TEC Technology for Energy Corporation	TITLE HUMIDITY TEST PROCEDURE FOR THE TEC MODEL 156 ANALOG ISOLATORS	NO. 156-QP-05
	INITIATED BY V. W. Lowry II	DATE 6/8/81
PROCEDURE	APPROVED BY [signature]	DATE 6-8-81
		DATE 6-9-81

1.0 PURPOSE

The purpose of this procedure will be to describe how the TEC Model 156 Isolators will be exposed to high humidity.

2.0 PROCEDURE

2.1 The equipment listed in Section 3.0 will be the equipment tested.

2.2 The equipment will be placed in a humidity chamber/oven. Wet and dry bulb thermometers will be used to monitor the humidity.

2.3 The humidity test will run for seven days. A readout from the wet bulb and dry bulb thermometers will be recorded twice a day. A functional test will be performed on each instrument being tested. All results must be recorded daily.

2.4 The electronics shall be wired as per Figure 1 of this procedure.

3.0 EQUIPMENT UNDER TEST

Four each of the TEC Model 156 Analog Isolators, S/N A-1, A-2, B-3, and C4.

4.0 TEST MONITORING EQUIPMENT

Wet Bulb/Dry Bulb Thermometer	Calibrated 2/13/31
Thermal Aging Oven	No Calibration
TEC #7903 Digital Multimeter	Calibration Due 12/31

8412190303 841207
PDR ADOCK 05000285
PDR
F

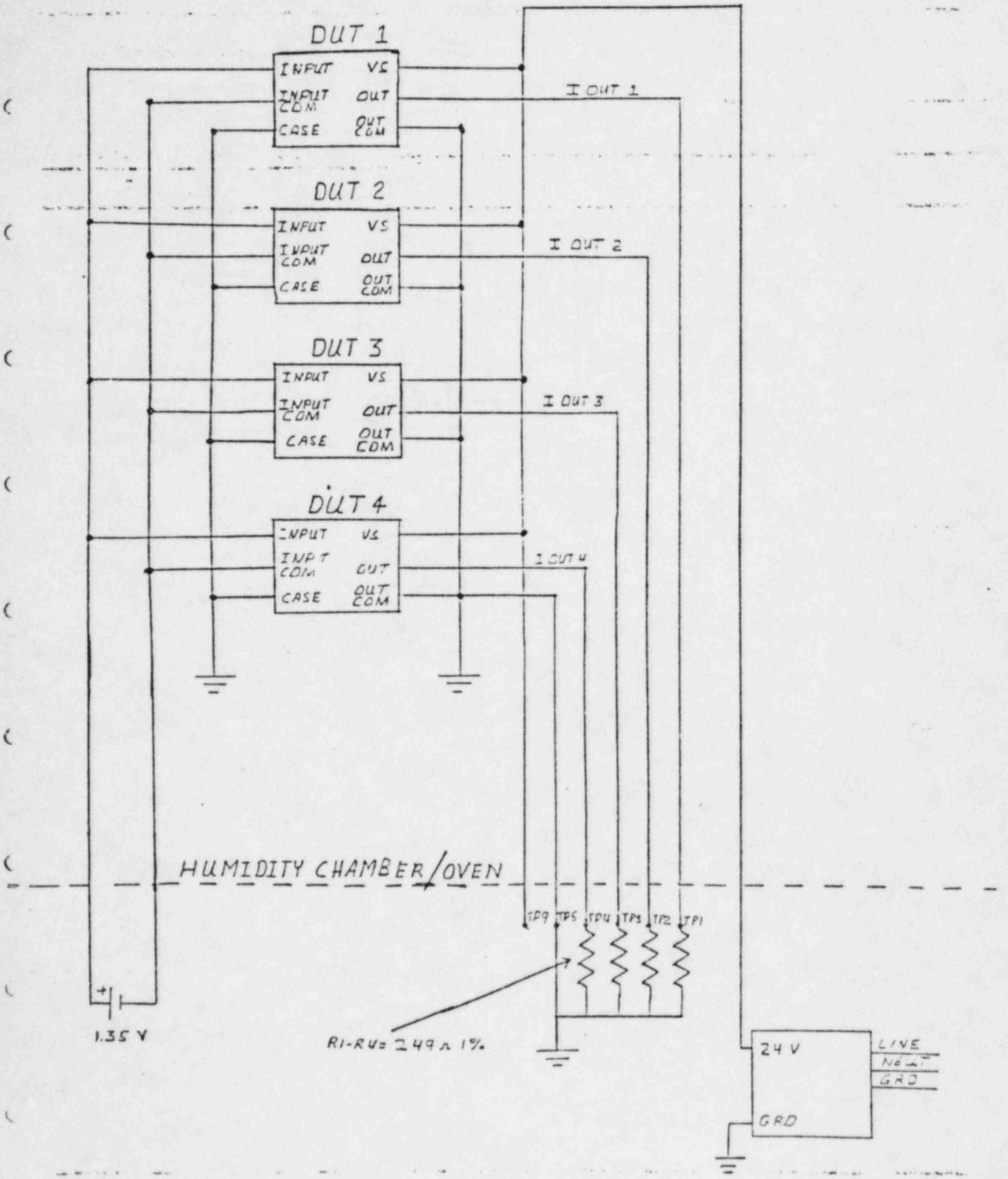
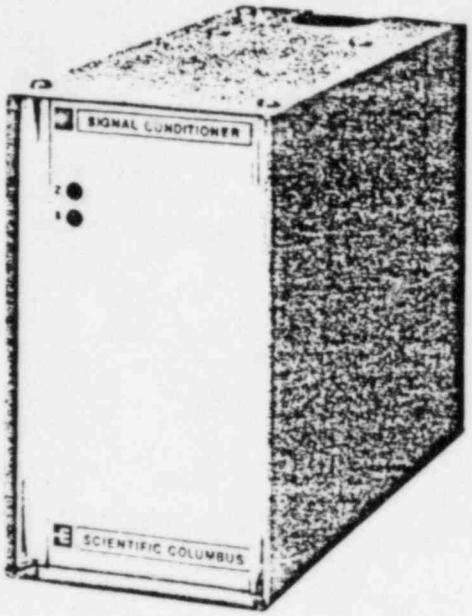
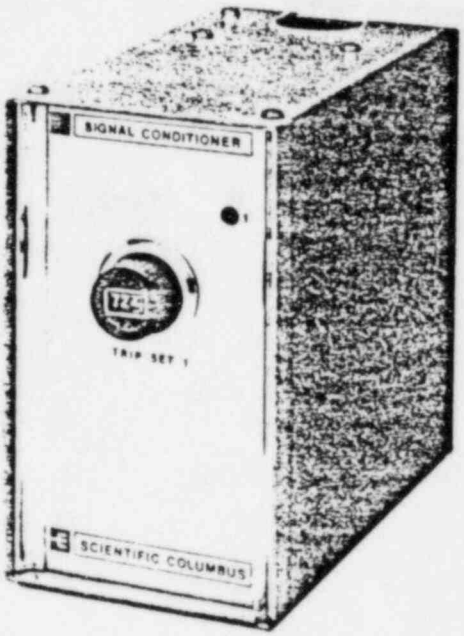

DUT 1
INPUT
INPUT COM
CASE
VS
OUT
OUT COM
I OUT 1
DUT 2
INPUT
INPUT COM
CASE
VS
OUT
OUT COM
I OUT 2
DUT 3
INPUT
INPUT COM
CASE
VS
OUT
OUT COM
I OUT 3
DUT 4
INPUT
INPUT COM
CASE
VS
OUT
OUT COM
I OUT 4
HUMIDITY CHAMBER/OVEN
TP6
TP5
TP4
TP3
TP2
TP1
1.35 V
R1-R6 = 249 Ω 1%
24 V
GRD
LINE
NEUT
GRD

FIGURE 1

DC CURRENT DC VOLTAGE TRANSMITTERS

7000 SC SERIES





- Advanced, All Solid-State Circuitry
- 0.1% Accuracy/Linearity
- Plug-in Packaging for Easy Installation and Interchangeability
- Accepts Wide Range of Inputs
- Provides All Standard Process Outputs, Field Selectable
- Surge Protected for High Reliability

DESCRIPTION AND OPERATION

The 7000 SC Series Signal Conditioners from Scientific Columbus offer a wide variety of features and options to fit any application or situation. Advanced integrated circuit technology gives an Accuracy/Linearity of ± 0.1% and also provides the best temperature stability available (0.005%/° F maximum).

The unique plug-in package allows easy installation and interchangeability, including plug-in relays on alarm units. All units are wall mounting, but are also available for panel mounting. Uniform package configurations permit ease of layout and installation.

The 7000 SC Series Signal Conditioners from Scientific Columbus accept dc mA or dc Voltage signals from many sources.

All conventional outputs are available, including 1-5mA, 4-20mA, and 10-50mA dc field selectable by jumper. Zero based outputs in these ranges are available. Also, 0-1.0 mAdc and 0-10 Vdc may be specified.

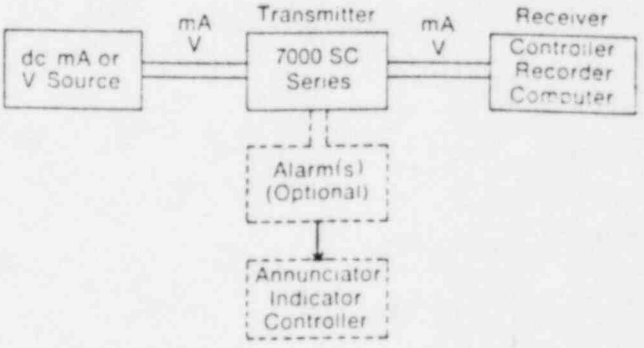
Complete isolation of input from output is optional. Either the input or the output may be grounded or floating on units with the isolation option.

All transmitters are precision calibrated as specified by purchase order.

All units surpass the IEEE recommended surge protection specifications; and with the 1500 V ac withstand capability, provide the highest possible safety and reliability. These features become increasingly important as power levels increase, and switching surges and line transient problems are magnified.

High level inputs may be accommodated by optional built-in voltage divider circuits.

Options include built-in alarms for high-only, low-only, high-low, high-high, or low-low operation. Several relay type, power supply, and enclosure options are available to fit your particular requirements. Many additional options, ranges, etc. are available. Please consult the factory.



