



Victoreen®

**942A-200L-M4 Universal Digital Ratemeter
with Trip Test and SCA/ Gross Mode Select Switch**

**942A-200L-M5 Universal Digital Ratemeter
with Trip Test**

Operator Manual

Fluke Biomedical

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Section 1 General Information

1.1 General Description

The Victoreen® Model 942A-200L-M4 or 942A-200L-M5 Universal Digital Ratemeters (UDR), when connected to a beta or gamma sensitive scintillation detector, comprises a monitoring system which operates in the range of 10 to 10^7 counts per minute (CPM). The UDR provides display, control, and enunciator functions for the monitoring system.

Standard features for the 942A-200L-M4 and 942A-200L-M5 instrument include a five-digit display of the CPM value and a multicolored bargraph indicator that covers the entire range of the UDR. The bargraph will change color in the event of an alarm condition. Front panel alarm indicators and rear panel output relays for alarm annunciation are also included. Front panel push-buttons are provided to display alarm limit set points and high voltage value, for alarm acknowledgment, activation of a check source function and activation of a trip test function. In addition, the 942A-200L-M4 includes a Model 942-200-90-M1 Single Channel Analyzer (SCA) option board, a front panel mounted SCA or Gross mode select switch and a Model 942-200-95-M1 Dual Analog Output option board that provides additional 0-10 mV and 0-5 VDC analog outputs. The Model 942A-200L-M4 and 942A-200L-M5 are designed to be used with the Model 943-25TL or 943-36L series scintillation detectors and a Model 844-211L series Junction Box to provide an interface for a light emitting diode (LED) check source. The 942A-200L-M4 and 942A-200L-M5 are internally wired to provide a +15v DC signal to operate the LED pulse circuit board mounted in the 844-211L series Junction Box. The +15v DC signal is available on rear panel connector P2. Refer to Figures 1-1 and 1-2 for a general view of the UDR front panel.

The Model 942A-200L-M4 UDR is equipped with the following modifications:

- Model 942-200-95-M1 Analog output option board, with 0-10 mV and 0-5 VDC analog outputs
- Model 942-200-90-M1 Single Channel Analyzer Option Board with front panel mounted SCA/ Gross Counting Mode select switch
- Front panel mounted trip test switch to verify display, bargraph, front panel LEDs and alarm relay operation
- LED check source option: When the check source pushbutton is depressed, a +15 V dc signal is sent to energize the pulser board in the 844-211L Junction Box. The pulser board then energizes a LED in the detector to provide a check of the photomultiplier tube, preamplifier, counting circuits and UDR.

The Model 942A-200L-M5 UDR is equipped with the following modifications:

- Front panel mounted trip test switch to verify display, bargraph, front panel LEDs and alarm relay operation
- LED check source option: When the check source pushbutton is depressed, a +15 V dc signal is sent to energize the pulser board in the 844-211L Junction Box. The pulser board then energizes a LED in the detector to provide a check of the photomultiplier tube, preamplifier, counting circuits and UDR.

NOTE

The Electrical Loop Drawings S174014D-102, S174014E1003, S27860A-102 and S321299A-104, provided in Appendix B, are intended to provide specific project information on the UDR.

Standard analog outputs of 0 to 10 VDC and 4 to 20 mA are provided for recording and computer monitoring. The 0 to 10 VDC output may also be used to drive a remote meter.

Except for the LED Check Source Pulser, all electronics required to interface to the VICTOREEN 943 series radiation detectors are included within the 942A-200L-M4 and 942A-200L-M5 UDR's. These electronics consist of a high voltage power supply, low voltage detector power supply, and detector input signal conditioning. The system also includes a detector shutdown feature on overrange to prevent damage to the detector and to preclude the possibility of on-scale readings in very high radiation fields due to radiation effects on the electronics.

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

1. 942-200-75: ANALOG OPTION INPUT BOARD - Contains four separate channels for analog input. 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 baud to 19200 baud. An asynchronous communication interface adapter is utilized to format the data and control the interface.
The VICTOREEN communications interface also provides the necessary circuitry to allow interconnecting to a standard VICTOREEN communication link. This interface allows multiple UDRs to share a common six-wire cable to a main central processor unit.
3. 942-200-90: SINGLE CHANNEL ANALYZER/ AMERICIUM REGULATOR - Designed to provide two independently adjustable windows for the discrimination of radiation pulses using the peak voltage analysis technique. When used with an AMERICIUM -231 doped sodium iodine crystal, provides the ability to automatically adjust the detector high voltage to compensate for photomultiplier tube gain changes due to ambient temperature variations.
4. 942-200-90-M1 Single Channel Analyzer/Americium Regulator modified to permit SCA/ Gross mode operation from an external switch, this option is supplied on the 942A-200L-M4 UDR.
5. 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 mV DC, 0 -100 mV DC, 0 -50 mV DV, or 0-10mVDC.
6. 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 mV DC, 0 -100 mV DC, 0 -500 mV DC, or 0 -1 VDC. This option is provided on the 942A-200L-M4 UDR.
7. S168319A-119: Line Filter/ Surge Suppressor Assembly - Designed to provide EMI/RFI protection for the 942A series digital ratemeter and 943 series scintillation detectors. The assembly consists of two (2) separate and independent line conditioning circuits that provide filtered AC power to each 942A series ratemeter. The S168319A-119 is designed to mount in the center section of the 948B-1A-5 rack Chassis, to provide EMI/RFI protection for two (2) 942A series digital ratemeters. The major active components of the S168319A-119 are two (2), 960SS-200 Surge suppressor circuit boards, two (2), 92-9015-A Line Filters, and two (2) 14-235 ferrite cubes. The S168319A-119 also contains AC line and neutral fuses to protect the internal circuitry from over voltage conditions.
8. 942A-200SS: Line Filter/ Surge Suppressor Assembly - Designed to provide EMI/RFI protection for the 942A series digital ratemeter and 943 series scintillation detectors. The assembly consists of two (2) separate and independent line conditioning circuits that provide filtered AC power to each 942A series ratemeter. The 942A-200SS is designed to mount in the center section of the 948A-1 rack Chassis, to provide EMI/RFI protection for two (2) 942A series digital ratemeters. The major active components of the 942A-200SS are two (2), 960SS-200 Surge suppressor circuit boards, two (2), 92-9015-A Line Filters, and two (2) 14-235 ferrite cubes. The 942A-200SS also contains AC line and neutral fuses to protect the internal circuitry from over voltage conditions.

1.2 Application

The Model 942A-200L-M4 and 942A-200L-M5 UDR's can be used with Victoreen 943 series beta scintillation detectors, and 943 series gamma scintillation detectors, equipped with a LED check source. The detector, when connected to the UDR and 844-211L series Junction Box with LED pulser, will comprise a single channel digital process monitoring system. Table 1-1 is a list of compatible 943 series detectors. Please contact Fluke Biomedical Radiation Management Services for additional information.

Table 1-1 943 Series Detectors Compatible with 942A-200L-M4 and 942A-200L-M5 UDR.

Detector	Type	Crystal	End Window/ Crystal Configuration (dia./size)
943-25TL	Beta Detector	Hi-Temp Plastic	Titanium/2 in.
943-25TLA:	Beta Detector	Hi-Temp Plastic 10:1 Efficiency Reaction	Titanium/2 in.
943-25TLB:	Beta Detector	Hi-Temp Plastic 100:1 Efficiency Reaction	Titanium/2 in.
943-36L:	Gamma Detector w/ LED Check Source	Nal (TI)	Aluminum/1.5 in. x 1 in.

1.3 Specifications

General specifications for the 942A-200L-M4 and 942A-200L-M5 UDR's are listed below. The 942-200L series are rated for nuclear applications, and any repairs to it by personnel not qualified to ANSI 45.2.6 1978, Skill Level II 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.

Table 1-2. General Specifications for the 942A-200L-M4 and 942A-200L-M5 UDR

Main Display	Five digits with back lighted units display
Bargraph Display	Three segments per decade, 10 to 10 ⁷ CPM
Alarm Indicators	HIGH Alarm (Red LED) – Flashing until acknowledged WARN Alarm (Amber LED) – Flashing until acknowledged RATE Alarm (Red LED) – Not Implemented FAIL Alarm (Red LED) – Does not flash, is not manually acknowledged RANGE Alarm (Red LED) – overrange/underrange – Does not flash
Display Selection	HV, High Voltage value HIGH, High Alarm limit WARN, Warn Alarm limit TEST, Initiates Trip Test
SCA/Gross	For the 942A-200L-M4 only, an illuminated alternate action switch is provided to select either Gross or Single Channel Analyzer counts for display, analog output and alarm processing. A Green LED indicator built into the switch illuminates when the SCA mode is selected.
Check Source	Activates with associated green LED indicator, supplies +15VDC to pulser circuit board in detector
Alarm Ack.	Alarm acknowledgement, resets alarm relay outputs and causes alarm indicators to go to a steady on state after acknowledgement. Internal jumper option causes alarms to be reset automatically when system returns to normal operation (no operator input required).

Power ON/OFF	Alternate action pushbutton
Relay Outputs	HIGH Alarm – 2 sets. SPDT rated 5 A @ 120 VAC (<i>one set 120 Vac powered for use with optional local alarm</i>) Auxiliary HIGH Alarm – 2 sets. SPDT rated 5 A @ 120 VAC (uses RATE relay) WARN Alarm – 2 sets. SPDT rated 5 A @ 120 VAC RATE Alarm – Not Implemented FAIL Alarm – 2sets. SPDT rated 5 A @ 120 VAC
High Voltage	Variable from 450 to 1500 VDC @ 0.2 mA
Detector Power	± 15 v @ 20 mA
Recorder/Computer Outputs	Two 4 to 20 mA (500 Ω load max. each), and one 0 to 10 VDC (1 KΩ load min.), scaled to the ratemeter range For the 942A-200L-M4 only, two additional analog outputs are provided from the Model 942-200-95-M1 Dual analog Output Option board. The ranges are 0-10mV and 0-5 VDC (1Kohm load min.). For further information, refer to the 942-200-95D Analog Output Option Instruction Manual, provided separately.
Remote Alarm Ack Input	Optically isolated DC input
Detector Input	Digital pulse train. Detector may be located up to 1500 feet from the ratemeter. Individually adjusted upper and lower level discriminators limit MeV response to desired range.
Statistical Accuracy	Statistical accuracy is user selectable at 2%, 5%, 10%, or fixed at a one second update. Count time automatically adjusts per selected accuracy and count rate (not recommended for safety related applications).
UDR Electronic Accuracy	± 1% of the displayed value (± 1 digit)
Single Channel Analyzer	For the 942A-200L-M4 only, a Model 942-200-90-M1 Single Channel Analyzer option circuit board is provided. This board provided the ability to perform pulse height analysis by counting the only pulses that fall between two adjustable voltage windows. For further information, refer to the 942-100-90D Single Channel Analyzer Instruction Manual, Provided separately.
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 5 lbs. (2.3 kg)
Power	120/240 VAC ± 10 %, 50/60 Hz, 28 watts
Operating Temperature	32 °F to 122 °F 0 °C to + 50 °C
Relative Humidity	0 to 99 % non-condensing
Compatible Detectors	VICTOREEN 943-XXL Series Scintillation Detectors w/LED
Modification Information	For the Model 942A-200L-M4, refer to Modification Instruction 942A-200L-M4MS, provided in Appendix E For the Model 942A-200L-M5, refer to Modification Instruction 942A-200L-M5MS, provided in Appendix E

Figure 1-1. 942A-200L-M4 Universal Digital Ratemeter

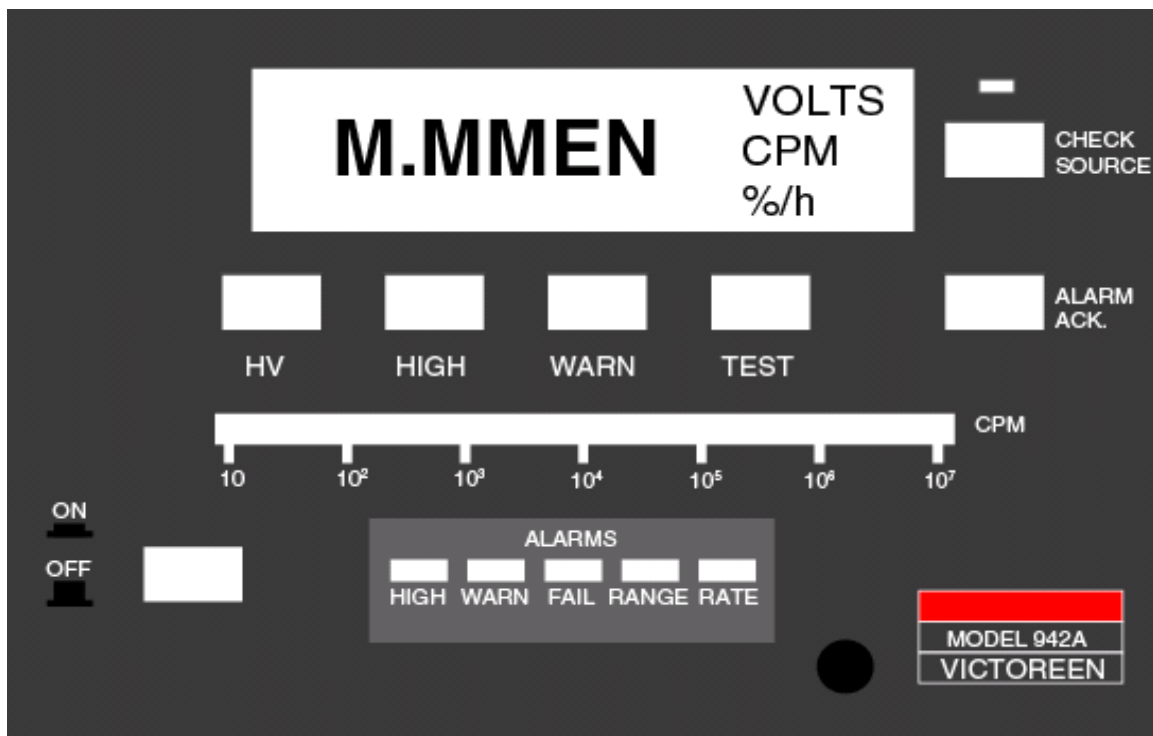
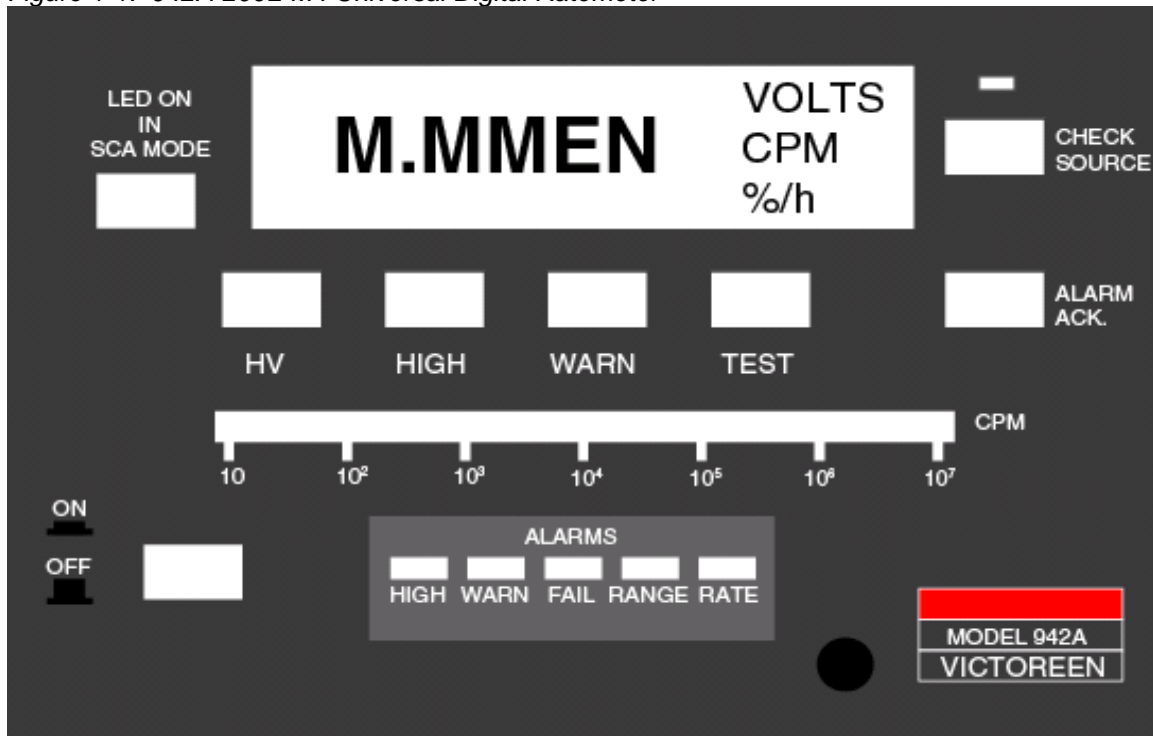


Figure 1.2 942A-200L-M5 Universal Digital Ratemeter

Table 1-3 Set Point Functions

Switch Position	Setpoint	Units	Factory Setting
0	High Alarm Limit	CPM	1.00E5
1	Warn Alarm Limit	CPM	1.00E3
2	Resolving Time (Tau)	Minutes/count	0.00E0
3	Full Scale Value	CPM	1.00E7
4	Overrange	CPM	1.00E7
5	Conversion Constant	-	1.00E0
6	Background Subtract	CPM	0.00E0
7	Low Scale Value	CPM	1.00E1
8	Calibration Mode	Seconds	6.0E1
9	Not Used	N/A	E0007 *
A thru E	Not Used	N/A	E0007 *
F	Unit I.D.	N/A	1.00E0

*= Press ENTER push button to clear error code.

Table 1-4 Standard Jumper Placement

Position	Jumper	Description
OUT	JP1	Reset
2-3	JP2	Standard 27256 PROM
IN	JP3-1	Fixed 1 Second Update
IN	JP3-2	Fixed 1 Second Update
IN	JP3-3	Latches alarms until acknowledged
IN	JP3-4	Gives fail condition without counts, in five minutes
IN	JP3-5	Alarms do not respond to check source counts
1-2	JP4	Negative Input Pulse
1-2	JP5	Negative Shield Polarity
1-2	JP6	Anti-Jam Active
1-2	JP7	Anti-Jam scintillation type detector

1.4 Auxiliary Equipment

<u>Model</u>	<u>Description</u>
Model 942TS	UDR Test Set
Model 948-5-XX	Local Alarm/Meter
Model 948-1	Rack Chassis (Three Bay)
Model 948-1A	Rack Chassis (Two Bay, 5.8 in. Wide)
Model 948A-1	Rack Chassis, Analog/Digital) Three Bay
Model 948B-1	Rack Chassis (Two Bay, Standard Width)
Model 948B-1A-5	Rack Chassis (Two Bay, Standard Width, with Surge Suppressor mounting)
Model 948A-2	Blank Panel
Model 948-3	Table Top Enclosure
Model 948-10	Panel Adapter
S168319A-119	Dual Line Filter/Surge Suppressor
942A-200SS	Dual Line Filter/Surge Suppressor (removable from front of chassis)

<u>942 A - 200X - YZZ</u>	
<u>942</u>	= Universal Digital Ratemeter for Process Monitoring Applications
<u>A</u>	= Rear Panel Options
A	= Rear Panel Connectors
B	= Rear Panel Terminal Blocks with retractable ribbon cable
<u>200X</u>	= Model Series
2	= High Reliability Electronic Components
00	= Reserved for Future Use
<u>X</u>	= Series Variation (Used for Factory Standard Series Variations only)
C	= Current Mode Detector Interface
L	= 15vDC output for Check Source
<u>YYY</u>	= Modification Suffix (Used for Factory Modification Options only)
Y	= Modification Type Identifier
M	= Process Monitor Application
S	= Simulator Application
ZZ	= Sequential number, 1 through N

Figure 1-3. 942A-200 UDR Ordering/Part Number Matrix

1.5 Recommended Spare Parts

Table 1-5. Recommended Spare Parts List for the Model 942A-200L-M4 or M5 Universal Digital Ratemeter.

Part Number	Description
942A-200L 20M4	Front Panel Assembly (942A-200L-M4 only)
942A-200L 20	Front Panel Assembly (942A-200L-M5 only)
942-100-15	Front Panel P.C. Board Assembly
11-282	DPDT Switch (942A-200L-M4 only)
105-37-1	Ribbon Cable, 18C, Front Panel (5 Required)
92-7027-A	Fuse F2, 1 AMP, Main Power
19-62	Fuse, F1, 50 mAmp
92-9042-A	Jumper Block (10 required)
67-80-37P	Receptacle, P1, I/O, 37 Pin
67-80-14S	Receptacle, P2, Detector, 14 Pin
67-80-4P	Receptacle, P3, Power, 4 Pin
92-9106-A	MHV Bulkhead Receptacle, P4, HV
92-9074-A	BNC Bulkhead Receptacle, P5, Signal
68-15	Receptacle, P6, Aux, 24 Pin
68-15	Receptacle, P7, RS 232
942A-100-4	Mating Connector Kit
942-200-50	Power Supply
942-100-70	Relay PC Board Assembly
82-73-1	Relay
942-200-60	H.V. PC Board Assembly

1.6 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 Fluke Biomedical Radiation Management Services Customer Service Department.

Fluke Biomedical
Radiation Management Service
6045 Cochran Road
Cleveland, Ohio 44139
Phone: 440.248.9300
Fax: 440.542.3682

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 Fluke Biomedical Radiation Management Service Customer Service Department.

1.7 Storage

Storage of Fluke Biomedical 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 Fluke Biomedical 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 2

Theory of Operation

2.1 Functional Description

The 942-200L-M4 and 942A-200L-M5 UDR's are composed of five circuit board assemblies, mounted within the unit. The 942A-200L-M4 contains two additional option boards for the SCA and dual analog outputs required. These circuit boards provide input/output, display 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 2-1 is a system block diagram of the UDR assembly.

2.2 Main Circuit Board (Schematic 942-200-13, Appendix B)

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 2-2 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 2-3 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 (AD - A15) provide for addressing of external devices.

The data bus (DO - 07) 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 non-maskable interrupt (NMI) input, upon detection of a low-going edge, requests that a non-maskable 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.

