Installation, Operation, and Maintenance Instruction Manual

Area Monitoring System

Model 955A

Part No. 955A-1

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PROCEDURES, WARNINGS, AND CAUTIONS

The equipment described in this manual is intended to be used for the detection and measurement of ionizing radiation. It should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation.

Although the equipment described in this manual is designed and manufactured in compliance with all applicable safety standards, certain hazards are inherent in the use of electronic and radiometric equipment.

WARNINGS and CAUTIONS are presented throughout this document to alert the user to potentially hazardous situations. **A WARNING** is a precautionary message preceding an operation which has the potential to cause personal injury or death. **A CAUTION** is a precautionary message preceding an operation which has the potential to cause permanent damage to the equipment and/or loss of data. Failure to comply with **WARNINGS** and **CAUTIONS** is at the user's own risk and is sufficient cause to terminate the warranty agreement between Victoreen and the customer.

Adequate warnings are included in this manual and on the product itself to cover hazards that may be encountered in normal use and servicing of this equipment. No other procedures are warranted by VICTOREEN. It shall be the owner's or user's responsibility to see to it that the procedures described here are meticulously followed, and especially that **WARNINGS** and **CAUTIONS** are heeded. Failure on the part of the owner or user in any way to follow the prescribed procedures shall absolve VICTOREEN and its agents from any resulting liability.

Indicated battery and other operational tests must be performed prior to each use to assure that the instrument is functioning properly. If applicable, failure to conduct periodic performance tests in accordance with ANSI N323-1978 (R1983) **Radiation Protection Instrumentation Test and Calibration**, paragraphs 4.6 and 5.4, and to keep records thereof in accordance with paragraph 4.5 of the same standard, could result in erroneous readings or potential danger. ANSI N323-1978 becomes, by this reference, a part of this operating procedure.

READ YOUR INSTRUCTION MANUAL

WARRANTY

This instrument with its accessories, excluding those accessories listed below, is warranted by VICTOREEN, INC., against defects in materials and workmanship for a period of one year from the date of original shipment. During the warranty period VICTOREEN will repair or, at its option, replace at no charge an instrument containing such defect, provided that it is returned, transportation prepaid, to an authorized VICTOREEN service facility. Instruments repaired under warranty will be returned transportation prepaid.

In addition, the nuclear radiation calibration (when applicable) for each instrument is warranted to be within its specified accuracy at the time of shipment. If an error in this initial calibration is discovered, the instrument will be recalibrated at no charge, provided it is returned as described above. This does not apply to any calibration deviation that may result from normal use.

There are no warranties, expressed or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond that stated here. This expressed warranty excludes coverage of, and does not provide relief for, incidental or consequential damages of any kind or nature, including, but not limited to loss of use, loss of sales or inconvenience. This exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the instrument at VICTOREEN's option.

This warranty does not apply if the product, as determined by VICTOREEN, has been damaged by accident or misuse, or as a result of service or modification by other than an authorized VICTOREEN service facility. This warranty is void if the unit is subjected to temperatures above 55°C unless otherwise indicated.

This warranty specifically excludes the following items which are covered by their original manufacturers' warranties: Photomultiplier tubes, Geiger and proportional tubes, crystal and other solid-state detectors, batteries, and major ancillary items of instrument systems, such as, but not limited to, recorders and pumps.

INSPECTION AND MATERIAL RETURN INSTRUCTIONS

Instruments should be examined and tested as soon as received by the purchaser. Claims for damage, if any, should be filed at once with the carrier. Any material returned for repair must be accompanied by a valid customer purchase order, identifying the work to be done. A Material Return Form is provided at the back of this Instruction Manual. Send the completed form with items returned for repair to enable our Sales Personnel to process the order as quickly as possible.

Material valued at $200.00 or more and/or weighing more than twenty pounds should be shipped the best way prepaid and fully insured.

Victoreen suggests that any instrument weighing over twenty pounds be wrapped in heavy Kraft paper and packed in a double corrugated carton or wooden box. Protect the instrument on all sides with at least three inches of excelsior or similar padding. Mark the case plainly with suitable caution warnings to ensure careful handling.

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Section 1 - Introduction

General Description

The Victoreen Model 955A is a single-channel area radiation monitoring system capable of operating over the ranges of 0.01 to 10^3 mR/h, 0.1 to 10^4 mR/h, or 1 to 10^5 mR/h, depending on the detector selected. The system monitors gamma radiation over a 5-decade range and provides indication when the radiation level decreases below a fail threshold, exceeds a warn set point, exceeds a high set point, or exceeds an over range set point. The over range feature provides two significant benefits. First, it prevents the system from displaying an on-scale, but inaccurate, reading should the detector become saturated. Second, it lessens the risk of damaging the detector by disabling it during an overrange condition. Relay outputs are available to activate alarm annunciators. Analog outputs are available for trend display on a strip chart recorder or computer. In addition, the monitoring system has an integral check source to verify operational integrity. The system consists of a Model 897A series Geiger-Mueller (G-M) Tube Detector with integral preamplifier and the Model 956A-201 Universal Digital Ratemeter (UDR). A more detailed description of each piece of equipment can be found in the following paragraphs.

Geiger-Mueller Detector, Model 897A-Series

Victoreen 897A-series GM detectors use a thin walled Geiger-Mueller tube to detect ionizing radiation. Each 897A-series detector has a GM tube, a check source, and a preamplifier. The check source is a low-level radioactive source actuated by a +15VDC meter movement. The preamplifier provides the pulse conditioning and cable driving capability necessary to drive a Victoreen 956A-201 series digital ratemeter.

All 897A-series detectors are functionally identical. They differ only in housing material, tube type, and range. The 897A series detectors operate in the voltage range of 500 - 650 Vdc. An example of the detector plateau, based on different high voltages, is located in figure 1-1. Refer to the specifications for all 897A-series GM detectors for further information.

NOTE

The 897A series GM detectors contain an eight microcuri ^{36}Cl check source. Nuclear Regulatory Commission regulations define this source as a exempt quantity.

Application

The Model 897A GM Detector is designed to operate with the Victoreen Model 956A-201 Universal Digital Ratemeter (UDR) or with other Victoreen readouts. Each detector measures a five decade range. Three measurement ranges are available: low, medium, and high. The low range covers 0.01 to 10^3 mR/h, the medium covers 0.1 to 10^4 mR/h, and the high covers 1 to 10^5 mR/h. The Model 897A detector may also be used with the Victoreen Model 960 Digital Radiation Monitoring System equipment or the Victoreen Model 856 Analog Readout.

Specifications, GM Detector, Model 897A Series

Dimensions (Approximate)	7 1/8 x 3 inches (18.1 x 7.6 cm)
Weight (Approximate)	1 lb. (0.45 kg)
Housing Material 897A-210, 897A-220, 897A-230 897A-211, 897A-221, 897A-231	 Aluminum, weatherproof Stainless Steel, weatherproof
Fill Gas: 897A-210, 897A-211 897A-220, 897A-221 897A-230, 897A-231	 Neon / Argon / Halogen Helium / Neon / Halogen Helium / Neon / Halogen
GM Tube Wall Thickness: 897A-210, 897A-211 897A-220, 897A-221 897A-230, 897A-231	 40 mg/cm^2 80 mg/cm^2 80 mg/cm^2
Mounting	Wall mount
Mating Connectors	897A-2x0: 92-7005-17A, 12 Pin Female 92-7005-12A, Bushing 92-7005-9A, Clamp 897A-2x1 (stainless steel): 92-7005-15A, 12 Pin Female (Stainless Steel) 92-7005-12A, Bushing 92-7005-13A, Bushing
Required Cable	Victoreen P/N 50-100 or substitute with two coaxial conductors, two twisted pairs, and overall shield
External Pressure Limit	30 psig
Storage Temperature	-10° to 122°F (-23° to 50°C)
Operating Temperature	-10° to 122°F (-23° to 50°C)
Relative Humidity	0 to 95% non-condensing
Operating Voltage	500 - 650 Vdc (supplied by digital ratemeter)
Plateau Length	100 - 150 Vdc
Plateau Slope: 897A-210, 897A-211 897A-220, 897A-221 897A-230, 897A-231	 0.1%/V 0.2%/V 0.3%/V
Dead Time (Approximate) 897A-210, 897A-211 897A-220, 897A-221 897A-230, 897A-231	 45 microseconds 28 microseconds 20 microseconds
Measurable Radiation : 897A-210, 897A-211 897A-220, 897A-221 897A-230, 897A-231	 0.01 to 10^3 mR/h 0.1 to 10^4 mR/h 1 to 10^5 mR/h
Detector Element Life	Exceeds 1000 hours at full-scale
Energy Dependence of Reading	+/-15% from 100 keV to 1.5 MeV
Detector Accuracy	± 20% of actual dose for Cs-137
Radiation Detected	Gamma rays, X-rays

Specifications, GM Detector Check Source, Model 897A Series

Radionuclide	^{36}Cl
Source Activity:	8 microcuries
Scale Reading (Approximate) 897A-210, 897A-211 897A-220, 897A-221 897A-230, 897A-231	 150 mR/h ±7.5 mR/h 150 mR/h ±7.5 mR/h 150 mR/h ±7.5 mR/h
Voltage	12 - 15 Vdc
Encapsulation	Brass, high temperature soldered

Specifications, Detector Preamplifier (Integral)

Input Impedance	>100 k-ohms
Output Impedance	50 ohms
Output Pulse Polarity	Positive
Output Signal (50 ohm terminated)	+5 Vdc square-wave
Low Voltage*	+15 Vdc (Optional +10 Vdc is Jumper Selectable)
Power Requirements	+15 Vdc @ 20 mA
Maximum Cable Length	2000 feet
Electronic Exposure Life	Approximately 10^5 rads
Discriminator Level	Adjustable from 0 to +2 Vdc (nominal value = 0.5 Vdc)
Anti-Jam Level	Adjustable from 0 to +3 Vdc
Anti-Jam Oscillator Frequency	Approximately 50 kHz
Pre-divide*	Jumper Selectable
Analog & Digital Monitor Configuration	Divide by 2, Square wave output
Optional Monitor Configuration	Raw pulse output

*Preamplifier low voltage and pre-divide are selected with jumpers. Refer to the preamplifier circuit description for more information. Standard Configuration for a 955A system is +15 Vdc, Divide by 2.

System Part Number Description

955A-XXYYZ

XX =	**Range / Material / Power / Detector**
10	0.01 to 1E3 mR/h, Aluminum, 120 Vac, 897A-210
20	0.1 to 1E4 mR/h, Aluminum, 120 Vac, 897A-220
30	1.0 to 1E5 mR/h, Aluminum, 120 Vac, 897A-230
11	0.01 to 1E3 mR/h, Stainless Steel, 120 Vac, 897A-211
21	0.1 to 1E4 mR/h, Stainless Steel, 120 Vac, 897A-221
31	1.0 to 1E5 mR/h, Stainless Steel, 120 Vac, 897A-231
YY =	**Local Alarm Option, P/N / Description / Voltage / Range / Material**
00	No local alarm
10	Model 958A-40, Local Alarm / No Indicator, Painted Steel
20	Model 958A-X0, Local Alarm / Meter, Painted Steel
30	Model 958A-41, Local Alarm / No Indicator, Painted Steel
40	Model 958A-X1, Local Alarm , Meter, Painted Steel
Z =	**Special Options / Modifications**
Blank	110 Vac
1	220 Vac (future)
MX	Special Modifications (X = the modification number)

Detector Part Number Description

897A-2XY

- Y = 0, Aluminum Housing
- Y = 1, Stainless Steel Housing
- X = 1, 0.01 mR/h - 1E3 mR/h
- X = 2, 0.10 mR/h - 1E4 mR/h
- X = 3, 1.00 mR/h - 1E5 mR/h
- 2 = High reliability components for Class 1E service
- PRODUCT SERIES:

897 = Sr-90 check source (NRC license required) with a 120 VAC solenoid actuator. No longer Manufactured.

897A = Cl-36 check source (exempt quantity) with + 15 VDC meter movement actuator.

Readout Part Number Description

956A-20X-ZX

- Blank = Standard Unit
  Z = Special Options/Modifications
  ZX = Special Modification (X = Modification Number)
- 00 = 120 Vac Check Source Mechanical (Discontinued 9/95)
  01 = 12 Vdc Check Source Mechanical (current product configuration)
  0X = Future Variations
- 2 = High reliability components for Class 1E service
- PRODUCT SERIES

956 = 16k PROM, 8k RAM; V-Channel front panel - No longer manufactured
956A = 32k PROM, 8 k RAM, 64 bytes EEPROM; flat front panel - revised rear panel pinouts.

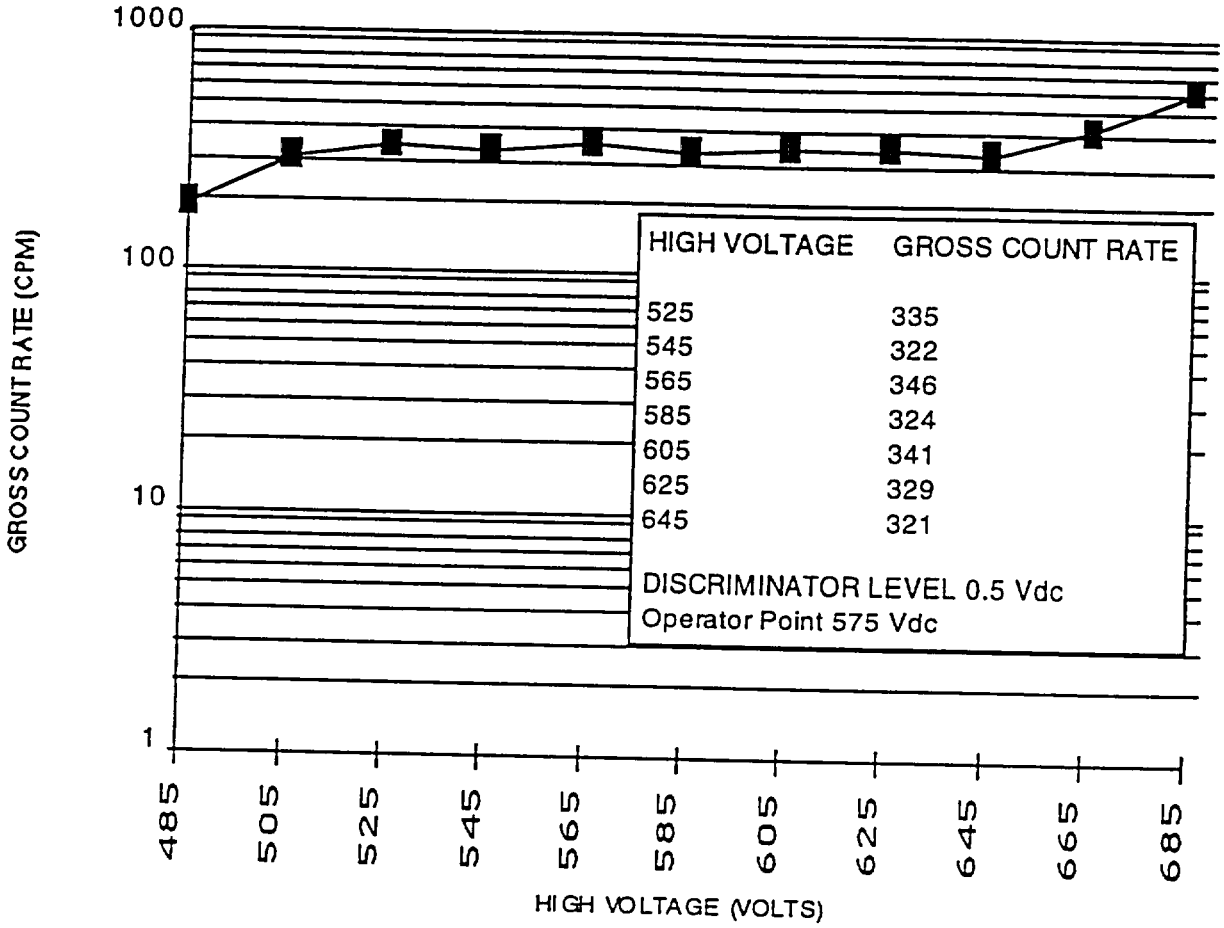

Figure 1-1. Detector Plateau (typical)

Specifications Model 956A-201

General specifications for the 956A-201 UDR are listed below. The 956A-201 is designed for nuclear applications, and any repairs to it by personnel not qualified may void the nuclear rating. If a problem develops, the UDR can either be returned to the factory for service, or repaired by a qualified technician.

Main Display	Five segment - three digits with backlighted radiation units display, and floating decimal point
Bargraph Display (Dynamic Range)	Three segments per decade, 10^{-2} to 10^{6} mR/h (24 segments) (green for norm, amber for warn, and red for high)
Alarm Indicators	**HIGH** Alarm (Red LED) - Flashing until acknowledged **WARN** Alarm (Amber LED) - Flashing until acknowledged **FAIL** Alarm (Red LED) - Does not flash, automatically resets **RANGE** Alarm (Red LED), overrange/underrange - Does not flash, automatically resets
Display Selection (Momentary Pushbuttons)	HIGH, High Alarm Setpoint WARN, Warn Alarm Setpoint
Check Source	Activates radioactive Check source and associated green LED indicator. Momentary, non-latching pushbutton operation
Alarm Ack.	Alarm acknowledgment causes alarm indicators to go to a steady on state after acknowledgment. Relays will reset when radiation level drops below setpoint. Internal jumper causes alarms to be reset automatically when radiation level drops below setpoint (no operator input required).
Power ON/OFF	Alternate action pushbutton for AC power.
Relay Outputs (Fail-safe operation)	**HIGH** Alarm - 1 set DPDT rated 5 A @ 120 Vac *(one set 120 Vac powered for use with optional local alarm)* **WARN** Alarm - 2 sets DPDT rated 5 A @ 120 Vac **FAIL** Alarm - 2 sets DPDT rated 5 A @ 120 Vac DC rating for all relays is 5A @ 29 Vdc
High Voltage Output	300 Vdc - 1800 Vdc @ 0.4 mA
Detector Check Source Power	+15 Vdc @ 20 mA
Analog Outputs	4 to 20 mA (2) (500 Ω load each, max.) and 0 to 10 Vdc (1 KΩ load min.), logarithmic. May be scaled for any one decade (minimum) or to the full range of the detector (maximum).
Remote Alarm Ack Input	Optically isolated DC input
Detector Input	Digital Pulse, Up to 2000 feet from UDR, 50 ohm input impedance
UDR Electronic Accuracy	±1 digit (± 1% of the displayed value, exclusive of the detector energy response
Dimensions (H x W x D)	3.5 in. x 5.6 in. x 13.5 in. (8.9 cm x 14.2 cm x 34.3 cm)
Weight	Approximately 3 7 lb. (1.67 kg)
Power	120Vac ±10%, 50/60Hz, 28 watts (240 Vac optional)
Operating Temperature	32° F to 122° F (0° C to + 50° C)
Relative Humidity	0 to 99% non-condensing
Compatible Detector	897A Series, GM (Geiger Mueller tube)
Heat Loading	Approximately 96 BTU/hr

Universal Digital Ratemeter, Model 956A-201

The Victoreen Model 956A-201 Universal Digital Ratemeter (UDR), when connected to a Victoreen Model 897A-2XY Geiger-Mueller (GM) tube detector, comprises a monitoring system which operates over a five decade range. The UDR provides display, control, and annunciation functions for the monitoring system, and will display readings in the range of 0.01 to 10^5 mR/h. Refer to Figure 1-2 for view of the 956A-201 front panel.

Standard features for the instrument consist of a three digit display of the radiation value and a multi-colored bargraph indicator which covers the entire range of the UDR. The bargraph will change color in the event of an alarm condition (green for normal, amber for warning, and red for high). Front panel alarm indicators and rear panel relay outputs for alarm annunciation are also included. Front panel pushbuttons are provided to apply power, display alarm limit set points, acknowledge alarms, and to activate the check source.

Analog outputs of 0 - 10 Vdc (1) and 4 - 20 mA (2) are provided for recording and computer monitoring. The outputs may also be used to drive a remote meter or a local (i.e. near the detector) indicator.

All electronics required to interface with the VICTOREEN 897A series GM detector are included within the 956A-201 UDR. The electronics consist of a high voltage power supply, low voltage DC power supply and the hardware/software required for UDR operation. The system also includes an overrange indicator to preclude the possibility of on-scale readings when the radiation field is beyond the range of the detector.

The following paragraphs describe the available options. A separate manual for each option board is available with more detailed information. Listed below are the option boards currently available.

1. 942-200-75: ANALOG INPUT OPTION BOARD - (Generally not used for normal operation with the 956A-201 UDR, however, it is used if the UDR is part of a simulator) Contains four separate channels for analog inputs. A 0 to 10 Vdc input or 4 to 20 mA input can be selected independently for each channel using the jumpers and switches provided on the board. Possible inputs to the board include: temperature, pressure, flow, or simulated radiation.

2. 942-200-80: COMMUNICATIONS LOOP OPTION BOARD - Designed to enable a EIA RS232C standard communications link between VICTOREEN's ratemeter and a user computer system or CRT terminal, with baud rates ranging from 50 to 19200 baud. An asynchronous communication interface adapter is utilized to format the data and control the interface.

   The VICTOREEN Communication Loop Option Board also provides an isolated multidrop, serial communications port for interface with a supervisory computer system. The serial data is in a modified RS-232 format, and utilizes Victoreen's proprietary VICO loop protocol. For maximum external noise protection, a six conductor communications cable is used.

3. 942-200-95: ANALOG OUTPUT BOARD - Designed to provide a user selectable single output voltage of: 0 - 10 Vdc, 0 - 5 Vdc, 0 - 1 Vdc, 0 - 500 mVdc, 0 - 100 mVdc, 0 - 50 mVdc, or 0 - 10 mVdc.

4. 942-200-95M1. DUAL ANALOG OUTPUT BOARD - Designed to provide two user selectable output voltages Output #1 is either 0 - 5 Vdc, or 0 - 10 Vdc, while output #2 is either 0 - 10 mV dc, 0 - 50 mVdc, 0 - 100 mVdc, 0 - 500 mVdc, or 0 - 1 Vdc.

Application

The Model 956A-201 UDR is used with all Victoreen 897A series GM Detectors. The detector specific setpoints for the 956A-201 UDR are configured by the user for the range of the particular detector supplied. The detector/preamp, when connected to a UDR, will function as a single channel digital area monitoring system. For additional information on various applications, please contact Victoreen, Inc.; Applications Engineering Group.

Auxiliary Equipment

Auxiliary Equipment	
Model	**Description**
Model 848-8	Field Calibrator (100 mCi)
Model 848-8B	Field Calibrator (20 mCi)
Model 848-8-105	897A Adapter (all types)
Model 848-8-400	897A Stainless Steel Detector Adapter, 897A-2x1
Model 942TS	UDR Test Set
Model 958A-40	Local Alarm, without meter
Model 958A-10, -20, -30	Local Alarm, with meter
Model 948-1	Rack Chassis
Model 948A-2	Blank Panel
Model 948-3	Table Top Enclosure
Model 948-10	Panel Adapter
Model 50-100	Interconnecting Cable

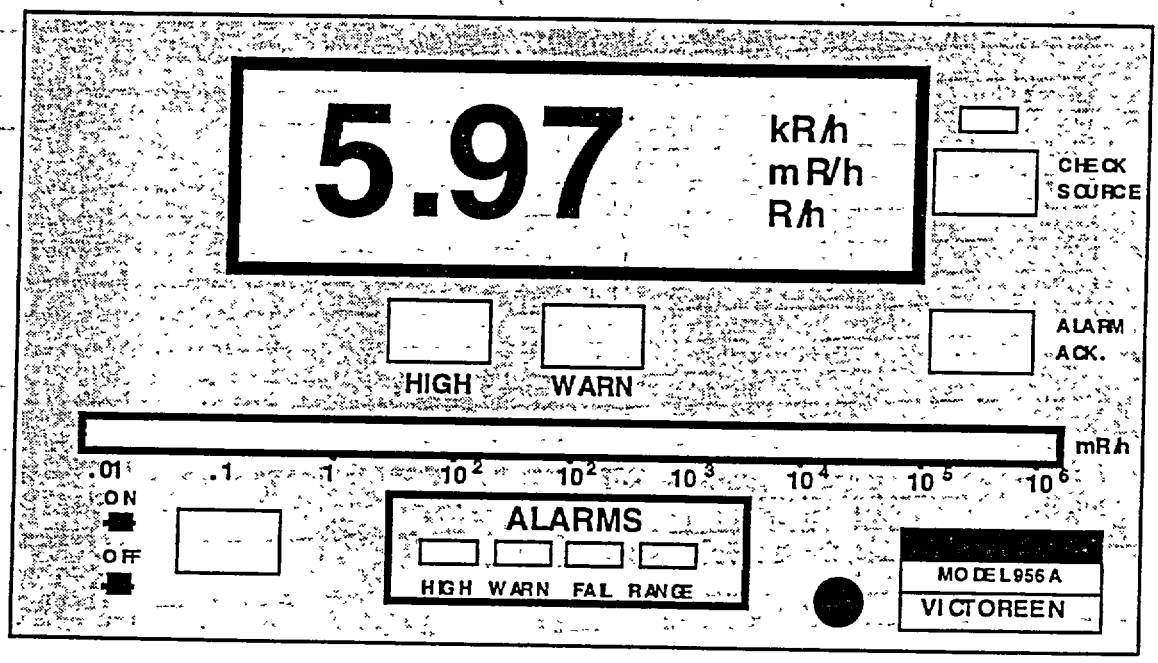

Figure 1-2. Front Panel, Model 956A-201 Universal Digital Ratemeter (not to scale)

For a view of the rear panel, refer to drawing 942A-100-30, located in Appendix B.

956A-201 Modifications

A number of application specific modifications to the 956A-201 Universal Digital Ratemeter are available for customer use. For further information contact Victoreen, Inc.

Recommended Spares

Table 1-2 lists the recommended spare parts for the 955A Radiation Monitoring System.

Table 1-2. Recommended Spare Parts List

897A Detector		
Part Number	**Description**	**Used On**
857-210-20	GM Tube Assembly, Low Range	897A-210
857-220-20	GM Tube Assembly, Medium. Range	897A-220
857-230-20	GM Tube Assembly, High Range	897A-230
857-211-20	GM Tube Assembly, Low Range, Stainless Steel	897A-211
857-221-20	GM Tube Assembly, Medium Range, Stainless Steel	897A-221
857-231-20	GM Tube Assembly, High Range, Stainless Steel	897A-231
857-210-30	Check Source Assembly, ^{36}Cl, 8 µCi	897A-2XX
46-77	"O"-Ring, Detector Housing	897A-2X0
857-211-15	Gasket, Detector Housing	897A-2X1
857-211-19	Mounting Strap	897A-2X1
857-211-18	Detector Mounting Bracket	897A-2X1
897A-210-10	Printed Circuit Board Assembly	All
956A-201 UDR		
Part Number	**Description**	**Used On**
956A-100-20	Front Panel Assembly	All
92-7027-1A	Fuse F2, 2 Amp, main AC power	All
19-62	Fuse F1, 50 mA, anti-jam circuit	All
92-9042-A	Jumper Block (10 required)	All
67-80-37P	Receptacle, P1, I/O, 37 Pin	All
67-80-14S	Receptacle, P2, Detector, 14 Pin	All
67-80-4P	Receptacle, P3, Power, 4 Pin	All
92-9106-A	MHV Bulkhead Receptacle, P4, HV	All
92-9074-A	BNC Bulkhead Receptacle, P5, Signal	All
68-15	Receptacle, P6, Aux., 24 Pin	All
68-15	Receptacle, P7, RS 232	Optional
942A-100-4	Mating Connector Kit	All
942-200-50	Power Supply	All
942-100-70	Relay PC Board Assembly	All
82-73-1	Relay	All
942-200-60	H.V. PC Board Assembly	All

Section 2 - Receiving Inspection and Storage

Receiving Inspection

Upon receipt of the unit:

1. Inspect the carton(s) and contents for damage. If damage is evident, file a claim with the carrier and notify the Victoreen Customer Service Department.

VICTOREEN, Inc.
6000 Cochran Rd.
Cleveland. Ohio 44139

Phone: (216) 248-9300
Fax: (216) 248-9301

2. Remove the contents from the packing material.

3. Verify that all items listed on the packing list have been received and are in good condition.

NOTE
If any of the listed items are missing or damaged, notify the Victoreen Customer Service Department.

Storage

Storage of Victoreen instruments must comply with Level B storage requirements as outlined in ANSI N45.2.2 (1972) Section 6.1.2(.2). The storage area shall comply with ANSI N45.2.2 (1972) Section 6.2 Storage Area, Paragraphs 6.2.1 through 6.2.5. Housekeeping shall conform to ANSI N45.2.3 (1972).

Level B components shall be stored within a fire resistant, tear resistant, weather tight enclosure, in a well ventilated building or equivalent.

Storage of Victoreen instruments must comply with the following:

1. Inspection and examination of items in storage must be in accordance with ANSI N45.2.2 (1972) Section 6.4.1.

2. Requirements for proper storage must be documented and written procedures or instructions must be established.

3. In the event of fire, post-fire evaluation must be in accordance with ANSI N45.2.2 (1972),Section 6.4.3.

4. Removal of items from storage must be in accordance with ANSI N45.2.2 (1972), Sections 6.5 and 6.6.

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Section 3 - Installation

Installation

Installation consists of selecting suitable mounting sites for the detector and ratemeter, mounting the equipment, making the required electrical connections, and entering the desired set points. Installation drawings are provided in Appendix B of this manual.

CAUTION

Remove all power prior to installing the UDR or detector.

GM Detector Mounting

The 897A series GM detectors can be mounted to any suitable structure e.g. a wall or post, using the mounting bracket (P/N 843-6-26) included with the detector. The maximum distance between the detector and ratemeter is 2000 feet (610 meters). The detector should be mounted above normal head height with the detector connector facing away from the area being monitored. For additional information refer to the applicable engineering drawings, provided in Appendix B, for detector mounting dimensions.

GM Detector Setup

The low voltage power supply input for the preamplifier is jumper selectable. This allows the use of either a +10 Vdc or +15 Vdc supply for detector power. If the detector is used in a 955A system, the standard +15 Vdc position is used. If the detector is used in a analog radiation monitoring system, the +10 Vdc position is used. Jumper configurations are listed in Table 3-1.

Table 3-1. Input Voltage Jumper Position

Jumper	Position	Input Voltage
J3	AB	+15 Vdc (factory set), digital readout
J3	BC	+10 Vdc, analog readout

The GM tube output pulse is conditioned with a divide by 2 pulse shaping circuit to transmit a square wave from the detector. The conditioning also permits use of the detector with analog readouts, using a diode pump counting circuit. For use with fast rise time scalers, a jumper is provided to output the detector pulse directly. Jumper configurations are listed in Table 3-2.

Table 3-2. Divide Options Jumper Position

Jumper	Position	Divide Option
J1, J2	AB	2, square wave output (factory set)
J1, J2	BC	1, direct coupled

UDR Mounting

The UDR is a self contained unit which can be mounted in four different ways.

CAUTION

When installing the UDR in enclosed panels or cabinets, ensure that the maximum operating temperature (122° F) is not exceeded. The total heat load should be calculated to determine whether cooling by natural convection or forced ventilation (i.e. fans) is required. The heat load for a single UDR is approximately 96 BTU/hr.

NOTE

Where more than four units are to be mounted in a cabinet, it is recommended that the center position in each chassis be left blank to facilitate the flow of cooling air through the cabinet.

NOTE

For seismic applications, the rear of the chassis must be supported, or the sides of the chassis must be fastened together. For further information, contact Victoreen.

1. The first mounting utilizes a 19 inch rack chassis adapter, Victoreen Model 948-1. This configuration requires 3.5 inches of rack height and can be used to mount up to three UDRs side by side. A blank filler panel, Victoreen Model 948A-2, is available to cover unused mounting positions. Refer to drawing GEL-948-1 for mounting dimensions.
2. The second mounting consists of a single channel table top enclosure, Victoreen Model 948-3. Dimensions for the enclosure are 4.5 inches high by 6.8 inches wide by 14.9 inches deep. Refer to drawing 948-3-5 for mounting dimensions.
3. The third mounting consists of a panel mount enclosure, Victoreen Model 948-9. Cutout dimensions for this enclosure are 3.75 inches high by 6.45 inches wide, the outside dimensions for the enclosure are 4.0 inches high by 6.7 inches wide by 13.7 inches deep. Refer to drawing 948-9-5 for mounting dimensions.
4. The fourth mounting utilizes the Victoreen Model 948-10 Rack Chassis Adapter to mount a 956A-201 UDR into an existing Victoreen analog ratemeter rack chassis such as those used for the Victoreen 842 series analog ratemeter. Refer to drawing GEL-948-10 for mounting dimensions.

The UDR is simply inserted into the selected mounting enclosure and secured using the front panel pawl fastener.

Electrical Interface

WARNING

Ensure all power is off prior to connecting the field wiring

Electrical interconnections at the detector are made via the mating "MS" style connector supplied with the detector and loop drawing 956A-201-106.

Electrical interconnections to the UDR are implemented with the mating connector kit, P/N 946A-100-4 (supplied with the readout) by using the connector input/output assignments provided in Tables 3-3 through 3-10, and loop drawing 956A-201-106, provided in Appendix B. Termination instructions for coaxial connections can be found in Appendix D. A service loop of approximately 12 to 16 inches should be provided to permit partial withdrawal of the UDR for setpoint adjustment and troubleshooting.

Connector pins should be soldered to the cable, using 60/40 tin/lead resin core solder and a soldering iron of 50 watts or less.