SPECIFICATIONS

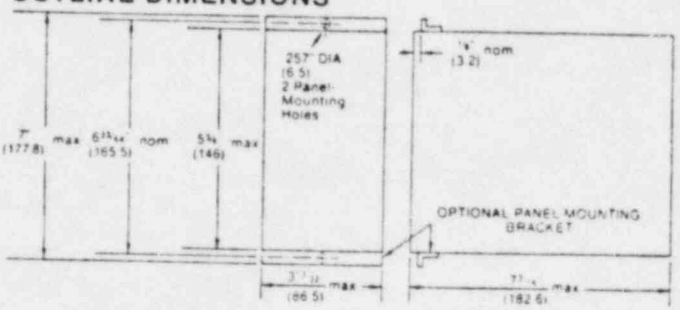
Input Signal:	Current — 1.5mA dc, 4-20 mA dc, 10-50mA dc Voltage — 0-1V dc, 0-10V dc (See note 3)
Input Impedance:	125Ω (1-5mA), 31.25Ω (4-20mA), 12.5Ω (10-50mA), 2KΩ/Volt for voltage inputs, (See note 3)
Span:	Adjustable to ± 10% of the calibrated value. Wider adjustment ranges are optional. (see Note 1)
Zero:	Adjustable form − 5% to + 25% or from + 20% to + 55% of rated span (field selectable)
Power Requirements:	117V ± 10%, 50/60 Hz, 6W (typ.)
Outputs:	1-5mA dc into 0-6000Ω 4-20mA dc into 0-1500Ω 10-50mA dc into 0-400Ω (0-600Ω opt) 0-10V dc or 0-1.0mA dc (optional)
Accuracy/Linearity:	± 0.1% of rated span
Temperature Effects on Accuracy:	± 0.005%/°F to 140°F)
Line Voltage Effects on Accuracy:	± 0.1% max for 117V ± 10%
Load Variation Effects on Accuracy:	Maintains calibrated accuracy over stated resistance range
Response Time:	0.6 sec max. (to 99%)
Isolation (Optional):	Input/Output/Case/Power Line
Mounting Configuration:	Wall mounting standard. Panel mounting optional.
Weight:	6 lbs. (2.72 kg) net (approx.)
Alarms (Optional):	See the 7900 SC Series Alarm Data Sheet
Stability, long term:	± 0.1%/year max.

Note 1: Wider span adjustment ranges may slightly derate accuracy.

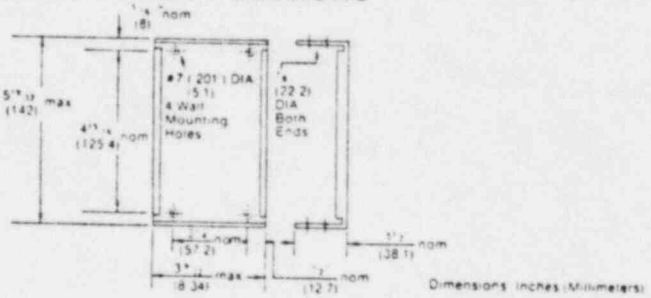
Note 2: Specify all input information at time of order (input range, zero and sensor data).

Note 3: Many other ranges may be accommodated on special order. Max. and Min. respectively.

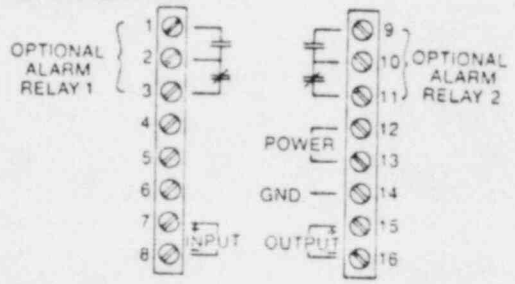
OUTLINE DIMENSIONS



BASE PLATE DIMENSIONS



WIRING DIAGRAM



OPTIONS AND ORDERING INFORMATION, Refer to page 45 for alarm option operation.

7000 SC —,—,—

OPTIONS
- **0** Standard
- **1** Single Alarm, Blind
- **2** Dual Alarm, Blind
- **3** Single Alarm, Calibrated (1 Turn) Dial
- **4** Dual Alarm, Calibrated (1 Turn) Dial
- **5** Single Alarm, Calibrated (Digital 10 Turn Pot)
- **6** Dual Alarm, Calibrated (Digital 10 Turn Pot)

OUTPUTS
- **0** Field Selectable 1-5, 4-20, 10-50mA dc
- **1** 1-5mA dc into 0-6000Ω
- **2** 4-20mA dc into 0-1500Ω
- **3** 10-50mA dc into 0-400Ω
- **4** 10-50mA dc into 0-600Ω
- **5** 0-10V dc
- **6** 0-1mA dc into 0-10kΩ

SPECIAL OPTIONS
- **AA** Standard
- **BA** Isolation
- **DA** Panel Mounting
- **EA** Adjustable Dead-Band (Single Alarm Only)
- **GA** Factory Calibration
- **HA** 10A Relay Contact Rating
- **HB** Hermetically Sealed Relay SPDT
- **HC** Hermetically Sealed Relay DPDT (Single Alarm Only)
- **HD** Dry Circuit Relay
- **JA** 120/240V Field Selectable, 60 Hz Power
- **JB** 24V dc Power
- **JC** 48V dc Power
- **KA** Oil Tight Enclosure (NEMA 12)
- **KB** Water Tight Enclosure (NEMA 4)
- **KC** Explosion Proof Enclosure

NOTE — Orders should include the following information:
1. The correct 4-digit Base Number, followed by SC.
2. The correct 2-letter designation for each special option.
3. Input range (zero and span) to be measured.

NOTE: For other options or special ranges, please consult the factory, or your local Scientific Columbus representative.

~~D. G. Morris~~ ~~W. J. Ponec~~
~~S. D. Tanner~~ ~~J. B. Little~~
~~B. D. Shekari~~ ✓ ~~K. M. Jackson~~

Plainville, Connecticut 06062
(203) 677-1311

Telex 99306

Enclosure 3

6 October 1980

Omaha Public Power District
1623 Harney Street
Omaha, NE 68102

Attention: Mr. Dave Shekari

Subject: Fort Calhoun Nuclear Plant
Sump Level Indication

Reference: 1. Telephone Conversation on 1 October 1980
2. Delaval Quotation No. 14525
Dated 7 August 1980

This is to confirm our telephone conversation of 1 October with Gems' representatives Chet Zajac, Dan Sabatino and myself and Omaha Public Power's representatives P. K. Mazumder and Dave Shekari.

1. The 4 - 20 ma output of the receiver type RE-36562 is isolated from the 0 to 200 microamp meter. In other words, should the 4 - 20 ma output be shorted, there would be no affect on the meter function.

2. This is to confirm our agreement to extend the validity of Gems' Quotation No. 14525 (dated 7 August 1980) an additional thirty days.

3. Delivery Schedule:

At present due to manufacturing commitments, it is impossible to deliver equipment before 30 November and there is only a remote possibility of shipping equipment during the month of December. Please note that Gems will need approximately six weeks to prepare drawings for approval. Upon your approval of Gems' drawings, we will require approximately twenty weeks to place vendor purchase orders, perform Quality Assurance Inspection on materials and components, assemble and perform Final Inspection.

In summary, delivery will be approximately twenty-six weeks from date of purchase order receipt. This would mean delivery would fall around 1 April.

Transamerica
Delaval

6 October 1980

Mr. D. Shekari
Omaha Public Power District

3. Delivery Schedule (continued):

Please understand that, in many cases, it is possible to improve on these deliveries and that we will work closely with you to achieve an earlier shipping date.

4. Gems' Quotation No. 14525 (dated 7 August 1980) contains two typographical errors. Refer to Item 004 on Page 1 and Item 007 on Page 2. Description should read P/N 31314, bulkhead mounting rack. Unit price is $78.75.

The panel mounting rack, P/N 31304, does not have and will not have seismic qualifications. P/N 31314 will be tested during the upcoming Wyle Laboratories Nuclear Transmitter Test Program.

Also, Item 005 which is the XM-54854 type nuclear transmitter has a 6-inch 150# flange, not a 5-inch 150# flange.

Should you have any questions with regard to the above information or require additional information, please feel free to contact our area representative whose address is listed below, Mr. William Meyer, Technical Sales at Gems, or the writer directly.

R. F. Ryder
Contract Analyst

RFR:ncm

cc: W. Meyer
R. Ryder
D. Sabatino
C. Zajac

Bill Meyer Tech sales
Bob Ryder contract spec.

Tel: (816) 842-2705

A. W. SCHULTZ COMPANY
822 Broadway
Kansas City, MO. 64105

Transamerica Delaval

Transamerica Delaval Inc.
Gems Sensors Division
Plainville, Connecticut 06062
(203) 677-1311

Telex 99306

Enclosure 4

13 January 1981

Omaha Public Power District
1623 Harney Street
Omaha, NE 68102

Attention: Mr. Dave Shekari
Project Engineer
Location GSE Electrical

Subject: Fort Calhoun Nuclear Power Station
Sump Level Indicators
OPPD Purchase Order 51821
Gems' Work Order 77615

Reference: OPPD Drawing Approval Letter
Dated 18 December 1980

We have received the sump level indication drawings with your comments and have the following information for your records.

1. Operating temperature/radiation resistance data and test report number will be applied to drawings Type XM-54854, P/N 61140; Type XM-54853, P/N 61135; Type XM-54852, P/N 61136; and Type RE-36562, P/N 61137 Sheet 1 of 2 after completion of the actual Test Program. Upon completion of the Test Program, the test data and report number will be included on these drawings and a sepia and blueprint will be provided for your information and records.

2. On Type RE-36562, P/N 61137 drawing, we will add the word "isolated" as shown on the returned marked print.

3. Installation drawing 61143 will remain as originally submitted. Your comment with regard to the quantity of butt connectors in the junction box is correct and we will supply one extra butt connector and shrink tubing for your installation purposes.

4. Mounting rack drawing 31314 has been approved without comments, therefore, no action is necessary.

Transamerica
Delaval

13 January 1981

Omaha Public Power District
Omaha, NE 68102

Attention: Mr. Dave Shekari
Project Engineer
Location GSE Electrical

An engineering change has been initiated to accomodate the requested change as described in Item No. 2 and upon completion a sepia and blueprint will be supplied for your information and records. All other comments with regard to parameters and report number will be addressed and provided after completion of the qualification tests.

