PSEG Nuclear Department CALCULATION COVER SHEET	TITLE DEGRADED VITAL BUS UNDERVOLTAGE SETPOINT		COVER SHEET
	ID NUMBER S-C-4kV-JDC-959	REFERENCE 1SC 2269	1 OF ~~48~~ 37

PSE & G FOR INFORMATION ONLY

CALCULATION REVISION	3	4	5
CP NUMBER		~~1SC 2269~~ 7/26/93	~~1SC 2269~~ 11/26/93
REVISION HISTORY (INTERIM or FINAL) INTERIM = Proposed Plant Change FINAL = Supports Installed Condition	FINAL	Pages #12 to #22, and #32 deleted. New page #12 added. Attachment page ## changed. FINAL	Revised pages 3 through 10 and 27 to increase calibration tolerances. FINAL
FUTURE CONFIRMATION REQUIRED:	N/A	N/A	
ORIGINATOR (Initial & Date)	A.E. Peterson AEP 5/28/93	A.E. Peterson AEP 6/18/93	Mark D Mitchell 11/10/93
REVIEWER (Initial & Date)	[signature] ST 5/28/93	[signature] ST 6/18/93	[signature] 11/22/93
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COVER SHEET (Number Pages)	1	1	1
CALCULATIONS (Number Pages) (Excluding Attachments)	21	11	11
ATTACHMENTS (Number/Total Pages)	5/26	5/25	5/25
TOTAL PAGES	48	37	37

IMPORTANT TO SAFETY ☒ YES ☐ NO

If yes, design verification required per DE-AP.ZZ-0010(Q) (Design Verification, Ref. 8.3)

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1.0 OBJECTIVE

To determine the setpoints of the Model 27N Undervoltage Relays for degraded grid protection at Unit #1 and Unit #2 per Electrical Upgrade Project power system configuration. The following components are affected: (4)

1ASWGRUVLT1A1	1BSWGRUVLT1B1	1CSWGRUVLT1C1
1ASWGRUVLT1A2	1BSWGRUVLT1B2	1CSWGRUVLT1C2
1ASWGRUVLT1A3	1BSWGRUVLT1B3	1CSWGRUVLT1C3
2ASWGRUVLT2A1	2BSWGRUVLT2B1	2CSWGRUVLT2C1
2ASWGRUVLT2A2	2BSWGRUVLT2B2	2CSWGRUVLT2C2
2ASWGRUVLT2A3	2BSWGRUVLT2B3	2CSWGRUVLT2C3

(4)

2.0 DESIGN BASIS

2.1 The minimum allowable vital bus voltage is 94% (Ref. 6.2). The undervoltage relay dropout setpoint should be above 94% with the sufficient margin to compensate a combined accuracy/repeatability error of the relays, potential transformers and testing equipment. The dropout setpoint of 95.1% will be considered in calculation. (5)

The minimum value of a vital bus recovery voltage during the worst transient is above 97% (Ref. 6.2, 6.3 and 6.8). The 97% will be considered in calculation. The undervoltage relay reset setpoint should be below the minimum bus recovery voltage.

The present technical specification time delay setpoint is 13 seconds and allowable value is 15 seconds (Ref. 6.5).

All voltage and time delay setpoints will be evaluated to determine if the accuracies resulting from using relays, PTs and testing equipment are conservative.

2.2 It is required that the testing will be performed using a Digital Fluke model #8600A or equivalent. This model has an accuracy of 0.2% at 60 hz.

2.3 All repeatability errors are based on percent of dropout setpoint (113.0 VAC), per telecon with relay manufacturer. 5

2.4 Drift is considered in the accuracies given in the instruction manual, per conversation with relay manufacturer.

2.5 In accordance with Technical Standard, DE-TS.ZZ-001(Q), a 2σ (2 Sigma) accuracy is used within this calculation.

2.6 The voltage and time delay setpoints determined in this calculation for the degraded grid undervoltage protection are applicable for both Units and will be used as input data for the Technical Specification (Ref. 6.5). 4

3.0 ASSUMPTIONS

3.1 The ambient temperature range inside the associated cubicle will be between 65°F and 125°F. Reference CBD states that the ambient room temperature is between 65°F and 105°F (Ref. 6.7).

3.2 Since the dropout (trip setpoint) is set as a percent of pickup (reset setpoint), it is assumed that both settings drift directly proportional to each other.

3.3 A 3σ (3 Sigma) accuracy can be assumed on accuracies given in the instruction manual, per telecon with manufacturer. This is based on the manufacturers' shop testing, quantity of samples, and Class 1E dedication test program.

4.0 ANALYSIS

4.1 Dropout Setpoint Calculation

4.1.1 Vital Bus Voltage Base: 4160 VAC

With PT ratio of 35:1, 4160/35
= 118.857 VAC

4.1.2 Minimum Allowable Bus Voltage:

94% of 4160/35 volt (Refer to section 2.1)
= (0.94) (118.857) = 111.726 VAC (2)

4.1.3 Undervoltage Relay Trip Setpoint:

95.1% of 4160/35 volt (Refer to section 2.1)
= (0.951) (118.857) = 113.033 VAC

Actual Trip Setpoint - 113.0 VAC
(Calibration tolerance: 112.5 to 113.5 VAC) (5)

4.2 Error Effects:

4.2.1 Temperature Effect:

For relay with harmonic filter (Ref. 6.1)
±0.75% from 32°F to 131°F (0 to +55°C)

(Diff = 99°F)

$$TE = \frac{0.75\%}{99°F} = \frac{0.0076\%}{°F}$$

Ambient temperature range = 65°F to 125°F
(Diff = 60°F)

Temperature effect over the temperature range:
(Percent of Trip Setpoint) (2)

$$TE = \left[\frac{(.0076)(60)}{100}\right] [113.0] = 0.515\ VAC$$ (5)

4.2.2 Repeatability over "Allowable" DC control power range:

±0.1% of Trip Setpoint (note: 100 - 140 VDC = DC power range) (Ref. 6.1) (2)

0.1% of 113.0 VAC
(0.001) (113.0) = 0.113 VAC (5)

4.2.3 Repeatability at constant temperature and constant control voltage:

±0.1% of Trip Setpoint (Ref. 6.1)

0.1% of 113.0 VAC
(0.001) (113.0) = 0.113 VAC

4.2.4 Fluke Accuracy:

±0.2% + ½ Div. Least Significant Digit

FA = 0.2% of Trip Setpoint + 0.05V
= (0.002)(113.0) + 0.05
= 0.276 VAC

4.2.5 Potential Transformer Accuracy:

± 0.3% of Trip Setpoint

PTA = 0.3% of 113.0 VAC
= (0.003) (113.0)
= 0.339 VAC

4.3 Relay Accuracy: (with 3σ accuracy)

$$RA = (2/3)\sqrt{(0.515)^2 + (0.113)^2 + (0.113)^2}$$

= 0.3595 VAC

4.4 Total Error Calculation with Fluke and PT accuracies:

4.4.1 Total error for the Trip Setpoint.

$$\text{Total Error} = \sqrt{(RA)^2 + (FA)^2 + (PTA)^2}$$
$$= \sqrt{(0.3595)^2 + (0.276)^2 + (0.339)^2}$$
$$= \sqrt{0.3203}$$
= 0.5659 VAC
= 0.566 VAC

4.5 Error Evaluation

The error evaluation determines the minimum voltage which may cause the UV relay to trip. This considers the actual trip setpoint, calibration tolerances and total loop errors.

UV relay setpoint	= 113.000 VAC
Calibration Tolerance	= -0.500 VAC
Total error (4.4)	= -0.566 VAC

Allowable "LOOP" Trip = 111.934 VAC (94.17%)

which is greater than the minimum allowable bus voltage of 111.726 VAC (94%), therefore the UV relay setpoint of 113.0 VAC (95.1%) is acceptable.

4.5.1 Allowable Value (Maximum expected Trip Calibration Error)

The Allowable value for the Trip Setpoint considers only the part of the loop tested during surveillances (Relay and Test instrument). The calculated allowable value is the minimum voltage that ensures the relay would have functioned at or above the 94% setpoint.

Allowable value (AV) = Calculated Trip Setpoint (CSP) - Testing Inaccuracy (TI). CSP is the difference between the Analytical Limit and the Total Loop Accuracy (TLA). In this case, the limit not to be exceeded is a process limit (PL) which is the Minimum Bus Voltage (111.726 VAC or 94%) and TLA is 0.566 VAC (section 4.4.1).

CSP = PL + TLA
= 111.726 + 0.566
= 112.292 VAC

TI = 0.319 (section 4.6.4)

AV = CSP - TI
= 112.292 - 0.319
= 111.973 (94.2%)

4.6 Reset Setpoint Calculation

4.6.1 The reset setpoint of the degraded grid relays must be less than the minimum expected recovery voltage at vital bus. The total error value from section 4.4.1 (0.566 VAC) should be used in the reset calculation.

Minimum bus recovery voltage is 97% (Refer to section 2.1).

Relay reset setpoint plus total error
≤ (0.97) (118.857)
≤ 115.291 VAC

4.6.2 The 0.9 % Deadband between trip and reset setpoints (99% dropout tap setting and internal potentiometer) is acceptable because of the following calculation:

Reset Setpoint = Trip setpoint/99.1%
= 113.0/(0.991)
= 114.026 VAC

Actual Reset Setpoint = 114.1 VAC (96.0 %)

(Calibration Tolerance: 113.6 to 114.6 VAC)

4.6.3 The maximum relay reset voltage combines the relay reset setpoint including calibration tolerance and total error.

Maximum reset = 114.600
0.566

= 115.166 VAC (96.9%)

which is less than the minimum bus recovery voltage 115.291 VAC.

Therefore, the undervoltage relay reset setpoint of 114.1 VAC is acceptable.

4.6.4 Allowable Value (Maximun Expected Reset Calibration Errors) : (Ref. 6.9)

Allowable Value (AV) = Calculated Setpoint (CSP) + Testing Inaccuracy (TI).

CSP is the difference between the Analytical Limit (AL) and the Total Loop Accuracy (TLA). For this case, the limit not to be exceeded is a Process Limit (PL) which is Minimum Bus Recovery Voltage (115.291 VAC or 97%) and TLA is 0.566 VAC (section 4.4.1).