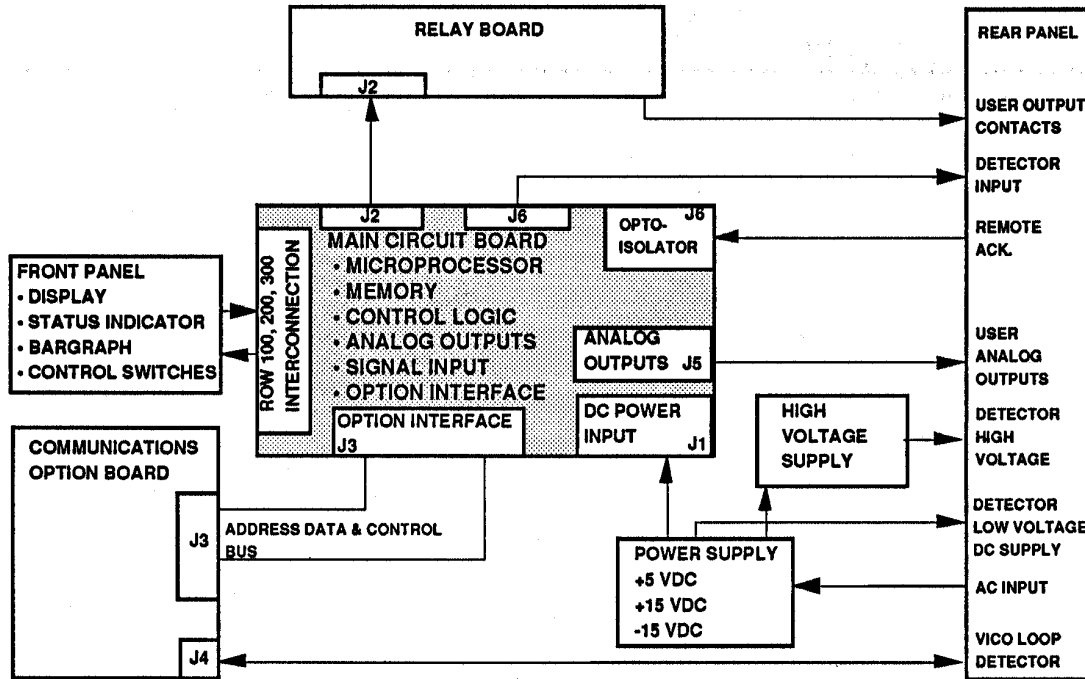


Figure 2-1 System Block Diagram

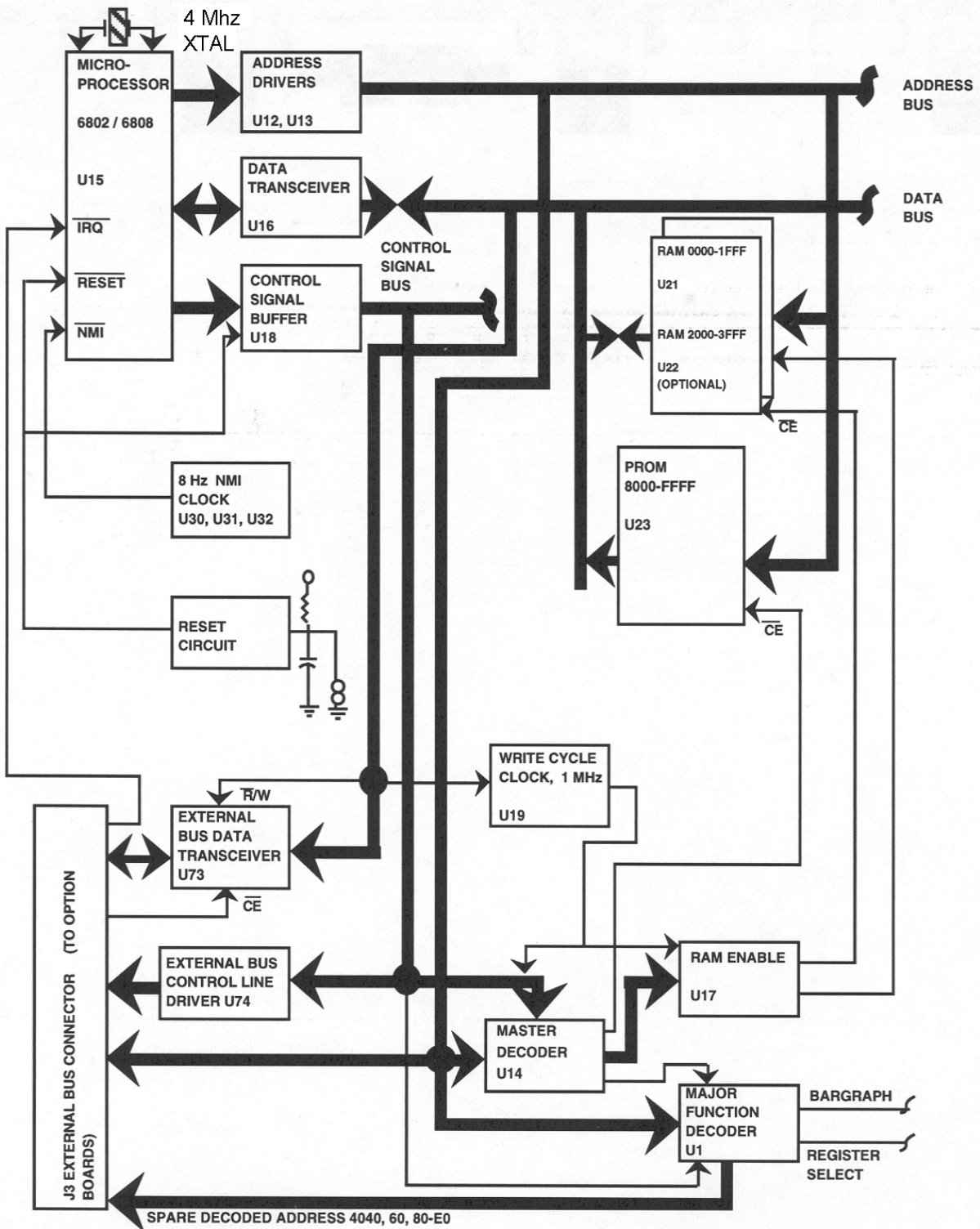


Figure 2-2. Page 1 of 3. Block Diagram - Main Circuit Board

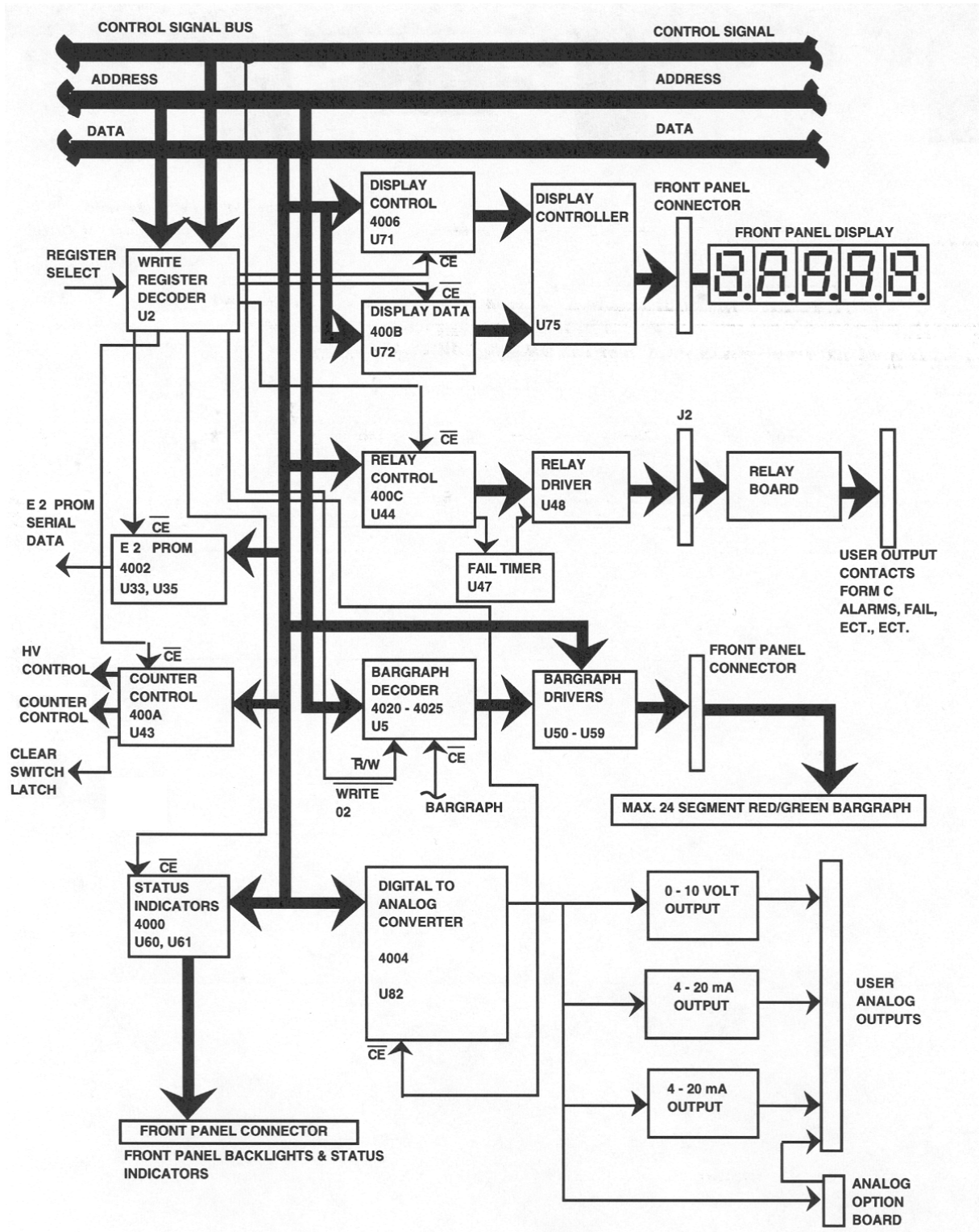


Figure 2-2. Page 2 of 3. Block Diagram - Main Circuit Board

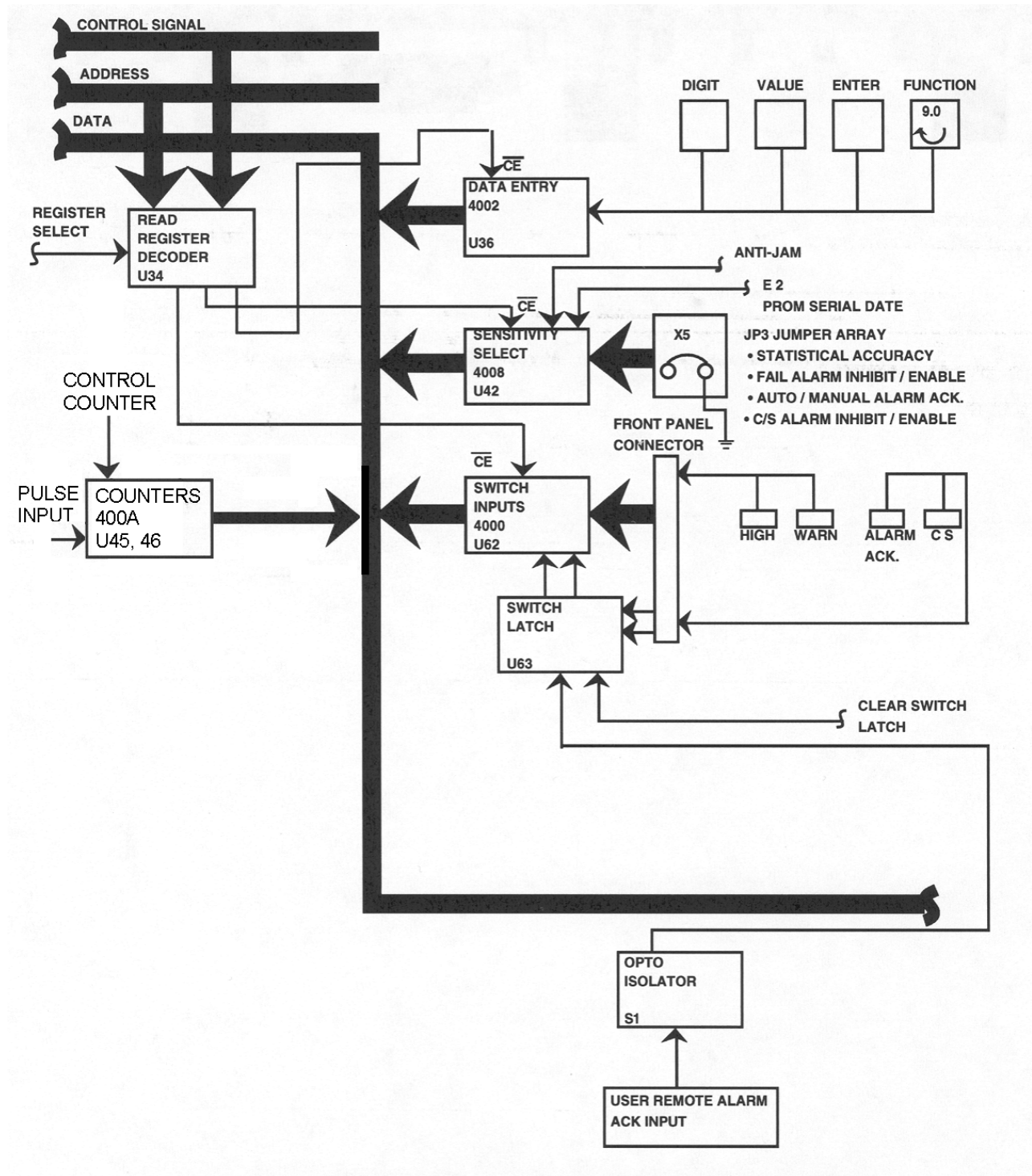
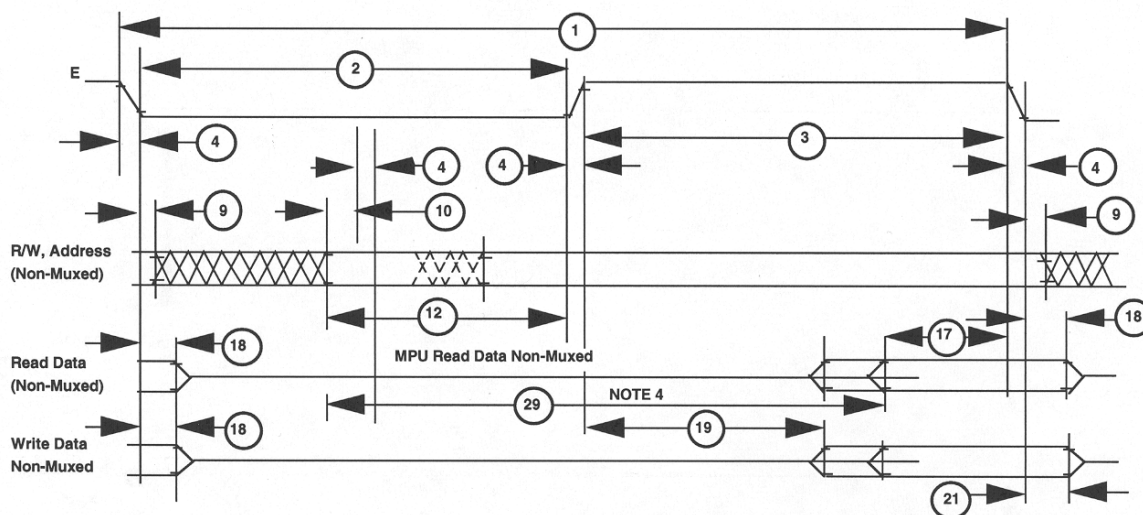


Figure 2-2. Page 3 of 3. Block Diagram - Main Circuit Board

Table 2-1. 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	t_{AV1} t_{AV2}	16	---	100	---	50	---	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 $V_L \leq 0.4 V$, $V_H \leq 2.4 V$, unless otherwise specified.
2. Measurement points shown are 0.8 V and 2.0 V, unless otherwise noted.
3. All electricals 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 2-3. 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 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. The system clock (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 2-4 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 that are used by the system.

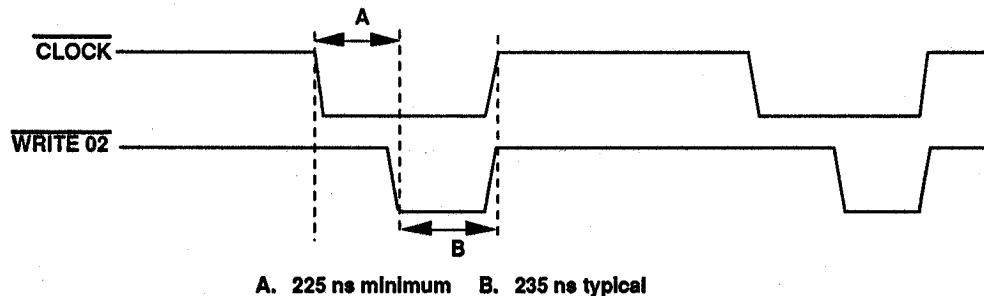


Figure 2-4. Write Cycle Clock Timing Diagram

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 that 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 (/R/W). 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 (/R/W) 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 interlace 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 (/R/W) used to decode memory and I/O addresses in 4K hex blocks. Table 2-2 lists the output signals from U 14.

Table 2-2. Output Signals (U14)

U14 Pin	Signal Name	Address	Read/Write
9	/PROM 8000	8000-FFFF	Read Only
7	/SPARE	Spare	
6	/RAM 2000	2000-3FFF	Read/Write
5	/ RAM 0000	0000-1FFF	Read/Write
4	//O	4000-4FFF	Read/Write
3	/RAM WRITE	0000-3FFF	Write Only
2	/RAM READ	0000-3FFF	Read Only
1	/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 by U17. /RAM READ drives the RAM output. /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 connected to J3, the optional interface buss connector.

The //O output signal is applied to major function decoder U1 that is a 1 of 8 decoder. U1 utilizes address lines A5, A6, A7, and A8 as well as CLOCK to generate outputs that are decoded in 32 hex blocks starting at address 4000. Table 2-3 lists U1 outputs, their functions and addresses.

Table 2-3. U1 Outputs

Address State				Address	Function
A8	A7	A6	A5		
0	0	0	0	4000	Register Select
0	0	0	1	4020	Bargraph
0	0	1	0	4040	ACIA (Communication Interface)
0	0	1	1	4060	SCA (Analyzer)
0	1	0	0	4080	GPIB (General Purpose Interface Bus)
0	1	0	1	40A0	(Spare)
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) is provided to the optional interface connector for use by external option circuit boards.

PROM

The Programmable Read Only Memory is typically a 27256 that 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 that allows the use of a 27256 PROM (32K x 8).

RAM

Dynamic Random Access Memories (U21, U22) are utilized for temporary data storage. U21 J that responds to address 0000-1FFF (8K x 8-bit) is always present. U22, which responds to address 2000-3FFF, is an option. Data stored in the RAM is lost on power down.

E²

Sixteen (16) monitor specific, operator entered setpoints are stored in 64 bytes of electrically erasable memory (E²). U33 provides storage for the setpoints (256 bytes max.). The 16 setpoints are loaded serially into PROM memory (U23) upon power up. U35 is an 8-Bit control register for the setpoints.

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 falling edge of /RAM 0000. Data becomes valid approximately 250 ns later.

A write cycle is performed by sequencing /RAM 0000 and /RAM WRITE, while holding /RAM READ high (inactive). Identical to the read cycle, the address (A0 - A12) is latched by the falling edge of /RAM 0000. Data is stored 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 /REGSELECT, /R/W (active high), /WRITE02 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 2-4 lists write registers, their assigned function and address.

Address State			Hex Address	Function
A3	A2	A1		
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)

Table 2-4. Write Register Functions

The following paragraphs describe the operation of each of these registers.

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 2-5 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 2-5. Counter Control Register Write Functions

Data Bit	Function
D0	COUNTER CLEAR
D1	COUNTER ENABLE
D2	HV SHUTDOWN
D3	HV SELECT (used to digitize HV)
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 are set occurs or new data is written. Table 2-6 lists relay control write functions.

Table 2-6. 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 or Aux Relay (optional)
D5	Remote Indicator

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.

Watchdog Timer

The fail bit D0 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)

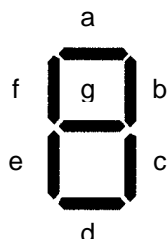
The bargraph addresses are decoded by U5, which is a 1 of 8 decoder. Control line inputs to U5 are /R/W, /WRITE 02, and /BARGRAPH. When the bargraph address is selected (4020-4025), U5 further decodes the addresses listed in Table 2-7.

Table 2-7. Bargraph Write Address

Address State			Hex Address	Function	Driver
A3	A2	A1			
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 2-7. 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 that 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:

Typical 7 - Segment



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 2-8.

Table 2-8. Status Indicator Write Functions

Data Bit	Function
D0	Check Source Indicator
D1	Rate-of-Rise (Optional)
D2	Overrange Indicator
D3	Warn Indicator
D4	High Alarm Indicator
D5	%/hr Backlight (942)
D6	Volts Backlight (942)
D7	CPM Backlight (942)

U60 output's, when high, control U61 inverter/driver to activate the appropriate front panel status indicators.

U60 output's, 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



Data inputs D0-D3 and the decimal point, supplied by U72, are used to enter data in the selected digit as shown in Table 2-9.

Table 2-9. 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 (U82) is an 8-bit buffered multiplying device that responds to address 4004. Data is written and latched by U82 when /DAC, /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.

Table 2-10. Digital to Analog Conversion

MSB	LSB	ANALOG OUTPUT
1111	1111	-10 VDC
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 span 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 /REGSELECT, 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 2-10 lists the READ register, the assigned function and the address.

Table 2-11. Control Signal Address Decoding (U34)

Address State			Hex Address	Function
A3	A2	A1		
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)

The following paragraphs describe the operation of each of these registers.

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 2-12. The function switch logic is shown in Table 2-13.

Table 2-12. 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	D4 – D7 (16 position function switch, see Table 2-11.)
D5	
D6	(Not Used)
D7	(Not Used)

Table 2-13. 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	Undefined
B	1	0	1	1	4	Overrange
A	1	0	1	0	C	Undefined
9	1	0	0	1	5	Calibration Constant
8	1	0	0	0	D	Undefined
7	0	1	1	1	2	Resolving Time
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	Background Subtract
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 E² PROM to the internal data bus and MPU. U42 responds to address 4008. The sensitivity read functions are listed in Table 2-14. The accuracy is shown in Table 2-15.

Table 2-14. 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 (OUT) Alarms active during check source operation
D4	JP3-4 (IN) Fails in five minutes with no counts (OUT) Does not fail
D5	JP3-3 (OUT) Auto alarm acknowledge, after counts return to normal (IN) Manual Reset
D6	JP3-2 Sensitivity select: JP3 jumper IN MPU reads low (0) JP3 jumper OUT MPU reads high (1)
D7	JP3-1 Sensitivity select: JP3 jumper IN MPU reads low (0) JP3 jumper OUT MPU reads high (1)

Table 2-15. Sensitivity Selections (Accuracy)

JP3-1	JP3-2	Selection
IN	IN	Fixed 1 second update
IN	OUT	10%
OUT	IN	5%
OUT	OUT	2%

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 2-16.

Table 2-16. Switch Input Bit Assignments (U62)

Data Bit	Function
D0	Alarm Acknowledge (Latched)
D1	Check Source (Latched)
D2	(Spare)
D3	(Spare)
D4	Rate-of-Rise/ Trip Test
D5	Warn Alarm
D6	High Alarm
D7	High Voltage

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 the single channel analyzer option (two channels), asynchronous communications interlace 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 (factory set), Scintillation Detectors
JP4 2-3	Pulse Polarity (Input)	For positive input, GM Detectors
JP5 1-2	Pulse Polarity (Shield)	For negative input (factory set), Scintillation Detectors
JP5 2-3	Pulse Polarity (Shield)	For positive input, GM Detectors

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-1 is available as a test point for this pulse.

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 2-5 shows signal "A" below both discriminators, signal "B" between discriminators, and signal "C" above discriminators.

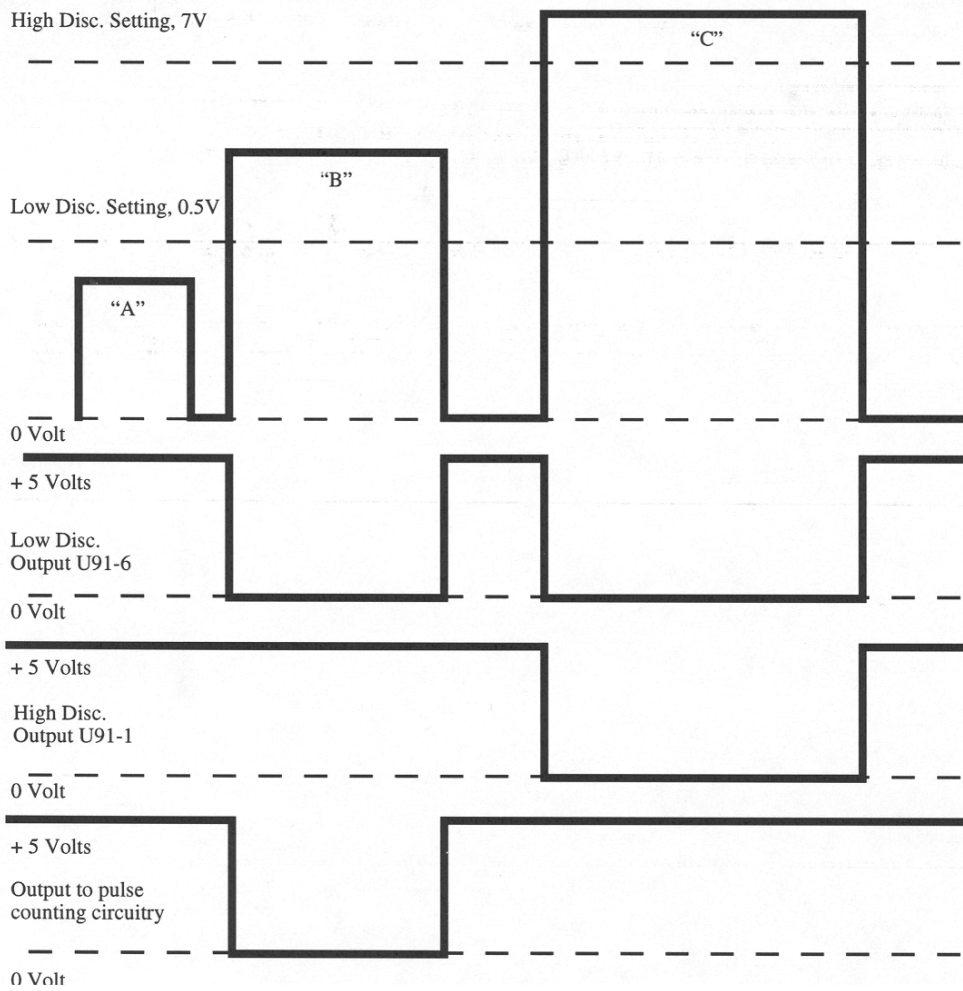


Figure 2-5. Discriminator Setting

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 multiplexer 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 HVf 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.

Voltage to Frequency Converter

The V/F converter (U100) monitors the high voltage supply and outputs a frequency to the signal multiplexer, allowing the MPU to determine and display the detector high voltage. The input to the V/F circuit is provided in a 1000:1 ratio by the HV supply board. VR3 adjusts the gain of the converter. A 1 volt (representing 1000 volts) causes a frequency output of 10 kHz. Likewise, a 0.6 volt input (representing 600 volts) produces a frequency of 6 kHz. Therefore, $f_{out} = V_{in} \times 10,000$.

2.3 High Voltage Supply (Schematic 942-200-63, Appendix B)

The high voltage is utilized in a scintillation detector by the photomultiplier tube (typical range 750 volts to 1500 volts) or 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 - C. U1 device 3-10, normally held at ground by R17, allows an error input in applications using the optional americium regulator option board. The output U1-8 will vary under control of either R5 or the error input voltage. Table 2-17 shows the effect of the error input voltage on the high voltage.

Table 2-17. Error Input Voltage Range

+1 Volt	(HV) +135 Volts
+2.5 Volts	(HV) +335 Volts
-1 Volt	(HV) -135 Volts
-2.5 Volts	(HV) -335 Volts
+10 mV	(HV) +1.35 Volts

Operation amplifier U1-A 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-C voltage increases which causes U1-A 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 2-6.

R2 is a 1000:1 voltage divider which provides feedback to control the high voltage. U1-B is used as a buffer between the 1000:1 divider and the 1000:1 output signal utilized by the V/F converter on the main circuit board. This output signal is also utilized by U1-A 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-A 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.