Finally, your purchase order has been released to our Purchasing Department to proceed with the purchase of components and parts for use in fabrication of the equipment.

Delivery of the equipment will be approximately 20 to 22 weeks after receipt of approved drawings and release to production and therefore, delivery is tentatively scheduled for May 26, 1981. We will attempt to improve the delivery in any way possible.

Should you have any questions with regard to the enclosed information, please feel free to contact Mr. William Meyer at the Gems' facility, our local representative at the address listed below or the writer directly.

Robert F. Ryder
Contract Analyst

RFR:pmj

cc:

Tel: (816) 842-2705
A. W. SCHULTZ COMPANY
822 Broadway
Kansas City, MO. 64105

SEE

APERTURE

CARDS

*OVERSIZED DRAWINGS

(ADDITIONAL DOCUMENT PAGES FOLLOW)

APERTURE CARD NO: 8412190311

AVAILIBILITY PDR CF HOLD

NUMBERS OF PAGES.

Comsip, inc.
instrument and control systems
HEADQUARTERS • 3030 Red Hat Lane, Whittier, CA 90601 (213) 692-9021 Telex: 67-4768

October 2, 1984

Omaha Public Power District
1623 Harney
Omaha, Nebraska 68102

Attention: S. K. Gambhir

Reference: Fort Calhoun Nuclear Station
Post-LOCA Containment Hydrogen Monitoring System
Purchase Order 49622
Comsip, Inc. Sales Order 80020

Subject: OPPD Letter Dated September 25, 1984

Dear Mr. Gambhir:

The Comsip, Inc./AGM Model CD-4000 current transmitter is an isolated 4-20 mA output. The schematics for these transmitters are proprietary in nature and therefore are not available for submittal.

Comsip, Inc. can however provide the attached Specifications as well as the Test Procedures for these modules. The CD-4000 transmitter is an acceptable isolation device per the IEEE-384 criterion however the module was not tested to IEEE-384-1977, i.e. shorting out output, etc.

Best Regards,

COMSIP, INC.

Sid Lohmeyer, Jr.
Product Manager

SL:ns

attachments

CUSTOMLINE DIVISION
1418 E. Linden Ave., P.O. Box 152
Linden, NJ 07036
(201) 486-1272 Telex: 13-8496

GULF BRANCH
7201 Fairbanks North Houston Road
Houston, Texas 77040
(713) 460-0096

DELPHI SYSTEMS DIVISION
3030 Red Hat Lane
Whittier, CA 90601
(213) 692-9021 Telex: 67-4768

SPECIFICATIONS

CURRENT TRANSMITTER

Input Signal:

Nominal Range:	0 to 1 VDC
Maximum Operation:	-.25 to 1.25 VDC
Input Impedance:	Greater than 100 K ohms
Common Mode Rejection:	Greater than 100 dB

Output:

Nominal Range:	4 to 20 mA
Maximum Operation:	0 to 24 mA
Maximum:	40 mA
Load:	0 to 500 ohms
Response Time Constant:	Less than 1 second
Accuracy:	Better than 1/2% (.1 mA) over the maximum operation range and all specified environments. Line frequency output noise (ripple) shall be included as error.

ALARM MODULE (Single Set Point)

Input Signal:

Nominal Range:	0 to 1 VDC
Maximum Operation:	-.25 to 1.25 VDC
Input Impedance:	Greater than 100 K ohms
Common Mode Rejection:	Greater than 100 dB
Set Point Range:	-.25 to 1.25 VDC
Set Point Drift:	Less than 10 mV over all environments
Set Point Adjustment:	Screw or knob, accessible from top of module
Output:	DPDT Relay, energized with signal below set point. Contact rating 2A @ 120 VAC or 28 VDC, resistive load. Contact Life, 10^4 operations.
Deadband:	Fixed, less than 1/4% of span
Response Time:	Less than 1 second

CD-4000 Test Procedure

1. Plug module in.
2. Plug power cord in.
3. Put switch #1 to position A.
4. Put switch #2 to position A and adjust offset for .0400V.
5. Put switch #2 to position B and adjust span for .2400V.
6. Repeat sets #4 and #5 until readings are correct.
7. With switch #2 in position B put switch A to position #2. Both readings should be the same.
8. Return switch A to position #1.
9. Unplug power cord.

CD-4004 Test Procedures

1. Turn pot full clock-wise.
2. Put switch to "A" position.
3. Plug power cord in.
4. L.E.D.'s "1A" and "1B" should be on.
5. Turn pot counter clock-wise until L.E.D.'s "1A" and "1B" go out.
6. L.E.D.'s "2A" and "2B" should now be on.
7. Put switch to "B" position.
8. L.E.D.'s "2A" and "2B" should go off and L.E.D.'s "1A" and "1B" should come on.
9. Turn pot counter clock-wise until L.E.D.'s "1A" and "1B" go out.
10. L.E.D.'s "2A" and "2B" should now be on.
11. Unplug power supply.
12. Put in new module and go to step one.

DC VOLTAGE/CURRENT CONVERTER

APPLICATION

This converter is used within a process control loop to ratio, bias, invert, limit, isolate, convert or amplify any existing DC process control signal to another desired process control signal. The minimum input signal that can be specified is one mvdc. The available options for various input/output signal requirements, singular or combinational, and field adjustments provide the flexibility needed in start-up and retrofit situations in the field.

FEATURES

- COMPACT ASSEMBLY for small space requirements.
- INPUT/OUTPUT INVERSION option.
- HIGH/LOW LIMIT signal bounding option.
- ADJUSTABLE RESPONSE TIME, 5msec to 125msec option.
- CUSTOM FACTORY CALIBRATION is standard for specified input/ratio/bias requirements.
- EXTREMELY HIGH performance specifications and calibration accuracy.
- 1 KV ISOLATION, power to input/output signals is standard, power/input/output isolation optional.
- ENCAPSULATED circuitry in vacuum degassed rubber provides immunity to industrial gasses, humidity, and vibrations.
- SEVEN YEAR WARRANTY

DESIGN

The circuit design utilizes the latest CMOS digital and analog "chip" technology. The input amplifier circuitry uses micropower monolithic devices that have extremely low input offset voltages and high common mode rejection ratios. Optical isolators are used where signal isolation is required. Ample transformer design and zener protection guarantee a minimum of 1 KV p-p voltage isolation. The circuit package is hermetically sealed in a module and is repairable at the factory.

INPUT SIGNAL

- Standard: 1/5 VDC
- Custom: 1. Any 0/100% values specified for madc, mvdc, VDC.
  2. Options
     I—madc values
     V—mvdc, VDC values. Minimum span is 1 mvdc.

OUTPUT SIGNAL

- Standard: Isolated, 4/20 madc
- Custom: 1. Any 0/100% values specified for madc, mvdc, DCV. Output can be inverted or suppressed.
  2. Options
     I—isolated
     N—not isolated
     F—field adj. response time from 5ms to 125ms. Input/output isolated.
     U—ratio transmitter; cal dial, specify ratio = 0/1, 0/3, 0/10. Input/output not isolated.
     X—ratio/bias transmitter, blind adj., specify ratio = 0/1, 0/3, 0/10; bias = 0/1. Input/output not isolated.
     Y—high/low signal limiter, blind adj. over 0/100% span for both high & low. Input/output isolated.

FEATURES

- IMPEDANCES: V-in 10 Meg.; I-in 50Ω shunt for 4/20 madc. V-out 1Ω, 10 madc max. load; I-out 650Ω, 1650Ω optional, on 4/20 madc basis.
- ACCURACY: Better than ±0.10% of span; calibration, hysteresis and linearity.
- ISOLATION: One KV peak to peak, power/input/output.
- TEMPERATURE EFFECT: ±0.0025% of span per degree F.
- REJECTION: cmrr is 130db, nmr 90db 60 Hz
- HUMIDITY, LINE VOLTAGE REGULATION: No effect.
- POWER option:
  A — 117 VAC ± 10%, 60 Hz, 3 watts.
  B — 220 VAC ± 10%, 60 Hz, 3 watts.
  D — 24 VDC ± 10%, 3 watts.
  E — 117 VAC ± 10%, 50 Hz, 3 watts.
  F — 220 VAC ± 10%, 50 Hz, 3 watts.
- ENCLOSURE OPTIONS: PTA, AUX, FEA, REA, NEM.

HOW TO ORDER

- CREATE MODEL NUMBER

( )( )( )4000( )( )( )

Enclosure option: _____
Input signal: Z for std. or V, I _____
Output signal: Z for std. or I, N, F, U, X, Y _____
Power option: A, B, D, E, F _____

- SPECIFY CUSTOM INPUT OUTPUT 0/100% VALUES

"Example" PTA4000IIA
IN = 12/20 madc. Out = 20/4 madc

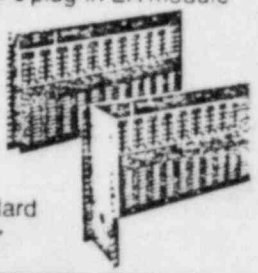
PTA plug-in TA module

2¾" W, 8½" H, 3¾" D

AUX

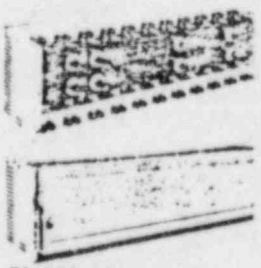
1⅞" x 3" x 2"

FEA plug-in EA module



Standard 19"

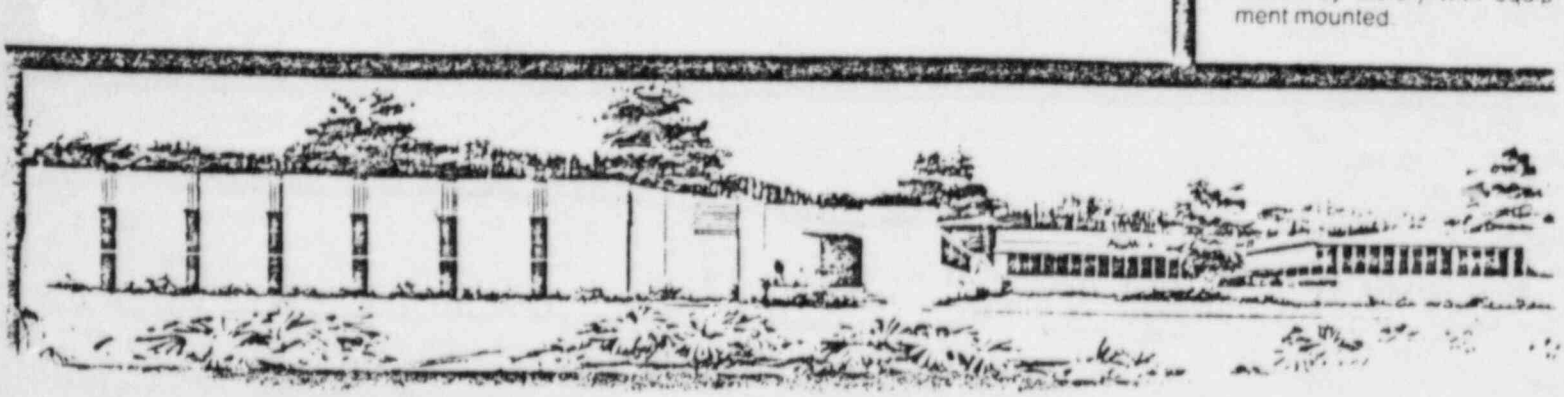
REA plug-in EA module



19" W, 5¼" H, 10" max. D

NEM

NEMA enclosure by standard mfg., e.g., Hoffman, Killark, Crouse Hindes, etc. Box furnished by factory with equipment mounted.



