdc	422C1276
							48/110 Vdc	422C1206
							24/32 Vdc	422C1296
							250 Vdc	422C1256
			52-45 Hz				48/125 Vdc	422E1275
							48/110 Vdc	422E1206
							24/32 Vdc	422E1296
							250 Vdc	422E1256

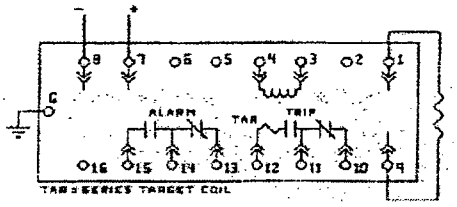
① For other control voltages contact the nearest ABB Representative.

To place an order, or for further information, contact the nearest ABB Representative.

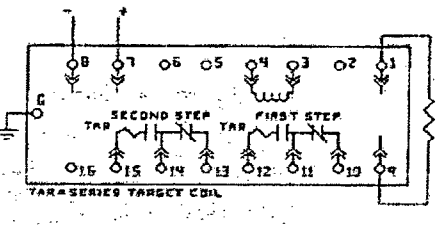
Internal Connection Diagrams

Note: Refer to Instruction Book IB 7.4.1 7-5 for contact logic data.

16D422A Type 81
One-Step Frequency Relay
Drawout Test Case



16D422B Type 81
Two-Step Frequency Relay
Drawout Test Case

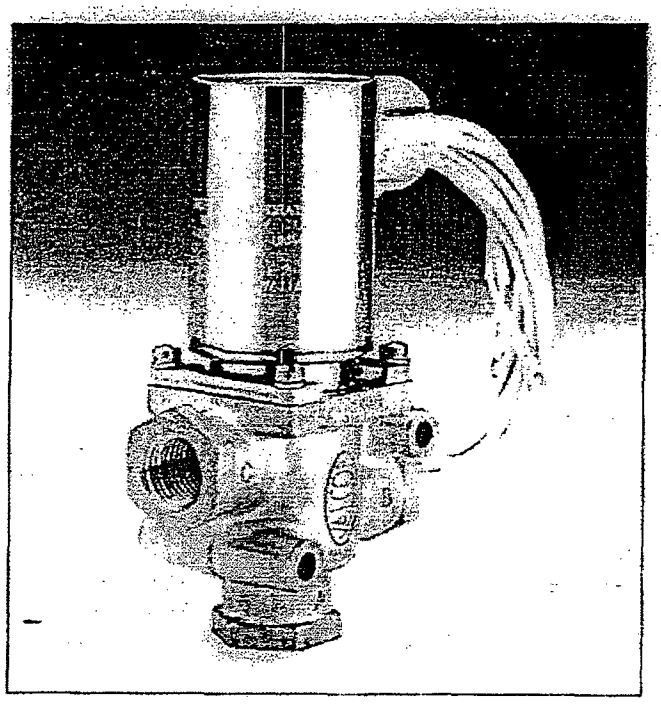


Valcor Nuclear

Moderate Flow Air Pilot Valve

3-Way, Direct-Acting, Compact Size Solenoid
Model V70900-65

ITEM 171



DESCRIPTION

Valcor Nuclear has created this compact size and low weight 3-way, direct-acting, balanced poppet, nuclear-qualified solenoid valve, to be used as pilot operators on control valves in nuclear power plants.

It has been designed specifically to prevent the chronic operational problems, associated with the conventional solenoid valves currently installed in many PWR, BWR and CANDU plants.

Valcor Model V70900-65 is ideal for use in a host of safety-related, moderate flow solenoid valve applications. The principal function is pressurizing and venting pneumatic diaphragm actuators, air cylinders under extremely harsh environmental conditions.

These valves may also be used on compressors and turbines.

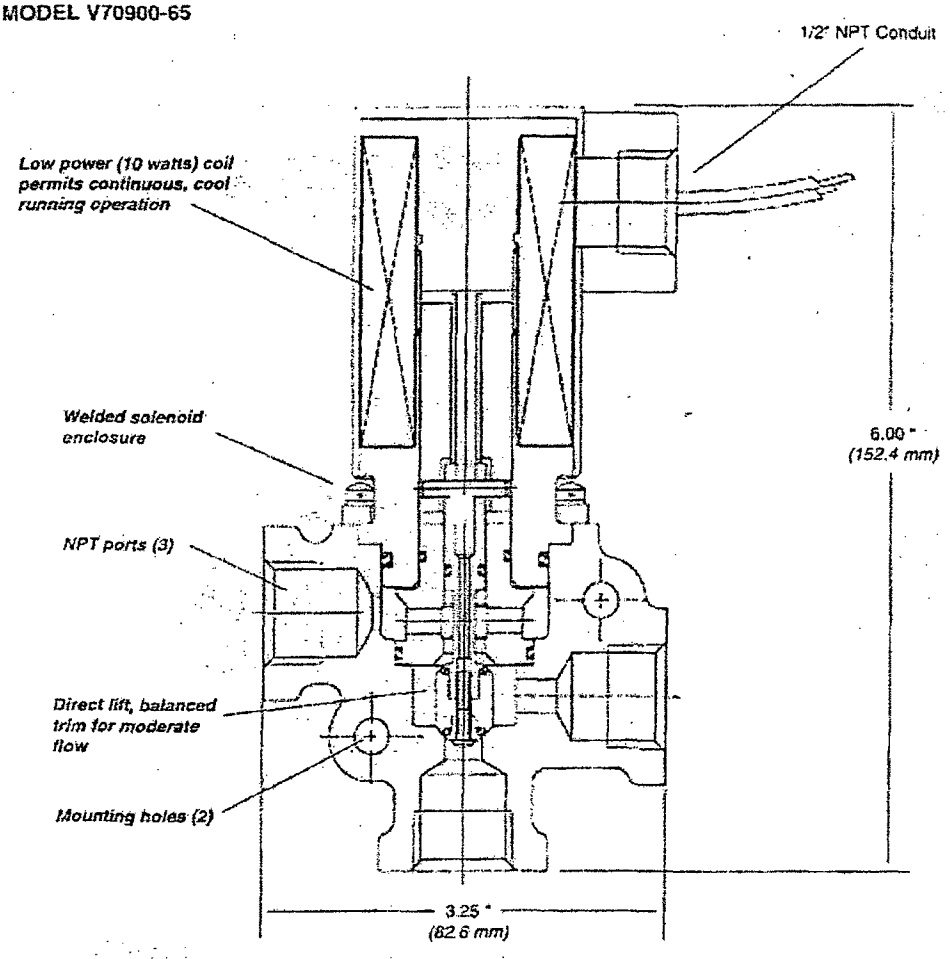
It's cool running single coil design is both highly reliable and adaptable. Its versatility offers significant improvements for a variety of applications and configurations, including 2-way *(one port plugged)*, normally closed, normally open and universal modes, with AC or DC voltages. No minimum operating pressure differential is required in any mode.

THE V70900-65 INCORPORATES THESE OUTSTANDING FEATURES

- Compact size, low weight and rugged construction are special characteristics; can replace outdated valves in most cases
- 3/8" NPT is standard; also available in 1/8", 1/4" and 1/2" line size
- Direct-acting, balanced poppet, *with no diaphragms*
- Universal operation - normally open, normally closed, selector or diverter modes feasible with same design
- Internal flow path sealing by O-ring poppets on metal seats
- Brass is standard; also available in aluminium or stainless steel
- Mounting brackets available as an option
- Solenoid enclosure is all stainless steel, seal welded construction for NEMA-4,-7 compliance *(Water tight and explosion proof)*
- Class H Insulation
- Coil requires less than 10 watts power; cool running/potted design
- Powered with 48 VDC; 120 VAC/125 VDC, or other voltage options also available
- Can be mounted in any attitude
- Maintenance-free. Coil replacement in the field can be made without disturbing in-line piping
- Designed for continuous duty up to 150°F (66°C) ambient
- Qualified life - 40 years for coil & 10 years for O-rings

© 1996 Valcor Engineering Corporation®

OUTLINE DIMENSIONS
MODEL V70900-65



TYPICAL SPECIFICATIONS

Fluid:	Air/Inert Gas
Size:	3/8" NPT
Operating Pressure:	0-150 psig (10.3 bar)
Operating Temperature:	150°F (66°C)
Flow, C_v:	>0.2 up to 1.2
Leakage, per MSS-SP-61:	25 sccm @ 150 psig (10.3 bar) (Bubble tight at factory)
Voltage:	98-136 VAC/90-140 VDC/48VDC
Power	10 Watts
Response Time:	30 m-sec
Weight:	4.5lb (2.0kg) for brass

VALCOR

Valcor Nuclear

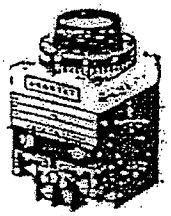
Valcor Engineering Corporation®
2 Lawrence Road • Springfield, New Jersey 07081
973-467-8400 • Fax: 973-467-8382
E-mail: nuclear@valcor.com • http://www.valcor.com

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AGASTAT.

E7000 Series timing relay (Double Pole Model)

INSTALLATION AND OPERATION



Every AGASTAT timing relay is a precise timing instrument which balances pneumatic, electrical and mechanical forces in a unique design using a minimum of moving parts. Its accuracy and performance to specifications have been carefully tested before shipment. Properly applied, it offers exceptional life expectancy. A few minutes spent in familiarizing yourself with these instructions will help you get the best possible service from this unit in your application.

QUALIFICATION

These relays have been qualification tested to IEEE STD 323-1974 and IEEE STD 344-1975. Performance of units with factory installed or customer installed special options has not been determined or tested.

MOUNTING INSTRUCTIONS

The E7000 Series relay must be mounted in the vertical position. All performance specifications of these units are valid only when they are mounted in this manner.

A bracket for mounting the device and the screws and lockwashers required to attach it to the relay are supplied with each unit. Four 8-32 tapped holes are provided in the rear of the device for attaching the mounting bracket, or for mounting the relay directly to a panel, from the rear.

CATALOG NUMBER CODE

E	70	1	Z	A	A	001
NUCLEAR SAFETY RELATED	AGASTAT 7000 Series timing relay	OPERATION 1-On-delay 2-Off-delay	CONTACT ARRANGEMENT 2-Dble Pole Dble Throw	COIL VOLTAGE	TIME RANGE	*CONFIGURATION CODE

ITEM 180

COIL VOLTAGE CODE

AC	A	120V 60Hz 110V 50Hz
	B	240V 60Hz 220V 50Hz
	C	480V 60Hz
	D	550V 60Hz
	E	24V 60Hz
	F	127V 50Hz
	G	240V 50Hz
	H	12V 60Hz
	I	5V 60Hz
	J	208V 60Hz
DC	M	28 VDC
	N	48 VDC
	O	24 VDC
	P	125 VDC
	Q	12 VDC
	R	60 VDC
	S	250 VDC
	T	550 VDC
	U	18 VDC
	V	32 VDC
	W	36 VDC
	Y	5 VDC
	Z	220 VDC

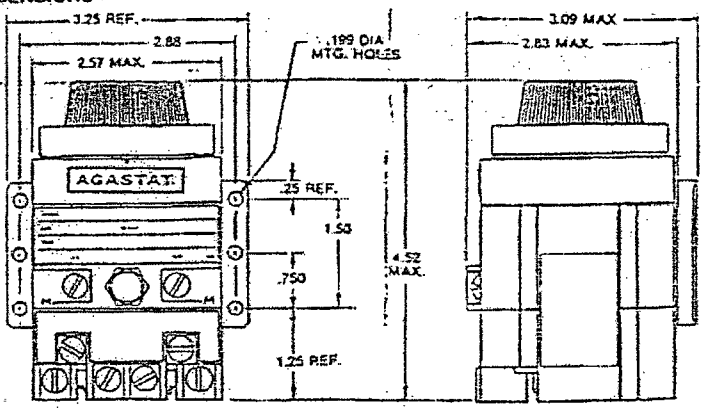
TIME RANGE CODE

A	.1 to 1 sec.
B	.5 to 5 sec.
C	1.5 to 15 sec.
D	5 to 50 sec.
E	20 to 200 sec.
F	1 to 10 min.
H	3 to 30 min.
I	6 to 60 min.
K	1 to 300 sec.

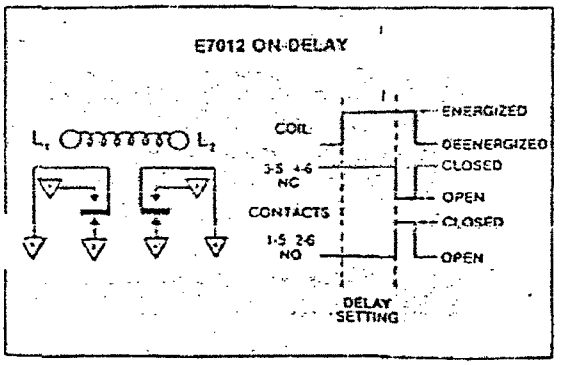
***CONFIGURATION CODE**

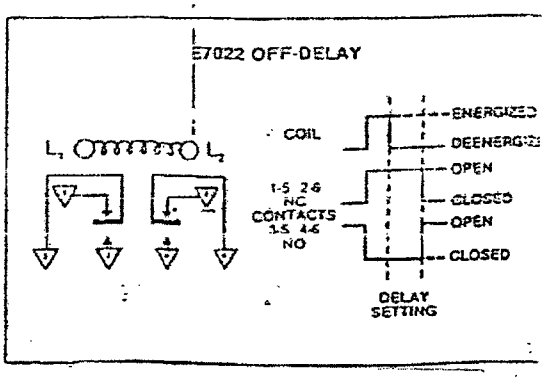
The Configuration Code is a suffix to the Model Number which provides a means of identification. When a significant product change is introduced, the Configuration Code and specification sheets will be revised. (001 to 002, etc.)

DIMENSIONS



QUALIFICATION TESTED FOR VERTICAL OPERATION ONLY





TIME DELAY INFORMATION

All units are furnished with dials calibrated linear increments covering the range ected. (See "Catalog Number Code"). In ..dition, time-calibrated ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone. For easiest adjustment and lowest cost, the shortest time range suitable to the application should be selected.

REPEAT ACCURACY

Repeat accuracy at any fixed temperature is: ± 10% of setting.

The first time delay afforded by units with H (3 to 30 minutes) and I (6 to 60 minutes) time ranges may be up to 15% longer than subsequent delays, due to coil temperature rise.

Dial calibration error is not included in the repeat accuracy specification above.

DELAY SETTING

Dial calibrations are provided to minimize the time required to set the unit to a specific delay. Rotate the dial clockwise to increase the delay; counter-clockwise to decrease it.

The following procedure is recommended if the unit must be set to a very precise delay value:

1. Set dial to desired time delay. (On letter-calibrated units, this requires an approximation of a percentage value between the arrowhead "▼" on the dial, which provides minimum time, and the letter "E", which provides maximum time.)
2. Record as many time delays as required to establish a stable average.
3. If the recorded average delay is shorter than the desired time, turn dial slightly clockwise; if it is longer, turn dial counter-clockwise.
4. Repeat step 2 after each adjustment, until required delay is recorded.

Because of a variety of environments in which time delay relays are applied, we recommend a re-check of the time delay after approximately three hours of operation. If any change from the initial time setting is apparent, the relay should be re-set to the desired delay. The time delay accuracy should then be monitored on a monthly basis for several months, and if no substantial change in time delay has taken place, the frequency of checking may be reduced. It is recommended that this procedure be incorporated in the Operating Instructions for your equipment.

COIL DATA

All units draw approximately 8 watts power at rated voltage.

The operating voltage range for AC relays is 85 to 110 percent of nominal rated value.

AC units drop-out at approximately 50% of rated voltage.

The operating voltage range of DC relays is 80 to 110 percent of nominal rated value.

DC units drop-out at approximately 10% of rated voltage.

All units may be operated on intermittent duty cycles (50% on/off, maximum 30 minutes on) at voltages 10% above the listed maximums.

CONTACT RATINGS — NUCLEAR

Resistive at 125VDC ..... 1.0 Amp.
Resistive at 120 VAC 60 Hz ..... 10.0 Amp.

CONTACT RATINGS — NON-NUCLEAR

CONTACT CAPACITY IN AMPS. (Resistive Loads)

Contact Voltage	Min. 100,000 Operations	Min. 1,000,000 Operations
30 VDC	15.0	7.0
110 VDC	1.0	0.5
120V 60Hz	20.0	15.0
240V 60Hz	20.0	15.0
480V 60Hz	12.0	10.0

Contact ratings as listed under the UL Component Recognition Program for 100,000 operations:

10 Amps., resistive, 240 VAC
¼ horsepower, 120 VAC/240 VAC
15 Amps., 30 VDC
5 Amps., General Purpose, 600 VAC

} Per Pole

In the event of malfunction, return units to:
CONTROL PRODUCTS DIVISION
AMERACE CORPORATION
1000 HICKORY STREET
GRAFTON, WISCONSIN 53024
ATTENTION: PRODUCT SERVICE DEPARTMENT

WARRANTY:

The AGASTAT® timing relay is warrantec against mechanical and electrical defect: for a period of one year from date of shipment from factory if it has been installec and used in accordance with factory recommendations.

Any field repairs or modifications to the original unit will void the Warranty and the Qualification.

NOTE:

Control Products Division of Amerace Corporation does not recommend the use of its products in the containment areas of Nuclear Power Generating Stations.

REPLACEMENT SCHEDULE

The qualified life of this unit is 25,000 operations or 10 years from date of manufacture, whichever occurs first.

The date of manufacture can be found in the first four (4) digits of the serial number on the nameplate:

XX XX

First two digits indicate the year.

Second two digits indicate the week.

Example: Date code 8014: 80 indicates 1980; 14 indicates the week of April 2 through 8.

MODEL E7012PC001	
COIL 125VDC	SERIAL 8014—
TIME 1.5 TO 15 SEC.	
L1	L2

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 196 of 219

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E70-2
January 1981 (Supersedes 3/80)
PIN 39999-36

CONTROL PRODUCTS DIVISION

Amerace Corporation, Control Products Division
2330 Vauxhall Road, Union, New Jersey 07083, U.S.A.
Telex 136-978

Printed in U.S.A.

SPECIFICATIONS (See also pp. 3 through 7 for basic operational specifications)

Environmental Conditions (Qualified Life)

PARAMETER	MIN.	NORMAL	MAX
Temperature (°F)	40	70-104	156
Humidity (%R.H. Non-condensing)	10	40-60	95
Pressure	—	Atmospheric	—
Radiation (rads)	—	—	2.0×10^5 (Gamma)

Operating Conditions (Normal Environment)

NORMAL OPERATING SPECIFICATIONS	WITH DC COILS	WITH AC COILS
Coil Operating Voltage Nominal (Rated)	As Spec	As Spec
Pull-in (% of rated value)	80% Min	85% Min
Dropout (% of rated value)	10% Approx	50% Approx
Power (Watts at rated value)	6 Approx	6 Approx
Relay Operate Time		
Model E7012	N/A	N/A
Model E7022	50 ms Max	50 ms Max
Relay Release (Recycle) Time		
Model E7012	50 ms Max	50 ms Max
Model E7022	N/A	N/A
Contact Ratings Continuous		
Resistive at 125 vdc	1.0 amp	1.0 amp
Resistive at 120 vac 60 Hz	10.0 amp	10.0 amp
Insulation Resistance		
(Megohms at 500 vdc)	500 Min	500 Min
Dielectric (Vrms 60 Hz)		
Between Terminals and Ground	1,500	1,500
Between Non-connected Terminals	1,000	1,000
Repeat Accuracy	± 10%	± 10%
Approximate Weight	Model E7012 and E7022 2.25 lbs. Model E7014 and E7024 2.57 lbs.	Model E7012 and E7022 2.13 lbs. Model E7014 and E7024 2.43 lbs.

(Weight may vary slightly with particular coil voltage.)

Operating Conditions (Adverse Environment)

ADVERSE OPERATING SPECIFICATIONS	NORMAL	DBE "A"	DBE "B"	DBE "C"	DBE "D"
Temperature (°F)	70-104	40	120	145	156
Humidity (%R.H.)	40-60	10-95	10-95	10-95	10-95
DC Operating Voltage* (% of Rated)					
Model E7012 AC	85-110	85-110	85-110	85-110	85-110
DC	80-110	80-110	80-110	90-110	90-110
Model E7022 AC	85-110	85-110	85-110	85-110	85-110
DC	80-110	80-110	80-110	80-110	80-110

*All coils may be operated on intermittent duty cycles at voltages 10% above listed maximums. (Intermittent Duty = Maximum 50% duty cycle and 30 minutes "ON" time.)

ORDERING INFORMATION

Catalog Number Code

E	70	1	2	A	A	**002

- **E** — Nuclear Safety Related
- **70** — Model Series: AGASTAT Series 7000 Timing Relay
- **1** — Operation: 1 = On-Delay, 2 = Off-Delay
- **2** — Contact Arrangement: 2 = Double Pole Double Throw, 4 = Four Pole Double Throw
- **A** — Coil Voltage:
  - AC: A = 120V 60Hz / 110V 50Hz; B = 240V 60Hz / 220V 50Hz; C = 480V 60Hz; D = 550V 60Hz; E = 24V 60Hz; F = 127V 50Hz; G = 240V 50Hz; H = 12V 60Hz; I = 6V 60Hz; J = 208V 60Hz
  - DC: M = 28 VDC; N = 48 VDC; O = 24 VDC; P = 125 VDC; Q = 12 VDC; R = 60 VDC; S = 250 VDC; T = 550 VDC; U = 16 VDC; V = 32 VDC; W = 96 VDC; Y = 6 VDC; Z = 220 VDC
- **A** — Time Range:

	E7012, E7022	E7024
A	.1 to 1 sec	.1 to 1 sec
B	.5 to 5 sec	.5 to 5 sec
C	1.5 to 15 sec	1.5 to 15 sec
D	5 to 50 sec	5 to 50 sec
E	20 to 200 sec	20 to 200 sec
F	1 to 10 min	1 to 10 min
H	3 to 30 min	3 to 30 min
J	6 to 60 min	6 to 60 min
K	1 to 300 sec	1 to 300 sec
†E7014		
A		2 to 2 sec
B		7 to 7 sec
C		2 to 20 sec
D		10 to 100 sec
E		30 to 300 sec
F		1.5 to 15 min
H		3 to 30 min

- ****002** — Configuration Code

† Model E7014 is available with identical dials only. The upper end of the time ranges in this mode may be twice the values shown.

** CONFIGURATION CODE

The Configuration Code is a suffix to the Model Number which indicates a means of identification. When a significant product change is introduced, the Configuration Code and specification sheets will be revised (001 to 002, etc.).

Replacement Schedule

The qualified life of this unit is 25,000 operations or 10 years from the date of manufacture, whichever occurs first.

The date of manufacture can be found in the first four (4) digits of the serial number on the nameplate. XX XX

First two digits indicate the year. _____

Second two digits indicate the week. _____

Example: Date code 8014: 80 indicates 1980; 14 indicates the week of April 2 through 8.

MODEL E7012PC002	
COIL 125VDC	Serial 8014 —
TIME 1.5 TO 15 SEC.	
L1	L2

Mounting Instructions

The Series E7000 relay MUST BE MOUNTED IN THE VERTICAL POSITION; all performance specifications are valid only when they are mounted in this manner.

A mounting bracket and screws and lockwashers required to attach it to the relay are supplied with each unit. Four 8-32 tapped holes are provided in the rear of the relay for attaching the mounting bracket, or for mounting the relay directly to a panel from the rear.

WARRANTY

This product is warranted against mechanical and electrical defects for a period of two years from date of shipment from factory if it has been installed and used in accordance with factory recommendations. Any field repairs or modifications to the original unit will void this warranty. Amerace Corporation's liability is limited to replacement of parts proved defective in workmanship or materials. (W-AB2)

NOTE: THE BASIC UNIT IS SUBJECTED TO IEEE STD 323-1974 AND IEEE STD 344-1975 QUALIFICATION TESTS. PERFORMANCE WITH FACTORY INSTALLED AND/OR CUSTOMER SPECIAL OPTIONS HAS NOT BEEN TESTED.

Agastat® control relays GP series

DCO-3928-65-E
Attach 2 & 6 of 8

specifications

Power consumption

Typical power consumption at rated voltage is 6VA for A.C. coils and 6 Watts for D.C. coils. There is no surge current during operation.

Contacts

Number of contacts
4 single pole double throw

Nominal rating
10A @ 120 Volts A.C.

Typical pressure between moving contact and
Normally closed contact:
30 grams
Normally open contact:
100 grams

Contact resistance measured at terminals
250 milliohms @ 125V D.C.
1 amp

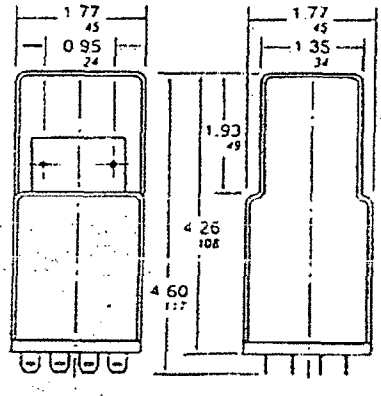
Insulation resistance

Between all non-connected terminals as well as between non-connected terminals and the relay yoke: 1000 megohms at 500 volts D.C.

Dielectric

2000 volts RMS 60 Hz between points specified above

Dimensions



Operate time

Operate time at 20°C and rated voltage:

Between energizing and opening of normally closed contacts/less than 18 milliseconds on A.C. and less than 15 milliseconds on D.C.

Between energizing and closing of normally open contacts/less than 35 milliseconds on A.C. and less than 30 milliseconds on D.C.

Between de-energizing and opening of normally open contacts/less than 70 milliseconds on A.C. and less than 8 milliseconds on D.C.

Between de-energizing and closing of normally closed contacts/less than 85 milliseconds on A.C. and less than 25 milliseconds on D.C.

Operating temperature range

0°C to 60°C.

Shock

The relay, when kept energized by means of one of its own contact sets, will withstand 40g shock load when operating on D.C. and 150 g shock load on A.C.

Vibration

Single axis fragility curve data are available on request at frequencies from 5 Hz to 33 Hz.

Life

100,000,000 mechanical operations.

Weight

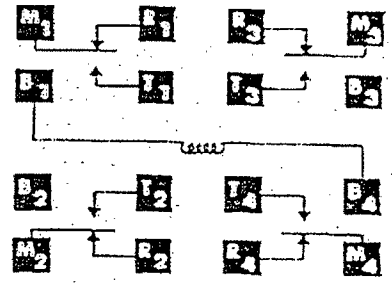
Relay complete with cover: 10.9 oz. Net.

Wiring and connections

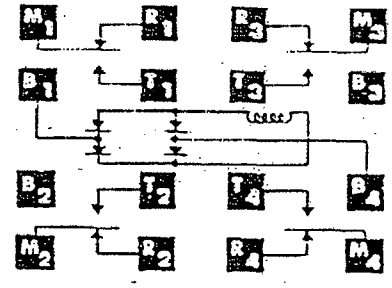
The 16 flat base pins are arranged in four symmetrical rows of four pins; the pitch in both directions being .394". Connection may be made to the relay by soldering. Sockets are available with screw terminals or quick-connect lugs.

The internal wiring of the relay is also symmetrical as shown in the adjacent figure, allowing the relay to be inserted into its base in either of two positions. Terminals B2 and B3 are provided as extra connections for special applications.

D.C.



A.C.



UL Recognized, CSA Certified

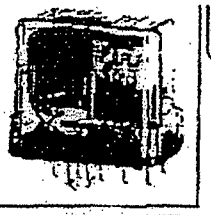
Agastat GP Series control relays are UL Recognized under Guide NLDX2, File No. E15631; they are CSA Certified under Guide 380-W-1.14, File No. 29186.

300 VOLT GENERAL PURPOSE PLUG-IN RELAYS

219 Series

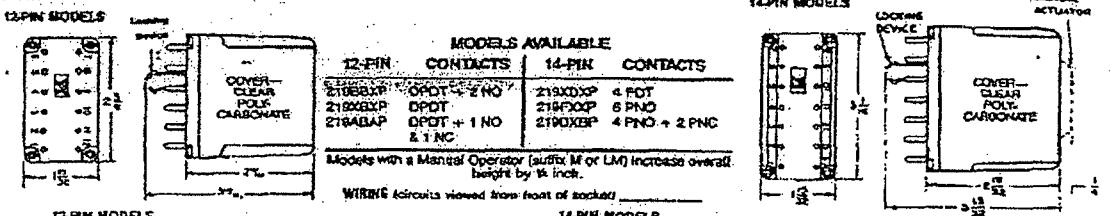


Socket 27390



Series 219 General Purpose Industrial Plug-In Relays feature a 12 pin and a 14 pin size, from 2 Form C to 4 Form C or 6 Form A/Form B combinations. A locking clip on the plug is provided as standard. The coil is encapsulated for protection. Gold diffused silver cadmium oxide contacts are standard. The screw terminal socket has all terminals on a single level, which facilitates the wiring process. Nuclear qualified versions are available. Contact the factory for details.

DIMENSIONS inches

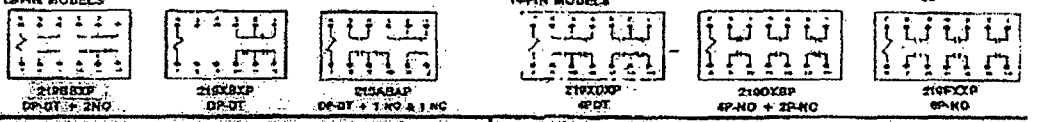


MODELS AVAILABLE

12-PIN	CONTACTS	14-PIN	CONTACTS
21988XP	DPDT + 2 NO	219XDXP	4 PDT
21906XP	DPDT	219FXXP	6 PNO
2194BAP	DPDT + 1 NO & 1 NC	2190XBP	4 PNO + 2 PNC

Models with a Manual Operator (suffix M or LM) increase overall height by ¼ inch.

WIRING (circuits viewed from front of socket)



CONTACT DATA

Ratings — Standard Contacts-Silver Cadmium Oxide-Gold Diffused

Volts	Make	Carry	Break Resist.	Break Induct†
24 Vdc	30A	10A	10A	10A
120 Vac	30A	10A	10A	3A
240 Vac	30A	10A	5A	1A
28 Vdc	30A	10A	10A	3A
125 Vdc	30A	10A	0.5A	0.1A
125 Vdc*SM	30A	10A	1.5A	0.5A
125 Vdc*DM	30A	10A	4A	1.5A
250 Vdc*SM	30A	10A	0.5A	150MA
250 Vdc*DM	30A	10A	1.5A	0.5A

*For Relays with 69 Feature (check with Factory for U.L. & CSA Listing)
†Inductive load is defined as other relay coils.

COIL DATA

AC Relays, 50-60 Hz, 5VA (Coil Data at 60 Hz)

Voltage	Milliamperes open	Milliamperes closed	Impedance Ohms	Resistance Ohms
6	1500.	840.	7.2	1.1
12	750.	410.	27.	4.2
24	375.	200.	120.	15.5
120	75.	40.	2700.	540.
240	32.	17.	13,400.	2100.

DC Relays, 1.8 Watts (2.5W at 125VDC) at 25°C

Voltage	Milliamperes Cold	Milliamperes Hot	Resistance Cold, Ohms
6	385.	304.	15.5
12	189.	147.	63.5
24 (28)*	96.	77.	250.
32	66.	62.	375.
115/125*	20.	16.	6200.