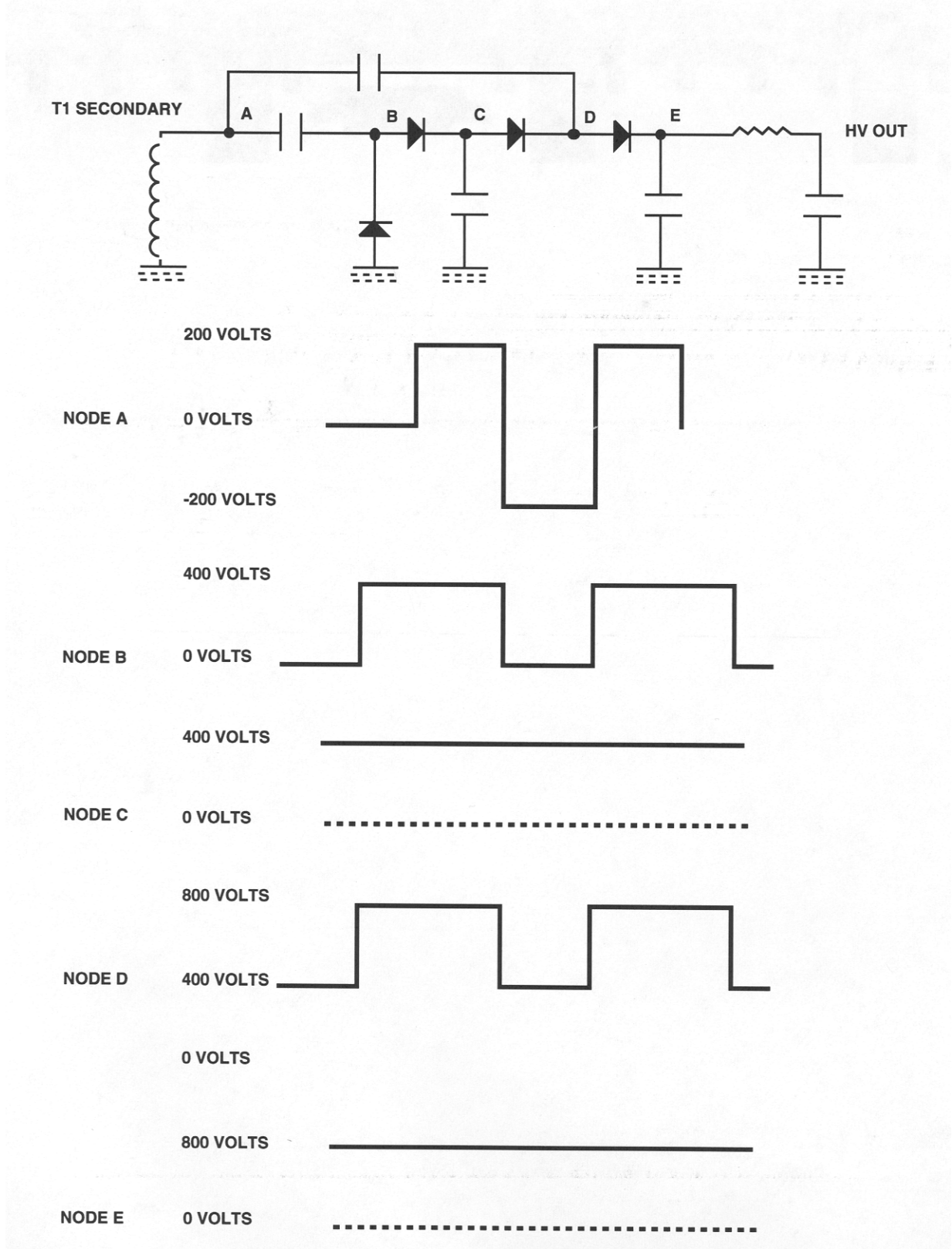


Figure 2-6. High Voltage Output (800VDC)

2.4 Relay Circuit Board (942-100-70, Appendix B)

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 relay which provides 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: Optional Rate-of-Rise/ Auxiliary Function
- K2: Check Source
- K3: Fail
- K4: Warn
- K5: Alarm

The relay contacts are provided to the user via rear panel connector P1, with the exception of the check source via detector connector P2. See specifications for contact ratings. Varistors (V1-V16) provide transient protection across the contacts.

2.5 Front Panel Circuit Board (942-100-15, Appendix B)

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 2-7 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."

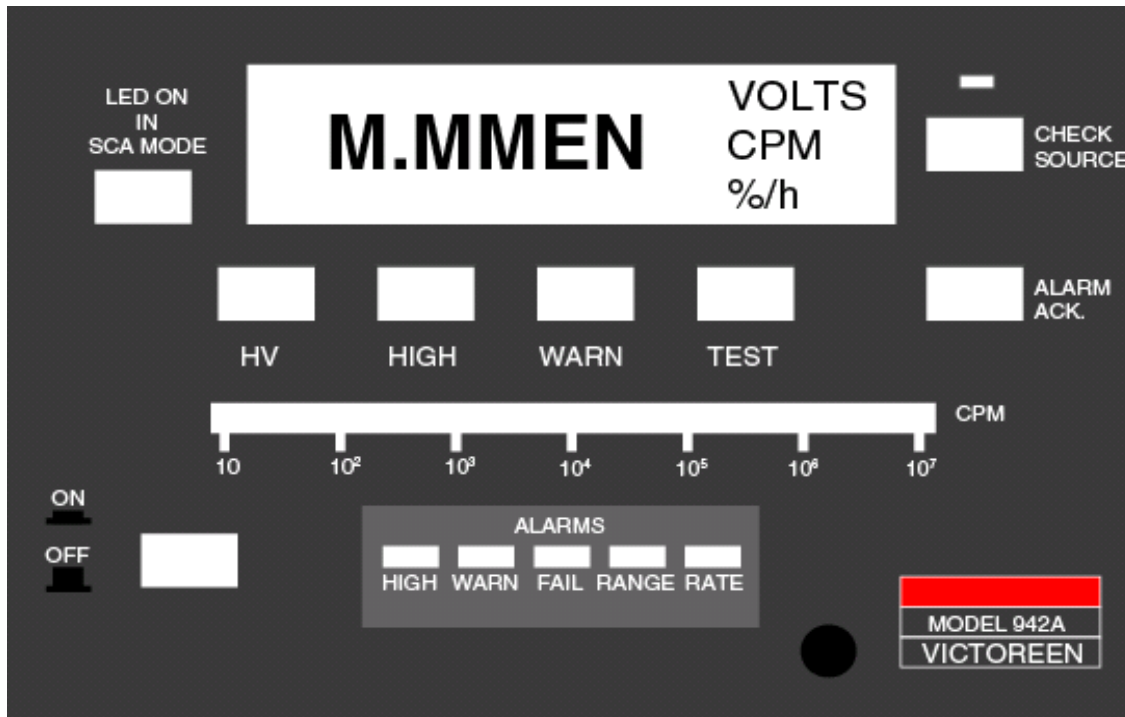


Figure 2-7. Front Panel, Model 942A-200L-M4

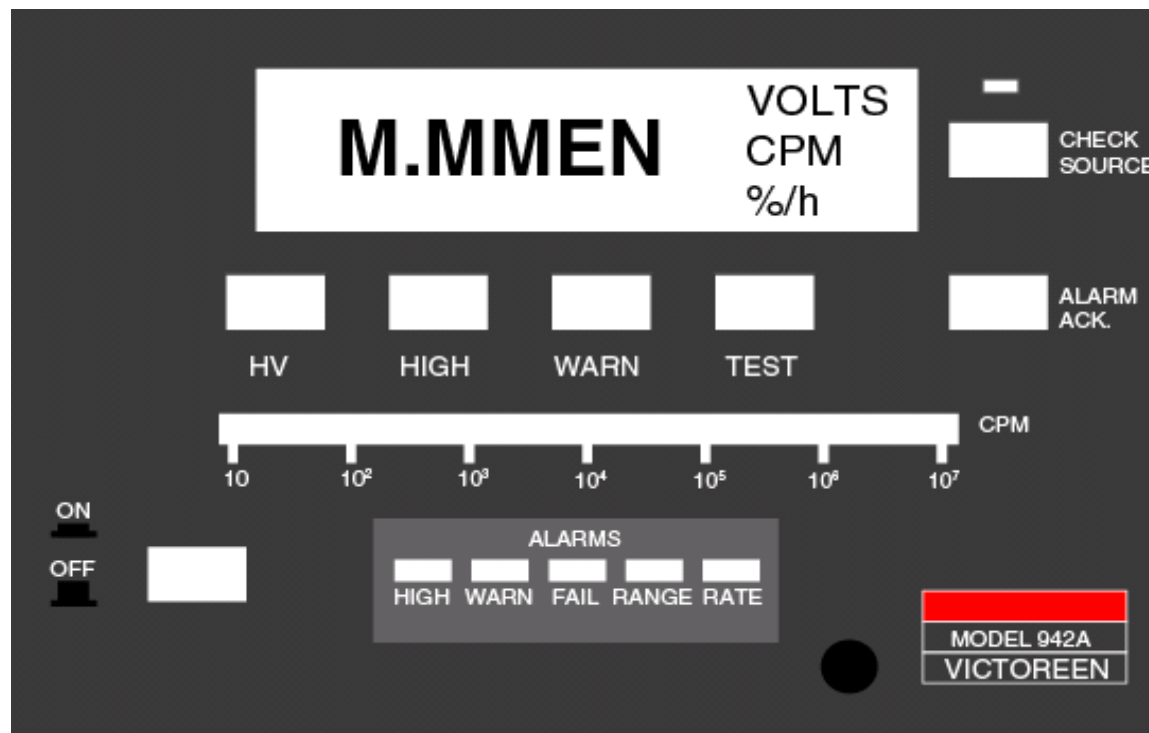


Figure 2-7. Front Panel, Model 942A-200L-M5

2.6 Power Supply (942-200-50, Appendix B)

The UDR power supply is an Astec RBT 45, Kepco KRW351KV, or equivalent. The power supply is rated at +5 volts @ 3 amps, +15 volts @ 2.0 amps, and -15 volts @ .5 amps. The power supply will operate from an input voltage from 90VAC to 240 VAC, 47 to 67 Hz. For older units, using the KEC electronics power supply, 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/VDE requirements.

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.

2.7 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.

1. 942-200-75: ANALOG OPTION INPUT BOARD - Contains four separate channels for analog input. 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 communications link between VICTOREEN's ratemeter and a user computer system or CRT terminal, with baud rates ranging from 50 baud to 19200 baud. An asynchronous communication interface adapter is utilized to format the data and control the interface.

The VICTOREEN communications interface also provides the necessary circuitry to allow interconnecting to a standard VICTOREEN communication link. This interface allows multiple UDRs to share a common six-wire cable to a main central processor unit.

3. 942-200-90 and 942-200-90-M1: SINGLE CHANNEL ANALYZER (AMERICIUM REGULATOR) - Designed to provide two independently adjustable windows for the discrimination of radiation pulses using the voltage peak analysis technique. When used with an Americium -231 doped sodium iodine crystal, provides the ability to automatically adjust the detector high voltage to compensate for photomultiplier tube gain changes due to ambient temperature variations. (A separate channel is utilized to regulate system gain via the high voltage supply. This channel is locked to an americium pulse within the detector and is used to maintain a constant gain.)

This channel includes a 16-bit counter. The counter control and sample period functions under MPU control. A selector switch allows the user to select channel display on the front panel.

For the 942A-200L-M4, the Model 942-200-90-M1 Single Channel Analyzer circuit board is provided. The -M1 modification suffix identified the circuit board has been modified to permit transferring from Gross to SCA mode via a Front Panel mounted switch.

4. 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 mV DC, 0 -100 mV DC, 0 -50 mV DV, or 0-10m VDC.
5. 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 mV DC, 0 -100 mV DC, 0 -500 mV DC, or 0 -1 VDC.

For the 942A-200L-M4, the Model 942-200-95-M1 Dual Analog Output circuit board is provided. The -M1 modification suffix identified the circuit board has been modified to provide two additional analog outputs with a voltage range of 0-10mV and 0-5 VDC

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Section 3 Operation

3.1 Installation

Installation consists of mounting the equipment, making the required electrical connections, and entering the desired set points.

CAUTION

Remove all power prior to installing the UDR.

UDR Mounting

The UDR is a self-contained unit that 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 Fluke Biomedical.

1. The first mounting utilizes a 19-inch rack chassis adapter, Victoreen Model 948-1 or 948A-1. This configuration requires 3.5 inches of rack height and can be used to mount up to three UDRs side by side. The 948A-1 will accommodate both 84X series analog readouts and 94X series digital readouts. The 948-1 will accommodate the 94X series digital readouts only. A blank filler panel, Victoreen Model 948A-2, is available to cover unused mounting positions. Refer to drawing GEL-948-1 or GEL-948A-1 for mounting dimensions.
2. The second mounting consists of a single channel tabletop 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 948-1 0 Rack Chassis Adapter to mount a 94XA-200 UDR into an existing Victoreen analog ratemeter rack chassis. 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 are made using the mating connector kit, VICTOREEN part number 942A-100-4, the connector input/output assignments provided in Appendix B, and the loop drawings S174014D-102, 174014E1003, S27860A-102 and S321299A-104 are provided in Appendix B. Termination instructions for coaxial connections can be found in Appendix D.

Connector pins should be soldered to customer furnished cable, using 60/40 tin/lead resin core solder, or equivalent.

3.2 Set-up

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

NOTE

Ensure you have read and fully understand Section 3 prior to continuing.

1. Verify that jumpers and DIP switches on the UDR, are set for the operational features desired. Refer to Section 3, Table 3-1.
2. Apply power to the unit. The bargraph will illuminate in amber, followed with a display of 0.- -0.-. The unit will then begin to display the ambient radiation at the detector location.

NOTE

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

3. Detector dependent set points such as analog outputs, Range, Overrange limit, calibration constant, detector deadtime value, and channel dependent setpoints such as alarm limits may now be verified and if required, modified using the procedures outlined in Section 3.11.
4. 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 4 should be performed.

3.3 Operation

Operation of the UDR consists of operator functions and configuration functions. All operator functions are performed using the front panel shown in Figures 2-7 or 2-8. Configuration functions are performed using internal data entry switches and/or jumpers, which are accessible with a partial removal of the UDR from the mounting enclosure. Calibrations involving trim pots are described in Section 4.

Normal Operation

If the measured radiation field is within the range of the detector during power-up, the CPM value will be displayed as a three digit number: M.MMEN, where M = 0 to 9 with a single digit exponent N, where N = 0 to 9 and can be either positive or negative. For example, 2.97×10^4 would be displayed as 2.97E4. The bargraph will display the value on the fixed CPM scale and any indicator lights which are on (ON/OFF, CHECK SOURCE) should be green, providing the operator with a visual indication of normal operation.

WARN/HIGH/RATE Alarms

NOTE

The RATE alarm is an option and is not implemented on the Model 942A-200L-M4 or 942A-200L-M5.

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 and rate (also identified as auxiliary high) alarm relay will de-activate.

NOTE

Normal WARN, and HIGH alarm relay operation is fail-safe. The relay is normally energized, and de-energized when the alarm condition is active. 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 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 energized until the alarm condition returns to normal.

Upon resumption of normal operation, the relays and alarm indicators will de-energize. 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 may be used to display the respective alarm set points.

Range Alarm

The UDR is provided with three types of Range alarms, Under Range, Over Range and Anti-Jam.

Under Range: If the measured radiation field is below a minimum range of 1.00E1 CPM, the front panel display will indicate 0.00E0 CPM, the bargraph will extinguish the analog output will be at its low scale value and the RANGE alarm indicator will illuminate in red. The minimum range is factory set to 10 CPM. When the measured radiation field increases into the range of the detector, the RANGE alarm indicator will extinguish and normal operation will begin. There is no relay output associated with the under range alarm.

Over Range: If the measured radiation field goes above the Overrange set point, the RANGE alarm indicator will illuminate, the bar graph will illuminate in red, full scale, the Warn alarm LED will turn on, flashing, the Warn relay will change state, the High alarm relay will turn on, flashing, the High alarm relay will change state, the analog output will be at its full scale value and the front panel display will indicate EEEEE. The maximum range of the detector is used to determine 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, the radiation alarms will clear, and normal operation will resume.

Anti Jam: In the event the detector output exceeds the electronic Anti-jam circuit trip level, the Anti-jam fuse will open the FAIL alarm indicator will illuminate, the FAIL relay will change state, the RANGE alarm indicator will illuminate, the detector high voltage will shut down, the bar graph will illuminate in red, full scale, the analog output will be at its full scale value and the front panel display will indicate EEEEE. In most cases, as the radiation value increases, the WARN and HIGH alarm indicators will also be turn on, flashing and the WARN and HIGH alarm relays will also have changed state. The Anti-jam condition is provided to ensure that if the radiation level exceeds the range of the detector, and the detector output drops to a steady DC level, the UDR display will not drop to a value less than full scale. In our design, this is accomplished by forcing the digital display to display an error message, EEEEE. In addition, the detector high voltage supply is also shut down to protect the detector from damage and the Anti-jam fuse is blown, locking the UDR in the Anti-jam condition. To recover from an Anti-jam trip, once the radiation has decreased, the following steps are required:

Anti-jam Recovery:

- Turn UDR AC power OFF
- Remove Anti-jam fuse F1 (1/20 amp, plug-in type)
- Replace Anti-jam fuse
- Turn AC power ON

If the Anti-jam fuse is in the bypassed, or test condition (i.e. UDR Main Board jumper JP6 is in the 2-3 position), the Anti-jam fuse will not be opened, and the unit may be returned to normal operation by cycling the AC power ON and OFF.

The difference between the Overrange state and the Anti-jam state are as follows:

Description	Overrange:	Anti-jam
Display	EEEEEE	EEEEEE
Range LED	ON	ON
FAIL LED	OFF	ON
FAIL Relay	Normal	Tripped (de-energized)
High Voltage	Normal	Turned off
Bar Graph	ON, RED	ON, RED
Analog Output	Full Scale	Full Scale
Recovery (Once radiation field is normal)	Press Acknowledge *	Power Down, Replace Anti-jam fuse Power back up *

* = Input must be below the Over range set point

Fail Alarm

There are several equipment failure conditions that 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.

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 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. The bar graph remains active during check source operation.

Trip Test

The Models 942A-200L-M4 and 942A-200L-M5 UDRs are equipped with a Trip Test function. As a part of the Trip Test option, a momentary contact push button is provided on the Front Panel to test the operation of the front panel display and alarm relays. Pressing and holding in the TEST push button on the front panel, SW5, results in the display of 8.8.8.8., turning on the backlight unit displays, illuminates the bar graph in amber, illuminates all of the front panel LEDs, drives the analog outputs full scale, and de-energizes the WARN, HIGH, Aux and FAIL relays.

When the TRIP push button is released, the digital display, units backlights, analog output, FAIL, RANGE, RATE and CHECK SOURCE LEDs return to normal, the bar graph illuminates red and the WARN, HIGH, Aux and FAIL relays energize. The HIGH and WARN alarm LEDs flash ON and OFF.

The Trip Test function is exited by pressing the Acknowledge push button. This turns the HIGH and WARN LEDs off and returns the unit to normal operation.

Single Channel analyzer (SCA), 942A-200L-M4 only

The Models 942A-200L-M4 is equipped with a Single Channel Analyzer (SCA) function. The SCA function is provided to permit monitoring of a specific radioactive isotope, as identified by the energy of the gamma ray emitted as the radioisotope decays. A front panel mounted, alternate action switch is provided on the front panel to permit Gross or SCA mode operation.

The SCA function is not implemented on the Model 942A-200L-M5 UDR.

Firmware Version

This system requires a PROM for UDR operation. For the part number and the latest revision of the PROM, see the UDR Factory Test Data Sheet. This Manual has been prepared for use with the P/N 94094217, Rev. 5 or 6, Prom.

3.4 Operational Modes

Normal Operation, Rate, Gross Mode

The UDR is in normal operation when the UDR function switch (see "Parameter Entry" Section 3.11) is in any position except 8, the Trip Test function is not active and the Check Source button is OFF. During normal operation, the display shows the radioactive activity data received from the detector in counts per minute (CPM). The bargraph will also show the present CPM value. The color of the illuminated segments is green when the CPM rate is below the WARN setpoint, amber when the CPM rate is above the WARN setpoint and below the HIGH setpoint, and red when the CPM rate is above the HIGH setpoint. The analog outputs are active while the UDR is in RATE, GROSS MODE and all alarms are enabled. In GROSS MODE, all of the detector pulses that fall between the Low and High discriminator are counted by the UDR.

Normal Operation, Rate, Single Channel Analyzer (SCA) Mode, 942A-200L-M4 only

The Models 942A-200L-M4 is equipped with a Single Channel Analyzer (SCA) function. The SCA function is provided to permit monitoring of a specific radioactive isotope, as identified by the energy of the gamma ray emitted as the radioisotope decays. By using a gamma scintillation detector with a NaI crystal and a photo multiplier tube, a linear relationship between the energy of the gamma ray and the voltage of the pulse produced in the detector may be established. The result is a pulse produced by the detector is proportional to the energy of the gamma ray emitted by the radioisotope. During normal operation in the SCA mode, the display shows only the detector pulses for the isotope of interest in counts per minute (CPM). The bar graph will display the CPM value for Gross detector output. The color of the illuminated segments will be green when the CPM rate is below the WARN setpoint, amber when the CPM is above the WARN setpoint and below the HIGH setpoint, and red when the CPM rate is above the HIGH setpoint. The analog outputs are active while the UDR is in RATE, SCA mode, and all alarms are active. Only the detector pulses that fall between in the SCA window are displayed by the UDR.

To operate in the SCA mode, the Model 942A-200L-M4 is provided with a Model 942-200-90-M1 SCA option circuit board. The 942-200-90-M1 provides an electrically adjustable voltage window that will count only the pulses that fall into the voltage window established. By knowing the energy of the isotope of interest and the gamma energy to voltage relationship of the detector, the appropriate window voltage may be calculated and adjusted to respond to the gamma radiation emitted in the decay of a specific radioisotope. The 942-200-90-M1 is provided with potentiometers to adjust the peak voltage and window width as required to detect the presence of a specific isotope. When the SCA circuit is operating, the UDR is said to be operating in the SCA mode. When the SCA circuit board is not supplied, or the SCA board is not active, the UDR will respond to pulses over the full range of the gamma detector, approximately 70 KeV to 2.5 MeV. This is referred to as the Gross counting mode of operation, or Gross mode.

In addition, the front panel of the UDR is provided with an alternate action Gross/SCA mode select switch. The UDR is normally in the Gross mode of operation. When the Gross/SCA mode switch on the UDR front panel is pressed, the UDR operating mode is changed from Gross to SCA, and a green LED built into the Gross/SCA switch illuminates. Pressing the switch again returns the UDR to the Gross mode, and turns the green SCA mode LED indicator off. Operation of the UDR in Gross and SCA mode are summarized below:

Function:	Mode:	
	Gross	SCA
Digital Display:	Gross CPM	SCA CPM
High Alarm Trip:	Gross CPM	SCA CPM
Warn Alarm Trip:	Gross CPM	SCA CPM
Analog Output:	Gross CPM	Gross CPM
Range alarm:	Gross CPM	Gross CPM
Fail Alarm Trip:	Gross CPM	Gross CPM
Bar graph Display:	Gross CPM	Gross CPM

The -M1 suffix on the Model 942-200-90-M1 SCA indicates the standard SCA circuit board has been modified for this application. The -M1 modification consists of adding a jumper wire from the internal DIP switch, SW1-5, pin 12, to the W1-2 jumper on the SCA board. W1-2 is internally connected to the J2-1 on the SCA board. As a part of the 942A-200LM4 modifications, J2-1 on the SCA board is wired to the Normally Open switch contact on the Gross/ SCA switch, SW8-1. The common contact, SW8-2, is wired to the SCA J2-2 connector, grounding the SCA select input when SW8 is pressed. A LED mounted internally in SW8 is powered from the +15 VDC power supply available on SCA J3-41 (Ground) and J3-45 (+15VDC). A 511-ohm, 0.5-watt current limiting resistor is wired in series with the LED. The resistor is physically mounted on the body of SW8, between SW8-4 (+15 VDC, from SCA J3-45) and SW8-(LED + terminal). The LED - terminal is wired to ground through SCA J3-41. Refer to the modification instruction 942A-200L-M4MS and 942-200-90-M1MS, located in Attachment for further information.

The SCA function is not implemented on the Model 942A-200L-M5-M5 UDR.

Alarm Inhibit

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 (jumper selectable) or Calibrate. During Alarm Inhibit, 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.

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 "Parameter Entry" Section 3.11). The selected setpoint is displayed in exponential format (e.g. 1.00E2) with the left most digit flashing. If the FUNCTION switch is not in a setpoint position, pressing the ENTER button has no effect. Refer to Table 3-2 for FUNCTION switch positions.

In the Data Entry Mode, all alarms are active. The bar graph and analog outputs are active. The check source and alarm acknowledge functions are active.

Check Source Mode

The LED check source verifies operation of the photomultiplier tube, detector preamplifier, and the UDR electronic circuits. The integrity of the crystal is verified through the No CPM FAIL logic in the UDR. The LED check source option requires the use of a Model 9420-200L UDR, a Model 844-211L Junction Box and a 943-25TL or 943-36L series scintillation detector. To operate the check source, press the CHECK SOURCE pushbutton and hold it down. Pressing the CHECK SOURCE pushbutton will energize the CHECK SOURCE relay to provide + 15v DC to the pulser circuit board located in the Model 844-211L Junction Box, illuminate the green check source indicator and force the display to 0.00E0. The pulser circuit will provide a fixed pulse output to drive a LED mounted in the photomultiplier (PMT) tube base of the 943-25TL or 943-36L series scintillation detectors. The pulsed light output of the LED will be seen by the PMT, converted to an output pulse, and displayed as an increased radiation value on the UDR digital display. Releasing the CHECK SOURCE pushbutton will turn off the +15v DC to the pulser circuit board, extinguish the check source indicator, de-energize the check source relay, clear the 60 second count buffer, and return the UDR to normal operation. The UDR will then display 0.00E0 and begin counting the detector pulses. Within approximately 10 seconds, an estimate of the current radiation value will be displayed and the displayed value will begin to increase, indicating the normal background radiation level within 60 seconds. An internal configuration jumper allows the alarms to be activated or muted if the alarm limits are exceeded by the check source reading.

The bargraph operates the same way as it does during normal operation.
The analog outputs are at low scale during check source operation.

Refer to Manual 844-211L-1 for further information.

The normally OPEN (NO) contact on check source relay, K2 (P2, Pins 13 and 14), closes when the check source function is active and opens when the check source function is inactive.

3.5 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, any high and warn conditions will clear, the fail-safe, warn and high alarm relays will de-energize, 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, pressing the ENTER button will start the calibration. The display will go to zero and the backlights will begin to flash. The UDR will count the pulses received for the entered calibration time, displaying the current summation of counts received each second. When the calibration is completed, the final summation of counts for the calibration time is displayed and the backlights will be steady on.

Another calibration can then be executed by pressing the ENTER button, and the system will again display the calibration time for editing. Pressing the enter button again starts the calibration cycle. A calibration in process can be stopped by pressing the ENTER key. Calibrate mode can be aborted at any time by moving the rotary switch to a position other than position 8. If this is done while the calibration time is being displayed for editing, press the ENTER key to exit the setpoint edit mode, then rotate the rotary function switch out of position 8 to exit the calibration mode. Once the calibration mode is exited, the UDR will do a reset and continue normal operation.