Instruction

MI
2AO-125
August 1978

2AO-V2I SERIES VOLTAGE-TO-CURRENT CONVERTERS
4 to 20 mA dc Isolated

Models
2AO-V2I, 2AO-V2I-FGB, 2AO-V2I-CGB, 2AO-V2I-PGA
2AO-V2I-BGA, 2AO-V2I-YGA, 2AO-V2I-XGB*

INTRODUCTION

GENERAL

The Voltage-to-Current Converter (Figure 1) is a solid-state output component located in the nest assembly. Its output is a current signal that is proportional to the voltage input signal. The converter has two inputs and outputs for dual operation with a common power supply.

The converter slides into the nest assembly and is held in place by two captive screws on the top and bottom of the front plate. The converter receives its power from the power bus in the nest assembly. The signal connections and adjustments are made on the front plate.

The Voltage-to-Current Converter is designed for installation in ordinary locations. However, components with specific suffixes are certified to have intrinsically safe output circuits which may be connected to field equipment located in classified locations as shown in Table 1.

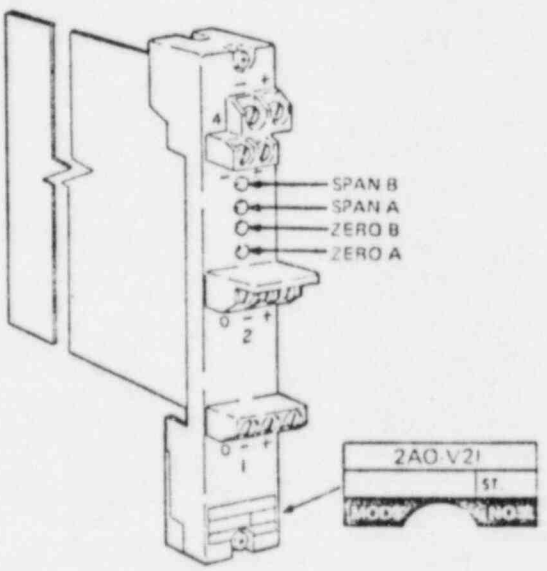


FIGURE 1

CONTENTS...

Table 1.

	INSTRUMENT SUFFIX		
	-CGB	-FGB, -XGB	-PGA, -BGA, -YGA
Classified Hazardous Location To Which Output Leads May Extend	Class I, Groups B,C,D Division 1 (CSA)[1]	Class I, Groups A,B,C,D Division 1 and Class II Groups E,F,G, Division 1 (NEC)[1]	Groups IIA, IIB and IIC Zone 0 and Zone 1 (IEC)[1]

[1]CSA - Canadian Standards Association - Canada
NEC - National Electrical Code - U.S.A.
IEC - International Electrotechnical Commission - Worldwide

*Model 2A-V2I-H and formerly Model 2AO-V2I-HGB

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FOXBORO

Agency certifications are dependent upon mounting the Voltage-to-Current Converter in a corresponding approved nest assembly which contains a corresponding approved power distribution component (refer to Table 2).

Table 2.

Nest Assemblies[1]	2ANU-D-CGB,-FGB, or 2ANU-DE-CGB,-PGA,-BGA,-YGA
Power Distribution Component	2AX + DPIO-CGB, -FGB, -XGB -PGA, -BGA, -YGA

[1]Foxboro Self-certified instruments (-XGB versions) use standard 2ANU-D or 2ANU-DE nests.

Also, this certification is dependent upon connecting to corresponding approved field devices which have been connected according to the rules of the certifying agency. Refer to the following MI and TI overview documents for the specific circuit requirements of each agency.

-BGA	(BASEEFA,U.K.)	200-257
-CGB	(CSA, CANADA)	200-255
-FGB	(FM, U.S.A.)	200-255
-PGA	(PTB, GERMANY)	200-256
-YGA	(S-COMMISSION, YUGOSLAVIA)	200-256*
-XGB	(FOXBORO SELF-CERTIFIED, U.S.A.)	200-255

*For similar requirements

In addition, certain other limitations pertain to each agency approval as listed in Table 3.

Table 3.

AGENCY AND MODEL SUFFIX	LIMITATION
BASEEFA (-BGA)	The capacitance and inductance or the inductance to resistance ratio of the load connected to the output (field) terminals shall not exceed the following values for Group IIC: Capacitance 0.37 µF, Inductance 8.0 mH, Inductance to Resistance Ratio 73 µH per ohm. These values increase by 3 times for Group IIB and by 8 times for Group IIA.
FM(-FGB) FOXBORO SELF-CERTIFIED (-XGB)	Field wiring limited to 2 miles in length with total inductance and capacitance not to exceed 3 mH and 0.1 µF respectively as measured at the control room end of the loop.
PTB(-PGA) S-COMMISSION(-YGA)	Allowable field cable length based on 5m/nF is 1100 metres.

SPECIFICATIONS

Power Requirements (Total for dual-circuit card):
+15 and -15 V dc ±5% at 80 mA when receiver powered from system supply via nest bus, or 40 mA when output connected to external power supply in series with load

Inputs: Two 0 to 10 V dc

Input Impedance: Greater than 500 kΩ

Outputs: Two 4 to 20 mA dc into a maximum of 600 Ω (See Output Load Section)

PRINCIPLE OF OPERATION

Figure 2 shows a simplified circuit diagram of one of the two channels of the dual voltage-to-current (isolated, 4 to 20 mA dc output) converter when the transmitter is powered from the nest field bus.

The input voltage (0 to 10 V dc) is applied to a high-impedance operational amplifier. The signal from the amplifier is "chopped" (interrupted and polarized to appear as an ac signal) and fed to the primary of the output power amplifier transformer. The output of the transformer is amplified and filtered to produce the 4 to 20 mA dc converter output signal. The output voltage is simultaneously stepped down and rectified/filtered to provide a negative feedback voltage to the input amplifier for adjustment and control of span.

For intrinsically safe applications, the voltage on the field bus is limited by a specially designed high-voltage limiting circuit in the nest power distribution component. Current limiting is provided by resistor Ra in the output circuit. Resistors Rb and Rc protect against accidental fault voltages (up to 250 volts nominal) from the system circuits.

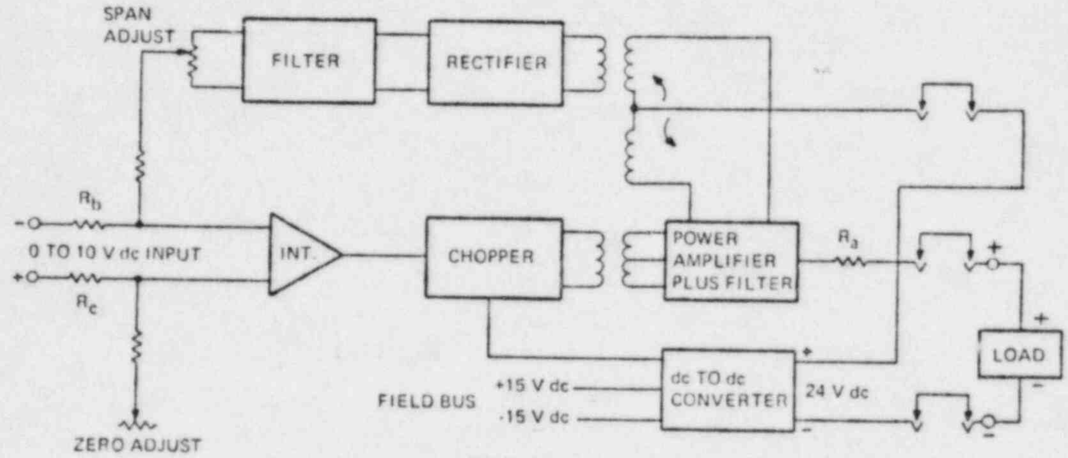


FIGURE 2

All the converter circuits, including the associated output signal loads, are powered from the SPEC 200® system field bus located in the nest. The 24 V dc field voltage is generated by a dc-to-dc converter, a part of the circuit card. To power the field load from an external source (Figure 3), the converter is easily changed by relocating jumpers on the printed circuit card, as shown in Figure 4.

CAUTION

An external power supply must not be used if the field circuits are to be intrinsically safe.

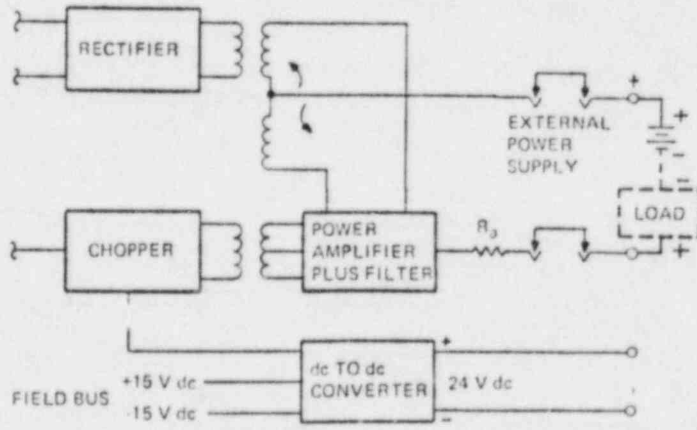


FIGURE 3

OUTPUT LOAD

The Voltage-to-Current Converter has an output signal of 4 to 20 mA into an output load of 600 ohms maximum, provided the internal power supply is used (refer to Figure 5a). Only the internal power supply may be used for the intrinsically safe versions.