*NOTE: Stock 24 Vdc and 115 Vdc relays have nameplates stamped 24-28 Vdc and 115-125 Vdc respectively. These relays operate at 80% of the lower voltages and operate within allowable temperature rises at the higher voltages.
250/DC—Use 125/DC relay and a series resistor (6,000 ohms, 5W) not supplied.

Min. Operate: AC—85% of nominal voltage; DC—80% of nominal voltage
Max. Overvoltage: 110% of nominal

APPROVALS

- UL White Card and Component Listings: File #E13224
- CSA: File #LR40787

GENERAL DATA

Insulation:	1/4" surface, 1/8" air
Dielectric:	1500 Volt AC
Operate Time:	25 ms max.
Release Time:	20 ms max.
Ambient Temperature Range:	−10° to +60°C
Life Expectancy:	10 million mechanical operations 100,000 at Rated Load 500,000 at ½ Rated Load
Cover:	Clear Polycarbonate
Sockets:	12-pin—#27390 14-pin—#33377 (See pages 62-63 for Styles and Dimensions)

OPTIONS

Feature	Suffix
Indicator Lamp:	L
Manual Actuator:	M
Fine Silver-Gold Diffused Bifurcated Contacts:	33
Permanent Magnet Blowouts:	69
130°C Coil:	U
Nuclear Qualified Versions—Contact Factory	
Coil Suppression:	V

ORDERING CODE

Typical Type No. 219 XBX P L

Note: Coil voltages and frequency must also be specified.

Series
219—Industrial Plug-In

Contact Arrangements
XBX (2 Form C)
ABA (1 Form A, 2 Form C and 1 Form B)
BBX (2 Form A & 2 Form C)
XDX (4 Form C)
FXX (6 Form A)
DXB (4 Form A & 2 Form B)

Standard Feature
P—Polycarbonate Cover

Optional Features (See Options)
Indicator Lamp—Code L
Manual Actuator—Code M
Bifurcated Contacts—Code 33
Permanent Magnet Blowout—Code 69

per Tom Mahaffey of Starters Dept. Min Pickup/Dropout is 10-30% of pull in voltage - 9/9/97 pbf

GENERAL SERVICE 186839

2 Way Solenoid Valves

Normally Closed and Normally Open Operation
Brass, Stainless Steel and Nylon Bodies • ¼" to 3" N.P.T.

ASCO Red-Hat
BULLETINS
8210, 8211

APE J-7370 REV. Ø
ATTACHMENT 2
SHT. 1 OF 3

General Description

These valves provide long trouble-free life on general service applications. A broad selection of body materials and operating pressures is available.

Applications

These dependable 2 way valves are used in:

- pumps
- spraying
- cooling
- air dryers
- pollution controls
- laundry equipment
- irrigation
- compressors
- dishwashers
- water treatment

Special valves available for: • dry air-gas • continuous cycling • exceptionally long life • heavy-duty operation • clickless and quiet (no AC hum) operation. Refer to Long Life Construction.

Specifications

Operation: Two types available:

(a) Normally Closed — valves closed when de-energized, open when energized.

(b) Normally Open — valves closed when energized, open when de-energized.

Valve Parts in Contact with Fluid:

Body — Brass, Stainless Steel (Series 300), Nylon or Bronze, as listed.

Seals and Discs — Buna "N," Teflon* or Ethylene Propylene, as listed.

Disc Holder — Nylon, as listed.

Core Tube — 305 s.s.

Core and Plugnut — 430F s.s.

Springs — 302 s.s.

Shading Coil — Copper (brass and nylon body); Silver (stainless steel body).

Solenoid Enclosures: Two types available:

(a) Type 1 — General Purpose.

(b) Types 4 and 7 (C and D) — Combination Watertight and Explosion-Proof. Also meets Types 3 and 9 (E, F and G). Refer to Engineering Section for definitions and details. Consult your local ASCO office for Types 3S and 4X.

Electrical: Standard Voltages:

24, 120, 240, 480 volts, AC, 60 Hz (or 110, 220 volts, AC, 50 Hz).

6, 12, 24, 120, 240 volts, DC.

Other voltages available when required.

*DuPont Co. trademark.



Coil: Continuous Duty Molded Class A, B, F and H, as listed.

Temperature:

Fluid: To 210°F., as listed.

Ambient: Nominal Range, 32°F. to 77°F. (104°F. occasionally — refer to Engineering Section.)

Installation:

Dimensions: Refer to Dimensions Tables for envelope size and mounting.

Attitude: Valves may be mounted in any position except as noted in Dimensions Table.

Approvals: UL listed and CSA certified, as indicated. Refer to Engineering Section for details and coding explanation.

SPECIFICATIONS

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Minimum	Maximum Air-Inert Gas AC	Maximum Air-Inert Gas DC	Maximum Water AC	Maximum Water DC	Maximum Light Oil @ 300 SSU AC	Maximum Light Oil @ 300 SSU DC	Maximum Fluid Temp. °F. AC	Maximum Fluid Temp. °F. DC	Type 1 General Purpose Solenoid Enclosure Catalog Number	Constr. Ref. No. ⑦	UL Listing	Types 4 and 7 (C and D) Watertight and Explosion-Proof Solenoid Enclosure Catalog Number	UL Listing	Watt Rating/ Class of Coil Insulation AC	Watt Rating/ Class of Coil Insulation DC
NORMALLY CLOSED OPERATION, Forged Brass Body, Buna "N" or Teflon® Seating for General Service																		
⅛	⅛	1.2	5	125	—	125	—	—	—	180	—	8210B20	3D	•	—	—	6.5/B	—
	1/16	1.2	5	125	—	125	—	—	—	180	—	8210B21	3D	•	—	—	6.5/B	—
¼	⅛	1.5	①	125	40	125	40	—	—	180	150	8210C73⑤	1P	•	8211C73⑤	•	6/A	11.2/A
	5/16	3	0	125	40	125	40	—	—	180	150	8210C93	5D	○	8211C93	○	11/A	11.2/A
	⅜	3	5	200	125	135	100	135	100	180	150	8210D3	6D	○	8211D1	○	6/A	11.2/A
	⅜	3	5	300	—	300	—	300	—	175	—	8210C6	5D	○	8211C6	○	16.7/F	—
⅜	7/16	2.2	①	125	40	125	40	—	—	180	150	8210A15	2P	•	8211A15	•	6/A	11.2/A
	½	4	5	200	125	135	100	135	100	180	150	8210D2	6D	○	8211D2	○	6/A	11.2/A
	½	4	0	125	40	125	40	—	—	180	150	8210C94	5D	○	8211C94	○	11/A	11.2/A
	½	4	5	300	—	300	—	300	—	175	—	8210C7	5D	○	8211C7	○	16.7/F	—
½	⅜	5	0	125	40	125	40	—	—	180	150	8210D95	8D	○	8211D95	○	11/A	11.2/A
	⅜	5	5	125	100	125	90	125	75	180	150	8210D9	9D	○	8211D9	○	6/A	11.2/A
	½	6	0	350	200	300	180	200	180	200	77	8210B26⑥	10P	⑤	8211B26⑥	⑤	15.4/A	30.6/H
	½	6.5	5	250	125	150	125	100	125	180	150	8210D3	11D	○	8211D3	○	6/A	11.2/A
1	1	13	5	125	125	125	125	100	125	180	150	8210D4	12D	○	8211D4	○	6/A	11.2/A
	1	13.5	10	300	225	300	200	300	200	200	180	8210E78⑥	13P	⑤	8211B78⑥	⑤	16.7/F	16.8/A
	1	13.5	0	300	—	225	—	115	—	200	—	8210B27	14P	•	8211B27	•	20/F	—
	1	13	0	125	100	125	100	125	80	180	77	8210B54	31D	⑤	8211B54	⑤	15.4/A	30.6/H
1¼	1⅛	15	5	125	125	125	125	100	125	180	150	8210D8	16D	○	8211D8	○	6/A	11.2/A
	1⅛	15	10	300	225	300	200	300	200	200	180	8210B80⑥	17P	—	8211B80⑤	—	16.7/F	16.8/A
	1⅛	15	0	125	100	125	100	125	80	180	77	8210B55	32D	⑤	8211B55	⑤	15.4/A	30.6/H
1½	1¼	22.5	5	125	125	125	125	100	125	180	150	8210D22	18D	○	8211D22	○	6/A	11.2/A
	1¼	22.5	10	300	225	300	200	300	200	200	180	8210B82⑥	19P	—	8211B82⑤	—	16.7/F	16.8/A
	1½	22.5	0	125	100	125	100	125	80	180	77	8210B56	33D	⑤	8211B56	⑤	15.4/A	30.6/H
2	1½	43	5	125	50	125	50	90	50	180	150	8210D100	20P	—	8211D100	—	6/A	11.2/A
2½	1⅞	45	5	125	50	125	50	90	50	180	150	8210D101	21P	—	8211D101	—	6/A	11.2/A
3	3	101	10	250	—	250	—	250	—	200	—	8210B51⑥	22P	—	8211B51⑤⑥	—	28/H	—

APE J-7370 REV. 0
ATTACHMENT 2
SHT. 2 OF 3

185839

SPECIFICATIONS (continued)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Minimum	Maximum Air-Inert Gas AC	Maximum Air-Inert Gas DC	Maximum Water AC	Maximum Water DC	Maximum Light Oil @ 300 SSU AC	Maximum Light Oil @ 300 SSU DC	Maximum Fluid Temp. °F. AC	Maximum Fluid Temp. °F. DC	Type 1 General Purpose Solenoid Enclosure Catalog Number	Constr. Ref. No. ①	UL Listing	Types 4 and 7 (C and D) Watertight and Explosion-Proof Solenoid Enclosure Catalog Number	UL Listing	Watt Rating/ Class of Coil Insulation AC	Watt Rating/ Class of Coil Insulation DC
NORMALLY OPEN OPERATION,② Forged Brass Body, Buna "N" Seating for General Service																		
⅛	⅛	3	0	125	125	125	125	125	80	180	150	8210C33	23D	•	8211C33	•	10.5/A	11.2/A
¼	⅛	4	0	125	125	125	125	125	80	180	150	8210C34	23D	•	8211C34	•	10.5/A	11.2/A
¼	¾ ⅜	5.5 8.6	0 5	125 250	125 250	125 200	125 200	125 200	80 200	180 180	150 180	8210C35 8210C13	25D 24D	• •	8211C35 8211C13	• •	10.5/A 15.4/A	11.2/A 16.8/A
1	1 1	13 13	0 5	125 125	— 125	125 125	— 125	125 125	— 125	180 180	— 180	8210B57 8210D14	34D 26D	• ③	— 8211D14	— —	20/F 15.4/A	— 16.8/A
1¼	1¼ 1¼	15 15	0 5	125 125	— 125	125 125	— 125	125 125	— 125	180 180	— 180	8210B58 8210D18	35D 28D	• —	— 8211D18	— —	20/F 15.4/A	— 16.8/A
1½	1¾ 1¾	22.5 22.5	0 5	125 125	— 125	125 125	— 125	125 125	— 125	180 180	— 180	8210B59 8210D32	36D 29D	• —	— 8211D32	— —	20/F 15.4/A	— 16.8/A
2	1¾	43	5	125	125	125	125	125	125	180	150	8210103	30P	—	8211103	—	15.4/A	16.8/A
2½	1¾	45	5	125	125	125	125	125	125	180	150	8210104	27P	—	8211104	—	15.4/A	16.8/A
NORMALLY CLOSED OPERATION, Forged Brass Body, Ethylene Propylene Diaphragm for Hot Water Service																		
⅜	⅜ ⅝	3 3	5 ④	—	—	125 100	100 40	—	—	210 210	150 150	8210D1HW 8210C93HW	6D 5D	⑤ ⑤	8211D1HW 8211C93HW	— ⑤	6/A 11/A	11.2/F 11.2/F
½	½ ½	4 4	5 ④	—	—	125 100	100 40	—	—	210 210	150 150	8210D2HW 8210C94HW	6D 5D	⑤ ⑤	8211D2HW 8211C94HW	— ⑤	6/A 11/A	11.2/F 11.2/F
¾	¾ ⅝	5 5	5 ⑤	—	—	125 100	100 40	—	—	210 210	150 150	8210D9HW 8210D95HW	9D 8D	⑤ ⑤	8211D9HW 8211D95HW	— ⑤	6/A 11/A	11.2/F 11.2/F
NORMALLY CLOSED OPERATION, Nylon Body, Buna "N" Diaphragm for General Service																		
½" O.D. Compression	½	1.2	5	125	—	125	—	—	—	130	—	8210B10	4D	•	—	—	6.5/B	—
NORMALLY CLOSED OPERATION, Stainless Steel Body, Buna "N" Diaphragm for Corrosive Liquids and Gases																		
⅛	⅛	1.5	⑤	125	40	125	40	—	—	180	150	8210A36④	1P	•	8211A36⑤	•	6/A	11.2/A
⅛	7/64 ⅛	2.2 4	⑤ 0	125 125	40 40	125 125	40 40	— 125	— —	180 175	150 150	8210A37⑤ 8210C87	2P 7D	• •	8211A37⑤ 8211C87	• •	6/A 16.7/F	11.2/A 11.2/A
¼	⅜	4.5	0	125	40	125	40	125	—	175	150	8210C88	7D	•	8211C88	•	16.7/F	11.2/A
1	1	11.2	0	125	100	125	100	125	80	180	177	8210D89	15D	⑥	8211D89	⑥	15.4/A	30.6/H
NORMALLY OPEN OPERATION, Stainless Steel Body, Buna "N" Diaphragm for Corrosive Liquids and Gases																		
½	⅜	3	0	125	125	125	125	100	80	180	150	8210B38	37D	•	8211B38	—	10.5/A	11.2/A
¾	⅜	3	0	125	125	125	125	100	80	180	150	8210D38	38D	•	8211D38	—	10.5/A	11.2/A

Notes: ②5 psi on air and inert gas; 1 psi on water.
①Letter "D" denotes diaphragm construction; "P" denotes piston construction.
③Main valve has bronze body.
④"0" psi on AC construction, ½ psi on DC.
⑤UL listed as General Purpose Valve on AC voltage only.
⑥Valve includes Ryton (Phillips Petroleum trademark) piston.
⑦Valve includes nylon disc holder, except 8210B57, 8210B58, 8210B59.
⑧Valves provided with Teflon main seat.
⑨Suitable for Types 4 and 7 (C and D) only and has a temperature range code T2B.

ELECTRICAL INFORMATION

Standard Coil and Class of Insulation	Watt Rating and Power Consumption DC Watts	AC Watts	AC VA Holding	AC VA Inrush	Spare Coil Part No. AC	Spare Coil Part No. DC
A	11.2	6	15.6	34	96-619	27-463
F	11.2	—	—	—	—	66-611
A	16.8	10.5 & 11	23	55	27-462	96-671
H	30.6	—	—	—	—	74-073
A	—	15.4	23.6	70	96-817	—
F	—	16.7	35	78	64-982	—
F	—	20	43	240	99-257	—
H	—	28	57	250	222-345	—
B	—	6.5	9.2	17.3	204-945	—

OPTIONAL FEATURES

Many optional electrical and construction features are available, refer to Optional Feature Section.

ORDERING INFORMATION

IMPORTANT: We must have CATALOG NUMBER, VOLTAGE and HERTZ, operating pressure and fluid handled. Use strainers with solenoid valves.

ITEM - 56

CUSTOMER P.O. NO. 5-03188

INSTRUCTION & OPERATING MANUAL W/DRAWINGS

EQUIPMENT: INVERTER -IP2

MODEL: SV12100/TSNB/TSMB

SERIAL NO: 7643-1,-2
State Inverters 21+22

State Inverter, 21+22
DN 4661

ABOVE EQUIPMENT IS COVERED BY THE FOLLOWING PATENT NUMBERS

3,273,071	3,310,728	3,382,455
3,422,342	3,515,894	3,515,895
3,515,896		

OTHER PATENTS PENDING

CONTENTS

	SECTION
Specifications & Applicable Drawings	1
Installation & Operating Instructions	2
Circuit Description	3
Maintenance & Trouble Shooting	4
Inverter Accessories	5
Battery Charger	6
Batteries & Racks	7

THESE INSTRUCTIONS do not purport to cover all details or variations in equipment nor to provide for every possible contigency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to:

SOLIDSTATE CONTROLS, INC. SCI

600 Oakland Park Avenue
Tel. 614-263-1886

Columbus, Ohio 43214
Telex-245-338

COVER DRAWING

OUTLINE DWG. 011D10920 TYPE 10 KVA INV SCI JOB 2643

CUSTOMER (CON. ED.) INDIAN POINT UNIT #2

QUAN.	SECTION	ASS'Y DWG.	BILL OF MAT'L	P.L.	SCHEMATIC
1	CABINET PARTS		100A10995		
1	INV. PLATE ASSY	110D7426	110A7426-1	10960	014D10960
1	SUPL. B/M TO INV PLT.		110A10972		"
1	SM. P.C. BD ASSY	160C7417	160A7417		"
1	VERT. P.C. BD. ASSY	190A10973	190A10973		"
1	INV/CAB. ASSY	100D10962	100A10962		"
1	10 KVA CVT	170C7648-6	170A7648-6	1302	022B7831
1	INV BRIDGE ASSY	150D7091	150A7091-14	10960	014D10960
1	C5 ASSY	170C7564-2	170C7564-2	2831	022B7831
1	MAN. BYPASS SW. BOX	370C10966	370A10966	10960	014D10960
1	STATIC SWITCH			10961	015C10961
1	SYNC BD	V111		9925	018D9925
1	FREQ DETECTOR BD	V092B		1177	018D7748
1	SCR SHORTING BD	V065C-2		1192	018C7406
1	GATE XFMR BD	V093A		521	018B3950
1	OSC BD	V091B		1163	018D7305
2	DC VOLT SENSE BD	V108A		9896	018D7696
1	DC NOISE SUPP'R BD.	V105		1117	018B7109
	CVT - G.E. 10KVA				
	BATTERY CHARGER				
1	STATIC SW. CONTROL BD	V107A		1157	018C7279

INPUT _____ VAC _____ AMPS AC

_____ FREQ _____ PHASE

105-140 VDC 112.0 AMPS DC

OUTPUT 113 VAC 84.7 AMPS AC

60 FREQ 1φ PHASE

_____ VDC _____ AMPS DC

LOAD 10KVA

MODEL NO. SV10100/TS100NB/TS100MB

SERIAL NO. 2643-1 2

DATE 6-3-13 DWG. BY SGK

Calculation FEX-00204-00
Rev. 0
Attachment S
Page 203 of 219

SOLIDSTATE CONTROLS INC.

600 OAKLAND PARK, COLUMBUS, OHIO

SECTION 2

INSTALLATION & OPERATING INSTRUCTIONS

Unpacking and Handling

Immediately upon receipt of the unit, it should be inspected for damage in transportation. This should include a visual inspection, looking for bent or deformed panels, broken terminal blocks, loose wiring, damaged transformers, heat sinks, or any other evidences of rough handling. If damage is found either internally or externally, the delivering freight carrier must be contacted immediately so a freight claim inspection can be made. Do this before proceeding further. Claims for transportation damages should be made against the transportation company.

Some packing material (tape, cardboard, bracing, etc.) may be used inside the inverter for shipment. Be sure this material is removed prior to operation.

If at any time the equipment is to be shipped to another location, all movable panels, doors, etc. shall be firmly secured. Tape and packing material should be used to insure against panels and doors opening do to vibration. Other heavy components, such as large transformers, should be protected against unusual stresses incurred in shipment. Meter fronts, switches, and indicators must be protected against coming in contact with shipping container. All cabinets must be shipped standing erect. Whenever equipment is to be shipped to Solidstate Controls, Inc., the SCI Field Service Department must be contacted for instructions prior to shipping.

Locating the Equipment

The area in which the unit is installed must be clean, dry and well ventilated. The unit must not be placed near radiators, boilers or other heat producing devices. Grinders, buffing wheels or other sources of grit, dirt, lint or mist which can cause deterioration in the efficiency of the heat sinks, should not be located in the vicinity of the inverter.

A minimum of six inches clearance should be allowed around louvered panels to provide for adequate air flow. On units having an open lifting base, the flow of air under the unit should not be blocked.

INSTALLATION

Before placing unit into operation, the necessary input and output connections must be made. The following procedure is recommended:

1. A thorough visual inspection of the equipment should be performed to check for damage in shipment as well as to familiarize the operator with component locations, adjustment points and input and output connection terminal blocks.
2. Turn all switches and circuit breakers to the "OFF" position.
3. Connect the specified DC voltage to the INPUT DC terminals using a wire size heavy enough to safely carry the nameplate DC current value. Note that the *reverse polarity light*, (an optional extra), will glow if the DC voltage is reversed. Never close any switches or breakers when this light is on. The DC polarity must first be corrected.
4. Connect the specified load to the *OUTPUT* terminals using a wire size heavy enough to safely carry the nameplate output currents.
5. If the unit has the AC input option (see Specifications), connect the specified voltage to the *AC INPUT* terminals using a wire size heavy enough to safely carry the nameplate AC input current.
6. If the unit has an alternate source input, connect the alternate source input terminals to voltage source of the correct amplitude and phase, using a conductor of a size that will be capable of carrying the full load current. The source must be properly phased to the inverter for the proper operation. See Section 5
7. With the connections correctly made, check (measure) the input voltages at the terminals for correct magnitude. Turn the *INVERTER OPERATIONS* or *BATTERY INPUT* circuit breaker to the "ON" position. At start up, an audible hum will be heard. Next, turn on the *AC OUTPUT* breaker. Check with meters for proper output voltage, current and frequency. The frequency has been pre-set at the factory to the desired value when the unit was thoroughly warm.
   If, due to the user's particular operating conditions the frequency should be out of tolerance, a small screw adjustment (Variable pot) is provided at the edge of the printed circuit oscillator board. Access to the oscillator is obtained by opening the hinged inverter door panel. Adjust this control while watching the frequency meter or an oscilloscope with line synchronization. *ALWAYS BE CAREFUL OF EXPOSED CONTACTS WHEN THE PANEL IS OPEN.*

The switches used in Figure 3-2 are not static since a switch contains moving parts. In Figure 3-3, the mechanical switches have been replaced with an electrical switch, the silicon controlled rectifier. Also shown are the commutating inductors L and commutating capacitor C. These components are necessary to turn one pair of controlled rectifiers off as the opposite pair are turned on. Turn-on is accomplished by the application of voltage to the gate leads of the controlled rectifiers by the oscillator.

Rectifier diodes RT1, RT1', RT2, and RT2' are not a part of the basic inverter switching circuit. They serve to clamp the amplitude of the load voltage to a value approximately equal to the magnitude of source voltage.

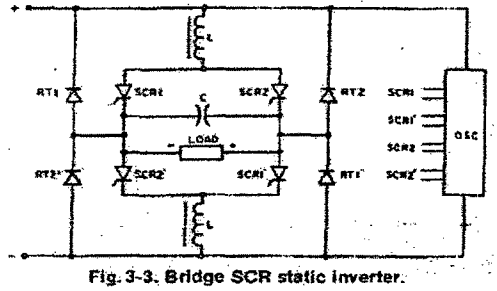


Fig. 3-3. Bridge SCR static inverter.

Figure 3-3 shows the diagram of a bridge-connected static inverter. This arrangement is frequently used for source voltages of 130, 260, and 600 volts. For source potentials of 12, 24, and 48 volts, the circuit of Figure 3-4 is frequently employed. Its operation is seen to be similar to that of the bridge circuit. It differs in that half the number of controlled rectifiers are used, and each must hold off a voltage approximately equal twice the supply voltage.

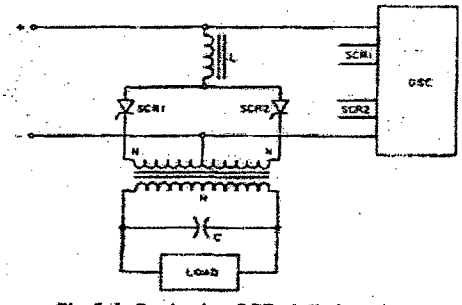


Fig. 3-4. Center-tap SCR static inverter.

Figure 3-5 shows a block diagram of the oscillator which controls the SCR's through properly spaced gating signals.

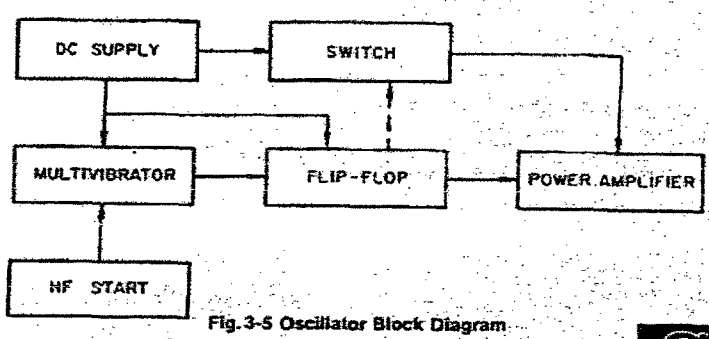


Fig. 3-5 Oscillator Block Diagram

4. Turn the unit off and remove the resistor. Place the oscilloscope leads across terminals 1 & 2 of the transformer located on this printed circuit board.
5. Restart the unit and adjust R-1 to make the waveform as nearly square as possible. There should be little or no rounding on the trailing edge of either the positive or negative half cycles. See drawing 3 7

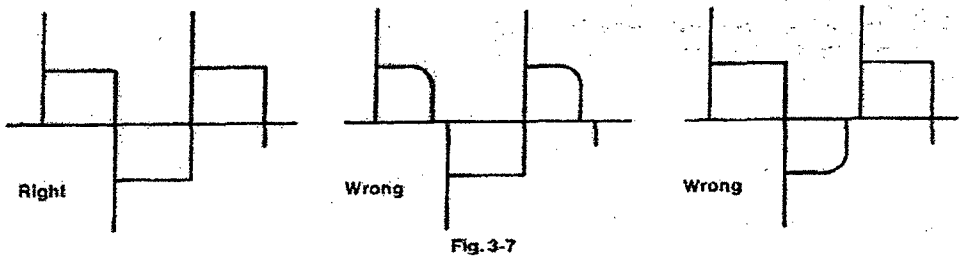


Fig. 3-7

SECTION 4

MAINTENANCE & TROUBLE SHOOTING TIPS

SCI Static Inverters do not require planned maintenance or preventive maintenance of the type associated with rotary inverter or conversion equipment. Rather, a periodic measurement of the output voltages and currents and output frequency will suffice as a check on the "heartbeat" of the static inverter.

All of the above quantities can be read on standard test equipment meters. At an installation where line voltage, battery voltage and inverter load are not subject to much deviation, a monthly scanning of the above quantities is sufficient. Observation rate should be increased or decreased as the installation dictates. A few rules of thumb follows:

1. If output voltage is below rated,
   a. input voltage is too low
   b. the inverter output is overloaded
   c. output AC frequency is too low.
2. If output frequency is too low or too high,
   a. input voltage is out of spec.
   b. ambient temperature is outside limits
   c. frequency "fine tuning" should be accomplished at the normal operating temperature.
3. Inverter will not start - breaker trips or fuse blows.
   a. input voltage is too high
   b. an SCR has failed
   c. one of the four clamp diodes around SCR bridge has failed
   d. a failure has occurred on one of the printed circuit boards. They should be replaced one at a time starting with the oscillator.
   e. a highly reactive load is connected to the inverter output
   f. the constant voltage transformer is magnetically saturated.

   If the inverter is single phase, reverse the leads 1 & 2 of the gate board and attempt to operate the inverter. After operating reconnect leads to their original position. If the inverter is three phase, operate each of the interter's single phase. This can be done by removing the wires connected to terminals 1 & 2 of each of the gate boards, except the one in the phase being operated. If single phase operation cannot be obtained, reverse the leads on 1 and 2 of the gate board and attempt to operate that inverter single phase again. After operating each of the three inverters single phase, they may all be reconnected with the leads on the gate boards connected back in their original position.
4. Inverter will not start - breaker does not trip or fuse does not blow.
   a. if input D.C. is a steady ½ to 1 amp. into the inverter, the oscillator board is at fault.
   b. if no input is seen, check for loose connections at the inverter input. Measure the voltage at the input to be sure it is present.

PARTS LIST NO 10960 SH. 1 OF 2

ASS'Y DWG. 100D10961 DATE 5-23-75 DWG. BY SQ VELTEN

SCHEMATIC 014D10960 SCI JOB 7643

TITLE SV12100 10KVA Inverter 129VDC

REV.	QUAN	ITEM	DESCRIPTION	UNIT PRICE	TOTAL PRICE
	1	A1	AC Ammeter - GE 251 0-100 amp. AC 1%		
	1	V1	AC Voltmeter - GE 251 0-150 VAC 1%		
	1	FMR1	FREQUENCY DETECTOR METER, BEEDE MR-23-05-01 (0-100 mS DC MOVEMENT) 1%		
	1	CT1	Current Transformer- Midwest# 3CT11B		
	1	CB1	Circuit Breaker- Westinghouse FB2150 W/110VDC SHUNT TRIP COIL		
	1	CB2	Circuit Breaker- Westinghouse CA2225N		
	1				
	1	CB4	Circuit Breaker- Westinghouse QCAL2100		
	1	CB5	" " (H) CJ2-G3-4-175-P		
	4	SCR1-4	SCR- SCI-235825N15		
	2	D2, 3	Diode- SCI-70D30		
	2	D4, 5	Diode- SCI-70D30R		
	7	C1	Capacitor- 5400x200-86P		
	4	C2	Capacitor- 40x150-331P		
	2	C4	Capacitor- 8200x25-36D		
	4	C15-18	Capacitor- 0.47x75-225P		
	1	R1	Resistor- 100x100FB		
	1	R4	Resistor- 1.5Kx25F		
	1	R5	Resistor- 10x25A		
	4	R15-18	Resistor- 100x.5P		
	1	CH1	Choke- SCI-T-4933		
	2	CH2, 3	Choke- SCI-T-545		
	1	T4	Transformer- Stancor# P-6377		
	1	CVT-1	CVT- SCI 10 KVA, Schematic 022B7831, P.L. 1302		
	2	FN1-2	FAN SCI10"		
	1	V065C-2	SCR Shorting Bd.- V065C-2 P.L. 1192		
	1	V073A	Gate Xfor. Bd.- V073A P.L. 521		
	1	V091B	Oscillator Bd.- V091B P.L. 1163		
	1	V105	DC Noise Suppressor Bd.- V105 P.L. 1117		

REV.	DATE	DR.	REV	DATE	DR.
A	7-10-75	LWF			

SOLIDSTATE CONTROLS INC.