CSP = PL - TLA
= 115.291 - 0.566
= <u>114.725 VAC</u>

If temperature is assumed to be relatively consistant between each calibration, the TI combines relay repeatability over "Allowable" DC control power range (section 4.2.2), relay repeatability at constant temperature and constant control voltage (section 4.2.3), and Fluke accuracy (section 4.2.4):

$$TI = \sqrt{(0.113)^2 + (0.113)^2 + (0.276)^2}$$

$$= \sqrt{0.1017}$$

$$= 0.319$$

Therefore, Allowable Value for Reset:

AV = CSP + TI
= 114.725 + 0.319
= <u>115.046 VAC</u> (96.8%)

4.7 Time Delay Evaluation:

Tech Spec Time Delay Setpoint: ≤ 13 Seconds (Ref.6.5)
Tech Spec Allowable Value: ≤ 15 Seconds (Ref.6.5)
(Tech Spec Table 3.3-4, func unit #7b)

Time Delay Setting Tolerances:

ABB Model 27N Undervoltage Relay with time delay range of 2 to 20 seconds (Ref. 6.10) = ± 10% of setting (Ref.6.1)
Doble FT-2 Power Timer = 0.1% of range (Ref.6.6)

27N Relay Error = (10%) (13 sec)
= 1.3 sec

Doble FT-2 Power Timer = (0.1%) (99.9 sec) = 0.1 sec

Conservatively add errors:
Total Time Error = 1.3 + 0.1 = 1.4 seconds

Total Time Error plus Technical Specification Time Delay must be less than allowable value of 15 seconds.

Time Delay = 13.0 sec
Total Error = + 1.4 sec
14.4 sec which is < 15 seconds

This calculation verifies that the total error from the ABB Model 27N Undervoltage Relay and the Doble FT-2 Timer is acceptable because the total time is less than the allowable time of 15 seconds. (3)

5.0 RESULTS

5.1 Trip Setpoint Result:

Conclusion: Required Trip Setpoint of 113.0 VAC (+ / - 0.500 VAC) or 95.1% based on postulated accuracy/repeatability of protective and testing devices is acceptable.

5.2 Reset Setpoint Result:

Conclusion: Required Reset Setpoint of 114.1 VAC (+ / - 0.500 VAC) or 96.0% based on postulated accuracy/repeatability of protective and testing devices is acceptable. (5)

5.3 Time Delay Result:

Conclusion: Current time delay of 13 seconds is acceptable based on the ABB Model 27N Undervoltage Relay and Doble FT-2 Power Timer Specifications.

5.4 The relay setpoints listed above are applicable for Unit #1 and Unit #2 of the Salem Nuclear Generating Station only after implementation of 1SC-2269 package 6 & 7 and appropriate License Change Request. (4)

NOTE: See Attachment #3 for pictogram of results.

6.0 REFERENCES

6.1 ABB Manufacturers Instruction Manual for the Type 27N High Accuracy Undervoltage Relay, #IB 7.4.1.7-7; (Attachment #1).

6.2 Calculation ES-15.008 "Salem Unit 1 & 2 Degraded Grid Study", Rev. 2.

6.3 Calculation ES-15.004 "Load Flow & Motor Starting Calculation", Rev. 0. 3

6.4 Salem Generating Station - FSAR - Section 7.3.1.1.10.5 and Section 8.3.1.2, 4160-Volt System, Revision #8.

6.5 Salem Technical Specifications - Engineered Safety Feature Actuation System, Table 3.3-4, page 3/4 3-26.

6.6 Doble Model FT-2 Power Systems Timer, Specification Sheet page 3, obtained from Salem (M&TE) Maintenance & Test Equipment Dept; (Attachment #2).

6.7 Control Area Ventilation CBD, DE-CB.CAV-0013(Q).

6.8 Calculation ES-15.012 "Salem Unit 1 & 2 Bus Transfers", Rev. 1. 3

6.9 PSE&G Letter #ELE-92-0626 from J. D. Carey to R. W. Chranowski, "Method for Calculating Allowable Value" dated 11/19/92; (Attachment #4).

6.10 PSBP #316072, Rev. 2; (Selected pages, Attachment #5). 3

6.11 Design Change Package (DCP) #1SC-2269.

6.12 License Change Request (LCR) #93-10.

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7.0 ATTACHMENTS

#1 ABB Manufacturers Instruction Manual for the Type 27N High Accuracy Undervoltage Relay, #IB 7.4.1.7-7.

#2 Doble Model FT-2 Power Systems Timer, Specification Sheet, page 3. (4)

#3 Pictogram for Final Trip and Reset Setpoint results.

#4 PSE&G Letter #ELE-92-0626 from J. D. Carey to R. W. Chranowski, "Method for Calculating Allowable Value" dated 11/19/92. See note below.

Note: This letter provided the methodology for determining the Allowable Value as well as provides the Allowable Value. Since the issuance of this letter the Allowable Value has changed due to a change in the calibration tolerance; therefore the Allowable Value as listed in the letter is no longer valid. However, since the methodology has not changed this letter is to remain as an attachment in order to provide the methodology used in calculating the Allowable Value. (5)

#5 PSBP #316072, Rev. 2, (Selected pages).

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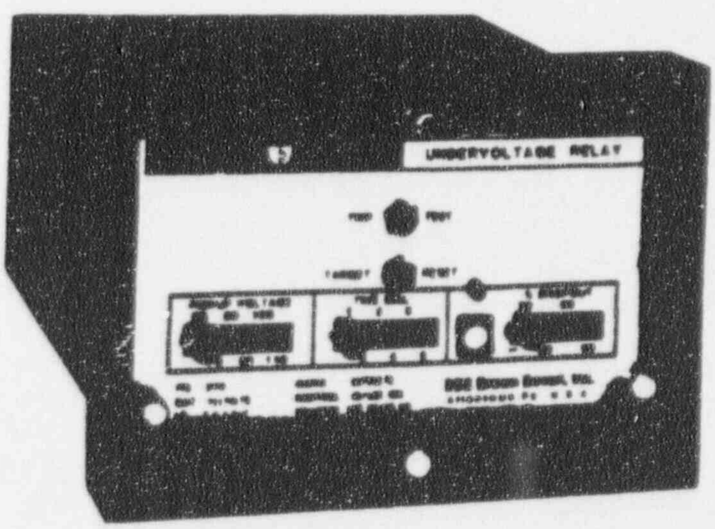
INSTRUCTIONS

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



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INTRODUCTION

These instructions contain the information required to properly install, operate, and test certain single-phase undervoltage relays type 27N, catalog series 211T and 411T; and overvoltage relays, type 59N, catalog series 211U and 411U.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 411T, and 411U catalog series are similar to relays of the 211T, and 211U series. Both series provide the same basic functions and are of totally drawout construction; however, the 411T and 411U series relays provide integral test facilities. Also, sequenced disconnects on the 410 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

Basic settings are made on the front panel of the relay, behind a removable clear plastic cover. Additional adjustment is provided by means of calibration potentiometers inside the relay on the circuit board. The target 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.

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. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.

4. High voltage insulation tests are not recommended. See the section on testing for additional information.

5. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.

6. 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:
Typical external connections are shown in Figure 2. Internal connections and contact logic are shown in Figure 3. Control power must be connected in the proper polarity.

For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the link should be placed in the position marked 125vdc.)

These relays have an external resistor wired to terminals 1 and 9 which must be in place for normal operation. The resistor is supplied mounted on the relay.

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

PICKUP
The pickup voltage taps identify the voltage level which the relay will cause the output contacts to transfer.

DROPOUT
The dropout voltage taps are identified as a percentage of the pickup voltage. Taps are provided for 70%, 80%, 90%, and 99% of pickup, or, 30%, 40%, 50%, and 60% of pickup.

Note: operating voltage values other than the specific values provided by the taps can be obtained by means of an internal adjustment potentiometer. See section on testing for setting procedure.

TIME DIAL
The time dial taps are identified as 1,2,3,4,5,6. Refer to the time-voltage characteristic curves in the Application section. Time dial selection is not provided on relays with an Instantaneous operating characteristic. The time delay may also be varied from that provided by the fixed tap by using the internal calibration adjustment.

4. OPERATION INDICATORS

The types 27N and 59N provide a target indicator that is electronically actuated at the time the output contacts transfer to the trip condition. The target must be manually reset. The target can be reset only if control power is available, AND if the input voltage to the relay returns to the "normal" condition.

An led indicator is provided for convenience in testing and calibrating the relay and to give operating personnel information on the status of the relay. See Figure 6 for the operation of this indicator.

Units with a "-L" suffix on the catalog number provide a green led to indicate the presence of control power and internal power supply voltage.

APPLICATION DATA

Single-phase undervoltage relays and overvoltage relays are used to provide a wide range of protective functions, including the protection of motors and generators, and to initiate bus transfer. The type 27N undervoltage relay and type 59N overvoltage relay are designed for those applications where exceptional accuracy, repeatability, and long-term stability are required.

Tolerances and repeatability are given in the Ratings section. Remember that the accuracy of the pickup and dropout settings with respect to the printed dial markings is generally not a factor, as these relays are usually calibrated in the field to obtain the particular operating values for the application. At the time of field calibration, the accuracy of the instruments used to set the relays is the important factor. Multiturn internal calibration potentiometers provide means for accurate adjustment of the relay operating points, and allow the difference between pickup and dropout to be set as low as 0.5%.

The relays are supplied with instantaneous operating time, or with definite-time delay characteristic. The definite-time units are offered in two time delay ranges: 1-10 seconds, or 0.1-1 second.

An accurate peak detector is used in the types 27N and 59N. Harmonic distortion in the AC waveform can have a noticible effect on the relay operating point and on measuring instruments used to set the relay. An internal harmonic filter is available as an option for those applications where waveform distortion is a factor. The harmonic filter attenuates all harmonics of the 50/60 Hz. input. The relay then basically operates on the fundamental component of the input voltage signal. See figure 5 for the typical filter response curve. To specify the harmonic filter add the suffix "-HF" to the catalog number. Note in the section on ratings that the addition of the harmonic filter does reduce somewhat the repeatability of the relay vs. temperature variation. In applications where waveform distortion is a factor, it may be desirable to operate on the peak voltage. In these cases, the harmonic filter would not be used.