When the Standby Unit 2AT-SPT is used with the Bypass Attachment Module 2AX+P, the output load must be reduced by [illegible] ohms.

For intrinsically safe -[illegible] versions, the Standby Unit [illegible] is used with Bypass Attachment Module 2AX+P-[illegible], or -[illegible], respectively. In these cases the maximum load is reduced by [illegible] ohms.

For intrinsically safe -BGA, -PGA, -YGA versions, the Standby Unit 2AT-SBU-BGA, -PGA, or -YGA is used with Bypass Attachment Module 2AX+P-BGA, -PGA, or -YGA, respectively. In these cases the maximum load is reduced by 290 ohms.

On nonintrinsically safe converters only, the output load capability can be extended when an external power supply is used if the external power source is greater than 24 V dc. The maximum voltage which can be used is 48 V dc without [illegible] overheating the output transistors in the event of a short-circuit [illegible]. If [illegible] used on the external power source, the load capability is increased to [illegible] ohms.

*[illegible]

INSTALLATION

FIELD POWER

Jumpers

Install jumpers as indicated in the following paragraph to configure the converter to the application.

Power Jumpers

The converter has available on the board assembly a dc-to-dc converter which supplies the power (24 V dc) to the output stage and also provides isolation. This limits the output load to 600 ohms maximum. However, if desired on nonintrinsically safe modules only, an external field power (48 V dc) may be used for the output stage, thereby increasing the output load to 1800 ohms maximum. A series of jumpers located on the board assembly can select the desired internal or external dc power source.

With the jumpers in the horizontal position (Figure 4, Output B), the internal supply is used to power the load. With the jumpers in the vertical position (Figure 4, Output A), an external supply is selected.

Figure 5 shows the effect on the internal wiring and output when jumpers are placed in the two positions on the board assembly.

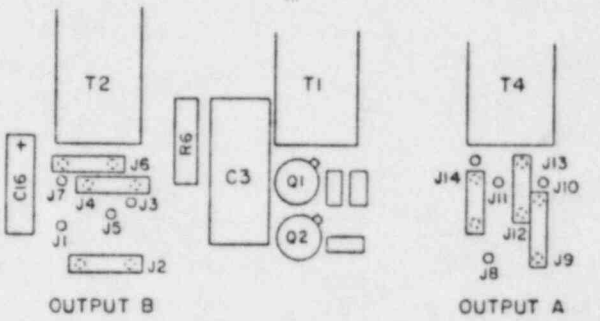


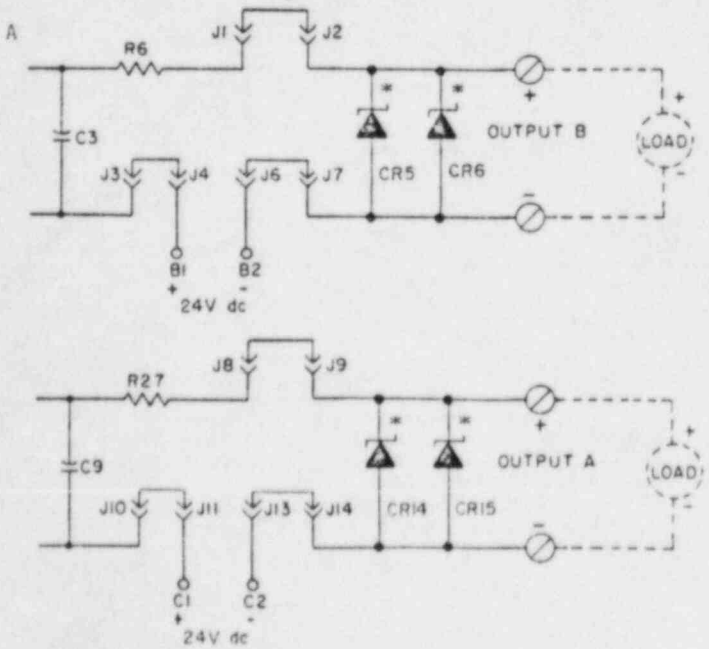
FIGURE 4

NOTES

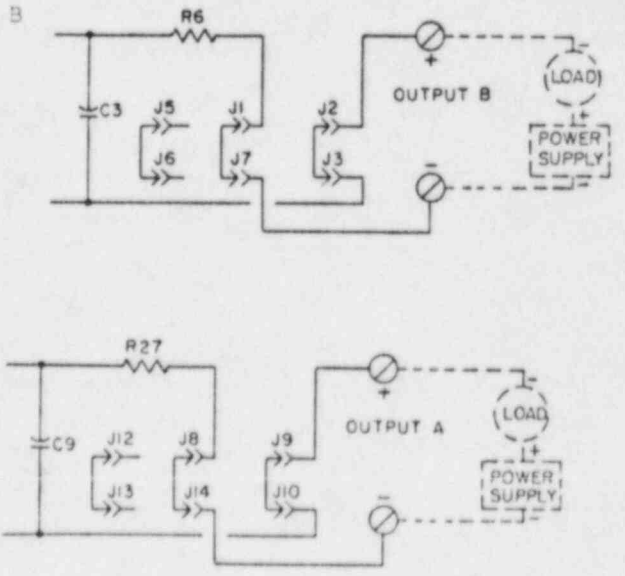
A. When an external field power supply is used, the load polarities are connected as shown in the illustration below.

B. The external Field Power Supply is NOT allowed in intrinsically safe applications.

Field Power From Converter
(Jumpers in Horizontal Position)
on the Board Assembly



External Field power
(Jumpers in Vertical Position)
on the Board Assembly



*Diodes on BGA, PGA, and YGA Versions only.

MOUNTING

The converter module slides into the nest assembly and is held in place by two captive screws on the top and bottom of the front plate.

CAUTION

When installing the module in a nest, care should be taken to tighten lower captive screw first to prevent bending of power bus pins. When removing module, loosen the upper captive screw first.

WIRING (See Figure 6)

The signal connections are located on the front plate of the converter. The top connections are for inputs A and B; the lower connections are for outputs A and B. The input signals are 0 to 10 V dc and the output signals are 4 to 20 mA dc. The converter has a set of jumpers on the board assembly to permit the use of converter field power or external field power to operate the output load (refer to Figure 4 for position of jumpers).

The signal connections are the same for all versions of the Voltage-to-Current Converter. However, there are specific installation practices which are required when intrinsic safety is involved. These are described in the following MIs and TIs:

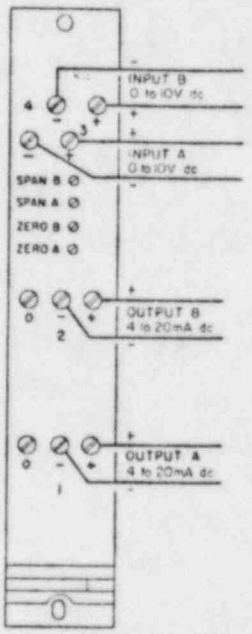


FIGURE 6

		REFER TO MI and TI
-BGA	(BASEEFA, U.K.)	200-257
-CGB	(CSA, CANADA)	200-255
-FGB	(FM, U.S.A.)	200-255
-PGA	(PTB, GERMANY)	200-256
-JGA	(S-COMMISSION, YUGOSLAVIA)	200-256
-XGB	(FOXBORO SELF-CERTIFIED, U.S.A.)	200-255

MAINTENANCE

CALIBRATION

Applying Power (Figure 7)

The converter power is supplied through the power bus strip in the nest assembly. When the converter is removed from the nest, the power is disconnected. If bench calibration or fault location is required, make the +15 V and -15 V connections at the power bus plug as shown in Figure 7. A power cable (Part Number N0305ZM) is available with the System Calibrator to make the power connections at the power bus plug. The signal connections on the front plate remain the same as shown under calibration.

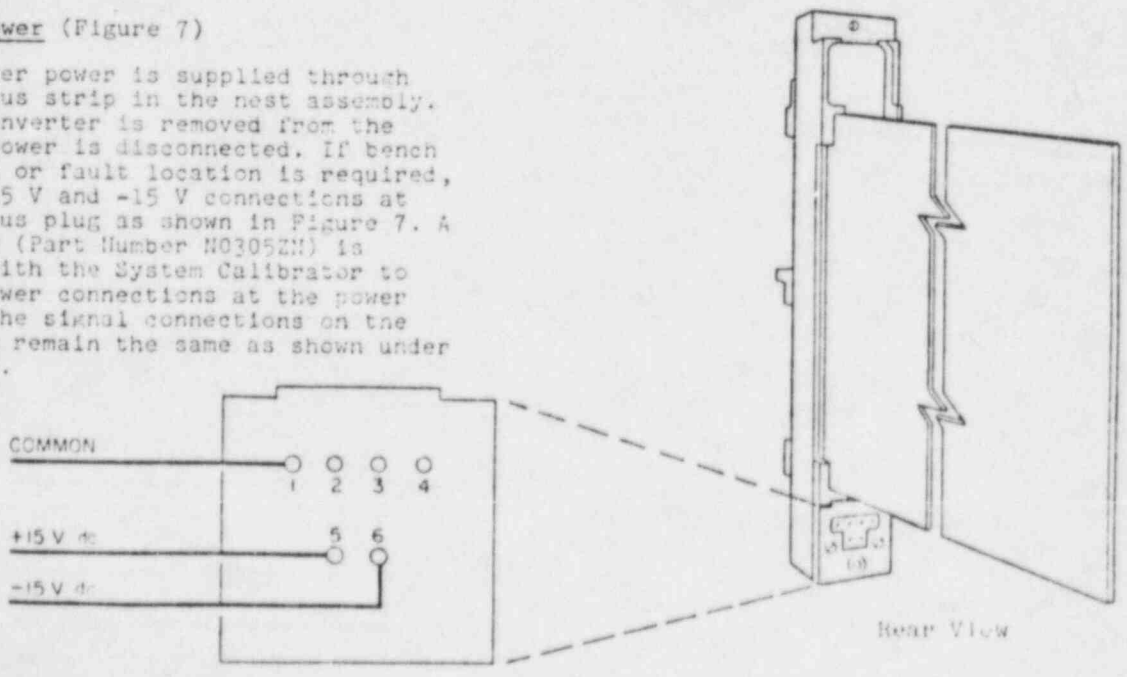


FIGURE 7

Equipment Required

(For Calibration and/or Fault Location)

System Calibrator: Model 2AT-CAL

Voltmeter: Range, 0 to 10 V dc
Accuracy, ±0.1%

Alternative equipment if System Calibrator is NOT available

Voltmeter:
Range: 0 to 10 volts dc
Accuracy: ±0.1%

Voltage Source:
Range: 0 to 10 volts dc
Accuracy: ±0.25%

Milliammeter:
Range: 0 to 20 mA dc
Accuracy: ±0.5%

Power Supply:
+15 V and -15 V dc, 100 mA dc

NOTE

Loop intrinsic safety is not permitted to be maintained during calibration procedures.