600 OAKLAND PARK, COLUMBUS, OHIO

PARTS LIST Nº 10960 SH. 2 OF 2

ASS'Y DWG. 100D10961 DATE 5-23-75 DWG. BY S.Q. VELTEN LWF

SCHEMATIC D14D10960 SCI JOB 7643

TITLE 5VI2100 10KVA INVERTER 128VDC

10960

V.	QUAN	ITEM	DESCRIPTION	UNIT PRICE	TOTAL PRICE
	2	AFS1-2	AIRFLOW SWITCH - ROTRON 2A-1000		
	1	A2	DC AMMETER - G.E. 0-150 AMP DC 1%		
	1	V2	DC VOLTMETER - G.E. 0-150 VDC 1%		
	1	V0928	FREQ DET BOARD - V0928 PL 1172		
	2	V10BA	DC VOLT SENSE BD - V10BA - PL9226		
	1	V111	SYNC BD - V111 PL9225		
	1	SH2	SHUNT - SIMPSON - 06714 (150 AMP)		
	1	SW1	MANUAL SWITCH - ELECTRO SW 107303A-35		
	1	RL1	RELAY - P&B KRP-11DG 110VDC		
	1	RL2	RELAY - P&B CHB-38-10001 120VAC (1-10SEC)		
	1	D14	DIODE - EOAL BASES		
	3	QA1-3	QUENCHARC - PARTRON QC-100 .1MFD & 100Ω		
	1	TY2	THYRECTOR - G.E. CR555P585		
	1	FU3	FUSE - BUSS MTH-5		
	3	PL3,4,5	PILOT LIGHT - LEECRAFT 32R2113T 125V NEON (AMBER)		
	1	PL6	PILOT LIGHT - LEECRAFT 32R2111T 125V NEON (RED)		

REV.	DATE	DR.	REV.	DATE	DR.
A	7-10-75	LWF			

SOLIDSTATE CONTROLS INC.

600 OAKLAND PARK, COLUMBUS, OHIO

PARTS LIST NO 10961 SH 1 OF 1

ASS'Y DWG. 100D10962 DATE 5-28-75 DWG BY S.O.Velten LWP

SCHEMATIC 015C10961 SCI JOB 2693

TITLE 1 Ø Static Switch - 5 - 10 KVA

REV.	QUAN	ITEM	DESCRIPTION	UNIT PRICE	TOT. PRICE
	1	FU4	Fuse - Chase Shawmut Form 101 A13x150		
	4	SCR7-10	SCR - SCI 110S50N30		
	1	PL1	Pilot Light - Leecraft - 125 V. Neon 32R2113T (amber)		
	1	PL2	Pilot Light - Leecraft - 125 V. Neon 32R2111T (red)		
	2	PB1-2	Push Button Switch - Micro Switch 2PB7 (Black)		
	1	CT2	Current Transformer SCI T-879		
	1	R2	Resistor - 25x25A		
	1	V107A	Static Switch Control Board - V107A - P.L. 1157		
	2		Guards - Grayhill #10C1015		

REV.	DATE	DR.	REV.	DATE	DR.

SOLIDSTATE CONTROLS INC.

600 OAKLAND PARK, COLUMBUS, OHIO

RECOMMENDED SPARE PARTS LIST NO. SPL-304D

PREPARED BY KEE/ih DATE 12-4-74 SH. 1 OF 1

TITLE SV12100

QUAN	ITEM	DESCRIPTION	UNIT PRICE	TOTA PRIC
1	C1	Capacitor - 5400 mfd @ 200 VDC		
1	C2	Capacitor - 40 mfd @ 150 V. Sq. Wave		
1	C4	Capacitor - 8,200 mfd @ 20 VDC		
1	C5	CVT Capacitor - 13 mfd @ 1,000 VAC		
2	D2,3	Diode - SCI 70D30I		
2	D4,5	Diode - SCI 70D30R-I		
4	SCR 1-4	SCR - SCI 235S25N15		
1	V091B	Oscillator Board - V-091B		
1	V073A	Gate Transformer Board - V-073A		
1	V065C2	Shorting Board - V-065C2		
1	V110A	Sync Board - V110A		
10	ACC	Fuse - Buss MTH5		

RECOMMENDED SPARE PARTS LIST NO. SPL-447D

PREPARED BY KEE/jh DATE 10-29-74 SH. 1 OF 1

TITLE TS-050-NB through TS-100-NB

QUAN	ITEM	DESCRIPTION	UNIT PRICE	TOTAL PRICE
10	FU4	Fuse - C.S. Form 101 A13x150		
4	SCR 7-10	SCR - SCI 110S50N80		
1	V-107A	Control Board - V107A		

SECTION 5

V-092 FREQUENCY DETECTOR BOARD

The V-092 frequency detector has been properly aligned at the factory using calibrated instruments. Several potentiometers are located on the board. Their purpose is to provide a means for accurately calibrating the device throughout it's indicated frequency range. No attempt should be made to completely re-align the circuit in the field. However, re-correction of an indicated error 0.1 Hz., or less may be accomplished by adjusting potentiometer R5. If indicated error is greater than 0.1 Hz., it is advised that the unit be returned for recalibration as interaction of potentiometer adjustment exists affecting absolute accuracy of other indicated frequencies.

SECTION 5

AC & DC VOLTAGE SENSING PRINTED CIRCUIT BOARDS

The AC & DC voltage sensing printed circuit boards are designed to be used in a variety of applications in which a relay contact has to be closed or opened when a voltage threshold has been passed. The DC voltage sensing circuit is made up of components which are mounted on a V-108 printed circuit board. The AC voltage sensing circuit is a variation of the DC circuit and carries the number V-108-1. The DC circuit has a voltage adjustability of from 100 to 145 volts DC, while the AC circuit covers a range of 90 to 130 volts AC. In both cases, the voltage limit is adjusted by rotating potentiometer R2. The AC and DC boards operate in such a way that that relay RL1 is de-energized when the voltage, being applied to the board is below the threshold limit set on potentiometer R2. For example, if R2 is adjusted so that the board will have a threshold value of 120 volts, and the voltage is increased slowly from 110 volts, the relay will begin de-energized and become energized as 120 volts is passed. By selecting the appropriate contacts on the relay, this allows the board to be used as either a high voltage or low voltage detector.

In many applications the board will be used for strictly alarm purposes. In these applications, the relay contacts will be brought out to terminal strips for customer connection or may be connected to an indicator lamp which becomes illuminated under alarm conditions. In other applications, the board may be inter-wired with other parts of the circuit to perform automatic functions. For example, the board may be used to trip a circuit breaker which has a shunt trip installed under a condition of low battery. It will be necessary to consult the schematic on the over-all system to determine precisely how the board is being applied.

If difficulty develops in a circuit that employs a voltage sensing board, the board should be tested to determine whether it's functioning normally. Prior to removing the board from the unit, fuse FU1, located on the p.c. board should be examined to be certain that it is not blown. If the fuse appears to be good, but the circuit is still inoperative, the p.c. board should be removed from the unit for bench alignment. Apply either DC or AC voltage (as appropriate) from a variable source to terminals 1 & 2 of the printed circuit board. If the input voltage is DC, the positive lead should be connected to terminal #2, and the negative to terminal #1. Adjust the input voltage over the appropriate range (as mentioned above) and listen for an audible click of relay RL1. If no click is heard, the printed circuit board is defective and should be replaced with a new one. If the relay does click, but does so at the wrong voltage, the voltage should be set to the desired value and control R2 adjusted until the relay just changes states. The printed circuit board can now be re-installed in the unit by re-connecting all the wires to terminal strip TS1.

SECTION 5

STATIC SWITCH TRANSFER ACCESSORY

For installations requiring the utmost in continuity of power to a critical load, the static switch offers a virtual zero time transfer in case of inverter failure.

The switch can be configured to transfer on any of three modes of abnormal operation.

1 - THE FAILURE OR DETERIORATION OF THE INVERTER SQUARE WAVE

Practically all possibilities of inverter component failures result in the deterioration or complete collapse of the square wave. This is the earliest sign that the inverter output (out of the CVT) will be sustained for only a few more milliseconds. The electrical "monuntum" of the CVT causes the output to be sustained for a few milliseconds following a failure at the input.

2 - THE FAILURE OR DETERIORATION OF THE SINUSOIDAL OUTPUT VOLTAGE OF THE FERRO-RESONANT FILTER (CVT)

The reason for sensing at this point is not necessarily to spot a failed CVT (it is an extremely long-life device), but rather to sense a slow (several cycles) amplitude change in the output sine wave due to a gradual overload or an inverter frequency deviation which causes the CVT output to deviate high or low from the nominal output level.

3 - A BRANCH LOAD FAULT OR SIMPLY AN OVERLOAD WHICH EXCEEDS THE CURRENT CAPACITY OF THE INVERTER AND CVT

This mode is useful for clearing branch fuses in the shortest possible time (the actual clearing time is more dependent on the auxiliary source and the fuse characteristics than on the static switch). This mode is also useful for preventing an inverter overload, which collapses output voltage when load for any reason accumulates beyond the inverter rating whether by accident or intent.

SECTION 5

ALIGNMENT OF THE SINGLE-PHASE STATIC SWITCH

The static switch contains two small controls located on the printed circuit board marked V-107. These control the overcurrent transfer threshold limit and the undervoltage level at which transfer occurs. The controls are adjusted at the factory, however, if further alignment should be required, it should be done in accordance with the following procedure.

CURRENT SENSE:

1 - Rotate R-22 fully counter-clockwise
Rotate R-23 fully counter-clockwise

2 - Load the inverter beyond it's normal full load current to the desired trip current. This is usually in the area of 120% of full load output current.

3 - Rotate R-22 slowly counter-clock until the switch transfers.

4 - Reduce the load to normal.

VOLTAGE SENSE:

1 - Disconnect the leads from TB2-3 & TB2-4 with the power off.

2 - Insert a variac between the leads and the terminal TB2-3 & 4 such that the voltage to the board can be reduced.

3 - Reduce the voltage at the terminals TB2-3 & 4 to the desired transfer value (usually 70% of the nominal output voltage).

4 - Rotate R-23 slowly clockwise until the switch transfers.

5 - Shut the unit off and re-connect the wires to the terminals.

SECTION 5

SYNCHRONIZING CIRCUIT ACCESSORY
V-111

The synchronizing circuit function is to compare the frequency and phase of a reference 120 VAC, 60 Hz., sine wave to the inverter output and cause the inverter to run at the same frequency and in-phase with the reference source. If the reference source fails, or is off frequency by more than approximately ± .7 Hz., the inverter will revert to its original free-running frequency and continue to operate until the reference source returns to its normal value.

The frequency detector determines that the reference frequency and the inverter output frequency are close enough to synchronize and then the phase detector circuit causes an in-frequency and in-phase condition to exist. During normal operation, the inverter will be synchronized to within 5 or 10 electrical degrees of the alternate source. This permits make-before-break load transfers via static and manual switches when these options have been supplied.

The sync circuit also illuminates a panel indicator which indicates that an in-sync condition exists when the lamp is lit. In addition, inter-lock contacts are available which lock out manual transfers of the static switch if this option has been supplied with the static inverter. The synchronizing circuit has been carefully factory tested for proper operation and adjustment is not possible in the field. Before determining that the synchronizing circuit is not properly operating, the user should insure that the free-running frequency of the inverter is indeed 60 Hz. This can be done by disabling the alternate source to the inverter (usually by turning the alternate source breaker off) and noting the inverter output frequency. It is important that this frequency be set as closely as possible to 60 Hz. If after adjusting the frequency to 60 Hz., the synchronizing circuit still does not work, the V-111 board should be replaced and returned to the factory for repair.

SOLIDSTATE CONTROLS, INC. SCI

600 OAKLAND PARK AVENUE* COLUMBUS, OHIO 43214

STANDARD TERMS AND CONDITIONS

1. SALES CONTRACTS:
(A) All quotations, proposals, bids or similar communications from Solidstate Controls, Inc. (hereinafter referred to as "Solidstate") shall be considered "invitations to contract." All orders placed by customers shall be considered "offers," and acknowledgements of orders by Solidstate shall be considered "acceptances," and when mailed, shall then result in a binding sales contract with respect to which these standard terms and conditions shall be a part. Acceptances may be made only at the Solidstate Home Office and all sales contracts shall be made pursuant to and controlled by the laws of the State of Ohio.
(B) Notwithstanding any term which may appear on customer's purchase order to the contrary, Solidstate's equipment, parts and services are sold only upon these standard terms and conditions.

2. ORDERS:
An order placed with Solidstate must be in the form of a written purchase order.

3. PRICES:
(A) Equipment and parts prices are f.o.b. Solidstate's plants.
(B) In addition to the prices quoted customer shall pay to Solidstate the amount of all present or future sales, use, privilege, occupational, excise or other similar Federal, State or local taxes which Solidstate is required to pay or collect in connection with customer's order.

4. DELIVERY:
(A) Shipping dates are subject to review at the time customer's order is accepted and will be determined at that time on the basis of Solidstate's then current shipping commitments.
(B) Shipping dates are quoted in good faith. Solidstate, however, will not be liable for loss or damage due to delay or failure to make delivery when such delay or failure is caused by fire, strike, civil or military authority, war, hostilities, governmental action, failure of suppliers to make delivery as scheduled, or other causes beyond the reasonable control of Solidstate. Further, Solidstate will not be liable for delays in shipment caused by or within the reasonable control of the customer.
(C) Unless otherwise specified, all deliveries to customer will be made f.o.b. Solidstate's plant and title and risk of loss shall pass to customer at said point. Shipments normally will be made via the most economical means and routing consistent with the handling requirements of the type of equipment involved. Solidstate, however, reserves the right to select the means of transportation and routing.

5. USE OF TRADEMARKS:
The acceptance by Solidstate of an order from customer for equipment bearing the registered trademark or other marks of Solidstate, does not automatically grant to customer the right to use such marks in advertising his products. All advertising material incorporating such marks in any manner must be approved by Solidstate prior to its release to the public.

6. REPRODUCTION OF DOCUMENTS:
When reproducible masters of drawings or other documents bearing a "proprietary data" legend are furnished to the customer, a reasonable number of copies may be made: (1) for the customer's own use, and (2) for the use of qualified vendors or parts suppliers, to the extent necessary for installation, operation, or maintenance of the equipment. No other disclosure, reproduction, or other use of documents bearing a restrictive legend may be made except upon written permission of Solidstate.

7. PATENT RIGHTS:
The sale of equipment to customer under these standard terms shall in no way be deemed to confer upon customer any right of interest in the patents or patent applications of Solidstate covering the equipment so sold, unless otherwise specifically provided.

8. WARRANTY:
(A) Standard Warranty — Solidstate will replace, f.o.b. its factory, any part or parts of its products and equipment sold new and delivered pursuant to the terms of any agreement between Solidstate and customer, which part or parts, upon inspection by Solidstate, are proven defective in workmanship or material within one (1) year after date of delivery to customer. This warranty, however, (a) extends only to, and is intended for the benefit only of, customer (original purchaser), and does not obligate, and shall not be construed to obligate, Solidstate to any person or organization other than customer; (b) is effective only when customer returns such defective part or parts to Solidstate's factory, transportation prepaid, immediately upon customer's discovery of the defect in question; (c) is not effective when the part or product in question is, or has been, operated beyond rated capacity, used or applied improperly, or used with parts which are not made or recommended by Solidstate; and (d) does not render Solidstate liable for any claim or claims for damages which may result, directly or indirectly, from any defect in any part or parts manufactured by Solidstate; except to replace the part or parts in question.
(B) In lieu of returning defective part or parts to Solidstate's factory as specified in subparagraph (b) of the foregoing standard warranty, the customer may request Solidstate to make necessary repairs on site when, in the sole discretion of Solidstate, such repairs on site are practical. Solidstate shall supply manpower for this purpose at one half the standard per diem rate normally charged for field service. Customer shall also pay to Solidstate the cost of traveling expenses incurred by Solidstate personnel traveling to and from said site, and living expenses of such personnel while so traveling and while on site.
(C) Solidstate shall in no event be liable for consequential or special damages.
(D) Solidstate makes no express or implied warranty that the use of its equipment, or any part thereof, does not infringe any valid patent. In the event any suit or legal proceeding is brought against customer which suit or legal proceeding is based upon a claim that any equipment, or any part thereof, furnished pursuant to the terms of any agreement or agreements between Solidstate and customer constitutes an infringement of any valid United States patent, Solidstate will arrange for the defense of such suit or legal proceeding on behalf of the customer, provided that Solidstate is notified promptly in writing of the institution of any suit or legal proceeding, and given the authority, information, assistance and co-operation (at Solidstate's expense) necessary and convenient for the defense of such suit or proceeding. Solidstate shall pay all damages and cost awarded against customer in such suit or proceeding. In the event such equipment or any part thereof is held in such suit or legal proceeding to constitute an infringement and the use of such equipment or part is enjoined, Solidstate shall, at its own expense and at its option, either (a) procure for customer the right to continue using such equipment or parts; or (b) replace such equipment or parts with non-infringing equipment or part; or (c) modify such equipment or parts so that it or they become non-infringing; or (d) remove such equipment or parts and refund the purchase price less a fair and reasonable rental fee not to exceed the purchase price of said equipment, to customer. This paragraph does not apply to any equipment or parts manufactured by Solidstate in accordance with a design or designs furnished to Solidstate by customer. As to such equipment or parts, Solidstate assumes no liability whatsoever for patent infringement. The foregoing states the entire liability of Solidstate for patent infringement by said equipment, any part thereof, or the use thereof.
(E) Solidstate shall in no wise be deemed to be obligated, liable, or accountable upon or under any guarantee, express or implied, statutory by operation of law or otherwise, in any manner or form beyond the express guarantees made in this section.

9. INSTALLATION:
Solidstate's equipment may be installed under the supervision of Solidstate engineers. Such supervisory services will be provided at Solidstate's then current standard service charge rates. Solidstate's current standard service charge rates are available upon request.

10. RETURNS:
(A) No equipment or parts may be returned for credit without written approval from Solidstate's home office.
(B) Equipment or parts for which return is authorized must be shipped prepaid to Solidstate's plant.

11. CANCELLATION CHARGES:
(A) Failure to accept and pay for equipment or parts ordered will subject customer to cancellation charges in whole or in part as follows:
(1) The full selling price for equipment or parts completed, or scheduled for completion within 30 days of the date customer gives notice of his refusal to accept shipment.
(2) Full costs, including overhead charged or accrued, plus 50%, for all equipment and parts actually in process and which are scheduled for completion more than 30 days from the date customer gives notice of his refusal to accept shipment.
(3) Solidstate's full cost plus 25%, for any raw materials or supplies purchased or contracted for by Solidstate for customer's order as of the date customer gives notice of his refusal to accept shipment.
(B) Any equipment or parts paid for by customer will become customer's property and shall be removed at his expense within 30 days from the date customer gives notice of his refusal to accept shipment. If not removed within 30 days, the equipment or parts will be shipped to customer at his expense.

12. CORRECTION OF ERRORS:
Solidstate reserves the right to correct any obvious errors in specifications or prices.

INSTRUCTION BOOKS AND DRAWINGS — See over

SCI

D O M E S T I C

FACTORY SERVICE RATES

Effective August 1, 1975

FACTORY SERVICE

Trained factory personnel are available for service, installation and maintenance in connection with equipment manufactured by SOLIDSTATE CONTROLS, INC., and, in some cases, for work on related equipment. Service is normally available on 48 hours notice, but every effort will be made to provide immediate attention for emergency situations.

Standard rates are as follows:

$225.00 per day portal plus travel and living expenses, with one and one-half times above rate for over eight hours per day or for work done on week-ends or holidays.

The above rates apply to all locations for work to be done in the continental United States, Mexico, Canada, Hawaii, and certain portions of the Caribbean area. To arrange for factory service, call or write the Vice-President of Engineering, at the address below. Above rates subject to change without notice or by negotiation as special conditions warrant.

SOLIDSTATE CONTROLS, INC. SCI

FACTORY RETURN INSTRUCTIONS

The following instructions apply to any item to be returned to the factory for repair and return to customer:

1. Return of equipment must have prior approval of SOLIDSTATE CONTROLS INC. To arrange for approval and directions for returning parts contact:

Factory Service Department
SOLIDSTATE CONTROLS, INC.
600 Oakland Park Avenue
Columbus, Ohio 43214
Tel. 614-263-1886
Telex: 245-338

2. Each item should be appropriately packed to avoid shipping damage and addressed exactly as directed by SCI.

3. Malfunction symptoms or any abnormalities observed by the customer should be reported with either an accompanying letter or a telephone call.

4. In the event the returned item is a part rather than a complete unit, the serial number of the complete unit *MUST* accompany the returned part.

5. All returned items should be designated as either returned for repair or for credit.

6. It is desirable that a purchase order number accompany all returned items. The purchase order will serve to cover shipping charges as well as provide a mutual reference number for customer and factory, as well as ship to and billing information.

7. Items for return shall be shipped prepaid to the following address:

SOLIDSTATE CONTROLS, INC.
600 Oakland Park Avenue
Columbus, Ohio 43214

8. Include return address and billing instructions if purchase order is not supplied.

9. Failure to comply with any of the above instructions will delay the expeditious return of the unit or part.

Attachment T

July 1, 2004 Letter from Tom Horner (IP2) to Robert Fletcher (FANP)

Entergy Nuclear Northeast
Entergy Nuclear Operations, Inc.
Indian Point Energy Center
295 Broadway
Buchanan, NY 10511

Thomas Horner
Project Manager – DBI CLC-2
Project Management

Indian Point Energy Center
Broadway & Bleakley Avenue
Buchanan, New York 10511

Internet: thorn90@entergy.com
Telephone: (914) 734-6781

July 1, 2004
Entergy Letter Number IP-DE-04-11

Framatome ANP, Inc.
39924 Golf Lane
Antioch, IL 60002

Attn: Mr. Robert Fletcher

Subject: Entergy Nuclear Northeast
Indian Point 2 – Nuclear Design Information Transmittal
IPEC DC System Calculations

Dear Mr. Fletcher:

This letter and its attachments contain the approved design inputs for Entergy Calculation No.s FEX-00203-00, FEX-00204-00, FEX-00205-00, FEX-00206-00 and FEX-00207-00. This information is being officially transmitted, via a Nuclear Design Information Transmittal (N-DIT), Concurrence Form for your information and use.

If you should have any questions regarding this transmittal, please do not hesitate to contact myself at (914) 734-6781 or Sam Martinovich at (914) 734-7653.

Sincerely,

Thomas Horner
Project Manager, DBI CLC-2

Attachment

cc: S. Martinovich
J. Raffaele
R. Milici

Entergy Nuclear Northeast, Indian Point 2
Nuclear Design Information Transmittal
July 1, 2004
IPEC DC System Calculations

Concurrence Form – Nuclear Design Information Transmittal

Subject: IPEC DC System Calculations

Reference: NA

Review for Entergy Letter: IP-DE-04-11

ORGANIZATION / TITLE	NAME	SIGNATURE	DATE
Design Engineering	R. Milici		7.1.04
Supervisor, Design Engineering Electrical	J. Raffaele		7-1-04

Division | **with type DH-P air circuit breakers** | data 32-28

75 to 750 mva interrupting capacity • 4160 to 13800 volts
1200 and 2000 amps • indoor and outdoor

page 1

52/CC ; 52/TC
Ref

type DH-P magnetic air circuit breaker—for indoor or outdoor Power-line metal-clad switchgear

outdoor Aisle-line

indoor

outdoor Shelterline-M

application

Westinghouse Power-line metal-clad switchgear with type D air circuit breakers provides centralized control and protec for generators, motors, transformers, capacitors, and all types feeder circuits. It is available in ratings of 4160 and 13,800 v with maximum interrupting capacities of 250 mva and 750 m respectively. It is available for both indoor and outdoor sy stations.

typical applications

Electric utility systems, industrial plants, commercial buildin municipal pumping stations, transportation systems, unit su stations.

description

Power-line metal-clad switchgear is an assembly of circuit break housings and auxiliary housings arranged to suit the specif requirements of a purchaser. Each housing is self-contained w Westinghouse components. These components include bus, i structure treatment, potential transformers, relays, i struments, meters and control devices—all assembled into a com pact, completely metal enclosed structure.

The circuit breaker housing includes a horizontal drawout typ DH-P air circuit breaker. It also includes high voltage equipment primary connections, low voltage equipment, and control device A hinged instrument panel is located on the front of the housing The auxiliary housing has no provisions for a circuit breaker. does include miscellaneous equipment and small equipment th cannot be combined in a circuit breaker housing. A hinge instrument panel is also located on the front of the housing.

Power-line metal-clad switchgear is available for both indoor an outdoor applications. The circuit breakers and design feature are similar whether the installation be indoor or outdoor. I general, outdoor metal-clad switchgear is constructed by mount ing a weatherproof enclosure onto and around standard indoor housings.

Outdoor Shelterline-M switchgear is an assembly of a weather proof enclosure onto and around indoor housings and includes an operating or maintenance aisle where equipment is accessibl without exposure to weather. The aisle permits interchange type DH-P circuit breakers. A weatherproof door is located a each end of the aisle and each is equipped with "crash" mech anisms permitting quick release from the inside when the door i pulled shut on the outside. Aisle lights, switches, and convenience receptacles are provided. Foundation requirements are simple the structure is supported by three base channels. Floor mounting is possible. No breather drawout pad is required and indoor connections may be used.

Outdoor Aisle-line switchgear is an assembly of a weatherproof enclosure onto and around indoor housings but not includin an operating or maintenance aisle. Weatherproof doors are located on the breather drawout side of each housing. A light and service receptacle is available in each housing. Aisle-line switchgear is similar to Shelterline-M without the aisle but with weatherproof front modules. Foundation requirements are simi --the structure is supported by two base channels. A breath drawout pad and outdoor accessories should be used.

August, 1961
new information
mailed to E/1138/GPA G/111/GR, C/211/AA

Calculation No. IP3-CALC-EL-00184
Rev. 3
Attachment: 16
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page 6

technical data

table a: air circuit breakers—type DH-P • 60 cycles

type	3-phase interrupting rating in amps	voltage ratings in kilovolts			current ratings in amperes			interrupting rating in amperes		approximate weight in pounds	
		rated	max.	min. for rated amps	continuous at 60 cycles	momentary	four second	at rated voltage	max.	closed only	tripout only
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

table b: control power requirements

rated control volts	closing amps volts	tripping amps volts	ind. light amps	AC coil rating amps	solenoid A.C.B. close coil "CC" E/I amps				stored energy A.C.B.			
					50DH-P 75/250	150DH-P 250 60000 A sym.	150DH-P 250 50000 A sym.	150DH-P 250	closing solenoid coil "CC" amps	motor run amps 3 hr A.C.B.	motor run amps 10 hr A.C.B.	non-code of charge
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

table c: control power transformers • disconnect type • 1 phase • 60 cycles

line no.	primary volts			secondary volts	kva	hv class
	tape +7½%	rated	tape −7½%			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

① If ungrounded, line to neutral system must be solidly grounded.

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REV 0
ATTACHMENT 11
PAGE 1 OF 1

type DH magnetic De-ion air circuit breakers *continued*

operating mechanisms

type DH solenoid operating mechanism

This closing mechanism for DH breakers is operated by a solenoid which pulls a moving core. The movement of the solenoid core is transmitted to the operating rods through a system of links which rotate about the operating cranks.

The solenoid operating mechanism is supplied as standard on all type DH breakers and has a long record of reliable service due to the sturdiness and simplicity of the design. The solenoid mechanism can be operated by d-c or rectified a-c current.

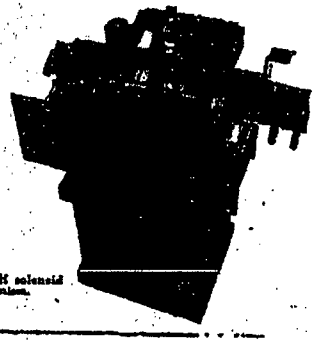


fig. 41: Type DH solenoid operating mechanism.

type SE spring stored energy operating mechanism

The spring stored energy mechanism can be supplied, as an option, for closing DH breakers at ratings 120 amp at 4.16 kv through 1200 amp at 13.8 kv.

In the stored energy mechanism the energy is first stored in a spring and then released for closing the breaker. The spring is compressed by means of an a-c or d-c operated motor and recharged over in 5 to 10 seconds, depending on the breaker rating. The spring energy is expended in approximately ½ to ¼ second for breaker closing.

Safety features has provided to assure discharging the spring before the breaker is withdrawn from the cell. In case of loss of control power, the spring can be compressed by hand. On reclosing duty the stored energy mechanism provides for one instantaneous reclosure with subsequent reclosures at 15 second intervals to permit time to recompress the spring.

Stored energy mechanisms are frequently applied on network systems where it is necessary to close several breakers simultaneously. The stored energy mechanism permits storing the energy at a relatively low rate, thus permitting a low demand control power source.

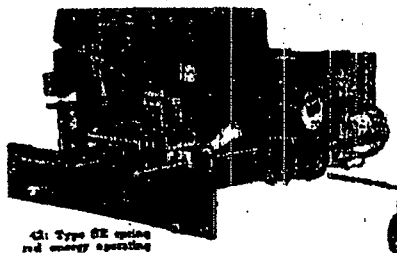


fig. 42: Type SE spring stored energy operating mechanism.

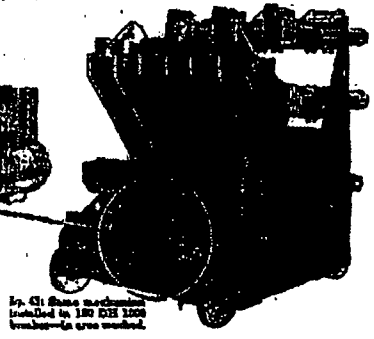
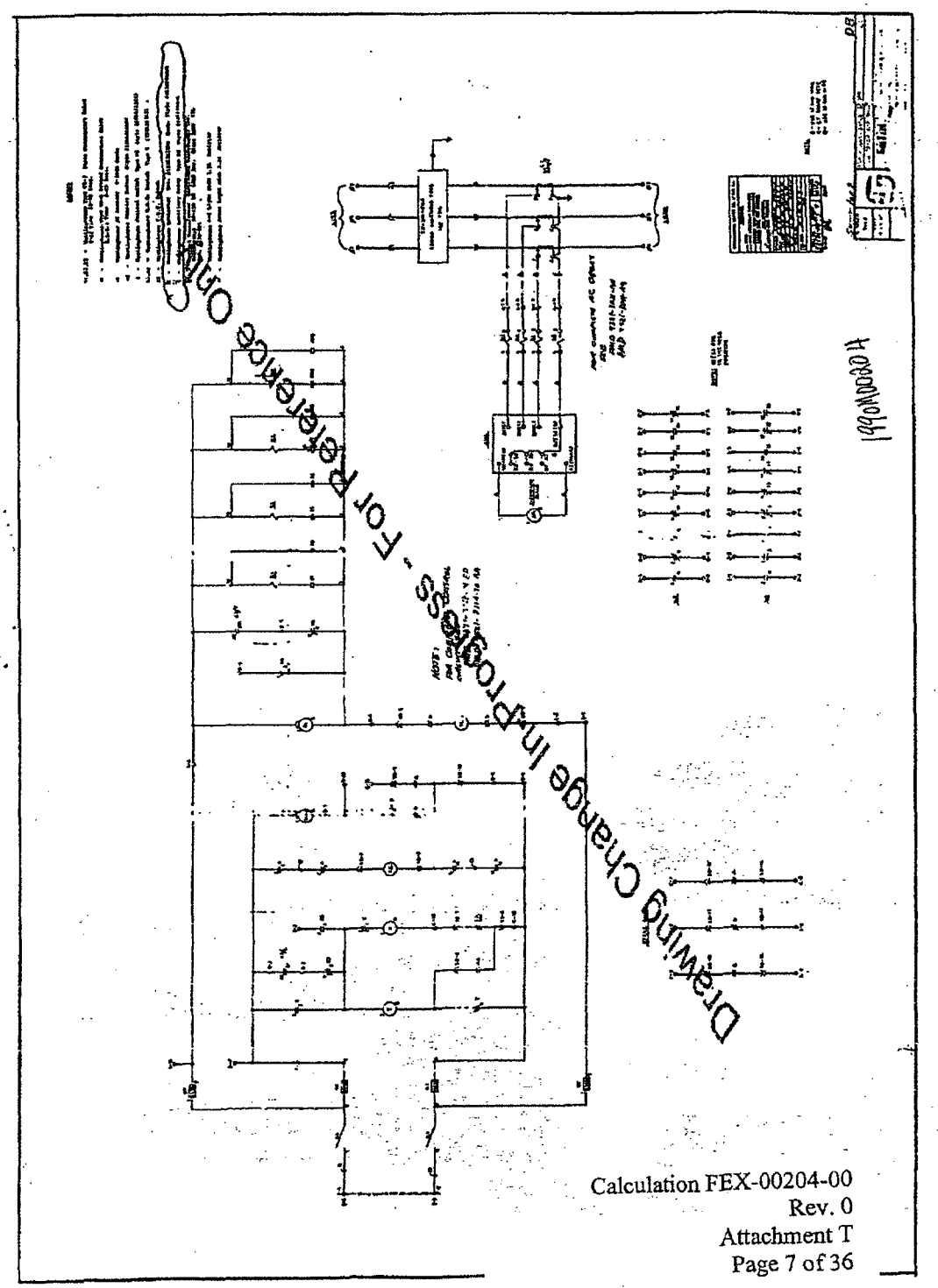


fig. 43: Same mechanism installed in 120 DH 1200 breaker—in open position.