CHARACTERISTICS OF COMMON UNITS

Type	Pickup Range	Dropout Range	Time Delay Pickup	Time Delay Dropout	Catalog Numbers Std Case	Catalog Numbers Test Case
27N	60 - 110 v	70% - 99%	Inst	Inst	211T01x5	411T01x5
			Inst	1 - 10 sec	211T41x5	411T41x5
			Inst	0.1 - 1 sec	211T61x5	411T61x5
	70 - 120 v	70% - 99%	Inst	Inst	211T03x5	411T03x5
			Inst	1 - 10 sec	211T43x5	411T43x5
			Inst	0.1 - 1 sec	211T63x5	411T63x5
	60 - 110 v	30% - 60%	Inst	Inst	211T02x5	411T02x5
			Inst	1 - 10 sec	211T42x5	411T42x5
			Inst	0.1 - 1 sec	211T62x5	411T62x5
59N	100 - 150 v	70% - 99%	Inst	Inst	211U01x5	411U01x5
			1 - 10 s	Inst	211U41x5	411U41x5
			0.1 - 1 s	Inst	211U61x5	411U61x5

IMPORTANT NOTES:

1. Each of the listed catalog numbers for the types 27N and 59N contains an "x" for the control voltage designation. To complete the catalog number, replace the "x" with the proper control voltage code digit:

   48/125 vdc 7
   250 vdc 5
   220 vdc 2
   48/110 vdc 0

2. To specify the addition of the harmonic filter module, add the suffix "-HF". For example: 411T4175-HF. Harmonic filter not available on type 27N with instantaneous delay timing characteristic.

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
48/125 vdc @ 0.05 A max.
48/110 vdc @ 0.05 A max.
220 vdc @ 0.05 A max.
250 vdc @ 0.05 A max.

Allowable variation:

48 vdc nominal		38- 58 vdc
110 vdc	-	88-125 vdc
125 vdc	-	100-140 vdc
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: All ratings are the same except:
(optional) 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)

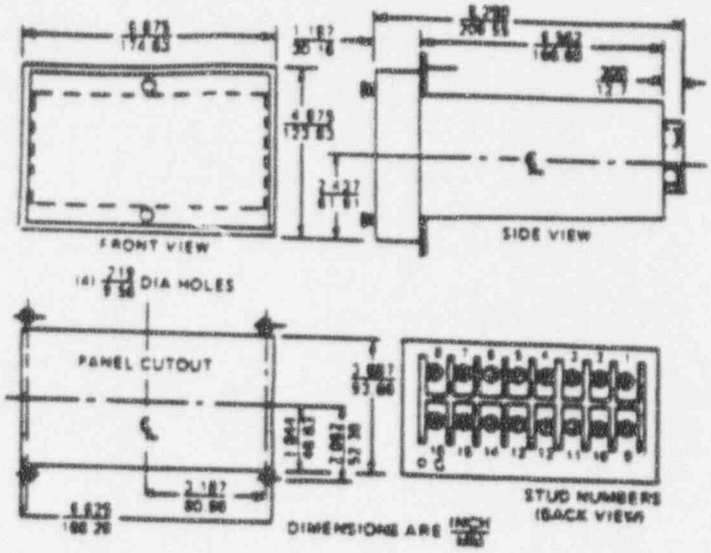


Figure 1: Relay Outline and Panel Drilling

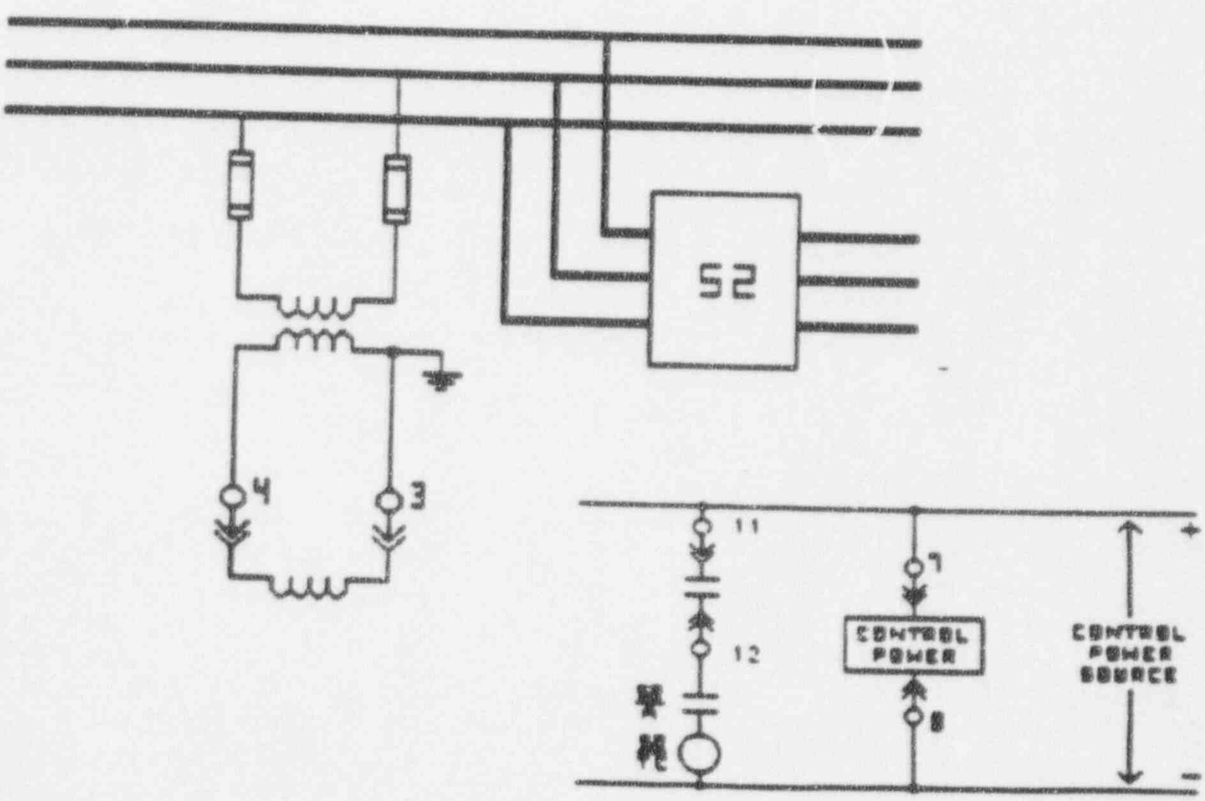
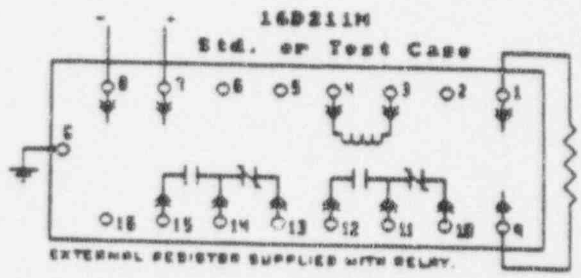


Figure 2: Typical External Connections

Figure 3: INTERNAL CONNECTION DIAGRAM AND OUTPUT CONTACT LOGIC

The following table and diagram define the output contact states under all possible conditions of the measured input voltage and the control power supply. "AS SHOWN" means that the contacts are in the state shown on the internal connection diagram for the relay being considered. "TRANSFERRED" means the contacts are in the opposite state to that shown on the internal connection diagram.

Condition	Contact State	
	Type 27N	Type 59N
Normal Control Power AC Input Voltage Below Setting	Transferred	As Shown
Normal Control Power AC Input Voltage Above Setting	As Shown	Transferred
No Control Voltage	As Shown	As Shown



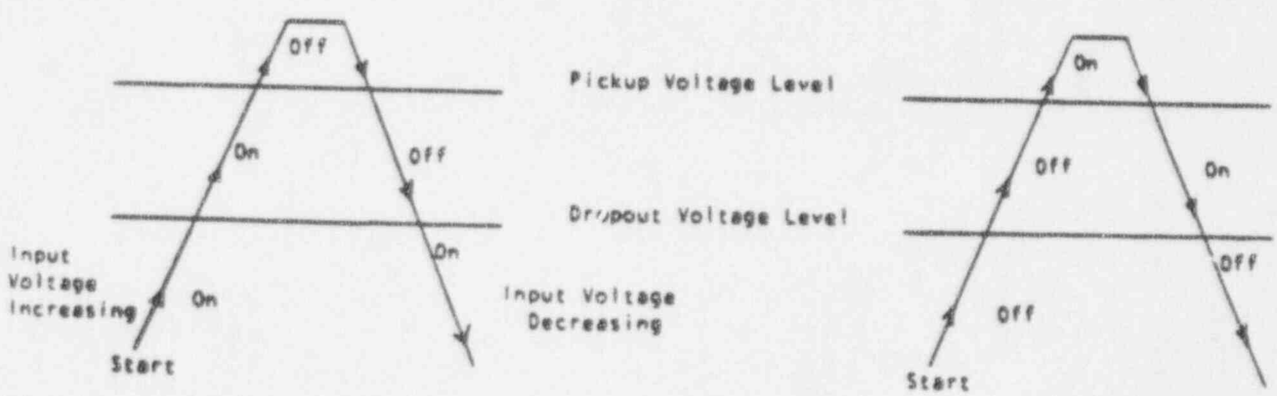
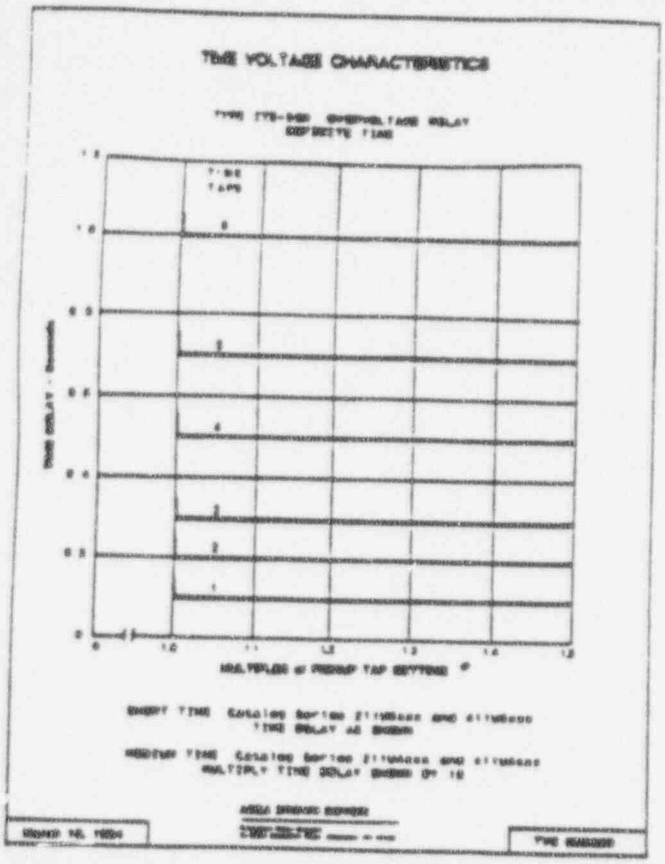
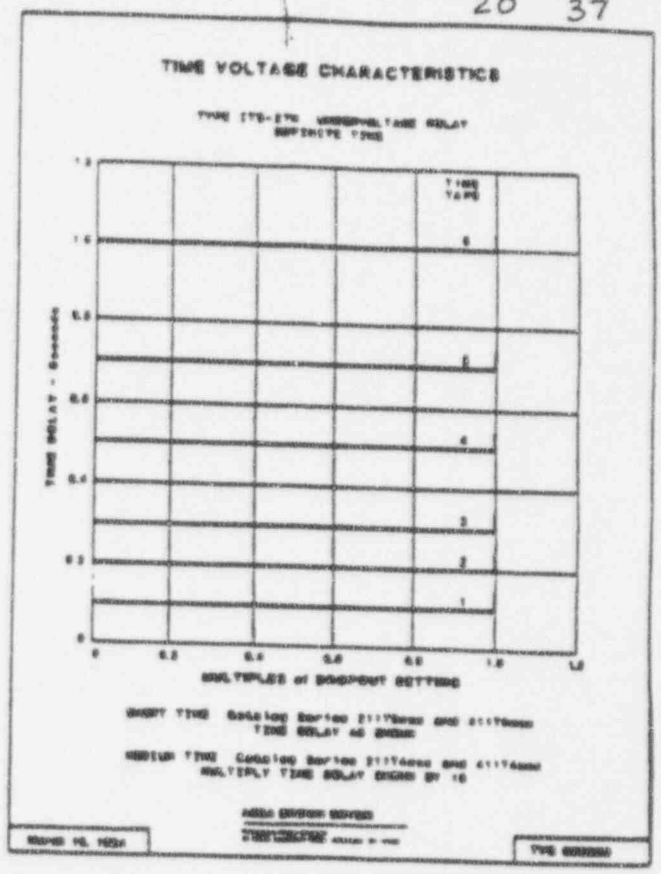