Jumper Positioning

Before starting calibration, the jumpers on the board assembly should be in the horizontal position. After calibration, place jumpers to their original position (refer to Figures 4 and 5).

Procedure

If Converter Unit is removed from nest assembly, connect dc power at bus connector as shown in Figure 7.

1. Connect Calibrator at input and output terminals as shown in Figure 8.
2. Either jumper input or adjust Calibrator voltage source for 0 V.
3. Adjust ZERO A screw on front plate until Calibrator reads 4 mA.
4. Adjust Calibrator voltage source for 10 V.
5. Adjust SPAN A screw on front plate until Calibrator reads 20 mA.
6. Repeat Steps 2 through 5 until no further adjustment is necessary.
7. For calibration of Input B and Cutput B, repeat same procedure except adjust ZERO B and SPAN B screws on front plate.

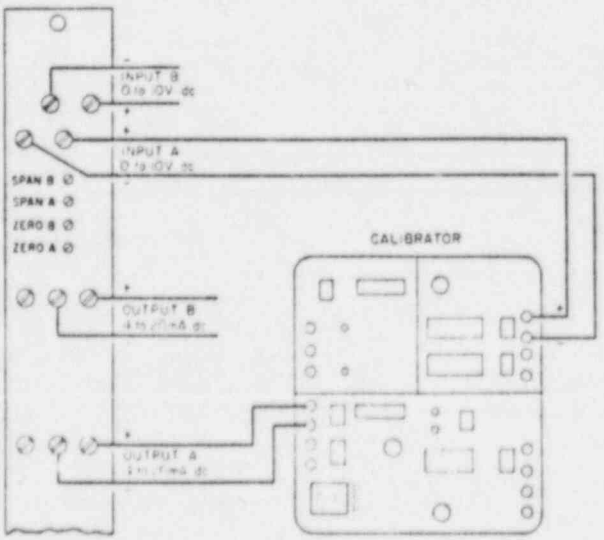


FIGURE 8

PARTS LIST

(Voltage-to-Current Converter 4 to 20 mA dc, Isolated)

Group A: Model 2AO-V2I
Model 2AO-V2I-CGB
Model 2AO-V2I-BGA
Model 2AO-V2I-DGA
Model 2AO-V2I-YGA

Group B: Model 2AO-V2I-FGB
Model 2AO-V2I-XGB

Item	Description	Part No.
R1	Resistor, 90.9 kΩ ±1%, 1/4 W	E0143KH
R2	Potentiometer, 500 Ω	E0286UR
R3	Resistor, 1.62 kΩ ±1%, 1/8 W	E0142TP
R4	Resistor, 150 Ω ±2%, 1/4 W	E0156EC
R5	Resistor, 15 Ω ±2%, 1/4 W	E0156PT
*R6 Group A	Resistor, 402 Ω ±1%, 1/4 W	E0286HJ
*R6 Group B	Resistor, 402 Ω ±1%, 1/4 W	E0286JQ
*R7, *R10 Group A	Resistor, 500 kΩ ±0.1%, 1/2 W	E0286EH
*R7, *R10 Group B	Resistor, 500 kΩ ±0.1%, 1/2 W	E0286JE
R8, R9, R11, R12	Resistor, 2 kΩ ±2%, 1/4 W	E0156PT
R13	Resistor, 90.9 kΩ ±1%, 1/4 W	E0143KH
R14, R18	Resistor, 1.62 kΩ ±1%, 1/8 W	E0142TP
R15, R19	Potentiometer, 500 Ω	E0286UR
R16, R20	Resistor, 68.1 kΩ ±1%, 1/4 W	E0143DC
R17	Resistor, 1.1 kΩ ±2%, 1/4 W	E0156FL
R21, R22	Resistor, 90.9 kΩ ±1%, 1/4 W	E0143KH
R23	Potentiometer, 500 Ω	E0286UR
R24	Resistor, 1.62 kΩ ±1%, 1/8 W	E0142TP
R25	Resistor, 150 Ω ±2%, 1/4 W	E0156EC
R26	Resistor, 15 Ω ±2%, 1/4 W	E0156PT
*R27 Group A	Resistor, 402 Ω ±1%, 1/4 W	E0286HJ
*R27 Group B	Resistor, 402 Ω ±1%, 1/4 W	E0286JQ
R28, R30, R31, R33	Resistor, 2 kΩ ±2%, 1/4 W	E0156PT
*R29, *R32 Group A	Resistor, 500 kΩ ±0.1%, 1/2 W	E0286EH
*R29, *R32 Group B	Resistor, 500 kΩ ±0.1%, 1/2 W	E0286JE
R34	Resistor, 15 kΩ ±2%, 1/4 W	R0154KD
R35	Resistor, 15 Ω ±2%, 1/4 W	R0156PT
R36	Resistor, 33 Ω ±2%, 1/4 W	R0156QR
C1, C5, C7	Capacitor, 0.1 µF, ceramic	R0140UP
C2, C8	Capacitor, 0.012 µF, ceramic	R0110DX
C3, C9	Capacitor, 4 µF, polycarb.	R0178UU
C4, C10	Capacitor, 0.47 µF, ceramic	R0140UK
C6, C12	Capacitor, 470 pF, ceramic	R0111CB
C11	Capacitor, 2.2 µF, ceramic	R0143BP
C13, C16	Capacitor, 6.8 µF, tantalum	R0160CP
C14, C15	Capacitor, 10 µF, tantalum	R0160CL
CR1, CR2, CR3, CR4	Diode, Type 1N914	R0304AH
CR7	[illegible]	R0110DA
CR8	[illegible]	[illegible]
CR9	[illegible]	[illegible]
CR10-CR13,	[illegible]	[illegible]
CR5-CR6,		
CR14	[illegible]	[illegible]
R17, R18	[illegible]	[illegible]
R37	[illegible]	[illegible]

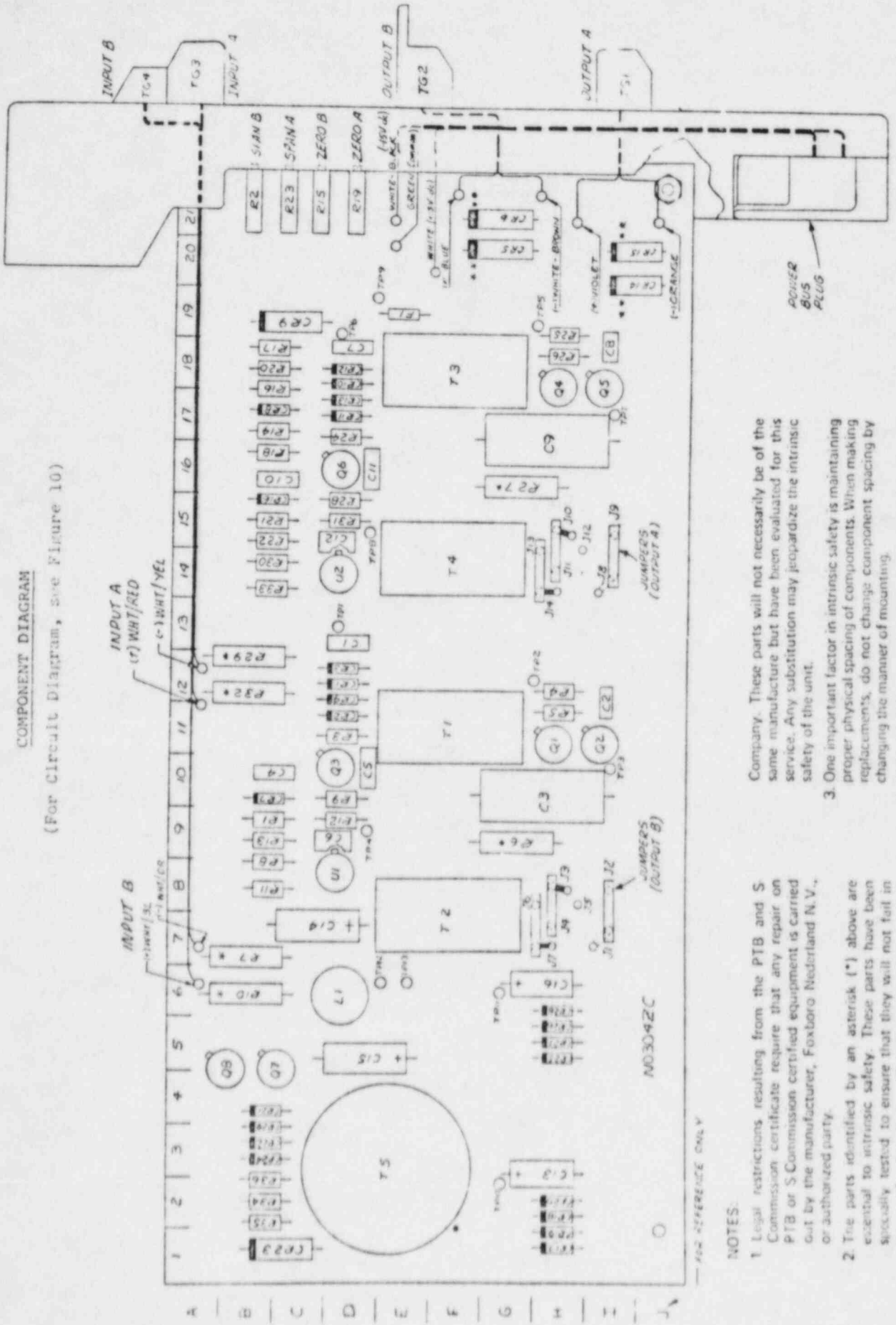
PARTS LIST (Cont.)