Table 3-3. Rear Panel Connections

Connector	Function
P1	Relay / Output, Remote Alarm Acknowledge
P2	Detector Connector
P3	AC Power Input
P4	Detector High Voltage (SHV)
P5	Detector Signal Input (BNC)
P6	Auxiliary outputs 0 - 10 VDC & 4 - 20 mA DC
P7	RS232C, Optional

Table 3-4. Connector P1 - Input/Output

Pin	Signal	Internal Connection
1	Spare	Relay Board K1-A
2	Spare	Relay Board K1-B
3	Spare	Relay Board K1-C
4	Spare	Relay Board K1-D
5	Spare	Relay Board K1-F
6	Spare	Relay Board K1-E
7	Fail Relay, common	Relay Board K3-A
8	Fail Relay, n.o.	Relay Board K3-B
9	Fail Relay, n.c.	Relay Board K3-C
10	Fail Relay, common	Relay Board K3-D
11	Fail Relay, n.o.	Relay Board K3-F
12	Fail Relay, n.c.	Relay Board K3-E
13	Warn Relay, common	Relay Board K4-A
14	Warn Relay, n.o.	Relay Board K4-B
15	Warn Relay, n.c.	Relay Board K4-C
16	Warn Relay, common	Relay Board K4-D
17	Warn Relay, n.o.	Relay Board K4-F
18	Warn Relay, n.c.	Relay Board K4-E
19	Alarm Relay, common	Relay Board K5-A
20	Alarm Relay, n.o.	Relay Board K5-B
21	Alarm Relay, n.c.	Relay Board K5-C
22	Spare	Not Used
23	Spare	Not Used
24	Spare	Not Used
25	+ Remote Acknowledge	Main Circuit Board J9-1
26	- Remote Acknowledge	Main Circuit Board J9-2
27 - 37	Spare	Not Used

n.o = normally open, n c = normally closed, Relays shown in shelf, or de-energized state.

Table 3-5. Connector P2 - Detector Connector

Pin	Signal	Internal Connection
1	Detector +15 Vdc Supply	Power Supply +15 Vdc
2	Not Used	Power Supply -15 Vdc
3	Supply Ground	Power Supply Ground
4	+15 V C/S On	Relay K2
5	-15 V C/S Off	Relay K2
6	Not Used	-
7	Not Used	-
8	Not Used	-
9	Not Used	-
10	0 - 10 Vdc*	Main Circuit Board J5-10
11	Ground	Main Circuit Board J5-9
12	Not Used	-
13	120 Vac (Neutral)	120 Vac (N)
14	Alarm N.C (Switched Line)	Relay Board K5-E (L)

* 0 - 10 Vdc selected for customer use on P2 (10,11) or P6 (5, 6), not both.

Table 3-6. Connector P3 - Power Input

Pin	Signal	Internal Connection
1	120 Vac, Line	Line fuse (F2)
2	120 Vac, Neutral	Power Supply, 120 Vac (n)
3	Safety Ground	Chassis

Table 3-7. Connector P4 - Detector High Voltage

Pin	Signal	Internal Connection
MHV	Detector High Voltage	Direct

Table 3-8. Connector P5 - Detector Signal Input

Pin	Signal	Internal Connection
BNC	Detector Signal	Direct

Table 3-9. Connector P6 - Auxiliary I/O

Pin	Signal
1	4 - 20 mA Output #1 (+)
2	4 - 20 mA Ground (-)
3	4 - 20 mA Output #2 (+)
4	4 - 20 mA Ground (-)
5	0 - 10 V * (+)
6	Ground (-)
7	Analog Output Option (+)
8	Ground (-)
9 through 24	Not Used

* 0 - 10 Vdc selected for customer use on P2 (10,11) or P6 (5, 6), not both.

Table 3-10. Connector P7 - RS232C Option

Pin	Signal
1	Protective Ground
2	Transmit Data
3	Receive Data
4	Request to Send (RTS)
5	Clear to Send (CTS)
6	Data Set Ready (DSR)
7	Signal Ground
8	Receive Line Signal Detect
20	Data Terminal Ready

Table 3-11. 897A Detector Connection

Pin	Signal
K	Protective Ground
H	Check Source
J	Check Source
E	High Voltage
MTG Screw	Chassis Ground
C	+ Voltage In
G	Signal Output

Set-up

Table 3-12 summarizes the jumper selectable configuration options. To place the system in operation, the following steps should be performed:

NOTE
Ensure you have read and fully understand section 4 prior to continuing.

1. Verify that jumpers and DIP switches, on the UDR and detector, are set for the operational features desired. Refer to Section 4, Table 4-2. The 897A Detector jumpers are preset at the factory per Tables 3-1 and 3-2, and should not be changed.

2. Apply power to the unit. The bargraph will illuminate, followed with a display of 0.- - 0.-. The unit will then begin to display the ambient radiation at the detector location.

NOTE
The default setpoints in the UDR memory are for an 897A-22X detector (0.10 mR/h to 1E4 mR/h), verify the appropriate setpoints for the actual detector are entered per section 4 (Parameter Entry).

NOTE
Calibration constant and detector deadtime value are obtained from the factory calibration data sheet for each detector.

3. Detector dependent set points such as analog outputs, High/Low scale values, Range, Underrange, Overrange limit, calibration constant, and detector deadtime may now be verified and if required, modified using the procedures outlined in Section 4.

4. Channel dependent setpoints such as alarm limits may be verified, and if required, modified using the procedures outlined in Section 4.

5. Electronic adjustments affecting calibration are factory set and should not be readjusted for initial operation unless the UDR has been in storage for more than one year. If the Unit has been in storage for more than one year, the electronic calibration described in Section 6 should be performed.

Table 3-12. Model 956A-201 Option Jumpers

Jumper	Function	Position	Operation
JP1	Microprocessor Reset	Out IN	Normal Operation (factory) Momentary connect to reset microprocessor without cycling AC power Not Applicable
JP2	PROM Type	1-2 2-3	PROM 27128 PROM 27256 (factory)
JP3-1/JP3-2	Statistical Accuracy (Note this accuracy refers only to the statistical interpretation of detector counts, and not detector accuracy)	Out / Out Out / In In / Out In / In	2% Accuracy - 9604 Target Counts 5% Accuracy - 1537 Target Counts 10% Accuracy - 384 Target Counts Fixed one second display update (factory)
JP3-3	Alarm Acknowledge	In Out	Manual Acknowledge (factory) Automatic
JP3-4	Fail Alarm	In Out	Enable No Counts Fail Alarm (factory) Inhibit No Counts Fail Alarm
JP3-5	Check Source Alarm	In Out	Alarm Inhibited (factory) Alarm Enabled
JP4	Input Pulse Selection	1-2 2-3	Negative Input Pulse (Other Detectors) Positive Input Pulse (GM Detectors) (factory)
JP5	Shield Polarity Selection	1-2 2-3	Shield for Negative Pulse Shield for Positive Pulse (GM) (factory)
JP-6	Anti-Jam Fuse Selection	1-2 2-3	Enable for Normal Operation (factory) Anti-Jam Circuit fuse bypassed (testing)
JP7	Detector Type for Anti-Jam Circuit Timing	1-2 2-3 Out	Scintillation GM Tube (factory) Anti-Jam Circuit Disabled (for testing only)

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Section 4 - Operation/Functional Description

Operation

This section describes the operation and set up of the Model 955A-XX Digital Area Monitoring System. The system consists of a Model 956A-201 UDR and a Model 897A series GM Detector. The detector preamplifier provides the electronics interface between the detector and the UDR. The preamplifier provides input pulse discrimination, predivide capability, anti-jam circuitry, pulse amplification and output drive capabilities. The output of the preamplifier is transmitted to the UDR. The 956A-201 UDR uses this information to generate the dose rate display, error codes, alarms, and analog outputs.

Operation of the 956A-201 UDR consists of operator functions and configuration functions. All operator functions are performed using the front panel shown in Figure 4-1. Configuration functions are performed using internal switches and/or jumpers, which are accessible with partial removal of the UDR from the mounting enclosure. Calibration involving trimpots is described in Section 6.

Detector Operation, Model 897A-2XX

The Model 955A Area Monitor uses a Model 897A-2XX GM tube as a gamma radiation detector. The tube is filled with a mixture of gases, one of which acts as a quenching agent, while the others tend to support ionization. Electrically, it consists of a positive electrode (anode), which is maintained at a steady potential of 500/650 Vdc and a negative electrode (cathode) which is near ground potential.

When a gamma photon penetrates the shield encasing the GM tube, an ionizing event occurs. An ion pair is produced, triggering an avalanche of ion pairs. The current pulses produced (one pulse per ionizing event) are independent of the energy of the initiating particle. Multiple discharge, caused by the release of electrons from the cathode due to excess energy, is eliminated after a short time (called dead time, typically 20-45 microseconds) by a quenching gas within the tube. The resulting pulses are conditioned and transmitted to the preamplifier.

The integral detector preamplifier provides input pulse discrimination and amplifies pulses received from the GM tube to a 5 Vdc amplitude. The current drive output of the preamplifier will drive a signal up to 2000 feet through a 50 ohm transmission line, without signal degradation.

Should a very high intensity radioactive source be detected, the GM tube may become saturated (i.e. pulses are separated by a period less than the dead time of the tube). This would have the effect of holding the preamplifier output at a relatively constant output voltage, resulting in count loss at the readout. Anti-Jam circuitry in the preamplifier produces a full scale output square wave signal, providing a full scale indication at the readout.

GM Detector Response Time

The response times for a change in reading within the same decade are listed in Table 4-1.

Table 4-1. Response Time

RANGE	RESPONSE TIME
0.01 to 0.1 mR/h	60 seconds
0.1 to 1.0 mR/h	60 seconds
1.0 to 10.0 mR/h	60 seconds
10.0 to 100.0 mR/h	60 seconds
100.0 mR/h to 1.0 R/h	60 seconds
1.0 to 10.0 R/h	60 seconds
10.0 to 100.0 R/h	60 seconds

The response time of the system to a step change in radiation value is 60 seconds, due to the operation of the pulse counting algorithms. The detector radiation value displayed is the result of a rolling average of the latest 60, one second values, and is updated once per second. An alarm will be initiated within one second after the current one minute average exceeds the alarm setpoint.

Check Source

A manual check source may be initiated from the UDR by the operator to check detector operation. The Check Source push-button is a momentary contact switch, and is active as long as the push-button is depressed. Upon removal of the check source request, the internal counting registers are cleared and the display value will slowly, within 1 minute, ramp up to the actual average radiation value. This is due to the action of the averaging algorithm in the UDR firmware. During check source activation, analog outputs are muted (forced to zero). The High and Warn alarms are normally inhibited during check source operation, but may be enabled by removing Jumper JP3-5, on the UDR main printed circuit board (see Table 3-12).

UDR Operation, Model 956A-201

Operation of the 956A-201 UDR consists of operator functions and configuration functions. All operator functions are performed using the front panel. Configuration functions are performed using internal switches and/or jumpers which are accessible via partial removal of the UDR from the mounting enclosure.

General Information

Normal Operation

If the measured radiation field is within the range of the detector during power-up, the mR/h value will be displayed as a three digit number: N.NN, where N = 0 to 9. A backlit insert will display engineering units in mR/h, R/h, or kR/h. The bargraph will display the value on the fixed mR/h scale and any indicator lights which are on should be green, providing the operator with a visual indication of normal operation. The analog outputs will track the displayed value, and the alarm outputs will be active. The Warn, High, and Fail relays operate in the Fail Safe Mode.

WARN/HIGH Alarms

If the measured radiation field increases above the WARN alarm limit, the WARN alarm indicator will turn on flashing (amber color), the bargraph will change color to amber, and the warn alarm relay will de-activate. If the measured radiation field increases above the HIGH alarm limit, the HIGH alarm indicator will turn on flashing (red color), the bargraph will change color to red, and the high alarm relay will de-activate.

NOTE

Non-failsafe relay operation for the HIGH and WARN alarms is available as an option at time of purchase.

The UDR can be configured to automatically reset the alarm relays and alarm indicators, or it can hold the alarm relays de-energized and flash the alarm indicators until the alarm acknowledge (ALARM ACK) pushbutton is pressed. If the ALARM ACK pushbutton is pressed while the alarm condition still exists, the indicators will go to a steady state, and the relays will remain de-energized until the alarm condition returns to normal. Upon resumption of normal operation, the relays will energize and alarm indicators will extinguish. The bargraph color will always indicate the current status; green for normal, amber for warn, and red for a high alarm.

Front panel pushbuttons labeled HIGH and WARN can be used to display the respective alarm set points.

Range Alarm

If the measured radiation field is below the underrange setpoint (minimum range of the detector used), the front panel display will indicate 0.00 mR/h, the bargraph will indicate the actual radiation value, and the RANGE alarm indicator will illuminate in red. The minimum range is adjustable by the underrange setpoint, and is defaulted to 1.00E-1 mR/h. When the measured radiation field increases into the range of the detector, the RANGE alarm indicator will extinguish and normal operation will begin.

There are three ranges for the ratemeter, one for each detector range (low, medium, & high). The specific range for each detector is established by operator entered setpoints (refer to "Setpoint Entry" for actual entry procedures). The detector range for each specific detector is shown below.

Detector	Detector Range	Underrange Setpoint	Overrange Setpoint
897A-210 / 211	0.01 to 10E3 mR/h	1.00E-2	1.00E3
897A-220 / 221	0.1 to 10E4 mR/h	1.00E-1	1.00E4
897A-230 / 231	1 to 10E5 mR/h	1.00E0	1.00E5

If the measured radiation field goes above the overrange set point, the RANGE alarm indicator will illuminate and the front panel display will indicate EEEEE mR/h, the bargraph will illuminate in red, and the analog output will be set to full scale. The maximum range of the detector used is determine by the overrange set point. When the measured radiation field returns within the maximum operating range of the detector and the condition is acknowledged, the RANGE alarm indicator will extinguish and normal operation will resume. In the event the detector output exceeds the electronic anti-jam circuit trip level, the anti-jam fuse will open and the fail relay will change state to indicate a monitor not in service condition. Replacement of the anti-jam fuse (F1) will be required in order to return the ratemeter to normal operation.

Fail Alarm

Detector failure, detector overrange, or microprocessor failure are some of the conditions which can produce a FAIL alarm and in some cases an error display. The fail condition is true whenever any equipment failure is detected and false when no equipment failures are detected. When a fail condition occurs, other than power failure, the red FAIL alarm indicator illuminates and the fail relay coil de-energizes.

To return the channel to normal operation after a FAIL alarm, the condition which caused the alarm must be located and corrected. Upon correction of the failure condition, the Fail alarm will automatically close.

Check Source

The check source pushbutton and electronics are provided to verify detector operation. To operate the check source, press the CHECK SOURCE pushbutton and hold it down. The Check Source LED will illuminate, and the radiation value will increase. Releasing the check source pushbutton will allow normal UDR operation. An internal configuration jumper (JP3-5) allows alarms to be activated or deactivated in the check source mode. The analog outputs are forced to their low scale value during a check source operation.

Firmware Version

This system requires a PROM for UDR operation. For the part number and the latest revision of the PROM, see the Factory Test Data Sheet.

Operational Modes

Normal Operation Mode

The UDR is in normal operation when the UDR function switch is in any position except 8, and the Check Source button is OFF. During normal operation, the display shows the dose rate data received from the preamplifier in mR/h, R/h, or kR/h. The bargraph will also show the dose rate. The color of the illuminated segments is green when the dose rate is below the WARN setpoint, amber when the dose rate is above the WARN setpoint and below the HIGH setpoint, and red when the dose rate is above the HIGH setpoint. The analog outputs are active and all alarms are enabled.

Data Entry Mode

Data Entry Mode is selected by pressing the ENTER pushbutton while the rotary FUNCTION switch is in a valid setpoint position **(see Setpoint Description)**. The selected setpoint is displayed in exponential format (e.g. 1.00E2) with the left most digit flashing. Setpoints are entered in exponential format (e.g. X.XXEN), where X is the mantissa and N is the exponent. The X value may be any integer value between 0 and 9. A positive exponent is entered by selecting the "E" symbol, and a negative exponent is entered by selecting the "-" symbol. The N value may be any integer value between 0 and 9. If the FUNCTION switch is not in a setpoint position, pressing the ENTER button has no effect. Refer to Table 4-3 for FUNCTION switch positions.

In the Data Entry Mode, the bargraph and analog outputs remain active.

Alarm Inhibit Mode

Alarms are inhibited in situations where an alarm trip would be meaningless because the UDR is not in a normal measurement mode (i.e., when the UDR is in the Check Source Mode). New alarm trips cannot occur and old alarms cannot be reset. When the inhibit period is over, alarm trips and resets are enabled again. Alarm inhibit conditions are discussed in the following paragraphs.

Check Source Mode

The check source pushbutton and electronics are provided to verify detector operation. To operate the check source, press the CHECK SOURCE pushbutton and hold it down. The check source relay will energize, the check source indicator will illuminate (green), and the check source mechanism will expose the check source (sealed capsule of ^{36}Cl) to the Gm tube by positioning the source over an access on the detector printed circuit board. The radiation value will be displayed on the front panel. Releasing the check source pushbutton will return the source capsule to it's shielded position and extinguish the check source indicator, allowing normal UDR operation to resume. After approximately 60 seconds, the displayed value will indicate ambient radiation. An internal configuration jumper (JP3-5) allows alarms to be activated or muted if alarm limits are exceeded by the check source radiation value.

The bargraph operates normally during Check Source operation.

The front panel Alarm and Warn status indicators are disabled during Check Source operation.

The analog outputs are set to zero (i.e. 4 mA or 0V) during Check Source operation.

Calibration (scaler) Mode Operation

Calibrate mode for the UDR is entered by turning the rotary set point switch to position 8 and pressing the ENTER button.

The current calibration time set point is displayed in seconds, with the first digit flashing to indicate the edit mode. The bargraph will turn off, high and warn conditions will clear, and the radiation unit light (backlights) will turn off. The calibration set point may be edited, but will reset to 60 seconds whenever the unit is turned off or the functional switch is moved from position 8.

Once the desired calibration time is set, momentarily pressing the ENTER button again will start the calibration. The display will go to zero, the units backlight will begin to flash, and the High, Warn, and Fail relays will change state. The UDR will count for the entered calibration time, displaying the current summation of counts each second. When the calibration is completed, the final summation of counts for the calibration time is displayed and the units backlights will be steady on.

Another calibration can then be executed by pressing the ENTER key, and the system will again display the calibration time for editing. A calibration in process can be stopped by pressing the ENTER key or by moving the rotary switch to a position other than position 8. Once the calibration mode is exited, the UDR will reset and continue normal operation.

NOTE

When the calibrate mode is initiated, the Alarm, Warn, and Fail relays change state to indicate the monitor is in a non-operational state.

The calibration mode can also be entered with the UDR in the check source mode of operation. Move the rotary switch to position 8 and press the check source button. While holding down the check source button, press the ENTER button to lock the check source on positive when the Check Source button is released. Pressing the enter button again will start the calibration. The check source light will remain on, indicating that the check source relay is energized. The check source condition will clear when the calibrate mode is exited.

NOTE

It is recommended that the check source not be left energized for extended periods of time in this mode.

Alarms

The alarm functions provided by the UDR include HIGH, WARN, FAIL, and RANGE. The HIGH, WARN , and FAIL alarms drive relay contact outputs. Some operating modes of the UDR disable alarms. The user is cautioned to read and fully understand section 4.

Alarm Logic Types

Alarm logic defines whether the alarm is reset manually or automatically and whether alarm relay coils are energized or de-energized in normal operation.

Standard alarm reset logic for the UDR is manual reset for the HIGH and WARN alarms, and auto reset for the RANGE and FAIL alarm. Failsafe operation is also standard.

Auto reset for the HIGH and WARN alarms may be selected by jumper JP3-3.

Manual Reset

When an alarm trips, the relay coil goes to its abnormal position. The indicator flashes until the alarm is acknowledged by pressing the ALARM ACK button on the UDR. The indicator then remains steady on until the alarm condition becomes false. At that time, the alarm resets by turning the indicator off and returning the contact to its normal position.

Auto Reset

When an alarm trips, the contact goes to its abnormal position. The indicator goes steady on. When the alarm condition becomes false, the alarm automatically resets, returns the relay coil to normal position, and turns the indicator off.

Auto reset may be selected for the HIGH and WARN alarms by removing jumper JP3-3 from the UDR main board.

Standard relay operation for the UDR is fail-safe. When the unit is powered, the relay coil energizes. If power is lost to the relay coil, or an alarm condition occurs, the relay de-energizes, giving a trip indication. This logic provides fail-safe operation for the alarm function.

Non-Failsafe relay operation for the HIGH and WARN alarms is available as an option.

HIGH Alarm

The HIGH alarm condition is "true" when the display dose rate is greater than or equal to the HIGH alarm set point and "false" for all other conditions.

The standard logic for the HIGH alarm is fail-safe, manual reset.

When the HIGH alarm is tripped, the red HIGH alarm indicator begins flashing, the bargraph goes to red, the HIGH alarm relay coil de-energizes, and the UDR sets its auxiliary output high. When the alarm is acknowledged, the HIGH alarm indicator goes steady on and the UDR sets its auxiliary output low. The auxiliary output on the UDR can be used to drive a remote alarm/alarm indicator.

The HIGH alarm relay will change state (i.e. energize) when the radiation value drops below the setpoint

The HIGH alarm is normally inhibited in Check Source mode. By removing jumper JP3-5, the High and Warn alarms may be enabled in Check Source mode.

WARN Alarm

The WARN alarm condition is "true" when the display dose rate is greater than or equal to the WARN alarm set point and "false" for all other conditions.

The standard logic for the WARN alarm is fail-safe, manual reset.

When the WARN alarm is tripped, the amber WARN alarm indicator begins flashing, the bargraph goes to amber, the WARN alarm relay coil de-energizes. When the alarm is acknowledged, the WARN alarm indicator goes steady on. With the alarm acknowledged, the relay will change state when the radiation value drops below the setpoint.

The WARN alarm is normally inhibited in Check Source mode. By removing jumper JP3-5, the High and Warn alarms may be enabled in Check Source mode.

RANGE Alarms

The underrange condition is "true" when the dose rate is below the underrange setpoint and "false" for all other conditions. The RANGE indicator illuminates, the analog output is set to zero, and the display reads 0.00 mR/h when the underrange condition is true. The bargraph will operate normally. The Alarm, Warn, and Fail relays are not affected by the underrange alarm. The underrange condition clears automatically when the detector output returns within the normal range. There is no relay associated with the UNDERRANGE alarm.

The OVERRANGE is true when the dose rate is greater than or equal to the overrange set point or the Model 897A preamplifier is sending an output pulse greater than the UDR electronics Anti-Jam circuit setpoint. The condition is false when neither of the conditions are true.

When the OVERRANGE alarm is active, WARN and HIGH alarms are true, the red RANGE indicator illuminates, the bargraph illuminates red, the analog output reads full scale, and the display reads EEEEE. The OVERRANGE alarm setpoint is operator adjustable.

The OVERRANGE alarm must be reset by pressing the acknowledge pushbutton when the overrange condition is false (i.e. radiation level returns to a value below the overrange setpoint). The OVERRANGE alarm will not reset automatically, at a later time, after the acknowledge pushbutton is pressed as it does for the HIGH and WARN alarms.

If auto reset is selected for HIGH and WARN alarms, these will reset automatically, but the overrange display will remain until the acknowledge pushbutton is pressed. In addition, if the detector output is above the electronic anti-jam circuit threshold, the anti-jam circuit will be activated, opening the anti-jam fuse on the UDR. This causes the fail relay to change state, indicating a non-operational mode. To return to normal operation, the 956A UDR must be powered off, and the anti-jam fuse replaced.

FAIL Alarms

Several equipment failure conditions are monitored which produce a FAIL alarm and in some cases an error message. The fail condition is "true" whenever any equipment failure is detected and "false" when no equipment failures are detected. When a fail condition occurs, other than power failure, the red FAIL alarm indicator illuminates and the fail relay coil de-energizes.

The FAIL alarm logic is always fail-safe, auto reset.

The following are the fail alarms included in the 956A-201 UDR:

1. NO COUNT Failure
2. POWER Failure
3. MPU Failure (hardware)
4. Anti-Jam Trip

No Count Failure

If no pulses are received by the UDR for five minutes, a no count failure is detected. A no count alarm usually indicates a failure in the detector or UDR detector high voltage supply. The UDR display, however, may read zero for five minutes or more without a low signal fail alarm. This is because the preamplifier is reporting a non-zero dose rate that is below the low range value. The No Count failure alarm can be disabled by removing jumper JP3-4 from the UDR main board.

Power Failure

If power is lost to the UDR, the bargraph, alarm indicators, and the display are blanked (turned off). The HIGH, WARN, and FAIL relay coils de-energize.

MPU Failure

If the fail timer circuit, which checks the MPU (main processor) function, is allowed to time out (because of a hardware failure), a failure condition will be indicated.

Anti-Jam Trip

Should the detector output exceed the UDR anti-jam circuit threshold, the anti-jam fuse opens and the fail logic will illuminate the FAIL LED, and de-energize the Fail relay.

Power Up Procedure

To place the system in operation, the following steps should be performed:

1. Verify that the UDR configuration jumpers are properly selected. Refer to **"Configuration Functions"** for addition information if required.

2. Verify that the UDR Function switch, located on the front right section of the UDR main board, is in a position other than 8.

3. Verify that the detector and UDR are properly connected.

4. Apply power to the system. If all connections are good, the UDR will power up and will begin to monitor the ambient radiation level.

NOTE

The appearance of error codes E0002 or E0008 may indicate that the setpoint memory has not been initialized. To initialize the set point memory to the default values, power-up the UDR with the ENTER button held down. (The UDR must be pulled out from its mounting to access the ENTER button).

5. Detector dependent setpoints (i.e. analog output High/Low scale values, range, underrange, overrange, calibration constant, detector deadtime) and channel dependent setpoints, (i.e. as alarm limits), may be entered using the procedure described in this section. The UDR contains default values for all setpoints to permit power-up prior to user defined values being entered.

NOTE

Ensure the setpoints entered are within the normal range of expected operation before entry, or spurious alarms may be generated.

6. Electronic adjustments affecting calibration are factory set and should not be readjusted for initial operation unless the UDR has been in storage for more than one year. If the unit has been in storage for more than one year, the electronic calibration described in Section 5 should be performed.

How to Enter Setpoints

Available setpoints are listed in Table 4-4. The setpoints are accessed using the Function switch, the Digit button, the Value button, and the Enter button. These are located on the main printed circuit board of the UDR. The UDR must be pulled about halfway out of its rack chassis in order to access them. The buttons are on the right side of the main board about two inches behind the front panel. The function switch is on the right side directly in front of the power supply.

To display a setpoint, rotate the function switch to one of the positions shown in Table 4-4 and press the ENTER button. The setpoint will be displayed in exponential format with the left-most digit flashing. Pressing the ENTER button again enters whatever is displayed into the non-volatile set point memory.

To change a setpoint, the DIGIT button is pressed and released until the digit to be changed is flashing. Then the VALUE button is pressed and released until the desired value appears. This process is repeated for all digits to be changed. The sign of the exponent can assume the values "E" or "-". The former represents a positive power of 10 and the latter represents a negative power.

When all digits and the exponent have been changed to their desired values, the ENTER button is pushed to enter the new value into memory. Setpoint entries not accepted by the UDR are indicated by the error code E0002 being displayed.

Refer to **"Table 4-3"** for function switch setpoint descriptions.

Configuration Functions

The UDR contains a series of eleven hardware jumpers and nine user specified set points which affect operation of the unit.

The jumpers are designated as JP1 and JP2, JP3-1 through JP3-5, and JP4 through JP7. Refer to the main circuit board assembly drawing located in Appendix B of this manual for jumper locations. The functions affected by JP1 through JP7 are described in the following paragraphs and shown in Table 4-2.

NOTE
The unit must be turned off when changing jumpers.

Microprocessor Reset

Jumper JP1 permits local reset of the microprocessor without cycling AC power.

PROM Type

Jumper JP2 must be installed in position 2-3 for use with the 27256 PROM installed.

Count Time Selection (Statistical Accuracy)

The user can specify the statistical accuracy of the displayed radiation value with the use of JP3-1 & JP3-2. This statistical accuracy selection affects count time and consequently, the update time of the display. Refer to Table 4-2 for additional information. The unit is normally shipped from the factory with both JP3-1 and JP3-2 installed

Alarm Reset (Acknowledge)

1. JP3-3 OUT - The unit resets alarm indicators and alarm relays after the radiation value falls below the set point without regard to the alarm acknowledge pushbutton.
2. JP3-3 IN - The unit maintains the alarm indicators and alarm relays in the alarm state until the alarm acknowledge pushbutton has been pressed and the radiation value falls below the set point. If the alarm acknowledge pushbutton is pressed while the radiation value is still above the set point, the flashing indicator will go to a steady state ON condition.

   The UDR is normally shipped from the factory with JP3-3 installed.

No Counts Fail Alarm

1. JP3-4 IN - The unit will go into a FAIL mode after five minutes with no counts from the detector.
2. JP3-4 OUT - The unit will not go into a FAIL mode when there are no counts from the detector.

   The UDR is normally shipped from the factory with JP3-4 installed.

Inhibit Alarms (Check Source Operation)

1. JP3-5 OUT - The alarms will become active during check source operation if alarm limits are exceeded.
2. JP3-5 IN - Alarms are inhibited during check source operation, but if the unit is in an alarm condition when the check source is activated, it will remain in the alarm condition.

   The UDR is normally shipped from the factory with JP3-5 in.

Input Pulse Selection

Jumper JP4 is set to position 2-3 for GM detector inputs. Position 1-2 is provided for use with other detectors.

Input Shield Polarity

Jumper JP5 is set to position 2-3 for GM detector inputs. Position 1-2 is provided for use with other detectors.

Anti-Jam Selection

Jumper JP6 is normally installed in position 1-2. Position 2-3 bypasses the anti-jam fuse for test purposes.

Detector Type

Jumper JP7 is set to position 2-3 for a GM detector input. Position 1-2 is provided for use with a scintillation detector. Removing the Jumper disables the anti-jam circuit for test purposes.

Jumper Selectable Options

NOTE
The unit must be turned off when changing jumpers.

Table 4-2. Model 956A-201 Option Jumpers

Jumper	Function	Position	Operation
JP1	Microprocessor Reset	Out IN	Normal Operation (factory) Momentary connect to reset microprocessor without cycling AC power Not Applicable
JP2	PROM Type	1-2 2-3	PROM 27128 PROM 27256 (factory)
JP3-1/JP3-2	Statistical Accuracy (Note this accuracy refers only to the statistical interpretation of detector counts, and not detector accuracy)	Out / Out Out / In In / Out In / In	2% Accuracy - 9604 Target Counts 5% Accuracy - 1537 Target Counts 10% Accuracy - 384 Target Counts Fixed one second display update (factory)
JP3-3	Alarm Acknowledge	In Out	Manual Acknowledge (factory) Automatic
JP3-4	Fail Alarm	In Out	Enable No Counts Fail Alarm (factory) Inhibit No Counts Fail Alarm
JP3-5	Check Source Alarm	In Out	Alarm Inhibited (factory) Alarm Enabled
JP4	Input Pulse Selection	1-2 2-3	Negative Input Pulse (Other Detectors) Positive Input Pulse (GM Detectors) (factory)
JP5	Shield Polarity Selection	1-2 2-3	Shield for Negative Pulse Shield for Positive Pulse (GM) (factory)
JP-6	Anti-Jam Fuse Selection	1-2 2-3	Enable for Normal Operation (factory) Anti-Jam Circuit fuse bypassed (testing)
JP7	Detector Type for Anti-Jam Circuit Timing	1-2 2-3 Out	Scintillation GM Tube (factory) Anti-Jam Circuit Disabled (for testing only)

UDR Function Switch / Function

Table 4-3 shows the UDR Function Switch positions and the function.

Table 4-3. UDR Function Switch Positions/Function

Switch Position	Function
0	Selects HIGH Alarm Setpoint
1	Selects WARN Alarm Setpoint
2	Selects Resolving Time Detector Dead Time
3	Selects Analog Full Scale Limit
4	Selects Overrange Limit
5	Selects Conversion Constant
6	(Not Used)
7	Selects Analog Low Scale
8	Selects Calibrate Mode
9	Selects Underrange Value

Parameter Entry

Parameter entry is accomplished using an sixteen position rotary switch labeled FUNCTION and three momentary pushbutton switches labeled ENTER, VALUE, and DIGIT. These switches are located on the right side of the main circuit board and are accessible by partially removing the unit from it's mounting case.

The FUNCTION switch is used to select the parameter to be entered. Table 4-4 defines the switch positions and a description of each parameter can be found in the following paragraphs.

Table 4-4. Function Switch Entry Parameters

Switch Position	Set Point	Units	Detector 897A-21X	Detector 897A-22X	Detector 897A-23X	Default Value
0	High Alarm Limit	mR/h	**	**	**	1.00E3
1	Warn Alarm Limit	mR/h	**	**	**	1.00E1
2	Resolving Time (Dead Time)	minutes	*	*	*	0.00E0
3	Analog Full Scale Value	mR/h	1.00E3	1.00E4	1.00E5	1.00E4
4	Overrange Limit	mR/h	1.00E3	1.00E4	1.00E5	1.00E4
5	Conversion Constant	mR/h / CPM	*	*	*	1.00E0
6	Not Used	N/A	Not Used	Not Used	Not Used	Not Used
7	Analog Low Scale Value	mR/h	1.00E-2	1.00E-1	1.00E0	1.00E-1
8	Calibration Mode/Time	seconds	**	**	**	6.00E1
9	Underrange Limit	mR/h	1.00E-2	1.00E-1	1.00E0	1.00E-1
A through F	Not Used	-	-	-	-	-

* Detector unique, provided with the detector/detector calibration sheet.
** User Selected (detector range dependent).

To enter a parameter, the FUNCTION switch is set to the desired position and the following steps are performed:

NOTE

In the event it is necessary to re-enter all of the default setpoints, the UDR EPROM memory may be reinitialized by turning the UDR power off, then depressing the ENTER pushbutton at the same time the power on switch is depressed. Releasing the ENTER pushbutton and momentarily depressing the ENTER pushbutton again to exit the setpoint entry mode and return to normal operation.

1. Press the ENTER pushbutton. The current value of the parameter, selected by the FUNCTION switch will be displayed on the front panel. The leftmost digit of the value will be flashing. The value is displayed in the format shown below.