Figure 4a: ITE-27N Operation of Dropout Indicating Light

Figure 4b: ITE-59N Operation of Pickup Indicating Light

Figure 4: Operation of Pickup/Dropout Light-Emitting-Diode Indicator





* NOT TO EXCEED INPUT RATING

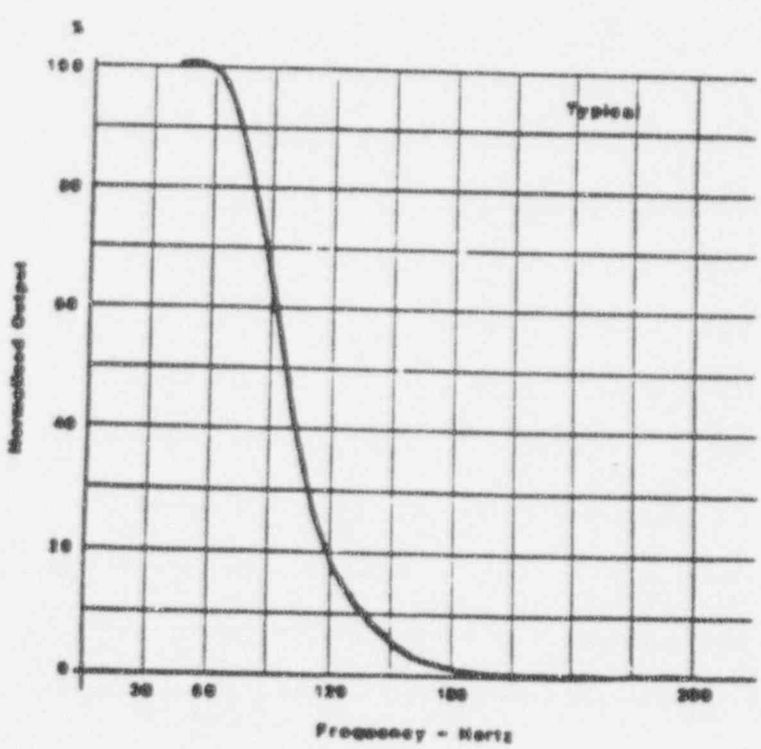


Figure 5: Normalized Frequency Response - Optional Harmonic Filter Module

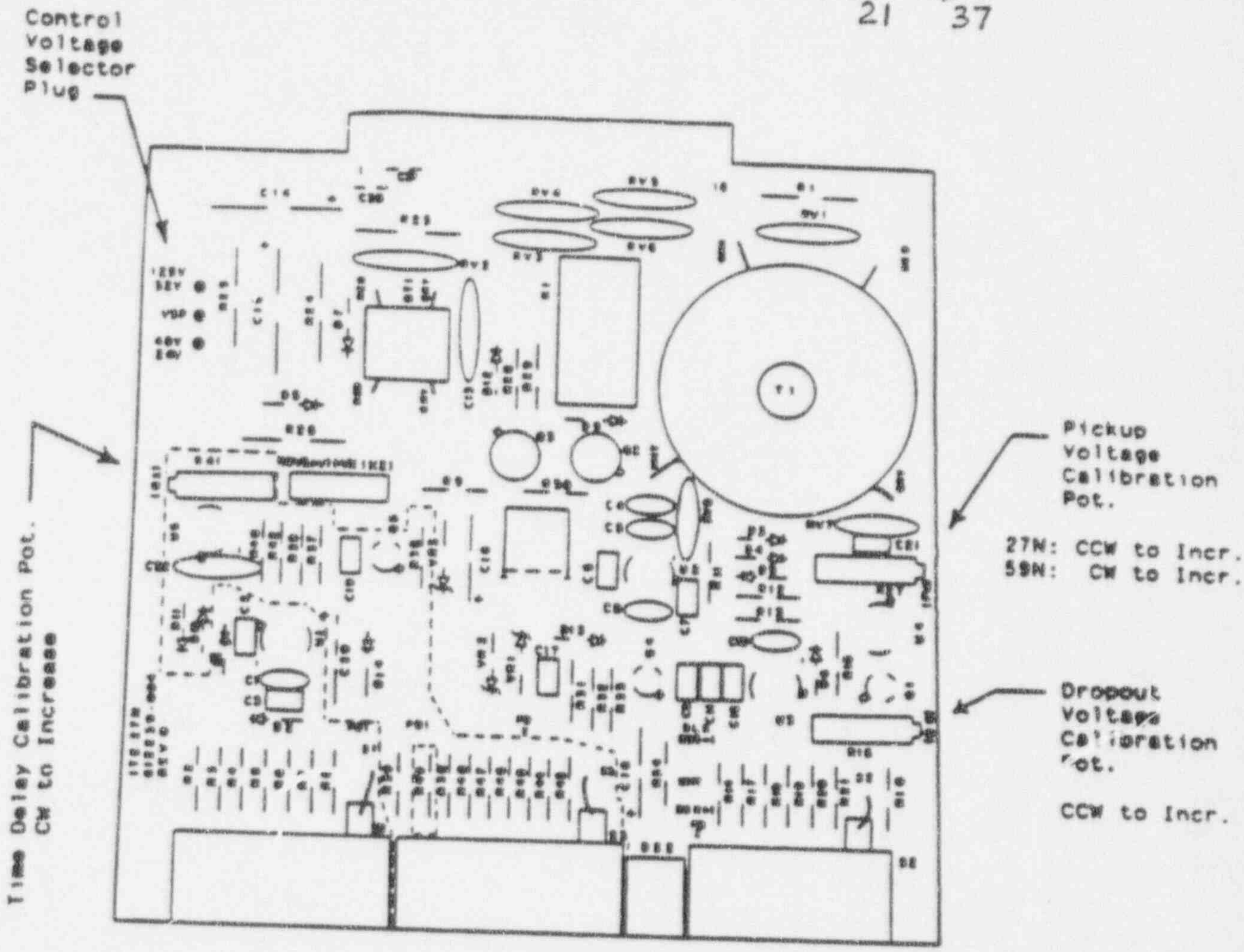


Figure 6: Typical Circuit Board Layouts, types 27N and 59N

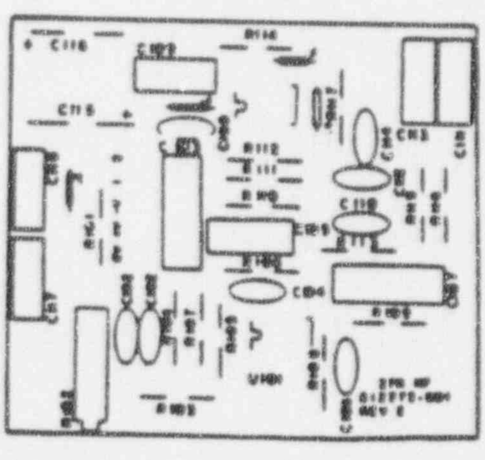


Figure 7: Typical Circuit Board Layout - Harmonic Filter Module

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 circuit description booklet CD7.4.1.7-7 which includes schematic diagrams, can be provided on request. Renewal parts will be quoted by the factory on request.

211 Series Units

Drawout circuit boards of the same catalog number are interchangible. A unit is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom side of the drawout circuit board.

The board is removed by using the metal pull knobs on the front panel. *Removing the board with the unit in service may cause an undesired operation.*

An 18 point extender board (cat 200X0018) is available for use in troubleshooting and calibration of the relay.

411 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 assembly is identified by the catalog number stamped on the front panel and a 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.

Important: these relays have an external resistor mounted on rear terminals 1 and 9. In order to test the drawout unit an equivilent resistor must be connected to terminals 1 & 9 on the rear vertical circuit board of the drawout unit. The resistance value must be the same as the resistor used on the relay. A 25 or 50 watt resistor will be sufficient for testing. If no resistor is available, the resistor assembly mounted on the relay case could be removed and used. *If the resistor from the case is used, be sure to remount it on the case at the conclusion of testing.*

Test Plug:

A test plug assembly, catalog number 400X0002 is available for use with the 410 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 the tests are run with the main circuit energized.