T1, T3	Transformer	N0233BK
T2, T4	Transformer	N0233BM
T5	Transformer	N0233BL
L1	Inductor, 0.8 mH	N0235AE
F1	Fuse, 1/4 A	N0262AB
--	Jumper Plug	N0308JY
--	Termination Assembly (front plate)	N0300FP
--	Power Bus Plug (rear of termination assembly)	N0300FX

* Critical Components (See note under Component Diagram Figure 9)

COMPONENT DIAGRAM

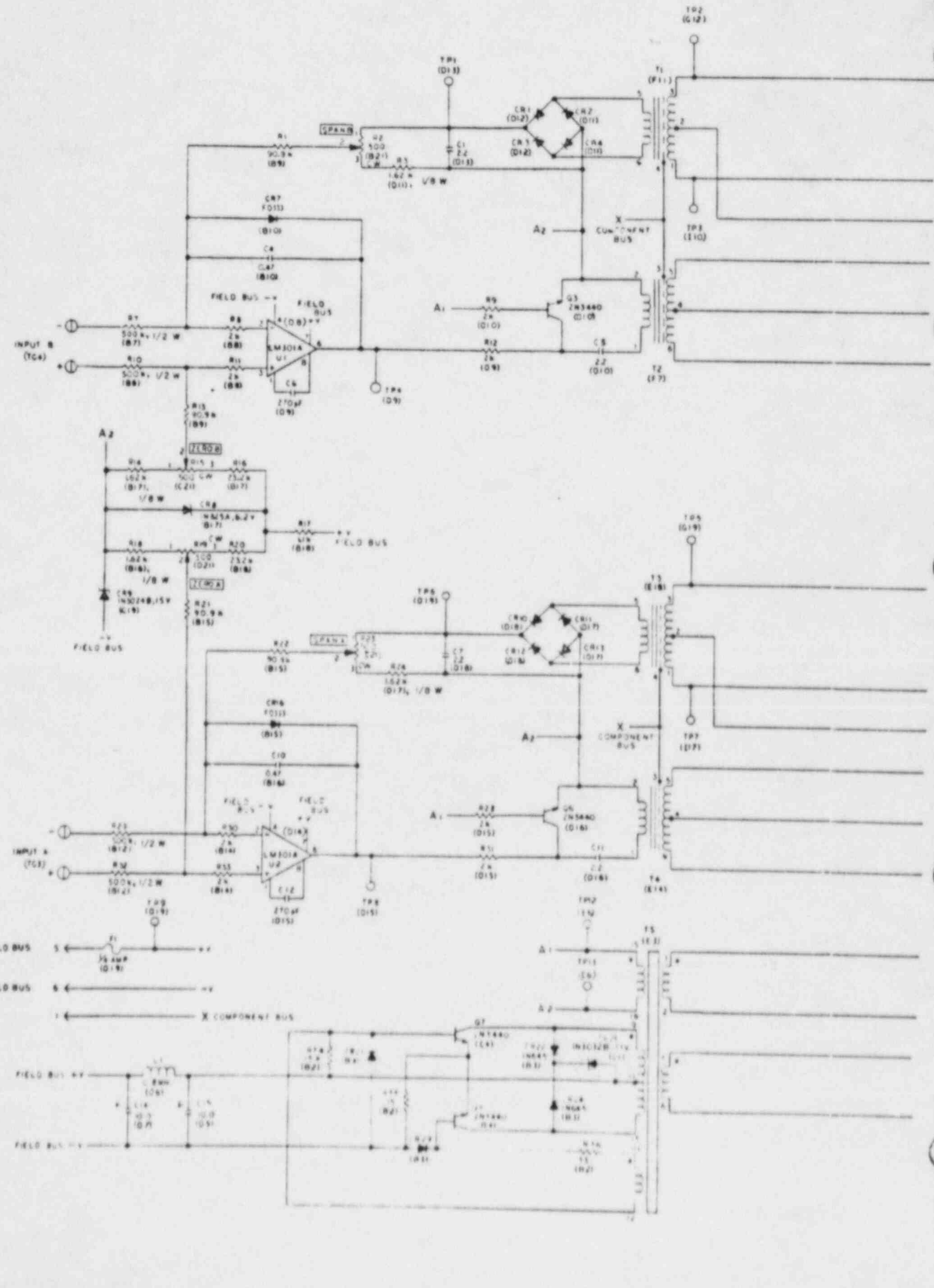
(For Circuit Diagram, see Figure 10)



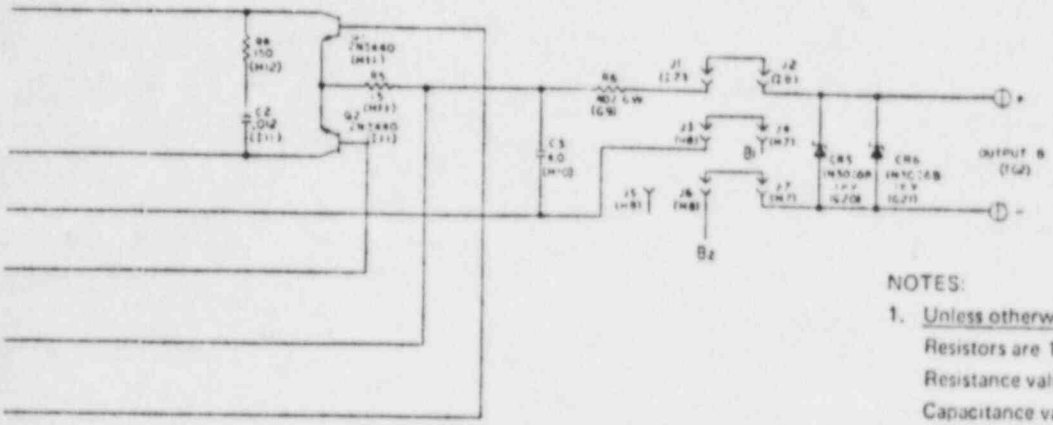
NOTES:

1. Legal restrictions resulting from the PTB and S Commission certificate require that any repair on PTB or S Commission certified equipment is carried out by the manufacturer, Foxboro Nederland N.V., or authorized party.
2. The parts identified by an asterisk (*) above are essential to intrinsic safety. These parts have been specially tested to ensure that they will not fail in an unsafe direction. If replacements are needed, order by part number, only from The Foxboro Company. These parts will not necessarily be of the same manufacture but have been evaluated for this service. Any substitution may jeopardize the intrinsic safety of the unit.
3. One important factor in intrinsic safety is maintaining proper physical spacing of components. When making replacements, do not change component spacing by changing the manner of mounting.
4. CR5, CR6, CR14, CR15, (double asterisk (**) are only on-BGA,-PGA,-YGA Versions.

FIGURE 9

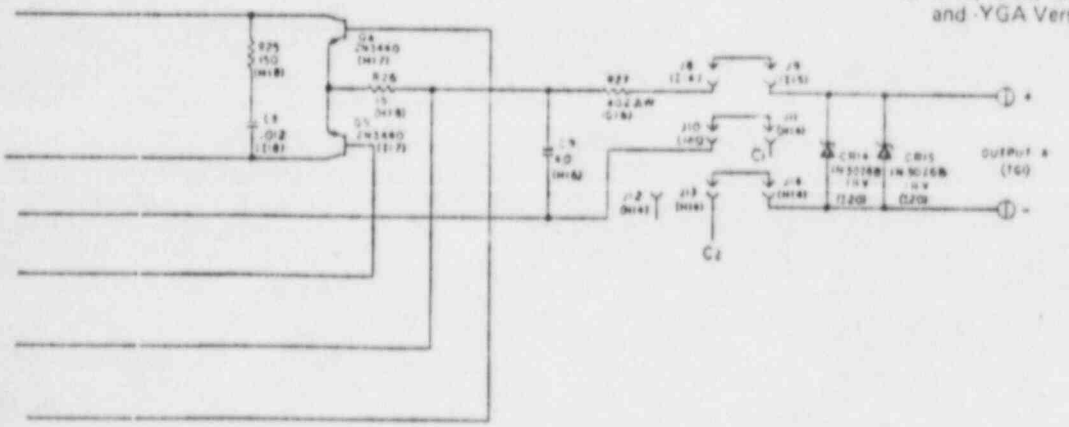


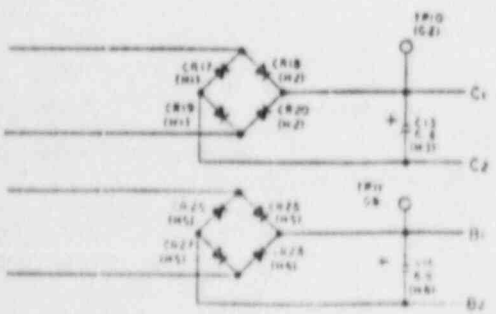
CIRCUIT DIAGRAM



NOTES:

1. Unless otherwise specified:
   Resistors are 1/4 W.
   Resistance values are in ohms.
   Capacitance values are in microfarads.
   Diodes are type 1N914.
2. Unless otherwise noted, all integrated circuits have +15 Volts at pin 7 and -15 Volts at pin 4.
3. The manufacturer's designation on integrated circuits is for reference only.
4. Numbers in parentheses indicate grid coordinates shown on component diagram.
5. CR5, CR6, CR14, and CR15, are on -BGA, -PGA and -YGA Versions only.





LEGEND:

- Screw terminal connection
- Bus connector pin
- Diagnostic test point
- Circuit and power common

*The components identified by an asterisk are critical to intrinsic safety. The values of the components on the circuit diagram are for the standard version. See parts list and NOTE under Figure 9 for additional information.