NOTE

When the calibrate mode is initiated, the Alarm and Warn relays change state (i.e. de-energize) 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. The check source button can be released, but the check source function is now latched on. Press the enter button again to start the calibrate timer. The check source light will remain on, indicating that the check source is energized. The check source condition will remain latched on until the calibrate mode is exited. This feature provides a uniform method to obtain a check source count.

NOTE

It is not recommended that solenoid operated check sources be left energized for extended periods of time in this mode.

The bargraph will turn off during calibration operation.
The analog outputs are at Low Scale during calibration operation.

3.6 Trip Test

The Models 942A-200L-M4 and 942A-200L-M5 UDRs are equipped with a Trip Test function. As a part of the Trip Test option, a momentary contact push button is provided on the Front Panel to test the operation of the front panel display and alarm relays. Pressing and holding in the TEST push button on the front panel, SW5, results in the following actions:

Press and Hold TRIP push button:

- Digital Display shows 8.8.8.8.8.
- All 3 backlight unit displays turn ON
- Bar graph illuminates, full scale, Amber
- Fail-safe HIGH alarm relay de-energizes
- Fail-safe WARN alarm relay de-energizes
- Fail-safe FAIL alarm relay de-energizes
- Fail-safe Auxiliary relay (not used) de-energizes
- HIGH alarm LED turns ON
- WARN alarm LED turns ON
- FAIL alarm LED turns ON
- RANGE alarm LED turns ON
- CHECK SOURCE LED turns ON
- RATE LED turns ON
- Analog Outputs are driven full scale

When the TRIP push button is released:

- Digital Display returns to normal
- Backlight display returns to normal
- Bar graph illuminates, Red, based on the radiation value
- Fail-safe HIGH alarm relay energizes
- Fail-safe WARN alarm relay energizes
- Fail-safe FAIL alarm relay energizes
- Fail-safe Auxiliary relay (not used) energizes
- HIGH alarm LED begins flashing
- WARN alarm LED begins flashing
- FAIL alarm LED returns to normal
- RANGE alarm LED returns to normal

- RATE alarm LED returns to normal
- CHECK SOURCE LED turns off
- Analog Outputs return to normal

The Trip Test function is exited by pressing the Acknowledge push button.

When the ACK push button is pressed and released:

- Bar graph returns to normal
- HIGH alarm LED stops flashing
- HIGH alarm returns to normal
- WARN alarm LED stops flashing
- WARN alarm returns to normal

3.7 Alarms

The alarm functions provided by the UDR include HIGH, WARN, FAIL, UNDERRANGE and OVERRANGE. 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 3.

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, WARN, and OVERRANGE alarms, and auto reset for the FAIL and UNDERRANGE alarm. Failsafe operation is also standard.

Manual Reset

When an alarm trips, the relay coil goes to its abnormal position. For the HIGH and WARN alarms, 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 energized 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.

HIGH Alarm

The HIGH alarm condition is “true” when the display CPM 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.

WARN Alarm

The WARN alarm condition is “true” when the display CPM 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. The auxiliary output on the UDR can be used to drive a remote alarm/alarm indicator.

RANGE Alarms (UNDERRANGE, OVERRANGE and ANTI-JAM)

The underrange condition is “true” when the CPM rate is below the underrange setpoint and “false” for all other conditions. The RANGE indicator illuminates, the bargraph is off, and the display reads 0.00 CPM when the underrange condition is true. The Alarm, Warn, and Fail relays are not affected by the underrange alarm. The underrange alarm is factory set to 10 cpm.

The overrange is true when the CPM rate is greater than or equal to the overrange set point or the detector is sending an output pulse greater than the UDR electronic Anti-Jam circuit threshold. The condition is false when neither of the above conditions is true.

When the OVERRANGE alarm is tripped, WARN and HIGH alarm logic is tripped, the red RANGE indicator illuminates steady on, the bargraph illuminates red, and the display reads EEEEE.

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 and the detector high voltage to turn off, indicating a non-operational mode. To return to normal operation, the ambient radiation must be reduced, the UDR AC power cycled ON/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 942A-200-M4 and 942A-200L-M5 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. 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 (Watchdog Timer)

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.

3.8 Configuration Functions

The UDR contains a series of eleven hardware jumpers and up to nine user specified set points that 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 3-1.

Microprocessor Reset (JP1)

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

PROM Type (JP2)

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

Count Time Selection (Statistical Accuracy JP3-1 and JP3-2)

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 3-1 for additional information.

Alarm Reset (Acknowledge JP3-3)

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 in.

No Counts Fail Alarm (JP3-4)

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 in. Note that other conditions which cause a Fail Alarm are not affected by this jumper setting.

Inhibit Alarms (Check Source Operation JP3-5)

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 (JP4)

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

Input Shield Polarity (JP5)

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 (JP6)

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

Detector Type (JP7)

Jumper JP7 is set to position 2-3 for a GM detector input. Position 1-2 provided for use with a scintillation detector.

3.9 Jumper Selectable Options

NOTE

The unit must be turned off when changing jumpers.

Table 3-1 Model 942A-200L-M4 and 942A-200L-M5 Option Jumpers (Refer to drawing 942-200-10, Appendix A, for Jumper Location)

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 (It should be noted that 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 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	- Input Pulse (Scintillation Detectors) (factory) + Input Pulse (GM Detectors)
JP5	Shield Polarity Selection	1-2 2-3	+ Shield for Negative Pulse (factory) - Shield for Positive Pulse (GM)
JP6	Anti-Jam Fuse Selection	1-2 2-3 Out	Enable for Normal Operation (factory) Anti-Jam Circuit fuse bypassed (testing) Anti-Jam Circuit Disabled (for testing only)
JP7	Detector Type for Anti-Jam Circuit	1-2 2-3	Scintillation (factory) GM Tube

3.10 UDR Function Switch/Function

Table 3-2 UDR Function Switch RDS1 Positions/Function (Refer to drawing 942-200-10, Appendix B, for Function Switch Location)

Switch Position	Function
0	Selects HIGH Alarm Setpoint
1	Selects WARN Alarm Setpoint
2	Selects Resolving Time (Tau) Limit
3	Selects Analog Full Scale Limit
4	Selects Overrange Limit
5	Selects Calibration Constant
6	Background Subtract
7	Selects Analog Low Scale
8	Selects Calibrate Mode
9	Not Used
A-E	Not Used
F	Unit I.D.

3.11 Parameter Entry

Parameter entry is accomplished using a 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 unit from its mounting case.

The FUNCTION switch is used to select the parameter to be entered. Table 3-3 defines the switch positions and a description of each parameter can be found in the following paragraphs.

Table 3-3. Function Switch Entry Parameters

Switch Position	Setpoint	Units	Factory Setting
0	High Alarm Limit	CPM	1.00E5
1	Warn Alarm Limit	CPM	1.00E3
2	Resolving Time (Tau)	Minutes/count	0.00E0
3	Full Scale Value	CPM	1.00E7
4	Overrange	CPM	1.00E7
5	Conversion Constant	-	1.00E0
6	Background Subtract	CPM	0.00E0
7	Low Scale Value	CPM	1.00E1
8	Calibration Mode	Seconds	6.0E1
9	Not Used	N/A	E0007
A thru E	Not Used	N/A	E0007
F	Unit I.D.	N/A	1.00E0

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. The ENTER push button should be held until the left most digit on the display is flashing.

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 or negative 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.

3.12 Set Point Descriptions

High Alarm Limit (Switch Position 0)

This parameter is entered in units of CPM in the exponential format described above. 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 (Switch Position 1)

This parameter is entered in units of CPM in the exponential format described above. 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.

Rate Alarm Limit - Not Implemented

Resolving Time (Tau Switch Position 2)

This parameter is entered in units of minutes per count. The actual value to be entered is a function of the individual detector and is supplied with the detector calibration data sheet. If a complete system is installed, this setpoint is factory entered.

Analog Full Scale Value (Switch Position 3)

This value is the dose rate at which the analog output is 10 volts or 20 milliamperes. 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 X equals -9 to +9. This parameter is entered in units of CPM 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 (Switch Position 4)

This parameter is entered in units of CPM. It is normally set for the upper limit value of the detector used (for a 943-xx series detector, this value is normally 1.00E7). 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.

Calibration Constant (Switch Position 5)

This parameter is a detector dependent value that is used to multiply the detector output by a fixed value or to convert the counts per minute (CPM) output to engineering units, (i.e. $\mu\text{Ci/cc}$). The actual value to be entered is based on the detector and the sampling geometry used for the monitor. The units may be $\mu\text{Ci/cc}$ per counts per minute, or other user defined value. The factory default value is 1.0.

Background Subtract (Switch Position 6)

This parameter is entered in units of counts per minute (CPM). The value entered is subtracted from the radiation value calculated by the microprocessor, and the net result is displayed. The alarm limit checks and analog output conversion are both processed based on the net count rate displayed, the background subtracted value. The background subtract value does not affect the bargraph display, which is processed based on the gross count rate.

Analog Low Scale Value (Switch Position 7)

This value is the dose rate at which the analog output is 0 volt or 4 milliamperes. 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 CPM 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 (Switch Position 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 – Not Implemented

Unit ID (Switch Position F)

This setpoint is used in multidrop communication systems, where a unique address is required for each UDR. The Unit ID has no impact on the operation of the 942A-200L-M4 or 942A-200L-M5.

3.13 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 3-4 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 for approximately 5 seconds, or until the first digit on the display is flashing. If initializing the setpoint memory does not help, then the setpoint PROM is defective or there is a hardware malfunction.

Code E0004 indicates that a setpoint entry error has occurred (e.g. WARN alarm set higher than HIGH alarm, HIGH alarm set lower than WARN alarm, OVERRANGE below HIGH alarm). The error code will be displayed for approximately 5 seconds, and will automatically clear, returning to the set point entry mode. The set point being edited should then be checked for agreement with the other related set points prior to continuing the edit process.

E0004 is also displayed if the analog output set points are invalid. This would occur when the Full Scale value is set below or equal to the Analog Low Scale value, or the Analog Low Scale value is set above or equal to the Analog Full Scale value. A minimum of 1-decade separation between the Analog Full and Low Scale set points is required.

E0004 will also be displayed if the Full Scale or Low scale set point values are not set to an even power of 10 (e.g. 1.00EX, where X= an integer between -9 and +9).

The appearance of either code may indicate that the setpoint memory has not been initialized.

Code E0007 identifies the set point function select switch is in a position where no set point has been defined. To clear the E0007 press the ENTER push button and move the function select switch to an active point position.

Table 3-4. Model 942A-200L-M4 and 942A-200L-M5 Error Codes

Error Codes	Function	Reference Section
E0001	Negative display data	Re-initialize to reset
E0004	Invalid setpoint value (s)	Automatically resets after 4 seconds
E0007	Invalid set point selected	Press the ENTER button to reset

3.14 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, 0-10 Vdc or optional analog output value 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

$$V = P (V_{Max} - V_{Min}) + V_{Min} \quad \text{or} \quad I = P (I_{Max} - I_{Min}) + I_{Min}$$

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
- V_{Max} = Maximum voltage available (usually 10Vdc)
- I_{Max} = Maximum current available (usually 20 mA)
- V_{Min} = Minimum voltage available (usually 0 Vdc)
- I_{Min} = 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 = 4mA.
 Then: P = [log (1E3/1E-1)] / [log (1E7) -log (1E-1)]
 = log (1E4) / log (E8)
 = 4/8 = 0.5
 and: I = 0.5 (20mA - 4mA) + 4 mA
 = 0.5 (16 mA) + 4 mA
 = 12 mA

To aid in calibrating the analog output, the high scale or low scale setpoint may be set to zero to force the output high or low. If the low scale setpoint is set to zero, the analog output goes to low scale. If the high scale value is set to zero, the analog output goes to full scale. If both are set to zero, the output goes to full scale. Error code E0004 will be displayed if either setpoint is set to zero. The procedure for calibrating the analog outputs is contained in Section 4.

3.15 Software Calculations

The 942A-200L-M4 and 942A-200L-M5 UDRs requires setpoints to be entered which are specific to each detector and sampling geometry. The following explains the calibration constant and resolving time.

Calibration Constant

The first of these set points is a calibration constant. The calibration constant converts the detector pulse rate into a CPM value, using the following equation:

D = (CPM- BKD) x K

Where:

- D = the calculated value in CPM (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, updated once per second)
- BKD = the optional operator entered background subtract set point, CPM
- K = the optional user calibration constant in CPM

The value of K is a user-supplied calibration constant. The normal value is 1.0.

Resolving Time (Tau)

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 non-linearity, the resolving time is corrected for by the following equation:

$$CPM = \frac{Ro}{1 - (Ro \times \text{Tau})} \quad (\text{or } Ro/1-(Ro \times \text{Tau}))$$

Where:

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

The value of Tau is supplied with the detector and is found on the detector calibration data sheet.

Statistical Accuracy

The normal mode of operation is to sample the radiation value, in units of Counts per Minute (CPM) once per second, and display the average of the 60, one second values. This provides a maximum response time of 1 minute to a step change in radiation value. At low counting rates, however, the displayed value will exhibit statistical fluctuations, even though the mean emission rate is not changing.

Note:

In this mode of operation, the alarm response time may exceed 1 minute. This mode of operation is NOT recommended for Safety-Related applications.

To reduce count rate fluctuations at low count rates, a 2% statistical accuracy function is provided. When enabled (via jumper selection), the 60 value average is replaced with a 9604 value average. In this mode, the 1/second update is replaced with a 1/minute update. If the new value differs from the old value by a 2 standard deviations, the new value is displayed and the display and alarm logic are updated 1/second. When the change in radiation value is less than 2 standard deviations, the update rate returns to once per minute. In this mode, the maximum integration time is 20 minutes (20, 1 minute averages).

To reduce count rate fluctuations at low count rates, a 5% statistical accuracy function is provided. When enabled (via jumper selection), the 60 value average is replaced with a 1537 value average. In this mode, the 1/second update is replaced with a 1/minute update. If the new value differs from the old value by a 2 standard deviations, the new value is displayed and the display and alarm logic are updated 1/second. When the change in radiation value is less than 2 standard deviations, the update rate returns to once per minute. In this mode, the maximum integration time is 20 minutes (20, 1 minute averages).

To reduce count rate fluctuations at low count rates, a 10% statistical accuracy function is provided. When enabled (via jumper selection), the 60 value average is replaced with a 384 value average. In this mode, the 1/second update is replaced with a 1/minute update. If the new value differs from the old value by a 2 standard deviations, the new value is displayed and the display and alarm logic are updated 1/second. When the change in radiation value is less than 2 standard deviations, the update rate returns to once per minute. In this mode, the maximum integration time is 20 minutes (20, 1 minute averages).

Section 4

Maintenance, Calibration and Troubleshooting

4.1 Maintenance

The 942A-200L-M4 or 942A-200L-M5 Universal Digital Ratemeters (UDR) are designed to operate for extended periods of time with no scheduled maintenance required. If a problem develops, troubleshoot the UDR per Section 4.3 and the drawings in Appendix B.

4.2 Calibration

Table 4-1 lists the electronic adjustments for the UDR. The procedures for making these adjustments are described in the following paragraphs. Procedures for calibration of the detector are provided in the detector instruction manual. Refer to drawing 942-200-10 for component location and drawing 942-200-13 for the circuit schematic drawing.

Table 4-1. Electronic Adjustments

Adjustment	Purpose
VR1	Zero Adjust/0 – 10 Volt Analog Output
VR2	Gain Adjust/0 – 10 Volt Analog Output
VR3	Gain Adjust V/F Converter (used to set frequency)
VR4	20 mA Adjust/4 – 20 mA Volt Analog Output #1
VR5	20 mA Adjust/4 - 20 mA Volt Analog Output #2
VR6	4 mA Adjust/4 – 20 mA Volt Analog Output #2
VR7	4 mA Adjust/4 – 20 mA Volt Analog Output #1
VR8	Gain Adjust/Signal Input Op Amp
VR9	DC Offset Adjust/Signal Input Op Amp
VR10	High Discriminator Adjustment
VR11	Low Discriminator Adjustment
VR12	Anti-Jam Threshold Adjust
VR13	Write Cycle Clock Adjust
HV Supply R5	High Voltage Adjust

For calibration of the 0-10 mV and 0-5 Vdc optional analog outputs provided on the 942A-200L-M4 only, refer to the 942-200-95D instruction manual, provided separately.

0 -10 Volt Output (Factory Set)- Refer to electrical loop drawings S174014D-102, S174014E1003, S27860A-102 and S321299A-104, Appendix B

1. Disconnect the detector.
2. Set the DVM to the 20 V range.
3. Connect the positive lead of the DVM to P2-10, and the negative lead to P2-11.
4. Adjust VR1 for a DVM reading of 0.00 volts.

NOTE

Prior to entering the value in step 5, note the previous setting.

5. Set the function switch to position 3 (overrange) and enter 0.00E0.
6. Adjust VR2 for a DVM reading of 10.00 volts.
7. Enter the original full-scale value set point for position 3.
8. Repeat steps 3 - 7 as necessary for verification.
9. When no further adjustment is necessary, restore the overrange value to the previous setting.

4 - 20 mA Output #1, Output #2 (Factory Set)- Refer to detector electrical loop drawings S1740140-102, S174014E1003, S27860A-102 and S321299A-104, Appendix B.

NOTE

The adjustments for output number 2 are shown in parentheses ().

1. Disconnect the detector.
2. Set the DVM to the 20 mA range.
3. Connect the positive lead of the DVM to P6-1 (P6-3) and the negative lead to P6-2, (P6-4).
4. Adjust VR7 (VR6) to obtain a DVM reading of 4.00 mA. It may be necessary to adjust VR4 (VR5) slightly.

NOTE

Prior to entering the value in step 5, note the previous setting.

5. Set the function switch to position 3 (full scale value) and enter 0.00E0.
6. Adjust VR4 (VR5) for a 20.00 mA reading on the DVM.
7. Enter the original full-scale value set point for position 3.
8. Repeat steps 3 - 7 as necessary for verification.
9. When no further adjustment is necessary, restore the overrange value to the previous setting.

V/F Converter Adjustment HV (Factory Set)

1. Set the DVM to the 2-volt range.
2. Connect the positive lead of the DVM to the HV test jack and the negative lead to ground.
3. Depress the HV switch on the front and wait for the HV reading to stabilize (about 2 seconds). The front panel reading should be 1000 times the DVM reading.
4. Adjust VR3, if necessary to obtain the correct reading. Repeat step 3 until the adjustment is completed.

Signal Input DC Offset and Gain Adjustment (Factory Set)

1. Disconnect the detector signal input.
2. Set the DVM to the 1-volt range.
3. Connect the positive lead of the DMV to TP-1 (labeled PULSE on the edge of the printed circuit board) and the negative lead to the ground test jack.
4. Short the signal input connector on the rear panel (P5)
5. Adjust VR9 for a DVM reading of 0.000 volts.
6. Disconnect the DVM and connect an oscilloscope (to channel 2) positive lead to TP-1 and the negative lead to the ground test jack.
7. Disconnect the short on the signal connector, on the rear panel (P5).
8. Connect a signal generator to P5.
9. Connect an oscilloscope to channel 1 to monitor the signal generator output.
10. Adjust the signal generator output to obtain a 1 microsecond negative going pulse, with a -1 volt amplitude at a 1 kHz repetition rate.
11. Adjust VR8 to obtain unity gain. A -1 volt input should produce a +1 volt output pulse.

High and Low Discriminator Adjustments

Refer to the appropriate detector calibration procedure.

Anti-Jam Threshold Adjustment (Factory Set)

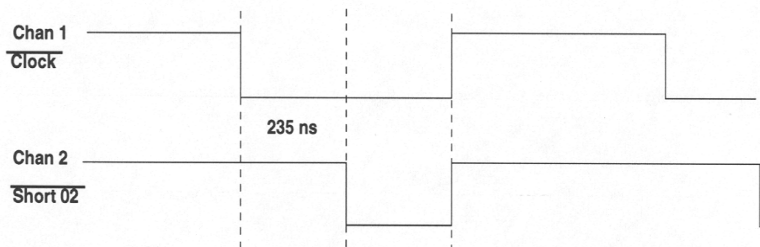
This adjustment is dependent on the type of detector used. Potentiometer VR12 is used to adjust the DC level measured at R94. Table 4-2 shows the DC adjustment values necessary for each detector type unless otherwise specified.

Table 4-2. Anti-Jam Threshold Adjustment

Test Pulse Width	Detector Type	DC Value at R94	Equivalent CPM	Jumper J7
1 microsecond (250 kHz)	943 Series Gamma Family	1.170 V	1.5×10^7	1 to 2
800 ns (250 kHz)	943 Series Beta Family	0.950 V	1.5×10^7	1 to 2
10 microsecond (50 kHz square wave)	843-251 Series GM Probe Family	0.900 V	3×10^6	2 to 3

Write Cycle Clock Adjustment (Factory Set)

1. Connect the channel 1 oscilloscope (x10 probe) to U19-2 (clock).
2. Connect the channel 2 oscilloscope (x10 probe) to U19-12 (short 02).
3. Adjust VR13 to obtain:



HV Supply Adjustment

R5 adjusts the detector high voltage, and the HV test jack allows a 1000:1 voltage measurement to be read. Refer to the appropriate detector calibration data sheet included with each detector for specific high voltage settings.

4.3 Troubleshooting

WARNING

Extreme care must be used when troubleshooting a system that has power applied. All standard troubleshooting precautions apply.

WARNING

Once a problem has been located, remove all power before continuing with the repair.

CAUTION

Personnel performing the troubleshooting/repair must be qualified to ANSI 45.2.6, 1978, Skill Level II.

Personnel performing the following procedure must be familiar with the operation of the monitoring system and the location of each piece of equipment used in the system.

If a problem develops, verify that the voltages at connection point inputs and outputs are present and that all wiring is secure. Refer to Appendix B and C for drawings and parts lists. If a PROM requires replacement, specify the board revision level when ordering the part.

NOTE

Improper set point entry can discontinue UDR operation. This includes the alarm set point, underrange set point, overrange set point, analog output low scale value, and analog output high scale value.

For example, if the OVERRANGE alarm set point is entered above the HIGH alarm set point, the UDR will display error Message E0004.

If a problem cannot be resolved by using the drawings in the Appendix while applying the troubleshooting instructions found in this manual, please contact the Fluke Biomedical Management's Power Systems Department at (440) 248-9300 or (800) 850-4608 for assistance.