   M.MMEN

   This format expresses the form of M.MM x EN, where M is a whole number from 0 to 9, E designates a positive exponent, and N represents the exponent value from 0 to 9. A negative exponent is expressed as a minus (-) character in the E position.

2. The value of the flashing digit can be incremented by pressing the VALUE pushbutton.
3. The flashing digit can be moved one place to the right by pressing the DIGIT pushbutton.
4. When the desired value has been entered into the display, pressing the ENTER pushbutton causes the displayed value to be entered into memory for permanent storage. The new parameter value is now effective.

Setpoint Descriptions

High Alarm Limit, Setpoint 0

This setpoint is entered in units of mR/h in the exponential format X.XXEN. The high alarm limit set point can be set to any value desired. When the display value exceeds this limit, the UDR will go into a HIGH alarm state. The HIGH alarm limit must be greater than or equal to the WARN alarm and the underrange limit. It must be less than or equal to the overrange limit.

Warn Alarm Limit, Setpoint 1

This setpoint is entered in units of mR/h in the exponential format X.XXEN. The warn alarm limit set point can be set to any value desired, but must be lower than the high alarm limit set point. When the displayed value exceeds this limit, the UDR will go into a WARN alarm state. The WARN alarm limit must be greater than or equal to the low scale value and less than or equal to the HIGH alarm limit.

Resolving Time (Dead Time), Setpoint 2

This setpoint is entered in units of minutes per count. The actual value to be entered is a function of the individual detector and is stated on the calibration data sheet supplied with the detector. If a complete system is purchased (i.e. 955A-100), this setpoint is entered at the factory.

Analog Full Scale Value, Setpoint 3

This value is the dose rate at which the analog output is set to full scale (i.e. 10 volts or 20 mA). This value must be an even power of 10 that is at least 1 decade higher than the analog low scale value. An even power of 10 is a number of the form 1.00EX, where E indicates a positive exponent, a (-) sign indicates a negative exponent, and X equals 9. This parameter is entered in units of mR/h and sets the upper value of the analog outputs. This value must be set to exact decade values. Example: 1.00E4 is acceptable, 2.00E4 is not.

Overrange, Setpoint 4

This setpoint is entered in units of mR/h. It is normally set for the upper limit value of the detector used (for the 897A-210 it is 1.00E3, for the 897A-220 it is 1.00E4, and for the 897A-230 it is 1.00E5). When the measured radiation value exceeds this set point, the unit goes into a range alarm state. The overrange limit must be greater than or equal to the HIGH or WARN setpoints.

Conversion Constant, Setpoint 5

This setpoint is a detector dependent value which is used to convert the detector output, counts per minute (CPM) to mR/h. The actual value to be entered is stated on the detector calibration data sheet. The units are mR/h per counts per minute. If a complete system is purchased (i.e. 955A-100), this setpoint is entered at the factory.

Analog Low Scale Value, Setpoint 6

This value is the dose rate at which the analog output is set to low scale (i.e. 0 volt or 4 mA). This value must be an even power of 10 that is at least 1 decade lower than the analog full scale value. An even power of 10 is a number of the form 1.00EX, where X equals -9 to +9. This parameter is entered in units of mR/h and sets the lower range of the analog outputs. This value must be set to exact decade values. Example: 1.00E-1 is acceptable, 2.00E-1 is not.

Calibrate Mode, Setpoint 8

This function permits use of the UDR as a scaler, by entering a fixed counting time, and displaying the integrated counts during this period. The units are entered in seconds.

Underrange Limit, Setpoint 9

This setpoint is normally set to the low range limit of the detector used, and is entered in mR/h. The underrange limit must be less than or equal to the HIGH and WARN limits. Note the radiation display will be 0.00 for dose rates under the underrange limit. When the measured radiation value is less than this value, the unit goes into a RANGE alarm state.

Set Point Error Codes

If, after entering a setpoint or upon power-up, an error code is displayed, it may be due to incorrect setpoints. If error code **E0002** or **E0008** is displayed, all alarms are inhibited. Refer to Table 4-5 for a listing of error codes.

Code **E0001** indicates that the display value is negative. Usually this means that the setpoint PROM is bad or needs to be initialized. To initialize the setpoint memory to the default values, power up the UDR with the ENTER button held down. If initializing the setpoint memory does not help, then the setpoint PROM is defective or there is a hardware malfunction.

Code **E0002** indicates that a setpoint entry error has occurred (e.g. High alarm setpoint is set above the overrange value). All setpoints should be checked for agreement with the setpoint descriptions.

The appearance of either code may also indicate that the setpoint memory has not been initialized. Refer to code **E0001** above.

Code **E0007** indicates that the specific function is not implemented, and that no setpoint may be entered.

Code **E0008** indicates that the analog output setpoints are invalid.

Code **EEEEE** indicates that the monitored radiation field is greater than the maximum range of the detector.

Error codes are cleared automatically when the initiating event is corrected.

Table 4-5. Model 956A-201 Error Codes

Error Codes	Function
E0001	Negative display data
E0002	Invalid setpoint value (s)
E0007	Invalid Function
E0008	Invalid analog scale values
EEEEE	Overrange Condition

Analog Output

The analog outputs are a logarithmic function of the current UDR reading. The outputs are scaled by the Full Scale Value and Low Scale Value, positions 3 and 7 respectively of the FUNCTION switch. An 8 bit DAC is used to convert the displayed dose rate to a 4-20 mA or 0-10 Vdc output on connector P6 (on the rear panel). Output current or voltage is calculated using the following equations (shown below):

$$P = \log (R/LSV) / [\log (FSV) - \log (LSV)]$$

and

$$V = P (VMax - VMin) + VMin \quad \text{or} \quad I = P (IMax - IMin) + IMin$$

where:

- P = Percent of scale, expressed in a decimal number
- R = Current reading
- LSV = Low Scale Value
- FSV = Full Scale Value
- V = Voltage output
- I = Current output
- VMax = Maximum voltage available (usually 10Vdc)
- IMax = Maximum current available (usually 20 mA)
- VMin = Minimum voltage available (usually 0 Vdc)
- IMin = Minimum current available (usually 4 mA)

If the current reading (R) is greater than the full scale value (FSV) the output is limited to the MAX. value (typically 10 Vdc or 20 mA).

As an example:

Assume: LSV = 1E-1, FSV = 1E7, R = 1E3, IMax = 20 mA, and IMin = 4 mA.

Then: $P = [\log (1E3/1E-1)] / [\log (1E7) - \log (1E-1)]$

$= \log (1E4) / \log (1E8)$

$= 4/8 = 0.5$

and: $I = 0.5 (20 \text{ mA} - 4 \text{ mA}) + 4 \text{ mA}$

$= 0.5 (16 \text{ mA}) + 4 \text{ mA}$

$= 12 \text{ mA}$

To aid in calibrating the analog output, the high scale or low scale setpoint may be set to force the output high or low. If the low scale setpoint is set above the displayed value, the analog output goes to low scale. If the high scale value is set below the displayed value, the analog output goes to full scale. Error code **E0008** will be displayed if either setpoint is set to zero. The procedure for calibrating the analog outputs is contained in Section 5.

Software Calculations

The 956A-201 UDR requires setpoints to be entered which are inherent to each particular detector. The following explains the calibration constant and resolving time.

Conversion Constant

The first of these set points is the conversion constant. The conversion constant converts the detector pulse rate into an mR/h value, using the following equation:

$$D = (CPM \times K) - BKG$$

Where: D = the calculated value in mR/h (used for alarm setpoint limit checks)
CPM = the current, true, count rate in CPM (the sum of the 60 most recent 1 second values, corrected for Tau)
K = the conversion constant in mR/h/CPM
BKG = 0 (not used)

The value of K is supplied on the detector calibration data sheet.

Resolving Time (Dead Time)

This constant is a correction for the resolving time of the detector. As the radiation field that the detector is viewing increases, the detector cannot count every pulse, because some are in coincidence or are so close together that two pulses may look like one. To correct for this nonlinearity, the resolving time is corrected for by the following equation:

$$CPM = \frac{Ro}{1 - (Ro \times \text{Dead Time})}$$

Where: CPM = the true count rate
Ro = the observed count rate *(the sum of the 60 most recent 1 second values)*
Dead Time = the resolving time in minutes / count

The value of Dead Time is supplied with the detector and is found on the detector calibration data sheet. This value identified as TAU on the data sheet.

FUNCTIONAL DESCRIPTION

Functional Description

The 955A-XXYYZZ consists of a Model 897A-2XX Detector, a Model 956A-201 Digital Readout, and an interconnecting cable. Optional local analog display and audible/visual alarm units may also be provided. The following describes the Model 897A-2XX and the Model 956A-201. Separate manuals are provided for the Model 958A Local Alarm Units.

897A Series Detector

Functionally, the detector is divided into the GM tube and the preamplifier. The high voltage power supply for the detector is located in the 956A-201 Universal Digital Ratemeter. The block diagram for the 897A series Detectors is shown in figure 4-1. For additional information, refer to the applicable drawings located in Appendix B. The following versions of the Model 897A detector are available:

Model Number	Range	Material
897A-210	0.01 to 1.00E3 mR/h	Carbon Steel Housing
897A-211	0.01 to 1.00E3 mR/h	Stainless Steel Housing
897A-220	0.10 to 1.00E4 mR/h	Carbon Steel Housing
897A-221	0.10 to 1.00E4 mR/h	Stainless Steel Housing
897A-230	1.00 to 1.00E5 mR/h	Carbon Steel Housing
897A-231	1.00 to 1.00E5 mR/h	Stainless Steel Housing

The 897A series detector is a thin walled, electronic tube composed of a negative electrode (cathode) and a positive electrode (anode). The tube is filled with a mixture of one or more noble gases, plus a small amount of an additional gas which acts as a quenching agent.

Circuit Description

Quad comparator Z1 consists of two circuit configurations with four states. Three of the four states are comparators (Z1A is an input comparator, Z1B is an output comparator, and Z1C is an anti-jam comparator). The fourth state, Z1D, is an oscillator for the anti-jam circuitry. Transistors Q3 and Q4, with associated circuitry, provide a divide by 2 function, for use with Victoreen analog and digital area monitor readouts.

When ionizing radiation is not present at the GM detector, the input level of Z1A (pin 9) is higher in potential than the voltage level at pin 8. Using discriminator bias control R44, the amount of potential difference can be adjusted between these inputs, allowing input pulse discrimination. Under the above condition, the output of Z1A is in a high state. R23, R20, and R30 create a voltage divider which biases pin 7 of Z1B to 7.5 Vdc. R24 and R36 bias pin 6 to 5 Vdc, causing the output of Z1B to go high. This action allows Q1 to conduct, causing a low state to exist at the output.

When an ionizing event occurs, the GM tube produces a negative pulse which is coupled through C10 to input comparator Z1A. Pin 9 is now at a lower voltage potential than pin 8, forcing the output of Z1A to a low state. The voltage at pin 7 of Z1B is reduced to 2.5 Vdc, causing a low output state. This action causes Q2 to conduct, presenting a +10 Vdc signal at the output (unterminated).

If saturation occurs, the detector provides a high dc current. The current flows through R25, inducing a voltage at pin 11 of Z1C. When the potential at Z1C is higher than the anti-jam set point (R41), the output is forced from a low state (normal operating condition) to a high state. Two events occur when a saturation condition exists:

1. Q5, normally off, enters saturation, clamping the output of Z1A to a low state. The potential at pin 5 of Z1D is reduced to 2.5 Vdc.

2. CR6 is reverse biased, enabling anti-jam oscillator Z1D. A square wave pulse is produced at pin 6 of Z1B which has an amplitude that is approximately 5.0 Vdc. Since pin 7 was previously biased to 2.5 Vdc, an output anti-jam square wave signal is generated and coupled to the readout.

The low voltage power supply input for the preamplifier is jumper selectable. This allows the use of either a +10 Vdc or +15 Vdc supply for detector power. If the detector is used in a 955A system, the +15 Vdc position is used. If the detector is used in a 855 analog area monitoring system, the +10 Vdc position is used. Jumper configurations are listed below.

Jumper	Position	Input Voltage
J3	AB	+15 Vdc (factory set), digital readout
J3	BC	+10 Vdc, analog readout

The divide by 2 (or binary stage) converts the GM tube pulse output into a pure square wave, at a frequency exactly one half of the value of the input pulse frequency. This circuit provides more reliable signal transmission to the readout electronics. The output pulse conditioning is required for use with the diode pump circuitry used on older analog readouts. The optional jumper position, to use the detector pulse directly (divide by 1), is provided for use with high speed pulse counting scalers. Jumper configurations are listed in below.

Jumper	Position	Divide Option
J1, J2	AB	2, square wave output (factory set)
J1, J2	BC	1, Direct coupled

Anti-Jam Setpoint

Adjustment of the anti-jam setpoint (R41) is performed during factory calibration. If replacement of the GM tube is required, the detector should be returned to the factory for proper determination of the anti-jam setpoint voltage, the dead time correction, and the count conversion factor.

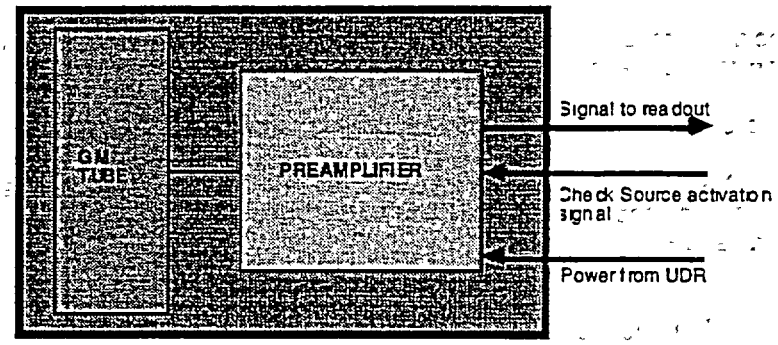


Figure 4-1. 897A Series Detector Block Diagram

Low Level Discriminator

In order to reduce electronic noise and the counting of spurious signals, an adjustable low level discriminator circuit is provided. The discriminator is factory set at 0.5 Volt. R44 is used to adjust this value.

Check Source Operation

The check source is provided to ensure that the GM tube and the preamplifier are functional. The check source consists of a 8 microcurie ^{36}Cl source attached to a D'Arsonoval meter movement. Upon actuation of the Check Source function, +15 VDC is applied to the meter movement. This causes the check source pan to move over the access hole in the printed circuit board, exposing the source to the detector. The GM tube then responds to the radioactivity present, resulting in an increase in the UDR display. Releasing the check source pushbutton applies + 15 VDC to the meter movement, moving the check source to its de-activation, or rest position.

Universal Digital Ratemeter (UDR), Model 956A-201

The Model 956A-201 UDR is composed of five (5) circuit board assemblies mounted within the unit. These circuit boards provide input/output, display, power, and control for the UDR. Each circuit board is described in detail in the following sections and accompanied by a block diagram where applicable. Schematic diagrams are located in Appendix B. Figure 4-2 is the system block diagram.

Main Circuit Board

The main circuit board contains the microprocessor, memory, analog output, signal input, and control circuitry. Some of the circuitry located on the circuit board may not be installed depending on the model. The following paragraphs explain the operation of the circuits in detail. Figure 4-3 is a block diagram of the main circuit board.

Microprocessor

The 6802 /6808 (U15) is a monolithic 8 bit microprocessor with 16 bit memory addressing. The 6802 / 6808 contains a crystal controlled internal clock oscillator and driver circuitry.

A 4 MHz crystal is utilized with the internal clock circuitry to obtain 1 MHz operation. The (E) enable pin on the MPU supplies the clock for both the MPU and the rest of the system. Figure 4-4 is a typical timing diagram for write and read cycles.

The read/write output signals the memory / peripherals that the MPU is in a read (high) state or a write (low) state. The normal standby state is read (high).

The valid memory address (VMA) output indicates to peripheral and memory devices that there is a valid address on the address bus.

The address bus outputs (A0 - A15) provide for addressing of external devices.

The data bus (D0 - D7) is bi-directional and is used for transferring data between the MPU and memory/peripheral devices. The data bus will be in the output mode for a write cycle and in the input mode for a read cycle.

The Interrupt Request Input (IRQ), when low, requests that an interrupt sequence be generated within the MPU. The processor will wait until it completes the current instruction that is being executed before it recognizes the request. Various internal registers are stored on the stack before a branch to the interrupt vector is carried out. When the interrupt routine has completed, the registers are restored and the MPU continues to execute the program. The IRQ input is not utilized on the main circuit board, however, it is provided to the external bus connector to be used by IRQ generating devices located on the option boards.

The reset input (active low) is used to restart the MPU from a power down condition, (restart from a power failure or an initial start-up). A low to high transition on this input signals the MPU to begin the restart sequence.

The nonmaskable interrupt (NMI) input, upon detection of a low-going edge, requests that a nonmaskable interrupt sequence is generated within the MPU. As with the interrupt request signal, the processor will complete the current instruction being executed before it recognizes the NMI signal. Various internal registers are stored on the stack before a branch to the NMI vector occurs. Upon completion of the NMI routine, the internal registers are restored and program execution continues.

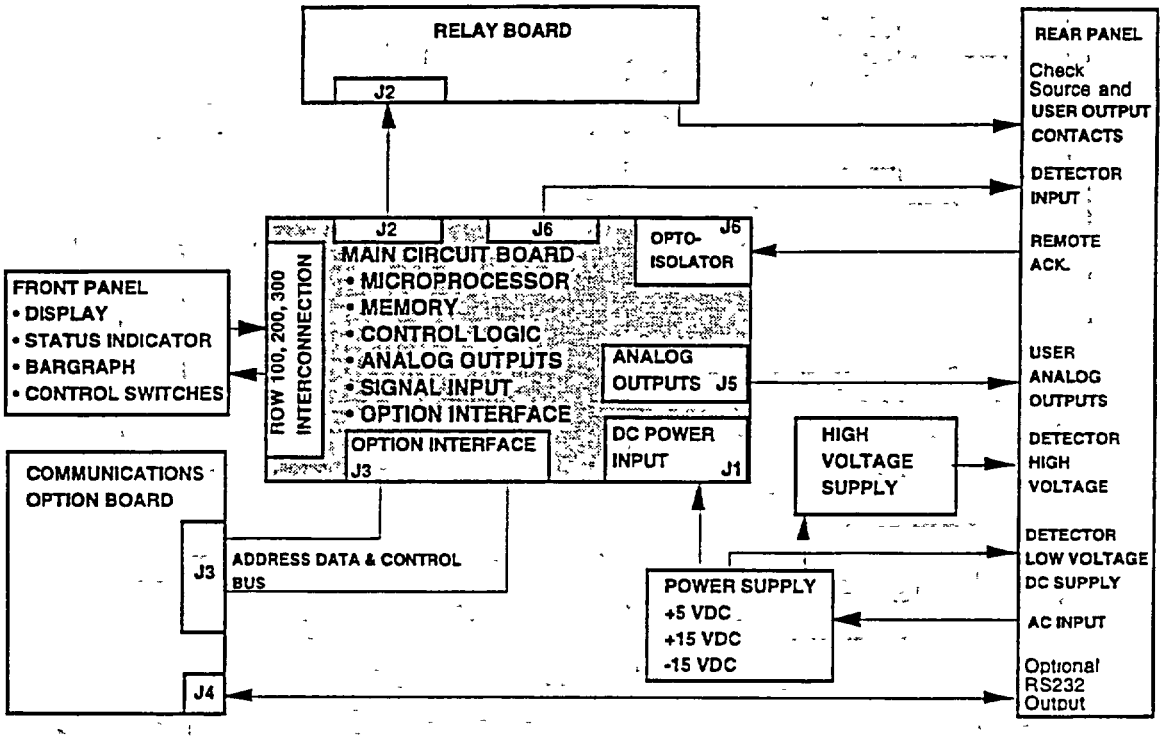


Figure 4-2. System Block Diagram

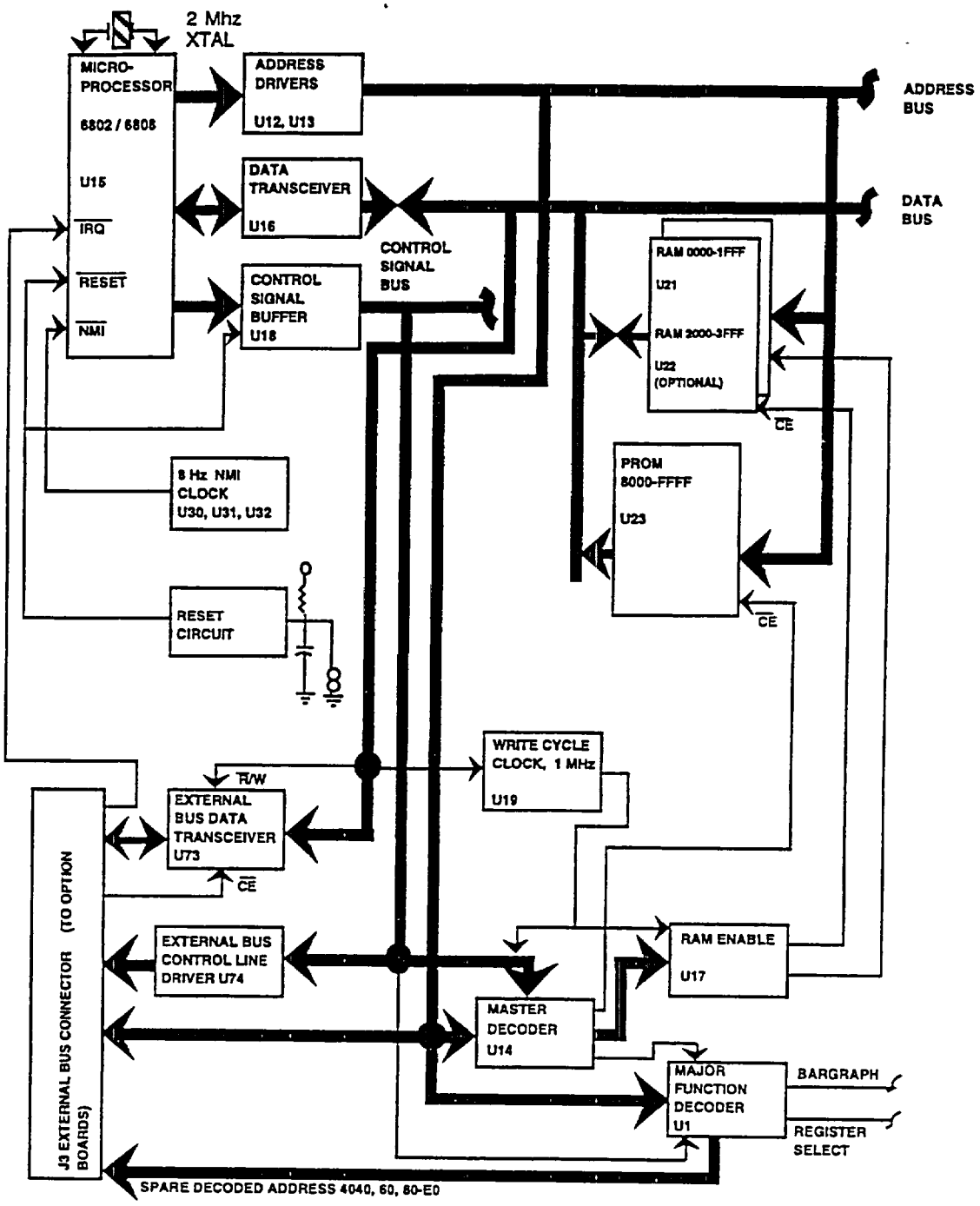


Figure 4-3. Page 1 of 3. Block Diagram - Main Circuit Board

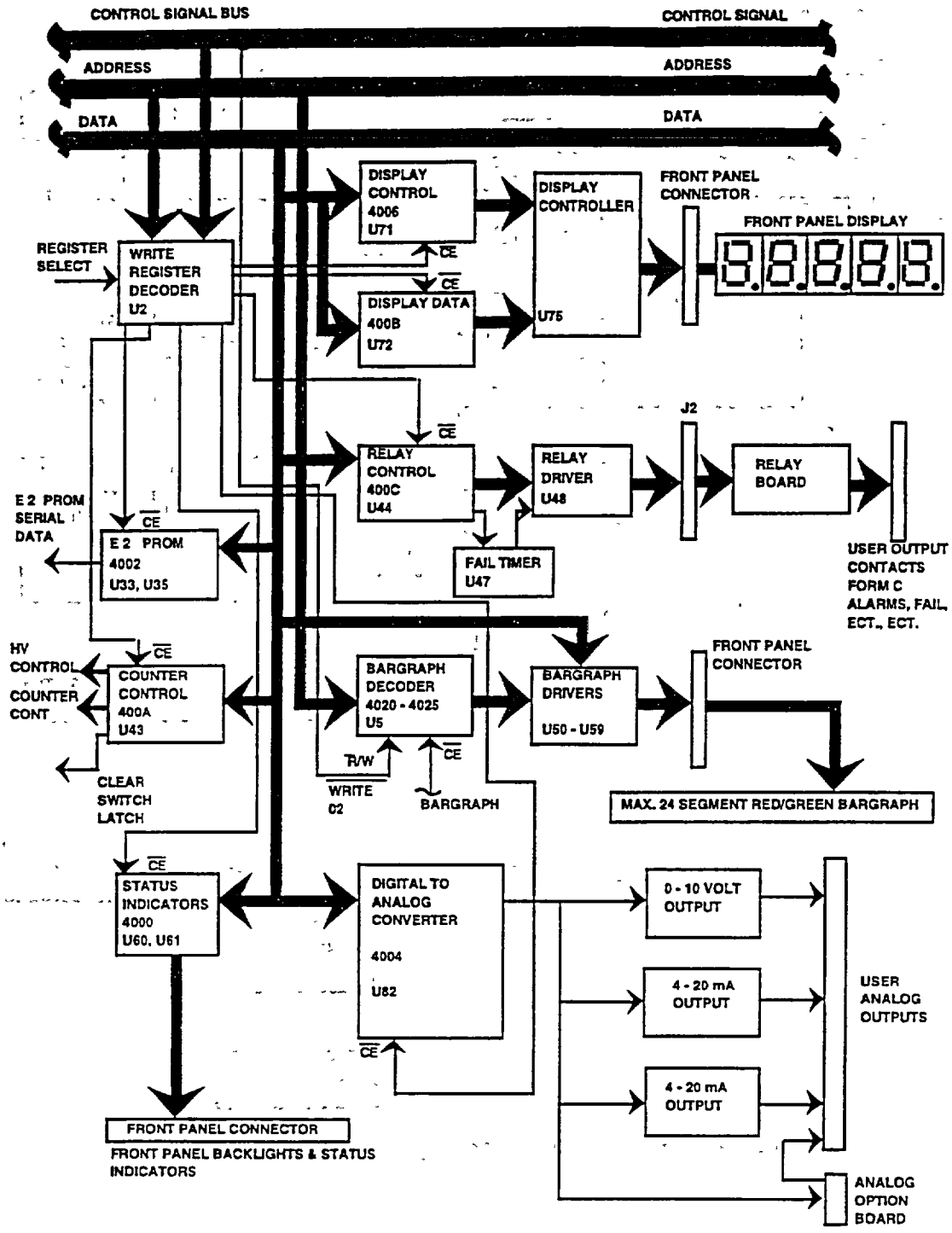


Figure 4-3. Page 2 of 3. Block Diagram - Main Circuit Board

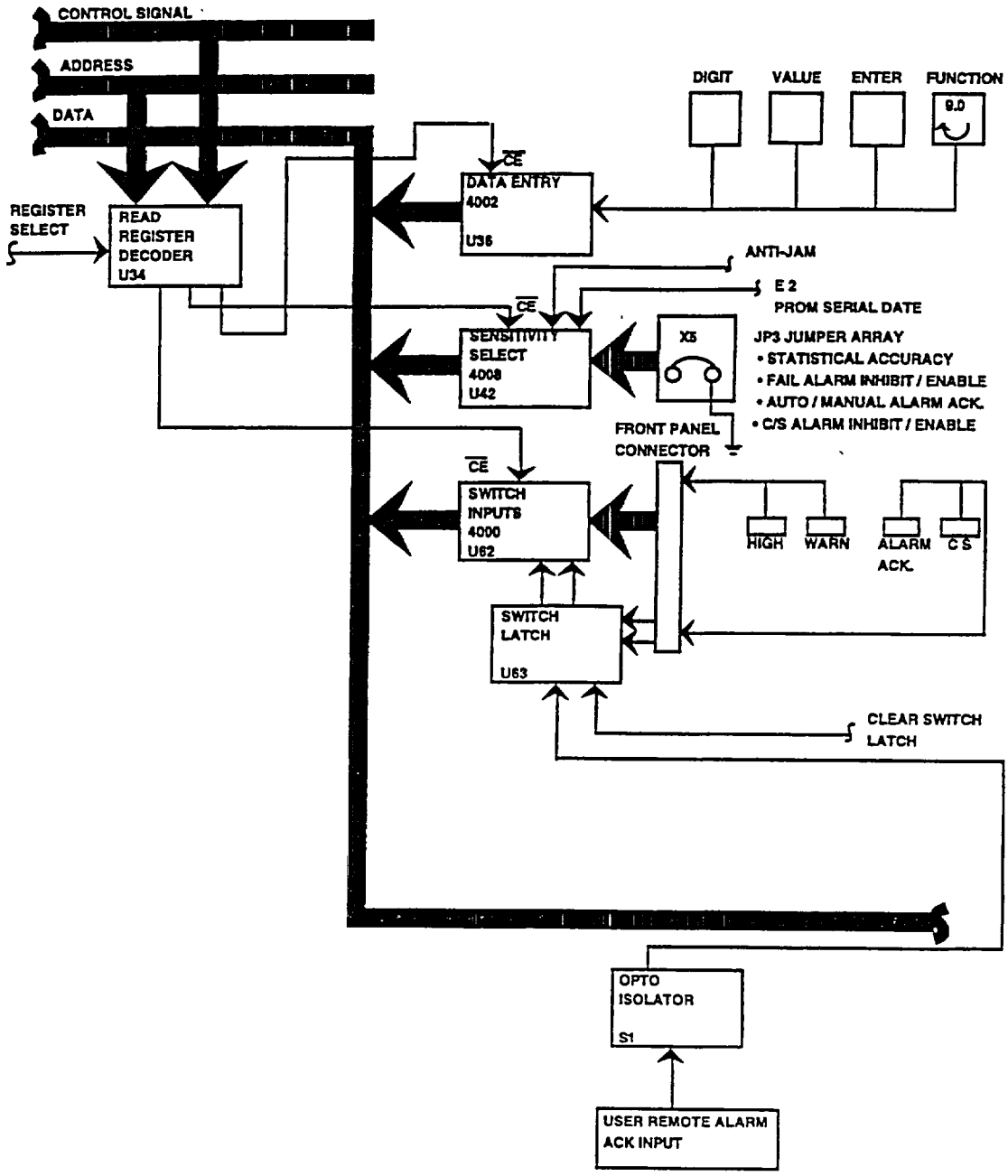
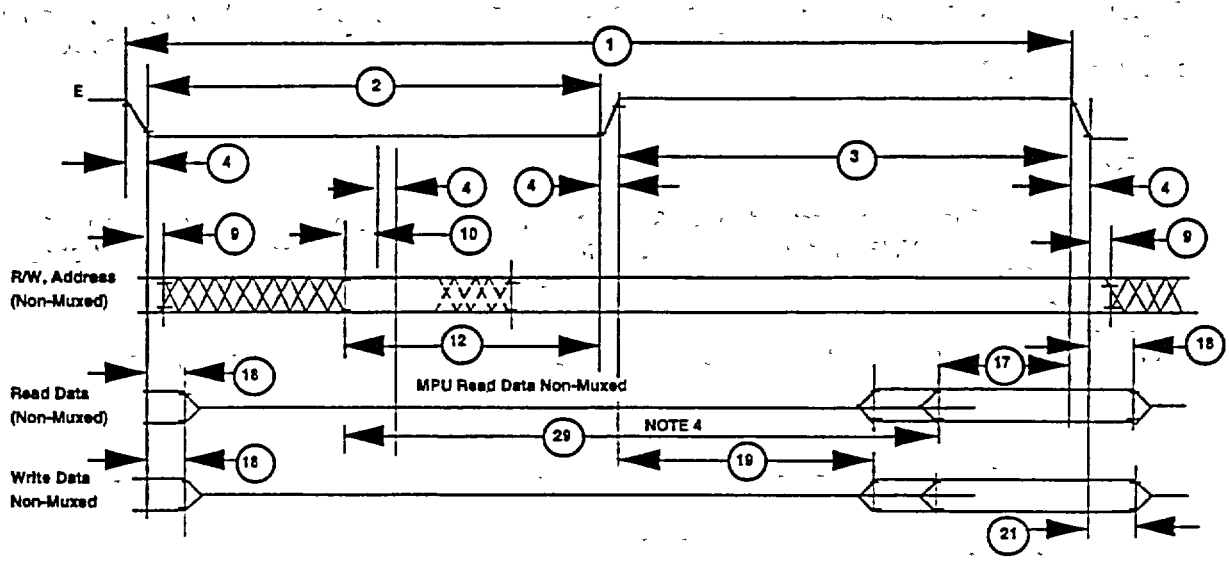


Figure 4-3. Page 3 of 3. Block Diagram - Main Circuit Board

Bus Timing Characteristics

Ident. Number	Characteristics	Symbol	MC6802NS MC6802 MC6808		MC68A02 MC68A08		MC68B02 MC68B08		UNIT
			Min.	Max.	Min.	Max.	Min.	Max.	
1	Cycle Time	t_{cyc}	1.0	10	0.667	10	0.5	10	µs
2	Pulse Width, E Low	PW_{EL}	450	5000	280	5000	210	5000	ns
3	Pulse Width, E High	PW_{EH}	450	9500	280	9700	220	9700	ns
4	Clock Rise and Fall Time	t_r, t_f	---	25	---	25	---	20	ns
9	Address Hold Time	t_{AH}	20	---	20	---	20	---	ns
12	Non-Muxed Address Valid Time to E (See Note 5)	t_{AV1} t_{AV2}	160 ---	--- 270	100 ---	--- ---	50 ---	--- ---	ns ns
17	Read Data Setup Time	t_{DSR}	100	---	70	---	60	---	ns
18	Read Data Hold Time	t_{DHR}	10	---	10	---	10	---	ns
19	Write Data Delay Time	t_{DDW}	---	225	---	170	---	160	ns
21	Write Data Hold Time	t_{DHW}	30	---	20	---	20	---	ns
29	Usable Access Time (See Note 4)	t_{ACC}	605	---	310	---	235	---	ns



NOTES.