FIGURE 10

TABLE 2. Input-Output Converter

Description	Model Code	Qualification Code Notes	Performance Specifications and Type Test Results
Dual function converter where channel A provides 30 V dc (+ 15 and − 15 V dc) transmitter power and converts the transmitted 4 to 20 mA signal to 0 to 10 V dc. When jumpered for self-powered transmitters, input resistance is 250 Ω. Channel B converts a SPEC 200 system 0 to 10 V dc signal to 4 to 20 mA dc. No input-output isolation on either channel.	N-2AS-I3I	(a) or (b)	QOAAB41
Same as above with addition of bypass module to permit use with N-2AT-SBU Standby Unit.	N-2AS-I3I + P	(a) or (b)	QOAAB41 and QOAAB21

(a) Code CS-N/SRC = For Qualification Class 1E per IEEE 323-1975 and IEEE 344-1975 (Safety Related).
(b) Code CS-N/SRD = For Qualification Class II per IEEE 344-1975 (Structural integrity only).

TABLE 3. Contact Input Isolator

Description	Model Code	Qualification Code Notes	Performance Specifications and Type Test Results
Dual converter which converts the status of each of two dry contact inputs to corresponding output status. Output may be transistor switch or logic level as selected by jumpers. Output status may be HI or LO (ON or OFF) for given input condition as jumper selected. Impedance isolation only provided input to output. Input contact resistance: Open — 100 kΩ minimum Closed — 1 kΩ maximum	N-2AI-C2L	(a) or (b)	QOAAB15

(a) Code CS-N/SRC = For Qualification Class 1E per IEEE 323-1975 and IEEE 344-1975 (Safety Related).
(b) Code CS-N/SRD = For Qualification Class II per IEEE 344-1975 (Structural Integrity only).

TABLE 4. Dual Output Converters

Description	Model Code	Qualification Code Notes	Performance Specifications and Type Test Results
Converts 0 to 10 V dc to 4 to 20 mA dc. No input-output isolation. Output normally powered from internal 30 V dc (+ 15 and − 15 V dc) power source. Output load 775 Ω maximum, or 725 Ω maximum if option + P is specified. (f)	N-2AO-V3I	(a) or (b)	QOAAB11
Optional bypass module on one channel Optional bypass module on both channels	+ P + P + P		QOAAB21
Converts 0 to 10 V dc to 4 to 20 mA dc. Output is transformer isolated from input. Output is normally powered from internal isolated 24 V dc source. Output load 600 Ω maximum, or 500 Ω maximum if option + P is specified. (f)	N-2AO-V2I	(a) or (b)	QOAAB50
Optional bypass module on one channel Optional bypass module on both channels	+ P + P + P		QOAAB21
Converts inputs with spans from 2.5 to 10 V dc within the limits of 0 and 10 V to proportional 4 to 20 mA dc output signals. Output is transformer isolated from input. Decreasing output for increasing input achieved by reversing input leads. Output is normally powered from internal isolated 24 V dc source. Output load 600 Ω maximum, or 550 Ω maximum if option + P is specified. (f)	N-2AO-VAI	(a) or (b)	QOAAB17
Optional bypass module on one channel Optional bypass module on both channels	+ P + P + P		QOAAB21

(a) Code CS-N/SRC = For Qualification Class 1E per IEEE 323-1975 and IEEE 344-1975 (Safety Related).
(b) Code CS-N/SRD = For Qualification Class II per IEEE 344-1975 (Structural Integrity only).
(f) Suffix + P permits use with N-2AT-SBU Standby Unit.

GENERAL ATOMIC COMPANY
P.O. BOX 81608
SAN DIEGO, CALIFORNIA 92138
(714) 455-3000

ELECTRONIC SYSTEMS DIVISION

BUFFER AMPLIFIER, MODEL BA-1A

Input:	Four independent inputs ± 0-10 Vdc Impedance 10 KΩ
Isolation:	Outputs can be grounded, shorted to ac line or to high-voltage supply (1,000 Vdc maximum) without affecting the input signals.
Outputs:	Four independent outputs 0-10 Vdc @ 4 ma

The Buffer Amplifier Model BA-1 consists of up to four unity gain buffer isolation amplifier circuits to provide vital circuit protection from various types of output cable faults. The outputs may be grounded, shorted to ac line voltages or detector high-voltage supplies without affecting the input signals.

The Model BA-1 finds particular application in providing a means of extracting dc signals from safety instrumentation for monitor and control functions while isolating the safety system from faults which may occur in non-safety equipment.

SPECIFICATIONS

Input:	± 0-10 Vdc, impedance 10KΩ, with capability for inverting or non-inverting mode of operation.
Isolation:	Grounded output, ac line short, or 1,000 Vdc output. Fault will not perturb buffer input signals.
Output:	± 0-10 Vdc @ 4 ma, impedance less than 1Ω.
Power Requirements:	± 15 Vdc @ ± 40 ma.

A GULF AND WESTERN INDUSTRIAL SERVICE COMPANY

INSTRUCTION MANUAL

FOR

VOLTAGE AND CURRENT TRANSDUCERS

MODELS VT110A2 AND CT510A2

1. INTRODUCTION

1.1 The voltage and current transducers Models VT110A2 and CT510A2 measure ac voltage or current and provide a constant current output signal of 0 to 1 mA dc. A patented circuit (# 3, 971, 979) reduces the burden. The units will operate from 50 to 500 Hz with slight recalibration. Testing insures surge withstand capability (IEEE test) and high potential insulation (1, 500 Vac) between inputs, outputs, and case. The current unit is surge rated at 400 A for 1/2 second/hour and constructed so that higher surges will not open the loop if soldered connections melt. (For other input ranges, consult factory.) Each unit is mounted in a Type III case (see page 4).

2. SPECIFICATIONS

Full Scale Input	
Voltage (VT110A2)	150 Vac (nominal 120 V)
Current (CT510A2)	5 Aac
Burden at RO	
Voltage	2.5 VA
Current	0.25 VA
Overload	
Voltage	180 V continuous
Current	10 A continuous, 400 A 1/2 sec./hr.
Frequency Range	50 to 500 Hz (specify nominal)
Operating Temperature Range	-20°C to +60°C
Maximum Temperature Effect On Accuracy	±0.5%
Accuracy at 25°C (% RO at Nominal Frequency)	±0.25%

Attachment 5

Consideration of Adding Steam Generator Pressure, Containment Sump Level and Steamline Radioactivity to the SPDS

The District has reviewed the parameters included in the SPDS as a result of the Commission's request for additional information dated July 24, 1984, Reference (1). Upon completion of this review, it was determined that the parameters, Steam Generator Pressure, Containment Sump Level and Steamline Radioactivity, are monitored and displayed by the Fort Calhoun Station SPDS. These three parameters were inadvertently omitted from the October 28, 1983 submittal, Reference (2).

A revised SPDS Parameter Selection Safety Analysis is provided in addition to the relationship between the selected parameters and the Critical Safety Functions (CSF) provided in Attachment 6. Please note that the Containment Sump Level parameter is listed with the CSF "Containment Conditions," Steam Generator Pressure is listed with the CSF "Reactor Core Cooling and Heat Removal from the Primary System," and Steamline Radioactivity is listed with the CSF "Reactivity Control."

Attachment 6

Relationship to Critical Safety Functions and SPDS Parameter Selection Safety Analysis

1. NUREG-0737, Supplement 1, Critical Safety Function: Reactivity Control

   Corresponding EPG Safety Function(s): Reactivity Control

EPG Parameters	SPDS Variables
CEA Bottom Lights	CEA Full In Positions
Reactor Power	Wide Range Log Power
Startup Rate	Startup Rate
Boron Concentration	Boronometer Boron Concentration

2. NUREG-0737, Supplement 1, Critical Safety Function: Reactor Core Cooling and Heat Removal From the Primary System

   Corresponding EPG Safety Function(s): RCS and Core Heat Removal

EPG Parameters	SPDS Variables
Steam Generator Level	Wide Range Steam Generator Level (Both)
Steam Generator Pressure	Wide Range Steam Generator Pressure (Both)
Feedwater Flow	Feedwater Flow to Both Steam Generators
T_H Temperature	RTD's on Both Hot Legs
T_C Temperature	RTD's on All Four Cold Legs
ΔT Temperature	ΔT Between Hot and Cold Legs
T_{AVE} Temperature	T_{AVE} Temperature
RCS Subcooling	Saturation Margin Saturation Margin Upper Head Saturation Margin
ECCS Delivery	HPSI FLow LPSI Flow
CET Temperature	Maximum CET Temperature All CET Temperatures Representative CET Temperatures
RCS Pressure	Pressurizer Pressure

3. NUREG-0737, Supplement 1, Critical Safety Function: Reactor Coolant System Integrity

Corresponding EPG Safety Function(s): RCS Inventory and Pressure Control

EPG Parameters	SPDS Variables
Pressurizer Level	Pressurizer Level
RCS Pressure	Pressurizer Pressure
RCS Subcooling	Saturation Margin Saturation Margin Upper Head Saturation Margin
ECCS Delivery	HPSI Flow LPSI Flow Reactor Vessel Level

4. NUREG-0737, Supplement 1, Critical Safety Function: Reactivity Control

Corresponding EPG Safety Function(s): Containment Isolation

EPG Parameters	SPDS Variables
Containment Radiation Monitors	Containment Radiation Monitors
Containment Pressure	Containment Pressure
Containment Isolation Valve Status	Status of Cont. Iso. Valves
Steam Plant Radiation Monitors	Secondary System Activity Monitors - Main Steam Line Monitor - Gaseous Effluent Monitors - Condenser Off-Gas Monitor - Liquid Effluent Monitors

5. NUREG-0737, Supplement 1, Critical Safety Function: Containment Conditions

Corresponding EPG Safety Function(s): Containment Temperature, Pressure, and Combustible Gas Control

EPG Parameters	SPDS Variables
Containment Temperature	Containment Temperature
Containment Pressure	Containment Pressure

5. NUREG-0737, Supplement 1, Critical Safety Function: Containment Conditions (Continued)

Corresponding EPG Safety Function(s): Containment Temperature, Pressure, and Combustible Gas Control (Continued)

EPG Parameters	SPDS Variables
Containment H_2 Concentration	Containment H_2 Concentration
Containment Spray Flow	Containment Spray Flow
Containment Sump Level	Containment Sump Level

Adequacy of SPDS Variables: As detailed in the above safety analysis, all EPG parameters are monitored by the Fort Calhoun Station SPDS.