Drawing Change Impact - For Reference Only

52/Mx Ref.

INSTRUCTION BOOK

MOTOR OPERATED STORED ENERGY (SPRING) CLOSING MECHANISM

Type SE-2

for

TYPE DH AIR CIRCUIT BREAKERS

Westinghouse Electric Corporation

I. B. 32-251-9A

FUNCTIONING OF BREAKERS

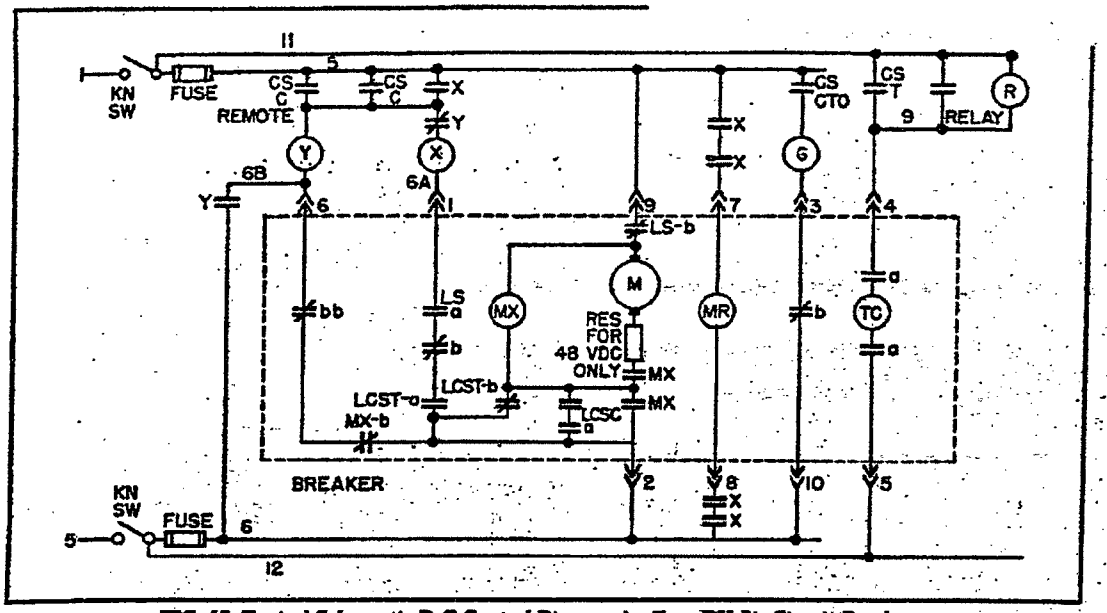


FIG. 15. Typical Schematic D-C Control Diagram for Type DH Air Circuit Breakers With Stored Energy (Spring) Closing Mechanism

LIST OF CONTROL COMPONENTS ON DIAGRAMS FIGS. 15, 16 AND 17

KN	Knife switch
CS-C	Close control switches
Y	Y-relay coil and contacts
X	X-relay coil and contacts
a or b	Auxiliary switch contacts
MX	Relay coil and contacts (on some diagrams this relay is designated as SG)
LS-a or LS-b	a-contact or b-contact of limit switch LS
bb	Microswitch operated from spring latch cam
LCST	Latch check microswitch operated from hand trip lever
LCSC	Latch check microswitch operated from closing latch shaft when breaker is closed
MR	Mechanism release (shunt) solenoid (breaker close)
TC	Trip shunt solenoid (breaker open)
R, G	Red or green signal light
CS-T	Trip control switch
CS-CTO	Lamp cut-out switch

when the charging of the spring has been completed. (The description of the mechanical arrangement see later). Similarly, the "a" contact is open when spring is discharged or not fully charged and it closes as charging the spring has been completed.

B. The "a" and "b" contacts of the auxiliary switch are operated in a conventional manner from the trip free lever.

C. The "bb" switch is located near the mechanism release and is operated from spring mechanism release cam in such manner that it is closed when the spring is not wound up and latched and it opens when the spring latch falls into latched position.

D. The latch check switch on trip lever LCST is operated from the breaker trip lever. It has two contacts, one normally open (a) and one normally closed (b). The switch is in normal position when the hand trip lever is up.

E. Relay MX has three or four contacts (two main contacts and one or two back contacts, depending on type of relay used; if relay with two back contacts is employed, only one of the two back contacts is used). This relay is energized from the source of the control power and its circuit is completed automatically in one of three different ways through switches which are tied in mechanically with the spring positions and/or with position of breaker contacts.

F. The closing latch check switch LCSC is located at lower left side of the mechanism and is operated mechanically from the closing latch; it is open when the breaker is open. It closes when the closing latch falls into latched position.

Switchgear Division
East Pittsburgh, Pa. 15112, U.S.A.

32-262

Page 1

CALC. NO. IP3 - CALC - EL - 00184 Rev. 3
ATTACHMENT :- 13
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June, 1977
Supersedes Application Data 32-262 A WE A dated December, 1975

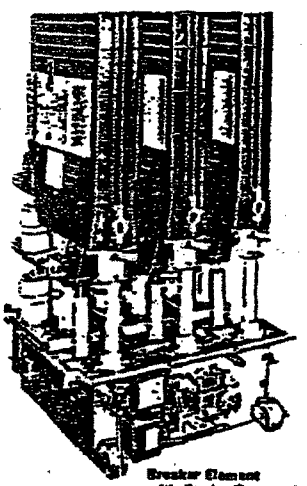
Mailed to: E. D. C/1942/D8

75 to 1000 MVA Interrupting.
4160 to 13800 Volts
1200 to 3000 Amperes, Indoor and Outdoor

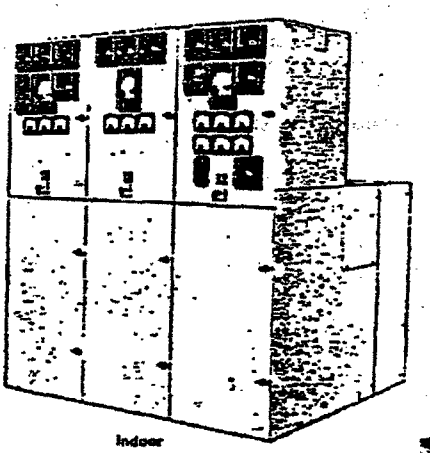
Standardized Typ DHP Medium Volt Metal-Clad Switchgear

6.9KV BKR STORED ENERGY

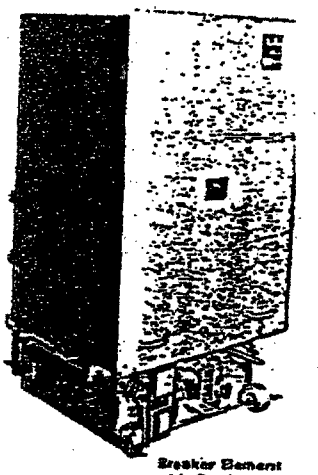
Calculation FEX-00204-00
Rev. 0
Attachment T
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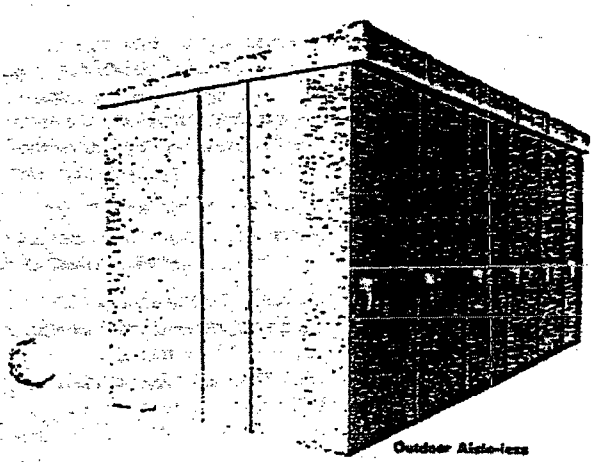
Breaker Element with Barrier Removed



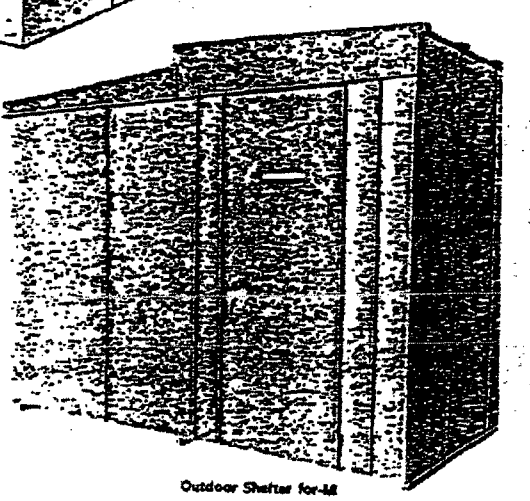
Indoor



Breaker Element with Barrier



Outdoor Aisle-less



Outdoor Shelter for-M

Circuit Breaker Control

The OHP circuit breaker has a motor charged spring type stored energy closing mechanism. Closing the breaker charges accelerating springs. Protective relays or the control switch will energize a shunt trip coil to release the accelerating springs and open the breaker. This requires a reliable source of control power for the breaker to function as a protective device.

For ac control, a capacitor trip device is used with each circuit breaker shunt trip and each WL-2 lockout relay to insure that energy will be available for tripping during fault conditions. A control power transformer is required on the source side of each incoming line breaker for closing and bus tie or bus sectionalizing breakers will require automatic transfer of control power. This control power transformer may also supply other Ac auxiliary power requirements for the switchgear.

Dc control would require a dc control battery, battery charger and an ac auxiliary power source for the battery charger. The battery provides a very reliable dc control source, since it is isolated from the ac power system by the battery charger. However the battery will require periodic routine maintenance and battery capacity is reduced by low ambient temperature.

Any economic comparison of ac and dc control for switchgear should consider that the ac capacitor trip is a static device with negligible maintenance and long life, while the dc battery will require maintenance and replacement at some time in the future.

Space Heaters

Outdoor bus runs and each unit of outd metal clad switchgear are provided wit space heaters to control condensation. Manual control is standard but optiona thermostatic control is available where conservation of energy is desired. Spac heaters are recommended for indoor sv gear installed in an unheated room or b ing and will be provided where specifie

Tubular type heaters are operated at ha voltage for long life. 500 volt or 250 vo rated heaters are used for 250 volt or 1: volt service as follows:

Space heater watts at half-voltage

375 watts/8 ft length bus run
500 watts/26 inch wide 5 Kv unit
750 watts/36 inch wide 7.5 Kv or 15 K unit

OHP or OVP Breaker Stored Energy Mechanism Control Power Requirements

Rated Control Voltage	Spring Charge Motor Run Amperes 5 Kv	15 Kv	Time Sec.	Close or Trip Amperes	Voltage Range Close	Trip	Ind. Light Amperes
48 V Dc	13.0	13.0	5	10	40-50	28-50	.035
125 V Dc	5.0	5.0	5	5	90-130	70-140	.035
250 V Dc	2.8	2.8	5	2	180-260	140-280	.035
115 V Ac	6.0	6.0	5	17	95-125	95-125	.035
230 V Ac	3.0	3.0	5	7	190-250	190-250	.035

Control Power Transformers • Disconnect Type • 1 Phase • 60 Hertz

Primary Volts ① Tape +7½%	Rated	−7½%	Secondary Volts	Kva	Kv Class
2580	2400	2220	240/120	5, 10, 15	5
4470	4160	3850	240/120	5, 10, 15	5
5160	4800	4400	240/120	5, 10, 15	5
7740	7200	6660	240/120	5, 10, 15	15
12900	12000	11100	240/120	5, 10, 15	15
14300	13300	12300	240/120	5, 10, 15	15

① If connected line to ground, system neutral must be solidly grounded.

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL 33065

Instruction Leaflet
41-751N

Effective: September 1995
Supersedes I.L. 41-751M, Dated August 1980
(|) Denotes Change Since Previous Issue.

Type SG Auxiliary Relay

CAUTION

Before putting protective relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

1. APPLICATION

The relay is intended for use in the applications requiring:

(1) Increased current-carrying or interrupting capability in a contact (low current contact energizes the SG coil to close the high current contact).

(2) Circuit isolation.

(3) Contact conversion (for example, from a normally open to a normally closed condition), or

(4) Contact multiplication (from one contact input to two contact output).

The SG relay is available with 2 N.O. (normally-open) and 2 N.C. (normally-closed) contacts. They change condition when the coil is energized at a voltage level above pickup. The contacts are arranged in a 3-lead configuration with a "common" connected to a N.C. and a N.O. contact.

The relay can be supplied with suitable coils for use on the following voltages:

6, 12, 24, 48, 125 and 250 volts dc
115 and 230 volts - 25 hertz
115, 230, 440 and 575 volts - 50 or 60 hertz

By using a series resistor, each of the different voltage relays may be used on higher voltage systems provided the proper dielectric and safety considerations are observed.

2. CONSTRUCTION & OPERATION

The SG relays are clapper-type devices designed to operate over a wide range of ac and dc voltages. When their coils are energized at or above pickup rating, the moving contacts on the armature assembly, close and/or open with the two stationary contacts to activate the electrically independent contact circuits.

Closed types are supplied with two make and two break contacts. Open types (front connected) can be supplied with two make and two break contacts, or with only the two make contacts which can be reversed to provide one make, one break, or two break contact circuits. Contact gap and follow should be readjusted per Table 1 after contacts have been reversed. Adjustment is accomplished by bending the stationary contacts.

Small coil springs on the moving contact arms provide adequate contact pressure to assure positive contact action between the moving and stationary contacts.

Dc types have a bronze pin on the core which serves as a stop pin for the armature, and prevents magnetic seal-in of the armature due to residual magnetism. Ac types have a non-magnetic washer at the base of the core assembly to prevent the armature from sticking in the closed-gap position. Copper shading

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

Printed in U.S.A.

rings are also provided on the core face of the ac types to prevent chattering of the armature.

3. CHARACTERISTICS

All relays will pick up at 80% of the nameplate voltage rating or less. No adjustments are provided for varying the pickup. The armature will open at 30% or less on direct current and at 60% or less on alternating current.

4. INSTALLATION

Mount the relay with the base against a vertical plane and with the contacts at the top.

When sheet metal cabinets are ordered for open-type relays, the relays and cabinets are shipped separately. The relays can be assembled on the tapped mounting holes in the bottom of the case by means of the mounting screws which are provided. The cabinets have knockouts for conduit connections on top, bottom and sides.

5. BURDEN

The closed gap volt-ampere burden at rated voltage (60 hertz) is 10, at a power factor of approximately 50%. The open gap volt-ampere burden at rated voltage (60 hertz) is 16, at the same power factor. The watt consumption at rated dc voltage is 3.5.

6. CONTACTS

Each contact will carry 12 amperes continuous and 30 amperes for one minute.

The contact interrupting ratings are as follows: All values are non-inductive currents.

INTERRUPTING RATING IN AMPERES

Volts	dc 1 Contact	2 Contacts in Series	ac 1 Contact
24	15	50	50
48	8	35	45
115	2.4	20	30
230	0.75	2.5	20
550	0.25	0.5	10

OPERATING TIME

Pickup: .033 - .05 sec. at dc rating
.016 - .033 sec. at ac rating

Dropout: less than .016 sec. on dc or ac

COIL DATA - DC

Rating amps	Volts	Resistance: Ohms	1 Second Rating: amps
1	-	2.5	35
2	-	0.7	55
3	-	0.33	85
4	-	0.2	110
5	-	0.1	165
-	6	12	-
-	12	48	-
-	24	185	-
-	32	294	-
-	48	725	-
-	62.5	1152	-
-	125	4650	-
-	250	17000	-

TABLE 1:
CONTACT GAP AND FOLLOW ADJUSTMENT

Contact Arrange	Contact Gap	Make-Contact Follow
2M	5/32"	3/64"
2B	5/32"	-
SPDT	5/32"	3/64"
DPDT	1/8-9/64"	3/64"
Break Contact Follow		
	(1)	(2)
2M	-	-
2B	1/32-3/64"	0.020-0.031"
SPDT	3/64"	0.031"
DPDT	3/64"	0.031"

7. MAINTENANCE

All contacts should be cleaned periodically. A contact burnisher style 182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

8. REPAIR AND RENEWAL PARTS

Major repairs can be most satisfactorily done at the factory or ABB Service Shops. However, for customers equipped to do their own work, parts may be furnished on order. In ordering any part or requesting any other information, always give entire nameplate data.

Relays for use on ac are assembled with a thin bronze washer between the yoke and core. A brass screw holds the yoke and core together. This washer helps to reduce the residual magnetism after the relay is de-energized. In case the relay should be dismantled, it is important that this washer be replaced when re-assembling it.

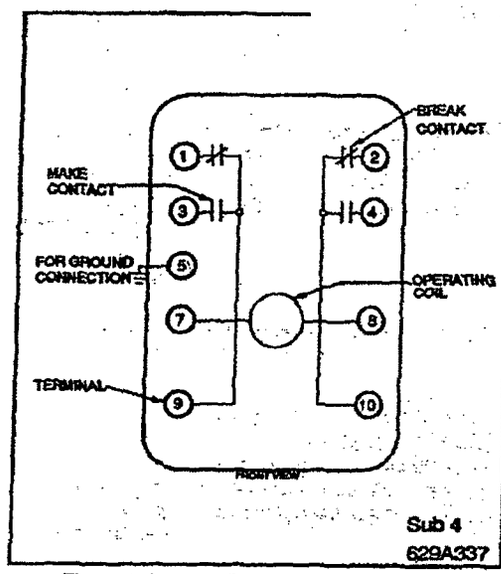


Figure 1. Internal Schematic for Type SG Relay in front connected case.

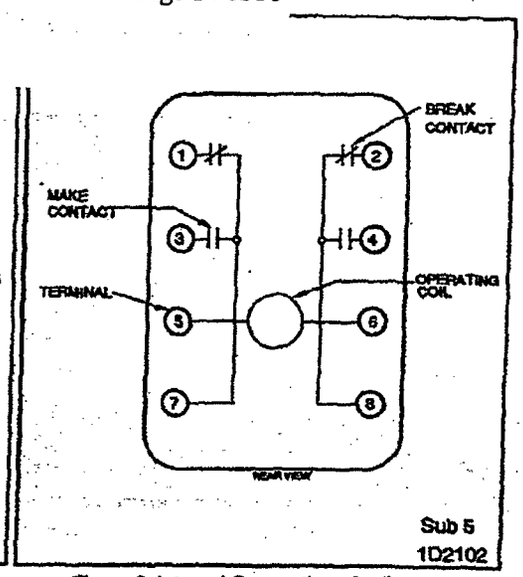


Figure 2. Internal Connections for Closed Type SG Relay.

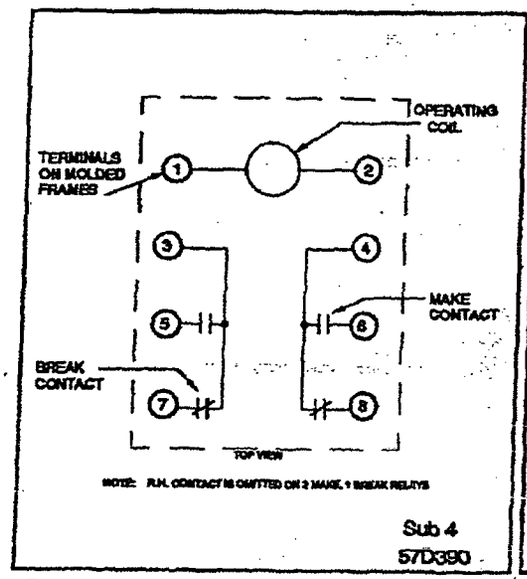


Figure 3. Internal Connections for 2-Make and 2-Break contact Open Type SG Relay.

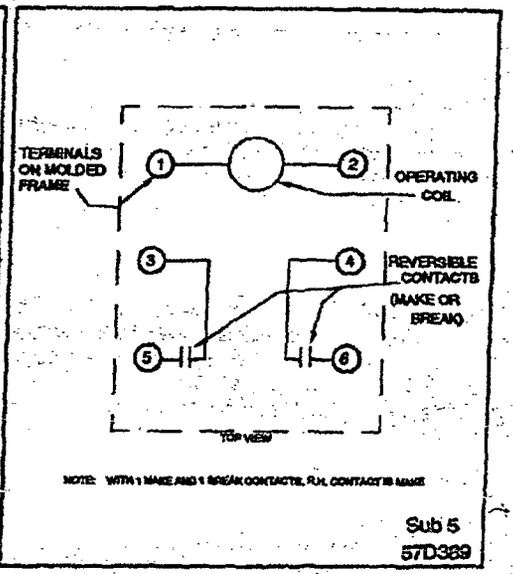


Figure 4. Internal Connections for Open Type SG Relay with Reversible Contacts.

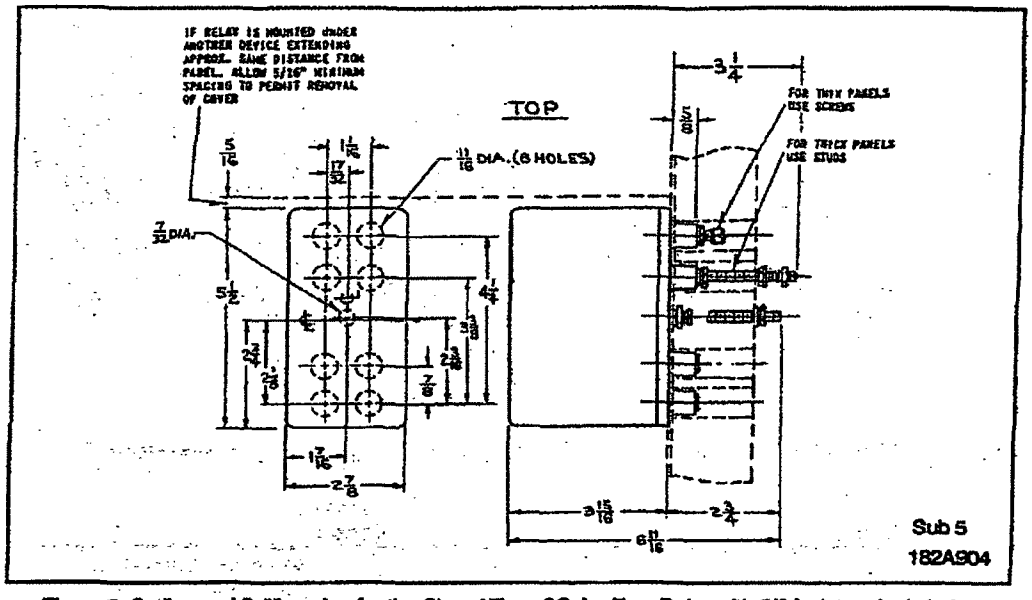


Figure 5. Outline and Drilling plan for the Closed Type SG Auxiliary Relay with 5/8 inch terminal studs.

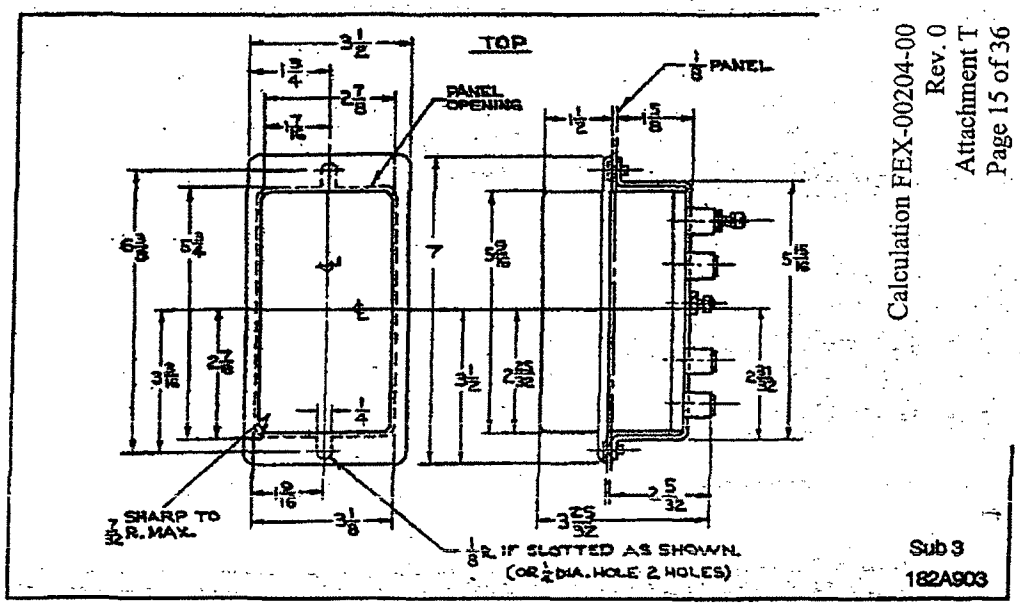


Figure 6. Outline and Drilling Plan for the Semi-flush Case for the Type SG Relay with 5/8 inch terminal studs.

Calculation FEX-00204-00
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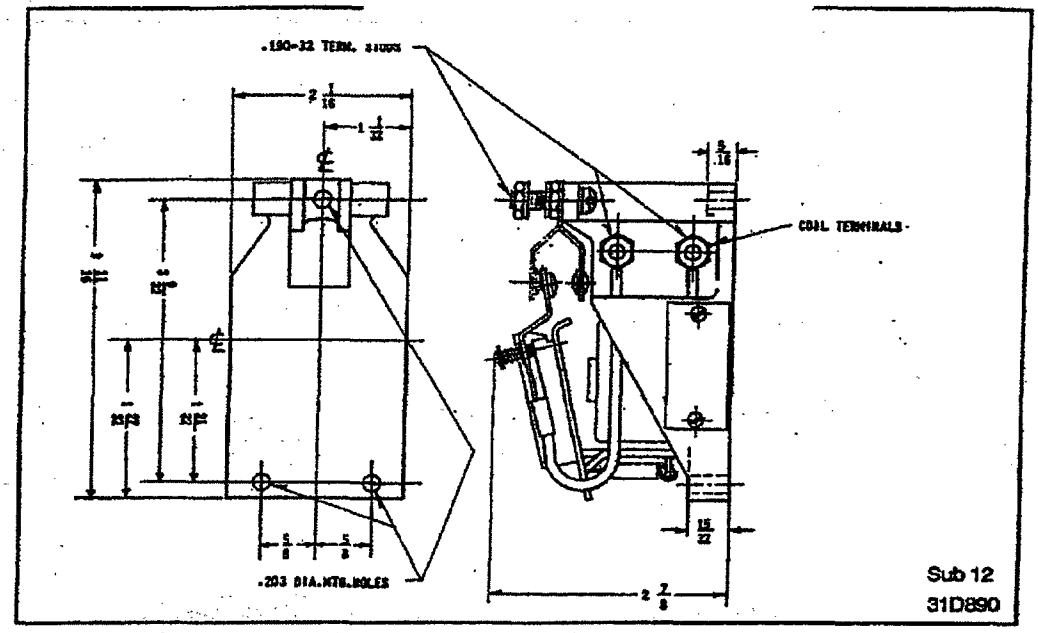


Figure 7. Outline and Drilling Plan for the Open Type SG Auxiliary Relay with Reversible Contacts.

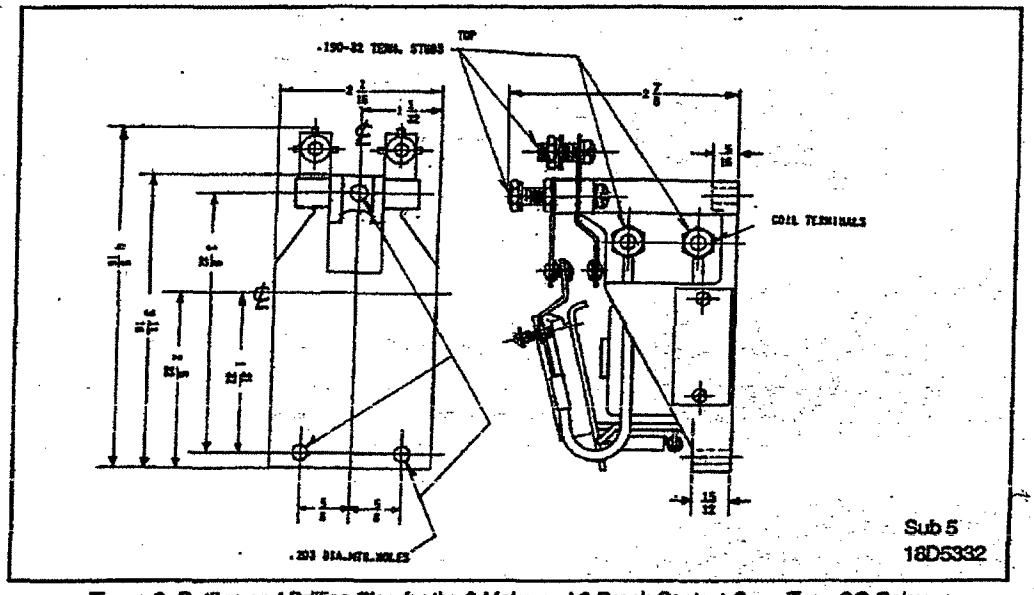


Figure 8. Outline and Drilling Plan for the 2-Make and 2-Break Contact Open Type SG Relay.