The built-in test is provided as a convenient functional test of the relay and associated circuit. When you depress the button labelled TRIP, the measuring and timing circuits of the relay are actuated. When the relay times out, the output contacts transfer to trip the circuit breaker or other associated circuitry, and the target is displayed. The test button must be held down continuously until operation is obtained.

4. ACCEPTANCE TESTS

Follow the test procedures under paragraph 5. For definite-time units, select Time Dial #3. For the type 27N, check timing by dropping the voltage to 50% of the dropout voltage set (or to zero volts if preferred for simplification of the test). For the type 59N check timing by switching the voltage to 105% of pickup (do not exceed max. input voltage rating.) Tolerances should be within those shown on page 5. If the settings required for the particular application are known, use the procedures in paragraph 5 to make the final adjustments.

5. CALIBRATION TESTS

__Test Connections and Test Sources:__
Typical test circuit connections are shown in Figure 8. Connect the relay to a proper source of dc control voltage to match its nameplate rating (and internal plug setting for dual-rated units). Generally the types 27N and 59N are used in applications where high accuracy is required. The ac test source must be stable and free of harmonics. A test source with less than 0.3% harmonic distortion, such as a "line-corrector" is recommended. Do not use a voltage source that employs a ferroresonant transformer as the stabilizing and regulating device, as these usually have high harmonic content in their output. The accuracy of the voltage measuring instruments used must also be considered when calibrating these relays.

If the resolution of the ac test source adjustment means is not adequate, the arrangement using two variable transformers shown in Figure 9 to give "coarse" and "fine" adjustments is recommended.

When adjusting the ac test source do not exceed the maximum input voltage rating of the relay.

__LED Indicator:__
A light emitting diode is provided on the front panel for convenience in determining the pickup and dropout voltages. The action of the indicator depends on the voltage level and the direction of voltage change, and is best explained by referring to Figure 4.

The calibration potentiometers mentioned in the following procedures are of the multi-turn type for excellent resolution and ease of setting. For catalog series 211 units, the 18 point extender board provides easier access to the calibration pots. If desired, the calibration potentiometers can be resealed with a drop of nail polish at the completion of the calibration procedure.

__Setting Pickup and Dropout Voltages:__
Pickup may be varied between the fixed taps by adjusting the pickup calibration potentiometer R27. Pickup should be set first, with the dropout tap set at 99% (60% on "low dropout units"). Set the pickup tap to the nearest value to the desired setting. The calibration potentiometer has approximately a +/-5% range. Decrease the voltage until dropout occurs, then check pickup by increasing the voltage. Re-adjust and repeat until pickup occurs at precisely the desired voltage.

Potentiometer R16 is provided to adjust dropout. Set the dropout tap to the next lower tap to the desired value. Increase the input voltage to above pickup, and then lower the voltage until dropout occurs. Readjust R16 and repeat until the required setting has been made.

__Setting Time Delay:__
Similarly, the time delay may be adjusted higher or lower than the values shown on the time-voltage curves by means of the time delay calibration potentiometer R41. On the type 27N, time delay is initiated when the voltage drops from above the pickup value to below the dropout value. On the type 59N, timing is initiated when the voltage increases from below dropout to above the pickup value. Referring to Fig. 4, the relay is "timing out" when the led indicator is lighted.

__External Resistor Values:__ The following resistor values may be used when testing 411 series units. Connect to rear connection points 1 & 9.

Relays rated	48/125 vdc:	5000 ohms;	(-HF models with harmonic filter 4000 ohms)
	48/110 vdc:	4000 ohms;	(-HF models with harmonic filter 3200 ohms)
	250 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)
	220 vdc:	10000 ohms;	(-HF models with harmonic filter 9000 ohms)

ABB Power Transmission Inc.
Protective Relay Division
35 N. Snowdrift Rd.
Allentown, Pa. 18106
215-395-7333

Issue D (2/89)
Supersedes Issue C

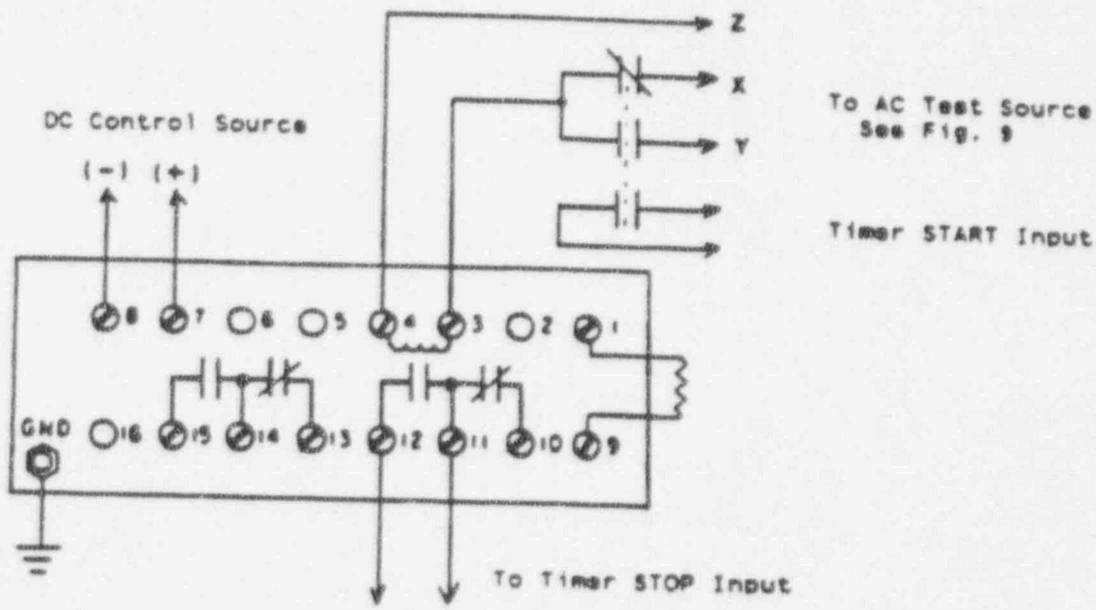


Figure 8: Typical Test Connections

T1, T2	Variable Autotransformers	(1.5 amp rating)
T3	Filament Transformer	(1 amp secondary)
V	Accurate AC Voltmeter	

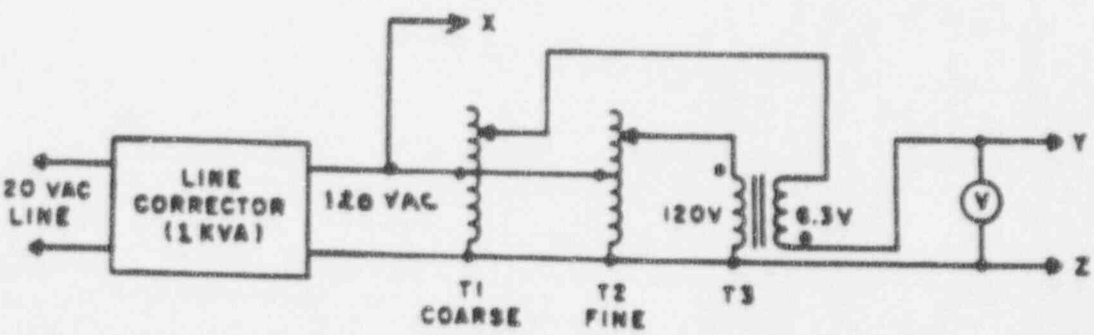


Figure 9: AC Test Source Arrangement

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.

GENERAL

The Doble Model FT2 Power System Timer is a rugged, portable solid state electronic instrument for measuring the elapsed time between two events that are marked by electrical signals. It measures intervals from 0.1 millisecond up to 999 seconds using five 3-digit decimal ranges, and notifies the user at the end of the interval. The FT2 is designed to operate safely and reliably in the demanding environment of the power industry, and provides accurate and repeatable measurements—without any input adjustments—in the presence of severe electrical noise. Continuous accuracy is assured by a quartz crystal time standard.

The FT2 responds to a wide variety and range of electrical signals. Both the START and STOP terminals accept signals from either dry contacts or switched ac or dc potentials up to 250 Volts. Operating conditions are established by simple Sense Switches, which select the polarity of the "from-to" transition that marks the starting and stopping events. A Range Switch selects the maximum measurement period, and automatically positions the decimal point and lights the correct units indicator. Should the interval exceed the selected period, a SPILL indicator is lighted and the display is blanked to avoid erroneous readings.

SPECIFICATIONS

Time Base	1 MHz, crystal controlled
Ranges	0 to 99.9/999 ms, 0 to 9.99/99.9/999 s
Resolution	least significant digit
Accuracy	±1 least significant digit
Display	3 decimal digits, 0.43 in high
Indicators	SPILL, SEC, MSEC, STOP
Input Signals	optically isolated
Dry Contact Sensing	6 V/50 μA
Voltage	±1—250 V dc or ac at 40—40K Hz
Source Impedance	≤1KΩ
Duration	>12.8 ms
Temperature	0 to 50°C operating, −20 to 70°C storage
Humidity	0—90% noncondensing
Power	105—125 or 210—250 V, 47—63 Hz, 1 φ
Size	9.75 in (24.8 cm) wide, 6.25 in (15.8 cm) deep, 6.25 in (16.1 cm) high
Weight	4.86 lb (2.2 kg)
Case	molded ABS