1. Voltage levels shown are $V_L \leq 0.4$ V, $V_H \geq 2.4$ V, unless otherwise specified.
2. Measurement points shown are 0.8 V and 2.0 V, unless otherwise noted.
3. All electrical shown for the MC6802 apply to the MC6802NS and MC6808, unless otherwise noted.
4. Usable access time is computed by: 12 + 3 + 4 - 17.
5. If programs are not executed from on-board RAM, TAV1 applies. If programs are to be stored and executed from on-board RAM, TAV2 applies. For normal data storage in the on-board RAM, this extended delay does not apply. Programs cannot be executed from on-board RAM when using A and B parts (MC68A02, MC68A08, MC68B02, MC68B08) On-board RAM can be used for data storage with all parts

Figure 4-4. Read / Write Timing Diagram

Reset Circuitry

The reset circuit generates a 650 ms wide low pulse to the MPU reset input and various external registers. The R1 / C1 network generates a delayed trigger pulse to the U10 multivibrator. Upon power up, C1 charges through R1. When approximately 1.4 volts is reached, U11-8 goes low, triggering U10. U10-4 goes low, U10-13 goes high; this condition is held for 650 ms. When U10's delay is complete, U10-4 returns high and U10-13 returns low. The low to high transition on U10-4 signals the MPU to begin a reset sequence. JP1 - Reset Pins, on the circuit board, may be shorted to initiate an MPU reset for troubleshooting purposes.

Clocks

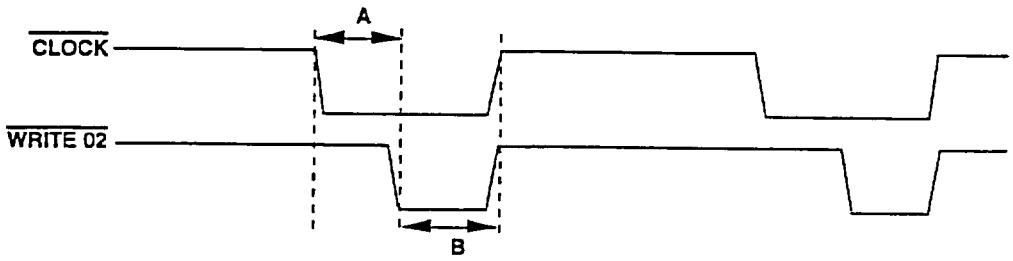
The system clock is generated by the MPU using a 4 MHz crystal, CR1. The system clock, from which others are derived, is an output on the MPU pin 37 and operates at 1 MHz.

NMI Clock

The NMI clock is generated by U30, U31, and U32, which are dual decade counters. The 1 MHz system clock is applied to the U30-1 input. U30 is a divide by 100 counter, while U31 is a divide by 50 counter, with respect to the input frequency. Therefore, U30-9's output is 10 kHz and U31-9's output is 200 Hz. U32 is connected for operation as a divide by 25 counter, which produces an 8 Hz output on U32-9.

Write Cycle Clock

The Write Cycle Clock is generated by U19. The 1 MHz system clock is applied to the U19-2 input, which is adjusted via VR13 for a -225 ns delay from the falling clock edge. The second stage of U19 produces a 225 ns output pulse width. Figure 4-5 is the timing diagram for the write cycle clock. Signals short 02 and short 02 are buffered by U18 to produce write 02 and write 02 which are used by the system.



A. 225 ns minimum B. 235 ns typical

Figure 4-5. Write Cycle Clock Timing Diagram

Address Drivers

Line drivers U12 (low order addresses) and U13 (high order addresses) provide signal buffering and capability to drive 15 TTL's unit loads for the address bus. The output drives are all internal devices utilizing address signals on the main circuit board as well as the J3 option interface bus connector for additional circuit boards.

Data Transceivers

Data transceiver U16 is an octal tri-state bi-directional transceiver which provides drive capability to the data bus. The MPU data I/O signals are connected to U16 "A" ports. U16 "B" ports drive the data bus under control of the read/write signal. When U16-11 is low, data is transferred from the "B" ports (internal bus) to the "A" ports (MPU data). When U16-11 is high, data is transferred from the "A" ports (MPU data) to the "B" ports (internal bus) during a write cycle.

Data transceiver U73 provides buffer and drive capability to the external data bus interface, available for optional circuit boards on J3. Data direction is controlled by the read/write line on U73-11 providing U73-9 (bus enable) is low, which enables port to port data transfer to occur. The bus enable signal is generated by the option board/boards when they are addressed by the MPU. When U73-11 is low, for a read cycle, data is transferred from the external bus to the internal bus. When U73-11 is high, for a write cycle, data is transferred from the internal bus to the external bus.

Control Signal Buffer

Line driver U18 provides a signal drive for all system control signals and clocks utilized by circuitry within the main circuit board.

Line driver U74 provides the drive for control lines and clock signals for external circuitry utilizing the J3 option interface connector.

Address Decoding

The master decoder (U14) is an open-collector 32 x 8 bit bipolar PROM. Address lines A15, A14, A13, and A12 as well as read/write are used to decode memory and I/O addresses in 4K hex blocks. Table 4-6 lists the output signals from U14.

Table 4-6. Output Signals (U14)

U14 Pin	Signal Name	Address	Read/Write
9	$\overline{\text{PROM 8000}}$	8000-FFFF	Read Only
7	Spare	Spare	
6	$\overline{\text{RAM 2000}}$ *(future)*	2000-3FFF	Read/Write
5	$\overline{\text{RAM 0000}}$	0000-1FFF	Read/Write
4	$\overline{\text{I/O}}$	4000-4FFF	Read/Write
3	$\overline{\text{RAM Write}}$	0000-3FFF	Write Only
2	$\overline{\text{RAM Read}}$	0000-3FFF	Read Only
1	$\overline{\text{5000 Block}}$	5000-5FFF	Read/Write

PROM 8000 directly drives the enable pins of the PROM. RAM 0000, RAM 2000 and RAM Read are logic OR'd with Clock from U17. RAM Read drives the RAM output. Enable pins RAM 0000 and RAM 2000 act as chip enables for the appropriate RAM. RAM Write is logic OR'd with Write 02 by U17, which is connected to the write enable pins on the rams. The 5000 Block output signal is applied to driver U74 and connect to J3, the optional interface connector.

The I/O output signal is applied to major function decoder U1 which is a 1 of 8 decoder. U1 utilizes address lines A5, A6, A7, and A8 as well as Clock to generate outputs which are decoded in 32 hex blocks starting at address 4000. Table 4-7 lists U1 outputs, their functions and addresses.

Table 4-7. U1 Outputs

Address State A8 A7 A6 A5	Address	Function
0 0 0 0	4000	Register Select
0 0 0 1	4020	Bargraph
0 0 1 0	4040	ACIA (Communication Interface, optional)
0 0 1 1	4060	SCA (Analyzer, optional)
0 1 0 0	4080	GPIB (General Purpose Interface Bus)
0 1 0 1	40A0	Analog Input Option
0 1 1 0	40C0	(Spare)
0 1 1 1	40E0	(Spare)

Address 4000 is further decoded by the write register decoder (U2) and the read register decoder (U34). The bargraph output, address 4020, is further decoded by U5. The remaining output address (4040 through 40E0) are provided to the optional interface connector for use by external option circuit boards.

PROM

The Programmable Read Only Memory is typically a 27256 which is a UV erasable 32K x 8 bit PROM. U23, which responds to address 8000-FFFF, is always present. U23 contains the operating program for the UDR (firmware). Jumper JP2 is normally set from 2 - 3. By setting JP2 from 2 - 3, A14 is applied to pin 27 of U23 which allows the use of a 27256 PROM (32K x 8).

RAM

Dynamic Random Access Memory (U21) is utilized for temporary data storage. U21, which responds to address 0000-1FFF (8K x 8 bit), is always present. Data stored in the RAM is lost on power down.

E^2

Sixteen (16) monitor specific, operator entered setpoints are stored in 64 bytes of non-volatile electrically erasable memory (E^2). U33 provides storage for the setpoints (256 bytes max.). U35 is an 8-Bit control register.

Read - Write Cycles

A read cycle is performed by sequencing RAM 0000 and RAM Read, while RAM Write is held high (inactive). The address (A0 - A12) are latched by the failing edge of RAM 0000. Data becomes valid approximately 250 ns later.

A write cycle is performed by sequencing RAM 000 and RAM Write, while holding RAM Read high (inactive). Identical to the read cycle, the address (A0 - A12) are latched by the falling edge of RAM 000. Data is strobed into RAM on the falling edge of RAM Write.

Write Register Decoding

Decoding for write registers within the main circuit board is performed by U2, which is a 1 of 8 decoder. Control signals for U2 are Reg. Select, R/W (active high), Write 02 as well as addresses A1, A2, and A3. U2 decodes two addresses per output, starting at 4000, and ending with 400E. These outputs are active low. Table 4-8 lists write registers, their assigned function and address.

Table 4-8. Write Register Functions

Address State A3	A2	A1	Hex Address	Function
0	0	0	4000	Status Indicators
0	0	1	4002	E^2 PROM
0	1	0	4004	D/A Converter
0	1	1	4006	Display Control
1	0	0	4008	Display Data
1	0	1	400A	Counter Control
1	1	0	400C	Relay Control
1	1	1	400E	(Spare)

Counter Control (Write Only)

The counter control register (U43) is an 8 bit register with clear, and responds to address 400A. Upon initial power-up, the system resets all outputs low. Table 4-9 lists the counter control register write functions.

NOTE

Data written into U43 remains at the outputs until a reset occurs or new data is written.

Table 4-9. Counter Control Register Write Functions

Data Bit	Function
D0	Counter Clear
D1	Counter Enable
D2	HV Shutdown
D3	HV Select
D4	Clear Switch Latch
D5	Not Used
D6	Not Used
D7	Not Used

Relay Control Register (Write Only)

The Relay Control Register (U44) is an 8 bit register with clear, and responds to address 400C. Upon initial power-up, the system reset signal sets all outputs low. Data written into U44 remains at the outputs until a reset occurs or new data is written. Table 4-10 lists relay control write functions.

Table 4-10. Relay Control Register Write Functions

Data Bit	Function
D0	Fail Relay and Indicator
D1	Check Source Relay
D2	Warn Relay
D3	Alarm Relay
D4	Rate-of-rise Relay (not used)
D5	Remote Indicator (not used)

With the exception of the fail bit (D0), all outputs are applied to U48, which is an inverting open collector driver. The outputs of U48, including fail, drive (via the J2 connector) mechanical relays located on the relay board. The fail bit is used as an input to U47-3 which, when set high-low-high once per second, causes output U47-6 to remain low. Should this high-low-high sequence fail to occur (under MPU control), U47 will time out and set U47-6 high, causing the fail indicator on the panel and the fail relay to de-activate. U48 also drives the remote indicator (when used) on the front panel.

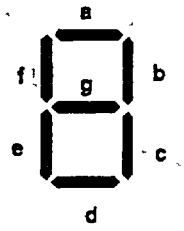
Bargraph (Write Only)

The bargraph addresses are decoded by U5, which is a 1 of 8 decoder. Control line inputs to U5 are R/W, Write 02, and Bargraph. When the bargraph address is selected (4020-4025), U5 further decodes the addresses listed in Table 4-11.

Table 4-11. Bargraph Write Address

Address State A3 A2 A1	Hex Address	Function	Driver
0 0 0	4020	Green 1-10	U55, U56
0 0 1	4021	Green 11-20	U57, U58
0 1 0	4022	Green 21-24	U59
0 1 1	4023	Red 1-10	U50, U51
1 0 0	4024	Red 11-20	U52, U53
1 0 1	4025	Red 21-24	U54

The outputs of U5 drive the latch enable pins on U50-U59 in pairs as shown in Table 4-11. U50-U59 are BCD-to-7 segment latch/decoder/drivers. Each drives five segments (either red or green) with the exception of U54 and U59 which drive four segments each. BCD to bargraph decoding is accomplished by latching data into the appropriate device to turn on the required bargraph segments. Segment decoding is shown below:



BCD Character	
LED 1 OF 5 =	1
LED 2 OF 5 =	7
LED 3 OF 5 =	3
LED 4 OF 5 =	9
LED 5 OF 5 =	8
NONE =	A = F

Assume that all bargraph segments are off. Example: Write hex data 38 to bargraph address 4020. Data 38 is stored, low byte (8) in U55 and high byte (3) in U56. Data (8) in U55 causes the code for an 8 to be output, which drives all output segments. The result is that the first five green LEDs turn on. Data (3) in U56 causes the code for a 3 to drive segments 1,2, and 3 connected to that device. The result is that the first 3 of 5 segments associated with U56 will turn on green.

Status Indicators (Write Only)

The status register (U60) is an 8 bit register with clear, and responds to address 4000. Data written into U60 remains at the outputs until a reset occurs or new data is written. Upon initial power-up, the system reset signal sets all outputs low. The status indicator write functions are listed in Table 4-12.

Table 4-12. Status Indicator Write Functions

Data Bit	Function
D0	Check Source Indicator
D1	Rate (not used)
D2	Overrange Indicator
D3	Warn Indicator
D4	High Alarm Indicator
D5	R/hr Backlight
D6	kR/h Backlight
D7	mR/h Backlight

U60 outputs, when high, control U61 inverter/driver to activate the appropriate front panel status indicators. U60 outputs, when low, control U61 to deactivate the appropriate front panel status indicators.

Display Control (Write Only)

Registers U71 and U72 are used to control and display data on the front panel 7-segment displays. Five digits are used along with two spare digit drive signals. The display control register (U71) is an 8 bit register, utilizing four data bits (D0-D3). The display data register (U72) is also an 8 bit register utilizing five data bits (D0-D4). Both U71 and U72 outputs are reset (low) upon initial power-up.

U71 is used to select the digit to be written as well as to set the WRITE bit input to U75, the display controller. U72 is used to enter the data to be written and a decimal point for the selected digit.

U75 is a universal eight digit 7-segment LED driver controller used with common anode devices. Address inputs (A0-A2), supplied by U71, are used to select the digit as shown below:

A2	A1	A0	Selects
0	0	0	Digit 1
0	0	1	Digit 2
0	1	0	Digit 3
0	1	1	Digit 4
1	0	0	Digit 5

7 - Segment Front Panel Display

Digit 5 **Digit 4** **Digit 3** **Digit 2** **Digit 1**

Data inputs D0-D3 and the decimal point, supplied by U72, are used to enter data in the selected digit as shown in Table 4-13.

Table 4-13. Hex Data (Written to Address 4008)

Hex Data	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Display Character	0	1	2	3	4	5	6	7	8	9	-	E	H	L	P (blank)	

The display controller contains all necessary circuitry including address decoding, static RAM, and multiplex oscillator for interdigit blanking.

Digital to Analog Converter and Output Circuitry (Write Only)

The D/A converter (U32) is an 8 bit buffered multiplying device which responds to address 4004. Data is written and latched by U82 when CS and WR are active (low). The converter is configured for unipolar operation with a voltage reference of + 10VDC. Below is the digital to analog conversion table with the voltage measured at U82-1 referenced to ground.

MSB LSB	Analog Output
1111 1111	- 10VDC
1000 0000	- 5 Vdc
0000 0001	- 0.039 V
0000 0000	0 V

U81 operational amplifier 1 buffers the converter output to drive the three analog output circuits. This voltage is also provided to J4, analog option connector. J4 is provided with the necessary supply voltages to configure a custom analog output range for special applications (i.e. 10 mV to 50 mV). U81 operational amplifier 3 provides the user with a 0 - 10 volt analog output. VR1 is the zero adjustment and VR2 is the gain adjustment for the 0 - 10 volts output.

The circuitry comprised of U80 operational amplifiers 1 and 2, as well as U81 operational amplifier 2, provides a 4 - 20 mA user output. VR7 is adjusted to obtain a 4 mA reading on the output, and VR4 is adjusted to obtain a 20 mA reading on the output. U81 operational amplifier 2 and Q1 are configured as a constant current source controlled by the output of U80 operational amplifier 1. The positive feedback circuitry, comprised of R41 and R43, ensures that the output current will remain constant regardless of the output load impedance. The maximum load impedance is 500 ohms.

The circuitry comprised of U80 operational amplifiers 3 and 4 as well as U81 operational amplifier 4 provides a second 4 - 20 mA user output. Operation is identical to the circuitry previously described in this section. VR6 is adjusted to obtain a 4 mA reading at the output and VR5 is adjusted to obtain a 20 mA reading at the output.

Read Register Decoding

Decoding for READ registers within the main circuit board is performed by U34, which is a 1 of 8 decoder. Control signals for U34 are REG SELECT, and R/W (active high) as well as address A1, A2, and A3. U34 decodes address per output, starting with 4000 and ending with 400E. These outputs are active low. Table 4-14 lists the READ register, the assigned function and the address.

Table 4-14. Control Signal Address Decoding (U34)

Address State A3	A2	A1	Hex Address	Function
0	0	0	4000	Switch Interface
0	0	1	4002	Data Entry
0	1	0	4004	Gross Counter Low
0	1	1	4006	Gross Counter High
1	0	0	4008	Sensitivity Select
1	0	1	400A	(Spare)
1	1	0	400C	(Spare)
1	1	1	400E	(Spare)

Data Entry (Read Only)

Octal buffer U36 functions as an interface to supply the status of the switches for data entry to the internal data bus address (4002). The data entry read functions are shown in Table 4-15. The function switch logic is shown in Table 4-16

Table 4-15. Data Entry Read Functions

Data Bit	Function
D0	Enter Switch (Active Low)
D1	Value Select Switch (Active Low)
D2	Digit Select Switch (Active Low)
D3	(Not Used)
D4	(16 position function switch, see Table 4-16)
D5	(16 position function switch, see Table 4-16)
D6	(16 position function switch, see Table 4-16)
D7	(16 position function switch, see Table 4-16)

Table 4-16. Function Switch Logic

Hex Data	D7	D6	D5	D4	Position	Function
F	1	1	1	1	0	High
E	1	1	1	0	8	Calibrate Mode
D	1	1	0	1	1	Warn
C	1	1	0	0	9	Underrange
B	1	0	1	1	4	Overrange
A	1	0	1	0	C	Undefined
9	1	0	0	1	5	Conversion Constant
8	1	0	0	0	D	Undefined
7	0	1	1	1	2	Tau
6	0	1	1	0	A	Undefined
5	0	1	0	1	3	Full Scale Value
4	0	1	0	0	B	Undefined
3	0	0	1	1	6	Undefined
2	0	0	1	0	E	Undefined
1	0	0	0	1	7	Low Scale Value
0	0	0	0	0	F	Undefined

Gross Counter (Read Only)

The gross counter is a 16 bit configuration. Octal buffer/drivers U40 (4004) and U41 (4006) interface the low and high counter bytes to the data bus from U45 and U46 respectively. Dual module 16 counters (U45, U46) accumulate counts from the signal processing circuitry over a program controlled sample period and make this data available to the MPU. A high level on U45 pins 2 and 12, and U46 pins 2 and 12 cause the counters to clear in anticipation of a sample being initiated. A low level activates the counters to accept pulses from the signal processing circuitry. Maximum count for a sample period is 32,768. When this count is achieved, U46 pin 8 goes high which causes the pulse counting to stop. This condition is recognized by the MPU as an indication of counter overflow.

Sensitivity Select (Read Only)

Octal buffer U42 functions as an interface to provide the status of the sensitivity selection jumpers, mode jumpers, anti-jam bit data, and serial data from E^2 PROM to the internal data bus and MPU. U42 responds to address 4008. The sensitivity read functions are listed in table 4-17.

Table 4-17. Sensitivity Select Read Functions

Data Bit		Function
D0		Serial data from E^2 PROM
D1		Anti-Jam
D2		(not used)
D3	JP3-5	(IN) Inhibit alarms during check source operation (factory setting) (OUT) Alarms active during check source operation
D4	JP3-4	(IN) Fails in five minutes with no counts (factory setting) (OUT) Does not fail
D5	JP3-3	(OUT) Auto alarm acknowledge, after counts return to normal (IN) Manual Reset (factory setting)

JP3 jumper IN MPU reads a low (0)
JP3 jumper OUT MPU reads a high (1)

Switch Inputs

Octal inverting buffer U62 functions as an interface to provide the status of the front panel control switches to the internal data bus and MPU. U62 responds to address 4000. The switch input bit assignments are listed in table 4-18.

Table 4-18. Switch Input Bit Assignments (U62)

Data Bit	Function
D0	Alarm Acknowledge
D1	Check Source
D2	(Spare)
D3	(Spare)
D4	Rate-of Rise (not used)
D5	Warn Alarm
D6	High Alarm
D7	High Voltage (not used)

When a switch is pressed, the appropriate input to U62 is pulled low. When U62 is read by the MPU, a high (1) is available on the data bus. When no switches have been pressed, all outputs (U62) will be low when read. U63 is a latch which latches switch data from the check source and alarm acknowledge switches. The MPU controls the clear switch latch signal to reset U63. The circuit comprised by S1, D1, and R11 is a remote alarm acknowledge. R11 is selected to allow a 20 mA signal to flow through the S1 infrared diode when a given voltage is present on the J9 remote acknowledge input. When this voltage is present, the S1 infrared diode is forward biased, causing the S1 phototransistor to conduct. This effectively forces a low (0) to U63-10, setting the alarm acknowledge bit.

Option Board Bus

The option board bus is available on connector J3. All address, data, and control signals are provided to allow various digital/analog circuit boards to directly interface to the main circuit board. Decoded signals for asynchronous communications interface adapter option, and the general purpose interface bus option are available on the option board interface connector.

Signal Input Circuitry

Detector input pulse circuitry consists of an input buffer, high/low discriminators, signal detection, anti-jam and signal multiplexer circuits. The following paragraphs describe circuit operation in detail.

Buffer Amplifier

The detector input is connected to J6. The input impedance is 50 ohms to match the signal cable and the detector's output impedance. Jumpers JP4 and JP5 are used to select the proper pulse polarity as shown below.

Jumper	Function	Remarks
JP4 1-2	Pulse Polarity (Input)	For negative input
JP4 2-3	Pulse Polarity (Input)	For positive input (factory set)
JP5 1-2	Pulse Polarity (Shield)	For negative input
JP5 2-3	Pulse Polarity (Shield)	For positive input (factory set)

The detector input signal (with appropriate polarity jumpers installed) is applied to unity gain buffer amplifier U90. VR8 is used to fine adjust for unity gain. Regardless of input signal polarity, U90-6 outputs positive going pulses. VR9 is a zero offset adjust for U90. The buffer amplifier output is provided to the J7 connector (for use by analyzer option circuitry) as well as the high and low discriminators. TP-Pulse is available as a test.

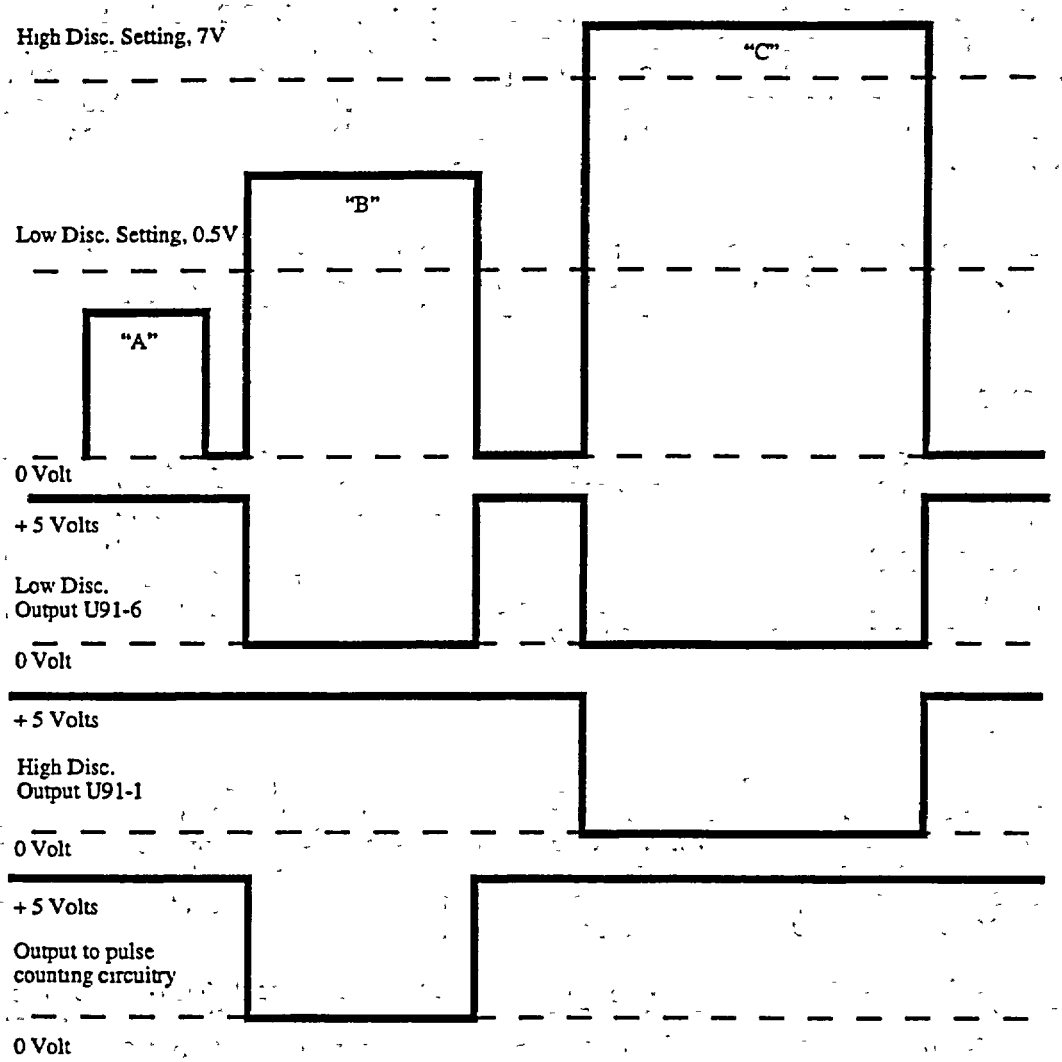
Discriminators

The low level discriminator is comprised of comparator U91 device 2 and associated circuitry. VR11 is used to set the trip threshold. The adjustment range is 50 mV to 1 volt, which can be measured at the low discriminator test jack. As the positive pulse, applied to the input, passes through the trip threshold, the output (U91-6) is forced low. When the pulse returns through the trip threshold, the output U91-6 returns high and is ready to accept another input pulse. Pulses below the trip threshold do not trigger the output.

The high discriminator is comprised of comparator U91 device 1 and associated circuitry. VR10 is used to set the trip point. The adjustment range is 3.5 to 7.5 volts, which can be measured at the high discriminator test jack. As the positive pulse, applied to the input, passes through the trip threshold, the output (U91 device 1) is forced low. When the pulse returns through the trip threshold, the output (U91 device 1) returns high and is ready to accept another input pulse. Pulses below the trip threshold do not trigger the output.

The normal factory setting are: Low Disc.: 0.500 Vdc
High Disc.: 7.000 Vdc

Figure 4-6 shows signal "A" below both discriminators, signal "B" between discriminators, and signal "C" above discriminators.



A: This pulse is below the low discriminator voltage and is not passed

B: This pulse is above the low discriminator voltage and below the upper discriminator voltage, and is passed to the counters

C: This pulse is above the upper discriminator and is not passed.

Figure 4-6. Discriminator Operation.

Signal Detection

The circuitry comprised of flip-flop U93 and inverters U11 and U94 utilize the low discriminator and high discriminator outputs to ensure that only input signals which peak between the discriminators are made available to the gross counters.

When U93-2 counter enable is brought high, under software control to initiate a sample period, and the low discriminator threshold is exceeded, a positive going edge on U93-3 clocks a high into flip-flop U93-5. Assuming the high discriminator has not been exceeded, when the input pulse returns through the low discriminator threshold, a positive going edge on U93-11 clocks the high on U93-12 to the output U93-9. A delayed positive pulse produced by the R/C network (R80/C35) on U93-13 allows the flip-flop output U93-9 to remain high until the delayed pulse on U93-13 returns low, which resets the output U93-9 low. U93-9 is connected to the signal multiplexer circuitry as described below.

When an input pulse exceeds both the high and low discriminators, the high (U93-5) clocked by the transition through the low discriminator is reset by the low (U91-1) resulting from the transition through the high discriminator. This action causes no pulse to be generated at U93-9.

Signal Multiplexer

The signal mutiplexer comprised of U101, U102, and U94 allows the MPU to select either the radiation pulse or the frequency output representing the high voltage to be input to the gross counters. When counter enable is active (high), the signal detection circuit output (representing radiation) is routed to the gross counters. When HV select is active (high), the HV frequency is routed to the gross counters. The outputs connected to pull-up resistor R81, are open collectors allowing the most significant bit of the counters to force this node low, effectively terminating the pulse input to the counters and indicating an overflow condition.

Anti-Jam Circuitry

The anti-jam circuitry allows for the detection of rapid increase in pulses (due to a rapid increase in radiation at the detector) and provides a bit to the sensitivity select register. A detector will reach a point, in a very high radiation field, when it will no longer provide pulses, but conducts continuously. The absence of pulses would normally indicate a low radiation field, when in actuality this is not the case. The purpose of the anti-jam circuit is to detect that this situation is about to occur, and to indicate it to the MPU. The MPU will then shut down the high voltage.

The input to the anti-jam circuit is provided by the low discriminator output (U91-6). JP7 selects detector type, 1-2 for scintillation detectors and 2-3 for GM type. Q3 turns ON/OFF with input pulses, which allows C39 to charge to an average DC level. VR12 (adjustment range 0 to 1.6 volts) is used to adjust the trip threshold on comparator U92-2. When the repetition rate of the input pulse causes C39 to charge and the DC level to exceed the threshold, comparator output U92-1 (low in normal operation) is forced high. When this occurs, U96-2 goes high (U96-1 is high after power-up) U93-3 goes low and U96-4 goes high. Diode D9 effectively latches this circuit in the jam mode. That is, if C39 discharges (due to absence of input pulses) and U92-1 goes low, D9 becomes forward biased which holds U92-2 high. The high, now on U96-4 causes Q4 to turn on driving Q5 on, forcing U96-8,& 9 node to ground. In normal operation, JP6 is in position 1-2 allowing high current flow through F1 (1/20 Amp fuse) causing it to blow. R82 will now hold U96-8,& 9 node at ground, causing U96-10 (anti-jam bit) to be active (high). At this point, normal operation can only be achieved by replacing fuse F1. Jumper JP6 - position 2-3 is for test purposes only and allows fuse F1 to be removed from the circuit and R79 provides pull-up to + 5 volts. In this mode, cycling of power resets the anti-jam circuit. R93/C41 on U96-1 provides a delay from power-up to inhibit false tripping of the anti-jam circuit.

High Voltage Supply

The high voltage is utilized by a GM detector (typical range 500 volts to 650 volts). The adjustment range of the HV supply is 300 Vdc to 1800 Vdc. The HV output is short circuit proof in that it will current limit the oscillator section within ten seconds of the output being shorted. The board plugs into the main circuit board at the J8 connector.

R5 and associated circuitry provide the DC voltage adjustment to U1 device 3. The output U1-8 will vary under control of R5.

Operation amplifier U1 device 1 drives transistor Q1 which in turn drives the oscillator section transistor Q2, the transformer primary and feedback windings, and associated circuitry. As R5 is adjusted to increase the high voltage, U1-8 voltage increases which causes U1 device 1 to increase transistor Q1 base current. This increases the emitter/collector current, raising the voltage on the emitter. As this control voltage increases, the voltage developed across the transformer primary also increases. The transformer secondary increases in voltage, which causes the high voltage output to increase. The voltage quadrupler operation is illustrated in figure 4-7.

R2 is a 1000:1 voltage divider which provides feedback to control the high voltage. U1-2 is used as a buffer between the 1000:1 divider and the 1000:1 output signal. This output signal is also utilized by U1-1 to regulate the high voltage and is sent to the HV test jack. The shutdown signal (provided by the controller) when low, has no effect on the high voltage. When the shutdown signal goes high, Q3 conducts causing Q1 to turn off. This action forces the oscillator to turn off, effectively shutting down the high voltage.

Short circuit protection is provided by the positive temperature coefficient thermistor (PTC). The PTC resistance in normal operation is nominally 5 ohms. When the high voltage output is shorted, the control circuitry U1 device 1 attempts to maintain regulation by increasing the base drive for transistor Q1. Excessive current flows through the PTC, causing the internal temperature to increase. As the temperature increases, the PTC resistance also increases dramatically. The effect is that the control voltage to the oscillator is decreased to a minimum level. The response of the PTC is approximately ten seconds. Removal of the short circuit condition results in restoration of the high voltage to the preset level.