ABB Power T&D Company Inc.
Relay Division
Coral Springs, FL
Allentown, PA

September, 1990
Supersedes Descriptive Bulletin 41-750A
pages 1-8, dated August, 1989
Mailed to: E, D, C/41-900A

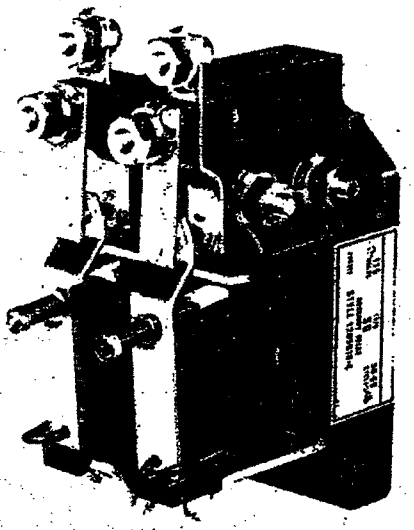
For Ac or Dc Voltage or Dc Current Operation
Device Number: 94X, Y, Z

Type SG Auxiliary Relays

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Contact Data	4
Coil Data	4
Time Delay Type	5
Internal Wiring	6, 7
External Capacitor Dimensions	8
External Resistor Dimensions	8

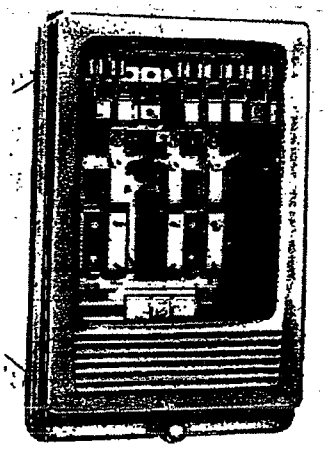
Molded Base, Front Connected



SG Open Type

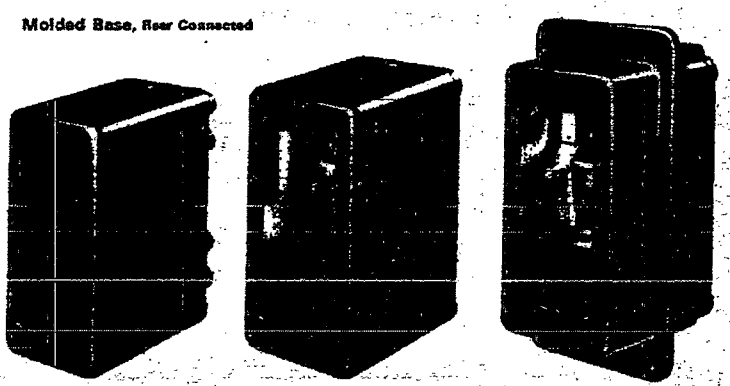
Calculation FEX-00204-00
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Flexitest®



Projection or Semi-Flush Mounting

Molded Base, Rear Connected



Projection Mounting Solid Cover

Projection Mounting Glass Window Cover

Semi-Flush Mounting Glass Window Cover Only

ABB

Application
The SG auxiliary relays are for use in miscellaneous automatic and remote control switching. It is suitable for many industrial applications. SG relays are supplied for use on the following voltages without an external resistor by the use of suitable coils. The standard coils are:

6, 12, 24, 48, 125, and 250 volts dc
115 and 230 volts, 25 hertz
115, 230, 440, and 575 volts, 50 and 60 hertz

External series resistors are used with the voltage rated dc relays, for higher control circuit voltages up to 600 volts dc. Relays having limited time-delay in operation are also available.

Construction and Operation
The SG relays are clapper-type devices designed to operate over a wide range of ac and dc voltages. When their coils are energized at or above pickup rating, the moving contacts on the armature block close and/or open with the two stationary contacts to complete the electrically independent contact circuits.

Closed types are supplied with two make and two break contacts. Open types (front connected) can be supplied with two make and two break contacts, or with only the two make contacts which can be reversed to provide one make, one break, or two break contact circuits.

Small coil springs on the moving contact arms provide adequate contact pressure, to assure positive contact action between the moving and stationary contacts.

Dc types have a bronze pin on the core which serves as a stop pin for the armature, and prevents magnetic seal-in of the armature due to residual magnetism. Ac types have a nonmagnetic washer at the base of the core assembly to prevent the armature from sticking in the closed-gap position. Copper shading rings are also provided on the core face of the ac types to prevent chattering of the armature.

All standard SG relays will pickup on 80% of rating, and will withstand 110% of rating continuously.

Contact Data
Both the moving and stationary contacts are made of pure silver. Each will close and carry 12 amperes continuously, or will carry 30 amperes for one minute.

Contact Legend
Dpst – double pole single throw
Dpdt – double pole double throw
cc – circuit closing
co – circuit opening

Basic SG Unit

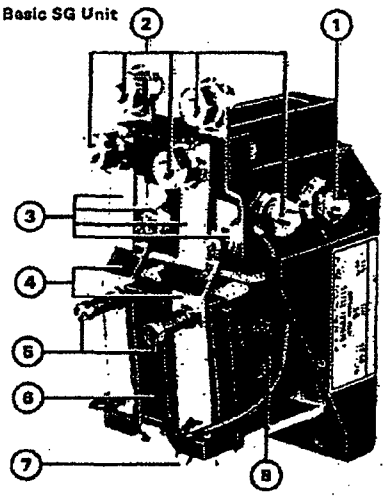


Fig. 1: Dpdt

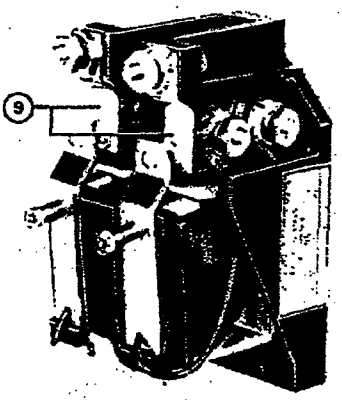


Fig. 2: Dpst Reversible

Dpdt Contacts (2 cc and 2 co) or Dpst Contacts (2 cc)

The design features illustrated in Figures 1 and 2 apply to all SG relays.

1. Terminals to Coil
2. Terminals to Contact Connections
3. Stationary Contacts
4. Moving Contacts
5. Contact Wipe Armature Spring
6. Armature Block
7. Armature Reset Spring
8. Coil
9. *Reversible Stationary Contacts* (Applies to Dpst only)

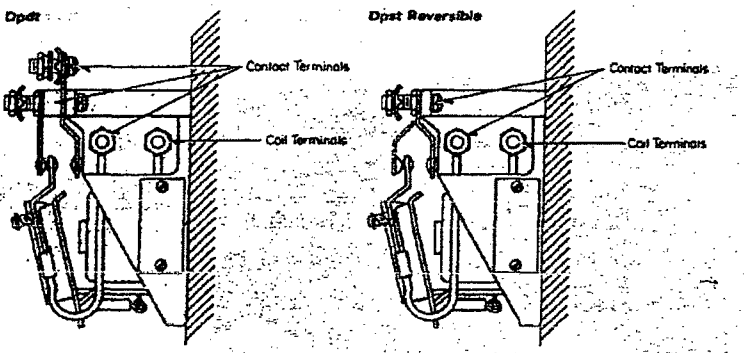


Figure 3: Contact Arrangements (Open Type)

SG In Molded Base With Cover Removed
Projection Mounting

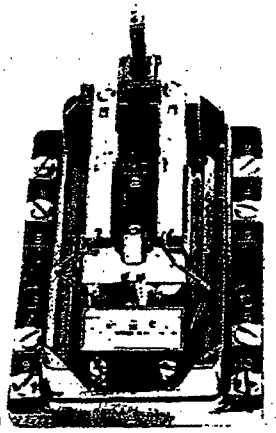


Fig. 4:
Front
Connected

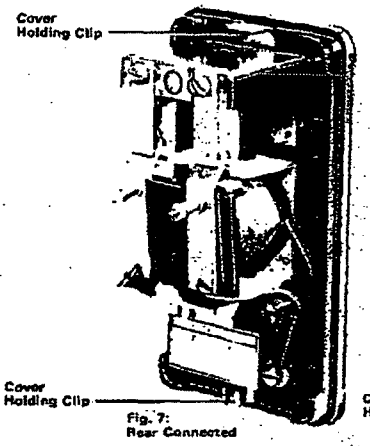


Fig. 7:
Rear Connected

SG In Molded Base With Cover
Semi-Flush
Mounting

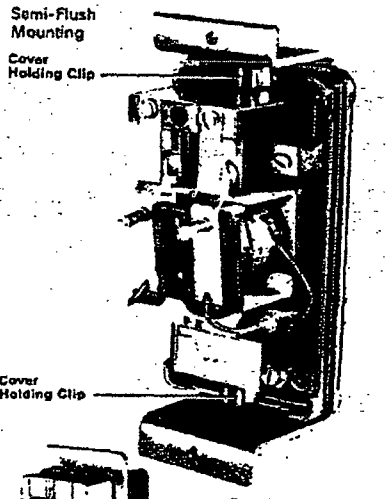


Fig. 10



Fig. 5:
Glass
Window
Cover
for Fig. 4



Fig. 6:
Solid
Front
Cover
for Fig. 4



Fig. 8: Glass
Window Cover
for Fig. 7



Fig. 9:
Solid Front
Cover for Fig. 7



Fig. 11: Glass
Window Cover
for Fig. 10

SG In Flexitest Case Dpdt Contacts
Projection or Semi-Flush Mounting



Fig. 12
Single Unit Type in FT-11 Case
Double Unit Type in FT-22 Case



Fig. 13

SG Relay Characteristics
Relay Operating Time

Pickup
2 to 3 cycles on a 60 Hz base (.033 to .05 second) at dc rating.

1 to 2 cycles on a 60 Hz base (.016 to .033 second) at ac rating.

Dropout
Less than 1 cycle on a 60 Hz base on ac or dc.

Non-Adjustable Pickup and Dropout
Both pickup and dropout time values are non-adjustable.

Minimum Pickup
80% of ac or dc rating.

Maximum Dropout
30% of dc rating.
60% of ac rating.

Burden Data
Dc
Burden of dc operated SG relays is 3.5 watts at rated voltage or current.

Ac
Burden of ac, 50/60 hertz types is 10 volt-amperes at .55 power factor with the armature closed, or 16 volt-amperes at .45 power factor with the armature reset or open.

Contact Interrupting Ratings
Non-Inductive Circuits

Contact Circuit Voltage		Non-Inductive Interrupting Rating in Amperes		
Dc	Ac	Single Contact		Two Contacts in Series
		Ac	Dc	Dc
12	...	..	30	...
24	24	50	15	50
48	48	48	9	35
125	115	30	2.4	20
250	230	20	.75	2.5
...	460	15	.50	1.5
...	575	10	.25	.5

Inductive Circuits

Contact Circuit Voltage		Inductive Interrupting Rating in Amperes			
Dc	Ac	Single Contact		Two Contacts in Series	
		Ac	Dc	Ac	Dc
48	...	...	5	...	30
125	...	...	1	...	5
250	...	...	.2	...	.4
...	115	20	...	30	...
...	230	15	...	20	...
...	460	7.5	...	10	...
...	575	4.0	...	7.5	...

Coil Data
Dc

Rating Amps	Volts	Resistance: Ohms	1-Second Rating: Amps
1	...	2.5	35
2	...	0.7	55
3	...	0.33	85
4	...	0.2	110
6	...	0.1	185
..	6	12	...
..	12	48	...
..	24	185	...
..	32	294	...
..	48	725	...
..	62.5	1152	...
..	125	4650	...
..	250	17000	...

Ac, 50/60 Hertz

Rating: Volts	Resistance: Ohms	Closed Gap Impedance: Ohms
12	1.7	12.5
24	7.3	55
90	112	878
115	185	1320
208	630	4250
230	725	5300
275	1042	7500
460	2770	21000
575	4650	33000

SG Relays With Time Delay, Dc Operated

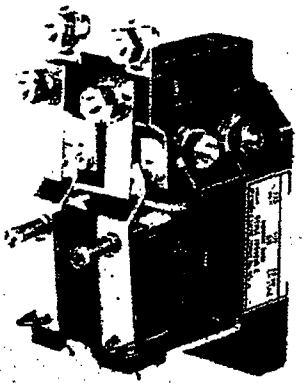


Fig. 14

Slug Type, Intermittent Duty

SG relays available with time delay have a special core and heavy copper ring (slug) which provide an additional time delay of 0.6 cycles (.01 second) on pickup, and 2½ cycles (.04 second) on dropout.

Induced current in the copper slug briefly retains the magnetic flux in the relay core, thereby creating the added 2½ cycles delay on dropout. Therefore, the total operating time of the relay on dc is 3 or 4 cycles for either pickup or dropout.

Use of the copper slug results in a reduction of available coil space, making the slug type SG suitable for intermittent duty only.

Additional Time Delay, Voltage Operated Types

Additional time delay on pickup or dropout can be obtained by the use of resistors and capacitors. When such are employed, the relays are continuously rated.

Resistor-Capacitor Type, Continuous Duty

Typical Time Delay Values Using 125-Volt Relay Coil (with 125 Volts Dc Applied)

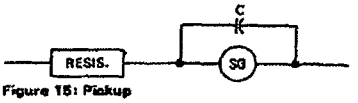


Figure 15: Pickup

Microfarads Across Coil (C)	Pickup Time Delay in Seconds Using Standard Core	
	500 Ohms (R)	1000 Ohms (R)
0	.045	.049
5	.047	.052
10	.049	.057
20	.054	.058

Dropout

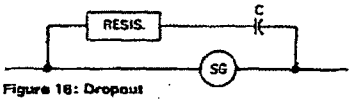


Figure 16: Dropout

Microfarads Across Coil (C)	Ohms (R)	Dropout Time Delay in Seconds, Standard Core
10	0	.081
10	1000	.080
10	3000	.075
10	5000	.070
10	7100	.064
20	0	.140
20	1000	.141
20	3000	.139
20	5000	.128
20	7100	.092

Capacitors and Resistors for Use With Time Delay Relays

Capacitors, Rated 1000 Vdc

Description	Style Number①
5 mfd	289B492H02
10 mfd	289B493H01
20 mfd	use two 289B493H01 in parallel

Resistors②

Description	Style Number①
500 ohms	184A369G10
1000 ohms	184A369G11
3000 ohms	184A369G12
5000 ohms	184A369G13
7100 ohms	184A369G14

① See figures 25 and 26 for dimensions.
② Style numbers include 3½-inch, two terminal resistor and mounting bracket.

Calculation FEX-00204-00
Rev. 0
Attachment T
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Internal Wiring for SG Relay With:

Molded Base, Open Type (Front Connected)
Dpdt Contacts: 2 cc and 2 co
(Top View)

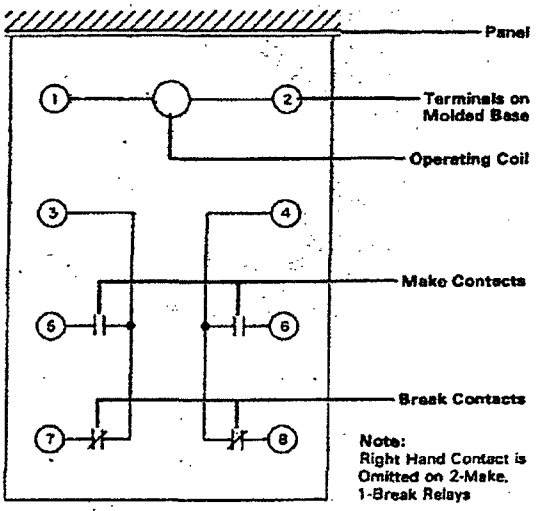


Figure 17 570390

Molded Base, Open Type (Front Connected)
Dpst Contacts: 2 cc and 2 co
(Top View)

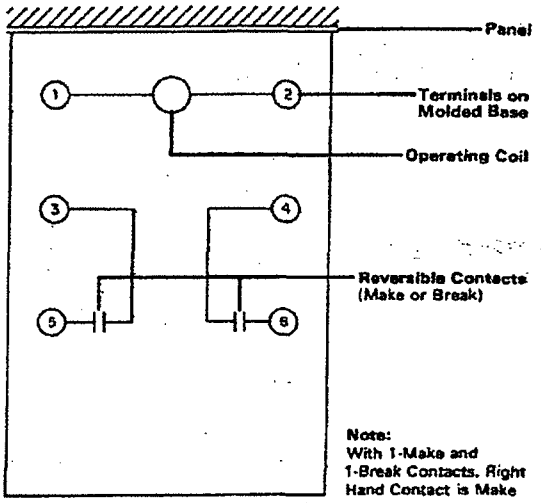


Figure 18 570389

Molded Base With Cover (Rear Connected)
Dpdt Contacts: 2 cc and 2 co
(Rear View)

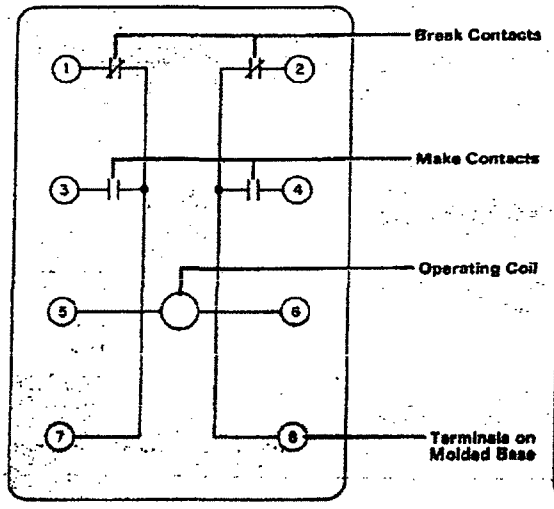


Figure 19

Molded Base With Cover (Front Connected)
Dpdt Contacts: 2 cc and 2 co
(Front View)

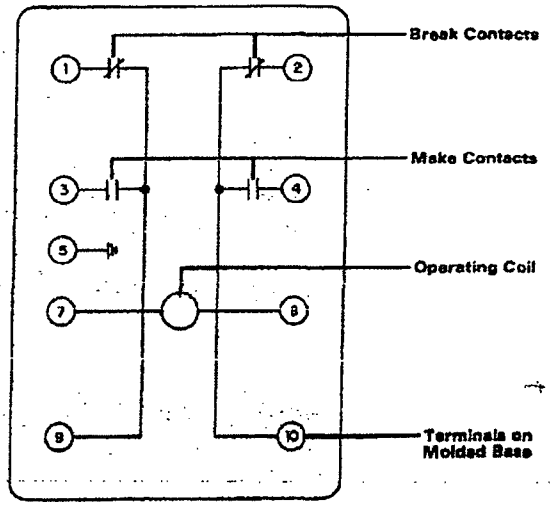


Figure 20 529A337

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Internal Wiring for SG Relay With:

Flexitest Case (Front View)
Single Unit, 2 Make and 2 Break Contacts (FT-11 Case)

Current Operated

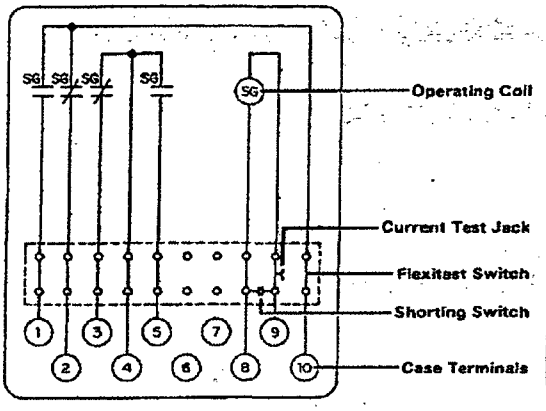


Figure 21 183A340

Voltage Operated

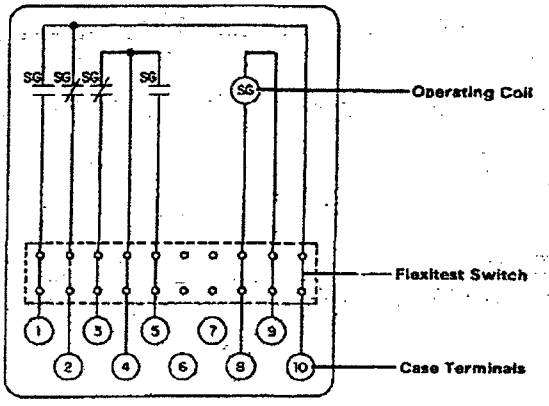


Figure 22 183A108

Two Units, Each With 2 Make and 2 Break Contacts (FT-22 Case)

Current Operated

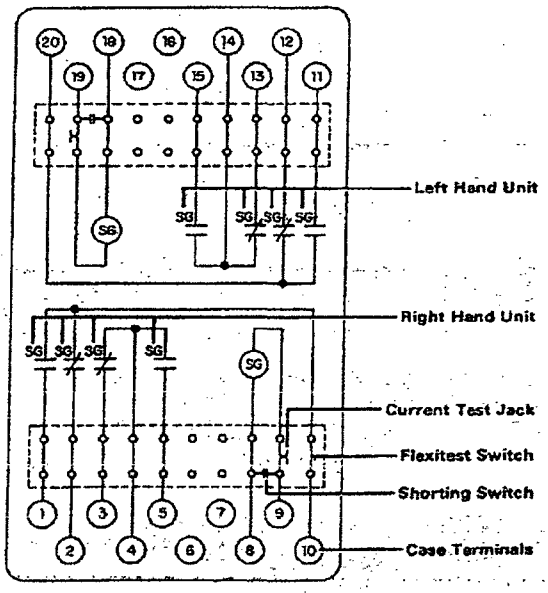


Figure 23 3512A58

Voltage Operated

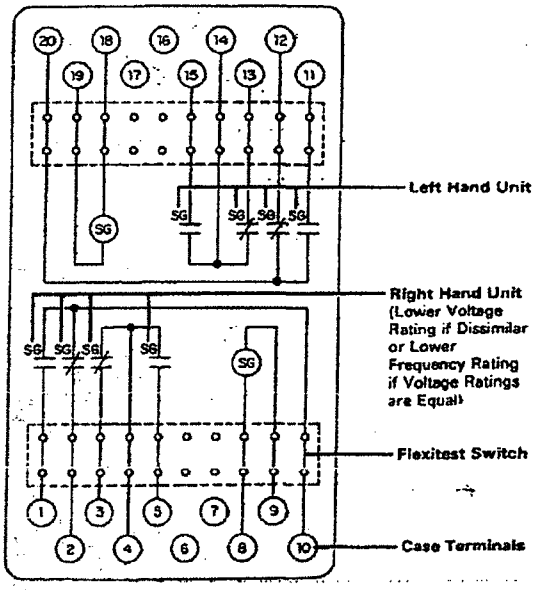


Figure 24 183A457

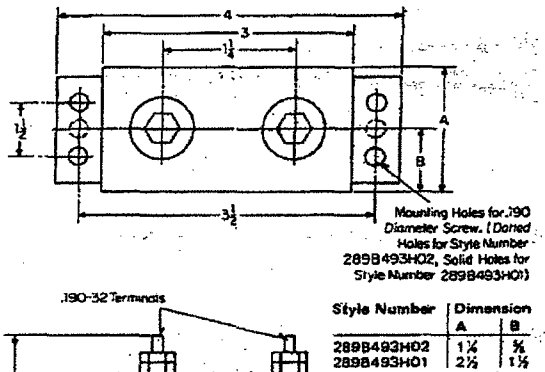
Shipping Weights and Carton Dimensions

Relay Case Type	Weight, Lbs: Approx. Net	Shipping	Domestic Shipping Carton Dimension: Inches
Molded Base			
Without Cover	¾	1	8½ x 9½ x 10
With Cover	¾	2	8½ x 9½ x 10
Flexitest Case			
FT-11 (Single Unit)	6	9	9 x 9 x 10
FT-22 (Double Unit)	7	10	9 x 9 x 10

Further Information
List Prices: PL 41-020
Technical Data: TD 41-025
Instructions:
Type SG, It. 41-751
Flexitest, It. 41-751.1
Renewal Parts: RPD 41-989
Flexitest Case Dimensions: DB 41-076
Contactor Switches: DB 41-081
Other Protective Relays:
Application Selector Guide, TD 41-016

Accessory Dimensions (In Inches)

Capacitors



Style Number	Dimension A	Dimension B
2898493H02	1¼	⅝
2898493H01	2½	1½

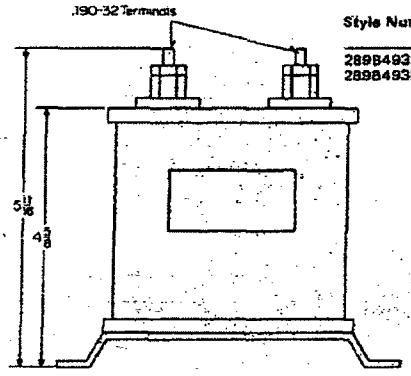
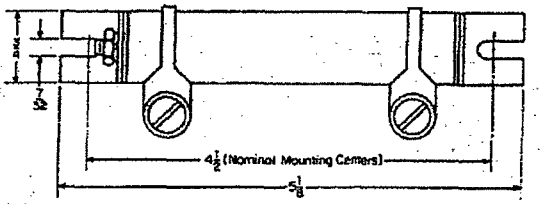


Figure 25

External Resistors



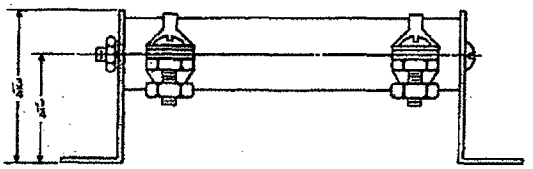


Figure 26

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December, 1990
Supersedes TD 41-020, Type SG on pages 130 and 131, dated November, 1987
Mailed to: E, D, C/41-900A

For Ac or Dc Voltage or Dc Current Operation

Type SG Auxiliary Relays

Auxiliary, Ac Voltage, or Dc Voltage or Current
Non-Adjustable Pickup, Double Pole, Flexitest Case (Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data					
				Single Unit			Double Unit		
				Internal Schematic	Style Number	Case Size	Internal Schematic	Style Number	Case Size
SG	Dpdt-2 cc and 2 co	Dc	1 amp dc	183A340	1878 755	FT-11	3S14A07	1955 556	FT-22
			2 amps dc		1878 756			1955 557	
Current or voltage			3 amps dc		1878 757			1955 558	
			4 amps dc		1878 758			1956 447	
			5 amps dc		1878 759			1955 449	
Self-reset			6 volts dc	183A108	1878 760		183A457	1955 560	
			12 volts dc		1878 761			1955 561	
			24 volts dc		1878 762			1955 562	
			32 volts dc		1878 763			1955 563	
			48 volts dc		1878 764			1955 564	
			82.5 volts dc		1878 765			1955 565	
			125 volts dc		1878 766Ⓒ			1955 566	
			250 volts dc		1878 767			1956 567	
		50/60	12 volts ac	183A108	1878 768		183A457	1955 568	
			24 volts ac		1878 769			1955 569	
			90 volts ac		1878 770			1955 570	
			115 volts ac		1878 771			1955 571	
			208 volts ac		1878 772			1955 572	
			230 volts ac		1878 773			1955 573	
			275 volts ac		1878 774			1955 574	
			460 volts ac		1878 775			1955 575	
			575 volts ac		1878 776			1955 576	

Non-Adjustable Pickup, Double Pole, Molded Case (Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data			
				Internal Schematic	Solid Projection Cover	Projection Glass Window Cover	Semi-Flush Glass Window Cover
					Style Number	Style Number	Style Number
Rear Connected							
SG	Dpdt: 2 cc and 2 co	Dc	1 amp dc	1D2102	1157 848	1162 959	1342 932
			2 amps dc		1729 023	1729 024	1729 025
Current or voltage			3 amps dc		1157 849	1162 960	1342 933
			4 amps dc		1956 249	1956 253	1956 257
			5 amps dc		1157 850	1162 961	1342 934
Self-reset			6 volts dc		1343 116	1340 082	1343 117
			12 volts dc		1155 686	1162 949	1343 118
			24 volts dc		1155 687	1162 950	1342 923
			32 volts dc		1729 011	1729 012	1729 013
			48 volts dc		1155 688	1162 951	1342 924Ⓒ
			82.5 volts dc		1729 017	1729 018	1729 019
			125 volts dc		1155 689Ⓒ	1162 952	1342 925Ⓒ
			250 volts dc		1343 088	1343 089	1343 090
		50/60	12 volts ac		1956 250	1956 254	1956 258
			24 volts ac		1878 284	1878 285	1878 286
			90 volts ac		1956 251	1956 255	1956 259
			115 volts ac		1155 693	1162 956	1342 929Ⓒ
			208 volts ac		1726 053	1726 054	1726 055
			230 volts ac		1155 694	1162 957	1342 930
			275 volts ac		1956 252	1956 256	1956 260
			460 volts ac		1155 695	1162 958	1342 931
			575 volts ac		1725 778	1725 799	1725 780

Ⓒ Denotes item available from stock.

Auxiliary, Ac Voltage, or Dc Voltage or Current
Non-Adjustable Pickup, Double Pole, Molded Base Without Cover, Open Type
(Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data	
				Without Cover	
				Internal Schematic	Style Number
Front Connected					
SG	Dpst-2 cc	Dc	1 amp dc	S7D389	1157 852
			2 amps dc		1729 026
Current or voltage			3 amps dc		1157 853
			4 amps dc		1956 261
Self-reset			5 amps dc		1157 854
			6 volts dc		1338 226
			12 volts dc		1059 230
			24 volts dc		1059 231
			32 volts dc		1729 014
			48 volts dc		1008 534
			62.5 volts dc		1729 020
			125 volts dc		1008 535Ⓢ
			250 volts dc		1337 424Ⓢ
		50/60	12 volts ac		1163 654
			24 volts ac		1337 364
			90 volts ac		1537 212
			115 volts ac		1008 539Ⓢ
			208 volts ac		1728 056
			230 volts ac		1008 540
			275 volts ac		1003 884
			460 volts ac		1008 541
			575 volts ac		1544 302

Non-Adjustable Pickup, Double Pole, Molded Base, With and Without Cover (Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data			
				Without Cover (Open Type)		Solid Cover & Base (Front Conn.)	
				Internal Schematic	Style Number	Internal Schematic	Style Number
Front Connected							
SG	Dpdt-2 cc and 2 co	Dc	1 amp dc	S7D390	1875 946	623A337	293B254A09
			2 amps dc		1729 027		293B254A10
Current or voltage			3 amps dc		1875 947		293B254A11
			4 amps dc		1956 245		293B254A12
Self-reset			5 amps dc		1875 948		293B254A13
			6 volts dc		1340 727		293B254A14
			12 volts dc		1205 619		293B254A15
			24 volts dc		1205 620Ⓢ		293B254A16
			32 volts dc		1729 015		293B254A17
			48 volts dc		1205 612Ⓢ		293B254A18Ⓢ
			62.5 volts dc		1729 021		293B254A19
			125 volts dc		1161 540Ⓢ		293B254A20Ⓢ
			250 volts dc		1210 939Ⓢ		293B254A21Ⓢ
		50/60	12 volts ac		1956 248		293B254A22
			24 volts ac		1878 282		293B254A23
			90 volts ac		1956 247		293B254A25
			115 volts ac		1205 616Ⓢ		293B254A26Ⓢ
			208 volts ac		1728 057		293B254A27
			230 volts ac		1205 617Ⓢ		293B254A28
			275 volts ac		1956 248		293B254A29
			460 volts ac		1205 618Ⓢ		293B254A30
			575 volts ac		1725 781		293B254A31

Ⓢ Denotes item available from stock.