Appendix A Connector Designations

A.1 Connector Designations, 942A-200L-M3 and 942A-200L-M4

Table A-1. Connector P1 - Input/Output

Pin	Signal	Internal Connection
1	Rate of Rise Relay/Aux – Common (optional)	Relay Board K1-A
2	Rate of Rise Relay/Aux – N.O. (optional)	Relay Board K1-B
3	Rate of Rise Relay/Aux – N.C. (optional)	Relay Board K1-C
4	Rate of Rise Relay/Aux – Common (optional)	Relay Board K1-D
5	Rate of Rise Relay/Aux – N.O. (optional)	Relay Board K1-F
6	Rate of Rise Relay/Aux – N.C. (optional)	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

• N.O. - Normally Open

• N.C. - Normally Closed

Table A-1. Connector P1 - Input/Output

Pin	Signal	Internal Connection
22	Spare	
23	Spare	
24	Spare	
25	+ Remote Acknowledge	Main Circuit Board J9-1
26	- Remote Acknowledge	Main Circuit Board J9-2
27	Spare	
28	Spare	
29	Spare	
30	Spare	
31	Spare	
32	Spare	
33	Spare	
34	Spare	
35	Spare	
36	Spare	
37	Spare	

N.O. - Normally Open
 N.C. - Normally Closed

Table A-2. Connector P2 - Detector Connector

Pin	Signal	Internal Connection
1	Detector + 15 Volt Supply	Power Supply +15 VDC
2	Detector - 15 Volt Supply	Power Supply -15 VDC
3	Supply Ground	Power Supply Ground
4	Transmit +	Communications Board Option
5	Transmit -	Communications Board Option
6	Receive +	Communications Board Option
7	Receive -	Communications Board Option
8	Loop Voltage +	Communications Board Option
9	Loop Voltage -	Communications Board Option
10	0 – 10 V Analog Output	Main Circuit Board J5-10
11	Ground	Main Circuit Board J5-9
12	Check Source +15V	Power Supply, +15V DC
13	Check Source Contact (NO)	Relay Board, K2-F
14	Check Source Contact, Common	K2-D

Table A-3. 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 A-4. Connector P4 - Detector High Voltage

Connector	Signal
P4	High Voltage

Table A-5. Connector P5 - Detector Signal Input

Connector	Signal
P5	Input Signal

Table A-6. Connector P6 - Auxiliary I/O

Pin	Signal	Internal Connection
1	4-20 mA output	Main circuit board J5-8
2	GND	Main circuit board J5-7
3	4-20 mA output	Main circuit board J5-6
4	GND	Main circuit board J5-5
5	0-10 mV analog output	Analog Option W3-c
6	GND	Main circuit board J5-9
7	0-5V	Main circuit board J5-4; Analog Option J4-6
8	GND	Main circuit board J5-3; Analog Option J4-2
17	Not Provided	Analog input option board J2-1
18	Not Provided	Analog input option board J2-2
19	Not Provided	Analog input option board J2-3
20	Not Provided	Analog input option board J2-4
21	Not Provided	Analog input option board J2-5
22	Not Provided	Analog input option board J2-6
23	Not Provided	Analog input option board J2-7
24	Not Provided	Analog input option board J2-8

Table A-7. Connector P7 - RS232C- Not Provided

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/Data Carrier Detector
20	Data Terminal Ready

Table A-8. 942-200-10 Main Board J3 Connector - Option Board Bus

Pin	Signal	Pin	Signal
1	A0	2	A1
3	A2	4	A3
5	A4	6	A5
7	A6	8	A7
9	A8	10	A9
11	A10	12	A11
13	A12	14	A13
15	A14	16	A15
17	D0	18	D1
19	D2	20	D3
21	D4	22	D5
23	<u>D6</u>	24	<u>D7</u>
25	<u>BUS ENABLE</u>	26	<u>IRQ</u>
27	<u>WRITE 02</u>	28	<u>CLOCK</u>
29	<u>R/W</u>	30	<u>NMI</u>
31	<u>RESET</u>	32	<u>5000 BLOCK</u>
33	<u>40E0</u>	34	<u>4080</u>
35	<u>40A0</u>	36	<u>4080 (GPIB)</u>
37	4060 (TWA)	38	4040 (ACIA)
39	-15V	40	-15 V
41	GND	42	GND
43	GND	44	GND
45	+ 15 V	46	+15 V
47	+ 5 V	48	+5 V
49	+ 5 V	50	+5 V

Table A-9. Standard Jumper Placement

Position	Jumper	Description
OUT	JP1	Reset
2-3	JP2	Standard 27256 PROM
IN	JP3-1	Fixed 1 Second Update
IN	JP3-2	Fixed 1 Second Update
IN	JP3-3	Latches alarms until acknowledged
IN	JP3-4	Gives fail condition without counts, in five minutes
IN	JP3-5	Alarms do not respond to check source counts
1-2	JP4	Negative Input Pulse
1-2	JP5	Negative Shield Polarity
1-2	JP6	Anti-Jam Active
1-2	JP7	Anti-Jam scintillation type detector

Table A-10. UDR Jumper Setting Options

Jumper	Connect	Description
JP1	-	Momentary connect resets microprocessor
JP2	1-2	PROM type 27128
JP2	2-3	PROM type 27256
JP3-1	IN/OUT	Accuracy selection
JP3-2	IN/OUT	Accuracy selection
JP3-3	IN/OUT	Alarm reset control, manual/automatic
JP3-4	IN/OUT	Low count fail control, enable/inhibit
JP3-5	IN/OUT	Alarm when check source is on, inhibit/enable
JP4	1-2	Negative input pulse selection
JP4	2-3	Positive input pulse selection
JP5	1-2	Positive shield (for negative pulse)
JP5	2-3	Negative shield (for positive pulse)
JP6	1-2	Anti-Jam fuse enable – Normal Operation
JP6	2-3	Anti-Jam fuse disable – Test Only
JP7	1-2	Scintillator detector anti-jam input
JP7	2-3	GM tube detector anti-jam

Table A-11 UDR Error Codes

Error Codes	Function	Reference Section
E0001	Negative display data	Setpoint Error Codes
E0004	Invalid setpoint value (s)	Setpoint Error Codes
E0007	Invalid set point selected	Setpoint Error Codes

Appendix B Applicable Drawings

B.1 Applicable Drawings 942A-200L-M4

<u>Drawing No.</u>	<u>Description</u>
GEL 942A	General Equipment Layout
942A-200L-3	Loop Diagram, Detector, LED Check Source
942A-200L-6-M4	Wiring Diagram, Internal (2 sheets)
S1740140D-102	Loop Diagram, External Connections (Customer Specific)
S174014E1003	Loop Diagram, External Connections (Customer Specific)
942A-200L-5-M4	Main Assembly, UDR with Trip Test, SCA and Dual Analog Outputs
942-200-10	Ratemeter Main Circuit Board Assembly
942-200-13	Schematic Diagram (8 sheets)
942-200-60	HV Power Supply Assembly
942-200-63	Schematic, High Voltage Power Supply
942-100-15	Front Panel Circuit Board Assembly
942A-100-30	Rear Panel Assembly
942A-200-55M2	Power Supply Assembly
942-200-50	Power Supply
942-100-70	Relay Circuit Board Assembly
GEL948-1	Dimensional Outline, Three Bay Chassis
GEL948A-1	Dimensional Outline, Chassis, Three Bay, Analog/ Digital
948A-1-5	19in Wide Rack Chassis, Three Bay, Analog/ Digital
50-100-TAB	Cable Specification

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B.2 Applicable Drawings 942A-200L-M5

<u>Drawing No.</u>	<u>Description</u>
GEL 942A	General Equipment Layout *
942A-200L-M5	Main Assembly, UDR with Trip Test
942A-200L-3	Loop Diagram, Detector, LED Check Source *
S174014E1003	Loop Diagram, External Connections (Customer Specific)*
S278680A-102	Loop Diagram, External Connections (Customer Specific)
S321299A-104	Loop Diagram, External Connections (Customer Specific)
942-200-10	Ratemeter Main Circuit Board Assembly *
942-200-13	Schematic Diagram (8 sheets) *
942-200-60	HV Power Supply Assembly *
942-200-63	Schematic, High Voltage Power Supply *
942-100-15	Front Panel Circuit Board Assembly *
942-A-100-30	Rear Panel Assembly *
942A-200-55M2	Power Supply Bracket Assembly *
942-200-50	Power Supply
942-100-70	Relay Circuit Board Assembly *
GEL 948-1	Dimensional Outline, Three Bay Chassis *
GEL948A-1	Dimensional Outline, Chassis, Three Bay, Analog/ Digital *
948A-1-5	19in Wide Rack Chassis, Three Bay, Analog/ Digital *
50-100-TAB	Cable Specification *

*Drawing listed for reference only. Actual drawing supplied with B.1

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APPENDIX C

Bill of Materials

C.1 Bill of Materials- 942A-200L-M4

Part Number	Description
942A-200L-M4	Bill of Materials, Ratemeter Modified with Trip Test, SCA, and Dual Analog Outputs
942A-200L-5-M4	Bill of Materials, Ratemeter, Main Assembly
942-200-10	Bill of Materials, Ratemeter Main Assembly
942-200-60	Bill of Materials, HV Power Supply Assembly
942A-200L-20M4	Bill of Materials, Front Panel Assembly
942-100-15	Bill of Materials, Front Panel Circuit Board Assembly
942A-200-55M2	Bill of Materials, Power Supply Bracket Assembly
942A-100-30	Bill of Materials, Rear Panel Assembly
942-100-70	Bill of Materials, Relay Circuit Board Assembly
948-1-5	Bill of Materials, Rack Chassis Assembly, Three Bay
948A-1-5	Bill of Materials, Rack Chassis Assembly, Three Bay, Analog/Digital

C.2 Bill of Materials- 942A-200L-M5

Part Number	Description
942A-200L-M5	Bill of Materials, Ratemeter Modified with Trip Test
942-200-10	Bill of Materials, Ratemeter Main Assembly *
942-200-60	Bill of Materials, HV Power Supply Assembly *
942-100-15	Bill of Materials, Front Panel Circuit Board Assembly *
942A-200L-20	Bill of Materials, Front Panel Assembly
942A-200-55M2	Bill of Materials, Power Supply Bracket Assembly *
942A-100-30	Bill of Materials, Rear Panel Assembly *
942-100-70	Bill of Materials, Relay Circuit Board Assembly *
948-1-5	Bill of Materials, Rack Chassis Assembly, Three Bay *
948A-1-5	Bill of Materials, Rack Chassis Assembly, Three Bay, Analog/Digital *

*Drawings listed for reference only, actual BMTL supplied with C.1.

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Appendix D

Cable Termination Instructions

D.1 Cable Termination Instructions

The procedures and instructions provided in Appendix D are provided for reference in terminating the field cables to the Digital Ratemeter (UDR). Mating connectors are provided in the P/N 942A-100-4 Mating Connector Kit, provided with the UDR. The instructions provided below are based on the use of P/N 50-100 Multiconductor cable. For other customer-supplied cables, the same basic procedures, modified for the specific cable used, may be utilized.

Detector Field Cable Preparation (P2)

Prior to terminating the cable, the interior layout of the control room panel or cabinet must be evaluated to determine field cable routing, support, service loop space, and, where EMI/RFI protection is required, drain wire grounding. Note that to withdraw the UDR from the chassis for access to the monitor set point entry controls, the UDR field cables must include a service loop of a minimum of 6 inches in length. To permit complete removal of the UDR from the front of the panel or cabinet, a 21-inch, minimum, service loop is needed. In order to determine the actual length of stripped cable that will be needed, or that can be accommodated in the specific panel or cabinet, it is suggested that the cable be temporarily installed in the cabinet, following the actual routing that will be used.

Prior to stripping the outer cable jacket, a 4-inch length of 0.75 I.D. shrinkable tubing (provided by the user) should be slid over the 0.675 in cable jacket. The shrink tubing will be used to seal and protect the end of the cable after the termination process is completed. To prepare the cable for termination, a minimum of 7 inches of the cable outer jacket must be stripped off the cable. This will allow for the stripping of approximately one inch from the various conductors, and provide 6 inches of actual service loop cable. In addition, for EMI/RFI protection, the drain wire must be terminated to an earth ground within the control room panel or cabinet. The length of the drain wire will be based on the distance between the UDR rear panel and the ground location. The length of cable jacket to be stripped will then be based on the distance to the drain wire grounding point.

Once the cable outer jacket is stripped to the proper length, the aluminum tape shield and mylar binder may be removed, taking care not to damage the No. 20 AWG drain wire. The drain wire may then be separated from the remaining conductors, for routing and termination at the grounding point.

Next, the HV and Signal coaxial cables may be separated from the bundle, followed by the single conductors wires that are required for the specific application, and the polyester filler cord. Refer to the project specific detector loop drawing, or the generic detector loop drawing, 942A-200-106, provided in Appendix B for actual conductors to be used.

The polyester filler cord may now be removed. Cut the cord as close to the outer jacket as possible.

The cable should now be routed to the rear panel of the UDR, following the actual path that will be used. Ensuring a minimum of 7 inches of conductors is provided for the UDR service loop, the excess conductor length may now be removed. Any unused conductors may be cut away, or coiled for future use. To protect the single conductors from abrasion, and provide a finished look to the cable, a 5-inch length of heat shrinkable tubing, or sleeving, may be placed over the single conductors. For controlled environment applications, it is not required to apply heat to this shrink tubing. Termination instructions for each connector are provided below.

HV Connector Notes (P4)

The High Voltage Connector, P4, uses the RG59B/U conductor in the 50-100, or equivalent, multiconductor cable. The high voltage (HV) connector, P/N 30-92-1, uses a female, solder type contact, and is normally supplied by Kings Inc. Consult Kings Cabling Procedure CP-1000 for the appropriate assembly instruction for the Kings Inc. 1705-14 SHV connector. A minimum of 6 inches of cable between the end of the HV connector and the cable end is required. An optional crimp style connector, P/N 92-9105-A (Kings 1705-1 or Tyco/AMP 51426-5) is also available. Refer to Kings CP-400, trim code 441.

BNC Signal Connector Notes (P5)

The Signal Connector, P5, uses the RG 58C/U conductor in the P/N 50-100, or equivalent, multiconductor cable. The BNC connector provided, P/N 30-4, uses a male, solder type contact, and is normally supplied by Amphenol. Consult the Amphenol Assembly Instruction C25, enclosed for the appropriate assembly instruction for the Amphenol 31-2 connector. A minimum of 6 inches of cable between the end of the BNC connector and the cable end is required.

UDR Connector Notes (P2)

The Detector Connector, P2, uses the single conductors in the P/N 50-100, or equivalent, multiconductor cable. The Tyco Electronics /AMP Circular Plastic Connectors (Series CPC) are utilized for the UDR rear connector, P2. This connector utilizes male, push-in, solder type connector pins, terminating single conductors from the multiconductor cable. To prevent damage to these conductors, it is recommended that a 5 inch length of shrink tubing, or sleeving, be installed over the conductors, from the unstripped end of the multiconductor cable and into the strain relief of the detector backshell clamp. The shrink tube will protect the conductors from abrasion.

To terminate this connector, slide the Connector Shell/Clamp over the conductors. The conductors are then stripped to the length specified (0.156 in, 14 – 30 AWG). Prior to soldering, check to ensure a minimum of 6 inches of service loop conductor is provided. The connector pins are then soldered to the male connector pins provided and inserted into the appropriate location in the connector plug (Refer to the applicable project Detector Loop Drawing). The Shell/Clamp is then threaded onto the detector plug, and the backshell strain relief clamp is securely tightened. For controlled environment applications, it is not required to apply heat to this shrink tubing. For additional information, consult the appropriate manufacturer assembly instruction procedure provided.

Detector Cable Completion

Once all of the connectors are terminated, a ring-out of the completed wiring should be performed. After the integrity of the cable has been verified, heat may be applied to the shrink tubing that has been placed over the end of the multiconductor cable.

Auxiliary Connectors

UDR Connector Notes (P1 and P3)

The Alarm Output connector, P1, and AC Power connector, P3, normally uses a customer supplied multiconductor cable.

Where an EMI/RFI Surge Suppression panel, P/N S157033A2, or equivalent, is provided, the AC Power cable to be connected to P3, is supplied with the Surge suppressor panel.

The Tyco Electronics /AMP Circular Plastic Connectors (Series CPC) are utilized for the UDR rear connectors, P1 and P3. These connectors utilize female, push-in, solder type connector pins, terminating single conductors from various field cables. Follow the general instructions stated above for cable routing. A minimum of 6 inches of service loop is required for access to the UDR function/data entry switches. For front of panel removal, a service loop of 21 inches, minimum, is required. To prevent damage to these conductors, it is recommended that a 5-inch length of shrink tubing or sleeving be installed over the conductors, from the unstripped end of the multiconductor cable and into the strain relief of the detector backshell. The shrink tube will protect the conductors from abrasion.

To terminate this connector, slide the Connector Shell/Clamp over the conductors. The conductors are then stripped to the length specified (0.156 in, 14 – 30 AWG). Prior to soldering, check to ensure a minimum of 6 inches of service loop conductor is provided. The connector pins are then soldered to the female connector pins provided and inserted into the appropriate location in the connector plug (Refer to the applicable project Detector Loop Drawing). The Shell/Clamp is then threaded onto the detector plug, and the backshell strain relief clamp is securely tightened. For controlled environment applications, it is not required to apply heat to this shrink tubing. For additional information, consult the appropriate manufacturer assembly instruction procedure provided.

Analog Input Connector Notes (P6)

The P6 connector is a 24 pin, male, solder type connector. Amphenol manufactures the UDR rear connector, P6. The maximum size wire for this connector is 22 AWG. These connectors utilize single, or twisted pair conductors from various field cables, and are normally provided by the customer. Follow the general instructions stated above for cable routing. A minimum of 6 inches of service loop is required for access to the UDR function/data entry switches. For front of panel removal, a service loop of 21 inches, minimum, is required. The cable jacket is first stripped to a length of approximately 0.8 inches. This will permit using the cable jacket in the strain relief provided. If single conductors are used, it is recommended that shrink tubing or sleeving be installed over the conductors, to protect the conductors from abrasion.

The wires are then stripped to a length 0.07 – 0.09 inches, and soldered to the pins on the connector assembly. The connector pin assembly is then inserted between the two halves of the connector body, and secured using the fasteners provided. Finally, the screws on the connector body strain relief are securely tightened. For controlled environment applications, it is not necessary to apply heat to the shrink tubing. For additional information, consult the appropriate manufacturer assembly information provided.

RS232 Connector (P7)

The P7 connector is a 25-pin d-type, male, solder type connector. AMP manufactures the UDR rear connector, P7. The maximum size wire for this connector is 20 AWG. These connectors utilize single or twisted pair conductors from various field cables, and are normally provided by the customer. Follow the general instructions stated above for cable routing. A minimum of 6 inches of service loop is required for access to the UDR function/data entry switches. For front of panel removal, a service loop of 21 inches, minimum, is required. The cable jacket is first stripped to a length of approximately 0.8 inches. This will permit using the cable jacket in the strain relief provided. If single conductors are used, it is recommended that shrink tubing or sleeving be installed over the conductors, to protect the conductors from abrasion.

The wires are then stripped to a length 0.07 – 0.09 inches, and soldered to the pins on the connector assembly. The connector pins are then inserted into the appropriate location in the connector. The connector pin assembly is then inserted between the two halves of the connector body, and secured using the fasteners provided. For controlled environment applications, it is not necessary to apply heat to the shrink tubing. For additional information, consult the appropriate manufacturer assembly instruction procedure provided.

The following documents and connector identification information is included herein. The Vendor part number for each connector is the number in parenthesis, provided in column one.

Location	P/N	Document	Description
P1	67-81-37S (206150-1)	AMP, 408-7593 Instruction Sheet and 114-10038	Alarm Output Connector Plug, 37 pin, Female
AWG	67-83-3S (66181-1) 67-82-37 (207774-1)	Application Specification	Connector pin, Female, Solder, 16-18 Connector Shell/Clamp
P2	67-81-14P (206044-1)	AMP, 408-7593 Instruction Sheet and 114-10038	Detector Connector Plug, 14 pin, Male
AWG	67-83-3P (66180-1) 67-82-14 (206322-1)	Application Specification	Connector pin, Male, Solder, 16-18 Connector Shell/Clamp
P3 Female	67-81-4S (206060-1)	AMP, Inc. IS 6917 Instruction Sheet and 114-10038	AC Power Connector Plug, 4 pin, Connector pin, Female, Solder, 16-18
AWG	67-83-3S (66181-1) 67-82-4 (206062-1)	Application Specification	Connector Shell/Clamp
P4	32-92-1 (1705-14)	CP-1001, Kings Cabling Procedure, CP-1000,	High Voltage Connector, SHV, Female solder contact pin
Optional	92-9104-A (1705-1)	CP-400	Female crimp type pin
P5	30-4 (31-2)	Assembly Instructions – C25, Amphenol, BNC Connector	Signal Connector, BNC, Male solder contact pin
P6	68-23 (57-30240)	Amphenol Micro-Ribbon Connector, General Config, 57 Series	Analog Output Connector, 24 pin, Male, solder contacts
P7	68-27 (17-20250)	AMPHENOL 17 RR Series D-Subminiature Connector	Original Poke-Home d-sub, 17 Series, Male solder contacts
	with 780121 (745833-7)	Cable Clamp Kit, HD-20 Shielded Cable Clamp, IS-6609	Cable Clamp

UDR, P1, P2 AND P3 CONNECTORS

AMP AMP INCORPORATED Harrisburg, Pa. 17105		CUSTOMER HOTLINE 1 800 722-1111	APPLICATION SPECIFICATION 114-10038
REV	REASON	AMP* CIRCULAR PLASTIC CONNECTORS (CPC)	ENGINEERING RELEASE DATE 3-15-90 APPROVAL MARYANN KAPEZYNSKI

1. INTRODUCTION

This specification covers the requirements for application of AMP Circular Plastic Connectors (CPC). The connectors are available in various shell sizes and standard or reverse sex configurations. The four series available include standard, high, and power density connectors, and a combination standard and power density connector.

The CPCs are designed for use with various contacts. Applicable wire sizes range from 30 to 8 AWG and can be crimped with hand tools or by automatic machines.

Figure 1 shows typical products (Series 1) and their features. The terms identifying the features are used throughout this specification.

NOTE

All dimensions in this document are in inches. Dimensional tolerances are +.007 and angular tolerances are ±3° unless otherwise specified. Metric equivalents (mm) can be calculated by multiplying given dimensions by 25.4.

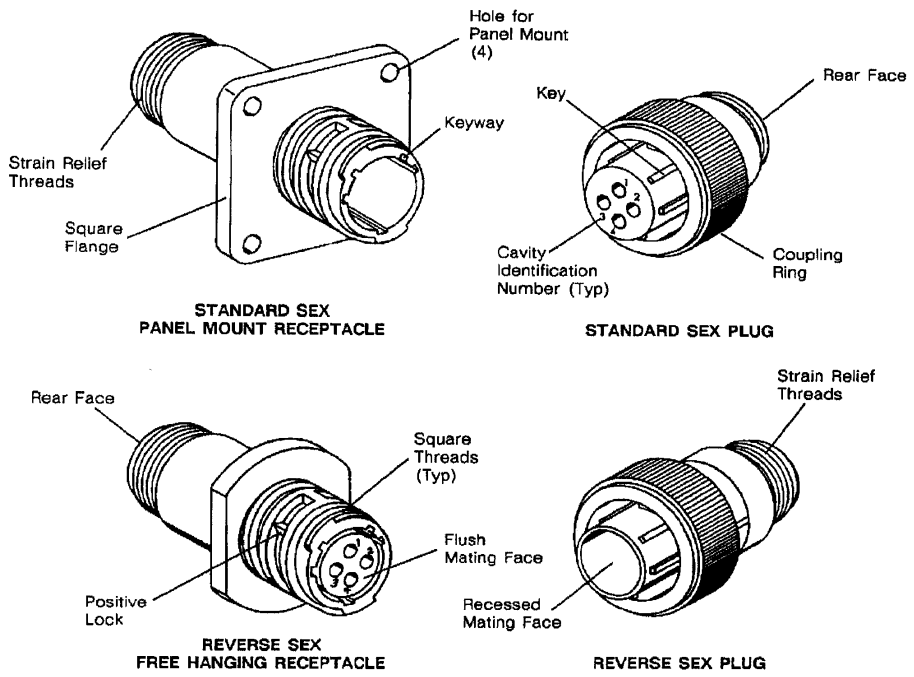


Fig. 1. Product Features

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CIRCULAR PLASTIC CONNECTORS

2. REFERENCE MATERIAL

2.1. Customer Assistance

Product Part Number 206060 and Product Code 5029 are representative of the AMP Circular Plastic Connectors. Use of these numbers will identify the product line and expedite your inquiries through an AMP service network established to help you obtain product and tooling information. Such information can be obtained through a local AMP Representative (Field Sales Engineer, etc) or, after purchase, by calling the CUSTOMER HOTLINE at the top of page 1.

2.2. Engineering Drawings

Customer drawings for specific products are available from the service network. The information contained in the Customer Drawings takes priority if there is a conflict with this specification or with any technical documentation supplied by AMP Incorporated.

2.3. Specifications

AMP Product Specifications provide performance test information. AMP Application Specifications provide application requirements and reference materials.

Product Specifications:

- 108-10024 — CPC Connectors 108-10037 — Type XII Contacts
- 108-10042 — Type III+ Contacts 108-12011 — Subminiature COAXICON* Contacts

Application Specifications:

- 114-10000 — 20DF (Series 2) Contacts
- 114-10004 — Type III+ (Series 1) Contacts 114-10005 — Type XII (Series 3) Contacts

2.4. Instructional Material

AMP Instruction Sheets contain detailed assembly instructions and repair procedures. The CPC Connectors and Accessories are covered in IS 7593 and IS 7582. Instruction Sheets pertaining to crimping the various contact types used in CPCs are listed in Figure 2. IS 7347, IS 1216, IS 6736, IS 9404, IS 7508 and IS 7276 cover insertion and extraction procedures. AMP Customer Manuals CM 1983, CM 512B, CM 5253, CM 5651 and Application Instruction Sheet AI 8040 provide information for machine set-up and operation procedures.

		CONTACT TYPE			
TYPE III+		20 DF	20 DM	SUBMINIATURE COAXICON	TYPE XII
IS 6810	IS 7586	IS 6895	IS 7516	IS 2024-2	IS 2085
IS 6814	IS 7773	IS 6709		IS 2024-3	IS 2723
IS 7414	IS 7942	IS 7521		IS 2095	IS 6510
IS 7574		IS 7954			
		IS 7799●			

● Solder Pot Contact

Fig. 2. Instruction Sheets for Hand Crimping Tools

2.5. Soldering Information

AMP Corporate Bulletin No. 52 is available upon request and can be used as a guide in soldering. This bulletin provides information on various flux types and characteristics along with the commercial designation and flux removal procedures. A checklist is attached to the bulletin as a guide for information on soldering problems.

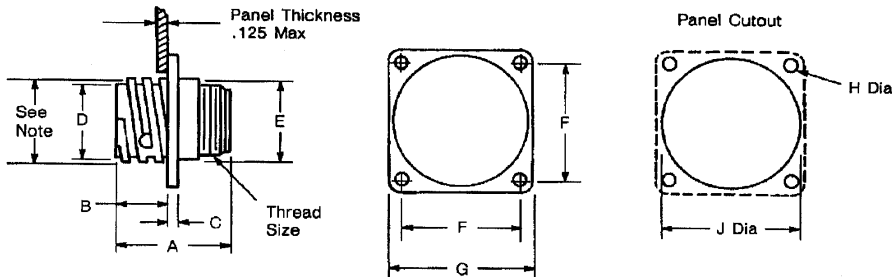
CIRCULAR PLASTIC CONNECTORS

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3. REQUIREMENTS

3.1. Mounting Holes and Panel Cutouts *NOT APPLICABLE*

Dimensions and layout for mounting holes and panel cutouts are shown in Figure 3.



	ARRANGE- MENT NO.	SEX	A MAX	B ±.015	C ±.010	D ±.010	E MAX	F ±.010	G ±.025	H +.007 -.000	J	THREAD SIZE
SERIES 1	11-4	Rev	1.070	.420	.094	0.687	.740	.844	1.125	.125	0.840	5/8-24 UNEF-2A
		Std	1.350									
	13-9	Std	1.350	.420	.094	0.812	.879	.969	1.281	.125	0.979	3/4-20 UNEF-2A
		Rev	1.070									
	17-14	Rev	1.070	.420	.094	1.050	1.110	1.125	1.435	.150	1.210	15/16-20 UNEF-2A
		Std	1.350									
23-24	Std	Rev	1.070	.520	.156	1.438	1.510	1.438	1.750	.150	1.610	1-3/8-18 UNEF-2A
		Std	1.350									
23-37	Std	Rev	1.070	.520	.156	1.438	1.510	1.438	1.750	.150	1.610	1-3/8-18 UNEF-2A
		Std	1.350									
SERIES 2	11-8	Std	0.809	.420	.094	0.688	0.630	.844	1.125	.125	0.840	5/8-24 UNEF-2A
		Rev										
	11-9	Std	0.809	.420	.094	1.050	0.943	1.125	1.435	.150	1.210	15/16-20 UNEF-2A
		Rev										
	23-57	Rev	0.924	.420	.156	1.438	1.515	1.438	1.750	.150	1.610	1-3/8-18 UNEF-2A
		Std										
23-63	Std	0.924	.420	.156	1.438	1.515	1.438	1.750	.150	1.610	1-3/8-18 UNEF-2A	
	Rev											
SERIES 3	17-3	Std & Rev	1.635	.420	.094	1.050	1.110	1.125	1.435	.150	1.210	15/16-20 UNEF-2A
	23-7	Std & Rev	1.635	.520	.156	1.438	1.510	1.438	1.750	.150	1.610	1-3/8-18 UNEF-2A
SERIES 4	23-16M	Std	1.635	.520	.156	1.438	1.510	1.438	1.750	.150	1.610	1-3/8-18 UNEF-2A
	23-22M											

NOTE: The first number of the Arrangement No. represents the dimension (in sixteenths) over the threads; the number after the hyphen represents the number of circuits per connector.