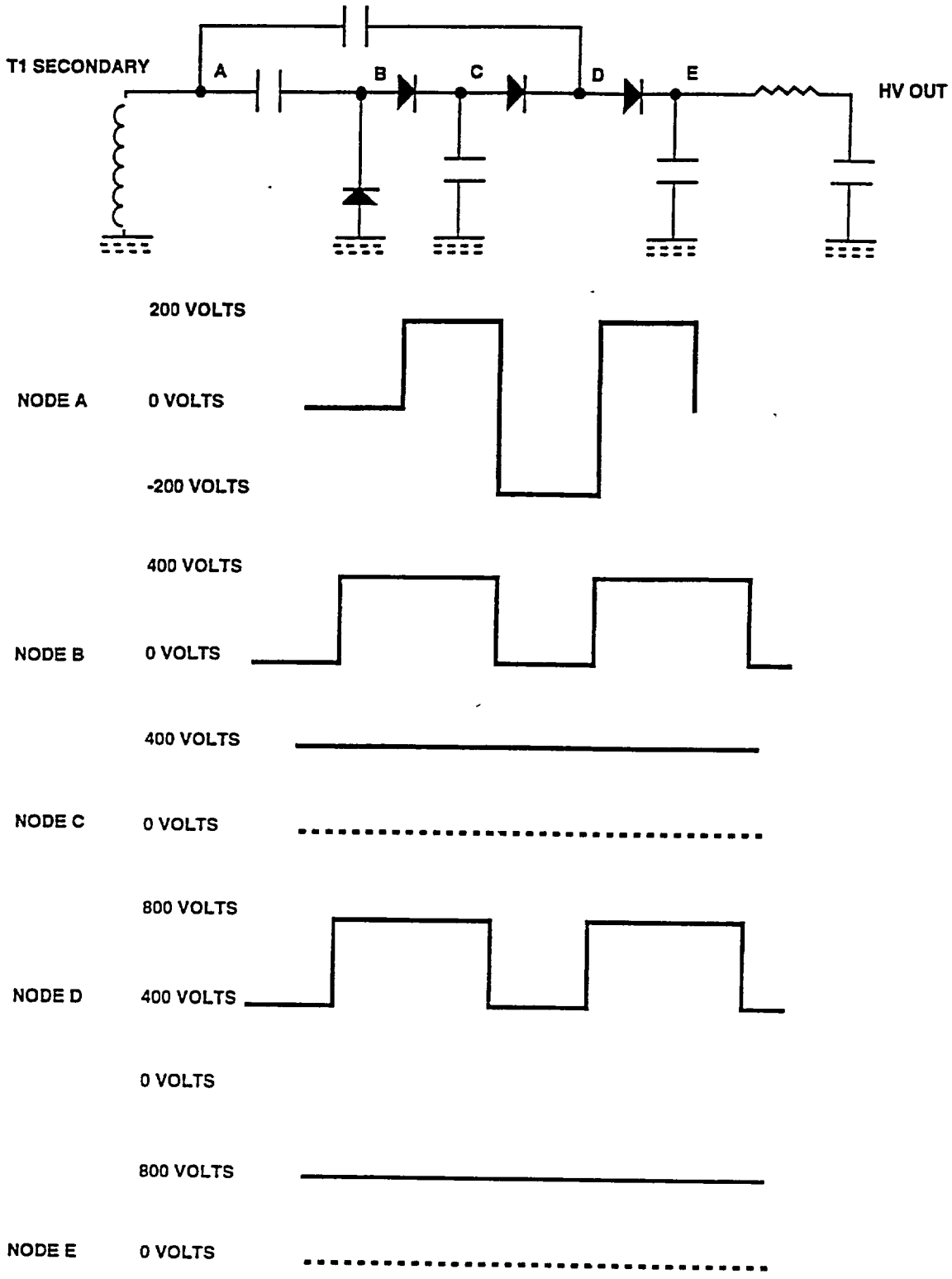


Figure 4-7. High Voltage Output (800VDC).

Relay Circuit Board

The relay circuit board contains five independently controlled mechanical relays. Each relay provides two Form C sets of contacts with the exception of the check source and alarm relays which provide a single Form C set of contacts. Interconnection is from J2 on the relay board to J2 on the main circuit board. The control signals (active low) and + 15 volts common are provided. The relays typically perform the following functions:

K1: Spare
K2: Check Source
K3: Fail
K4: Warn
K5: Alarm

The relay contacts are provided to the user via rear panel connector P1. See specifications for contact ratings. Varistors (V1-V16) provide transient protection across the contacts.

Front Panel Circuit Board

The front panel circuit board consists of the 7 segment display, backlights, status indicators, switches, and bargraph assembly. The front panel interfaces to the main circuit board via interconnecting row 100, 200, and 300. The main power switch also mounts to the front panel circuit board. Refer to figure 4-7 for a view of the front panel.

Circuit Description (Front Panel Circuit Board)

The 7 segment displays are controlled by the display controller as described in "Display Control". The bargraph is controlled by the circuitry described in "Bargraph (Write Only)". The status indicators are described in "Status Indicators (Write Only)". Switches are described in "Switch Inputs".

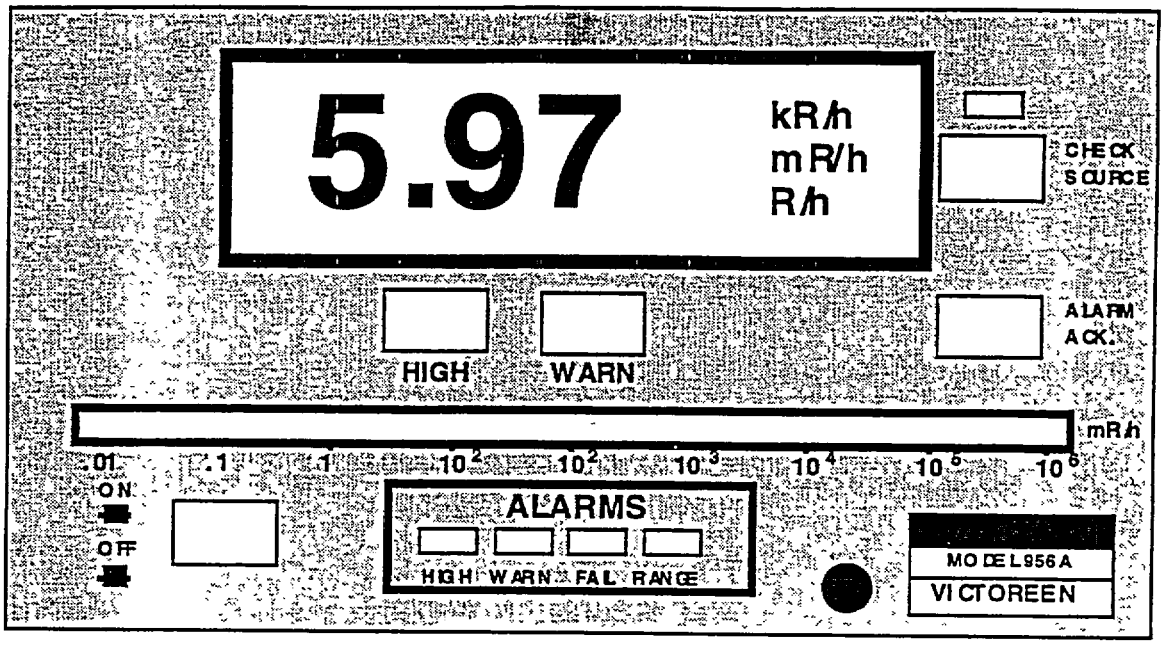


Figure 4-8. Front Panel, Model 956A-201.

Power Supply

The UDR power supply is rated at +5 volts @ 3 amps, +15 volts @ 2.0 amps, and -15 volts @ .5 amps. The input is user selectable at 115 Vac (92 to 132 Vac) or 230 Vac (180 to 264 Vac). The power supply is designed to meet safety requirements UL/CSA/VDE. EMI emissions comply with FCC/Class B requirements.

The AC input to the power supply may range from 90 to 204 Vac @ 50.60 Hz. The 956A, however, must be configured for use at 125 Vac, 50/60 Hz as a factory option.

The power supply provides all internal UDR voltages as well as detector supply voltages. All outputs are protected with automatic recovery upon removal of overload or short circuit condition.

Optional Circuit Boards

Option circuit boards are installed into the 50 pin J3 connector available on the main circuit board. As many as three option boards may be stacked into the J3 bus. The following paragraphs describe the available options. A separate manual for each option board is available with more detailed information. Listed below are the option boards currently available. Refer to Table 1-1 for currently available modifications and to Appendix C for the Bill of Materials.

1. 942-200-75: ANALOG INPUT OPTION BOARD - (Generally not used for normal operation with the 956A-201 UDR, however, it is used if the UDR is part of a simulator) Contains four separate channels for analog inputs. A 0 to 10 Vdc input or 4 to 20 mA input can be selected independently for each channel using the jumpers and switches provided on the board. Possible inputs to the board include: temperature, pressure, flow, or simulated radiation.

2. 942-200-80: COMMUNICATIONS LOOP OPTION BOARD - Designed to enable a EIA RS232C serial communications between VICTOREEN's ratemeter and a user computer system or CRT terminal, with baud rates ranging from 50 to 19200 baud. An asynchronous communication interface adapter is utilized to format the data and control the interface.

   The VICTOREEN communications interface option board also provides the necessary circuitry to allow interconnecting to a VICTOREEN proprietary serial communication port. This interface allows multiple UDRs to share a common six wire cable to a main central processor unit.

3. 942-200-95: ANALOG OUTPUT BOARD - Designed to provide a user selectable single output voltage of: 0 - 10 Vdc, 0 - 5 Vdc, 0 - 1 Vdc, 0 - 500 mVdc, 0 - 100 mVdc, 0 - 50 mVdc, or 0 - 10 mVdc.

4. 942-200-95M1: DUAL ANALOG OUTPUT BOARD - Designed to provide two user selectable output voltages. Output #1 is either 0 - 5 Vdc, or 0 - 10 Vdc, while output #2 is either 0 - 10 mV dc, 0 - 50 mVdc, 0 - 100 mVdc, 0 - 500 mVdc, or 0 - 1 Vdc.

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Section 5 - Maintenance

Maintenance

The 955A Area Monitoring System is designed to operate for extended periods of time with no scheduled maintenance required. However, periodic inspections may be performed to verify system integrity and calibration have not changed. If a problem develops, verify system calibration per section 6, or trouble shoot the system per section 7 and the drawings in Appendix B.

NOTE

If a maintenance question arises, please contact the Victoreen Customer Service Department at (216) 248-9300 for assistance.

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Section 6 - Calibration

Calibration

The 897A GM Detector is factory calibrated on a ^{137}Cs / ^{60}Co range. A ± 20%,8 point NIST traceable factory calibration performed to obtain the calibration factor and dead time correction for the detector. The calibration factor and dead time correction (referred to as TAU) are stated on the factory calibration data sheet, and are adjusted via setpoint numbers 5 and 2 on the 956A UDR. A field test source, P/N 848-8, is available as an option to verify detector operation. The detector, with integral preamplifier, should be returned to Victoreen for recalibration whenever performance degradation is noticed (i.e. detector response is not within ± 30% of the decayed source value in either the closed or open position.)

Calibration / Electronic Adjustment

Table 6-1 lists the electronic adjustments for the 956A, while Table 6-2 lists electronic adjustments for the 897A detector. The procedures for making these adjustments are contained in the factory calibration and test procedures listed below. Note that test firmware is required to perform most of the critical adjustments. Refer to Section7 for a description of user performed adjustments.

NOTE

The adjustments listed in Table 6-1 and Table 6-2 are for standard equipment. If an analog output option board has been furnished with the ratemeter, refer to the analog output option board instruction manual for additional adjustment instructions.

Table 6-1. Electronic Adjustments, UDR

Adjustment	Purpose	Type
VR1	Zero Adjust / 0 - 10 Volt Analog Output	Field
VR2	Gain Adjust / 0 - 10 Volt Analog Output	Field
VR4	20 mA Adjust / 4 - 20 mA Volt Analog Output #1	Field
VR5	20 mA Adjust / 4 - 20 mA Volt Analog Output #2	Field
VR6	4 mA Adjust / 4 - 20 mA Volt Analog Output #2	Field
VR7	4 mA Adjust / 4 - 20 mA Volt Analog Output #1	Field
VR8	Gain Adjust / Signal Input Op Amp	Factory
VR9	DC Offset Adjust / Signal Input Op Amp	Factory
VR10	High Discriminator Adjustment	Field
VR11	Low Discriminator Adjustment	Field
VR12	Anti-Jam Threshold Adjust	Factory
VR13	Write Cycle Clock Adjust	Factory
HV Supply R5	High Voltage Adjust	Field
VR51	+5 VDC Power Supply	Field

Table 6-2. Electronic Adjustments, Detector

Adjustment	Purpose	Type
R44	Detector Input Discriminator	Factory
R41	Anti-Jam Threshold (Factory Adjustment Only)	Factory

The following factory calibration and test procedures are included for reference at the end of this section:

Document	Description
CAL-GM1	Factory Calibration Procedure, 897A GM Detector
TP897A	Factory Test Procedure, 897A GM Detector
TP956A-201-3	956A-201 Digital Ratemeter Factory Test Procedure
TP956A/897A-21X	Loop Test Procedure - Low Range Detector
TP956A/897A-22X	Loop Test Procedure - Medium Range Detector
TP956A/897A-23X	Loop Test Procedure - High Range Detector

955A System Field Calibration

A field test source is available to verify the response of the detector to a known radioactive field in a fixed geometry. The following test sources are available:

Model	Activity
848-8	100 mCi Cs-137
848-8A	20 mCi Cs-137

848-8 Test Source provides tree data points when used with the 897A-22X or 897A-23X detector. Two points are available when used with the 897A-21X, low range detector. Should a third data point be required for the 897A-21X detector, use of the 848-8A Test Source is required.

The following adapters are required to use the above test sources:

Detector	Adapter
897A-210	848-8-105
897A-220	848-8-105
897A-230	848-8-105
897A-211	848-8-105 & 848-8-400
897A-221	848-8-105 & 848-8-400
897A-231	848-8-105 & 848-8-400

WARNING

Extreme care must be used when testing a system that has power applied. A 600 Vdc potential exists on terminal P1-10 of the detector and P4 of the 956 UDR. This potential will exist for one minute after power is removed.

CAUTION

For WARNINGS and CAUTIONS pertaining to the use of the Model 848-8 field calibrator, refer to the applicable field calibrator instruction manual.

NOTE

Voltages can be measured as soon as power is turned on, but further alignment should not be attempted until the instrument has had at least one hour to stabilize after startup.

NOTE

The following procedure applies only to an 897A series detector that has been previously calibrated and is functioning normally.

NOTE

If a question arises on the use of the field calibrator or the adapter, refer to the applicable instruction manual for the calibrator or adapter.

NOTE

By using two field calibrators in three positions each (open, closed, and intermediate) a total of six different exposure levels can be obtained. Select from these exposure levels the ones that correspond to the levels listed in Table 6-4.

1. To use the test source, determine the current radiation intensity for the closed, intermediate, and open positions from the decay curves on the field calibrators. Determine upper and lower tolerance limits by taking 75% and 125% of each intensity level.

WARNING

Do not turn the key of the field calibrator, until instructed to do so. Failure to comply may result in radiation exposure to the operator.

2. Insert the applicable adapters into the field test source.
3. Insert the applicable 897A detector, small end down, into the field source adapter.
4. Insert the key, **DO NOT** turn.
5. Record the displayed value (this is the **CLOSED** position).

NOTE

To put the field calibrator in the open position, the detector must be installed in the calibrator. Insert the key and turn it. Rotate the hand knob fully. The detector is fully exposed to the radiation source. This is the OPEN position

To put the field calibrator in the intermediate position, start from the closed position and hold a counter-clock-wise pressure on the key while rotating the knob to the open position. A stop will be felt before the open position is reached. This is the Intermediate Position.

6. Turn the key, and rotate the control lever until the Intermediate position stop is felt. Record the reading.

NOTE

The detector cannot be removed until the field calibrator is put back to the closed position and the key is removed.

7. Turn the control lever to the full counter-clockwise, or OPEN position. Record the reading.
8. Remove the detector from the field calibrator.
9. The values recorded in steps 5, 6, and 7 should be between the values calculated in step 1.

NOTE

If the values recorded are not within the calculated range, then the detector is out of calibration. Return the detector to Victoreen for evaluation and determination of proper course of action. Do not attempt to change the conversion constant to "fit" the readings.

Detector Calibration

Plateau Verification

NOTE

Plateau verification does not need to be performed if the detector is supplied with a calibration data sheet, identifying the factory high voltage setting. It may, however, be performed as a preventative maintenance test for monitoring changes in the length of the detector plateau over time. It should be performed if the detector calibration data sheet is not available. If the detector is a replacement part, the high voltage should be set to the value shown on the calibration data sheet supplied with the detector.

To determine the optimum high voltage setting for the GM detector, perform the following:

1. Connect an electrostatic voltmeter to the high voltage section of the readout. Adjust the high voltage to 500 Vdc.

2. Connect a counter to the input pulse circuitry at the readout. Adjust the counter for a 1 minute time base.

3. Place a source near the detector and position it so that a reasonable count rate will be displayed on the readout.

4. Using the counter, take a 1 minute count. Record the high voltage setting and the gross count rate.

CAUTION

Do not exceed 650 Vdc under any condition. Damage to the GM tube will occur.

5. Repeat step 4, increasing the voltage in 20 Vdc increments until the maximum operating voltage is reached.

6. Plot the resulting data, gross count rate vs. high voltage. Locate the plateau where the slope is minimized (between the minimum voltage of 500 Vdc and the maximum voltage 650 Vdc). The operating point should be the mid point of this plateau. Figure 6-1 is an example of the detector plateau

7. If the plateau is not within the 500 Vdc to 650 Vdc range, return the unit to Victoreen for GM tube replacement and factory NIST source range calibration.

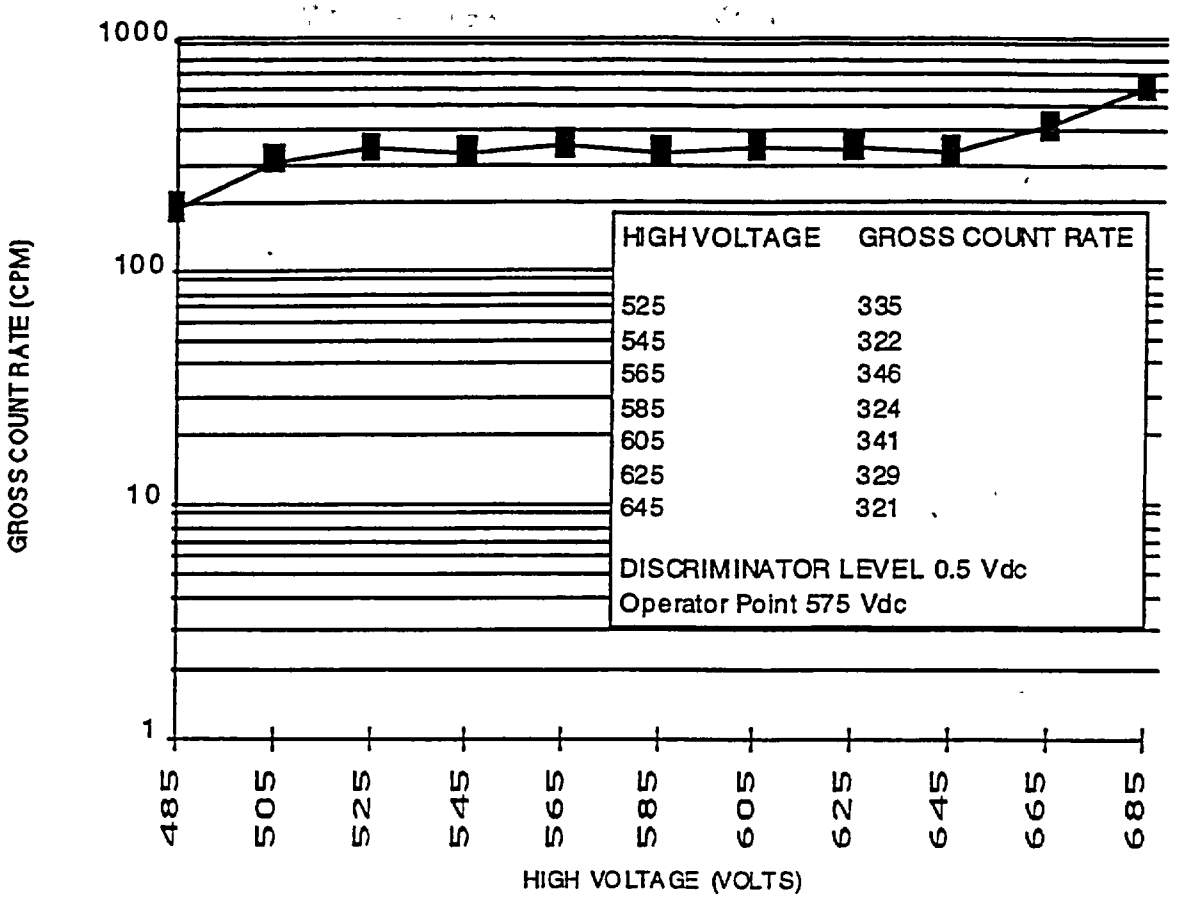

Figure 6-1. Detector Plateau (Typical)

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VICTOREEN, INC.		
TITLE:	GM DETECTOR CALIBRATION FOR AREA MONITORING SYSTEMS	
CUSTOMER:	N/A	PAGE
DOCUMENT:	CAL-GM1 REV. F	1 OF 11

ISSUE DATE:	SEPTEMBER 11, 1991

REVISION LIST

REV	ECO #	
F	11CR1-94	

APPROVAL		
MANAGER, RELIABILITY ENGINEERING	Andrew Lasko	11/21/94
GENERAL MANAGER, SYSTEMS		11/28/94
Q. A.		11/28/94
CALIBRATION SUPERVISOR	for Tom Kraus	11/28/94

ISSUED BY: D. WARNER

VICTOREEN, INC.
TITLE: GM Detector Calibration For Area Monitoring Systems
CUSTOMER: N/A
DOCUMENT: CAL-GM1 REV. F

DOCUMENT REV. LEVEL	DESCRIPTION/PAGES AFFECTED
A	ORIGINAL ISSUE
B	Change position 4, 0 and 1 filter page 4
C	General revision to comply with S.O.P. 450.001; pages 3 through 8
D	Add sign-off line for physicist on pages 6-8 *to background on pages 6-8
E	General revision to incorporate MICR use and computer data sheets. Added 857 & 857A Detectors; pages all.
F	Correct typographical errors, clarify 94085701 usage and delete cal. points.

1.0 SCOPE

1.1 To develop calibration data for the detector so that parameters can be determined for use with the 960 based Digital Area Monitor or 956 Series Area Monitor Readouts and to set or verify the detector's anti-jam function. In addition, the performance of 857 Series detectors used with Analog Area Monitors or provided as replacements will be verified. Consult Reliability Engineering for detector types not covered by this procedure.

1.2 The parameters that will be determined by this procedure are:

- Conversion Constant
- Dead Time Correction
- Background Countrate
- Linearity

2.0 RESPONSIBILITIES

2.1 Personnel performing this procedure must have a skill level per S.O.P. 902.003 of Level 1.

2.2 QA has the responsibility to insure that this procedure is properly implemented and that all data is reviewed and approved prior to movement of material to the next work station.

3.0 ENVIRONMENTAL CONDITIONS

3.1 Environmental conditions for temperature and humidity are the prevailing laboratory ambient.

4.0 EQUIPMENT REQUIRED

4.1 Digital Voltmeter (DVM), must be calibrated.

4.2 Oscilloscope 50MHz min. band width, must be calibrated.

4.3 956 or 956A Digital Readout Module, must be calibrated.

4.4 Calibrated Source Ranges (TRI-SOURCE and MICR or SICR).

4.5 Computer and Disc containing program 94085701 Rev. B for GM Area Monitors.

4.6 Mounting Fixtures for detectors in TRI-SOURCE and SICR as required.

4.7 956 to 857 Adaptor Cable (857-X,857-XX & 857A-XXX only)

4.8 857-X or 857A-XXX Adaptor Cable if required.

4.9 Data Sheets. (Sample attached. These sheets delineate the minimum recordin requirements; other data sheets may be used as long as the minimum information is recorded)

5.0 REFERENCES

5.1 Procedure CAL-TRI-SOURCE.

5.2 Procedure CAL-MICR or CAL-SICR as required.

6.0 PROCEDURE

6.1 Configure Readout device as shown in Table 1.

TABLE 1

Detector Type	High Voltage	Low Disc.	High Disc.
857-1X,2X	600	0.500	7.00
857-3X	550	0.500	7.00
857A-X-1X,X2X	600	0.500	7.00
897-X1X,X2X	600	0.500	7.00
897-X3X	550	0.500	7.00

NOTE

Anti-jam function on Readouts used for calibration should be disabled by removing Jumper JP7 and placing JP6 in the 2 - 3 position.

6.2 Mount detector in TRI-SOURCE using Adaptor Fixture and allow 15 minute warm-up period for detector and all electronics prior to data collection. Adjust Table height so that the laser spot is located on the detector housing centerline.

NOTE

For 857-XX and 857A-XXX detectors, the 857 to 956 adaptor cable must be used. Verify that Check Source switch on the adaptor cable is in the OFF position.

6.3 For 897-XXX detectors, verify the detector's internal discriminator is adjusted to 0.500 volts +/- 0.01 volts. Discriminator voltage is measured between pin 9 (+) and pin 8 (-) of I.C. Z1. Adjust potentiometer R44 if required and record value on Data Sheet. Verify that jumpers J1, J2 and J3 are all in the A-B position.

NOTE

857-XX and 857A-XXX detectors do not have an internal discriminator adjustment.

6.4 Connect Oscilloscope to signal input of Readout device using X10 probe. Set Oscilloscope vertical gain to 1 volt/division, DC coupled and a sweep rate of 5 microseconds/division. Set triggering to internal and adjust triggering after the detector is exposed to the source.

6.5 Using the TRI-SOURCE in accordance the instructions in Procedure CAL-TRI-SOURCE, expose the detector per Table 2 for anti-jam adjustment or verification. Record anti-jam frequency in CPM and 50% duty cycle/5volt square wave output verification on Data Sheet.

NOTE

Anti-jam trip point is adjusted in 897-XXX detectors via potentiometer R41 (CCW decreases trip point). For 857A-XXX detectors, trip point is adjusted via R23. For 857-XX detectors, trip point is set by fixed resistor R4.

TABLE

DETECTOR TYPE	REQUIRED FIELD INTENSITY
857-1X 857A-X1X 897-X1X	3.09E3 to 3.22E3 mR/h
857-2X 857A-X2X 897-X2X	3.07E4 to 3.20E4 mR/h
857-3X 857A-X3X 897-X3X	2.45E5 to 2.55E5 mR/h

6.6 Place the 956 Readout function switch in position 8 (Calibrate Mode) to enter the required count time in seconds as noted on the Data Sheet.

6.7 Using the Calibration Sources in accordance with instructions in procedures CAL-TRI-SOURCE and CAL-SICR or CAL-MICR, expose the detector in accordance with Tables 3, 4, or 5 depending on detector type. Begin counting only after the source if fully open or raised.

6.8 Using computer and program 94085701 Rev. B, enter NET count rates to determine Dead Time Correction value and Conversion Constant and record on Data Sheet. Attach print-out to Data Sheet. Acceptance Criteria is a value of less than 20% for linearity error. If information is available, enter Customer, S.O. Number, etc., into 94085701 program.

6.9 Place the 956 Readout function switch in position 5 and enter the Conversion Constant (CC1). Move the function switch to position 2 and enter the Deadtime (TAU) value.

6.10 Place the Detector in the minimum background position and activate the check source. Record the check source reading on the Data Sheet.

NOTE

For 897-XXX detectors the 956A check source front panel switch is used. For 857 or 857A series the check source switch is located on the 956/857 interface adaptor and the 956A check source switch non functional.

6.11 Forward Data Sheet and print-out to Physicist for approval and insert in the detector Traveller (if applicable) when completed.

7.0 DOCUMENTATION

7.1 Computer generated Data Sheets may be used for Source Range and Set-up Data. A legible copy of the Curve Fit printout shall be attached to the Data Sheet. A copy of these data sheets will be forwarded to the Staff Physicist.

7.2 When a detector is accepted into stock, the Data Sheets shall remain with the detector.

7.3 When a detector is assigned to a job, the Traveller (if applicable) shall be completed with the P.O. number and any other appropriate customer identification.

7.4 When a job is shipped, records shall be retained by QA appropriately filed and microfilmed.

TABLE 3: To be used with 857-3X, 857A-X3X and 897-X3X Detectors

CALIBRATION POINT	MINIMUM FIELD STRENGTH	MAXIMUM FIELD STRENGTH
#1	9.50E4 mR/hr	1.00E5 mR/hr
#2	3.00E4 mR/hr	4.00E4 mR/hr
#3	9.50E3 mR/hr	1.20E4 mR/hr
#4	3.00E3 mR/hr	4.00E3 mR/hr
#5	9.50E2 mR/hr	1.20E3 mR/hr
#6	3.00E2 mR/hr	4.00E2 mR/hr
#7	9.50E1 mR/hr	1.20E2 mR/hr
#8	3.00E1 mR/hr	4.00E1 mR/hr

TABLE 4: To be used with 857-2X, 857A-X2X and 897-X2X Detectors

CALIBRATION POINT	MINIMUM FIELD STRENGTH	MAXIMUM FIELD STRENGTH
#1	9.50E3 mR/hr	1.00E4 mR/hr
#2	3.00E3 mR/hr	4.00E4 mR/hr
#3	9.50E2 mR/hr	1.20E3 mR/hr
#4	3.00E2 mR/hr	4.00E2 mR/hr
#5	9.50E1 mR/hr	1.20E2 mR/hr
#6	3.00E1 mR/hr	4.00E1 mR/hr
#7	9.50E0 mR/hr	1.20E1 mR/hr
#8	3.00E0 mR/hr	4.00E0 mR/hr
#9	9.50E-1 mR/hr	1.20E0 mR/hr

TABLE 5: To be used with 857-1X, 857A-X1X and 897-X1X Detectors

CALIBRATION POINT	MINIMUM FIELD STRENGTH	MAXIMUM FIELD STRENGTH
#1	9.50E2 mR/hr	1.00E3 mR/hr
#2	3.00E2 mR/hr	4.00E2 mR/hr
#3	9.50E1 mR/hr	1.20E2 mR/hr
#4	3.00E1 mR/hr	4.00E1 mR/hr
#5	9.50E0 mR/hr	1.20E1 mR/hr
#6	3.00E0 mR/hr	4.00E0 mR/hr
#7	9.50E-1 mR/hr	1.20E0 mR/hr

897-X1X DETECTOR DATA SHEET

Customer _____ P.O. # _____

Project _____ W.O. # _____

S.O. # _____

Detector Model # 897-210 Serial # _____ Tag # _____

Readout Model # 956-100 Serial # 137 Cal Date _____

6.3 Detector Discriminator NA volts (897 ONLY)

6.5 Anti-Jam Duty Cycle Verification ? (Pass/Fail)

Intensity (mR/h)	Position & No. Of Attenuaters	Count Time (sec)	Accumulated Counts	Gross Counts (cpm)	Net Count Rate (cpm)
S.I.C.R. CALIBRATION INFORMATION					
BACK GROUND	41 mR/h & 5 Attn's	300	????????????	0.00E+00	N / A
1.15	41 mR/h & 3 Attn's	240	????????????	0.00E+00	0
3.67	41 mR/h & 2 Attn's	240	????????????	0.00E+00	0
11.71	41 mR/h & 1 Attn	240	????????????	0.00E+00	0
TRI SOURCE CALIBRATION INFORMATION					
34.5	10 R/h & 5 Attn's	120	????????????	0.00E+00	
102.2	10 R/h & 4 Attn's	120	????????????	0.00E+00	
312	10 R/h & 3 Attn's	120	????????????	0.00E+00	
953	10 R/h & 2 Attn's	60	????????????	0.00E+00	
3150	10 R/h & 1 Attn	60	Anti Jam	??????????	N / A

6.10 Check Source Response??????????? mR/h

Conversion Constant ??????????

Dead Time Correction ??????????

Conducted By _____

Q.A. Review By _____

Cal Date _____

Date _____

897-X2X DETECTOR DATA SHEET

Customer _____ P.O. # _____

Project _____ W.O. # _____

S.O. # _____

Detector Model # 897-210 Serial # _____ Tag # _____

Readout Model # 956-100 Serial # 137 Cal Date _____

6.3 Detector Discriminator NA volts (897 ONLY)

6.5 Anti-Jam Duty Cycle Verification ? (Pass/Fail)

Intensity (mR/h)	Position & No. Of Attenuaters	Count Time (sec)	Accumulated Counts	Gross Counts (cpm)	Net Count Rate (cpm)
	S.I.C.R. CALIBRATION INFORMATION				
BACK GROUND	41 mR/h & 5 Attn's	300	????????????	0.00E+00	N / A
1.15	41 mR/h & 3 Attn's	240	????????????	0.00E+00	0
3.67	41 mR/h & 2 Attn's	240	????????????	0.00E+00	0
11.71	41 mR/h & 1 Attn	240	????????????	0.00E+00	0
	TRI SOURCE CALIBRATION INFORMATION				
34.5	10 R/h & 5 Attn's	120	????????????	0.00E+00	
102.2	10 R/h & 4 Attn's	120	????????????	0.00E+00	
312	10 R/h & 3 Attn's	120	????????????	0.00E+00	
953	10 R/h & 2 Attn's	60	????????????	0.00E+00	
3150	10 R/h & 1 Attn	60	Anti Jam	??????????	N / A

6.10 Check Source Response???????????? mR/h

Conversion Constant ??????????

Dead Time Correction ??????????

Conducted By _____

Q.A. Review By _____

Cal Date _____

Date _____

897-X3X DETECTOR DATA SHEET

Customer _____ P.O. No. _____

Project _____ W.O. No. _____

S.O. No. _____

Detector Model # 897-3 Serial # _____ Tag # _____

Readout Model # 956-100 Serial # _____ Cal Date _____

6.3 Detector Discriminater _____ volts (897 ONLY)

6.5 Anti-Jam Duty Cycle Verification _____ (Pass/Fail)

Intensity (mR/h)	Position & No. Of Attenuaters S.I.C.R.	Count Time (sec) Calibration	Accumulated Counts Information	Gross Counts (cpm)	Net Count Rate (cpm)
BACK GROUND	41 mR/h & 5 Attn's	300	_____	0.00E+00	N / A
11.71	41 mR/h & 1 Attn	240	_____	0.00E+00	0
	TRI SOURCE CALIBRATION INFORMATION				
34.5	10 R/h & 5 Attn's	120	_____	0.00E+00	0
102.2	10 R/h & 4 Attn's	120	_____	0.00E+00	0
383	100 R/h & 5 Attn's	60	_____	0.00E+00	0
1120	100 R/h & 4 Attn's	60	_____	0.00E+00	0
3310	100 R/h & 3 Attn	60	_____	0.00E+00	0
9940	100 R/h & 2 Attn	60	_____	0.00E+00	0
31400	100 R/h & 1 Attn	60	_____	0.00E+00	0
98800	100 R/h & 0 Attn	60	_____	0.00E+00	0
250000	250 R/h & 0 Attn	60	Anti Jam _____		N / A

6.10 Check Source Response _____ mR/h

Conversion Constant _____ Dead Time Correction _____

Conducted By _____ Q.A. Review By _____

Cal Date _____ Date _____

VICTOREEN, INC.