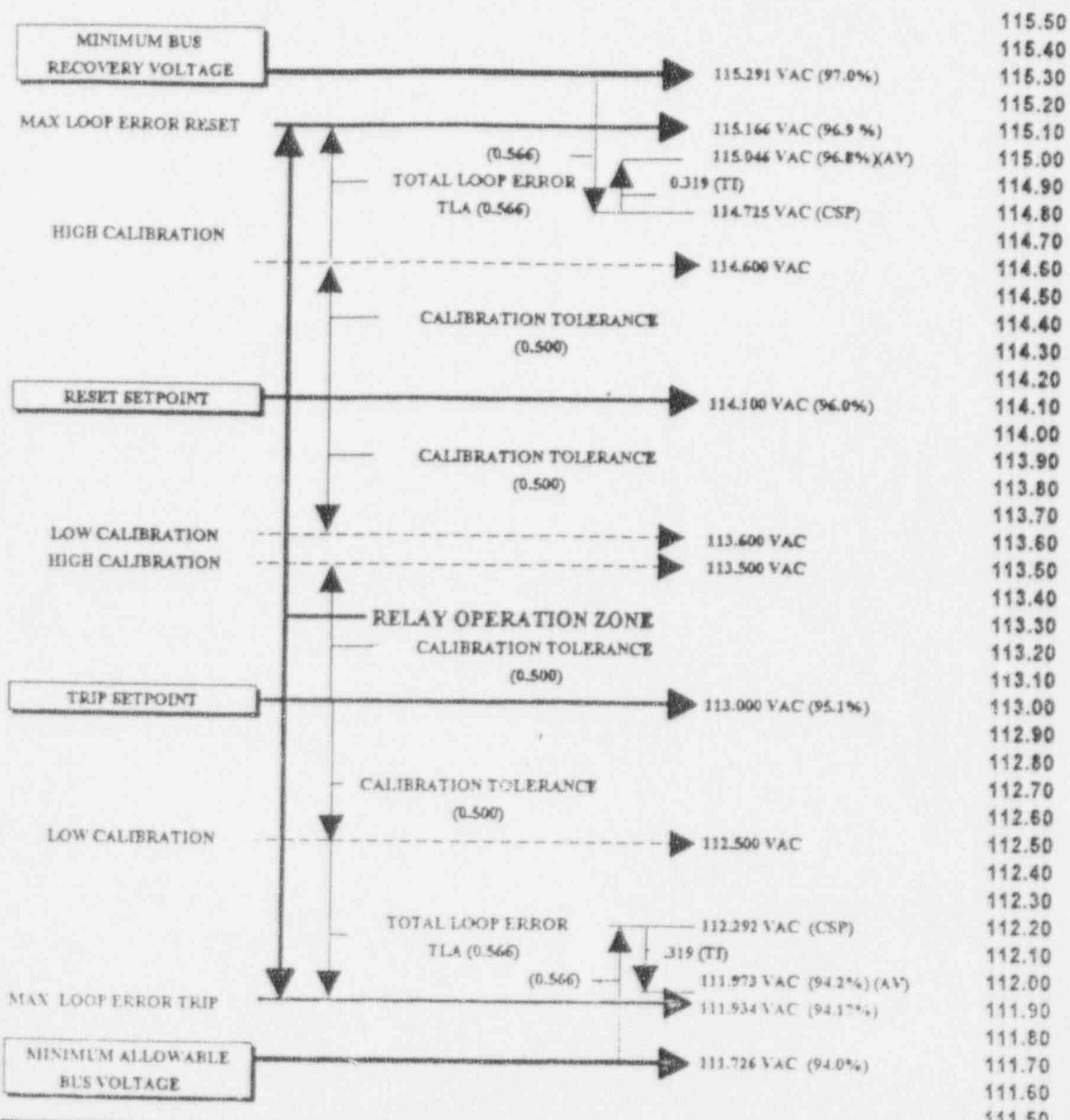
PSEG

CALCULATION CONTINUATION SHEET

TITLE DEGRADED VITAL BUS UNDERVOLTAGE SETPOINT	ID NO S-C-4kV-JDC-959			SHEET 26 ~~36~~ OF ~~48~~ 37
	REFERENCE ISC-2269			
ORIGINATOR / DATE	AEP 4/7/93 (2)	AEP 6/18/93 (4)	MDM 11/10/93 (5)	
PEER REVIEW / DATE	SC 4/7/93	ST 6/18/93	LFP 11/22/93	

ATTACHMENT 03

DEGRADED VITAL BUS UNDERVOLTAGE SETPOINT
PICTOGRAM FOR SALEM STATIONS UNIT 1 & 2



MINIMUN ALLOWABLE BUS VOLTAGE (4.1.2)	TI = TESTING INACCURACY (4.5.1,4.6.4)
TRIP SETPOINT (4.1.3)	MINIMUM BUS RECOVERY VOLTAGE (4.6.1)
TOTAL LOOP ERROR (4.4.1)	RESET SETPOINT (4.6.2)
TRIP CSP = TRIP CALCULATED SETPOINT (4.5.1)	RESET CSP (4.6.4)
TRIP AV = TRIP ALLOWABLE VALUE (4.5.1)	RESET AV (4.6.4)

PSEG

ATTACHMENT #4
S-C-4kV-JDC-959

Public Service Electric and Gas Company P.O. Box 236 Hancocks Bridge, New Jersey 08038

Nuclear Department

ELE-92-0626

TO: R. W. Chranowski
Technical Engineer

FROM: J. D. Carey
Salem I&C Supervisor [signature] for J.D. Carey

SUBJECT: METHOD FOR CALCULATING ALLOWABLE VALUE

DATE: November 19, 1992

For the setpoint calculation of concern no Technical Specification Allowable Value (Maximum Expected Calibration Errors) exists. Allowable Values are typically calculated only for setpoints used as inputs to the safety analysis. To assist you in explaining as left/as found values and setpoint calculation S-C-4KV-JDC-0959, a description for the method of calculating allowable values is provided below:

The method that Salem has accepted for calculating an allowable value is based on the direction provided in ISA-sR67.04 Part II. Draft 10 of the Recommended Practice "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation". Our technical standard for Instrument Setpoint Calculations, DE-TS.ZZ-1001(Q) is currently being revised to incorporate this direction.

The recommended practice states that "The allowance between the allowable value and the trip setpoint should contain that portion of the instrument channel being tested for the surveillance interval (monthly, quarterly, or refueling) and should account for no more than:

... drift (based on surveillance interval)

... Instrument calibration uncertainties for the portion of the instrument channel tested and

... instrument uncertainties during normal operation that are measured during testing.

The method adopted is to first subtract the Total Loop Accuracy (TLA) from the Analytical limit (AL) to ensure margin between the Analytical Limit and the setpoint. The difference between the AL and TLA is a fictitious number called the calculated setpoint (CSP). The instrument uncertainties as discussed above should then be added to the calculated setpoint (CSP) to determine the allowable value.

AL - TLA = CSP

AV = CSP + Errors expected during testing (as noted above)

For this case, the limit not to be exceeded is a Process Limit (PL) which is 110.418 Vac. The TLA is 0.549 Vac. The PL - TLA (110.418-0.549 Vac) = 109.87 Vac which leaves a positive margin of 0.02 Vac or (109.87 Vac-109.85 Vac). The errors expected during testing should consist of 0.309 Vac as shown below. Therefore the Maximum Expected Calibration Errors (Allowable Value) should be set at 110.179 Vac or lower.

From Calculation S-C-4KV-JDC-0959:

Section 4.2.2 (Repeatability) = 0.1089 Vac
Section 4.2.3 (Repeatability) = 0.1089 Vac
Section 4.2.4 (FA) = 0.2678 Vac

Testing Inaccuracy = ((0.2678)^2+(0.1089)^2+(0.1089)^2)^1/2

= 0.309 Vac

Note: Conservatively, temperature was assumed to be relatively consistant between each calibration.

If you have any questions or comments concerning this matter, please call Sandy Jannetty at extension 1802.

SJJ:mgh
Attachment

C L. Rajkowski
S. Jannetty
M. Mortarulo

PSE&G	TITLE DEGRADED UNDER-VOLTAGE SETPOINT	REFERENCE : S-C-4KV-JDC-959	SHEET 3
CALCULATION CONTINUATION SHEET	ORIGINATOR / DATE / PEER REVIEW / DATE 11-14-92		OF 3

Min. Bus Recovery Vac	(PL)=	110.418 Vac (92.9%)
Max. Loop Error Reset		110.399 Vac
110.179 Vac		
Testing Inaccuracy (.309)		
	LOOP ERROR (TLA) 0.549 Vac (Step 4.4.2)	
Calculated Setpoint (PL-TLA)= 109.87 Vac		
High Calibrated Reset		109.85 Vac
Low Calibrated Reset		109.7 Vac
Min. Allowed Reset		109.6 Vac
	Minimum DEADBAND (.5% of 109.05)	
Max. Calibration Tol.		109.05 Vac
TECH. SPEC. SETPOINT		108.9 Vac (91.6%)
	LOOP ERROR 0.438 Vac (Step 4.4.1)	
Max Loop Error Trip		108.462 Vac
T.S. ALLOWABLE VALUE		108.16 Vac (91.0%)

ATTACHMENT #4
S-C-4kV-JDC-959
Page ~~40~~ 29 of ~~48~~ 37

REVIEW/ APPROVAL FORM/ OVERLAY

PSE&G VTD No. 316072-02

- [X] ACTIVE - APPROVED DOCUMENTATION
- [ ] APCP - APPROVED, PENDING CHANGE PACKAGE
- [ ] ERP2 - APPROVED, PENDING EQUIVALENT REPLACEMENT CP
- [ ] CAN. - CANCELLED, NOT REQUIRED

ENGINEER'S SIGNATURE: Michael A Panko

DATE: 10/25/91

ENGINEER'S NAME (PRINT): MICHAEL A. PANKO

SUPERVISOR'S SIGNATURE: John D. Carey Jr

DATE: 12/2/91

DISCIPLINE SELECTION	ELECT	MECH	SCIENCES	OTHER	SPECI
	MP	X	X	X	X

SAFETY RELATED: [X] YES [ ] NO

MMIS ENG. CODE: SYS. 4KV

PURCHASE ORDER No. #392142

COMPONENT I.D. CODE: SEE ATTACHED PAGE

COMPONENT DESCRIPTION: 1E VITAL BUS UNDERVOLTAGE RELAY

CP No. 2EC-3084 | PKG No. 1,2,3 | PKG. REV. Φ | CD/MD No. I110/0, I210/0 / I310/0

- [ ] SALEM 1
- [X] SALEM 2
- [ ] SALEM 3
- [ ] SALEM COMMON
- [X] SALEM 1 & 2
- [ ] HOPE CREEK
- [ ] SALEM & HOPE CREEK
- [ ] ARTIFICIAL ISLAND

VENDOR NAME: BROWN BOVERI

VENDOR CODE: B455

COMMENTS

PSE & G
FOR INFORMATION ONLY

ACTUAL VENDOR No.: IB 7.4.1.7-7 / CD 7.4.1.7-7

NOTICE

SUPPLIER DOCUMENTS/DRAWINGS CONTAINED IN THIS MANUAL MAY HAVE BEEN SUBMITTED INDIVIDUALLY AND THE LATEST REVISION MAY NOT BE CONTAINED HEREIN. PLEASE CONSULT THE DOCUMENT CONTROL SYSTEM DATABASE TO IDENTIFY THE LATEST REVISION.