Fig. 3. Mounting Requirements

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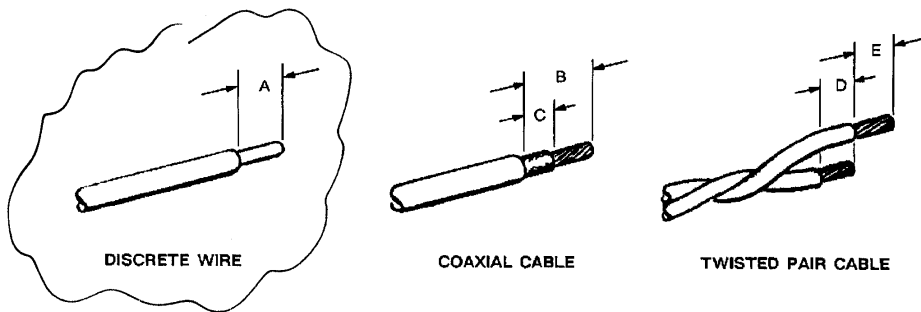
CIRCULAR PLASTIC CONNECTORS

3.2. Wire Size and Preparation

Jacketed or discrete wire may be used with this product. Jacketed cable will provide more protection from damage. Look for information on jacketed cable sealing kits in IS 7582.

Contacts are available for the wire sizes specified. Prepare wire for crimping by stripping insulation according to dimensions in Figure 4. DO NOT nick, scrape, or cut the stranded or solid wire conductor during stripping operation.

NOTE When using twisted pair cable, one wire should be cut shorter than the other by the same distance as the strip length of the longer wire (E).



WIRE SIZE RANGE (AWG)	CONTACT TYPE	WIRE STRIP LENGTH
30-14 <i>16-18 AWG CONTACT SUPPLIED</i> 26-16	III+ Crimp Type Solder Type Solder Type (With Preformed Wire Barrel Insulation Support)	.156(A)
24-20	20 DM (Screw Machine)	.140(A)
28-20	20 DF Precision Formed With Insulation Support Without Insulation Support	.100(A) .109(A)
28-20	20 DF (Solder Pot)	.141(A)
16-18	XIII	.281(A)
Coaxial Cable	Subminiature COAXICON	Cable Jacket .344(B) Center Conductor .219(C)
Twisted Pair 30-28		Short Wire .125(D) Long Wire .219(E)

Fig. 4. Wire Preparation

CIRCULAR PLASTIC CONNECTORS

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3.3. Loading Contact Into Housing

Normally an insertion tool is not required to insert contacts into housings. However, if the wire bundle is large or the individual wires are fragile, the use of an insertion tool is recommended. Refer to Paragraph 5.

3.4. Shield and Strain Relief

If wire at the rear of the housing is subjected to strain, use of a strain relief will prevent damage to the contacts, wires, and housing.

A. Strain Relief Kits

Several types and sizes of strain relief kits are available. Shield and strain relief kits include a shield, strain relief clamps, and two self-tapping screws. They can be attached to the plug and/or receptacle of free-hanging or panel-mounted connectors. Flexible strain relief boots and grippers are used with jacketed cable (or firmly taped discreet wires) to provide wire protection and prevent contact pullout when severe cable-angle applications are encountered, or when connectors are frequently disconnected and reconnected. See Figure 5. Heat shrink sealing boots can also provide a splash-proof strain relief for jacketed cable. See Paragraph 3.4. B.

NOTE *If a strain relief is used on the connector, the wires may be dressed to an angle at the end of the strain relief. However, without use of a strain relief, the wires should not be dressed closer than 2.50 inches from the back of the housing. To prevent damage to contacts and/or housing, avoid exerting stress on wire.*

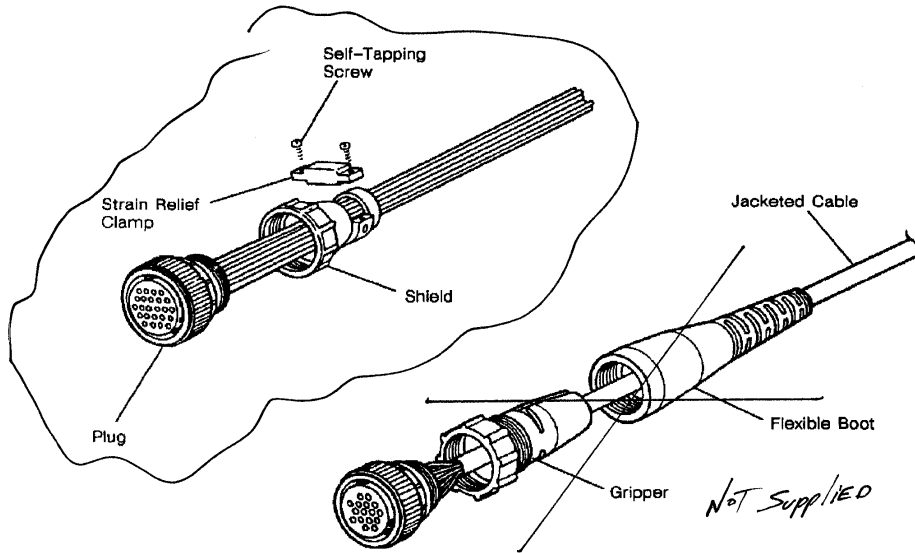


Fig. 5. Strain Relief Kits

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CIRCULAR PLASTIC CONNECTORS

B. Boots and Seals — *FOR INFORMATION*

Rubber boots are available and can be used with jacketed cable to provide splash-proof connections for Series 1 and Series 3 connectors. Heat shrinkable sealing boots are available for use with jacketed cable. They will provide an environmentally sealed wire to-connector system and can be used with plugs or receptacles. A jacketed cable seal will also provide an environmentally sealed connection for jacketed cable. Peripheral seals (for receptacles only) are recommended for use in sealing splash-proof applications, or where connectors will be subject to vibration. Instruction material is included in shipments.

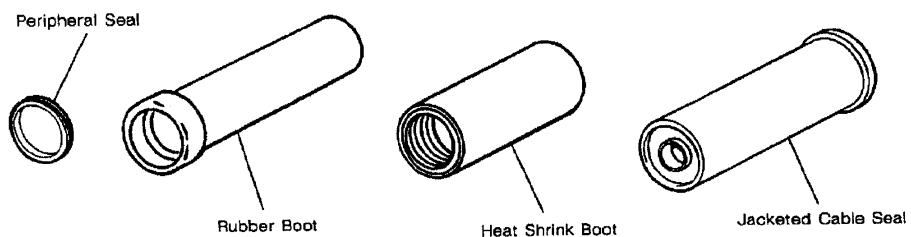


Fig. 6. Boots and Seals — *NOT SUPPLIED*

C. Cable Bundle Tie-Off — *FOR INFORMATION*

When no strain relief is used and wires need to be tied off, tie-off distance should be 2.00 in. minimum for up to 12 circuits and 3.00in. minimum for 12 circuits or more. Supporting the cable with wire harness tie-off will avoid strain on the contact retention system, and will prevent contact back-out or failures. See Figure 7.

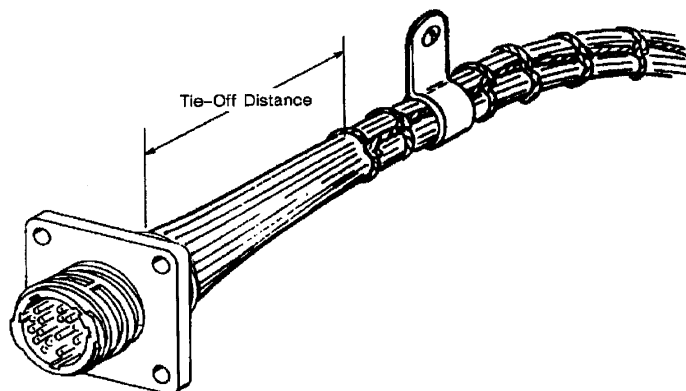


Fig. 7. Wire Tie-Off

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3.5. Polarizing and Keying Features

A. Mating

To prevent accidental disengagement, the CPCs have a positive lock feature. They are designed with polarizing keys and keyways for easy alignment.

NOTE

Align polarizing keys and keyways and insert plug into receptacle; rotate coupling ring clockwise until positive lock snaps into position.

B. Keying Plugs

Use of Keying plugs provides keying capabilities for all connector series. Keying plugs are used in socket cavities of standard sex plugs and reverse sex receptacles. They are available in three configurations. See Figure 8.

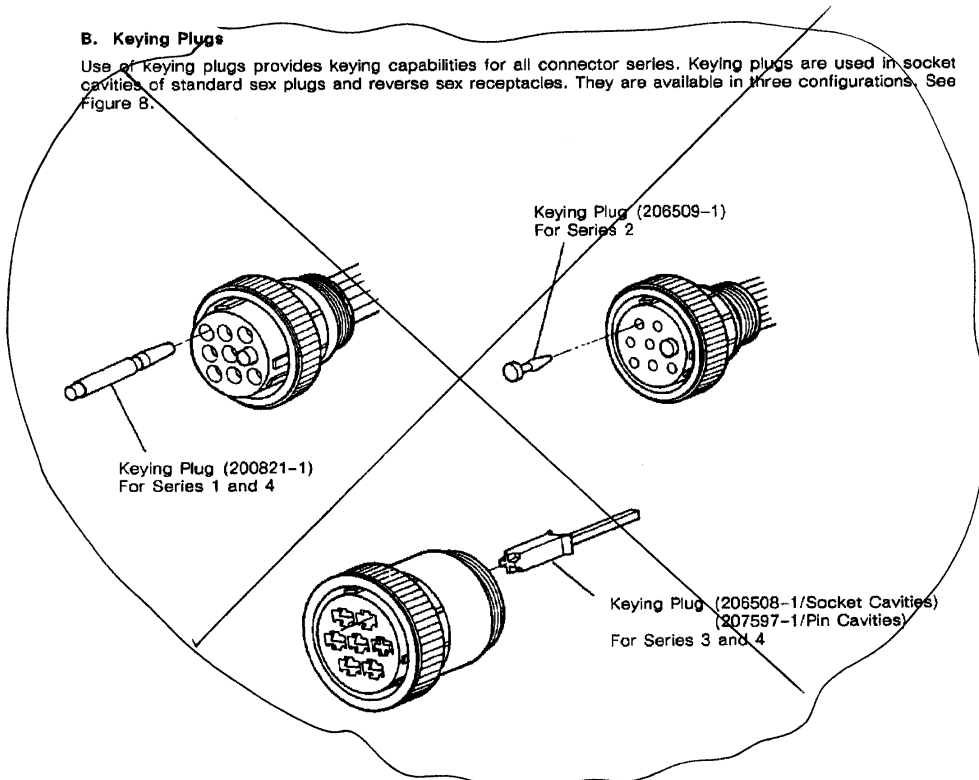


Fig. 8. Keying Plugs

3.6. Contact Crimp Criteria - *NOT APPLICABLE*

Contacts must be crimped to a designated height. Refer to Application Specification for particular type of contacts.

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CIRCULAR PLASTIC CONNECTORS

3.7. Connector Application

Receptacle connectors are available with mounting flanges for front or rear panel-mount applications, and without flanges for free-hanging applications. Refer to Paragraph 2.4 for applicable instruction sheets on mounting connectors. Square flange receptacles which are preloaded with square posted contacts are available.

3.8. Soldering and Cleaning (Solder Pot Contacts Only)

A. Flux Selection

Solder pot contacts must be fluxed prior to soldering. Selection of flux must be compatible with the solder method used, and safety requirements.

B. Cleaning

Removal of fluxes, residues, and activators is mandatory. Cleaning procedures will depend on the type of flux used.

DANGER

Consideration must be given to toxicity and safety requirements recommended by the solvent manufacturer.

NOTE

Consult your local AMP Representative for suitable cleaning solvents that can be used with these connectors.

C. Drying

When drying cleaned assemblies, make certain the temperature limitations of -55° to 105° C are not exceeded. Excessive temperatures may cause housing degradation.

D. Soldering Guidelines

Refer to Paragraph 2.4. for instruction material that is available for establishing soldering guidelines.

3.9. Repair

CAUTION

Care must be exercised to prevent damage to coupling rings of free-hanging connectors.

A. Coupling Ring Replacement

In the event it becomes damaged, the coupling ring, an integral part of the plug housing, can be replaced. Look for instruction sheet information under Paragraph 2.4 of this document.

B. Contacts

Crimped wire contacts as well as solder pot contacts are repairable. Find instructions in applicable IS sheet listed under Paragraph 2.4.

4. QUALIFICATIONS

The AMP Circular Plastic Connector is recognized under the Component Program of Underwriters' Laboratories, Inc., for 250-Volt service, File No. E28476. Each CPC Assembly has a UL flammability rating of 94 V-1. They are CSA certified under File No. LR7189. Some connectors are recognized for 600-Volt service. Consult AMP Incorporated for more details.

CIRCULAR PLASTIC CONNECTORS

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5. TOOLING — *FOR INFORMATION*

AMP Hand Crimping Tools and Applicators are available for applying crimp type contacts, also Insertion Tools and Extraction Tools assist in assembly and repair. Instruction Sheets and Applicator Instructions, describing tool operations, are packaged with the tool. See Figure 9.

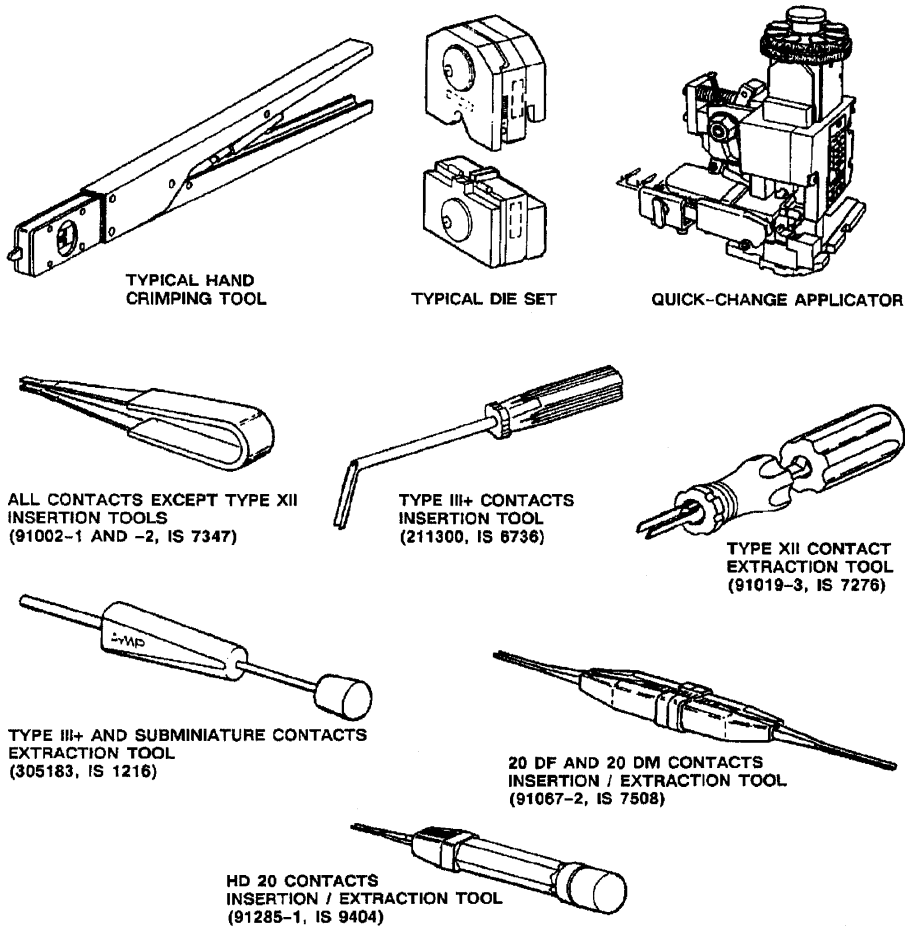


Fig. 9. Tooling (cont'd next page)

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CIRCULAR PLASTIC CONNECTORS

CONTACT TYPE	WIRE SIZE (AWG)	HAND TOOL NUMBER	INSTRUCT. MATERIAL	CONTACT TYPE	WIRE SIZE (AWG)	APPLICATOR NUMBER	INSTRUCT. MATERIAL		
III+	30-20	90066-7	IS 6510	III+	30-20	466598-2	AI 8040 CM 5128		
		90225-2	IS 7414			466585-3			
		90282-1	IS 7586			466321-4			
	24-16	90067-4	IS 8613		26-24	466908-2			
		90067-5	IS 8614			466323-4			
		90310-2	IS 7942			466907-2			
18-14	90310-3	IS 9387	24-20			466324-2			
	90312-1	IS 7694				466942-1			
	90374-1	IS 7954				466383-2			
20DF	28-24	90302-1			IS 7634	18-16		466325-2	
		90265-1			IS 7521			466906-1	
		90406-1			IS 6709			466752-2	
		90405-1	IS 8695		466958-1				
20DM	24-20	601966-1	IS 7516		18-14	466326-4			
		90145-2 ●	IS 7175			466923-2			
XII	16	90382-2	IS 8561		20DF	28-24		466423-1	AI 8040 CM 5128
	16-12	90145-1 ●	IS 7175					466423-2	
	14-12	90140-1 ●	IS 7175					466901-1	
	10-8	90384-1	IS 6510	466758-1					
90384-1		IS 6510	466758-2						
SUB-MINI-COAXIAL	28 (Twisted Pair/Solid)	69690 ●	IS 2024-3	466963-1					
	26 (Twisted Pair/Solid or Stranded)			567036-1					
	28 (Twisted Pair/Stranded)	69690-1 ●		567036-2					
	30 (Twisted Pair/Solid)	69690-2 ●		466422-1					
20DF	24-20	69690-2 ●	28-24	466506-1					
		69690-2 ●		466506-2					
		69690-2 ●		466903-1 ■		CM 5651			
		69710-1		466505-1	AI 8040				
				466505-2	CM 5128				
				466902-1 ■	CM 5651				
	24-20	567033-1	AI 8040						
		567033-2	CM 5128						
	22-18	599406-7 †	CM 5253						
	20DM	24-20	466425-2	XII	16-12	AI 8040			
	XII	16-12	466425-1		CM 5128				
			10-8		567021-2				

- Dies to be Used with Hand Tool Assembly 69710-1 or Pneumatic Tool 69365, CM 1983
- Stripper / Crimper Applicator
- † AMP-TAPEMATIC* Stripper / Crimper Machine Requiring a Funnel

Fig. 9. Tooling (end)

NOT APPLICABLE

UDR, P1, P2 AND P3 CONNECTORS



Circular Plastic Connectors (CPC)

Instruction Sheet
408-7593
(was IS 7593)
12 APR 01 Rev A

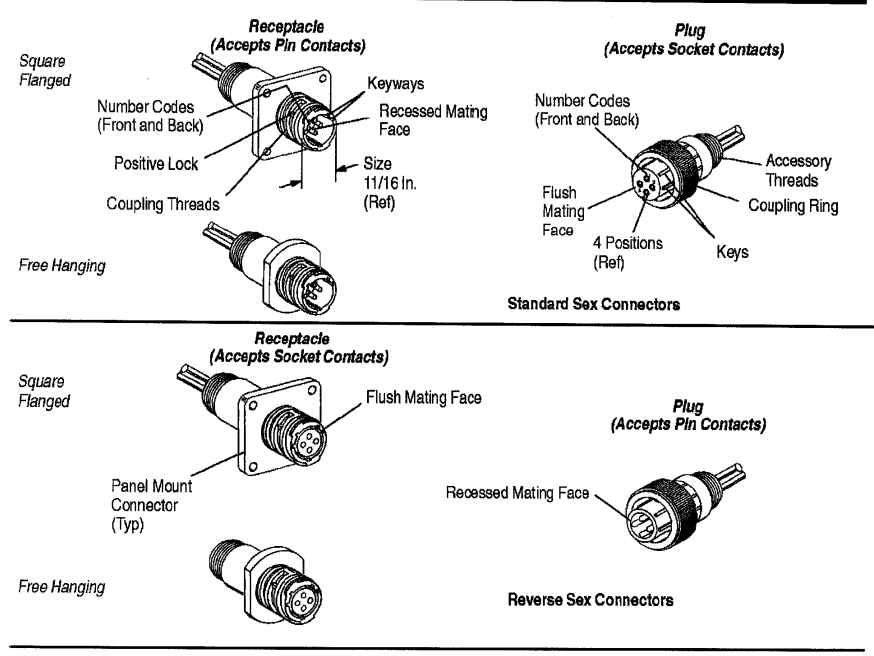


Figure 1

1. INTRODUCTION

This instruction sheet covers the assembly procedures for the AMP Circular Plastic Connectors (CPC) listed in Selection Charts 1 through 4. Typical connector configurations are shown in Figure 1.

Assembly procedures for CPC accessories—such as shield and strain relief, environmental sealing, keying plugs, and coupling rings—are covered on instruction sheet 408-7582.

Read this sheet carefully, and applicable referenced material, before assembling connectors, installing accessories, or panel mounting a connector.

Reasons for reissue are provided in Section 7, REVISION SUMMARY.

2. DESCRIPTION

There are four connector series. Series 1 connectors (Selection Chart 1) are available in four shell sizes

(11, 13, 17, and 23) and accept Type III+, and Subminiature COAXICON® contacts. Series 2 connectors (Selection Chart 2) are available in three shell sizes (11, 17, and 23) and accept size 20 DM (screw machined) and 20 DF (precision formed) contacts. Series 3 connectors (Selection Chart 3) are available in two shell sizes (17 and 23) and accept Type XII power contacts. Series 4 connectors (Selection Chart 4) are available in one shell size (23) and accept a mixture of Type XII contacts from series 3 and size 16 contacts previously mentioned for Series 1 connectors.

The connector designator indicates the size and contact positions of the connector. For example, 11/4 – size 11, meaning the outside diameter in 16ths of an inch as measured across the coupling threads, and contact positions 4, meaning the number of contact cavities in the connector.

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1 of 4
LOC B



CPC Connectors

408-7593

SERIES 1 CONNECTORS				RECOMMENDED CONTACTS	SERIES 2 CONNECTORS				RECOMMENDED CONTACTS		
DES	SEX	HOUSING			DES	SEX	HOUSING				
		DESCR	PART NO.			DESCR	PART NO.				
11/4	Std	Plug	206060-1	Type III+ and Subminiature COAXICON Contacts (See Figure 2) (See 408-1379 and Catalog 82021)	11/8	Std	Plug	205838-1	Size 20 DF and 20 DM (See Figure 3) (See 408-1379 and Catalog 82021)		
		Rcpt (PM)	206061-1				Rcpt (PM)	205841-1			
		Rcpt (FH)	206153-1				Rcpt (FH)	205841-2			
13/9	Rvs	Plug	206429-1			11/9	Rvs	Plug		206434-1	
		Rcpt (PM)	206430-1		Rcpt (RM)			206433-1			
		Rcpt (FH)	206430-2		Rcpt (FH)			206433-2			
17/14	Std	Plug	206708-1			17/28	Std	Plug		206485-1	
		Rcpt (PM)	206705-1		Rcpt (PM)			206486-1			
		Rcpt (FH)	206705-2		Rcpt (FH)			206486-2			
17/16	Rvs	Plug	206044-1			17/28	Rvs	Plug		205840-3	
		Rcpt (PM)	206043-1		Rcpt (PM)			205840-3			
		Rcpt (FH)	206043-3		Rcpt (FH)			206152-1			
23/24	Std	Plug	206037-1		23/57	Std	Plug	206039-1			
		Rcpt (PM)	206036-1	Rcpt (PM)			206038-1				
		Rcpt (FH)	206036-3	Rcpt (FH)			206038-2				
23/24	Rvs	Plug	206837-1		23/57	Rvs	Plug	206437-1			
		Rcpt (PM)	206838-1	Rcpt (PM)			206438-1				
		Rcpt (FH)	206838-1	Rcpt (FH)			206438-2				
23/37	Std	Plug	206150-1		23/63	Std	Plug	205842-1			
		Rcpt (PM)	206151-1	Rcpt (PM)			205843-1				
		Rcpt (FH)	206151-2	Rcpt (FH)			205843-2				
23/37	Rvs	Plug	206305-1		23/63	Rvs	Plug	205843-1			
		Rcpt (PM)	206306-1	Rcpt (PM)			205843-1				
		Rcpt (FH)	206306-2	Rcpt (FH)			205843-2				

SERIES 3 CONNECTORS				RECOMMENDED CONTACTS	
DES	SEX	HOUSING			
		DESCR	PART NO.		
17/3	Std	Plug	206037-2	Type XII (See Figure 4) (See 408-1379 and Catalog 82021)	
		Rcpt (PM)	206036-2		
		Rcpt (FH)	206207-1		
17/3	Rvs	Plug	206426-1		
		Rcpt (PM)	206425-1		
		Rcpt (FH)	206425-2		
23/7	Std	Plug	206136-1		
		Rcpt (PM)	206137-1		
		Rcpt (FH)	206137-2		
23/7	Rvs	Plug	206226-1		
		Rcpt (PM)	206227-1		
		Rcpt (FH)	206227-2		

SERIES 4 CONNECTORS				RECOMMENDED CONTACTS	
DES	SEX	HOUSING			
		DESCR	PART NO.		
23/13M	Std	Plug	211824-1	Type XII and Size 16 Multimate (See Figures 2 and 4) (See 408-1379 and Catalog 82021)	
		Rcpt (PM)	211825-1		
		Rcpt (FH)	211825-2		
23/16M	Std	Plug	207485-1		
		Rcpt (PM)	207486-1		
		Rcpt (FH)	207486-2		
23/22M	Std	Plug	206612-1		
		Rcpt (PM)	206613-1		
		Rcpt (FH)	206613-3		

There are two connector styles, standard and reverse sex. Standard plugs have a **flush** mating face and standard receptacles have a **recessed** mating face. Reverse sex connectors are just the opposite — plugs have a **recessed** mating face and receptacles have a **flush** mating face. Note that socket contacts should be installed in a connector that has a **flush** mating face.