TITLE: ELECTRONIC TEST PROCEDURE FOR 897A-2X0 AND 897A-2X1 DETECTORS

CUSTOMER: N/A

DOCUMENT: TP897A REV. A

ISSUE DATE: NOVEMBER 10, 1995

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	APPROVAL	DATE
PROJECT ENGINEER		11/14/95
TECHNICAL SUPPORT MANAGER		11/14/95
QUALITY ASSURANCE		11-14-95

ISSUED BY: DAVID WARNER

VICTOREEN, INC.
TITLE: ELECTRONIC TEST PROCEDURE FOR 897A-2X0 AND 897A-2X1 DETECTORS
CUSTOMER: N/A
DOCUMENT: TP897A REV. A

RECORD OF REVISIONS

DOCUMENT REV. LEVEL	DESCRIPTION/PAGES AFFECTED
A	ORIGINAL ISSUE

VICTOREEN, INC.
TITLE: ELECTRONIC TEST PROCEDURE FOR 897A-2X0 AND 897A-2X1 DETECTORS
CUSTOMER: N/A
DOCUMENT: TP897A REV. A

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VICTOREEN, INC.
TITLE: ELECTRONIC TEST PROCEDURE FOR 897A-2X0 AND 897A-2X1 DETECTORS
CUSTOMER: N/A
DOCUMENT: TP897A REV. A

1.0 PURPOSE

1.1 The purpose of this procedure is to verify the proper operation of the model 897A-2XX series of GM area monitor detectors prior to source range calibration.

2.0 SCOPE

2.1 This procedure is to be performed on all 897A-2X0 and 897A-2X1 series detectors prior to source range calibration to insure proper set-up and function. This procedure shall apply to production detectors as well as those received for repair or calibration. The following items are verified or adjusted by this procedure:

2.2 Detector current draw and local regulation.

2.3 Jumper placement.

2.4 Anti-jam function and range adjustment.

2.5 Discriminator range adjustment and final setting.

2.6 Detector output pulse height, period and symmetry.

2.7 Detector background countrate.

2.8 Check source operation in all positions of mounting.

3.0 RESPONSIBILITIES

3.1 Personnel performing this test must have a Technicians Skill Level 1 per S.O.P. 902.003.

3.2 Data generated by this test must be reviewed and approved by Q.A. prior to shipment. In addition, Q.A. has the responsibility of maintaining individual board test data in a job file.

3.3 The completed Data Sheet shall accompany the detector to the calibration range.

4.0 ENVIRONMENTAL CONDITIONS

4.1 Environmental conditions shall be the prevailing laboratory ambient for temperature and humidity. Radiation background levels shall not exceed 50 uR/h for the background check portion of this procedure.

5.0 EQUIPMENT REQUIRED

5.1 100 MHz Oscilloscope: Tektronix 465B or equivalent - must be calibrated and equipped with a X10 probe.

5.2 956A-201 Digital Ratemeter (UDR).

5.3 Digital Voltmeter (DVM): Fluke 8050A or equivalent - must be a calibrated device.

5.4 Test Data Sheets as attached.

5.5 Interconnection cable from 956A-201 to 897A series detector. Refer to Loop Diagram 956A-201-106.

5.6 Jumpers and test leads as required.

5.7 Precision DC voltage source or adjustable power supply: nominal 0-10 volt range.

5.8 IC test extended - 14 pin dual in-line package.

6.0 PROCEDURE

6.1 Initial set-up of device under test and test equipment.

6.1.1 Record Customer, P.O. and S.O. (or W.O.) numbers on the Data Sheet. Record detector assembly serial number and circuit board revision level and serial number on the Data Sheet.

6.1.2 Record the model, serial number and the calibration due date of the digital voltmeter and oscilloscope on the Data Sheet.

NOTE: The majority of the steps in this procedure are performed with the detector outer housing removed. Use caution as high voltage (575 volts) is present in some areas of the circuit board.

6.1.3 Adjust the high voltage supply on the 956A-201 to be used to 575 volts. Adjust the 956A-201 lower discriminator (VR11) to 0.50 volts and the upper discriminator (VR10) to 7.0 volts.

6.1.4 Turn off 956A-201 power and connect the 956A-201 to the 897A detector to be tested using the cable referenced in 5.5 of section 4.0. Do not connect the high voltage connector to 956A-201 P4 (HV) at this time.

6.1.5 Remove jumper J3 from the header block on the 897-210-10 circuit board.

6.1.6 Place the DVM in the current measuring mode (200 mA range) and connect the DVM negative lead to J3-A. Connect the DVM positive lead to J3-B.

6.2 Detector Quiescent Current Drain

6.2.1 Apply AC power and allow a five minute warm-up period to elapse prior to proceeding.

6.2.2 Record the DVM current indication on the Data Sheet. The value must be less than 100 Ma. Turn off 956A-201 ratemeter power when this measurement has been completed and replace jumper J3 into the A-B position.

6.3 Jumper placement and local regulator Operation

6.3.1 Record verification on the Data Sheet that jumpers J1, J2 and J3 are all in the A-B positions.

6.3.2 Turn 956A-201 ratemeter power back on and allow a five minute warm-up to elapse prior to proceeding.

6.3.3 Connect the Digital Voltmeter (DVM) negative lead to the negative side of C1 (DC ground) and the positive lead to cathode of CR9. Verify 10 +1/- 0.5 volts and record verification on the Data Sheet.

6.4 Anti-jam Adjustment Range and Pre-calibration Setting.

6.4.1 Place the IC test extender over Z1 on the 897A-210-10 circuit board.

6.4.2 Connect the DVM negative lead to Z1 pin 12 and the DVM positive lead to Z1 pin 10.

6.4.3 Adjust potentiometer R41 fully counter-clockwise and verify a DVM indication of < 0.100 volts. Record the final reading on the Data Sheet.

6.4.4 Adjust potentiometer R41 fully clockwise and verify a DVM indication of > 2.9 volts. Record the final reading on the Data Sheet.

6.4.5 Adjust R41 for a DVM indication of 1 +/- 0.001 volts. Record the final setting on the Data Sheet. This value is the anti-jam starting threshold voltage.

6.5 Discriminator Adjustment Range and Final Setting.

6.5.1 Move the DVM negative lead to Z1 pin 8 and the DVM positive lead to Z1 pin 9. Adjust potentiometer R44 fully counter-clockwise and verify a DVM indication of < 0.100 volts. Record the final reading on the Data Sheet.

6.5.2 Adjust potentiometer R44 fully clockwise and verify a DVM indication of > 1.5 volts. Record the final value on the Data Sheet.

6.5.3 Adjust potentiometer R44 for a DVM indication of 0.5 +/- 0.01 volts and record the final setting value on the Data Sheet. This is the factory discriminator setting for all standard 897A detectors.

6.6 Anti-jam Trigger Threshold Verification.

6.6.1 Set the output of the precision voltage source or power supply to zero and connect the negative lead of the supply to the negative side of C1 (DC ground). Connect the positive lead of the supply to the ANODE of CR7.

6.6.2 Connect the DVM across the precision DC volt source to monitor the output. Set the range to 2 volts DC.

6.6.3 Connect the oscilloscope ground lead to the negative side of C1 (DC ground) and the probe to the junction of resistors R1 and R2 on the 897A-210-10 circuit board. Set the oscilloscope as follows:

Vertical gain: 1 volt/division
Input coupling: DC
Trigger mode: Auto
Sweep rate: 5 uS/division

6.6.4 Increase the supply output until the oscilloscope displays the anti-jam square wave output from the detector. Adjust the DC supply as required to determine the exact point of anti-jam START. When this point has been determined, record the DVM indication on the Data Sheet. The value displayed must be 1 +/- 0.01 volts.

6.7 Detector Output Pulse Height, Period and Symmetry.

6.7.1 With the detector remaining in the anti-jam state, verify a symmetrical square wave of > 4.5 volts peak with a period of less than 25 uS. Record the peak value of the output and the period noted on the Data Sheet.

6.8 Check Source Operation and Background Check.

6.8.1 Set the supply output to zero and disconnect the supply from the detector.

6.8.2 Turn off power to the 956A-201 ratemeter and connect the high voltage coaxial cable to the rear panel P4 jack. Turn ratemeter power back on after this connection has been made.

6.8.3 Verify that the check source is in the OFF position, that is , the brass pan will be over the circuit board and not the hole over the GM tube.

6.8.4 With the check source in the OFF position, place the function switch 956A-201 in position #8 and enter a 1 minute (6.00E1 second) count of the GM tube background. The background value must be greater than 1 CPM but less than 25 CPM. If a higher than allowable background value is counted, recheck the actual background of the area where testing is being performed. If the results are still not acceptable, replace the GM tube and repeat this step after a 15 minute warm-up period. Record the final background countrate on the Data Sheet.

6.8.5 Move the 956A-201 function switch out of position #8 and depress the check source push-button. Verify that the check source moves to the ON position over the hole in the circuit board. Repeat this test with the detector GM tube pointing upward, downward and in 12 o'clock, 3 o'clock, 6 o'clock and 9 o'clock horizontal positions. The source must activate in each position. Record verification of source activation on the Data Sheet for each of these six positions.

6.9 Re-install the detector into the housing and secure with at least one screw. Forward to the calibration department for source range calibration all detectors which have passed this procedure along with the Data Sheets.

6.10 Reject and repair/rework any detectors which have failed this procedure and re-test when repairs have been completed.

6.11 Obtain Q.A. review of completed detectors and Data Sheets which have passed this procedure. Forward accepted units, with completed Data Sheets, to the Calibration Department for source range calibration.

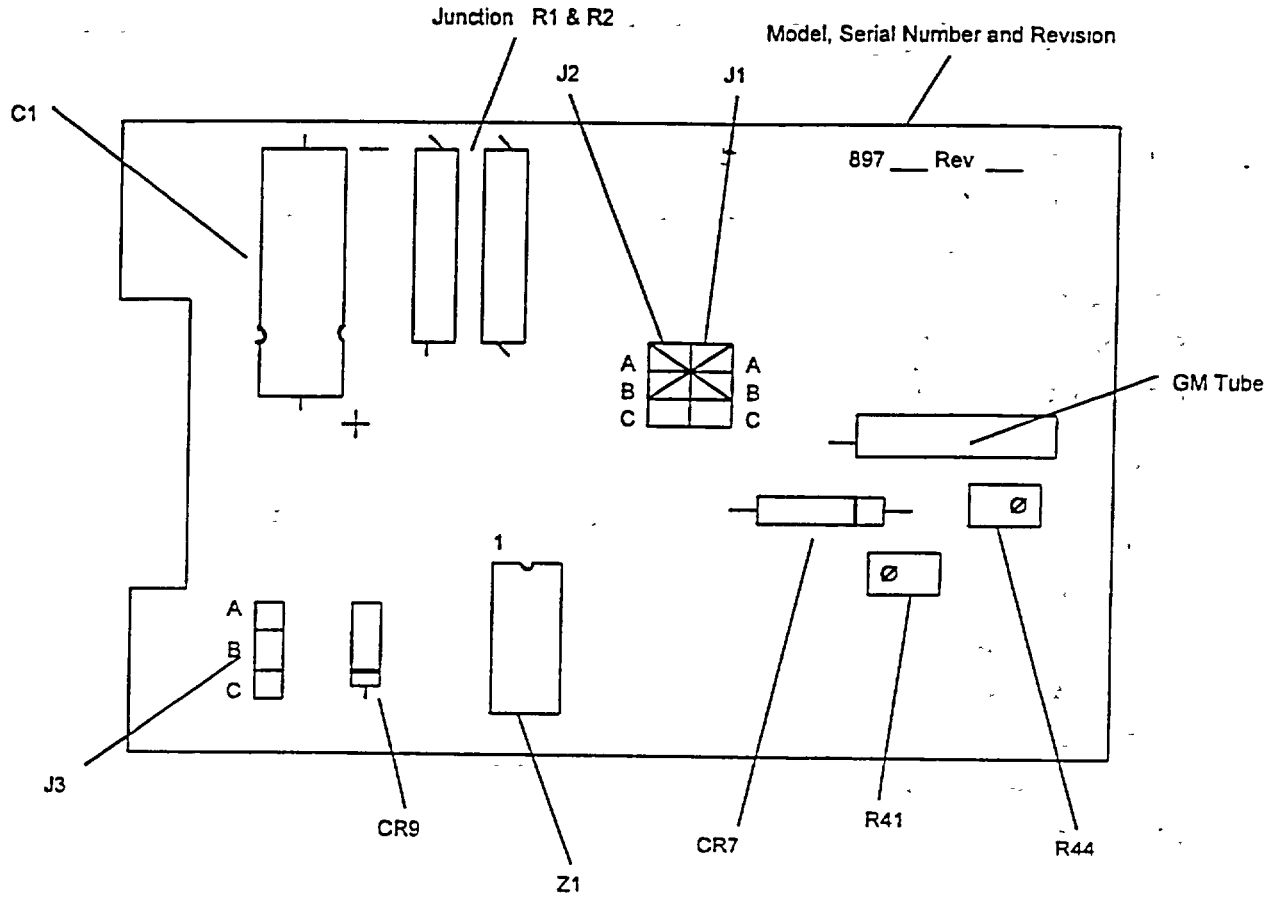

FIGURE 1

897A-210-10 Circuit Board

VICTOREEN, INC.
TITLE: ELECTRONIC TEST PROCEDURE FOR 897A-2X0 AND 897A-2X1 DETECTORS
CUSTOMER: N/A
DOCUMENT: TP897A REV. A

Test Data Sheet
TP897A for 897A-2X0 and 897-2X1 Detectors

Customer: _____ P.O. No.: _____

S.O. No.: _____ W.O. No.: _____

Model 897A- ____ Serial No.: _____

897A-210-10

Circuit Board Serial No.:_____ Revision Level: _____

Test Equipment

Oscilloscope Model No: _____ S/N: _____ Cal Due Date: _____

Digital Voltmeter Model: _____ S/N: _____ Cal Due Date: _____

Test Results

6.2.3	Detector Quiescent Current Draw	_____mA (100 mA max.)
6.3.1	Jumper Placement J1	____(A-B),J2 ____(A-B),J3____(A-B)
6.3.3	Local Zener Regulation	_____v (>9.5 and < 11.0 volts)
6.4.3	Anti-jam minimum setting	_____v (< 0.100 volts).
6.4.4	Anti-jam maximum setting	_____v (> 2.9 volts)
6.4.5	Anti-jam final setting	_____v (1 +/- 0.001 volts)
6.5.1	Discriminator minimum setting	_____v (< 0.100 volts)
6.5.2	Discriminator maximum setting	_____v (> 1.5 volts)
6.5.3	Discriminator final setting	_____v (0.5 +/0 0.01 volts)
6.6.4	Anti-jam trigger threshold	_____v (1 +/- 0.01 volts)
6.7.1	Detector output pulse height	_____v peak (4.5 minimum)
	Output square wave period	_____ uS (25 uS maximum)
6.8.4	Detector background CPM	_____ (> 1CPM / < 25 CPM)

6.8.5 Check source activation:

GM Tube up _____(yes) 12 o'clock _____ (yes) 6 o'clock _____ (yes)

GM Tube down _____(yes) 3 o'clock _____ (yes) 9 o'clock _____ (yes)

Performed By: _____ Date: _____

Q.A. Review By: _____ Date: _____

INOVISION RADIATION MEASUREMENTS

TITLE: TEST PROCEDURE FOR THE 956A-201 UNIVERSAL DIGITAL RATEMETER

CUSTOMER: N/A

DOCUMENT: TP956A-201-3 REV. 4

ISSUE DATE: JAN 18 2000

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ISSUED BY: GEORGE BUCK

INOVISION RADIATION MEASUREMENTS
TITLE: TEST PROCEDURE FOR THE 956A-201 UNIVERSAL DIGITAL RATEMETER
CUSTOMER: N/A
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DOCUMENT REVISION LEVEL	ECO NUMBER	DESCRIPTION/PAGES AFFECTED
A		Original Issue (Adapted from TP942-100-3)
B	5CR52-96	Revised/Renumbered Table of Contents; Paragraph 9.4, Added New Section; namely, Anti Jam Bit Test, Renumbered remaining sections and paragraphs; Revised/Renumbered Pages 1 through 4 of Test Data Sheet
C	10CR28-97	Corrected Anti-Jam Test Signal Input to 55 Khz, Para. 16.5; Added Note to Para 2.0, and Para 4.14, for use on 956A-200 units.
4	9CR48-99	Added M&TE use to "SCOPE"; added second 4-20 mA column to Data Sheet ; deleted 956A-200 applicability from "SCOPE"

INOVISION RADIATION MEASUREMENTS
TITLE: TEST PROCEDURE FOR THE 956A-201 UNIVERSAL DIGITAL RATEMETER
CUSTOMER: N/A
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1.0 PURPOSE

The purpose of this procedure is to provide a uniform method to functionally test the Model 956A-201 Ratemeter.

2.0 SCOPE

This procedure is to be performed on all 956A-201 series Universal Digital Ratemeters prior to placing in stock. In addition, this procedure is to be used to document post repair testing of any 956A-201 series units returned for repair or calibration.

NOTE: Refer to drawing 956A-201-106 for Ratemeter/Detector interconnections.

3.0 RESPONSIBILITIES

3.1 Personnel performing this test must have a Technicians Skill Level 2 per S.O.P. 902.003.

3.2 Data generated by this procedure must be reviewed and approved by Q.A. prior to shipment to customer. A copy of the test Data Sheet shall be retained by Q.A. and placed in a job file.

4.0 EQUIPMENT REQUIRED

4.1 942TS-100 Test Set with interconnecting cables 942ATS-100-14 and 942TS-100-37.

4.2 Televideo Terminal (TV) or RS-232 Compatible Device.

4.3 942-200-80A Communications PCB Assembly with Test Cable.

4.4 Dual Channel Oscilloscope/Tektronix 465 or equivalent.

4.5 High Voltage Probe: Fluke 80K-6 or equivalent -- must be calibrated.

4.6 Wavetek 187 Signal Generator or equivalent.

4.7 Frequency Counter: Fluke 1900A or equivalent -- must be calibrated.

Note: If the Function/Pulse generator used has a calibrated display, a calibrated frequency counter is not required.

4.8 Test Software 94094200200 (Latest Revision Level).

4.9 Test Leads, BNC terminated coaxial cables, etc.

4.10 Digital Multi-Meter (DMM): Fluke 8050A or equivalent -- must be calibrated.

4.11 956A-201/897A-2XX Interconnecting cable per drawing 956A-201-106.

4.12 Right Angle Connector for 942-200-80A Board.

4.13 Detector: 897A-210 or 897A-220 shop test unit.

5.0 SET-UP (See Figure 1)

5.1 Set-up the Main PCB Assembly jumpers (Located in rear, right hand corner except JP-3, located near center of PCB Assembly) as follows:

JP-1,	None,	Momentary short for RESET
JP-2,	2-3,	Prom size (27C256)
JP-3,	ALL,	Sensitivity Select, Auto Acknowledge, No Fail, Alarms on C/S
JP-4,	2-3,	Positive Input Pulse
JP-5,	2-3,	Shield Ground
JP-6,	2-3,	Anti-Jam Fuse Disable for testing
JP-7,	2-3,	GM Detector Anti-Jam Pulse Select

5.2 Set-up Televideo (referred to as TV) or other RS-232 compatible device, as follows:

Press "F5" key for "SET UP".
Press "F2" key for "COMM".
Press Function keys to set up the following:

4800	4800	NONE	8	1	FDX	X-ON
				2	HDX	

M.BAUD	P.BAUD	PARITY	D.BITS	S.BITS	MODE	PROTCL

Press "ALPHA LOCK" key. Observe a "*" in the Lower, Left Corner of the highlighted Menu Block (Televideo Only).

5.3 Set-up Signal Generator as follows:

A. Square Wave pulse
B. 1 volt peak positive pulse
C. DC offset: at ground reference
D. 100 kHz

5.4 Connect Line Cord to P3.

5.5 DC Power Supply Verification

5.5.1 Connect the DVM neg lead to the Ground point (black 18GA wires) located on the power supply assembly terminal block. Connect the DVM positive lead to the +5 point (blue 18 GA wires) located on the power supply assembly terminal block.

5.5.2 Apply power to the unit under test.

5.5.3 Verify a +5.00 VDC ± 0.100 VDC reading on the DVM. A single adjustment is VIA VR1 provided on the 5V power supply to trim all three supply outputs. Enter the final reading on the test data sheet.

5.5.4 Connect the DVM positive lead to the +15V terminal (red 18 GA wires). Verify a reading of +15V±0.75VDC. Enter the reading on test data sheet.

5.5.5 Connect the DVM positive lead to the -15VDC terminal (orange 18 GA wires). Verify a reading of -15VDC ±0.75 VDC. reading on the test Data Sheet.

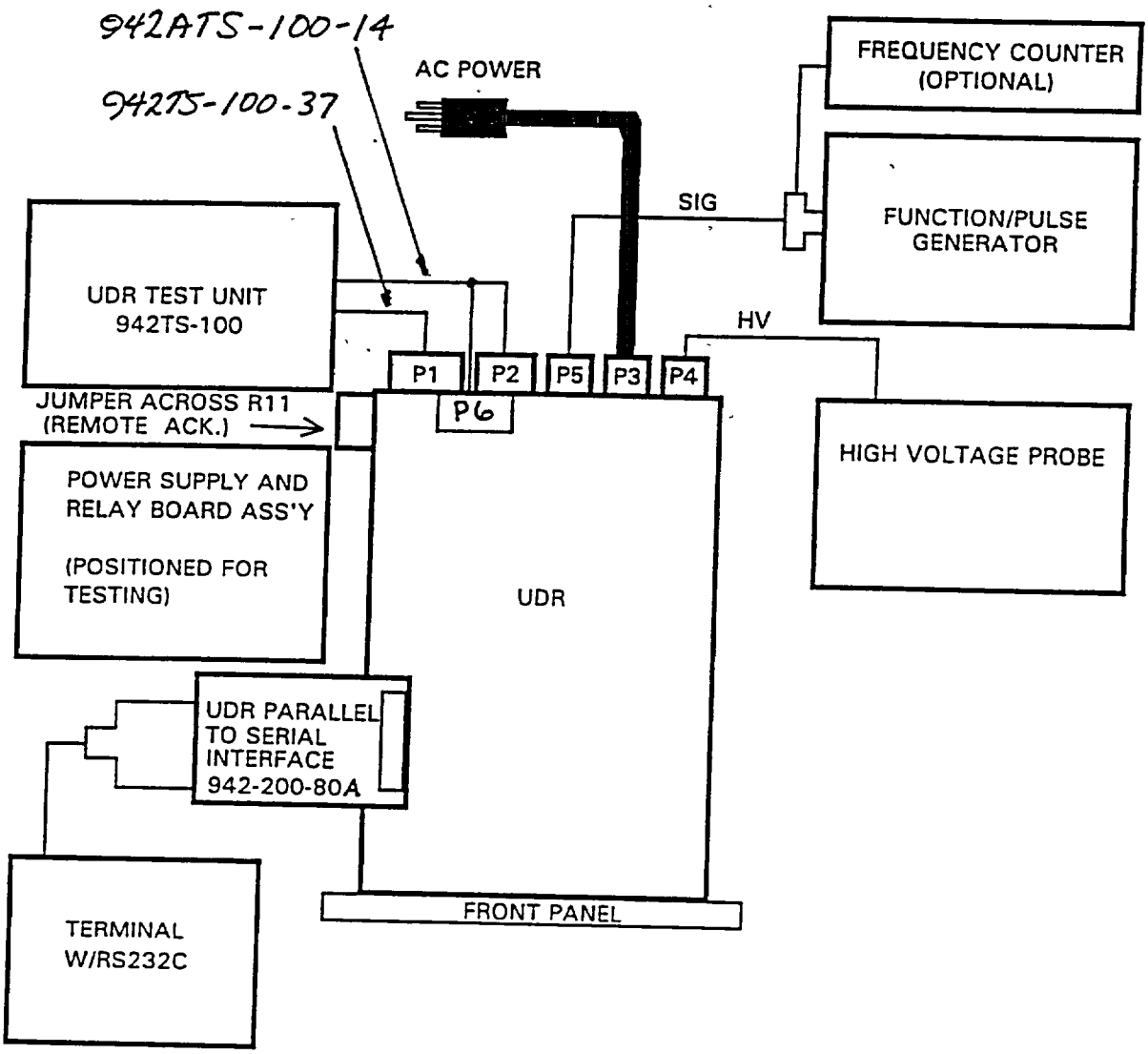

FIGURE 1

TABLE I -- Serial Interface Baud Rate, P/N 942-200-80A

SWITCH POSITION				OUTPUT RATE
4	3	2	1	(BAUD RATE)
OFF	OFF	ON	ON	110
OFF	ON	OFF	ON	150
ON	OFF	OFF	ON	300
OFF	OFF	OFF	ON	600
ON	ON	ON	OFF	1200
ON	OFF	ON	OFF	2400
* ON	ON	OFF	OFF	4800
ON	OFF	OFF	OFF	9600

* Normal setting for test and operational modes.

NOTE: Switches 5, 7 and 8 should be in the OFF position while Switch 6 should be in the ON position.

6.0 WRITE CLOCK ADJUSTMENT

6.1 Apply Power to the UDR.

6.2 Adjust Oscilloscope for 2 V/DIV., .2 uS/DIV. Set trigger to Channel 1 for a negative going pulse.

6.3 Connect Channel 1 to U19-2 (/CLOCK).

6.4 Connect Channel 2 to U19-12 (/SHORT 02).

6.5 Adjust VR13 to obtain a 225 nS delay between the negative going edge of Channel 1 and the negative going edge of Channel 2 as shown in Figure 2. Paint VR13.

6.6 Circle result (Pass/Fail) on Data Sheet.

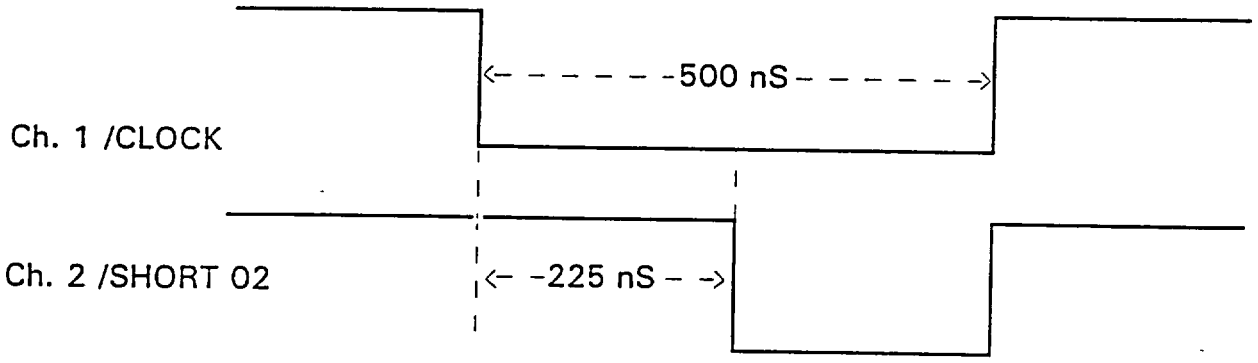

FIGURE 2

7.0 DISCRIMINATOR ADJUSTMENT

7.1 Connect DMM (+) lead to the "HI" test jack and the (-) lead to the "GND" test jack.

7.2 Adjust VR10, high discriminator, to both extremes verifying a range of approximately 3.6 V to 7.4 V. Record PASS or FAIL on the Data Sheet.

7.3 Adjust VR10 for 5 +/- 0.01 V and record the final value on the Data Sheet.

7.4 Connect DMM (+) lead to the "LO" test jack.

7.5 Adjust VR11, low discriminator, to both extremes verifying a range of approximately 0.07 V to 1.0 V. Record PASS or FAIL on the Data Sheet.

7.6 Adjust VR11 for 0.5 +/- 0.001 V and record the final value on the Data Sheet.

8.0 INPUT AMPLIFIER ADJUSTMENT

8.1 Using a test lead, short "P5 SIG." Input to chassis GND.

8.2 Connect DMM (+) lead to "PULSE" test point (Located near JP6).

8.3 Adjust VR9 for .0000 V +/- .0001 V. Paint VR9.

8.4 Record value on Data Sheet.

8.5 Remove test lead from "P5 SIG.". Connect Signal Generator to "P5 SIG.".

8.6 Set-up Oscilloscope for .2 V/DIV., 2 uS/DIV.

8.7 Connect Oscilloscope Channel 1 to "P5 SIG.".

8.8 Connect Oscilloscope Channel 2 to "PULSE" test point.

8.9 Adjust VR8 so that both waveforms are at equal amplitudes (Unity Gain). Paint VR8.

8.10 Circle result (Pass/Fail) on Data Sheet.

9.0 ANTI-JAM ADJUSTMENT

9.1 Connect DMM (+) lead to the right side of R94.

9.2 Adjust VR12 to both extremes verifying a range of approximately 0.0 V to 1.5 V.

9.3 Circle result (Pass/Fail) on Data Sheet.

9.4 Adjust VR12 for 0.875 V +/- .001 V. Paint VR12.

9.5 Record value on Data Sheet.

9.6 Turn UDR Power Off and install Test Software 94094200 into U23.

9.7 Connect 942TS-100 Test Set cables to the "P1 I/O", "P2 DET.", and "P6 AUX" connectors located on rear panel. See Figure 1.

9.8 On the 942-200-80A Communications PCB Assembly, place SW1-3, 4, and 6 in the ON position. See Table 1.

9.9 Connect the 942-200-80A Communications PCB Assembly to J3 of Main PCB Assembly via the Right Angle Connector. Connect the Televideo (Referred to as TV) RS-232 cable to the 942-200-80A's J4.

10.0 TEST 1: RAM TEST

10.1 Apply Power to UDR. TV should prompt. Select "M" for "TEST MENU". Select "1" for "BASE UNIT TEST" Menu. Menu will be displayed.

RAM TEST verifies read and write functions and data patterns in RAM address 0090 through 1FFF. Data patterns are 00, FF, 55, AA and 00-FF repeated. Error addresses will be displayed on the TV.

10.2 Select subtest "1".

10.3 Verify all RAM locations pass.

10.4 Circle result (Pass/Fail) on Data Sheet.

11.0 TEST 3: BAR GRAPH TEST

BAR GRAPH TEST activates each segment from left to right starting with Green, then Amber, and then Red.

11.1 Select subtest "3".

11.2 Verify that all Bar Graph Segments activate in proper sequence and color.

11.3 Circle result (Pass/Fail) on Data Sheet.

12.0 TEST 4: DISPLAY TEST

DISPLAY TEST cycles each character from right to left across the display. Character sequence is 1, 2, 3, 4, 5, 6, 7, 8, 9, -, E, H, L, P, ., .

12.1 Select subtest "4".

12.2 Verify that all units properly display each character and in the right sequence.

12.3 Circle result (Pass/Fail) on Data Sheet.

13.0 TEST 5: SWITCH TEST

SWITCH TEST reads status changes of the UDR's front panel switches and the 942TS-100 Test Set's REMOTE ACK switch.

13.1 Connect jumper wire across the R11 position (Located in rear, left hand corner).

13.2 Select subtest "5".

13.3 Press each front panel switch several times and verify that the TV displays the correct switch each time.

13.4 Press the 942TS-100 REMOTE ACK switch several times and verify that the TV displays the correct switch each time. Remove the jumper wire from across R11 position.

13.5 Circle result (Pass/Fail) on Data Sheet.

14.0 TEST 6: INDICATOR/BACKLITE/FAIL TEST

INDICATOR/BACKLITE/FAIL TEST cycles through front panel indicators/backlites in sequence as displayed on the TV. The fail light which is normally on will extinguish by this test. It will time out and re-activate in approximately 2 seconds. The Warn indicator is Amber.

14.1 Select subtest "6".

14.2 Verify each indicator/backlite activates as the TV display status indicates. Verify FAIL LED operation.

14.3 Circle result (Pass/Fail) on Data Sheet.

15.0 TEST 7: COUNTER/DISCRIMINATOR TEST

COUNTER TEST displays on the TV the input frequency in Hz, until any key is depressed. DISCRIMINATOR TEST involves adjusting the input signal amplitude below, within, and above the discriminator settings (262,126 Hz indicates overflow of counters). Connect Oscilloscope Channel A to P5 signal.

15.1 Adjust Signal Generator for a +400 mV pulse at 1 KHz.

15.2 Select subtest "7".

15.3 Verify TV reads 000000 HZ. Enter result on Data Sheet.

15.4 Adjust Signal Generator amplitude for a +1 V.

15.5 Verify TV reads 001000 Hz +/- 000010 Hz. Enter result on Data Sheet.

15.6 Adjust Signal Generator frequency for 100 Hz.

15.7 Verify TV reads 000100 Hz +/- 00001 Hz. Enter result on Data Sheet.

15.8 Adjust Signal Generator frequency for 10 kHz.

15.9 Verify TV reads 010000 Hz +/- 000100 Hz. Enter result on Data Sheet.

15.10 Adjust Signal Generator frequency for 100 kHz.

15.11 Verify TV reads 100000 +/- 001000 Hz. Enter results on Data Sheet.

15.12 Adjust Signal Generator frequency for 280 kHz.

15.13 Verify TV reads 262126 Hz (Overflow). Enter result on Data Sheet.

15.14 Adjust Signal Generator amplitude for a +5.5 V.

15.15 Verify TV reads 000000 Hz +/- 000010 Hz. Enter result on Data Sheet.

15.16 Disconnect Signal Generator from "P5 SIG.".

15.17 Adjust VR10 for a 7 +/- 0.01V DVM indication. Neg probe on "GND" test jack, and positive probe on "HI" test jack. Record the final value on the Data Sheet.