INTRODUCTION

This addendum covers models with the Definite-Long-Time delay characteristic.

These models are identified by catalog numbers that have the digit "5" directly following the letter "T" in the catalog number: i.e.: catalog numbers of the form 411T5xxx.

TIMING CHARACTERISTIC

The overall timing range of these relays is 2-20 seconds. The time-voltage characteristic is definite-time as shown on page 8 of the main instruction book, with the time-delay values versus time-dial selection as follows:

Time Dial Tap Pin Position	Nominal Delay Time - Seconds
# 1	2 seconds
# 2	4
# 3	6
# 4	10
# 5	14
# 6	20

CATALOG NUMBERS and CHARACTERISTICS

Type	Pickup Range	Dropout Range	Time Delay Pickup	Time Delay Dropout	Catalog No.
27N	60-110v	70-98%	Inst	2-20sec	411T5175
	70-120v	70-98%	Inst	2-20sec	411T5375

Catalog numbers shown are for drawout-test-case models, which are preferred for new applications.

Units in the standard-case, catalog series 211T5xxx would have the same electrical characteristics.

Rev 0 (9/91)

ABB Power T&D Company

ABB Power T&D Company
Protective Relay Division
7036 Snowdrift Road, Suite 2
Allentown, PA 18106
(215) 395-7333

Phone: (215) 395-
FAX : (215) 395-
WIN Phone: # 255-15
WIN Fax: #255-155

DATE: 10-15-91

TO: Mike Panko

FROM: Peter Kovacic

REFERENCE: Type 27 N Undervoltage Relay

NO. OF PAGES INCLUDING TRANSMITTAL SHEET:

Mike: There is an error in the Instruction Book IB 7.4.1.7-7D pg 9

The pickup voltage Calibration Pot (R27) should read clockwise (c To increase for Dev. 27N
The 59N notation is correct as is (cw to Incr,

The Instruction Book will be revised with this correction in the future.

Thank You

Peter Kovacic

ABB Power T&D Company
Protective Relay Division
35 North Snowdrift Road Allentown PA 18106
(215) 395-7333

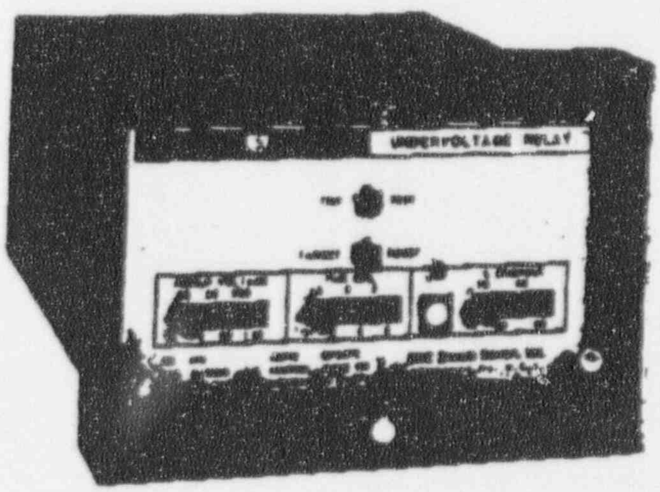
CD 7.4.1.7-7
Issue A

CIRCUIT DESCRIPTION

HIGH ACCURACY VOLTAGE RELAYS

ITE-27N UNDERVOLTAGE RELAY

ITE-59N OVERVOLTAGE RELAY



INTRODUCTION

The ITE-27N and ITE-59N are companion high accuracy under and overvoltage relays respectively. Basic information on application and testing is included in IB 7.4.1.7-7. This publication describes only the operation of the relay circuitry.

For the purpose of the following discussion PICKUP is defined as the high input voltage condition and DROPOUT as the low voltage condition.

For the ITE-27N Undervoltage Relay, PICKUP is the normal or reset condition and DROPOUT is the trip condition.

For the ITE-59N Overvoltage Relay, PICKUP is the trip condition and DROPOUT is the normal or reset condition.

POWER SUPPLY AND REFERENCE

The relay's power supply is derived from the DC control power input (terminals 7-8). RV2, balun coil BT1, and C13 provide transient protection. Voltage selector plug VSP sets the dropping resistors for either a 48 or 125VDC supply. Zener diodes VR1, VR2 provide +/-15VDC voltages for the circuitry. Integrated circuit U4 provides a highly stable 10 volt reference for the voltage measuring circuit.

INPUT CIRCUIT

Transformer T1 reduces the 120V nominal input signal by a 10:1 ratio. The gain of operational amplifier U1 is adjusted by the PICKUP tap selection (R3 thru R8). The gain is set to give a 10 volt peak signal when the input voltage to the relay equals the pickup tap voltage selected. Calibration potentiometer R27 provides additional gain adjustment to allow the relay to be calibrated for any voltage between the fixed tap settings.

PICKUP CIRCUIT

U2 is an operational amplifier used open loop as a comparitor. The 10V reference is applied through R10 to pin 3 of U2. When the peak AC signal on pin 2 exceeds 10 volts (input voltage above pickup) a negative pulse is obtained on output pin 6. Resistor R11 provides some positive feedback to stretch the pulse. The negative signal is filtered by capacitor C9 and applied to U3 pin 2. A negative input on U3-2 causes the U3 output to go high. LED indicator DS1 is off. FET Q1 is in the conducting state. The selected dropout tap resistor (R17-R20) causes the reference voltage at pin 3 of U2 to be lower than 10V. Calibration resistor R16 provides additional adjustment between taps. This is the dropout voltage reference value.

The dropout condition is reached when the input voltage to the relay drops such that the peak voltage at U2-2 is below the reference voltage. Output U2-6 then goes high, output U3-6 goes low. LED D31 turns on. FET Q1 turns off, re-establishing 10 volts as the reference at U2-3 (pickup voltage reference value).

TIMING CIRCUIT
(Not Used On ITE-27N Instantaneous Models)

The output of timer IC U5, pin 3, is normally high. When the output pin U3-6 goes low (dropout condition), a trigger pulse is applied through C19 to U5 pin 2. Capacitor C20 is then allowed to charge through the selected time delay tap resistor (R43-R48). When the voltage on C20 reaches a threshold vlaue, U5 output pin 3 goes low. R41 adjusts the threshold value to provide for timing calibration.

When the input voltage to the relay returns above pickup, Q5 turns on, causing U5 to be immediately reset and its output to return high.

OUTPUT AND TARGET CIRCUITS

For the output relay to be energized, the signal through D6 from the pickup circuit and the signal through D12 from the timer must be low. This allows Q3 to turn on, then Q2 to turn on energizing the coil of output relay K1. At the same time, Q4 is energized to discharge C13 through the target coil, thus changing the target status to orange. (On the ITE-27N with instantaneous timing, the timing circuitry is not used so the output responds directly to the signal from U3-6.)

ITE-59N

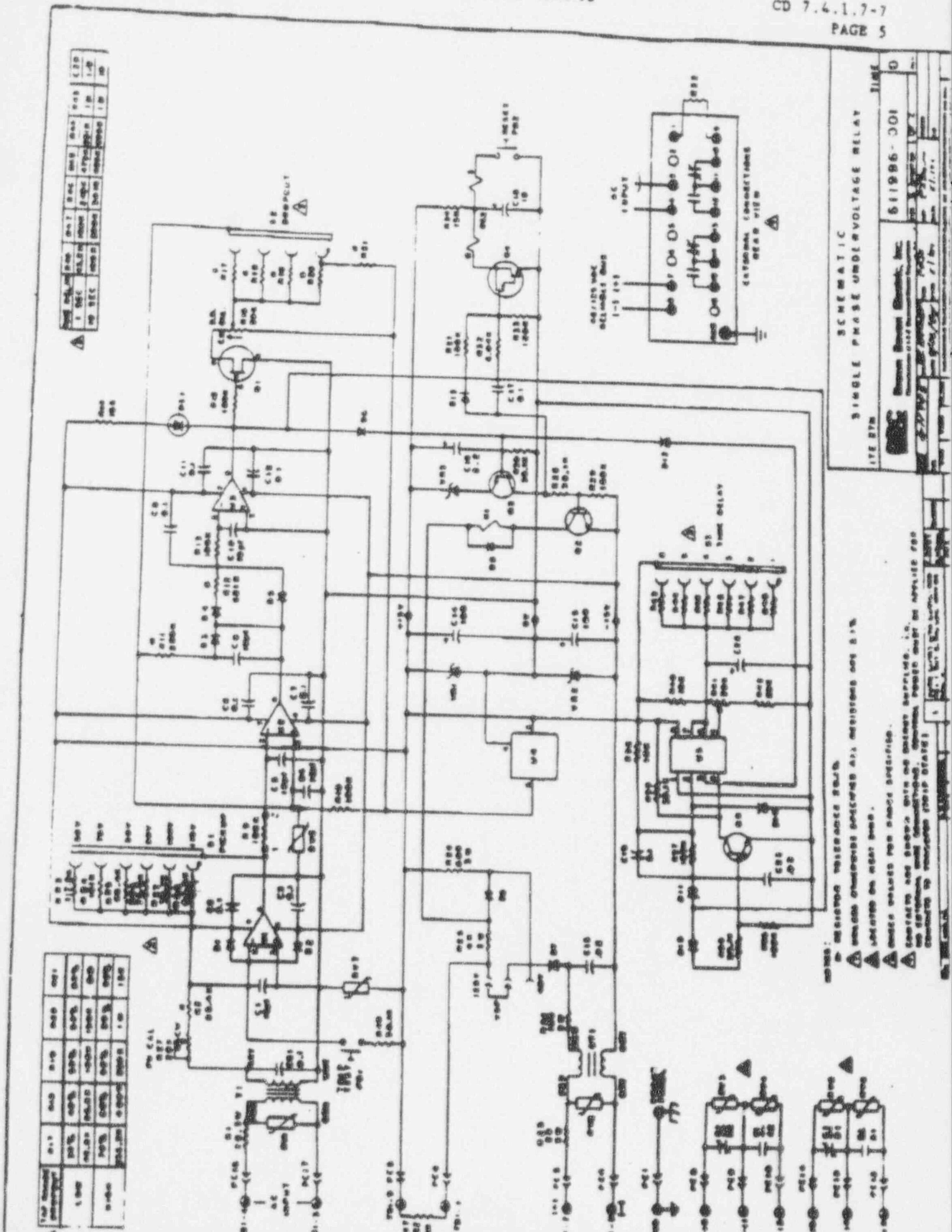
The operation of the ITE-59N relay is almost identical to that of the ITE-27N. The difference being that op amp U3 is changed to a dual type, with the U3-B section used to invert the logic, so that a high voltage condition causes the LED to light, the timer to run, and the output circuit to operate.