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Auxiliary, Ac Voltage, or Dc Voltage or Current
Non-Adjustable Pickup, Double Pole, Molded Base, With Glass Window Cover
(Device Number: 94X, Y, Z)

Type	Contacts	Frequency: Hertz	Rating	Relay Data	
				With Glass Window Cover	
				Internal Schematic	Style Number
Front Connected					
SG	Dpdt-2 cc and 2 co	Dc	1 amp dc	629A337	293B255A09
			2 amps dc		293B255A10
Current or voltage			3 amps dc		293B255A11
			4 amps dc		293B255A12
Self-reset			5 amps dc		293B255A13
			6 volts dc		293B255A14
			12 volts dc		293B255A15
			24 volts dc		293B255A16
			32 volts dc		293B255A17
			48 volts dc		293B255A18Ⓢ
			62.5 volts dc		293B255A19
			125 volts dc		293B255A20Ⓢ
			250 volts dc		293B255A21
		50/60	12 volts ac		293B255A22
			24 volts ac		293B255A23
			90 volts ac		293B255A25
			115 volts ac		293B255A26Ⓢ
			208 volts ac		293B255A27
			230 volts ac		293B255A28
			275 volts ac		293B255A29
			460 volts ac		293B255A30
			575 volts ac		293B255A31

Auxiliary Dc Voltage or Current, Non-Adjustable Pickup, With Copper Slug
For Time Delay Dropout, Intermittent Duty, Dc Operated (Device Number: 94X, Y, Z)

Type	Contacts	Rating	Relay Data			
			Molded Base With Solid Cover Projection Mounting		Molded Base With Glass Window Cover; Semi-Flush Mounting	
			Internal Schematic	Style Number	Internal Schematic	Style Number
Rear Connected						
SG	Dpdt: 2 cc and 2 co	1 amp dc	162A903	1961 590	102102	1961 593
		3 amps dc		1961 591		1961 594
Self-reset		5 amps dc		1961 592		1961 596
		24 volts dc		1961 578		1961 582
		48 volts dc		1961 579		1961 583
		125 volts dc		1961 580		1961 584Ⓢ
		250 volts dc		1961 581		1961 585

Type	Contacts	Rating	Relay Data					
			Molded Base Without Cover		Molded Base With Solid Cover		Molded Base With Glass Window Cover	
			Internal Schematic	Style Number	Internal Schematic	Style Number	Internal Schematic	Style Number
Front Connected								
SG	Dpdt: 2 cc and 2 co	1 amp dc	57D390	1961 596	629A337	293B257A09	629A337	293B256A09
		3 amps dc		1961 597		293B257A11		293B256A11
Self-reset		5 amps dc		1961 598		293B257A12		293B256A12
		24 volts dc		1961 586		293B257A17		293B256A17
		48 volts dc		1961 587		293B257A18		293B256A18
		125 volts dc		1961 588		293B257A19		293B256A19
		250 volts dc		1961 589		293B257A20		293B256A20

Ⓢ Denotes item available from stock.

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WO # IP2-00-17077 # FEX-98-13126-E: TRANSFER OF FEED FOR ESOP FROM BATT22 TO BATT11 – RELOCATE ESOF

Location PPNL22-17 SPARE WO Priority 4

Bldg/Elev IP2-CB-33 Work Type X PCRS Control ?

Equipment BRKR2070-001 WESTINGHOUSE ELECTRI LA2300 PCRS# 0

Reported By ALVAREZ Reported Date 2000-08-12-0.00.00 Phone System DC

Status CLOSED Status Date 2000-11-21-0.00.00 QA Class A

WR Tag Location - Loop

GL Account V75-7A-IP2-DEMD-5MMODS-095 WorkFlow Active? N Work Flow ID RWP #

References FEX-98-13126-E Proj. ID FEX-98-13126-E

PLANT CONDITION

Schedule Group 14N Week/Mode Causes LCO/AOT?

SCHEDULING INFORMATION RESPONSIBILITY

	Start Date	Due Date	Drop Dead Date	
Target				Supervisor SUPERV
Scheduled			Deferral #	Responsible Dept. CNSV
Actual	2000-10-27-0.00.00		P3 Scheduled?	Lead Crew
Estimated Duration (hours)	0:00		Outage ID NON	Department Billed V75
				Planner D. ALVAREZ
				Engineer

CONDITION IDENTIFICATION

Condition Class Condition Code

JOB DETAILS TAG OUT

Job Plan

Rep Task ID IST Tag Out Required?

ALARA Interest Zone	Work Class	Environmental Qualification?	
Post Work Test? Y	Task Type	Sect. XI/ Quality Group?	
Engineering Input 1	Deficiency Type	Risk Significant?	
GL91-18 N	Action Taken Y	Maintenance Rule?	

PRINT INFORMATION

PIMX Misc. Permits and Support Page Number of Controlled Copies Printed for Rev # 0

Facsimile Transmission

TOPAZ 1KVA INVERTER EGA 6

CSS NATIONAL PRODUCT SUPPORT
TECHNICAL & COMMERCIAL SUPPORT, THREE PHASE

TO : RICHARD Date : Sept 15, 2003

Company :

Tel :
Fax : 914 788 2344

Page : 7 (including cover)

FROM : LYNETTE WIDOWSKI, SENIOR PRODUCT SUPPORT ENGINEER

Tel : 800 523 0142 x 3801
Fax : 714-434-7652
Email : lynette.widowski@mgeups.com
Re : Secifications for 5353-13 GZ inverter

2

Subject : Hello Richard

Here are the specs.

Please call or e-mail me at lynette.widowski@mgeups.com.

Please feel free to contact me with any questions you may have regarding this issue.

Regards,
Lynette

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MGE UPS SYSTEMS, INC.
formerly EPE Technologies Inc.
1660 Scenic Avenue, Costa Mesa, CA 92626 • Tel 714/557-1636 • Fax 714/434-6915
http://www.mgeups.com

1.1 PREFACE

1.1.1 Shipping Damage

This equipment has been thoroughly tested and inspected by Powermark. While it has been packed and packaged for shipment in accordance with good commercial practice, the care exercised at Powermark does not preclude damage in transit.

The following actions should be taken upon receipt of the equipment:

a. Visually inspect for damage to the shipping container. If it is damaged, request that the carrier inspect the shipment.

b. Unpack. If the equipment is damaged, unpack in the presence of the carrier's inspector and take photos if appropriate. A full report of the damage should be obtained by the claim agent and forwarded to Powermark. If the equipment is undamaged, or only superficially damaged, test to confirm proper operation.

c. Notify Powermark within ten days after delivery if the equipment has been received in a damaged condition. After the inspection and examination by a representative of the carrier and (if necessary) an inspection and examination by a representative of Powermark and the receipt of a full report of the damage, Powermark will advise the customer on proper procedures to follow, including return to the factory (if necessary).

1.1.2 Proprietary Notice

The information disclosed in this manual was originated by and is the property of Powermark. Reproduction of drawings or schematics associated with this equipment and use of patented circuitry without written permission, in advance, from an officer of Powermark is forbidden.

1.2 SCOPE OF MANUAL

This manual describes the Z family of static inverters and frequency converters manufactured by Powermark. It contains installation, operating, maintenance and adjustment instructions, theory of operation and circuit description, troubleshooting guides and drawings which will aid the user in understanding the equipment.

1.2.1 Applicability of Manual

Prior to applying the information in this manual to a particular model, please check to be certain that the part number of the static inverter or frequency converter exactly matches the part number on the title page of the manual

SECTION 2
GENERAL DESCRIPTION

2.1 STATIC INVERTERS

Powermark GZ Static Inverters convert a dc input into a sinusoidal single-phase ac output at a specified voltage and frequency.

The dc input voltage is filtered and applied to the inverter. The inverter converts the dc input into a square-wave output at a frequency determined by the oscillator. Square-wave drive power to the ferro-resonant transformer is provided by the inverter. The transformer shapes the square-wave to provide a low-distortion sinusoidal output. It also provides output voltage regulation, current limiting, harmonic suppression, and input-to-output isolation.

Detectors turn the static inverter off under conditions of undervoltage or overvoltage at the dc input.

2.2 FREQUENCY CONVERTERS

Powermark FZ Frequency Converters accept widely varying ac inputs and provide a regulated ac output at a specified voltage and frequency.

The ac input voltage is rectified, filtered, and applied to the inverter. The inverter converts the dc input into a square-wave output at a frequency determined by the oscillator. Square-wave drive power to the ferro-resonant transformer is provided by the inverter. The transformer shapes the square-wave to provide a low-distortion sinusoidal output. It also provides output voltage regulation, current limiting, harmonic suppression, and input-to-output isolation.

Detectors turn the frequency converter off under conditions of undervoltage or overvoltage at the converter input.

2.3 FEATURES

Several features distinguish Powermark GZ static inverters and FZ frequency converters from other products commercially available. Notable among these are:

Proven Reliability
Excellent Stability
Design Simplicity
Input/Output Protection
Rugged Construction

SECTION 3
SPECIFICATIONS

3.1 INPUT SPECIFICATIONS

3.1.1 Voltage Range, Frequency, and Current

These specifications are listed in Table 3-1 for static inverters and in Table 3-2 for frequency converters.

3.1.2 Protection

3.1.2.1 INPUT CURRENT AND REVERSE POLARITY

Circuit breakers limit input current and provide protection against inadvertent input polarity reversal on static inverters.

3.1.2.2 OVERVOLTAGE AND UNDERVOLTAGE

High- and low-voltage detectors turn the unit off when the input voltage goes above or below the normal input voltage operating limits.

3.2 OUTPUT SPECIFICATIONS

3.2.1 Power

Output volt-ampere ratings are tabulated in Table 3-1 for static inverters and in Table 3-2 for frequency converters.

3.2.2 Load Power Factor

May range from 0.75 lagging to unity.

3.2.3 Output Frequencies

50 Hz, 60 Hz, and 400 Hz.

3.2.4 Frequency Stability

±0.5 percent maximum (±0.01 percent optional).

3.2.5 Static Regulation

Line Regulation: ±1 percent maximum for line variations between low line and high line, at half load.

Load Regulation: ±2 percent maximum for load variations between no load and full load, at nominal line.

3.2.6 Regulation Envelope

±5 percent maximum for any combination of line voltage, load current, and temperature within specifications.

Total Harmonic Distortion: ±5 percent maximum at nominal input voltage, full load, and unity power factor over the operating temperature range.

3.2.7 Overload

Overload and short circuit protection with automatic recovery upon removal of the overload or short circuit.

3.3 GENERAL SPECIFICATIONS

3.3.1 Temperature

Operating: -10 to +55°C.

Storage: -40 to +75°C.

3.3.2 Cooling

Internal fan.

3.3.3 Weight

Weights are tabulated in Table 3-3.

3.4 SIZES

Sizes are tabulated on installation drawing 901-16998.

3.5 OPTIONAL FEATURES

Option: 0.01 percent precision frequency control.

Option: External frequency synchronization.

Option: Output voltage and output current meters.

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Table 3-1. Input/Output Specifications for GZ Static Inverters

PART NUMBER	DC INPUT VOLTAGE RANGE	MAXIMUM INPUT CURRENT	OUTPUT POWER	OUTPUT VOLTAGE	OUTPUT FREQUENCY
5111	11-15V or 22-30V	28A or 14A	200VA	115/230V	50Hz
5121	24-32V	13A	200VA	115/230V	50Hz
5131	42-56V	7A	200VA	115/230V	50Hz
5151	105-140V	2.5A	200VA	115/230V	50Hz
5211	11-15V or 22-30V	54A or 27A	400VA	115/230V	50Hz
5221	24-32V	25A	400VA	115/230V	50Hz
5231	42-56V	14A	400VA	115/230V	50Hz
5251	105-140V	5A	400VA	115/230V	50Hz
5311	11-15V or 22-30V	110A or 55A	800VA	115/230V	50Hz
5321	24-32V	50A	800VA	115/230V	50Hz
5331	42-56V	28A	800VA	115/230V	50Hz
5351	105-140V	9A	800VA	115/230V	50Hz
5511*	11-15V or 22-30V	220A or 110A	1600VA	115/230V	50Hz
5521*	24-32V	100A	1600VA	115/230V	50Hz
5112	11-15V or 22-30V	32A or 16A	250VA	115V	60Hz
5122	24-32V	15A	250VA	115V	60Hz
5132	42-56V	8A	250VA	115V	60Hz
5152	105-140V	3A	250VA	115V	60Hz
5212	11-15V or 22-30V	60A or 30A	500VA	115V	60Hz
5222	24-32V	28A	500VA	115V	60Hz
5232	42-56V	15A	500VA	115V	60Hz
5252	105-140V	6A	500VA	115V	60Hz
5313	11-15V or 22-30V	120A or 60A	1000VA	115/230V	60Hz
5323	24-32V	56A	1000VA	115/230V	60Hz
5333	42-56V	30A	1000VA	115/230V	60Hz
5353	105-140V	13A	1000VA	115/230V	60Hz
5382	210-280V	6.5A	1000VA	115/230V	60Hz
5512*	11-15V or 22-30V	240A or 120A	2000VA	115V	60Hz
5522*	24-32V	110A	2000VA	115V	60Hz
5513*	11-15V or 22-30V	240A or 120A	2000VA	115/230V	60Hz
5523*	24-32V	110A	2000VA	115/230V	60Hz

*Multiple units in parallel operation.

Table 3-1. Input/Output Specifications for GZ Static Inverters (Continued)

PART NUMBER	DC INPUT VOLTAGE RANGE	MAXIMUM INPUT CURRENT	OUTPUT POWER	OUTPUT VOLTAGE	OUTPUT FREQUENCY
5312	11-15V or 22-30V	120A or 60A	1000VA	115V	60Hz
5322	24-32V	56A	1000VA	115V	60Hz
5332	42-56V	30A	1000VA	115V	60Hz
5352	105-140V	13A	1000VA	115V	60Hz

Based on Walkdown 9/15/03
U2 CCR
Richard C Miller

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SECTION 4
INSPECTION, INSTALLATION, AND OPERATION

4.1 INSPECTION UPON RECEIPT

Carefully inspect the static inverter or frequency converter and its shipping container for evidence of damage sustained in shipping. If there is evidence of such damage, contact the shipping company in accordance with the instructions in the preface of this manual.

4.2 INSTALLATION REQUIREMENTS

4.2.1 Cooling Considerations

Powermark static inverters and frequency converters must be installed so that unrestricted cooling is available. Do not install this equipment in unusually dirty or oily environments or where it is likely to become covered by anything which might restrict airflow.

4.2.2 Input Power Source

Be certain that the input power source has a low impedance. If the voltage source momentarily drops during power-on application or overshoots during output load removal, the undervoltage or overvoltage detectors can be activated, shutting the unit off.

4.2.3 Input Wiring

The wiring between the source and the static inverters or frequency converters must be of adequate gauge to prevent excessive wire voltage drops. Table 4-1 is a recommended wire gauge list as a function of static inverter and frequency converter input voltage and output power.

CAUTION

Correct polarity or phasing must be observed in connecting the input power source to the input terminal blocks. For dc input units, the + and - polarity legends at the input terminal blocks are

Table 3-3. Weights for Z Family Static Inverters and Frequency Converters

SINGLE UNIT WEIGHTS						
	APPROXIMATE WEIGHT IN POUNDS (KILOGRAMS)					
	200 & 250 VA		400 & 500 VA		800 & 1000 VA	
UNIT TYPE	50 & 60 Hz	400 Hz	50 & 60 Hz	400 Hz	50 & 60 Hz	400 Hz
GZ	39 (18)		65 (29)		95 (43)	
FZ (115V Input)	45 (21)	35 (16)	73 (33)	53 (24)	90 (41)	70 (32)
FZ (230V Input)	58 (26)	48 (22)	86 (39)	66 (30)	120 (55)	95 (43)

MASTER/SLAVE SYSTEM WEIGHTS				
	1500 VA		1600 & 2000 VA	
GZ	160 (73)	—	190 (86)	110 (50)
FZ (115V Input)	—	—	180 (82)	140 (64)
FZ (230V Input)	—	—	240 (109)	190 (86)

self-explanatory. For frequency converter units, the following tabulation defines the input terminal block legends for correct phase correlation.

115 Vac Input Legends

AC: 'Hot' or 'live' wire from the source.

ACC: (AC common) Neutral or grounded wire from the source.

⏚ *: Chassis connection for safety ground wire (not a load conductor).*

230 Vac Input Legends

AC1: Phase 1 'hot' or 'live' wire from the source.

AC2: Phase 2 'hot' or 'live' wire from the source.

⏚ *: Chassis connection for safety ground wire (not a load conductor).*

4.2.4 Output Connections

The outputs of the Z family static inverters and frequency converters are equipped with either a duplex outlet receptacle or a terminal block.

The following tabulation defines the output terminal block legends for correct phase correlation.

115 Vac Output Legends

AC: 'Hot' or 'live' connection to load.

ACC: (AC common) Neutral connection to load.

⏚ *: Chassis connection.*

230 Vac Output Legends

AC1: Phase 1 'hot' or 'live' connection to load.

AC2: Phase 2 'hot' or 'live' connection to load.

Table 4-1. Wire Gauge (AWG) versus Output Power (VA

INPUT VOLTAGE	OUTPUT POWER				
	250	500	1000	1500	2000
12 VDC	# 6	# 4	# 2	# 2	2 of #2
24 VDC	#12	# 8	# 4	# 2	# 2
28 VDC	#12	# 8	# 4	# 2	# 2
48 VDC	#16	#12	#10	# 8	—
125 VDC	#16	#14	#12	#10	—
250 VDC	—	—	#14	—	—
115 VAC	#16	#14	#12	#12	#10
230 VAC	#16	#16	#14	#14	#12

NOTICE: If input wires are longer than ten feet, increase the listed wire size in order to limit the total wire resistance to that of the listed wire size at ten feet.

ACC: (AC common) Center-tap of output transformer secondary winding.

Phase 2 is 180 degrees out of phase with Phase 1. Both Phase 1 and Phase 2 are at 115V with respect to ACC. ACC is a load-carrying conductor for 115V loads connected from AC1 or AC2 to ACC.

4.2.5 Multiple Unit — Parallel Operation (Master/Slave)

Connect the furnished drive cable(s) to the mating connectors on the master/slave units.

Connect the input terminal block (TB1) of the master unit in parallel with the input terminal block (TB1) of the slave unit using the two-wire cable furnished with the system. Connect as shown on the master/slave system schematic, observing proper phasing for ac inputs or polarity for dc input. Connections from the source are to be made to the master unit terminal block on two-unit systems (1500 VA, 1600 VA, and 2000 VA).

Connect the output terminal block (TB3) of the master unit in parallel with the output terminal block (TB3) of the slave unit using the three-wire cable furnished with the system. **Observe proper phasing.**

On master/slave systems each units input circuit breaker must be on for the system to operate.

CAUTION

Damage may result to either the master or slave unit if the input cable, output cable, and interconnecting cable are not completely connected to all units as specified.

4.3 OPERATION

4.3.1 General

Be certain that the installation instructions of Section 4.2 are thoroughly understood and complied

YQ-948 WALKDOWN – 33'el UNIT 2 CABLE SPREADING RM. NORTH WALL

SOLID STATE CONTROLS, INC.

MODEL No. ECONO-INVERTER EV-12005

SERIAL No. 26878101 (2001E-4)

INPUT VOLTAGE: 105-140 VDC INPUT CURRENT 6.35A

OUTPUT VOLTAGE: 120VAC OUTPUT CURRENT 4.16A

PERFORMED BY: Richard C. Milici
9.12.03

Attachment U

Voltage Margin Analysis

Voltage Margin Analysis

Notes:

1. Limiting device for 2 hour scenario minimum voltage.

2. Device has no additional voltage drop and is above the required voltage delta.

3. Device does not actuate during times of lowest node voltage (momentary due to breaker closing operations). Voltage delta will be greater than 6 volts when device would be required to actuate. If device previously actuated, hold in voltage (drop out voltage) is typically 50% or less of rated voltage (less than 60 volts).

4. Device will not actuate during the last minute. Voltage delta would be greater than 6 volts when actuation would be required.

Voltage Margin Analysis

node	circuit	Schematic	Device	MFGR	Model	Time	Node V	Device Voltage	Delta	Notes
13	PP22-07	IP2--S-000054	GEN REG INV1	UNKNOWN	GEN REG. INVERTER	W	108.97	108.97	3.97	1
14	PP22-09	9321-LL-3114 SH 02	52Y-UT3	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 03	52MR-UT3-ST6	UNKNOWN	RELAY	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 04	52Y-UT4	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 05	52MR-UT4-ST6	UNKNOWN	RELAY	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 06	52Y-ST6	UNKNOWN	Y- CUT-OFF RELAY(6.9)	35	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 07	52Y-RCP23	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 07	S4-RCP23	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3
14	PP22-09	9321-LL-3114 SH 09	52Y-HDP21	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 10	52Y-SS3	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 11	52Y-RCP22	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 11	S9-RCP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3
14	PP22-09	9321-LL-3114 SH 12	52Y-CP23	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 12	CPAS/23-CP23	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3,4
14	PP22-09	9321-LL-3114 SH 14	52Y-HDP22	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 17	62/ST6	UNKNOWN	TD-53 TIME DELAY REL	W	105.91	105.91	4.91	3, 4
14	PP22-09	9321-LL-3114 SH 17	62/UT3	UNKNOWN	TD-53 TIME DELAY REL	W	105.91	105.91	4.91	3, 4
14	PP22-09	9321-LL-3114 SH 17	62/UT4	UNKNOWN	TD-53 TIME DELAY REL	W	105.91	105.91	4.91	3, 4
14	PP22-09	9321-LL-3114 SH 18	71X/HDT	WHSE	SG	W	105.91	105.91	4.91	3,4
14	PP22-09	9321-LL-3114 SH 18	86X/ST6-OP	WHSE	MG-6	W	105.91	105.91	4.91	3, 4
14	PP22-09	9321-LL-3114 SH 18	86X/ST6-RESET	WHSE	MG-6	W	105.91	105.91	4.91	3, 4
14	PP22-09	9321-LL-3114 SH 19	52Y-GT26	UNKNOWN	Y- CUT-OFF RELAY(6.9)	35	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 20	51N-SS22RW3	WHSE	RELAY	W	105.91	105.91	4.91	2, 4
14	PP22-09	9321-LL-3114 SH 20	52Y-SS22RW3	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	9321-LL-3114 SH 16	52Y-SS6	UNKNOWN	Y- CUT-OFF RELAY(6.9)	35	105.91	105.91	4.91	2
14	PP22-09	B225123	27-3/62-BUS 3 UV/UF	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225123	27-3/62X-BUS 3 UV/UF	WHSE	MG-6	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225123	27-3/ICS-BUS 3 UV/UF	WHSE	CV	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225123	27-3/X1-BUS 3 UV/UF	WHSE	MG-6, 24 V, W/ 300 O	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225123	27-3/X2-BUS 3 UV/UF	WHSE	MG-6	W	105.91	105.91	4.91	2, 4

Voltage Margin Analysis

node	circuit	Schematic	Device	MFGR	Model	Time	Node V	Device Voltage	Delta	Notes
14	PP22-09	B225123	27-3/X3-BUS 3 UV/UF	WHSE	SG	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225123	81-3/ICS-BUS 3 UV/UF	WHSE	KF	W	105.91	105.91	4.91	3, 4
14	PP22-09	B225123	81-3/X1-BUS 3 UV/UF	WHSE	MG-6	W	105.91	105.91	4.91	3, 4
14	PP22-09	B225124	27-4/62-BUS 4 UV/UF	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225124	27-4/62X-BUS 4 UV/UF	WHSE	MG-6	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225124	27-4/ICS-BUS 4 UV/UF	WHSE	CV	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225124	27-4/X1-BUS 4 UV/UF	WHSE	MG-6, 24 V, W/ 300 O	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225124	27-4/X2-BUS 4 UV/UF	WHSE	MG-6	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225124	27-4/X3-BUS 4 UV/UF	WHSE	SG	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225124	81-4/ICS-BUS 4 UV/UF	WHSE	KF	W	105.91	105.91	4.91	3, 4
14	PP22-09	B225124	81-4/X1-BUS 4 UV/UF	WHSE	MG-6	W	105.91	105.91	4.91	3, 4
14	PP22-09	B225173	27-3/62A-BUS 3 UV/UF	AGASTAT	2122DH39YC	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225173	27-3A-BUS 3 UV/UF	ABB	TYPE 27N, SERIES 411	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225173	27-4/62A-BUS 4 UV/UF	AGASTAT	2122DH39YC	W	105.91	105.91	4.91	2, 4
14	PP22-09	B225173	27-4A-BUS 4 UV/UF	ABB	TYPE 27N, SERIES 411	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231669	43/CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3
14	PP22-09	B231669	49A/T-CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231669	49A/X-CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231669	49C/T-CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231669	49C/X-CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231669	52Y-CWP22	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	B231669	62/CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231669	62FLT/CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231669	63AR/CWP22	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231670	43/CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3
14	PP22-09	B231670	49A/T-CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231670	49A/X-CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231670	49C/T-CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231670	49C/X-CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231670	52Y-CWP24	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2

Voltage Margin Analysis

node	circuit	Schematic	Device	MFGR	Model	Time	Node V	Device Voltage	Delta	Notes
14	PP22-09	B231670	62/CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231670	62FLT/CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231670	63AR/CWP24	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231671	43/CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3
14	PP22-09	B231671	49A/T-CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231671	49A/X-CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231671	49C/T-CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231671	49C/X-CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	2, 4
14	PP22-09	B231671	52Y-CWP26	UNKNOWN	Y- CUT-OFF RELAY(6.9)	W	105.91	105.91	4.91	2
14	PP22-09	B231671	62/CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231671	62FLT/CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
14	PP22-09	B231671	63AR/CWP26	UNKNOWN	UNKNOWN	W	105.91	105.91	4.91	3, 4
18	DP22-06	IP2-S-000006	SOV1413-V1413	UNKNOWN	UNKNOWN	W	108.99	108.99	5.99	3
20	PP22-14	011D13784	INVERTER PA	SCI	10 KVA INV, SV12100/	W	110.21	110.21	5.21	2

Attachment V

Inverter Loading from Operator Logs

21 Inverter	DC Input (A)	22 Inverter	DC Input (A)	23 Inverter	DC Input (A)	24 Inverter	DC Input (A)
12/31/2003 12:34	50	12/31/2003 12:35	44	12/31/2003 12:33	46	12/31/2003 12:34	55
12/31/2003 21:33	50	12/31/2003 21:33	44	12/31/2003 21:33	46	12/31/2003 21:33	55
1/1/2004 13:31	50	1/1/2004 13:32	44	1/1/2004 13:31	46	1/1/2004 13:32	55
1/1/2004 21:37	50	1/1/2004 21:37	44	1/1/2004 21:37	46	1/1/2004 21:37	55
1/2/2004 12:09	50	1/2/2004 12:10	44	1/2/2004 12:09	46	1/2/2004 12:09	55
1/3/2004 0:16	50	1/3/2004 0:15	44	1/3/2004 0:17	46	1/3/2004 0:16	55
1/3/2004 12:20	50	1/3/2004 12:20	44	1/3/2004 12:19	46	1/3/2004 12:20	55
1/3/2004 23:07	50	1/3/2004 23:06	44	1/3/2004 23:07	46	1/3/2004 23:08	55
1/4/2004 8:21	50	1/4/2004 8:22	44	1/4/2004 8:21	46	1/4/2004 8:22	55
1/4/2004 22:16	50	1/4/2004 22:16	44	1/4/2004 22:16	46	1/4/2004 22:16	55
1/5/2004 8:59	50	1/5/2004 8:59	44	1/5/2004 8:59	46	1/5/2004 8:59	55
1/6/2004 0:35	51	1/6/2004 0:33	43	1/6/2004 0:35	46	1/6/2004 0:34	55
1/6/2004 8:23	50	1/6/2004 8:24	43	1/6/2004 8:22	47	1/6/2004 8:23	55
1/6/2004 23:12	50	1/6/2004 23:13	44	1/6/2004 23:12	46	1/6/2004 23:12	55
1/7/2004 11:59	50	1/7/2004 12:00	44	1/7/2004 11:59	46	1/7/2004 12:00	55
1/7/2004 23:27	50	1/7/2004 23:28	44	1/7/2004 23:27	46	1/7/2004 23:27	55
1/8/2004 12:56	50	1/8/2004 12:57	44	1/8/2004 12:56	46	1/8/2004 12:56	55
1/8/2004 23:37	50	1/8/2004 23:38	44	1/8/2004 23:37	46	1/8/2004 23:38	55
1/10/2004 3:06	50	1/10/2004 3:06	44	1/10/2004 3:04	46	1/10/2004 3:05	55
1/11/2004 1:02	51	1/11/2004 1:03	44	1/11/2004 1:02	46	1/11/2004 1:03	55
1/11/2004 12:51	51	1/11/2004 12:52	44	1/11/2004 12:50	46	1/11/2004 12:51	55
1/11/2004 20:58	51	1/11/2004 20:59	44	1/11/2004 20:58	46	1/11/2004 20:58	55
1/12/2004 9:14	51	1/12/2004 9:15	44	1/12/2004 9:14	46	1/12/2004 9:15	55
1/12/2004 23:07	50	1/12/2004 23:09	43	1/12/2004 23:07	45.5	1/12/2004 23:08	53
1/13/2004 12:52	50	1/13/2004 12:52	44	1/13/2004 12:51	46	1/13/2004 12:52	55
1/13/2004 23:59	50	1/14/2004	44	1/13/2004 23:59	46	1/14/2004	55
1/14/2004 10:33	50	1/14/2004 10:26	44	1/14/2004 10:33	46	1/14/2004 10:32	55
1/14/2004 22:54	50	1/14/2004 22:55	44	1/14/2004 22:53	46	1/14/2004 22:54	55
1/15/2004 9:58	50	1/15/2004 9:57	43	1/15/2004 9:58	46	1/15/2004 9:58	55
1/16/2004 2:30	50	1/16/2004 2:31	43	1/16/2004 2:30	46	1/16/2004 2:31	55

Attachment W
Battery Information

EnerSys Inc.
P.O. Box 14145
Reading, PA 19612-4145
800-538-3627 x 1680
Fax 610-208-1630
Email: jan.reber@enersysinc.com
www.enersysinc.com

Jan G. Reber
Director of Products

July 8, 2004

Bob Fletcher

Sr. Engineer, Electrical
AREVA
Framatome ANP, Inc.
339924 Golf Lane
Antioch, IL 60002

Dear Bob,

Reference curve S-1027GN was created for and is applicable to the GN23 battery series. This curve's values represent the fully developed capacity of the referenced cells. As noted in IEEE 450, the initial capacity of stationary batteries may be 90% of the rated capacity. As such, the battery selection calculations need to include an end of life factor of 90% for these curves to be used and ensure that the load will be carried initially. If this guidance is followed, the fully developed curves are applicable.