15.18 Verify VRII adjustment for 0.5 +/- 0.001 V. DVM Neg probe on "GND" test jack and positive probe on "LO" test jack. Record the final value on the Data Sheet.

16.0 ANTI JAM BIT TEST

This test exercises the anti jam circuitry by injecting a frequency greater than the anti jam voltage. The anti jam bit is D1 of location 4008H.

16.1 Cycle power on the UDR.

16.2 Adjust signal generator to 40 KHz with a +5V peak.

16.3 Type in 4008/.

16.4 The response will be 05 after the " / ". Record on Data Sheet.

16.5 Increase signal generator to 55 KHz.

16.6 Type in 4008/.

16.7 The response will be 07 after the " / ". Record on Data Sheet.

16.8 Decrease frequency generator to 40 KHz.

16.9 Cycle power on the UDR.

16.10 Type in 4008/.

16.11 The response will be 05 after the " / ". Record on Data Sheet

16.12 Type "M" and select the base unit test.

17.0 TEST 8: D/A CONVERTER 4-20 mA/0-10 V OUTPUT TEST

The D/A CONVERTER TEST sets the high scale and low scale output for calibration of two 4-20 mA outputs and one 0 -10 V output. The 942TS-100T Set has had 250 Ohm Load Resistors added to the 4-20 mA output connections. The measurements will be made in volts even though the TV instructions call for current. Verification of low, mid, and high scale are performed. Follow calibration instructions displayed on TV.

Refer to following table for correct conversions and tolerances.

4-20 mA OUTPUTS

SCALE	CURRENT	VOLTAGE
Low	4 mA	1.000 V +/- .001 V
Mid	12 mA	3.000 V +/- .015 V
High	20 mA	5.000 V +/- .001 V

0-10 V OUTPUT

SCALE	VOLTAGE
Low	.0000 V +/- .0001 V
Mid	5.000 V +/- .030 V
High	10.000 V +/- .001 V

17.1 Select subtest "8".

17.2 Follow TV calibration instructions.

17.3 Record Calibration Verification values on Data Sheet.

17.4 Paint VR1, VR2, VR4, VR5, VR6, and VR7.

18.0 TEST 9: EEPROM TEST

EEPROM TEST writes data patterns to the EEPROM device then prompts the user to cycle power. The program is re-entered by the user and a verification of data patterns is performed by the test program.

CAUTION
THIS TEST WILL DESTROY PREVIOUS SETPOINTS.

18.1 Select subtest "9".

18.2 Select "W".

18.3 Turn UDR Off, wait one minute, then turn on.

18.4 TV should prompt. Select "M" for "TEST MENU". Select "1" for "BASE UNIT TEST" Menu. Menu will be displayed.

18.5 Select subtest "9".

18.6 Select "V".

18.7 Result will be displayed on TV. Circle result (Pass/Fail) on Data Sheet.

19.0 TEST A: NON-MASKABLE INTERRUPT VERIFICATION (NMI) TEST

The NMI VERIFICATION TEST measures the time interval between interrupts and displays this time period in mS on the TV. NMI occurs at 8 Hz rate, therefore, the terminal should display 125 mS.

19.1 Select subtest "A".

19.2 Verify TV reads 125 mS +/- 1 mS.

19.3 Record result on Data Sheet.

20.0 TEST B: HIGH VOLTAGE POWER SUPPLY TEST

The HIGH VOLTAGE POWER SUPPLY TEST verifies the voltage range as well as testing the HV Shutdown function.

20.1 Connect HV Probe (-) lead to "GND" test jack. Connect HV Probe (+) lead to "P4 HV" MHV Connector.

20.2 Select subtest "B".

20.3 Adjust R5 (HV PCB Assy.) for a reading of 600 V ± 1 V.

20.4 Record value on Data Sheet.

20.5 Connect DMM (+) lead to the "HV TEST" test jack (Test jack provides a 1000:1 DC voltage measurement). Verify a DMM reading of 0.600 V ± .060 V.

20.6 Record value on Data Sheet.

20.7 Adjust R5 to both extremes verifying a voltage range of 400 V to 1800 V.

20.8 Record adjustment minimum and maximum values on the Data Sheet.

20.9 Re-adjust HV for 550 V +/- 1 Volt.

20.10 Enter "S" on TV. Verify that HV has been shut down.

20.11 Circle result (Pass/Fail) on Data Sheet.

21.0 TEST C: DATA ENTRY TEST

The DATA ENTRY TEST verifies operation of the Data Entry switches ("DIGIT", "VALUE", "ENTER") and the "FUNCTION" switch.

21.1 Select subtest "C".

21.2 Press each Data Entry switch several times and verify that TV displays correct entries.

21.3 Circle result (Pass/Fail) on Data Sheet.

21.4 Select "F" for Function switch test. Verify correct "FUNCTION" switch position. Repeat test for each "FUNCTION" switch position 0 through F.

21.5 Circle result (Pass/Fail) on Data Sheet.

22.0 TEST D: RELAY TEST

The RELAY TEST sets each relay from de-energized to energized state in sequence as displayed on the TV. The 942TS Test Set provides the relay status information. Note that the 956A-201 checksource will not cause a lamp state change to occur during this test. Checksource function is tested with a shop detector in Section 24.10.

22.1 Select subtest "D".

22.2 Hold down the "D" key for several executions of the test.

22.3 Verify each relay and its contacts response according to TV information displayed.

22.4 Circle result (Pass/Fail) on Data Sheet.

23.0 TEST F: JUMPER CONFIGURATION TEST

The JUMPER CONFIGURATION TEST verifies whether or not JP3 Jumpers 1-5 are installed and displays the appropriate position on the TV.

23.1 Select subtest "F".

23.2 Verify that all JP3 jumpers are installed.

23.3 Remove all JP3 jumpers. Repeat test and verify that all jumpers are removed.

23.4 Install one jumper at a time and verify the position of that jumper is correct by repeating the test.

23.5 Circle result (Pass/Fail) on the Data Sheet.

24.0 OPERATING SOFTWARE TEST

24.1 Remove Power from the UDR. Remove DMM leads. Remove 942TS Test Set connections. Remove 942-200-80A Communications PCB Assembly and angle bracket.

24.2 Replace Test Software with Operating Software. Standard operating software is 94095603.

24.3 Hold down the "ENTER" Key and then apply power to UDR (Automatically sets "HIGH" and "WARN" Alarm Levels). Turn Power Off then re-apply Power.

24.4 0.00 mR/h should be displayed and the "RANGE" LED should be On.

24.5 Depress the "HIGH" button. Verify 1.00E3 mR/h.

24.6 Depress the "WARN" button. Verify 1.00E1 mR/h.

24.7 Depress the "CHECK SOURCE" button. Verify CHECKSOURCE LED turns On.

24.8 Circle result (Pass/Fail) on Data Sheet.

24.9 Sign off Travelers and Data Sheet.

24.10 Send unit to Production for Final Assembly.

25.0 BURN-IN

25.1 The 956A-201 UDR Final Assembly will be installed in a 948-1 Rack Chassis and burned in for 100 hours.

25.2 Visual Assembly for cosmetic defects and loose hardware. Verify that correct Travelers and Data Sheets are properly completed. Record operational firmware number and revision level on Data Sheet and Travelers.

25.3 Place JMP-6 in the 1-2 position (Enable anti-jam circuit). Install the UDR into a 948-1 Rack Chassis.

25.4 Apply Power. 0.00 mR/h should be displayed and the "RANGE" LED should be On (If EEEEE is displayed, Anti-Jam Fuse F1 is defective. Replace if necessary.) After approximately five (5) minutes, the "FAIL" LED should turn On.

25.5 Depress the "HIGH" button. Verify 1.00E3 mR/h.

25.6 Depress the "WARN" button. Verify 1.00E1 mR/h.

25.7 Depress the "CHECK SOURCE" button. Verify LED turns On.

25.8 Log the start time of the burn-in on the Data Sheet.

NOTE

Quality Assurance is to be notified of any failures noted during burn-in. The entire procedure, Section 25, must be repeated in the event of a failure.

25.9 After 100 hours, log burn-in stop date and time, and repeat Steps 24.5 through 24.7. Remove power. Using an interconnection cable wired per drawing 956A-201-106, connect the 956A-201 under test to a shop 897A-210 or 897A-220 detector.

25.10 Apply Power. Verify that the UDR responds to the Detector by activating the 956A checksource push button and noting the increase in displayed value.

25.11 Remove Power. Remove the Interconnect Cable and the Line Cord. UDR is now ready to be cleaned up and packaged.

25.12 Circle results (Pass/Fail) on Data Sheet.

26.0 DOCUMENTATION

26.1 After final review, Quality Assurance shall file the completed original document in the Quality Assurance Sales or Job File.

956A-201 TEST DATA SHEET 1, Page 1 of 4

PART NUMBER_____

SERIAL NUMBER _____

DMM Model _____ S/N _____ Cal. Due Date ___/___/___

Scope_____ S/N _____ Cal. Due Date ___/___/___

H.V. Probe _____ S/N _____ Cal. Due Date ___/___/___

Frequency Counter _____ S/N _____ Cal. Due Date ___/___/___

Test Software 940942200200 Rev. Level _____

Operating Software _____ Rev. Level _____

5.5 SET-UP

+5VDC ± 0.100VDC _____V

+15VDC ± .75VDC _____V

-15VDC ± .75VDC _____V

6.0 WRITE CLOCK ADJUSTMENT

6.6 VR13 Adjustment Pass/Fail

7.0 DISCRIMINATOR ADJUSTMENT

7.2 VR10 Adjustment Pass/Fail

7.3 VR10 Final Setting _____(5 ± 0.01 V)

7.5 VR11 Adjustment Pass/Fail

7.6 VR11 Final Setting _____(0.5 ± 0.01 V)

8.0 INPUT AMPLIFIER ADJUSTMENT

8.4 VR9 Adjustment .0000 V +/- .0001 V _____V

8.10 VR8 Adjustment Unity Gain Pass/Fail

9.0 ANTI-JAM ADJUSTMENT

9.3 VR12 Adjustment Range Pass/Fail

9.5 VR12 Adjustment 0.875 V +/- .0001 V _____V

10.0 TEST 1: RAM TEST

10.4 RAM Locations Pass/Fail

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11.0 TEST 3: BAR GRAPH TEST

11.3	Bar Graph Segment Sequence and Color	Pass/Fail

12.0 TEST 4: DISPLAY TEST

12.3	Display Characters and Sequence	Pass/Fail

13.0 TEST 5: SWITCH TEST

13.5	Front Panel Switches and REMOTE ACK.	Pass/Fail

14.0 TEST 6: INDICATOR/BACKLITE/FAIL TEST

14.3	Indicator/Backlite/Fail LED Operation	Pass/Fail

15.0 TEST 7: COUNTER/DISCRIMINATOR TEST

15.3	Verify 000000 Hz	_____ Hz
15.5	Verify 001000 Hz +/- 000010 Hz	_____ Hz
15.7	Verify 000100 Hz +/- 000001 Hz	_____ Hz
15.9	Verify 010000 Hz +/- 000100 Hz	_____ Hz
15.11	Verify 100000 +/- 001000 Hz	_____ Hz
15.13	Verify Overflow 262126 Hz	_____ Hz
15.15	Verify 000000 Hz +/- 000010 Hz	_____ Hz
15.17	VR10 Adjustment, 7 V +/- 0.01 V	_____ V
15.18	VR11 Adjustment, 0.5 V +/- 0.001 V	_____ V

16.0 ANTI JAM BIT TEST

16.4	Verify 05 displayed	_____
16.7	Verify 07 displayed	_____
16.11	Verify 05 displayed	_____

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956A-201 TEST DATA SHEET Page 3 of 4

17.0 TEST 8: D/A CONVERTER 4-20 mA/0-10 V OUTPUT TEST

17.3 Calibration Verification, Analog Outputs:

4-20 mA OUTPUTS #1 and #2

SCALE	CURRENT	VOLTAGE SPEC.	Output #1	Output #2
Low	4 mA	1 +/- .001 V	_____V	_____V
Mid	12 mA	3 +/- .010 V	_____V	_____V
High	20 mA	5 +/- .001 V	_____V	_____V

0-10 V OUTPUT

SCALE	VOLTAGE SPEC.	VALUE
Low	.0000 V +/- .0001 V	_____V
Mid	5.000 V +/- .030 V	_____V
High	10.000 V +/- .001 V	_____V

18.0 TEST 9: EEPROM TEST

18.7 Write and Verify Pass/Fail

19.0 TEST A: NON-MASKABLE INTERRUPT VERIFICATION (NMI) TEST

19.3 Verify 125 mS +/- 1 mS Pass/Fail

20.0 TEST B: HIGH VOLTAGE POWER SUPPLY TEST

20.4 R5 Adjustment/"P4 HV" _____V

20.6 "HV TEST" Jack (0.600 +/- 0.010 V) _____ V

20.8 R5 Adjustment (400 V to 1800 V) ____min ____max

20.11 HV Shut Down Pass/Fail

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21.0 TEST C: DATA ENTRY TEST

21.3	DIGIT, VALUE, and ENTER Switches	Pass/Fail
21.5	FUNCTION Switch	Pass/Fail

22.0 TEST D: RELAY TEST

22.4	Relay Response	Pass/Fail

23.0 TEST F: JUMPER CONFIGURATION TEST

23.5	JP3 Jumpers	Pass/Fail

24.0 OPERATION SOFTWARE TEST

24.8	Display Reading, "RANGE" LED HV Reading, "High", "Warn", "Rate" Values, Check Source LED	Pass/Fail

25.0 BURN-IN

25.8	Burn-in Start Date/Time	_____
25.9	Burn-in Stop Date/Time)	_____
25.10	Check Source Function	Pass/Fail
25.12	No failures observed during burn-in and Post burn-in tests	Pass/Fail

Performed By _____ Date ___/___/___

Q.A. Review By _____ Date ___/___/___

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VICTOREEN, INC. TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-22X SERIES DETECTORS CUSTOMER: N/A DOCUMENT: TP956A/897A-22X REV. B	PAGE 1 OF 16

ISSUE DATE: JANUARY 9, 1996

REVISION LIST

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	APPROVAL	DATE
PROJECT ENGINEER	George H Buck	5/2/96
TECHNICAL SUPPORT MANAGER		5/2/96
QUALITY ASSURANCE		5/2/96

ISSUED BY: DAVID WARNER

VICTOREEN, INC.
TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-22X SERIES DETECTORS
CUSTOMER: N/A
DOCUMENT: TP956A/897A-22X REV. B

RECORD OF REVISIONS

DOCUMENT REV. LEVEL	DESCRIPTION/PAGES AFFECTED
A	Supersedes LT956/897
B	Revised Paragraphs 6.2, 7.1.5, 7.1.8, 7.1.12, 7.2.1, 7.2.5, Identified Tables, and revised Page 2 of Data Sheet Truth Table

VICTOREEN, INC.
TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-22X SERIES DETECTORS
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DOCUMENT: TP956A/897A-22X REV. B

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1.0 PURPOSE

The purpose of this procedure is to verify the proper operation of a complete MEDIUM RANGE 955A Area Monitor channel.

2.0 SCOPE

2.1 This procedure is to be performed on all MEDIUM RANGE 955A channels prior to shipment. This procedure gives detailed instructions on integrated testing of the model 956A-201 rate meter (UDR) and model 897A-220 or 897A-221 detectors. In addition, this procedure covers integrated testing of 958 or 958A series remote alarm/indicators if supplied. Any combination of the following equipment may be tested using this procedure.

Rate Meter	Detector	Remote Alarm (Optional)
956A-201	897A-220, 897A-221	958-20, 958A-20 958-40, 958A-40

Note: **Space on the Data Sheet is provided to identify and test some possible options such non-standard analog outputs.**

2.2 The following functions and operational parameters are tested by this procedure:

2.2.1 956A-201 Display value within tolerance.

2.2.2 956A-201 Analog Outputs within tolerance including optional outputs (if provided).

2.2.3 Check Source response greater than minimum requirements.

2.2.4 Alarm, Warn, Range, Overrange and Fail Actuation.

2.2.5 958/958A Remote Alarm display and annunciation (if applicable).

2.2.6 958A Remote Alarm silence feature (if applicable).

2.2.7 958 Remote Alarm relay auxiliary contacts (if applicable).

3.0 RESPONSIBILITIES

3.1 Personnel performing this test must have a Technicians Skill Level 1 per S.O.P. 902.003.

3.2 Data generated by this test must be reviewed and approved by Q.A. prior to shipment. In addition, Q.A. has the responsibility of maintaining channel or systems test data in a job file.

3.3 Individuals performing this procedure must insure that it is conducted in such manner as to minimize radiation exposure to both themselves and others. Personal radiation dosimetry is required for any individuals participating in this procedure when a Field Calibrator is in use.

4.0 ENVIRONMENTAL CONDITIONS

4.1 Environmental conditions shall be the prevailing laboratory ambient for temperature and humidity.

5.0 EQUIPMENT REQUIRED

5.1 Customer 848-8 to be supplied with channel -- must be calibrated. If no Customer Calibrator is provided or available, VICTOREEN Model 848-8 Field Calibrator Serial Number 119 is to be used.

5.2 848-8-105 Field Calibrator Adapter, customer provided or Victoreen equipment.

5.2.1 848-8-400 Adapter for 897A-221 detectors with stainless steel housing only.

5.3 Digital Voltmeter: Fluke 8050A or equivalent - must be calibrated.

5.4 Personal dosimetry.

5.5 Radiation control barriers (yellow/magenta rope) and Radiation Area warning signs (if access control of area cannot be assured).

5.6 Interconnection cables between detector, rate meter and remote alarm (if applicable) refer to one of the following loop diagrams:

5.6.1 956A-201-106: 956A-201 ratemeter to 897A-220 or 897A-221 detectors.

5.6.2 958-1-24: As above but including 958-20 or 958-40 Remote Alarm.

5.6.3 958A-1-24: As above but including 958A-20 or 958A-40 Remote Alarm.

5.6.4 Job Specific Loop Diagram (contact project engineer).

5.7 250 ohm, 1 % resistors (2) for 4-20 mA termination.

6.0 PREREQUISITES

6.1 Prior to interconnecting equipment, verify by model number that all of the equipment listed on the sales or work order is present and that all required option boards (if applicable) are installed in the 956A-201 ratemeter.

6.2 Completed and signed copies of CAL-GM6 (897A series detectors) and TP956-201-3 (956A-201 ratemeter) are required prior to beginning this procedure. Completed and signed copies of any option board tests are also required when option boards are installed.

7.0 PROCEDURE

7.1 Preliminary Data and Set-up.

7.1.1 Record the customer, P.O. and S.O. numbers on the Data Sheet.

7.1.2 Record the model and serial numbers of all equipment to be tested.

7.1.3 Record the model serial number and calibration due date of the digital voltmeter.

7.1.4 Record the 956A-201 firmware number and revision/date on the Data Sheet.

7.1.5 Decay correct to the current date the 897A dose rate listed on the 848-8 S/N 119 or Customer 848-8 Calibration Data Sheet for the CLOSED and MID positions. No dose rate calculations are required for the OPEN position as it will be used to overrange the unit under test. Enter the decay corrected dose rates under the "Desired" column of the Display/Analog Output Table on the Data Sheet.

Decay Formula: $\text{Current Dose Rate} = R * e^{\left(-0.693 \frac{(t_2 - t_1)}{30.0}\right)}$

Where R = is the baseline dose rate

The elapsed time in years from the date dose rate was determined to the current date

30.0 = the half-life of 137-Cs in years

Table 1, 137-Cs Half Life Table, may also be used to determine the current dose rate for this step.

TABLE 1

HALF-LIFE DECAY TABLE FOR Cs-137 OVER 10 YEARS (HALF-LIFE 30.00 YEARS)

	ELAPSED TIME -- MONTHS											
YEAR	0	1	2	3	4	5	6	7	8	9	10	11
0	1.000	0.998	0.996	0.994	0.992	0.990	0.989	0.987	0.985	0.983	0.981	0.979
1	0.977	0.975	0.973	0.972	0.970	0.968	0.966	0.964	0.962	0.960	0.959	0.957
2	0.955	0.953	0.951	0.949	0.948	0.946	0.944	0.942	0.940	0.938	0.937	0.935
3	0.933	0.931	0.929	0.928	0.926	0.924	0.922	0.921	0.919	0.917	0.915	0.913
4	0.912	0.910	0.908	0.906	0.905	0.903	0.901	0.900	0.898	0.896	0.894	0.893
5	0.891	0.889	0.887	0.886	0.884	0.882	0.881	0.879	0.877	0.876	0.874	0.872
6	0.871	0.869	0.867	0.866	0.864	0.862	0.861	0.859	0.857	0.856	0.854	0.852
7	0.851	0.849	0.847	0.846	0.844	0.843	0.841	0.839	0.838	0.836	0.834	0.833
8	0.831	0.830	0.828	0.826	0.825	0.823	0.822	0.820	0.819	0.817	0.815	0.814
9	0.812	0.811	0.809	0.808	0.806	0.805	0.803	0.801	0.800	0.798	0.797	0.795

7.1.6 Convert the dose rates determined in step 7.1.5 into equivalent analog output voltage and current values for each of the CLOSED and MID calibrator positions using the formulas and examples given below.

First, using the formula below, convert the dose rate to a percentage of full-scale.

P = log(R/LSV)/[log(FSV)-log(LSV)]

where P = percentage of full-scale in decimal number

R = Current dose rate determined in step 7.1.4

LSV = Low Scale Value (Analog Low scale Setpoint)

FSV = Full Scale Value (Analog Full-scale Setpoint)

7.1.7 Next, using the formula below, convert to analog output voltage and current values as required by the configuration of the 956A-201 under test. For a standard 956A-201 this will be 1-5 volts (4-20 mA across 250 ohm) for current loop outputs and 0-10 volts for voltage output.

$$V = P(FSV-LSV) + LSV$$

where P = Percent of full-scale as a decimal number

FSV = Full-scale voltage

LSV = Low scale voltage

Other optional analog output voltages are also calculated using the above formula. Record the voltage values for each position of the 848-8 field calibrator on the Data Sheet under the "Desired" column of the Display/Analog Output Table. Values listed under the OPEN position on the Data Sheet will be the full-scale value of the specific analog output. Values listed under the FAIL position on the Data Sheet will be the low scale value of the specific analog output.

7.1.8 Remove jumper J7 from the 956A-201 main circuit board and retain for re-installation. Jumper J7 is removed to prevent anti-jam actuation during testing.

7.1.9 Interconnect all channel components per standard loop or job specific drawing and record the drawing and revision on the Data Sheet.

7.1.10 Terminate both 4-20 MA analog outputs with the 250 ohm 1% resistors. Analog output #1 is located at P6-1 (+) and P6-2 (-) while analog output #2 is located at P6-3 (+) and P6-4 (-). If no remote alarm is supplied the 0-10 volt output is measured at P6-5 (+) and P6-6 (-). Refer to job specific drawings for optional analog outputs that may be supplied.

NOTE: If a remote alarm is included, fill in the 0-10 volt/remote meter desired row on the Data Sheet with mR/h values. If no remote is included, fill in the row with calculated voltage values for each position. Position the Remote Alarm in the vertical position and adjust the mechanical zero (if applicable) prior to power-up.

7.1.11 Apply AC power to the 956A-201 and allow a minimum 15 minute warm-up period to elapse prior to proceeding with testing. Reset any alarms that may have tripped on power-up.

7.1.12 Enter setpoints into the 956A-201 in accordance with Table 2.

TABLE 2

956A-201 Parameter	Function Switch Position	Data Entry Value
High Alarm	0	1.00E2
Warn Alarm	1	1.00E1
Dead Time (Tau)	2	*
Analog Full Scale	3	1.00E4
Over Range	4	1.00E3
Conversion Constant	5	*
Analog Low Scale	7	1.00-1
Under Range	9	1.00-1

* See the detector CAL-GM6 Data Sheet for these values.

7.1.13 If the channel under test contains optional analog outputs, list these optional outputs on the Data Sheet. If no optional outputs are provided, enter N/A on the Data Sheet.

7.2 Channel Functional Test

7.2.1 Place the detector in a low background area away from the field calibrator and complete column 1 of the Data Sheet truth table. If a 958-20 or 958-40 remote alarm is part of the channel under test, verify the following remote alarm internal relay contact logic:

TB1-5 to TB1-7: > 20 meg ohms
TB1-6 to TB1-7: < 1 ohm

7.2.2 Depress the CHECK SOURCE push button on the 956A-201 and record the 956A-201 display value on the Data Sheet when the indication has stabilized. A minimum response of 10 mR/h is required.

7.2.3 Using the 848-8-105 adapter (and 848-8-400 if a 897A-221 is being tested), place the detector into the 848-8 field calibrator and expose the detector to the CLOSED position. Complete column 2 of the Data Sheet Truth Table and the Display/Analog Output Table.

Note: The 897A-211 detector is positioned in the 848-8-400 adapter so that the connector key will be at the 12:00 o'clock position relative to the 6:00 o'clock position of the source aperture.

7.2.4 With the 848-8 still in the closed position, depress the 956A-201 ACKNOWLEDGE push-button and complete column 3 of the Data Sheet Truth Table.

7.2.5 Expose the detector to the MID position of the 848-8 field calibrator and hold. Complete column 4 of the Truth Table and the Display/Analog Output Table on the Data Sheet. If a 958-20 or 958-40 remote alarm is included, verify the following remote alarm relay contact logic:

TB1-5 to TB1-7: < 1 ohm
TB1-6 to TB1-7: > 20 meg ohms

7.2.6 If a 958A-20 or 958A-40 remote alarm is installed, depress the SILENCE push-button on the remote alarm enclosure and complete column 5 of the Data Sheet Truth Table. If 958-20, 958-40 or no remote alarm is installed, fill in column 5 with N/A in each box.

7.2.7 With the 848-8 still in the MID position, depress the 956A-201 ACKNOWLEDGE push-button and complete column 6 of the Data Sheet Truth Table.

7.2.8 Expose the detector to the OPEN position of the 848-8 field calibrator and complete column 7 of the Truth Table and the Display/Analog Output Table on the Data Sheet.

7.2.9 Expose the detector to the MID position of the 848-8 field calibrator and depress the ACKNOWLEDGE push-button on the 956A-201. Complete column 8 of the Truth Table on the Data Sheet.

7.2.10 Remove the detector from the field calibrator and depress the 956A-201 ACKNOWLEDGE push-button. Disconnect the P5 signal connector and note the time. In approximately five (5) minutes, complete column 9 of the Truth Table and the Display/Analog Output Table on the Data Sheet.

7.2.11 Divide each of the "Desired" values in the Display/Analog Output Table by the "Actual" values recorded during testing. The "Actual" values must be within ±25% of the calculated "Desired" values for dose rate and voltage. If all values are within tolerance, complete verification. If any values are not within tolerance, reject the channel component that is out of tolerance and forward to the Production Test Department for repair or calibration.

7.2.12 Enter a value of 1.00E4 in position 4 (OVER RANGE).

7.2.13 Turn off 956A-201 power and remove all interconnection cables. Re-install jumper J7 in the 2-3 position on the 956A-201 main circuit board assembly.

7.2.14 If all values are within tolerance and the truth table logic is correct, complete and sign the Data Sheet and forward to QA for review. Verify that all required accessories such as connector kits, mounting brackets and rack chassis are present. Complete and sign travelers and forward to QA with the loop test Data Sheets.

7.2.15 If any portion of this test has not been successfully completed, return the failed component to production test for rework/re calibration as required along with the Data Sheet identifying the failure.

LOOP TEST DATA SHEET Page 1 of 3

Medium Range GM Area Monitor

Customer: _____ P.O. No.: _____

Channel ID No.: _____ (If Applicable) S.O. No.: _____

Readout Model: _____ Serial No.: _____

Detector Model: _____ Serial No.: _____

Remote Alarm Model: _____ Serial No.: _____

Test Equipment:

Field Calibrator 848-8 S/N 119 or Customer 848-8 S/N _____

D. V. M. Model #: _____ S/N: _____ Cal Due Date: _____

7.1.4 956A-201 Firmware Part Number: _____ Rev. _____

7.1.12 Detector Conversion Constant: _____

Detector Dead Time (Tau): _____

7.1.13 Analog Output Option 1: Range: _____ to _____

Analog Output Option 2: Range: _____ to _____

LOOP TEST DATA SHEET Page 2 of 3
DATA SHEET TRUTH TABLE

Note: Enter N/A in any columns or rows that are not applicable.

Step	7.2.1 Col 1	7.2.3 Col 2	7.2.4 Col 3	7.2.5 Col 4	7.2.6 Col 5	7.2.7 Col 6	7.2.8 Col 7	7.2.9 Col 8	7.2.10 Col 9
Function	Bkgnd	Alert Trip	Alert Ack	High Trip	958A Silence	High Ack	Over Range	OverRng Reset	Fail
High Lamp	(Off)	(Off)	(Off)	(Flash)	(Flash)	(On)	(On)	(Flash)	(Off)
Warn Lamp	(Off)	(Flash)	(On)	(On)	(On)	(On)	(On)	(Flash)	(Off)
Fail Lamp	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(On)
Range Lamp	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(On)	(Off)	(On)
Remote Alrm Lamp	(Off)	(Off)	(Off)	(On)	(On)	(On)	(On)	(On)	(Off)
Remote Alrm Horn	(Off)	(Off)	(Off)	(On)	(Off)	* (On)	* (On)	* (On)	(Off)
Bargraph Color	(Green)	(Amber)	(Amber)	(Red)	(Red)	(Red)	(Red)	(Red)	(Off)
High Relay P1-19 to P1-20	(Closed)	(Closed)	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
High Relay P1-19 to P1-21	(Open)	(Open)	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Warn Relay P1-13 to P1-14	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
Warn Relay P1-13 to P1-15	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Fail Relay P1-7 to P1-8	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Fail Relay P1-7 to P1-9	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)

* Except with 958A-20 or 958A-40 Remote Alarm

7.2.1 958 Remote Alarm Relay:
TB1-5 to TB1-7 _____ (> 20 Meg Ohms)
TB1-6 to TB1-7 _____ (< 1 Ohm)

7.2.2 Check Source Response:
_____ (> 10 mR/h)

7.2.5 958 Remote Alarm Relay:
TB1-5 to TB1-7 _____ (< 1 Ohm)
TB1-6 to TB1-7 _____ (> 20 Meg Ohms)

LOOP TEST DATA SHEET Page 3 of 3

DISPLAY/ANALOG OUTPUT TABLE

	848-8 S/N ___ Position CLOSED		848-8 S/N ___ Position MID		848-8 S/N ___ Position OPEN		Signal Fail Condition	
Function	Desired	Actual	Desired	Actual	Desired	Actual	Desired	Actual
** 956A-201 in mR/h					EEEEE		0.00	
Anlg Output 1 1 - 5 Volts					5.00 V		1.00 V	
Anlg Output 2 1 - 5 Volts					5.00 V		1.00 V	
0 - 10 Volt or Remote Meter					10.00 V or 1.00E4 mR/h		0.00 V or 0.1 mR/h	
* Analog Option								
* Analog Option								

* Enter N/A if no Analog Optional outputs are provided.

** The "desired" value in this row is the decay corrected 848-8 dose rate.

7.2.11 All "Actual" value within ±25% of calculated "desired" values _____ (Yes)

7.2.12 Value of 1.00E4 entered in Position 4 _____ (Yes)

Performed By: _____ Date: _____

Q.A. Review By: _____ Date: _____

VICTOREEN, INC. TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-21X SERIES DETECTORS CUSTOMER: N/A DOCUMENT: TP956A/897A-21X REV. C	PAGE 1 OF 17

ISSUE DATE: NOVEMBER 27, 1995

REVISION LIST

REV	ECO #	
C	4CR37-96	

	APPROVAL	DATE
PROJECT ENGINEER	George H Buck	5/2/96
TECHNICAL SUPPORT MANAGER		5/2/96
QUALITY ASSURANCE		5/2/96

ISSUED BY: DAVID WARNER

VICTOREEN, INC.
TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-21X SERIES DETECTORS
CUSTOMER: N/A
DOCUMENT: TP956A/897A-21X REV. C

RECORD OF REVISIONS

DOCUMENT REV. LEVEL	DESCRIPTION/PAGES AFFECTED
A	Supersedes LT956/897
B	Added Customer 848-8 option for calibration check in place of 848-8 S/N 119
C	Added 956A-201-M1 to procedure, Para 2.1, 7.2; Updated base UDR test procedure, Para 6.2; corrected local alarm contact states, Para 7.2.1, 7.2.5, more verbiage clarifications, Para 2.1, 6.0, 7.1.5, 7.1.12; Updated Data Sheet per above

VICTOREEN, INC.
TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-21X SERIES DETECTORS
CUSTOMER: N/A
DOCUMENT: TP956A/897A-21X REV. C

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1.0 PURPOSE

The purpose of this procedure is to verify the proper operation of a LOW RANGE 955A Area Monitor channel.

2.0 SCOPE

2.1 This procedure is to be performed on all LOW RANGE 955A channels prior to shipment. This procedure gives detailed instructions on integrated testing of the model 956A-201 rate meter (UDR) and model 897A-210 or 897A-211 detectors. Unless stated otherwise, the Model 956A-201 refers to both the 956A-201 and the 956A-201-M1 readout. In addition, this procedure covers integrated testing of 958 or 958A series remote alarm/indicators if supplied. Any combination of the following equipment may be tested using this procedure.

Rate Meter	Detector	Remote Alarm (Optional)
956A-201 956A-201-M1	897A-210, 897A-211	958-10, 958A-10 958-40, 958A-40

Note: **Space on the Data Sheet is provided to identify and test some possible options such non-standard analog outputs.**

2.2 The following functions and operational parameters are tested by this procedure:

2.2.1 956A-201 Display value within tolerance.