HARMONIC FILTER

For applications where waveform distortion would be significant, a harmonic filter may be added. This filter preserves the 50 or 60Hz content of the input signal. (It does not determine the RMS value of the signal.)

The filter is inserted between U1 and U2. (R9 is removed.) The gain of the filter is adjusted to 1.0 so that the basic calibration of the relay is retained.

VOLTAGE RELAYS

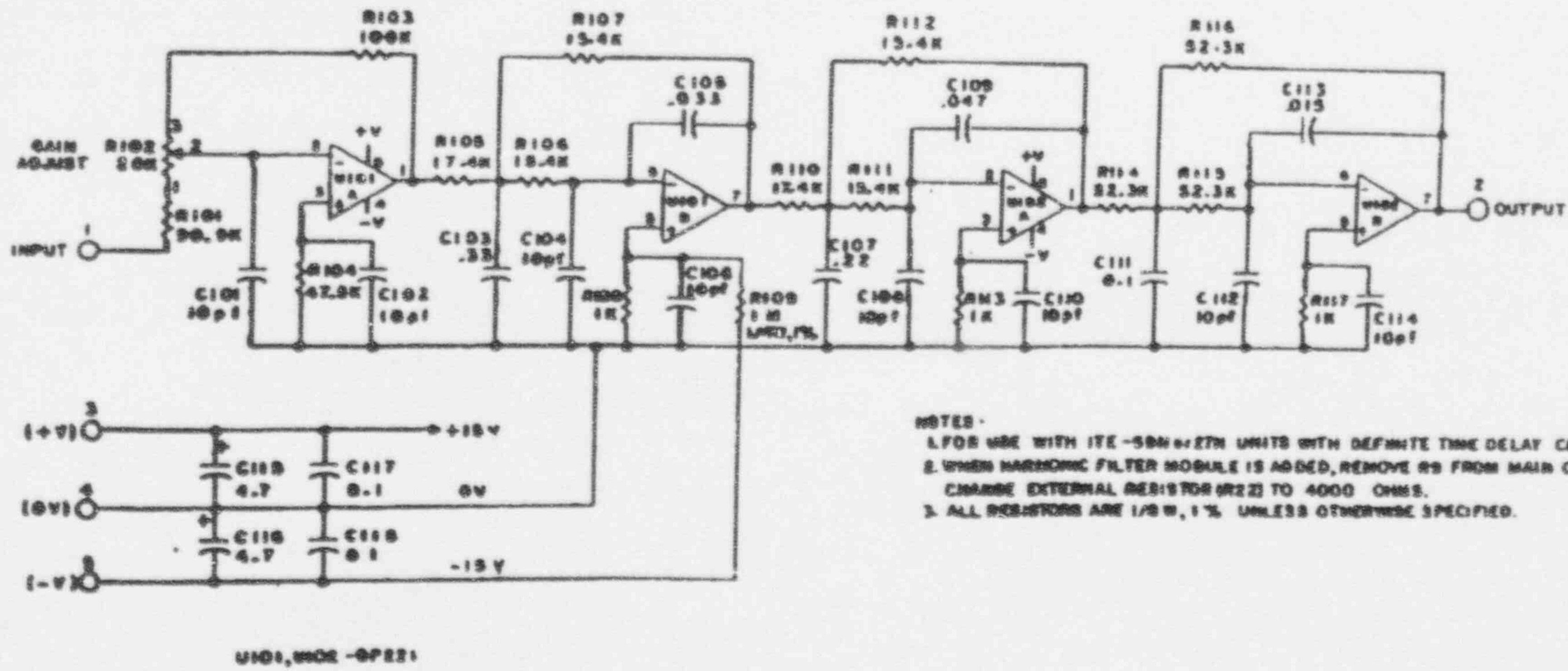


HARMONIC FILTER SCHEMATIC

BBC Brown Boveri Electric, Inc.

611798-001 REV. 0

NO.	REVISIONS	BY & DATE	NO.	REVISIONS	BY & DATE



NOTES:
1. FOR USE WITH ITE-59N or 27N UNITS WITH DEFINITE TIME DELAY CHARACTERISTICS.
2. WHEN HARMONIC FILTER MODULE IS ADDED, REMOVE R9 FROM MAIN CIRCUIT BOARD & CHANGE EXTERNAL RESISTOR (R22) TO 4000 OHMS.
3. ALL RESISTORS ARE 1/8 W, 1% UNLESS OTHERWISE SPECIFIED.

DRAWING NUMBER | DESCRIPTION

STANDARD TOLERANCE INFO. ON OS. 52010 DIMENSIONS ARE IN INCHES
TOLERANCES - UNLESS OTHERWISE SPECIFIED - 2 PL. DEC. ± 3 PL. DEC. ±

FORM NC.DE-AP.ZZ-0010-1

CERTIFICATION FOR DESIGN VERIFICATION

Reference No. S-C-4KV-JDC-959 REV. 4

SUMMARY STATEMENT

THE SCOPE OF THIS DESIGN VERIFICATION WAS TO REVIEW REVISION 4 CHANGES TO THE ABOVE REFERENCED CALCULATION. THE DESIGN VERIFICATION METHOD USED WAS A DESIGN REVIEW OF THE PACKAGE. THIS REVIEW INDICATES THAT THE REVISION IS CORRECT AND SATISFACTORY

The undersigned hereby certifies that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated.

L. J. RAJKOWSKI	VIC FREGONESE [signature] 7/23/93
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date

Page ___ of ___

GENERIC VERIFICATION CHECKLIST	REFERENCE DOCUMENT NUMBER/REVISION S-C-4KV-JDC-0959 / 4				
	YES	NO	N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
1. WERE DESIGN INPUTS CORRECTLY SELECTED AND INCORPORATED INTO DESIGN?	✓			Section 6, 7 & Attachments	N
2. ARE ASSUMPTIONS NECESSARY TO PERFORM THE DESIGN ACTIVITY ADEQUATELY DESCRIBED AND REASONABLE? WHERE NECESSARY, ARE THE ASSUMPTIONS IDENTIFIED FOR SUBSEQUENT RE-VERIFICATION WHEN THE DETAILED DESIGN ACTIVITIES ARE COMPLETED?		✓ ✓			
3. ARE THE APPROPRIATE QUALITY AND QUALITY ASSURANCE REQUIREMENTS SPECIFIED?			✓		
4. ARE THE APPLICABLE CODES, STANDARDS AND REGULATORY REQUIREMENTS INCLUDING ISSUES AND ADDENDA PROPERLY IDENTIFIED AND ARE THEIR REQUIREMENTS FOR DESIGN MET?			✓		
5. HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCE BEEN CONSIDERED?			✓		
6. HAVE THE DESIGN INTERFACE REQUIREMENTS BEEN SATISFIED?	✓			Electrical, generated if Calc ~~referenced~~ I&C Reviewed.	N
7. WAS AN APPROPRIATE DESIGN METHOD USED?	✓			DEAP.ZZ-0002(G)	N
8. IS THE OUTPUT REASONABLE COMPARED TO INPUTS?			✓		
9. ARE THE SPECIFIED PARTS, EQUIPMENT, AND PROCESSES SUITABLE FOR THE REQUIRED APPLICATION?			✓		
10. ARE THE SPECIFIED MATERIALS COMPATIBLE WITH EACH OTHER AND THE DESIGN ENVIRONMENTAL CONDITIONS TO WHICH THE MATERIAL WILL BE EXPOSED?			✓		
11. HAVE ADEQUATE MAINTENANCE FEATURES AND REQUIREMENTS BEEN SPECIFIED?			✓		
12. ARE ACCESSIBILITY AND OTHER DESIGN PROVISIONS ADEQUATE FOR PERFORMANCE OF NEEDED MAINTENANCE AND REPAIR?			✓		
13. HAS ADEQUATE ACCESSIBILITY BEEN PROVIDED TO PERFORM THE IN-SERVICE INSPECTION EXPECTED TO BE REQUIRED DURING THE PLANT LIFE?			✓		

FORM NC.DE-AP.ZZ-0010-1

CERTIFICATION FOR DESIGN VERIFICATION

REFERENCE DOCUMENT NO. REV. S-C-4KV-JDC-959, REV 4

COMMENTS	RESOLUTION	
pages 9 & 11 were revised previously in Rev. 3 of the Calc. Please provide Rev. 3 version of this page for Rev 4 markup.	pages added by AEP on 7/23/93	yes LF 7/23/93
[signature] 7/23/93 SUBMITTED BY DATE	AEP by LF 7/23/93 RESOLVED BY DATE	Acceptance of Resolution

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CERTIFICATION FOR DESIGN VERIFICATION

Reference No. S-C-4KV-JDC-0959, REV. 5 .

SUMMARY STATEMENT

A DESIGN VERIFICATION OF REVISION 5 TO THIS CALCULATION WAS PERFORMED IN ACCORDANCE WITH PROCEDURE NC.DE-AP.ZZ-0010. THE DESIGN VERIFICATION METHOD USED WAS AN DESIGN REVIEW OF THE PACKAGE. THE EXTENT AND DEPTH OF THE VERIFICATION INVOLVED A CHECK OF THE CHANGES ASSOCIATED WITH REVISION 5 OF THIS CALCULATION, AND THE DESIGN APPROACH USED. NO ENGINEERING JUDGEMENT WAS USED DURING THE VERIFICATION PROCESS WHICH REQUIRES INCLUSION IN THIS SUMMARY STATEMENT.

THIS DESIGN VERIFICATION HAS DETERMINED THAT THE CALCULATION IS CORRECT AND SATISFACTORY

The undersigned hereby certifies that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated.

L. J. RAJKOWSKI Design Verifier Assigned By	V. FREGONESE [signature] 11/11/93 Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date

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