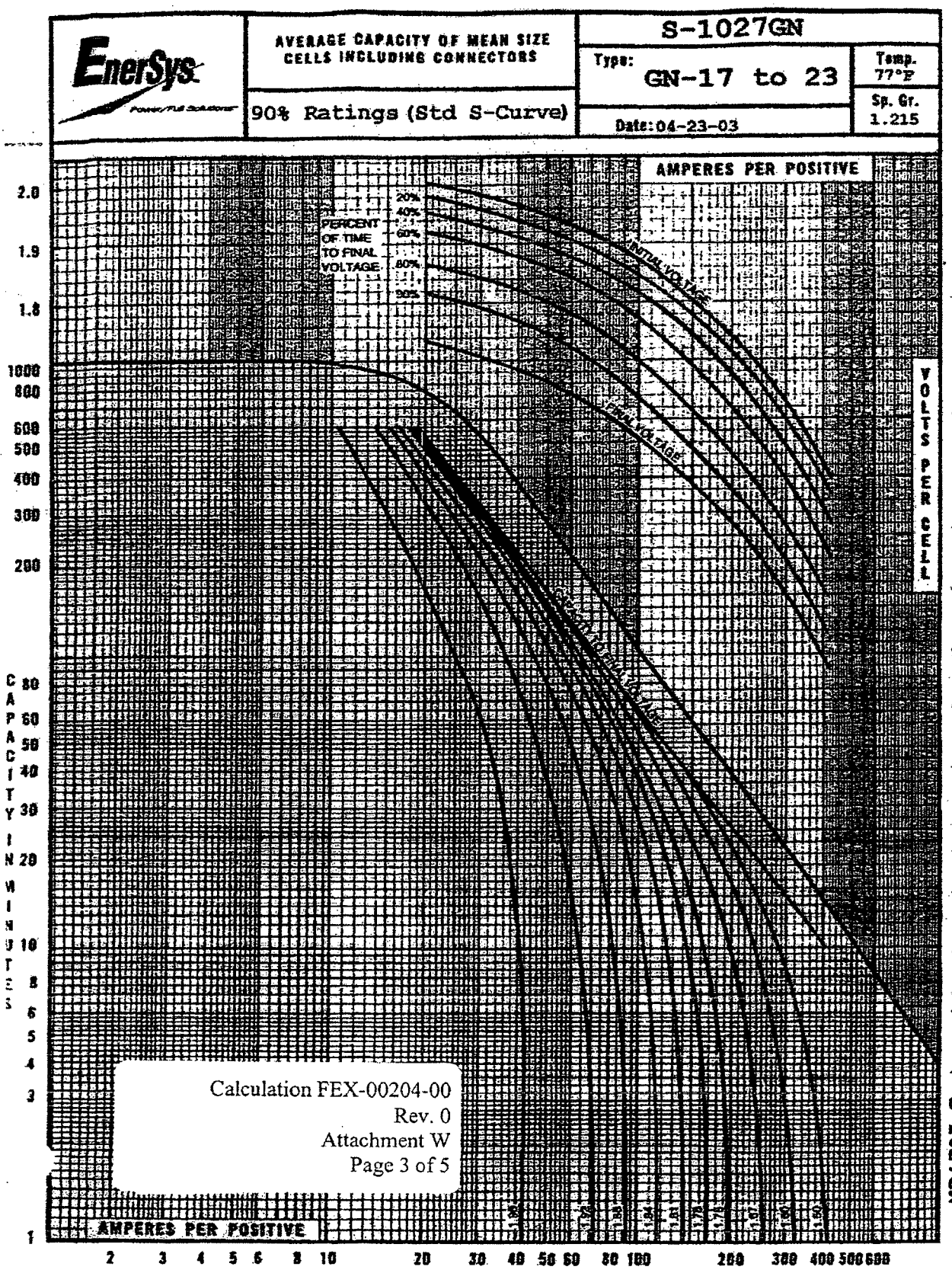
The short circuit current of a cell is a function of the cell's design. The 1 minute currents to 1.75 and 1.50 for the GN series of batteries have been listed on Catalog cut sheet 51.52, which is no longer carried in our public information, but is available for those involved with the nuclear industry. If you require those values, please contact me and I will have a copy forwarded to you.

If there are any further questions, feel free to contact me.

Sincerely

Jan G. Reber
Director of Wet Stationary Products
EnerSys Corporation

Cc: J. Gagge, S Weik, A Schwab, File 352



Calculation FEX-00204-00
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Attachment W
Page 3 of 5

SECTION 51.52

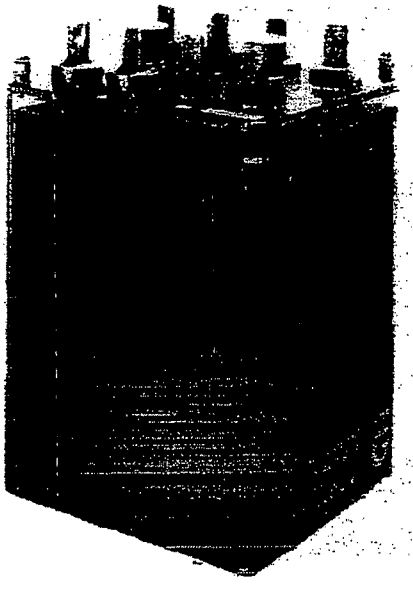
EXIDE

Calcium Flat Plate

Type GN

Nuclear Qualified

- ☐ Highest 1-minute rates
- ☐ Lowest maintenance—lowest water loss, lowest maintenance costs
- ☐ "Slide Lock"™ terminal post seal—virtually eliminates terminal post corrosion, while allowing plate growth.
- ☐ 20-year life expectancy
- ☐ Flat-plate construction—calcium alloy grids
- ☐ For floating applications where high ambient temperatures are not probable
- ☐ Optimum ratio of plate surface area to electrolyte volume for maximized performance in discharges of 1-minute to 8-hours duration. Specifically suited for demanding complex load profiles requiring high initial and end currents



SPECIFICATIONS

PLATE DIMENSIONS:

	HEIGHT	WIDTH	THICKNESS
POSITIVE	17.3 in./439 mm	12.7 in./323 mm	0.31 in./7.9 mm
NEGATIVE	17.3 in./439 mm	12.7 in./323 mm	0.21 in./5.3 mm

SEDIMENT SPACE: 1.32 in./33.5 mm
ELECTROLYTE OVER PLATES: 3.4 in./88 mm
CONTAINER: Polycarbonate
COVER: Polycarbonate
SEPARATORS: Microporous rubber
RETAINERS: "Vlies"—glass fiber
POST TYPE: GN-13 and 15—Single Post, lead-plated copper
GN-17 through 23—Double Posts, lead-plated copper
POST SEAL TYPE: Slide-Lock™
PLATE SUSPENSION TYPE—
POSITIVE: Bridge Hung
NEGATIVE: Bottom Supported
ELECTROLYTE WITHDRAWAL TUBE: One per cell
VENT TYPE: Flame arrestor, fused alumina
FLOAT VOLTAGE—
ACCEPTABLE RANGE: 2.17-2.28 VPC
RECOMMENDED: 2.25 VPC
SPECIFIC GRAVITY: 1.215
BOLT CONNECTORS: Stainless Steel, Standard English Measure, Hex-Head
INTERCELL CONNECTORS: Lead-Plated Copper
NUCLEAR QUALIFICATIONS:
IEEE-323-1983
IEEE-344-1975
IEEE-535-1986

LEAD RETURN RECYCLE

Capacities-Dimensions-Weights

TYPE*	NOM. A.H. CAP.	OVERALL DIMENSIONS						WEIGHTS—VOLUMES								OUTLINE DRAWING: SEE CATALOG SECTION
		LENGTH		WIDTH		HEIGHT		UNPACKED		DOMESTIC PACKED		ELECTROLYTE ONLY 1.215 SP. GR.				
		in	mm	in	mm	in	mm	lbs	kg	lbs	kg	lbs	kg	gal	l	
2GN-13	1140	12.4	315	15.1	384	27.2	691	445	202	465	211	119	54	11.9	45	57.40
2GN-15	1260							485	220	505	229	111	50	11.1	42	
2GN-17	1500	16.6	422	15.1	384	27.2	691	585	265	607	275	163	74	16.3	62	
2GN-19	1600							620	281	642	291	155	70	15.5	59	
2GN-21	1700							655	297	677	307	147	67	14.7	56	
2GN-23	1800							695	315	717	325	139	63	13.9	53	

*Prefix Number Indicates Cells Per Unit, Suffix Number Indicates Total Plates Per Cell

Average Cell Performance Data*

(Discharge Rates in Amperes.)

1.215 SP. GR. ELECTROLYTE AT 77° (25°C), INCLUDING CELL CONNECTORS

TYPE	NOM. A.H. CAP.	72 HR.	24 HR.	12 HR.	8 HR.	5 HR.	4 HR.	3 HR.	2 HR.	1.5 HR.	1 HR.	30 MIN.	15 MIN.	1 MIN.	TO 1.50 VPC 1 MIN.
To 1.75 VPC Final															
GN-13	1140	24.3	64	109	143	198	225	270	355	420	535	760	922	1090	2035
GN-15	1260	25.7	69	118	157	215	248	295	390	465	600	860	1046	1230	2300
GN-17	1500	30.0	77	135	187	255	304	365	480	560	710	980	1230	1680	3360
GN-19	1600	31.1	82	145	199	280	333	400	525	615	785	1075	1365	1830	3725
GN-21	1700	31.8	86	154	213	300	360	430	565	670	855	1160	1500	1970	4085
GN-23	1800	31.9	89	160	225	325	385	460	605	725	925	1240	1625	2100	4430
To 1.81 VPC Final															
GN-13	1140			103	136	185	212	250	315	370	465	610	719	817	
GN-15	1260			112	149	200	231	278	350	400	525	690	815	922	
GN-17	1500			129	175	240	284	336	430	505	625	805	965	1200	
GN-19	1600			139	189	260	310	367	474	555	685	885	1070	1315	
GN-21	1700			147	203	283	385	396	515	605	745	960	1170	1425	
GN-23	1800			155	214	303	360	422	555	650	800	1035	1285	1525	

* One minute rates above are provided for short circuit current calculation and are not to be used as performance data.

**Amperes values listed represent 100% of the cells capacity. Initial capacity shall be a minimum of 90% of these values per IEEE 450.

Accessories

	CATALOG NUMBER
†PORTABLE HYDROMETER	81332
†HYDROMETER HOLDER—WALL MOUNT	27717
†THERMOMETER (portable or Flame Arrestor Mounting)	27167
†CELL NUMBER SET: 1-24	802361
1-60	802362
1-120	802363
1-240	802364
†CELL LIFTING DEVICE: GN-13 thru 15	84974
GN-17 thru 23	84975
FLAME ARRESTOR (Supplied With Each Cell) GN-13 thru 23	83437

†Included with 12 or more cells

For complete information about these and all other accessories, see Catalog Section 80.05.

For Racks, contact the local sales office.

Note:
All inter-cell, inter-tier, inter-step, end-to-end inter-rack, back-to-back inter-rack connectors, terminal lugs, and terminal plates are included with every battery. Across-aisle inter-rack connectors are not included.

YUASA Has Changed Its Name To,

EnerSys
Power-Full Solutions

Corporate Office: P.O. Box 14145, Reading, PA 19612-4145, 610-208-1991, FAX 610-208-1913, 800-538-3627
Eastern Regional Office: 201-641-5800, 800-882-1287
Western Regional Office: 310-949-1200, 800-423-4687

Printed 03/94 - 5,000
Rev. - 10/93
Printed in USA

Attachment X

September 18, 2003 Letter from Richard Milici (IP2) to Jim Hausser (FANP)

Entergy

Entergy Nuclear Northeast
Indian Point Energy Center - Unit 2
1 Park Place
Peekskill, NY 10566

September 18, 2003

Mr. Jim Hausser
Framatome ANP
106 Bayview Lane
Grayslake, IL 60030

Subject: DBI CLC-2-3 125VDC Load Study Open Item Resolution

Dear Mr. Hausser,

Please find enclosed input to support resolution of the following open items identified by their associated Comp. ID as provided in your open item listing:

5, 13, 29, 38, 39, 46, 98, 133, 134, 178, 184 (YQ-948)

Also, For the following items Entergy would like to use the following equipment for determining load and voltage requirements:

All Indicating Lights (35, 53, 67, 68, and 113) Assume 4 Watts per Westinghouse type EZC Minalite Typical

All Control Relays (42) Westinghouse Type BFD or NBFD Relays

All Timers 49, 51, and 61 Agastat 7000 Series

Sincerely,

Richard C. Milici
SR. Electrical Engineer

enclosures

Attachment Y

DIR-FEX-00204

ATTACHMENT 9.1 **DESIGN INPUT RECORD**

Sheet 1of 1

Design Input Revision 00 Page 1 of 5

DESIGN INPUT RECORD

Document Type: calculation

Document Number: FEX-00204 Document Revision: 00

Problem Summary: (Attach additional sheets as required)

The calculation will review electrical components, determine load profiles for Battery 22, and analyze DC system performance. (IP-2)

Design Objective: (Attach additional sheets as required)

Analyze battery sizing, device voltages, short circuit levels, battery charger sizing and overvoltage conditions.

Discipline Review:
Contributing Disciplines

	Prepared By	Reviewed By:		Prepared By	Reviewed By:
☐Mechanical			☒Electrical		
☐I & C			☐Civil/Structural		
☐Other			☐Engineering Programs		

Outside Design Organization_____ Project Engineer (Print/Sign/Date)_____

The contributing discipline engineer shall provide his/her name beside the appropriate block.

Lead Discipline Electrical

Prepared by: (Print/Sign) H A Robinson / H A Robinson Date 8/1/05

Engineering Supervisor: J Raffaele / Joe Raffaele Date 8/2/05

ATTACHMENT 9.2 **DESIGN INPUT RECORD CONTINUATION SHEET**

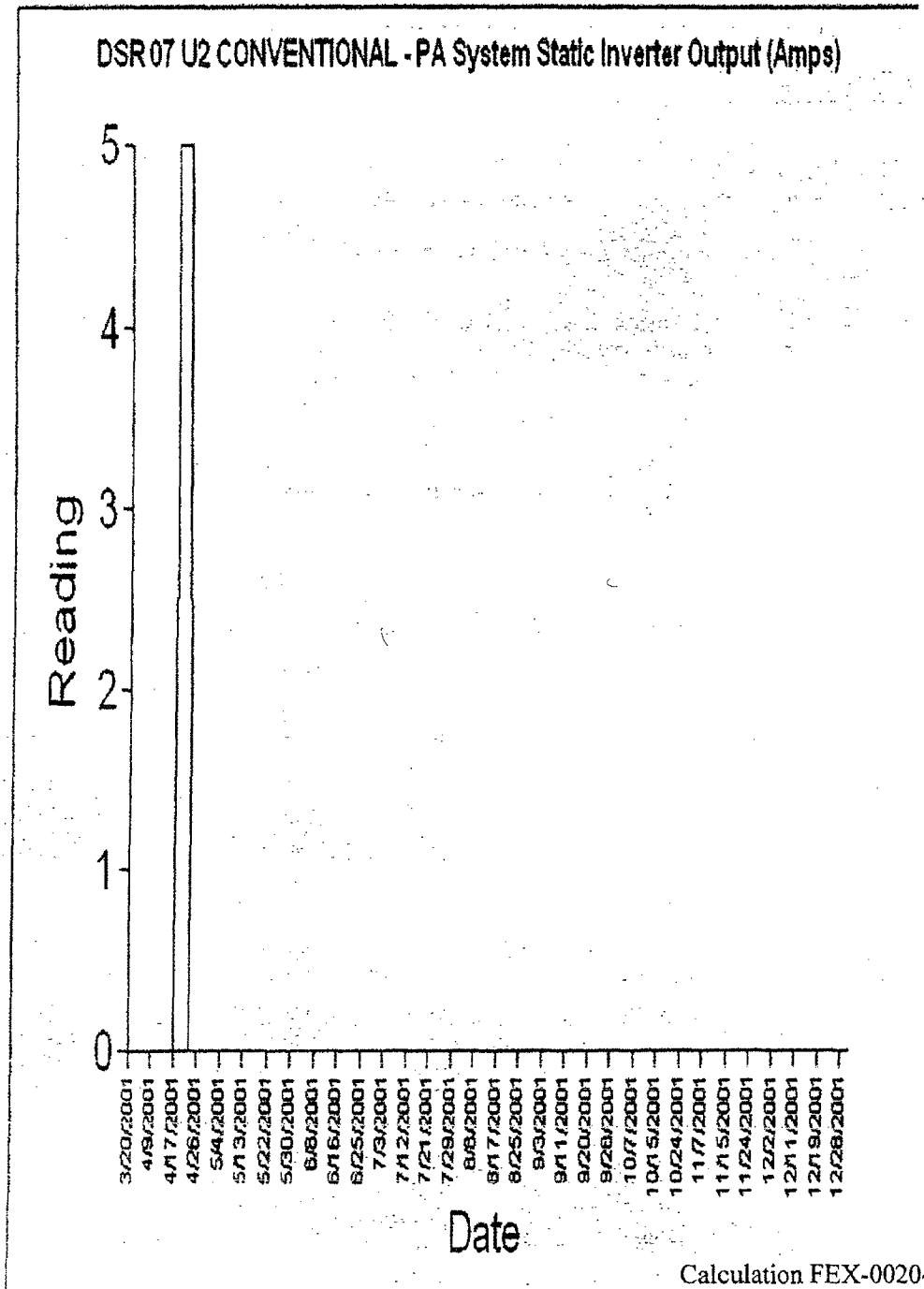
Sheet 1of 1

Design Input Revision 00 Page 2 of 5

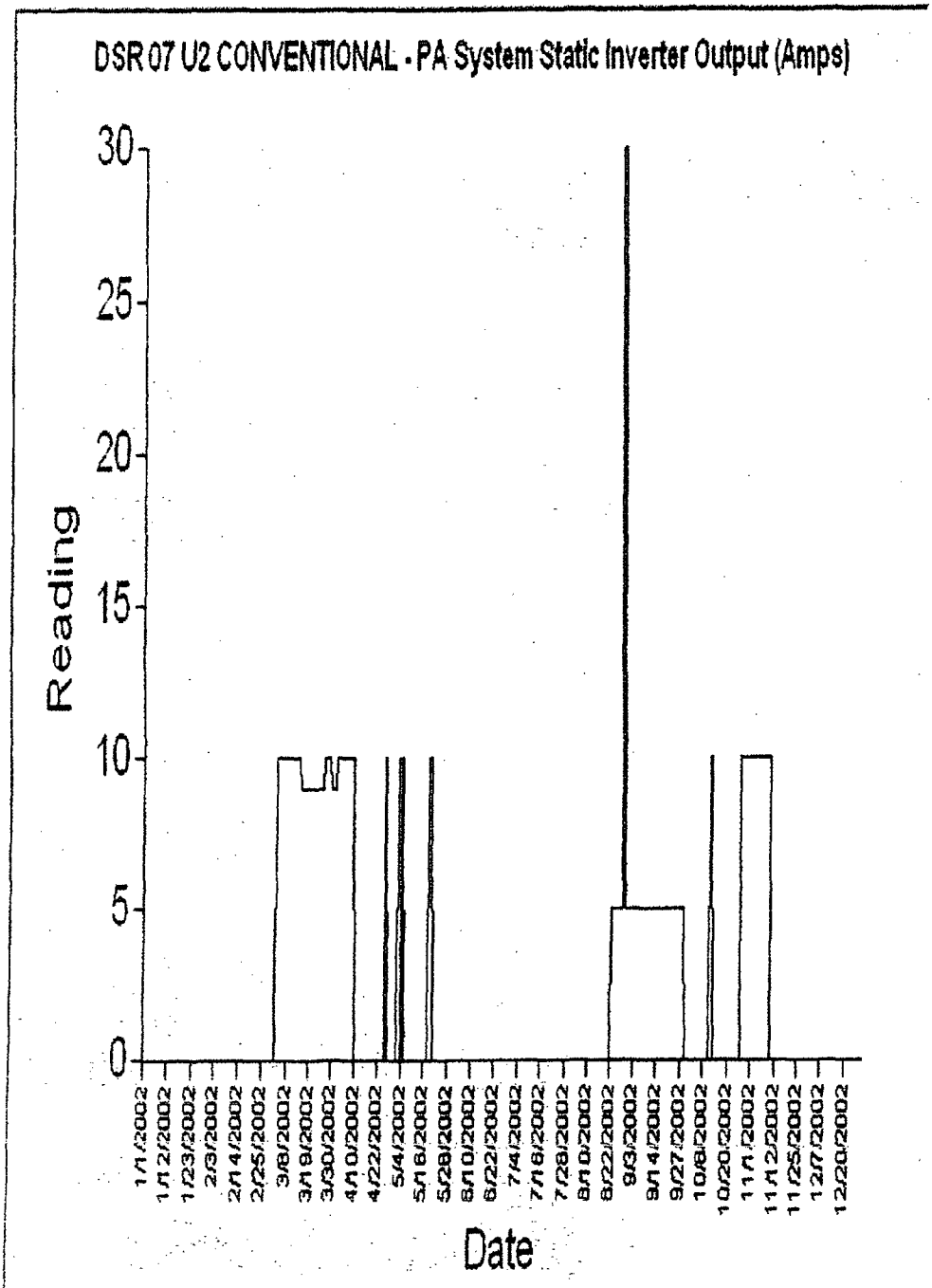
The following design input items correspond to the design requirements specified in Attachment 9.3:

Reference No.	Inputs	Input Source
1	DC Power Panel 22 (Ckt-14) - Loading for PA System Static Inverter shall be 26 amps, 132VDC, based on walkdown information and engineering judgment on operator log readings. - walkdown - 24amps, 132VDC. - Ops log - 2amps additional. (some readings from '03 and '04 are not valid as inverter was bypassed (WO IP2-03-07188))	1. Walkdown data 2. SOMS – DSR-07 operator log readings for PA inverter output for 2001, 2002 & 2004. (log charts attached)

SOMS

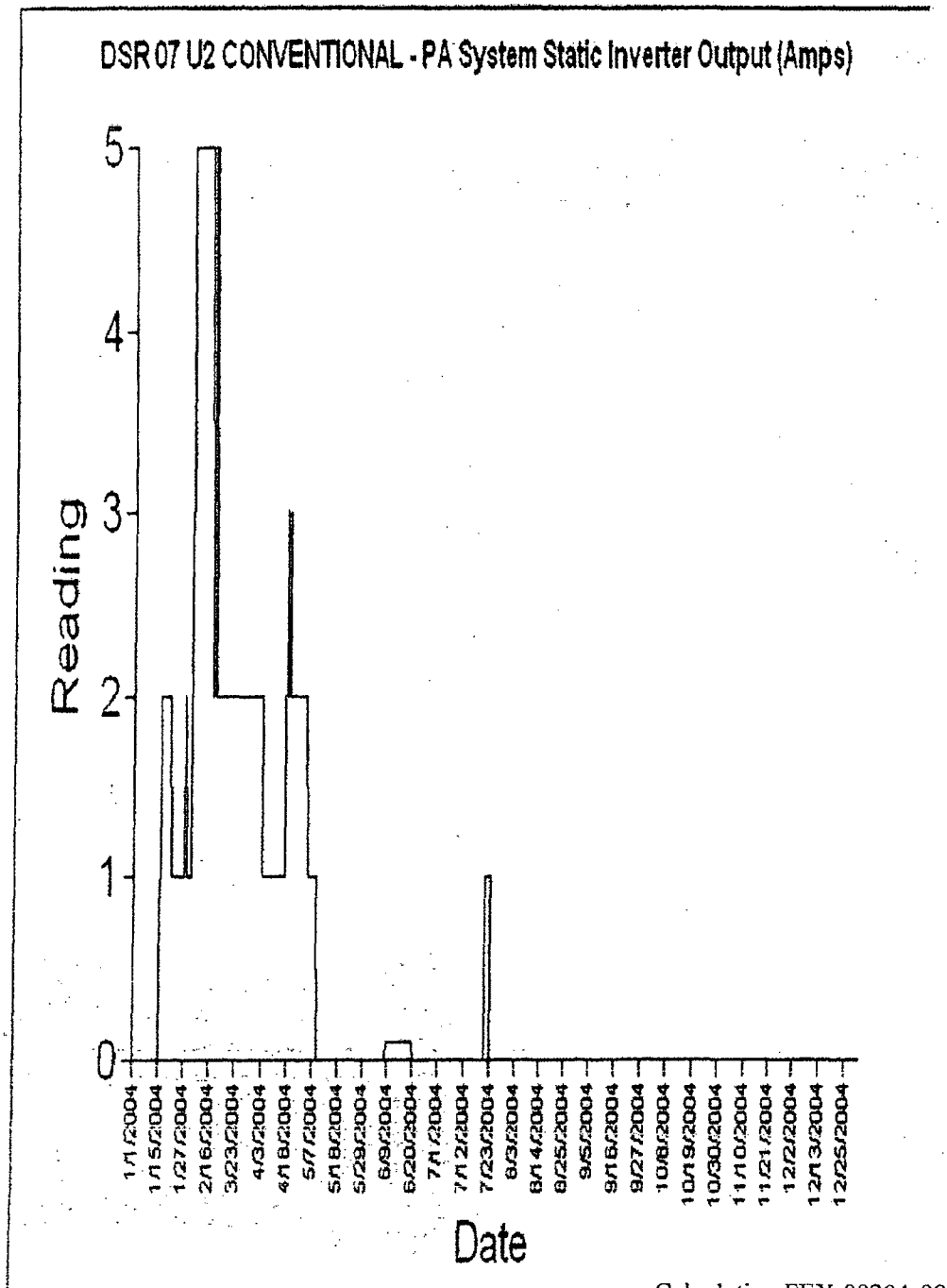

DSR 07 U2 CONVENTIONAL - PA System Static Inverter Output (Amps)
Reading
0
1
2
3
4
5
3/20/2001
4/9/2001
4/17/2001
4/26/2001
5/4/2001
5/13/2001
5/22/2001
5/30/2001
6/8/2001
6/16/2001
6/25/2001
7/3/2001
7/12/2001
7/21/2001
7/29/2001
8/6/2001
8/17/2001
8/25/2001
9/3/2001
9/11/2001
9/20/2001
9/28/2001
10/7/2001
10/15/2001
10/24/2001
11/7/2001
11/15/2001
11/24/2001
12/2/2001
12/11/2001
12/19/2001
12/28/2001
Date

SOMS


DSR 07 U2 CONVENTIONAL - PA System Static Inverter Output (Amps)
Reading
30
25
20
15
10
5
0
1/1/2002
1/12/2002
1/23/2002
2/3/2002
2/14/2002
2/25/2002
3/8/2002
3/19/2002
3/30/2002
4/10/2002
4/22/2002
5/4/2002
5/16/2002
5/28/2002
6/10/2002
6/22/2002
7/4/2002
7/16/2002
7/28/2002
8/10/2002
8/22/2002
9/3/2002
9/14/2002
9/27/2002
10/8/2002
10/20/2002
11/1/2002
11/12/2002
11/25/2002
12/7/2002
12/20/2002
Date

DIR- FEX-00204
Page 5 of 5

SOMS



Problem data - Inverter bypassed

Attachment Z

Miscellaneous Vendor Documentation

ROSS Series 27 Poppet Valves for Line Mounting

Valves in this Series are available with single or double solenoid pilots or an air head for remote pressure control. Valve elements have end-guided stainless steel stems. Flush flexible manual override buttons are standard on solenoid models. Solenoid models listed in this catalog use an internal pilot supply. They are, however, easily field-convertible for use with an external pilot supply. Models for external pilot supply may also be ordered from ROSS.

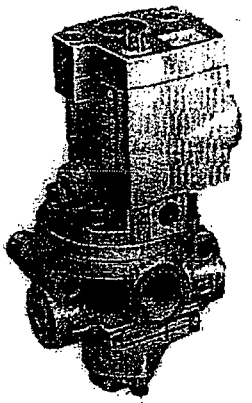
To provide special control functions, most models are also available with the following **LOGICAIR®** adaptors.

Timed Sequence Adaptor: Allows the actuation and/or de-actuation of a valve to be delayed up to 30 seconds for 2/2 valves, and up to 3 seconds for 3/2 and 4/2 valves. For longer delays see "Q" adaptor below.

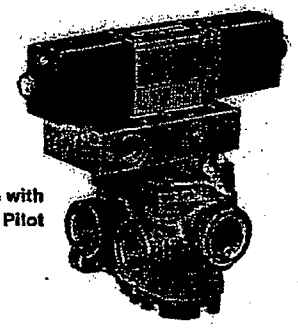
"PB" Adaptor: Increases the actuating force on the valve piston. Useful with low pilot pressure.

Air Index Adaptor: Allows a single control valve to function as an impulse controlled, detented valve. Successive momentary signals from the same source actuate and de-actuate the valve.

"Q" Adaptor: For use in conjunction with the timed sequence adaptor to extend the delay interval up to 60 seconds. The "Q" adaptor also provides quicker response to actuating and de-actuating signals.

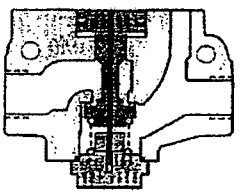


3/2 Valve with Single Solenoid Pilot

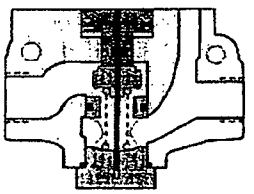


4/2 Valve with Double Solenoid Pilot

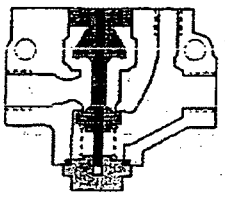
Series 27 Valve Bodies



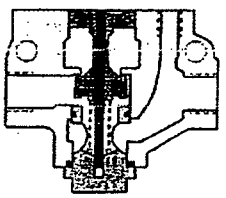
2/2 Normally Closed



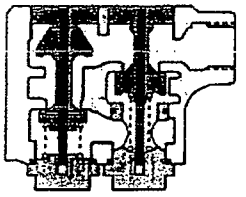
2/2 Normally Open



3/2 Normally Closed



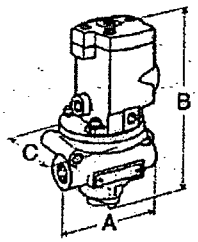
3/2 Normally Open



4/2

Series 27 Single Solenoid Pilot Inline Valves

2/2 Valves

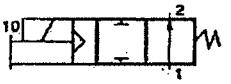


Port Size	Valve Model Numbers Normally Closed	Normally Open	Average C_v N.C.	N.O.	Weight lb. (kg)
1/4	2771B2001	2772B2001	2.3	2.3	
3/8	2771B3001	2772B3001	3.8	3.3	2.5 (1.1)
1/2	2771B4011	2772B4011	4.0	3.5	
1/2	2771B4001	2772B4001	7.7	6.5	
3/4	2771B5001	2772B5001	9.0	7.3	3.3 (1.5)
1	2771B6011	2772B6011	9.0	7.9	
1	2771B6001	2772B6001	24	21	
1-1/4	2771B7001	2772B7001	29	20	7.0 (3.2)
1-1/2	2771B8011	2772B8011	29	21	
1-1/2	2771B8001	2772B8001	49	49	
2	2771B9001	2772B9001	57	57	15.5 (6.9)
2-1/2	2771B9011	2772B9011	64	72	

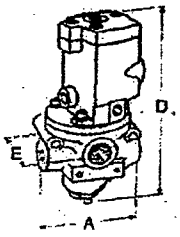
Normally Closed



Normally Open



3/2 Valves



Port Sizes In-Out	Exh.	Valve Model Numbers Normally Closed	Normally Open	Average C_v N.C.	N.O.	Weight lb. (kg)
1/4	1/2	2773B2001	2774B2001	2.8	2.5	
3/8	1/2	2773B3001	2774B3001	4.0	3.0	2.5 (1.1)
1/2	1/2	2773B4011	2774B4011	3.8	3.0	
1/2	1	2773B4001	2774B4001	7.8	7.2	
3/4	1	2773B5001	2774B5001	9.4	7.2	3.3 (1.5)
1	1	2773B6011	2774B6011	10	7.2	
1	1-1/2	2773B6901	2774B6001	29	21	
1-1/4	1-1/2	2773B7001	2774B7001	31	22	7.0 (3.2)
1-1/2	1-1/2	2773B8011	2774B8011	31	21	
1-1/2	2-1/2	2773B8001	2774B8001	69	58	
2	2-1/2	2773B9001	2774B9001	70	60	16.5 (7.4)
2-1/2	2-1/2	2773B9011	2774B9011	71	55	

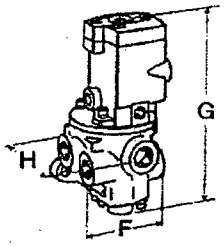
Normally Closed



Normally Open



4/2 Valves



Port Sizes In-Out	Exhaust	Valve Model Numbers	Average C_v	Weight lb. (kg)
1/4	1/2	2776B2001	2.5	
3/8	1/2	2776B3001	3.6	3.0 (1.4)
1/2	1/2	2776B4011	3.7	
1/2	1	2776B4001	6.9	
3/4	1	2776B5001	8.2	5.3 (2.4)
1	1	2776B6011	8.9	
1	1-1/2	2776B6001	23	
1-1/4	1-1/2	2776B7001	24	11.3 (5.1)
1-1/2	1-1/2	2776B8011	25	



IMPORTANT NOTE
Please read carefully and thoroughly all of the CAUTIONS.