2.2.2 956A-201 Analog Outputs within tolerance including optional outputs (if provided).

2.2.3 Check Source response greater than minimum requirements.

2.2.4 Alarm, Warn, Range, Overrange and Fail Actuation.

2.2.5 958/958A Remote Alarm display and annunciation (if applicable).

2.2.6 958A Remote Alarm silence feature (if applicable).

2.2.7 958 Remote Alarm relay auxiliary contacts (if applicable).

3.0 RESPONSIBILITIES

3.1 Personnel performing this test must have a Technicians Skill Level 1 per S.O.P. 902.003.

3.2 Data generated by this test must be reviewed and approved by Q.A. prior to shipment. In addition, Q.A has the responsibility of maintaining channel or systems test data in a job file.

3.3 Individuals performing this procedure must insure that it is conducted in such manner as to minimize radiation exposure to both themselves and others. Personal radiation dosimetry is required for any individuals participating in this procedure when a Field Calibrator is in use.

4.0 ENVIRONMENTAL CONDITIONS

4.1 Environmental conditions shall be the prevailing laboratory ambient for temperature and humidity.

5.0 EQUIPMENT REQUIRED

5.1 Customer 848-8 to be supplied with channel -- must be calibrated. If no Customer Calibrator is provided or available, VICTOREEN Model 848-8 Field Calibrator Serial Number 119 is to be used.

5.2 848-8-105 Field Calibrator Adapter, customer provided or Victoreen equipment.

5.2.1 848-8-400 Adapter for 897A-211 detectors with stainless steel housing only.

5.3 Digital Voltmeter: Fluke 8050A or equivalent - must be calibrated.

5.4 Personal dosimetry.

5.5 Radiation control barriers (yellow/magenta rope) and Radiation Area warning signs (if access control of area cannot be assured).

5.6 Interconnection cables between detector, rate meter and remote alarm (if applicable) refer to one of the following loop diagrams:

5.6.1 956A-201-106: 956A-201 ratemeter to 897A-210 or 897A-211 detectors.

5.6.2 958-1-24: As above but including 958-10 or 958-40 Remote Alarm.

5.6.3 958A-1-24: As above but including 958A-10 or 958A-40 Remote Alarm.

5.6.4 Job Specific Loop Diagram (contact project engineer).

5.7 250 ohm , 1 % resistors (2) for 4-20 mA termination.

6.0 PREREQUISITES

6.1 Prior to interconnecting equipment, verify by model number that all of the equipment listed on the sales or work order is present and that all required option boards (if applicable) are installed in the 956A-201 ratemeter.

6.2 Completed and signed copies of CAL-GM6 (897A series detectors) and TP956A-201-3 (956A-201 ratemeter) are required prior to beginning this procedure. Completed and signed copies of any option board tests are also required when option boards are installed.

7.0 PROCEDURE

7.1 Preliminary Data and Set-up.

7.1.1 Record the customer, P.O. and S.O. numbers on the Data Sheet.

7.1.2 Record the model and serial numbers of all equipment to be tested.

7.1.3 Record the model serial number and calibration due date of the digital voltmeter.

7.1.4 Record the 956A-201 firmware number and revision/date on the Data Sheet.

7.1.5 Decay correct to the current date the 897A dose rate listed on the 848-8 S/N 119 or Customer 848-8 Calibration Data Sheet for the CLOSED and MID positions. No dose rate calculations are required for the OPEN position as it will be used to overrange the unit under test. Enter the decay corrected dose rates under the "Desired" column of the Display/Analog Output Table on the Data Sheet.

Decay Formula: $\text{Current Dose Rate} = R * e^{\left(-0.693 \frac{(t_2 - t_1)}{30.0}\right)}$

Where R = is the baseline dose rate

The elapsed time in years from the date dose rate was determined to the current date

30.0 = the half-life of 137-Cs in years

Table 1, 137-Cs Half Life Decay Table, may also be used to determine the current dose rate for this step.

TABLE 1

HALF-LIFE DECAY TABLE FOR Cs-137 OVER 10 YEARS (HALF-LIFE 30.00 YEARS)

	ELAPSED TIME -- MONTHS											
YEAR	0	1	2	3	4	5	6	7	8	9	10	11
0	1.000	0.998	0.996	0.994	0.992	0.990	0.989	0.987	0.985	0.983	0.981	0.979
1	0.977	0.975	0.973	0.972	0.970	0.968	0.966	0.964	0.962	0.960	0.959	0.957
2	0.955	0.953	0.951	0.949	0.948	0.946	0.944	0.942	0.940	0.938	0.937	0.935
3	0.933	0.931	0.929	0.928	0.926	0.924	0.922	0.921	0.919	0.917	0.915	0.913
4	0.912	0.910	0.908	0.906	0.905	0.903	0.901	0.900	0.898	0.896	0.894	0.893
5	0.891	0.889	0.887	0.886	0.884	0.882	0.881	0.879	0.877	0.876	0.874	0.872
6	0.871	0.869	0.867	0.866	0.864	0.862	0.861	0.859	0.857	0.856	0.854	0.852
7	0.851	0.849	0.847	0.846	0.844	0.843	0.841	0.839	0.838	0.836	0.834	0.833
8	0.831	0.830	0.828	0.826	0.825	0.823	0.822	0.820	0.819	0.817	0.815	0.814
9	0.812	0.811	0.809	0.808	0.806	0.805	0.803	0.801	0.800	0.798	0.797	0.795

7.1.6 Convert the dose rates determined in step 7.1.5 into equivalent analog output voltage and current values for each of the CLOSED and MID calibrator positions using the formulas and examples given below.

First, using the formula below, convert the dose rate to a percentage of full-scale.

$P = \log(R/LSV)/[\log(FSV)-\log(LSV)]$

where P = percentage of full-scale in decimal number

R = Current dose rate determined in step 7.1.4

LSV = Low Scale Value (Analog Low scale Setpoint)

FSV = Full Scale Value (Analog Full-scale Setpoint)

7.1.7 Next, using the formula below, convert to analog output voltage and current values as required by the configuration of the 956A-201 under test. For a standard 956A-201 this will be 1-5 volts (4-20 mA across 250 ohm) for current loop outputs and 0-10 volts for voltage output.

V = P(FSV-LSV) + LSV

where P = Percent of full-scale as a decimal number

FSV = Full-scale voltage

LSV = Low scale voltage

Other optional analog output voltages are also calculated using the above formula. Record the voltage values for each position of the 848-8 field calibrator on the Data Sheet under the "Desired" column of the Display/Analog Output Table. Values listed under the OPEN position on the Data Sheet will be the full-scale value of the specific analog output. Values listed under the FAIL position on the Data Sheet will be the low scale value of the specific analog output.

7.1.8 Remove jumper J7 from the 956A-201 main circuit board and retain for re-installation. Jumper J7 is removed to prevent anti-jam actuation during testing.

7.1.9 Interconnect all channel components per standard loop or job specific drawing and record the drawing and revision on the Data Sheet.

7.1.10 Terminate both 4-20 MA analog outputs with the 250 ohm 1% resistors. Analog output #1 is located at P6-1 (+) and P6-2 (-) while analog output #2 is located at P6-3 (+) and P6-4 (-). If no remote alarm is supplied the 0-10 volt output is measured at P6-5 (+) and P6-6 (-). Refer to job specific drawings for optional analog outputs that may be supplied.

NOTE: If a remote alarm is included, fill in the 0-10 volt/remote meter desired row on the Data Sheet with mR/h values. If no remote is included, fill in the row with calculated voltage values for each position. Position the Remote Alarm in the vertical position and adjust the mechanical zero (if applicable) prior to power-up.

7.1.11 Apply AC power to the 956A-201 and allow a minimum 15 minute warm-up period to elapse prior to proceeding with testing. Reset any alarms that may have tripped on power-up.

7.1.12 Enter setpoints into the 956A-201 in accordance with Table 2.

TABLE 2

956A-201 Parameter	Function Switch Position	Data Entry Value
High Alarm	0	1.00E2
Warn Alarm	1	1.00E1
Dead Time (Tau)	2	*
Analog Full Scale	3	1.00E3
Overrange	4	1.00E3
Conversion Constant	5	*
Analog Low Scale	7	1.00-2
Under Range	9	1.00-2

* See the detector CAL-GM6 Data Sheet for these values.

7.1.13 If the channel under test contains optional analog outputs, list these optional outputs on the Data Sheet. If no optional outputs are provided, enter N/A on the Data Sheet.

7.2 Channel Functional Test

Note: If a 956A-201-M1 UDR is supplied as a part of this channel, fill out the Aux. High Relay Functions in the Data Sheet Truth Table. If not, enter N/A on the Data Sheet.

7.2.1 Place the detector in a low background area away from the field calibrator and complete column 1 of the Data Sheet truth table. If a 958-10 or 958-40 remote alarm is part of the channel under test, verify the following remote alarm internal relay contact logic:

TB1-5 to TB1-7: > 20 meg ohms
TB1-6 to TB1-7: < 1 ohm

7.2.2 Depress the CHECK SOURCE push button on the 956A-201 and record the 956A-201 display value on the Data Sheet when the indication has stabilized. A minimum response of 10 mR/h is required.

7.2.3 Using the 848-8-105 adapter (and 848-8-400 if a 897A-211 is being tested), place the detector into the 848-8 field calibrator and expose the detector to the CLOSED position. Complete column 2 of the Data Sheet Truth Table and the Display/Analog Output Table.

Note: The 897A-211 detector is positioned in the 848-8-400 adapter so that the connector key will be at the 12:00 o'clock position relative to the 6:00 o'clock position of the source aperture.

7.2.4 With the 848-8 still in the closed position, depress the 956A-201 ACKNOWLEDGE push-button and complete column 3 of the Data Sheet Truth Table.

7.2.5 Expose the detector to the MID position of the 848-8 field calibrator and hold. Complete column 4 of the Truth Table

and the Display/Analog Output Table on the Data Sheet. If a 958-10 or 958-40 remote alarm is included, verify the following remote alarm relay contact logic:

TB1-5 to TB1-7: < 1 ohm
TB1-6 to TB1-7: > 20 meg ohms

7.2.6 If a 958A-10 or 958A-40 remote alarm is installed, depress the SILENCE push-button on the remote alarm enclosure and complete column 5 of the Data Sheet Truth Table. If 958-10, 958-40 or no remote alarm is installed, fill in column 5 with N/A in each box.

7.2.7 With the 848-8 still in the MID position, depress the 956A-201 ACKNOWLEDGE push-button and complete column 6 of the Data Sheet Truth Table.

7.2.8 Expose the detector to the OPEN position of the 848-8 field calibrator and complete column 7 of the Truth Table and the Display/Analog Output Table on the Data Sheet.

7.2.9 Expose the detector to the MID position of the 848-8 field calibrator and depress the ACKNOWLEDGE push-button on the 956A-201. Complete column 8 of the Truth Table on the Data Sheet.

7.2.10 Remove the detector from the field calibrator and depress the 956A-201 ACKNOWLEDGE push-button. Disconnect the P5 signal connector and note the time. In approximately five (5) minutes, complete column 9 of the Truth Table and the Display/Analog Output Table on the Data Sheet.

7.2.11 Divide each of the "Desired" values in the Display/Analog Output Table by the "Actual" values recorded during testing. The "Actual" values must be within ±25% of the calculated "Desired" values for dose rate and voltage. If all values are within tolerance, complete verification. If any values are not within tolerance, reject the channel component that is out of tolerance and forward to the Production Test Department for repair or calibration.

7.2.12 Turn off 956A-201 power and remove all interconnection cables. Re-install jumper J7 in the 2-3 position on the 956A-201 main circuit board assembly.

7.2.13 If all values are within tolerance and the truth table logic is correct, complete and sign the Data Sheet and forward to QA for review. Verify that all required accessories such as connector kits, mounting brackets and rack chassis are present. Complete and sign travelers and forward to QA with the loop test Data Sheets.

7.2.14 If any portion of this test has not been successfully completed, return the failed component to production test for rework/re calibration as required along with the Data Sheet identifying the failure.

LOOP TEST DATA SHEET Page 1 of 4

Low Range GM Area Monitor

Customer: _____ P.O. No.: _____

Channel ID No.: _____ S.O. No.: _____
(If Applicable)

Readout Model: _____ Serial No.: _____

Detector Model: _____ Serial No.: _____

Remote Alarm Model: _____ Serial No.: _____

Test Equipment:

Field Calibrator 848-8 S/N 119 or Customer 848-8 S/N _____

D. V. M. Model #: _____ S/N: _____ Cal Due Date: _____

7.1.4 956A-201 Firmware Part Number: _____ Rev. _____

7.1.12 Detector Conversion Constant: _____

Detector Dead Time (Tau): _____

7.1.13 Analog Output Option 1: Range: _____ to _____

Analog Output Option 2: Range: _____ to _____

LOOP TEST DATA SHEET Page 2 of 4 DATA SHEET TRUTH TABLE

Note: Enter N/A in any columns or rows that are not applicable.

Step / Function	7.2.1 Col 1 Bkgnd	7.2.3 Col 2 Alert Trip	7.2.4 Col 3 Alert Ack	7.2.5 Col 4 High Trip	7.2.6 Col 5 958A Silence	7.2.7 Col 6 High Ack	7.2.8 Col 7 Over Range	7.2.9 Col 8 OverRng Reset	7.2.10 Col 9 Fail
High Lamp	(Off)	(Off)	(Off)	(Flash)	(Flash)	(On)	(On)	(Flash)	(Off)
Warn Lamp	(Off)	(Flash)	(On)	(On)	(On)	(On)	(On)	(Flash)	(Off)
Fail Lamp	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(On)
Range Lamp	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(On)	(Off)	(On)
Remote Alrm Lamp	(Off)	(Off)	(Off)	(On)	(On)	(On)	(On)	(On)	(Off)
Remote Alrm Horn	(Off)	(Off)	(Off)	(On)	(Off)	* (On)	* (On)	* (On)	(Off)
Bargraph Color	(Green)	(Amber)	(Amber)	(Red)	(Red)	(Red)	(Red)	(Red)	(Off)
High Relay P1-19 to P1-20	(Closed)	(Closed)	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
High Relay P1-19 to P1-21	(Open)	(Open)	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Aux. Hi Relay** P1-1, P1-2	(Closed)	(Closed)	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
Aux. Hi Relay** P1-1, P1-3	(Open)	(Open)	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Aux. Hi Relay** P1-4, P1-5	(Closed)	(Closed)	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
Aux. Hi Relay** P1-4, P1-6	(Open)	(Open)	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Warn Relay P1-13 to P1-14	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
Warn Relay P1-13 to P1-15	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Fail Relay P1-7 to P1-8	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Fail Relay P1-7 to P1-9	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)

**Applies to 956A-201-M1 Only

LOOP TEST DATA SHEET Page 3 of 4

DATA SHEET TRUTH TABLE

7.2.1	958 Remote Alarm Relay:	TB1-5	to	TB1-7	_____	(>20 Meg Ohms)
		TB1-6	to	TB1-7	_____	(< 1 Ohm)
7.2.2	Check Source Response:				_____	(> 10 mR/h)
7.2.5	958 Remote Alarm Relay:	TB1-5	to	TB1-7	_____	(< 1 Ohm)
		TB1-6	to	TB1-7	_____	(> 20 Meg Ohms)

LOOP TEST DATA SHEET Page 4 of 4

DISPLAY/ANALOG OUTPUT TABLE

	848-8 S/N ___ Position CLOSED		848-8 S/N ___ Position MID		848-8 S/N ___ Position OPEN		Signal Fail Condition	
Function	Desired	Actual	Desired	Actual	Desired	Actual	Desired	Actual
** 956A-201 in mR/h					EEEEE		0.00	
Anlg Output 1 1 - 5 Volts					5.00 V		1.00 V	
Anlg Output 2 1 - 5 Volts					5.00 V		1.00 V	
0 - 10 Volt or Remote Meter					10.00 V or 1000 mR/h		0.00 V or 0.01 mR/h	
* Analog Option								
* Analog Option								

* Enter N/A if no Analog Optional outputs are provided.

** The "desired" value in this row is the decay corrected 848-8 dose rate.

7.2.11 All "Actual" value within ±25% of calculated "desired" values _____ (Yes)

Performed By: _____ Date: _____

Q.A. Review By: _____ Date: _____

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VICTOREEN, INC. TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-23X SERIES DETECTORS CUSTOMER: N/A DOCUMENT: TP956A/897A-23X REV. B	PAGE 1 OF 16

ISSUE DATE: JANUARY 9, 1996

REVISION LIST

REV	ECO #
B	4CR37-96

	APPROVAL	DATE
PROJECT ENGINEER	George R Buck	5/2/96
TECHNICAL SUPPORT MANAGER	Bill Wright	5/2/96
QUALITY ASSURANCE	[illegible]	5/2/96

ISSUED BY: DAVID WARNER

VICTOREEN, INC.
TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-23X SERIES DETECTORS
CUSTOMER: N/A
DOCUMENT: TP956A/897A-23X REV. B

RECORD OF REVISIONS

DOCUMENT REV. LEVEL	DESCRIPTION/PAGES AFFECTED
A	Supersedes LT956/897
B	Revised Paragraphs 6.2, 7.1.5, 7.1.8, 7.1.12, 7.2.1, 7.2.5 Identified Tables, and revised Page 2 of the Data Sheet Truth Table

VICTOREEN, INC.
TITLE: TEST PROCEDURE FOR 956A-201 AND 897A-23X SERIES DETECTORS
CUSTOMER: N/A
DOCUMENT: TP956A/897A-23X REV. B

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Section	Description	Page
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1.0 PURPOSE

The purpose of this procedure is to verify the proper operation of a complete HIGH RANGE 955A Area Monitor channel.

2.0 SCOPE

2.1 This procedure is to be performed on all HIGH RANGE 955A channels prior to shipment. This procedure gives detailed instructions on integrated testing of the model 956A-201 rate meter (UDR) and model 897A-230 or 897A-231 detectors. In addition, this procedure covers integrated testing of 958 or 958A series remote alarm/indicators if supplied. Any combination of the following equipment may be tested using this procedure.

Rate Meter	Detector	Remote Alarm (Optional)
956A-201	897A-230, 897A-231	958-30, 958A-30 958-40, 958A-40

Note: **Space on the Data Sheet is provided to identify and test some possible options such non-standard analog outputs.**

2.2 The following functions and operational parameters are tested by this procedure:

2.2.1 956A-201 Display value within tolerance.

2.2.2 956A-201 Analog Outputs within tolerance including optional outputs (if provided).

2.2.3 Check Source response greater than minimum requirements.

2.2.4 Alarm, Warn, Range, Overrange and Fail Actuation.

2.2.5 958/958A Remote Alarm display and annunciation (if applicable).

2.2.6 958A Remote Alarm silence feature (if applicable).

2.2.7 958 Remote Alarm relay auxiliary contacts (if applicable).

3.0 RESPONSIBILITIES

3.1 Personnel performing this test must have a Technicians Skill Level 1 per S.O.P. 902.003.

3.2 Data generated by this test must be reviewed and approved by Q.A. prior to shipment. In addition, Q.A has the responsibility of maintaining channel or systems test data in a job file.

3.3 Individuals performing this procedure must insure that it is conducted in such manner as to minimize radiation exposure to both themselves and others. Personal radiation dosimetry is required for any individuals participating in this procedure when a Field Calibrator is in use.

4.0 ENVIRONMENTAL CONDITIONS

4.1 Environmental conditions shall be the prevailing laboratory ambient for temperature and humidity.

5.0 EQUIPMENT REQUIRED

5.1 Customer 848-8 to be supplied with channel -- must be calibrated. If no Customer Calibrator is provided or available, VICTOREEN Model 848-8 Field Calibrator Serial Number 119 is to be used.

5.2 848-8-105 Field Calibrator Adapter, customer provided or Victoreen equipment.

5.2.1 848-8-400 Adapter for 897A-231 detectors with stainless steel housing only.

5.3 Digital Voltmeter: Fluke 8050A or equivalent - must be calibrated.

5.4 Personal dosimetry.

5.5 Radiation control barriers (yellow/magenta rope) and Radiation Area warning signs (if access control of area cannot be assured).

5.6 Interconnection cables between detector, rate meter and remote alarm (if applicable) refer to one of the following loop diagrams:

5.6.1 956A-201-106: 956A-201 ratemeter to 897A-230 or 897A-231 detectors.

5.6.2 958-1-24: As above but including 958-30 or 958-40 Remote Alarm.

5.6.3 958A-1-24: As above but including 958A-30 or 958A-40 Remote Alarm.

5.6.4 Job Specific Loop Diagram (contact project engineer).

5.7 250 ohm, 1 % resistors (2) for 4-20 mA termination.

6.0 PREREQUISITES

6.1 Prior to interconnecting equipment, verify by model number that all of the equipment listed on the sales or work order is present and that all required option boards (if applicable) are installed in the 956A-201 ratemeter.

6.2 Completed and signed copies of CAL-GM6 (897A series detectors) and TP956A-201-3 (956A-201 ratemeter) are required prior to beginning this procedure. Completed and signed copies of any option board tests are also required when option boards are installed.

7.0 PROCEDURE

7.1 Preliminary Data and Set-up.

7.1.1 Record the customer, P.O. and S.O. numbers on the Data Sheet.

7.1.2 Record the model and serial numbers of all equipment to be tested.

7.1.3 Record the model serial number and calibration due date of the digital voltmeter.

7.1.4 Record the 956A-201 firmware number and revision/date on the Data Sheet.

7.1.5 Decay correct to the current date the 897A dose rate listed on the 848-8 S/N 119 or Customer 848-8 Calibration Data Sheet for the CLOSED and MID positions. No dose rate calculations are required for the OPEN position as it will be used to overrange the unit under test. Enter the decay corrected dose rates under the "Desired" column of the Display/Analog Output Table on the Data Sheet.

Decay Formula: $\text{Current Dose Rate} = R * e^{\left(-0.693 \frac{(t_2 - t_1)}{30.0}\right)}$

Where R = is the baseline dose rate

The elapsed time in years from the date dose rate was determined to the current date

30.0 = the half-life of 137-Cs in years

Table 1, 137-Cs Half Life Decay Table, may also be used to determine the current dose rate for this step.

TABLE 1

HALF-LIFE DECAY TABLE FOR Cs-137 OVER 10 YEARS (HALF-LIFE 30.00 YEARS)

YEAR	ELAPSED TIME -- MONTHS											
	0	1	2	3	4	5	6	7	8	9	10	11
0	1.000	0.998	0.996	0.994	0.992	0.990	0.989	0.987	0.985	0.983	0.981	0.979
1	0.977	0.975	0.973	0.972	0.970	0.968	0.966	0.964	0.962	0.960	0.959	0.957
2	0.955	0.953	0.951	0.949	0.948	0.946	0.944	0.942	0.940	0.938	0.937	0.935
3	0.933	0.931	0.929	0.928	0.926	0.924	0.922	0.921	0.919	0.917	0.915	0.913
4	0.912	0.910	0.908	0.906	0.905	0.903	0.901	0.900	0.898	0.896	0.894	0.893
5	0.891	0.889	0.887	0.886	0.884	0.882	0.881	0.879	0.877	0.876	0.874	0.872
6	0.871	0.869	0.867	0.866	0.864	0.862	0.861	0.859	0.857	0.856	0.854	0.852
7	0.851	0.849	0.847	0.846	0.844	0.843	0.841	0.839	0.838	0.836	0.834	0.833
8	0.831	0.830	0.828	0.826	0.825	0.823	0.822	0.820	0.819	0.817	0.815	0.814
9	0.812	0.811	0.809	0.808	0.806	0.805	0.803	0.801	0.800	0.798	0.797	0.795

7.1.6 Convert the dose rates determined in step 7.1.5 into equivalent analog output voltage and current values for each of the CLOSED and MID calibrator positions using the formulas and examples given below.

First, using the formula below, convert the dose rate to a percentage of full-scale.

$P = \log(R/LSV)/[\log(FSV)-\log(LSV)]$

where P = percentage of full-scale in decimal number

R = Current dose rate determined in step 7.1.4

LSV = Low Scale Value (Analog Low scale Setpoint)

FSV = Full Scale Value (Analog Full-scale Setpoint)

7.1.7 Next, using the formula below, convert to analog output voltage and current values as required by the configuration of the 956A-201 under test. For a standard 956A-201 this will be 1-5 volts (4-20 mA across 250 ohm) for current loop outputs and 0-10 volts for voltage output.

$$V = P(FSV-LSV) + LSV$$

where P = Percent of full-scale as a decimal number

FSV = Full-scale voltage

LSV = Low scale voltage

Other optional analog output voltages are also calculated using the above formula. Record the voltage values for each position of the 848-8 field calibrator on the Data Sheet under the "Desired" column of the Display/Analog Output Table. Values listed under the OPEN position on the Data Sheet will be the full-scale value of the specific analog output. Values listed under the FAIL position on the Data Sheet will be the low scale value of the specific analog output.

7.1.8 Remove jumper J7 from the 956A-201 main circuit board and retain for re-installation. Jumper J7 is removed to prevent anti-jam actuation during testing.

7.1.9 Interconnect all channel components per standard loop or job specific drawing and record the drawing and revision on the Data Sheet.

7.1.10 Terminate both 4-20 MA analog outputs with the 250 ohm 1% resistors. Analog output #1 is located at P6-1 (+) and P6-2 (-) while analog output #2 is located at P6-3 (+) and P6-4 (-). If no remote alarm is supplied the 0-10 volt output is measured at P6-5 (+) and P6-6 (-). Refer to job specific drawings for optional analog outputs that may be supplied.

NOTE: If a remote alarm is included, fill in the 0-10 volt/remote meter desired row on the Data Sheet with mR/h values. If no remote is included, fill in the row with calculated voltage values for each position. Position the Remote Alarm in the vertical position and adjust the mechanical zero (if applicable) prior to power-up.

7.1.11 Apply AC power to the 956A-201 and allow a minimum 15 minute warm-up period to elapse prior to proceeding with testing. Reset any alarms that may have tripped on power-up.

7.1.12 Enter setpoints into the 956A-201 in accordance with Table 2.

TABLE 2

956A-201 Parameter	Function Switch Position	Data Entry Value
High Alarm	0	1.00E2
Warn Alarm	1	1.00E1
Dead Time (Tau)	2	*
Analog Full Scale	3	1.00E5
Overrange	4	1.00E3
Conversion Constant	5	*
Analog Low Scale	7	1.00-E0
Under Range	9	1.00-E0

* See the detector CAL-GM6 Data Sheet for these values.

7.1.13 If the channel under test contains optional analog outputs, list these optional outputs on the Data Sheet. If no optional outputs are provided, enter N/A on the Data Sheet.

7.2 Channel Functional Test

7.2.1 Place the detector in a low background area away from the field calibrator and complete column 1 of the Data Sheet truth table. If a 958-30 or 958-40 remote alarm is part of the channel under test, verify the following remote alarm internal relay contact logic:

TB1-5 to TB1-7: > 20 meg ohms
TB1-6 to TB1-7: < 1 ohm

7.2.2 Depress the CHECK SOURCE push button on the 956A-201 and record the 956A-201 display value on the Data Sheet when the indication has stabilized. A minimum response of 10 mR/h is required.

7.2.3 Using the 848-8-105 adapter (and 848-8-400 if a 897A-231 is being tested), place the detector into the 848-8 field calibrator and expose the detector to the CLOSED position. Complete column 2 of the Data Sheet Truth Table and the Display/Analog Output Table.

Note: The 897A-231 detector is positioned in the 848-8-400 adapter so that the connector key will be at the 12:00 o'clock position relative to the 6:00 o'clock position of the source aperture.

7.2.4 With the 848-8 still in the closed position, depress the 956A-201 ACKNOWLEDGE push-button and complete column 3 of the Data Sheet Truth Table.

7.2.5 Expose the detector to the MID position of the 848-8 field calibrator and hold. Complete column 4 of the Truth Table and the Display/Analog Output Table on the Data Sheet. If a 958-30 or 958-40 remote alarm is included, verify the following remote alarm relay contact logic:

TB1-5 to TB1-7: < 1 ohm
TB1-6 to TB1-7: > 20 meg ohms

7.2.6 If a 958A-30 or 958A-40 remote alarm is installed, depress the SILENCE push-button on the remote alarm enclosure and complete column 5 of the Data Sheet Truth Table. If 958-30, 958-40 or no remote alarm is installed, fill in column 5 with N/A in each box.

7.2.7 With the 848-8 still in the MID position, depress the 956A-201 ACKNOWLEDGE push-button and complete column 6 of the Data Sheet Truth Table.

7.2.8 Expose the detector to the OPEN position of the 848-8 field calibrator and complete column 7 of the Truth Table and the Display/Analog Output Table on the Data Sheet.

7.2.9 Expose the detector to the MID position of the 848-8 field calibrator and depress the ACKNOWLEDGE push-button on the 956A-201. Complete column 8 of the Truth Table on the Data Sheet.

7.2.10 Remove the detector from the field calibrator and depress the 956A-201 ACKNOWLEDGE push-button. Disconnect the P5 signal connector and note the time. In approximately five (5) minutes, complete column 9 of the Truth Table and the Display/Analog Output Table on the Data Sheet.

7.2.11 Divide each of the "Desired" values in the Display/Analog Output Table by the "Actual" values recorded during testing. The "Actual" values must be within ±25% of the calculated "Desired" values for dose rate and voltage. If all values are within tolerance, complete verification. If any values are not within tolerance, reject the channel component that is out of tolerance and forward to the Production Test Department for repair or calibration.

7.2.12 Enter a value of 1.00E5 in position 4 (OVER RANGE).

7.2.13 Turn off 956A-201 power and remove all interconnection cables. Re-install jumper J7 in the 2-3 position on the 956A-201 main circuit board assembly.

7.2.14 If all values are within tolerance and the truth table logic is correct, complete and sign the Data Sheet and forward to QA for review. Verify that all required accessories such as connector kits, mounting brackets and rack chassis are present. Complete and sign travelers and forward to QA with the loop test Data Sheets.

7.2.15 If any portion of this test has not been successfully completed, return the failed component to production test for rework/re calibration as required along with the Data Sheet identifying the failure.

LOOP TEST DATA SHEET Page 1 of 3

High Range GM Area Monitor

Customer: _____ P.O. No.: _____

Channel ID No.: _____ S.O. No.: _____
(If Applicable)

Readout Model: _____ Serial No.: _____

Detector Model: _____ Serial No.: _____

Remote Alarm Model: _____ Serial No.: _____

Test Equipment:

Field Calibrator 848-8 S/N 119 or Customer 848-8 S/N _____

D. V. M. Model #: _____ S/N: _____ Cal Due Date: _____

7.1.4 956A-201 Firmware Part Number: _____ Rev. _____

7.1.12 Detector Conversion Constant: _____

Detector Dead Time (Tau): _____

7.1.13 Analog Output Option 1: Range: _____ to _____

Analog Output Option 2: Range: _____ to _____

LOOP TEST DATA SHEET Page 2 of 3
DATA SHEET TRUTH TABLE

Note: Enter N/A in any columns or rows that are not applicable.

Step	7.2.1 Col 1	7.2.3 Col 2	7.2.4 Col 3	7.2.5 Col 4	7.2.6 Col 5	7.2.7 Col 6	7.2.8 Col 7	7.2.9 Col 8	7.2.10 Col 9
Function	Bkgnd	Alert Trip	Alert Ack	High Trip	958A Silence	High Ack	Over Range	OverRng Reset	Fail
High Lamp	(Off)	(Off)	(Off)	(Flash)	(Flash)	(On)	(On)	(Flash)	(Off)
Warn Lamp	(Off)	(Flash)	(On)	(On)	(On)	(On)	(On)	(Flash)	(Off)
Fail Lamp	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(On)
Range Lamp	(Off)	(Off)	(Off)	(Off)	(Off)	(Off)	(On)	(Off)	(On)
Remote Alrm Lamp	(Off)	(Off)	(Off)	(On)	(On)	(On)	(On)	(On)	(Off)
Remote Alrm Horn	(Off)	(Off)	(Off)	(On)	(Off)	* (On)	* (On)	* (On)	(Off)
Bargraph Color	(Green)	(Amber)	(Amber)	(Red)	(Red)	(Red)	(Red)	(Red)	(Off)
High Relay P1-19 to P1-20	(Closed)	(Closed)	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
High Relay P1-19 to P1-21	(Open)	(Open)	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Warn Relay P1-13 to P1-14	(Closed)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)
Warn Relay P1-13 to P1-15	(Open)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Fail Relay P1-7 to P1-8	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Closed)	(Open)
Fail Relay P1-7 to P1-9	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Open)	(Closed)

* Except with 958A-30 or 958A-40 Remote Alarm

7.2.1 958 Remote Alarm Relay:
TB1-5 to TB1-7 _____ (> 20 Meg Ohms)
TB1-6 to TB1-7 _____ (< 1 Ohm)

7.2.2 Check Source Response:
_____ (> 10 mR/h)

7.2.5 958 Remote Alarm Relay:
TB1-5 to TB1-7 _____ (< 1 Ohm)
TB1-6 to TB1-7 _____ (> 20 Meg Ohms)

LOOP TEST DATA SHEET Page 3 of 3

DISPLAY/ANALOG OUTPUT TABLE

	848-8 S/N ___ Position CLOSED		848-8 S/N ___ Position MID		848-8 S/N ___ Position OPEN		Signal Fail Condition	
Function	Desired	Actual	Desired	Actual	Desired	Actual	Desired	Actual
** 956A-201 in mR/h					EEEEE		0.00	
Anlg Output 1 1 - 5 Volts					5.00 V		1.00 V	
Anlg Output 2 1 - 5 Volts					5.00 V		1.00 V	
0 - 10 Volt or Remote Meter					10.00 V or 1.00E5 mR/h		0.00 V or 1 mR/h	
* Analog Option								
* Analog Option								

* Enter N/A if no Analog Optional outputs are provided.

** The "desired" value in this row is the decay corrected 848-8 dose rate.

7.2.11 All "Actual" value within ±25% of calculated "desired" values _____ (Yes)

7.2.12 Value of 1.00E5 entered in position 4 _____ (Yes)

Performed By: _____ Date: _____

Q.A. Review By: _____ Date: _____