Receptacle connectors are available with mounting flanges for FRONT or REAR panel mount (PM) applications, and without mounting flanges for free hanging (FH) applications.

Each receptacle has polarizing keys to assure proper mating. To provide circuit identification, contact cavities are numbered on the FRONT and BACK of each connector.

- ### 3. CONNECTOR SELECTION
- Using the Selection Charts and Section 2, DESCRIPTION, determine the appropriate connectors to be used by the following method:
1. Determine application requirements (Series 1, 2, 3, or 4).
 2. Determine number of contact positions required.
 3. Determine which connector style (standard or reverse) is desired.
 4. Select plug housing. Determine whether or not panel mount application is to be used and select applicable receptacle housing.



CPC Connectors

408-7593

4. CONTACTS

Selection – When selecting contacts according to the Selection Charts on this sheet, refer to Catalog 82021. For visual identification of the proper contacts to be used in the various connector series, see Figures 2, 3, and 4.

For contacts used in Series 1 connectors, Multimite contacts, see Figure 2. Due to the large selection available for crimp type contacts and hand crimping tools, refer to instruction sheet 408-1379.

For contacts used in Series 2 connectors, size 20 DM and 20 DF contacts, see Figure 3.

For contacts used in Series 3 connectors, Type XII contacts, see Figure 4.

For contacts used in Series 4 connectors, Multimite and Type XII contacts, see Figures 2 and 4.

Recommendation – Socket contacts should be attached to wires leading to power source and installed in housing that has flush mating surface. This procedure provides maximum protection for both the pin and the socket contact, and minimizes the possibility of electrical shock.

Crimping – Strip form contacts are designed to be crimped with a semi-automatic or automatic machine. Consult your local Tyco Electronics representative for assistance in selecting the machine that will best suit your needs.

Loose piece contacts are designed to be crimped with crimp tooling (hand tools, die assemblies, or crimping heads). The applicable crimp tooling for the contacts is listed on 408-1379. Read the material packaged with the crimp tooling for the proper crimping procedure.

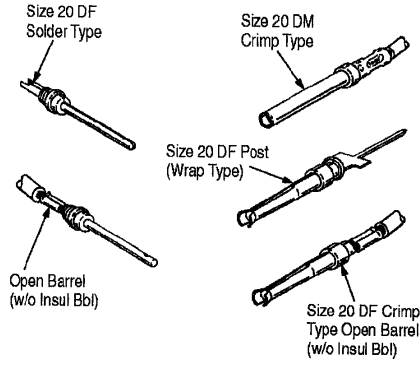


Figure 3

Power Contacts

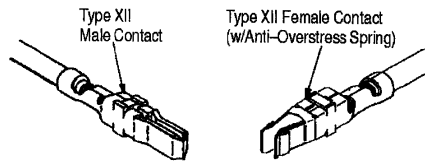


Figure 4

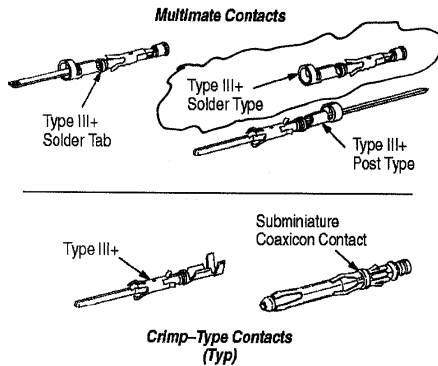


Figure 2

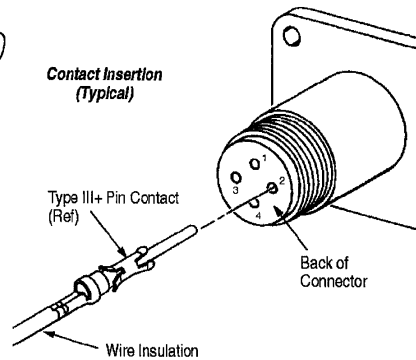


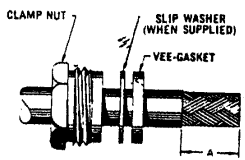
Figure 5

F4
PN 30-92-1
KINGS
CABLING PROCEDURE CP-1000


MASTER

CP-1001


Fig 202



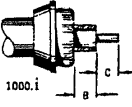
1. Cut cable end square, place clamp-nut, slip washer (when supplied), and gasket over jacket. Remove jacket to dimension "A."



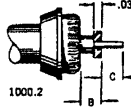
2. Comb out braid and taper forward. Place braid clamp over braid against jacket cut.



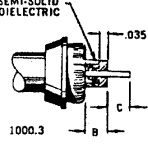
3. Fold braid back over braid clamp and trim as shown above. Remove dielectric to dimension "B." Cut center conductor to dimension "C."
When cable positioning insulators are used adjust trim code dimensions as shown below, and assemble as indicated.




1000.1




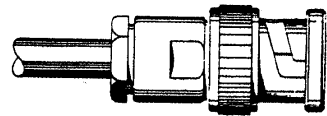
1000.2



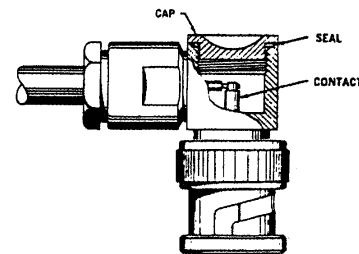
1000.3



4. Solder or crimp contact to center conductor. For access type angle connectors, omit this step and proceed to step 5. For captive contacts, assemble contact capturing parts on cable before attaching contact as shown below.

5. Thread assembly into connector, and lock securely. Vee gasket must be split by braid clamp.



6. For access type angle connectors, solder center conductor in contact groove. Close access opening.

TRIM CODE CHART			
CODE	A	B	C
1001	11/16	.440	7/64

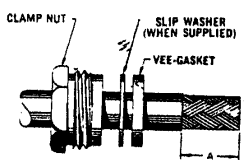
F4
PN 30-92-1

KINGS
CABLING PROCEDURE CP-1000


MASTER

CP-1001


Fig 2 of 2



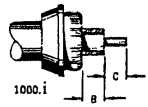
1. Cut cable end square, place clamp-nut, slip washer (when supplied), and gasket over jacket. Remove jacket to dimension "A."



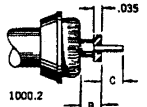
2. Comb out braid and taper forward. Place braid clamp over braid against jacket cut.



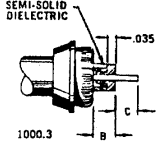
3. Fold braid back over braid clamp and trim as shown above. Remove dielectric to dimension "B." Cut center conductor to dimension "C."
When cable positioning insulators are used adjust trim code dimensions as shown below, and assemble as indicated.



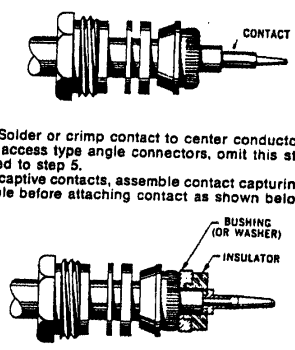
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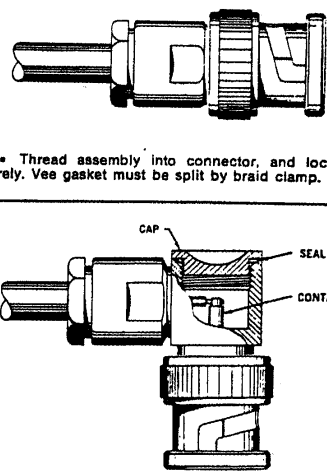
1000.2



1000.3



4. Solder or crimp contact to center conductor. For access type angle connectors, omit this step and proceed to step 5. For captive contacts, assemble contact capturing parts on cable before attaching contact as shown below.



5. Thread assembly into connector, and lock securely. Vee gasket must be split by braid clamp.

6. For access type angle connectors, solder center conductor in contact groove. Close access opening.

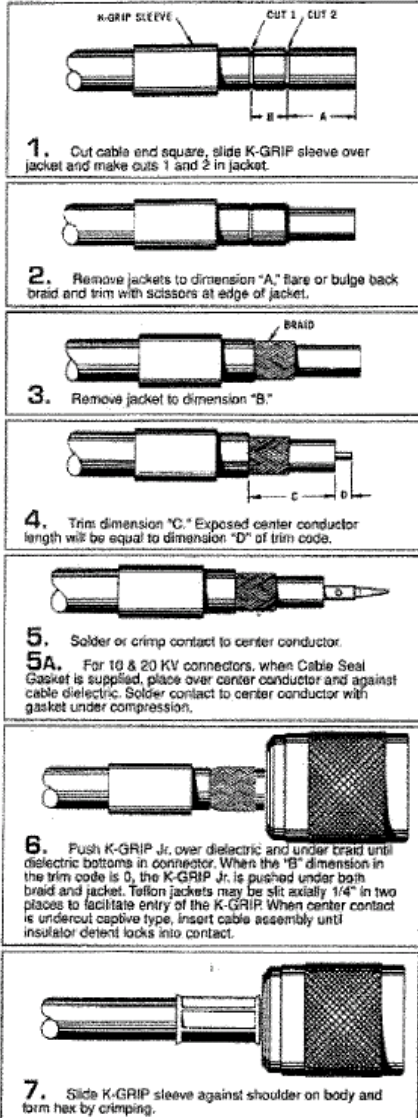
TRIM CODE CHART			
CODE	A	B	C
1001	11/16	.440	7/64

ALTERNATE P4 CRIMP THE CONNECTOR (P/N 92-9105-A)
CABLING PROCEDURE (King 1705-1)



Fig 1 of 1

CP-400



TRIM CODE CHART				
CODE	A	B	C	D
401	23/64	7/32	.468	7/64
402	11/32	7/32	.375	3/16
403	7/16	7/32	.493	5/32
405	49/64	7/32	.671	7/64
406	9/32	0	.093	3/16
407	11/16	0	.496	3/16
408	45/64	7/32	.809	7/64
409	19/64	3/16	.406	7/64
410	31/32	7/32	.562	5/8
413	21/32	7/32	.717	5/32
414	29/64	7/32	.566	7/64
415	15/32	3/16	.530	5/32
417	41/64	7/32	.743	7/64
418	45/64	7/32	.809	7/64
419	7/8	7/32	.884	7/64
421	15/64	0	.150	5/64
424	11/32	7/32	.450	7/64
426	17/64	7/32	.406	5/64
430	1/2	0	.211	1/4
431	9/16	0	.366	3/16
432	17/64	7/32	.390	3/32
433	5/16	7/32	.375	5/32
435	25/64	7/32	.524	5/64
436	95/64	7/32	.512	1/4
439	7/32	7/32	.345	3/32
440	11/32	7/32	.480	5/64
441	23/32	7/32	.772	5/32
447	1-1/64	7/32	.653	9/32
451	1-5/64	7/32	1.018	9/32
452	1-3/32	7/32	.690	5/8
457	45/64	7/32	.794	5/32
458	5/8	7/32	.671	11/64
459	99/64	7/32	.638	3/16
462	5/16	7/32	.437	3/32
464	15/32	7/32	.493	3/16
465	1/4	11/32	.432	5/32
468	25/64	7/32	.501	3/32
469	1/2	7/32	.560	9/64
470	13/32	7/32	.462	5/32
474	15/16	3/16	.890	15/64
475	1-3/4	3/16	1.627	5/16
477	19/64	9/32	.468	7/64
480	.281	.406	.500	.187
484	1-13/64	7/32	.948	15/64
487	27/64	7/32	.550	3/32
488	45/64	7/32	.316	39/64
489	11/32	11/32	.500	3/16
493	1/4	9/32	.390	.140
499	23/64	7/32	.316	17/64
5401	5/16	9/32	.432	5/32
5402	3/8	5/16	.500	3/16
5403	5/8	5/16	.780	3/16
5406	13/32	9/32	.500	3/16
5407	5/16	1/4	.437	1/8
5416	3/4	0	.560	3/16
5417	19/32	1/4	.703	9/64
5425	5/16	0	.187	1/8
5457	5/16	5/16	15/32	5/32

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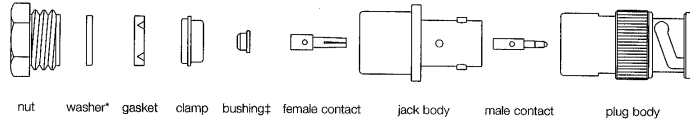
UDR P5

**Assembly Instructions-C25
BNC**

Amphenol®

By 10/1

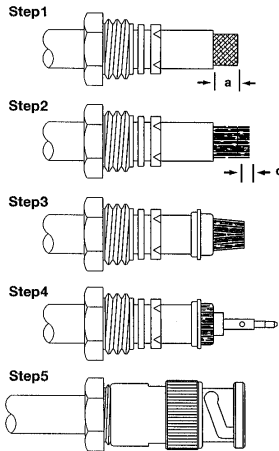
CLAMP CONNECTORS



* Not supplied on all items ‡ For use on RG-62, 71, 122, 178, 180, 196, 210

Amphenol Number	Connector Type	Cable RG-/U	Stripping Dims, Inches (Millimeters)	
			a	c
6775	BNC Plug	8, 9, 11, 213, 214	.490(12.4)	.200(5.1)
6775-75	75Ω BNC Plug	11	.490(12.4)	.200(5.1)
8525	BNC Angle Plug	58, 141, 142, 400	.343(8.7)	.187(4.7)
8575	BNC Angle Plug	59, 62, 140, 210	.297(7.5)	.094(2.4)
9350	BNC Plug	6	.405(10.3)	.094(2.4)
15875	BNC Plug	178, 196	.156(3.96)	.078(1.98)
16300	BNC Plug	180	.250(6.4)	.094(2.4)
33275	BNC Angle Plug	174, 179, 187, 188, 316	.540(13.7)	.156(3.96)
69475	BNC Plug	174, 179, 187, 188, 316	.281(7.1)	.172(4.4)
84975	BNC Plug	122	.281(7.1)	.172(4.4)
86350	BNC Bulkhead Jack	174, 179, 187, 188, 316	.265(6.73)	.156(3.96)
86425	BNC Panel Jack	174, 179, 187, 188, 316	.313(7.95)	.203(5.15)
86850	BNC Bulkhead Jack	178, 196	.266(6.75)	.109(2.76)
31-2	BNC Plug	58, 141, 142, 400	.312(7.9)	.094(2.4)
31-2-RFX	BNC Plug	58, 141, 142A	.315(8.0)	.118(3.0)
31-15	BNC Jack	59, 62, 71, 140, 210	.297(7.54)	.109(2.75)
31-202	BNC Plug	55, 58, 141, 142, 223, 400	.274(6.95)	.094(2.4)
31-204	BNC Angle Plug	55, 58, 141, 142, 223, 400	.297(7.54)	.109(2.8)
31-206	BNC Bulkhead Jack	58, 141, 142, 400	.297(7.5)	.109(2.8)
31-207	BNC Bulkhead Jack	59, 62, 71, 140, 210	.297(7.54)	.109(2.75)
31-212	BNC Plug	59, 62, 71, 140, 210, 302	.250(6.4)	.094(2.4)
31-212-1005	BNC Plug	59 (20GA CC)	.250(6.4)	.094(2.4)
31-850	BNC Angle Plug	59, 62, 71, 140, 210	.375(9.52)	.109(3.17)
31-3202	BNC Plug	55, 58, 141, 142, 223, 400	.250(6.4)	.094(2.4)
31-3301	BNC Plug	58, 141, 142, 223	.250(6.4)	.094(2.4)
31-3302	BNC Plug	59, 62, 71, 140, 210	.250(6.4)	.094(2.4)

UDR P5
PIN 30-4
(AMPHENOL 31-2)



▲ For angle plug only: (except 31-204) Solder center conductor to preassembled contact. Assemble cap and lightly punch center of cap for retention in body, or solder in place.

- Step 1** Place nut, washer (when supplied) and gasket over cable and strip jacket to dimension a shown in table above.
- Step 2** Comb out braid and fold out. Trim insulation off center conductor to dimension e shown in table above. [For RG-62, 71 and 210/U cable, trim an additional .032"(0.8mm) of insulation off center conductor and add bushing.] Tin center conductor.
- Step 3** Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.
- Step 4** Fold back braid wires as shown, trim to proper length [approximately .125" (3.2mm) long] and form over clamp as shown. Braid wire should not extend beyond step of braid clamp. Solder contact to center conductor, sliding bushing first (when supplied) over center conductor. ▲
- Step 5** Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut to approximately 15 inch pounds.

Assembly

Amphenol® Micro-Ribbon® connectors

57 series

general configuration — *UDR P6* *B182*
57 series solder termination *IRM P/N 68-23*
(AMPHENOL 57-30240)

description

Micro-Ribbon connectors offer a fast, economical and distinctively different method of achieving electrical interconnection.

The heart of the connector is the ribbon contact, selectively plated gold over nickel on a copper alloy base.

With contacts designed to mate easily and positively, the 57 series Micro-Ribbon connector delivers electrically and mechanically sound interconnections time after time.

Exceptionally versatile, 57 series Micro-Ribbon connectors are available in rack and panel, cable to panel, cable to cable and printed circuit types.

general specifications

Current Capacity	5 amps per contact
Voltage Rating	700 volts D.C. at sea level 200 volts D.C. at 70,000 ft.
Operating Temperature	-55°C to +105°C -67°F to +221°F
Wire Sizes	Solid: 22-gauge maximum Stranded: 24-gauge maximum
Contacts	Selectively plated 20 microinches gold over 50 microinches nickel on a copper alloy base
Dielectric	Diallyl phthalate per MIL-M-14G Type MDG
Shells	Zinc-plated steel with clear chromate coating; trapezoidal shape for polarization.

features

- Copper alloy contacts, selectively plated gold-over-nickel for excellent current-carrying characteristics.
- UL 94 VO rated diallyl phthalate dielectric per MIL-M-14G Type MDG, for operation at up to 700 volts D.C. (sea level) without shorting or flashover. Resists cracking or chipping and has low moisture absorption.
- Float bushings on receptacles allow .020" radial float, for easy mating.
- Zinc-plated steel outer shell, with clear chromate finish, for corrosion resistance.
- Wide, flat mating surfaces, pressed tightly together by flexing action of both contacts, for electrical continuity.
- Positive mating action that wipes contacts clean, removing film or foreign matter, for low contact resistance.
- Solder cup type contact tails (for easy wire attachment) and pin style tails (for printed circuit board attachment) both are available. A high barrier between contact rows also is available.
- A trapezoidal-shape shell that assures correct polarity.

connector deviations (1,000 piece m.o.q)

Deviation Number	Deviation Description for 57/157 Series Connectors
(398)	Connector shells and steel hardware nickel plated
(424)	Contacts fully plated, 30 microinches gold select over 50 microinches nickel.
(438)	Gold flashed contacts on mating area, 50 microinches min. nickel underplate.
(441)	Tin plated shells
(448)	Contacts selectively plated, 30 microinches min. gold on mating area, 50 microinches min. nickel underplate
(450)	Contacts selectively plated, 50 microinches min. gold on mating area, 50 microinches min. nickel underplate

NOTE: Not all part numbers are available in all deviations. To verify availability contact the factory directly, or your local manufacturer's representative or distributor. Check with factory for other deviations not listed above.

connector deviation ordering information

To order a deviation of a catalog miniature-ribbon connector, add one of the listed deviation numbers in parenthesis to the catalog part number. Example: To order 57-10500 with tin plated shells, request 57-10500 (441).

NOTE: Only one deviation number can be applied to a catalog part number at a time.



FILE E64911



Canadian Standards Association

FILE LR 45516-14

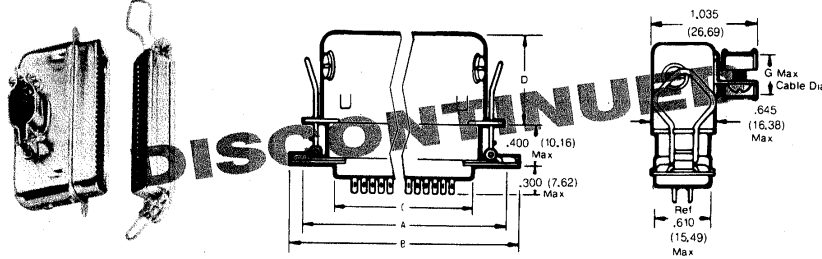
Amphenol® Micro-Ribbon® connectors

57 series

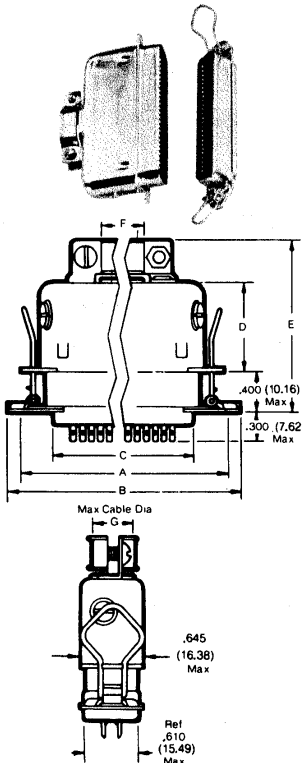
B 2 of 2

57 series cable-to-panel connectors

side cable entry type



top cable entry type



dimensions

	14 Contacts		24 Contacts		36 Contacts		50 Contacts	
	In.	mm	In.	mm	In.	mm	In.	mm
A	1.417	35.992	1.842	46.787	2.352	59.741	2.947	74.854
B	1.770	44.958	2.195	55.753	2.705	68.707	3.300	83.820
C	.910	23.114	1.335	33.909	1.845	46.863	2.440	61.976
D	.850	21.59	.830	21.08	.910	23.11	1.000	25.4
E	1.665	42.29	1.645	41.78	1.725	43.82	1.815	46.10
F	.348	8.84	.473	12.01	.648	16.46	.772	19.61
G	.348	8.84	.473	12.01	.500	12.7	.500	12.7

NOTE: All dimensions are reference.

order information

Contacts	Plugs: Top Cable Entry Part Number	Plugs: Side Cable Entry Part Number	Receptacle Mating Connection With Spring Latches Part Number
14	57-30140	57-50140	57-40140
24	57-30240	57-50240	57-40240
36	57-30360 (screwtype hood)	57-50360	57-40360
36	57-30360-18 (snap on hood)	—	—
36	—	—	57-40360-9 (high barrier)
50	57-30500	57-50500	57-40500
50	57-30500-3 (high barrier)	—	57-40500-4 (high barrier)

STRIP JACKET 0.80 +/- 0.1 IN
STRIP CONDUCTORS 0.08 +/- 0.01 IN

B141

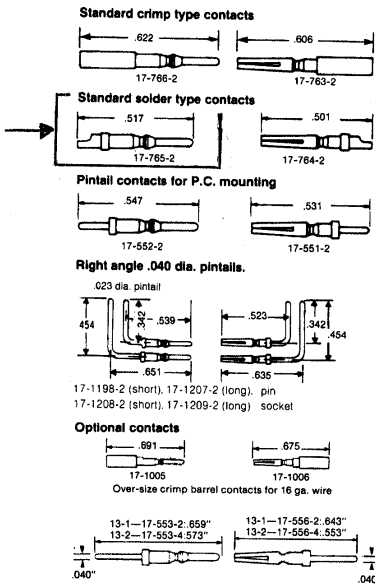
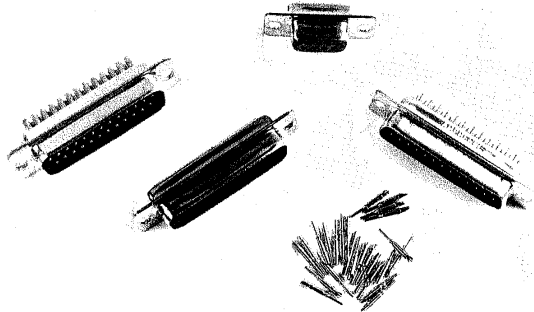
original Poke-Home® d-sub 17 series

UDR P7
IRM FN 68-27
(17-20250)

WPI original poke-home blocks can accept the wide range of contact types described on this page.

Poke Home® d-sub connectors

A removable contact type connector that meets most commercial requirements. The connector is available with crimp type contacts, solder type, and printed circuit types in both .023 and .040 inch diameter pintails. The .040 inch pintail is available in two lengths or with right angles.



specifications

Temperature ranges:
-67° F (-55° C) to
+257° F (+125° C)
Current rating: 7.5 A
Voltage rating:
500 VAC (RMS) at sea level
150 VAC (RMS) at 90,000 feet
Dielectric: Zytel 101
nylon per Mil M-20693

Shells: Steel clear chromated over zinc.
Gold iridite finish available on request per QQP416A Type II
Contacts: Crimp - gold over nickel plated copper alloy
Solder - gold over nickel plated copper alloy
Wire size: Solder: up to #20
Crimp #20, #22, and #24AWG

contact arrangements



Number of Contacts	Receptacle	Receptacle with Float Bushings	Plug
9	17-300-1	17-785	17-301-1
15	17-302-1	17-783	17-303-1
25	17-304-1	17-789	17-305-1
37	17-306-1	17-797	17-307-1
50	17-308-1	17-1001	17-309-1

Connectors above have zinc plated clear chromate steel shells. For gold-iridite finish, add one number to suffix. Examples: 17-300-2, 17-786. See page 5 for optional right tin.

Number of Contacts	Crimp Type		Solder Type	
	Receptacle Socket Contacts	Plug Pin Contacts	Receptacle Socket Contacts	Plug Pin Contacts
9	17-10090-1	17-20090-1	17-10090	17-20090
15	17-10150-1	17-20150-1	17-10150	17-20150
25	17-10250-1	17-20250-1	17-10250	17-20250
37	17-10370-1	17-20370-1	17-10370	17-20370
50	17-10500-1	17-20500-1	17-10500	17-20500

Number of Contacts	PC Board Type			
	Receptacle With 17-551-02 Socket Contacts	Plug With 17-552-02 Pin Contacts	Receptacle With 17-556-XX Socket Contacts	Plug With 17-553-XX Pin Contacts
9	17-10890-11	17-20890-11	17-10890-13-XX	17-20890-13-XX
15	17-10150-11	17-20150-11	17-10150-13-XX	17-20150-13-XX
25	17-10250-11	17-20250-11	17-10250-13-XX	17-20250-13-XX
37	17-10370-11	17-20370-11	17-10370-13-XX	17-20370-13-XX
50	17-10500-11	17-20500-11	17-10500-13-XX	17-20500-13-XX

Connectors can also be ordered without contacts for use with bulk packed contacts in semi-automatic crimping machines. Contact sales office nearest you.