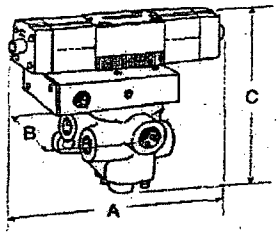
OVERALL DIMENSIONS inches (mm)

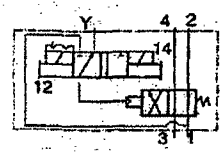
Port Size	A	B	C	D	E	F	G	H
1/4 to 1/2	3.6 (90)	6.9 (175)	3.1 (79)	7.1 (181)	3.1 (79)	3.9 (99)	7.5 (191)	3.9 (99)
1/2 to 1	4.6 (116)	7.6 (193)	3.1 (79)	7.9 (201)	3.6 (91)	4.6 (117)	9.5 (241)	5.3 (134)
1 to 1-1/2	6.6 (168)	10.3 (263)	4.1 (104)	10.3 (263)	4.8 (123)	6.5 (165)	10.8 (274)	8.3 (211)
1-1/2 to 2-1/2	8.6 (219)	11.8 (300)	5.1 (130)	12.3 (313)	6.3 (161)	—	—	—

STANDARD SPECIFICATIONS: For valves on this page.
Solenoids: AC or DC power.
Power Consumption: 87 VA inrush, 30 VA holding on 50 or 60 Hz; 14 watts on DC.
Ambient Temperature: 40° to 120°F (4° to 50°C).
Media Temperature: 40° to 175°F (4° to 80°C).
Flow Media: Filtered air. 5 micron recommended.
Inlet Pressure:
1/4 to 1-1/2 Port Sizes: 15 to 150 psig (1 to 10 bar).
1-1/2 to 2-1/2 Port Sizes: 30 to 150 psig (2 to 10 bar).
Pilot Pressure: When external supply is used, pressure must be equal to or greater than inlet pressure.
Threads: Model numbers above specify NPT pressure port threads.

Series 27 Double Solenoid Pilot Inline Valves

4/2 Valves





OVERALL DIMENSIONS inches (mm)

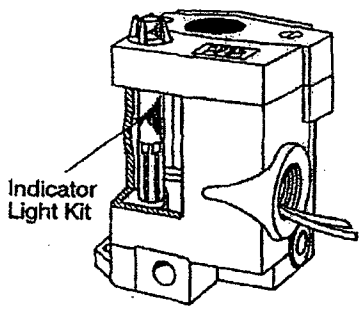
Port Size	A	B	C
1/4 to 1/2	9.4 (239)	3.9 (99)	7.9 (201)
1/2 to 1	9.4 (239)	5.3 (134)	9.7 (248)
1 to 1-1/2	9.4 (239)	8.2 (208)	11.6 (295)

IMPORTANT NOTE
Please read carefully and thoroughly all of the **CAUTIONS**.

Port Sizes In-Out	Port Sizes Exhaust	Valve Model Numbers	Average C_v	Weight lb. (kg)
1/4	1/2	2776B2003	2.5	
3/8	1/2	2776B3003	3.6	4.0 (1.8)
1/2	1/2	2776B4013	3.7	
1/2	1	2776B4003	6.9	
3/4	1	2776B5003	8.2	6.3 (2.8)
1	1	2776B6013	8.9	
1	1-1/2	2776B6003	23	
1-1/4	1-1/2	2776B7003	24	12.3 (5.5)
1-1/2	1-1/2	2776B8013	25	

STANDARD SPECIFICATIONS: For valves on this page.
Solenoids: AC or DC power.
Power Consumption: Each solenoid; 190 VA inrush, 40 VA holding on 50 or 60 Hz; 20 watts on DC.
Indicator Lights: In each solenoid housing.
Ambient Temperature: 40° to 120°F (4° to 50°C).
Media Temperature: 40° to 175°F (4° to 80°C).
Flow Media: Filtered air. 5 micron recommended.
Inlet Pressure: 15 to 150 psig (1 to 10 bar).
Pilot Pressure: If external supply is used, pressure must be equal to or greater than inlet pressure.
Threads: Model numbers above specify NPT pressure port threads.

Indicator Light Kit



An indicator light extends through the solenoid or pilot cover and is illuminated when the solenoid is energized. Such lights are standard on double solenoid valves in Series 21 and 27.

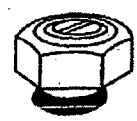
An indicator light is available in kit form for single solenoid models in Series 16, Series 21 (type O only), and Series 27. Order kit number **862K87** and specify the voltage of the solenoid.

Manual Override Kits

Flush flexible manual overrides are standard on single solenoid models in Series 16 and Series 27. Double solenoid models in Series 21 and 27 have flush metal-button overrides. Both types are non-locking.

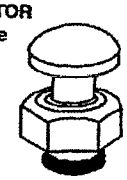
Each of the buttons in the override kits below is made of metal and is spring-returned. The locking type button, however, can be kept in the actuated position by turning the slot in the top of the button with a screwdriver.

Order by the kit numbers shown below.

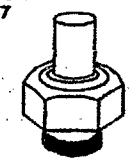


FLUSH BUTTON
Locking type ..... **Kit 792K87**
Non-locking type ..... **Kit 790K87**

EXTENDED BUTTON WITH PALM ACTUATOR
Non-locking type
Kit 984H87



EXTENDED BUTTON
Non-locking type
Kit 791K87



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** TOTAL PAGE.01 **

HOMEWOOD ENERGY SERVICES
820 WASHINGTON BLVD.
PITTSBURGH, PA 15206
(412) 665-2700
1-800-777-1172
FAX: 412-665-2760

December 5, 2003

Mr. Rich Milici
Entergy Nuclear NE
P.O. 215
Broadway and Bleakley
Buchanan, NY 10511

Dear Rich,

Per our conversation, here is part of Test Spec. T346365 which relates to the min/max values of your DH Breakers Close & Trip Coil.

Nominal Voltage d-c.	Close DH Min.	Close DH Max.	Close N.E.M.A. Min.	Close N.E.M.A. Max.	Trip DH end N.E.M.A. Min.	Trip DH end N.E.M.A. Max.
12	–	–	–	–	7	15
24	–	–	–	–	14	30
48	24 - 29	52	36	52	28	60
125	62 - 75	130	90	130	70	140
250	124 - 150	260	180	260	140	280

Regards,

John R. Mikach
Engineering Manager

PANALARM DIVISION

ANNUNCIATOR APPLICATION INFORMATION

Annunciators are subject to the same considerations associated with other electrical equipment regarding (1) Environment, (2) Power Supply, (3) Physical Mounting and (4) Function. The last of these has been discussed in the preceding pages, and the following pertinent data covers the others.

1. Environment includes pressures, temperatures and surrounding atmospheric conditions.

   a. Atmospheric pressures normally found anywhere on earth are satisfactory for annunciator operation. Special pressure chamber or high flying airborne applications must be given further consideration.

   b. Satisfactory ambient temperatures include the range of 0° F. to 120° F. Further consideration should be given to internal annunciator cabinet temperatures which normally should not exceed 165° F. Observing the above ambient range, this will not be exceeded except in cases where a majority of the alarm points are off-normal for long periods of time.

   Larger annunciator cabinets can easily have over 1000 watts to dissipate due to lamps alone when many points are off-normal. Therefore, *provision should be made for disconnecting the annunciator from its power supply during plant shutdown periods and during start-up periods.*

   c. While plug-in relays, the only moving and operating components, are hermetically sealed, all terminals, wiring, insulation and the like should be protected from excess moisture (weather exposure, splashing water, etc.) and corrosive atmospheres. Special enclosures for this purpose are shown on Pages 37-39.

   d. Ambient lighting levels higher than 80 footcandles reduce the effectiveness of backlighted nameplates even where clear lamps and white nameplates are used in the annunciator. Colored lamps and nameplates lose some effect in ambient levels over 60 footcandles. Colored bullseyes are still less contrasting in high lighting ambients.

2. Standard power supplies are 120 volts 60 cycle AC and 125 volts DC. Other voltages may be accommodated on special order. Commercial fluctuations in voltage of 10% are acceptable. Low energy transients even in excess of 1000 volts will not harm the annunciator nor cause it to malfunction.

3. Plug-ins and the overall annunciator will operate in any position. Conventional applications involve panel mounting. Shock loads, up to 5Gs, applied to the panel will not injure the annunciator. Special shock mounting extends this range.

4. Incandescent lamps as used in annunciator equipment have filament failure rates generally illustrated by the Maxwellian curve in which a few fail very early in their service history, some carry on almost indefinitely, and the majority attain a so-called average life, generally indicated as rated life. The value of applied voltage significantly influences this average life as shown in the chart.

NOMINAL 120 VOLT SYSTEM

356, 3 Watt Clear Lamp			656, 6 Watt Clear Lamp		
Voltage	Life	Approx. Light Output	Voltage	Life	Approx. Light Output
140	1200 hrs.	125% of rated	140	600 hrs.	130% of rated
130	3000 hrs.	100% of rated	130	1500 hrs.	100% of rated
120	9000 hrs.	75% of rated	120	4500 hrs.	75% of rated
110	24000 hrs.	55% of rated	110	12850 hrs.	55% of rated

PANALARM DIVISION

ANNUNCIATOR ENGINEERING DATA

ANNUNCIATOR COMPONENT	VOLTAGE	POWER CONSUMPTION STAND-BY	MAXIMUM	MINIMUM	CONTACT CAPACITY
Self-Policing Plug-Ins	120 AC 125 DC	6.5 VA 3.7 Watts	8.5 VA 7.4 Watts	0 0	2.0 amps 0.5 amps
No-Drain Plug-Ins	120 AC 125 DC	0 0	7.2 VA 4.3 watts	0 0	2.0 amps 0.5 amps
Flashers, All Models	120 AC 125 DC	0 0	2.7 VA 5.0 Watts	0 0	1200 watts lamp load** 500 watts lamp load**
Auxiliary Relays (Model ACS-X1)	120 AC 125 DC	0 0	5.0 VA 3.5 Watts	0 0	10.0 amps 2.0 amps
Backlighted Nameplates 2¼" x 2¾" 1" x 1½"	 Any Any	 0 0	 12.0 Watts 3.0 Watts	 0 0	 — —
Bullseye Lamps	Any	0	3.0 Watts	0	—
Pushbuttons Models SI-10, SI-41	 120 AC 125 DC	 — —	 — —	 — —	 6.0 amps 2.0 amps
Model SI-11	120 AC 125 DC	— —	— —	— —	20.0 amps 10.0 amps
Models 51-PB, 51-PB41 Models ACS-PB, ACS-PB41	120 AC 125 DC	— —	— —	— —	6.0 amps 2.0 amps
Horn Model HSA Model HSD	 120 AC 125 DC	 0 0	 20.0 VA 13.0 Watts	 0 0	 — —

*All contact ratings are for non-inductive loads at 120/60 for AC applications and at 125 volts for DC applications.

**The number of lamps handled by one flasher is a function of this rating and lamp wattage. Consider total wattage of maximum number of lamps flashing at any one time. Where lamp load exceeds flasher contact rating, an auxiliary flasher relay is required, not an additional flasher.

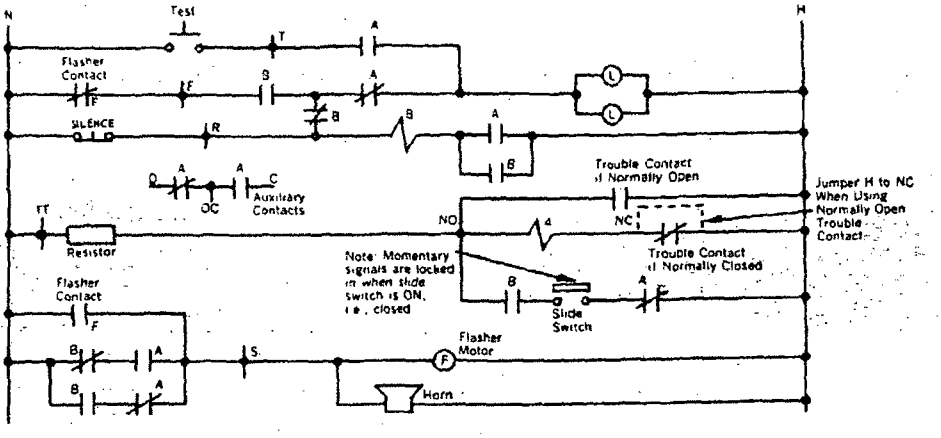
In most cases, plug-in relays are designed for use on either 50 or 60 cycles. Nameplates so designate, for example 120/50-60. *Flashers must be ordered for exact frequency however.*

TYPICAL ANNUNCIATOR DIAGRAMS

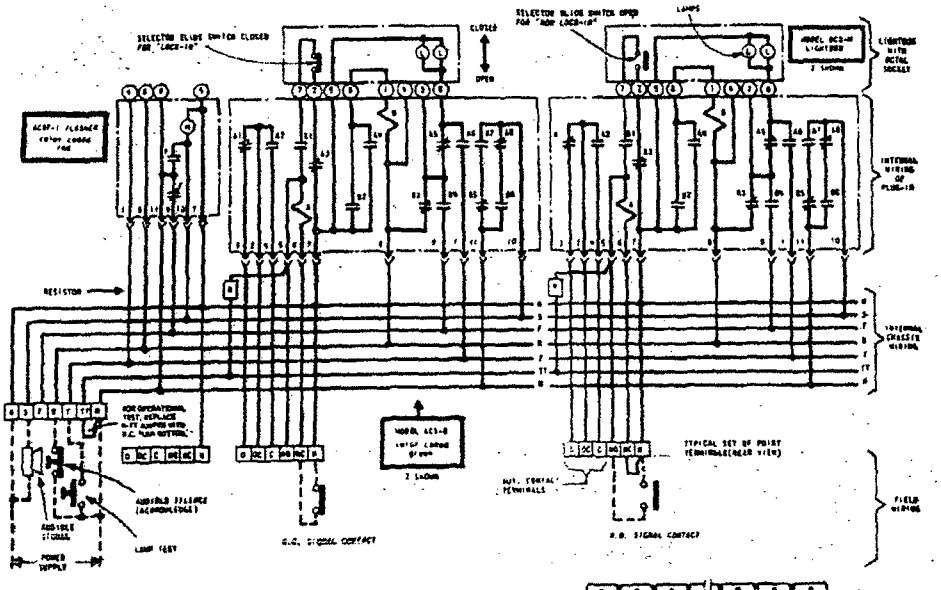
To further illustrate annunciator operation, representative Schematic and General Electrical and Field Wiring Diagrams are shown below.

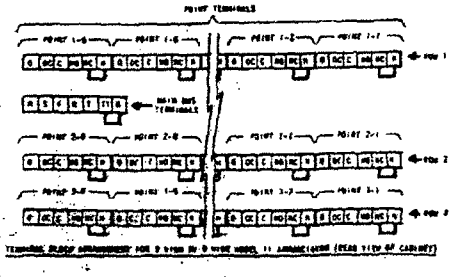
Series 10, MODEL 11 Sequence AF with Plug-In Model ACS-8

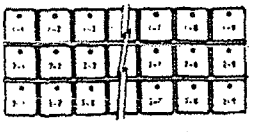
SCHEMATIC DIAGRAM



GENERAL ELECTRICAL AND FIELD WIRING DIAGRAM







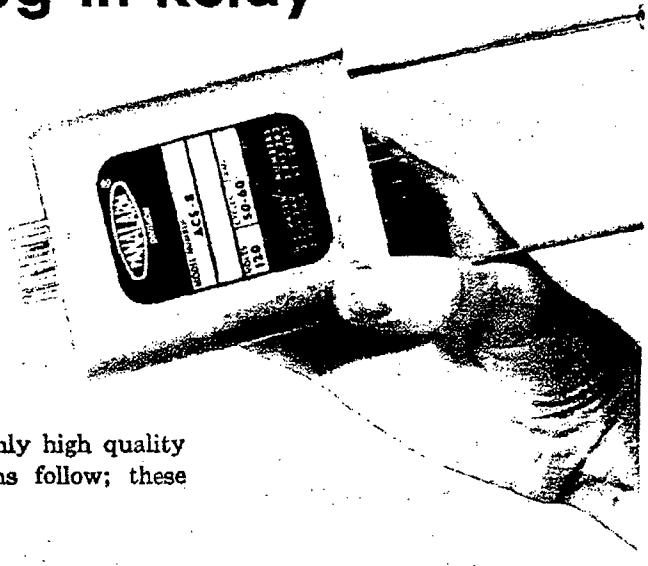
SEQUENCE CHART

CONDITION	TROUBLE CONTACT	NAMEPLATE SIGNAL LAMPS	AUDIBLE SIGNAL	"A" RELAY	"B" RELAY
NORMAL	NORMAL	OFF	OFF	ENERGIZED	ENERGIZED
ALERT	ABNORMAL	FLASHING	ON	DEENERGIZED	ENERGIZED
AUDIBLE SILENCED (ACKNOWLEDGED)	ABNORMAL	STEADY-ON	OFF	DEENERGIZED	DEENERGIZED
NORMAL AGAIN	NORMAL	OFF	OFF	ENERGIZED	ENERGIZED
LAMP TEST	NORMAL	STEADY-ON	ON	ENERGIZED	ENERGIZED

THE HEART OF THE

PANALARM® DIVISION

ANNUNCIATOR... the Plug-In Relay



Modular plug-in relay assemblies are a principal feature of PANALARM Annunciators, contributing importantly to their utility and quality. Coil and contact combinations, many ingeniously suited to Annunciator functions, are packaged to insure long life while facilitating quick replacement should failure occur. Workmanship, inspection and continuous testing throughout the manufacturing process are of the highest order. Engineering specifications are the basis for controlling these manufacturing phases, resulting in a uniformly high quality product. Some of the PANALARM specifications follow; these apply to regular alarm point plug-in assemblies.

I. COMPONENTS

A. Relays

1. COILS

a. Insulation . . . Class B.
b. Temperature rise . . . 35° C. maximum at rated voltage when totally enclosed and non-ventilated.
c. Resistance Tolerance ± 5% of nominal.
d. Power requirement, average 1.7 watts per relay. (Note that two relays are generally mounted in one assembly to serve one alarm point so the total power per point is 3.4 watts.)

2. CONTACTS

a. Material . . . silver and silver alloys.
b. Rating
1) 2 amperes continuous current.
2) 8 amperes inrush.
3) Make or break 2 amperes non-inductive AC at design voltage.
4) Make or break 65 watts non-inductive DC at design voltage.
5) Contact resistance, average 0.05 ohms.

3. OPERATING CHARACTERISTICS

a. Pull-in voltage, maximum, 75% of design voltage.
b. Drop-out voltage, maximum, 65% of design voltage.
c. Operating life 1,000,000 cycles minimum.
d. Duty rating: Continuous.
e. Will operate in any position.

B. Connecting Wire... High temperature Teflon insulation. Gauge consistent with circuit current ratings.

C. Enclosure, Header, Hardware, etc. to general inspection specifications and to military specifications where practical.

II. PACKAGING

A. Assembled and wired observing appropriate clearances.
B. Enclosed in sturdy metal container.
C. Oven-processed to drive off any possible residual volatiles and moisture.
D. Purged with inert gas (Dry nitrogen).
E. Hermetically sealed—inert gas atmosphere.



III. TESTING

100% at Several Stages of Manufacture Including Final.

A. Contact pressure.
B. Functional.
C. Electrical Breakdown . . . 1500 volts RMS for one minute.

$P = \frac{E^2}{R}$ $R = \frac{E^2}{P}$ $\frac{(125)^2}{1.7}$

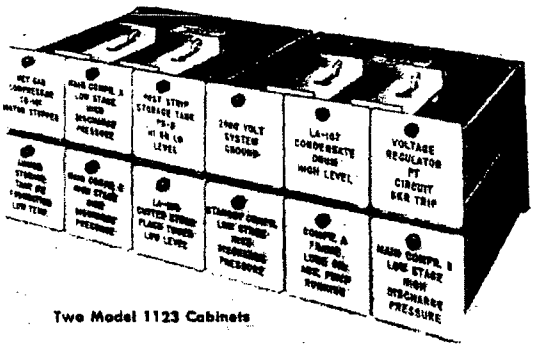
PANALARM DIVISION

DE-LINE MODULAR

- The "Engineer's Annunciator"
- Electrical and mechanical design flexibility
- Magna-Plac nameplates standard
- Requires less panel space

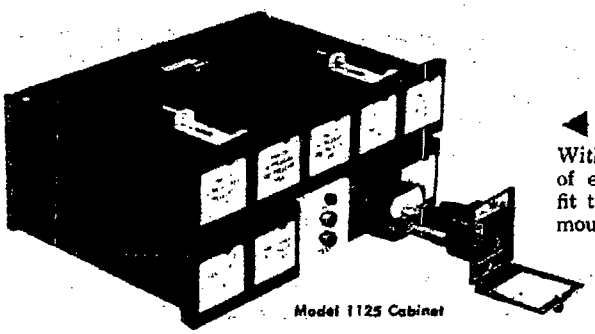
MODEL 11

With Magna-Plac nameplates, M56-W, providing 10 sq. in. of engraving area per plate. Also available in totally enclosed version. See Page 38.



Two Model 1123 Cabinets

With special nameplates, A56-W, providing 6.2 sq. in. of engraving area per plate. Note that pushbuttons fit the alarm positions of De-Line. These also can be mounted separately.

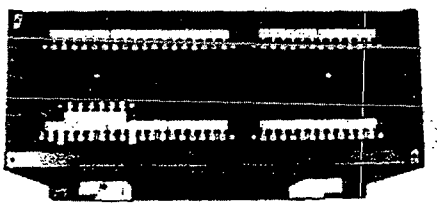


Model 1125 Cabinet

As with all De-Line annunciators, modular construction permits either side-by-side or stacked mounting, as well as convenient additions to the system. The *two* Model 1123 cabinets illustrated have the appearance of a single annunciator.

De-Line modular construction provides further benefits in economy and flexibility. The light box plugs into the relay assembly, which, in turn, plugs into the chassis at rear of cabinet.

The entire assembly is held in place by a single thumb screw. This De-Line plug-in and single fastener arrangement provides the fastest "changeout" possible.



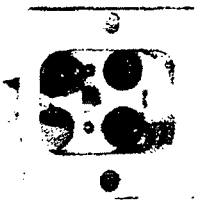
FULL TERMINAL ACCESS

Rear cover is removable, giving full access to terminals. Note that the terminals for each alarm point plug-in assembly are immediately behind that assembly and in line with the corresponding light box to make circuit checking convenient. Knock outs are furnished in each side and in the top of the terminal compartment.

Sturdy, removable, adjustable mounting clamps eliminate the requirement for holes in panel. Panel thicknesses up to ⅛" are accommodated by

UNDERWRITERS LISTED

Series 10, Model 11 Annunciator

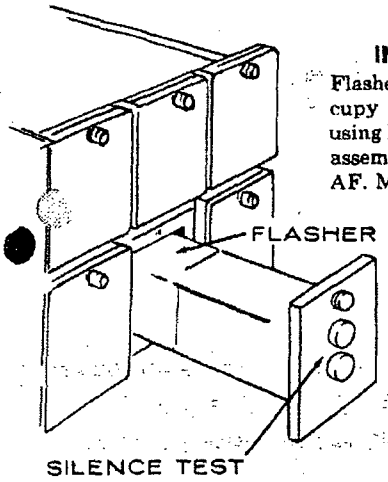


MODEL BCS-M LIGHT BOX

Two lamps connected in parallel for maximum operating safety—6 watts each.

Lamp bulb change is simplified as only one alarm point is disturbed due to individual door construction.

DE-LINE FLEXIBILITY



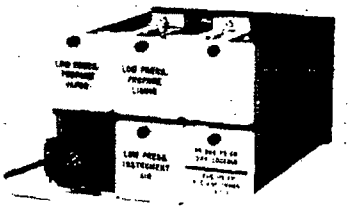
INTEGRAL FLASHER

Flasher and pushbutton may occupy the same alarm space by using Model ACS-8 plug-in relay assemblies for Sequence AO or AF. Model ACS-PB pushbutton accomplishes SILENCE only, in which case a separately mounted test pushbutton, Model SI-10, should be specified. Model ACS-PB41 pushbutton features duplex SILENCE and TEST operators, thus combining these functions with the flasher in one alarm space.

PLUG-IN POSITIONS CAN ASSUME MANY FORMS.

Flasher coded red can be mounted in one alarm position as shown (or a remote mounted flasher can be used).

Blank covers, upper right, are used over spare positions.



Model 1123 Cabinet

Dual or high-low alarms (Plug-In Model SC-10) from Model 12 equipment may be intermixed with Model ACS-8 and Model ACS-124 plug-ins in Model 11 cabinets.

DE-LINE MODEL 11 OPERATION

The Model 11 is furnished with self-policing (normally energized) plug-ins as standard for most sequences. This provides for a signal on annunciator circuit failure. (No-drain versions are available on special order.)

Another standard feature with most Model 11 sequences is their ability to operate from either Normally Open or Normally Closed trouble contacts. Thus it is unnecessary to pre-determine the exact number of each type when ordering. Furthermore, any change or addition of an actuating device such as a pressure or temperature switch, after installation of the system, can be handled with the standard plug-ins. Another advantage of this N.O./N.C. plug-in is that *only one* type of spare must be kept on hand to assure continuity of service.

Notice in the following diagrams and sequence charts that many plug-in relay assemblies include auxiliary contacts wired to terminals and ready for use in operating secondary equipment such as a remote annunciator, remote lamps, back-up devices (e.g. emergency oil pump motor) and others.

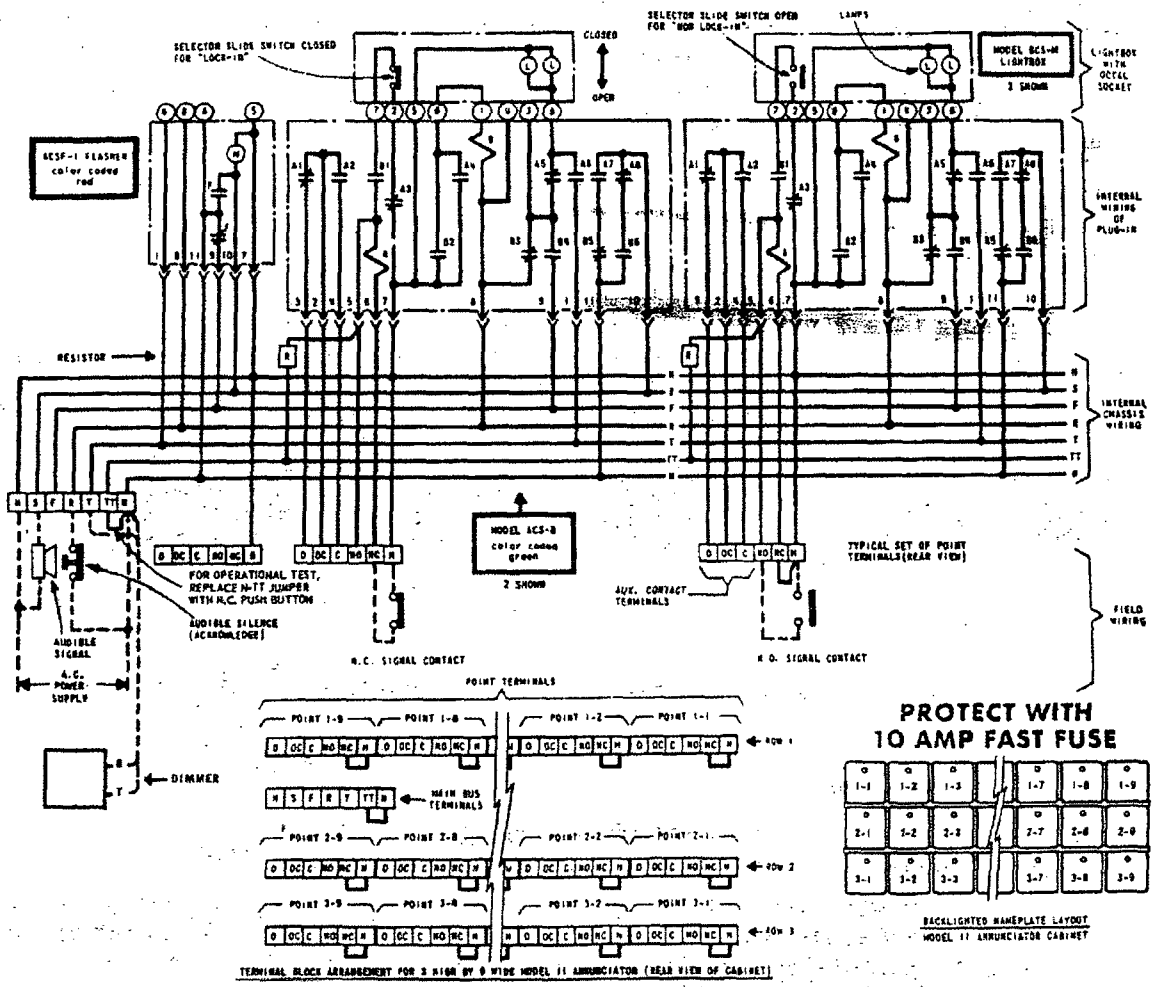
Full operational test, in which relays are actually operated, is provided for in all standard sequences.

PANALARM DIVISION

SEQUENCE AD SERIES
With Plug-In MODEL ACS-8 MODEL

GENERAL ELECTRICAL AND FIELD WIRING DIAGRAM

(Patent Nos. 2,709,249 & 2,813,263)



SEQUENCE CHART

OPERATIONAL SEQUENCE "AD"					
CONDITION	TROUBLE CONTACT	NAMEPLATE SIGNAL LAMPS	AUDIBLE SIGNAL	"A" RELAY	"B" RELAY
NORMAL	NORMAL	DIM	OFF	ENERGIZED	ENERGIZED
ALERT	ABNORMAL	FLASHING	ON	DEENERGIZED	ENERGIZED
AUDIBLE SILENCED (ACKNOWLEDGED)	ABNORMAL	STEADY-ON	OFF	DEENERGIZED	DEENERGIZED
NORMAL AGAIN	NORMAL	DIM	OFF	ENERGIZED	ENERGIZED

EQUIPMENT REQUIRED

One Model 11 Annunciator

- Model ACS-8 plug-in relays, one for each active position
- One Model ACSF-1 integral flasher, or one Model 50-F1 flasher with remote mounting receptacle WB-2
- One Model 50-DM1 dimmer (resistors if DC)
- One audible signal, horn or bell
- One pushbutton for SILENCE

[redacted]

Calculation FEX-00204-00
Rev. 0
Attachment Z
Page 12 of 12