STRIP
CABLE
TRACKET
0.50 4/0 dia
STRIP
CONDUCTORS
0.08
1/0.01 in

(SEE IS 6609
FOR CABLE CLAMP KIT)

WPI - Salem Division
23 Front Street, Salem, NJ 08079 U.S.A.
phone (609) 935-7601
fax (609) 935-0102 twx (510) 680-4750
country code 1



P7 IRM P/N 780121 (745833-7)

AMP AMP INCORPORATED HARRISBURG, PA 17105 CUSTOMER HOTLINE 1 800 722-1111	AMP* AMPLIMITE* HD-20 SHIELDED CABLE CLAMP KITS	IS 6609
		RELEASED 11-1-88

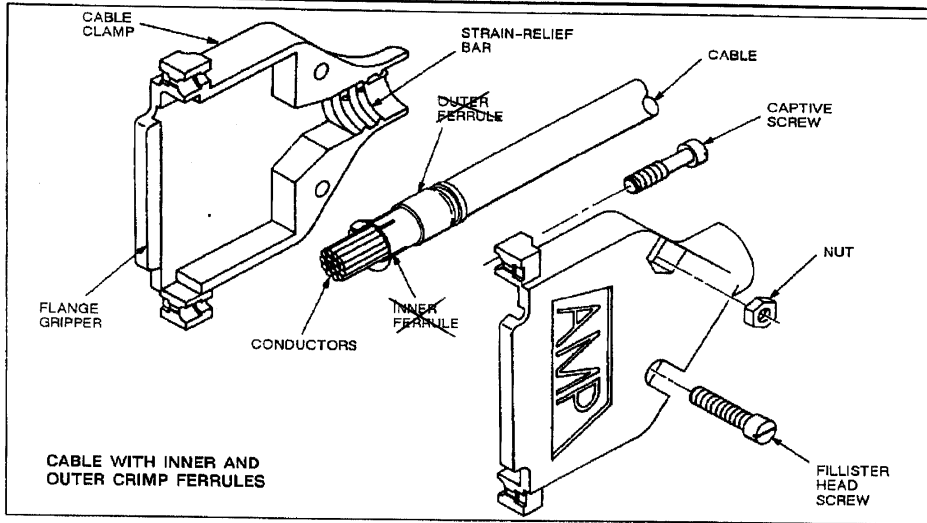


Fig. 1

1. INTRODUCTION

This Instruction Sheet (IS) covers the use of AMPLIMITE HD-20 Shielded Cable Clamp Kits with available ferrules listed in Figures 2 and 8, and grommets listed in Figure 14.

NOTE

All dimensions on this sheet are in inches. Do not scale drawings.

Read these instructions carefully before using cable clamp kits and ferrules.

2. DESCRIPTION (Figure 1)

Each shielded cable clamp kit consists of two symmetrical cable clamps which contain strain-relief bars. Each kit also includes two captive screws, two fillister head screws, and two nuts.

The cable clamps are designed to provide electromagnetic shielding and strain relief for braid- and/or foil-type (with drain wire) shielded cables. The cable clamps may be used on cables fitted with split-ring or crimp ferrules, on cables without ferrules, or on cables fitted with grommets.

Refer to Paragraph 3 when using cable without ferrules, to Paragraphs 5 and 6 for installation of cable clamps on cable with ferrules, and to Paragraph 7 for installation of cable clamps on cable with grommets.

Cable clamps are available in five sizes for AMPLIMITE connectors with corresponding contact positions (9, 15, 25, 37, and 50 for HD-20 and 15, 26, 44, 62 and 78 for HD-22).

Refer to Figures 2 and 8 to determine appropriate cable clamp kit relative to cable diameter, AMPLIMITE connector size, and type of ferrule (if used) for the cable.

Refer to Figure 14 to determine appropriate grommet set and cable clamp kit relative to cable diameter.

CAUTION

If cable diameter is too small to fit properly into strain relief, apply heat-shrinkable tubing before working braid over cable jacket to build up the outside diameter of the cable. The inside diameter of the heat-shrinkable tubing should be no more than twice the outside diameter of the cable. See Figure 3.

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IS 6609

AMPLIMITE CABLE CLAMP KITS

SIZE CONNECTOR (HD-20/HD-22)	RECM WIRE RANGE (OD)●	FERRULES		STRAIN RELIEF	
		INNER	OUTER	ZINC DIE CAST	PLATED PLASTIC
1 (9 Posn/15 Posn)	.190-.240	1-745129-8†	745130-8	745171-5	745854-1
	.230-.280	1-745129-6	745130-8	745171-1	745854-3
	.320-.370	3-745129-4	1-745130-6	745171-5	745854-1
2 (15 Posn/26 Posn)	.190-.240	1-745129-7	1-745130-0	745171-5	745854-1
	.230-.280	2-745129-1†	745130-8	1-745172-3	747099-1
	.300-.350	1-745129-8	745130-8	745172-1	747099-3
	.315-.365	3-745129-2	1-745130-6	1-745172-3	747099-1
	.380-.430	2-745129-0	745130-9	1-745172-3	747099-1
3 (25 Posn/44 Posn)	.190-.240	1-745129-7	1-745130-0	745172-1	747099-3
	.230-.280	1-745129-9	1-745130-1	1-745172-3	747099-1
	.300-.350	2-745129-1	745130-8	745173-3	745833-5
	.380-.430	3-745129-2	1-745130-6	745173-3	745833-5
	.470-.530	2-745129-0	745130-9	745173-3	745833-5
		2-745129-4†	745130-9	745173-1	745833-1
		1-745129-9	1-745130-1	745173-3	745833-5
4 (37 Posn/62 Posn)	.190-.240	2-745129-3†	1-745130-1	745173-1	745833-1
	.230-.280	2-745129-2	1-745130-2	745173-1	745833-1
	.300-.350	2-745129-2	1-745130-2	745173-1	745833-1
	.380-.430	2-745129-1	745130-8	745174-4	747100-7
	.465-.525	3-745129-2	1-745130-6	745174-4	747100-7
	.590-.650	2-745129-0	745130-9	745174-4	747100-7
	.700-.750	1-745129-9	1-745130-1	745174-4	747100-7
5 (50 Posn/78 Posn)	.190-.240	2-745129-7†	1-745130-1	745174-1	747100-1
	.300-.350	2-745129-6	1-745130-2	745174-1	746100-1
	.315-.365	2-745129-5	1-745130-3	745174-1	746100-1
	.380-.430	1-745129-8	745130-8	745175-6	1-747098-1
	.470-.530	2-745129-4	745130-9	745175-4	747089-7
	.600-.650	1-745129-7	1-745130-0	745175-6	1-747089-1
	.700-.750	2-745129-3	1-745130-1	745175-4	747089-7
		2-745129-2	1-745130-2	745175-4	747089-7
		3-745129-0†	1-745130-2	745175-1	747089-1
		2-745129-9	1-745130-3	745175-1	747098-1
	2-745129-8	1-745130-4	745175-1	747098-1	

● MAXIMUM CABLE DIAMETER ASSUMES A MINIMUM INSULATION THICKNESS OF .060".
† INDICATES FERRULES WITH REDUCED NECKS.

Fig. 2

3. ATTACHING CABLE CLAMP ASSEMBLY (Figure 3)

A. Braided Shield Cable (Without Ferrule)

1. Strip cable jacket from end of conductors. Refer to the chart in Figure 7 for the cable jacket strip length for HD-20 and HD-22 connectors.
2. Push braided shield away from conductors to form a bulge at base of outer cable jacket. Work braided shield back over outer jacket. It may be necessary to unweave shield and place strands over outer jacket (strands should be spread evenly over outer jacket).
3. Install tape or heat-shrinkable tubing without sealant to secure loose strand ends to cable until cable clamps are installed. The braid should be exposed 9/16 in. between tape or tubing and con-

ductors. See Figure 3. Refer to Instruction Sheet IS 2607 for proper application of tubing. Use an electric heat gun as the heat source.

4. Terminate conductors with contacts and insert contacts into rear of connector or terminate to connector per the appropriate document listed in Figure 4.
5. Position one half of cable clamp on cable and connector. Ensure that flange of connector is behind flange gripper of clamp and that braided shield of cable is in strain relief grooves of clamp.
6. Position the other half of clamp on top of cable and start the two fillister head screws and nuts on the clamps.
7. Insert captive screws into mounting holes. Alternately tighten the fillister head screws until the two clamp halves bottom on each other.

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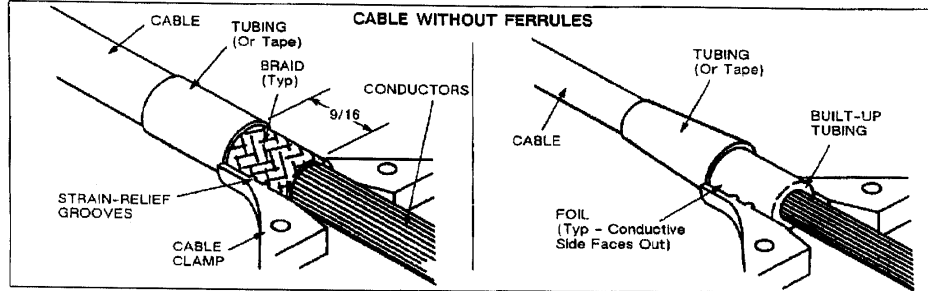


Fig. 3

NOTE

Excess braided shield may be left secured or may be trimmed off directly behind clamps with a sharp shield trimming tool. Take care not to nick or cut conductors. If heat-shrinkable tubing was used to secure braid, do NOT trim the tubing.

of cable and the drain wire are in strain relief grooves of clamp.

6. Position the other half of the clamp on top of cable and start the two fillister head screws and nuts on the clamps.
7. Insert captive screws into mounting holes.
8. Alternately tighten the fillister head screws until the cable clamp halves bottom on each other.

B. Foil Shield Cable (Without Ferrule)

1. Strip the cable jacket from end of conductors. Refer to the chart in Figure 7 for the cable jacket strip length for HD-20 connectors.
2. Unwrap foil shield from cable and wrap it around outer jacket. Wrap drain wire around foil. Ensure that conductive side of foil is facing outward.
3. Secure ends of foil and drain wire with tape or heat-shrinkable tubing until clamps are installed. Leave 9/16 in. of foil exposed between tape or tubing and conductors.
4. Terminate conductors with contacts and insert contacts into rear of connector or terminate to connector per the appropriate document listed in Figure 4.

CONNECTOR TYPE	AMP DOCUMENT
HDP-20 Crimp Snap	IS 7514
HDP-20 Solder Cup	IS 9193
HDE-20 All Plastic	IS 6621
HDE-20 Metal Shell	IS 6645
HDP-22	Application Specification 114-10001

Fig. 4

5. Position one half of cable clamp on cable and connector. Ensure that flange of connector is behind flange gripper of clamp and that foil shield

NOTE

Excess foil may remain secured with tape or may be trimmed directly behind clamp with a sharp trimming tool. Take care not to nick or cut conductors. If heat-shrinkable tubing was used to secure foil, do NOT trim the tubing.

4. LATCHING BLOCKS (Figure 5)

The AMPLIMITE cable clamps may be mounted to a connector-mounted block or a panel-mounted block.

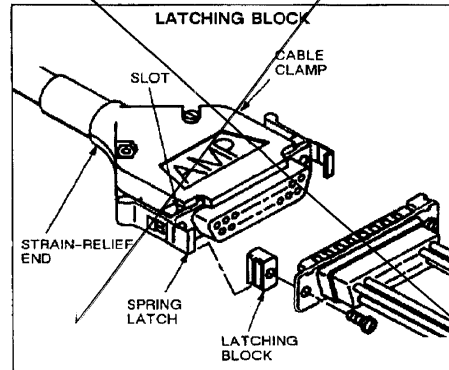


Fig. 5

IS 6609

AMPLIMITE CABLE CLAMP KITS

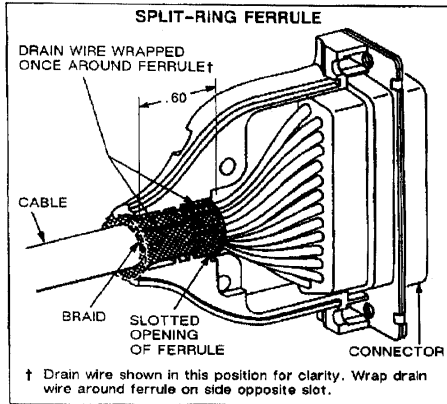


Fig. 6

Cable clamps may be used with latching blocks (208101, 745007, 745245, and 745286) by removing mounting screws and replacing them with spring latches (745255-2). Refer to IS 9130 and to Figure 5 of this document for proper assembly of spring latches.

5. SPLIT RING FERRULE ASSEMBLY (Figure 6)

Refer to the chart in Figure 8 for the proper ferrule for the cable and for the AMPLIMITE connector you are using, and proceed as follows:

1. Cut the cable to the desired length and slide the ferrule onto the cable.
2. Strip cable jacket from end of conductors. Take care not to nick or cut braid. Refer to the chart in Figure 6 for the cable jacket strip length for HD-20 and HD-22 connectors.

CABLE JACKET STRIP LENGTH FOR HD-20/HD-22 CONNECTORS									
CONNECTOR STYLE	POSN HD-20/ HD-22	GROMMET/ FERRULE STYLE	STRIP LENGTH DIM. (Inches)	MASS TERM. ** HAND TOOLING DIM. (Tooling Ident.)	CONNECTOR STYLE	POSN HD-20/ HD-22	GROMMET/ FERRULE STYLE	STRIP LENGTH DIM. (Inches)	MASS TERM. ** HAND TOOLING DIM. (Tooling Ident.)
HDE-20	9	None/Grommet	1.00-1.50	J	HDP-20/-22	9/15	Crimp Style	1.90-2.10	—
HDE-20	9	Split Ring	1.00-1.50	J	HDP-20/-22	15/26	None/Grommet	1.00-1.50	—
HDE-20	9	Crimp Style	1.90-2.10	F	HDP-20/-22	15/26	Split Ring	1.00-1.50	—
HDE-20	15	None/Grommet	1.00-1.50	J	HDP-20/-22	15/26	Crimp Style	1.90-2.10	—
HDE-20	15	Split Ring	1.00-1.50	J	HDP-20/-22	25/44	None/Grommet	1.10-1.60	—
HDE-20	15	Crimp Style	1.90-2.10	F	HDP-20/-22	25/44	Split Ring	1.10-1.60	—
HDE-20	25	None/Grommet	1.30-1.60	J	HDP-20/-22	25/44	Crimp Style	2.20-2.40	—
HDE-20	25	Split Ring	1.30-1.60	J	HDP-20/-22	37/62	None/Grommet	1.10-1.60	—
HDE-20	25	Crimp Style	1.90-2.10	F	HDP-20/-22	37/62	Split Ring	1.10-1.60	—
HDE-20	37	None/Grommet	1.40-1.70	J	HDP-20/-22	37/62	Crimp Style	2.20-2.40	—
HDE-20	37	Split Ring	1.40-1.70	J	HDP-20/-22	50/78	None/Grommet	1.10-1.60	—
HDE-20	37	Crimp Style	2.20-2.40	F	HDP-20/-22	50/78	Split Ring	1.10-1.60	—
HDP-20/-22	9/15	None/Grommet	1.00-1.50	—	HDP-20/-22	50/78	Crimp Style	2.20-2.40	—
HDP-20/-22	9/15	Split Ring	1.00-1.50	—					

●NOTE: The strip length dimension range is designed to accommodate a variety of cable designs. In order to determine the proper strip length, before beginning production runs, consideration must be given to the flexibility and type of wire, bundling of wire due to circuit arrangement, and other like factors. In any case, the ferrule placement discussed in the assembly procedures must be per Figure 10 for split ring ferrules and per Figure 11 for crimp ferrules.

●●NOTE: Mass termination hand tooling dimension pertains to HDE connectors ONLY.

Fig. 7

AMPLIMITE CABLE CLAMP KITS

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SIZE CONNECTOR (HD-20/HD-22)	CABLE RANGE (OD)	SPLIT-RING FERRULE	STRAIN RELIEF 180° CABLE EXIT	
			ZINC DIE CAST	PLATED PLASTIC
1 (9 Posn/15 Posn)	.160-.200	745508-2	745171-2	745854-5
	.210-.240	745508-3	745171-1	745854-3
	.330-.370	745508-6	745171-5	745854-1
2 (15 Posn/26 Posn)	.185-.225	745508-3	745172-3	747099-7
	.240-.300	745508-4	745172-2	747099-5
	.335-.375	745508-6	745172-1	747099-3
	.390-.430	745508-1	745172-3	747099-1
	.240-.280	745508-4	745173-5	745833-9
3 (25 Posn/44 Posn)	.310-.350	745508-5	745173-4	745833-7
	.390-.430	745508-1	745173-3	745833-5
	.440-.480	745508-1	745173-2	745833-3
	.490-.530	745508-9	745173-1	745833-1
	.310-.350	745508-5	745174-5	747100-9
4 (37 Posn/62 Posn)	.390-.430	745508-1	745174-4	747100-7
	.460-.500	745508-8	745174-3	747100-5
	.535-.575	1-745508-0	745174-2	747100-3
	.610-.650	1-745508-1	745174-1	747100-1
	.335-.375	745508-6	745175-6	1-747098-1
5 (50 Posn/78 Posn)	.410-.450	745508-7	745175-5	747098-9
	.485-.525	745508-9	745175-4	747098-7
	.560-.600	1-745508-0	745175-3	747098-5
	.635-.675	1-745508-1	745175-2	747098-3
	.710-.750	1-745508-2	745175-1	747098-1

Fig. 8

3. If using braided cable, fold braid back over cable without splitting or slicing the braid. If using foil cable with a drain wire, cut the foil to the jacket and remove foil. Wrap the drain wire once around the ferrule, making sure that the drain wire is NOT left in the slotted opening in the ferrule. If using cable with both foil and braid, cut foil to jacket and remove foil after folding braid back over jacket. Slide ferrule under braid to end of cable jacket.

4. Trim excess braid or drain wire to approximately .60 in. from end of cable jacket.

5. Terminate conductors with contacts and insert contacts into rear of connector or terminate to connector per the appropriate document listed in Figure 4.

6. Position one half of cable clamp on cable and connector. Ensure that flange of connector is behind flange gripper of clamp and that ferrule is positioned against inner strain relief bar of cable clamp (see Figure 10).

7. Position other half of cable clamp on top of cable and secure with attaching hardware.

6. CRIMP FERRULE ASSEMBLY (Figure 9)

Refer to the chart in Figure 2 for the proper ferrule for the cable and for the AMPLIMITE connector you are using, and proceed as follows:

NOTE

Crimp ferrules are for use with cables with braided shield ONLY. They are not for use with foil shield cable. If a cable with both braid and foil is being used, remove the foil before crimping ferrules.

- Slide outer ferrule over cable.
- Strip cable jacket from end of conductors. Be careful not to cut braid. Refer to the chart in Figure 7 for the cable jacket strip length for HD-20 and HD-22 connectors.
- Cut braid approximately 1/2 in. from end of cable jacket.
- Flare braid and slide inner ferrule under it. Do NOT unweave braid. Make sure that inner ferrule butts against cable jacket.
- Slide outer ferrule over inner ferrule.
- Place the cable assembly into AMP Hand Crimping Tool 543344-1, equipped with Die Assembly 543013-1, if crimping manually. See Instruction Sheet IS 9318, packaged with the die set, for specific crimping instructions. The hand crimping tool is described in IS 9315. If using an applicator in an automatic machine, consult the appropriate applicator instruction (AI) sheet or consult your local AMP representative.
- Crimp the ferrules and remove crimped assembly from crimping dies. Trim excess braid from between the two ferrules. Take care not to nick or cut conductors.

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AMPLIMITE CABLE CLAMP KITS

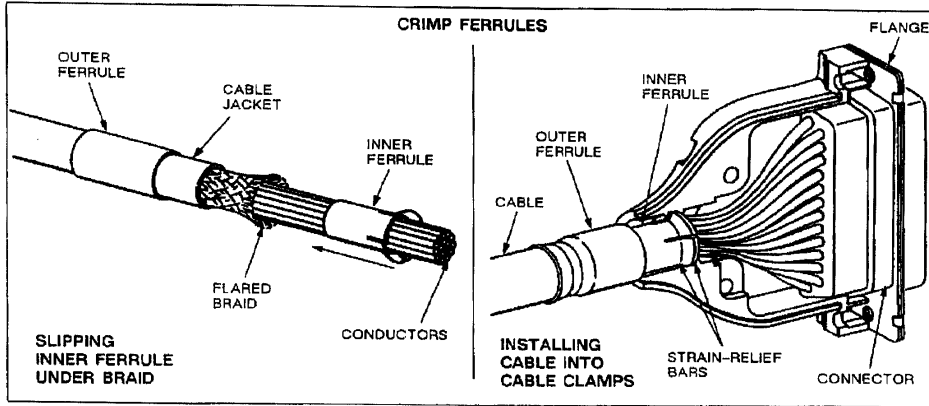


Fig. 9

8. Terminate conductors with contacts and insert contacts into rear of connector or terminate to connector per the appropriate document listed in Figure 4.

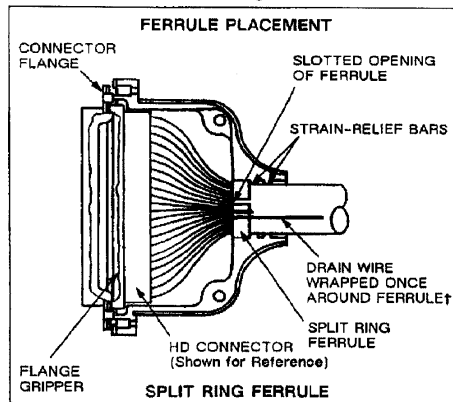
9. Position one half of cable clamp on cable and connector. Ensure that flange of connector is behind flange gripper of clamp and that inner ferrule is positioned between the two strain-relief bars of the clamp (see Figure 11).

10. Position other half of clamp on top of cable and secure with attaching hardware.

7. GROMMET ASSEMBLY (Figure 13)

Refer to the chart in Figure 14 to select the proper cable clamp kit with grommets for the cable you are using and proceed as follows:

1. Cut the cable to the desired length and slice the grommet onto the cable.
2. Strip cable jacket from end of conductors. Take care not to cut foil or braid. Refer to chart in Figure 7 for the cable jacket strip length for HD-20 and HD-22 connectors.
3. If using braided cable, fold braid back over cable without splitting or slicing braid. If using foil



† Drain wire shown in this position for clarity only. Wrap drain wire around ferrule on side opposite slot.

Fig. 10

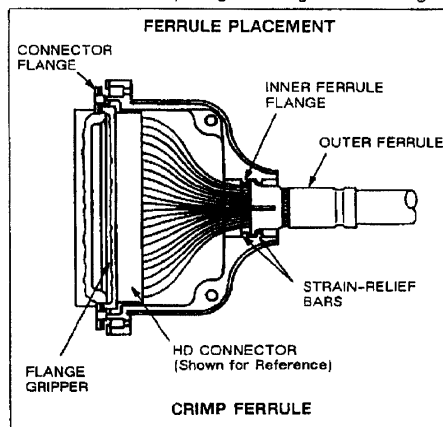


Fig. 11

AMPLIMITE CABLE CLAMP KITS

IS 6609

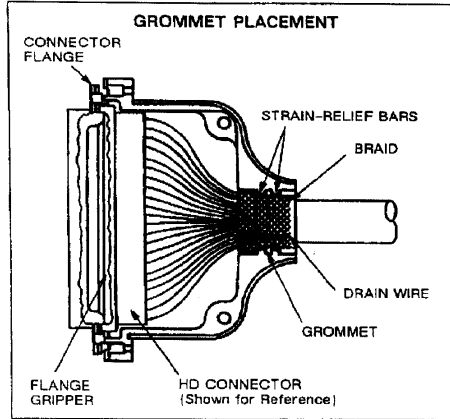


Fig. 12

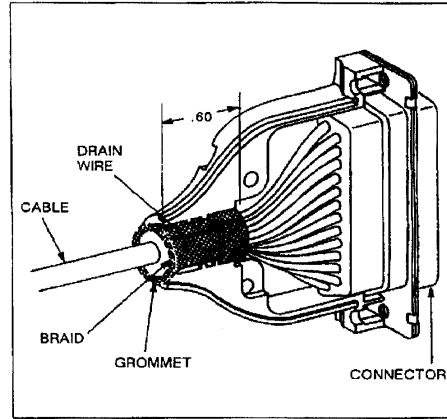


Fig. 13

cable, cut foil to jacket and remove foil. If using cable with both foil and braid, cut foil to jacket and remove foil after folding braid back over jacket.

4. Trim excess braid or drain wire to approximately .60-in. from end of cable jacket.

5. If using cable with braid, slide grommet under braid to end of cable jacket. If using cable with drain wire, slide grommet to end of cable jacket and fold drain wire over grommet.

6. Terminate conductors with contacts and insert contacts into rear of connector or terminate the connector per the appropriate document listed in Figure 4.

7. Position one half of cable clamp on cable and connector. Ensure that flange of connector is behind flange gripper of clamp and that grommet edge is positioned against inner strain relief bar of cable clamp (see Figure 12).

8. Position other half of cable clamp on top of cable and secure with attaching hardware.

CONNECTOR SIZE HD-20/HD-22	CABLE RANGE (OD)	180° STRAIN RELIEF		
		SHIELDED		UNSHIELDED
		ZINC DIE CAST	PLATED PLASTIC	UNPLATED PLASTIC
1 9 Posn/15 Posn	.185-.320	745171-5	745854-1	748678-1
2 15 Posn/26 Posn	.185-.320	745172-1	747099-3	748678-2
3 25 Posn/44 Posn	.190-.470	745173-1	745833-1	748678-3
4 37 Posn/62 Posn	.190-.470	745174-3	747100-5	748678-4
5 50 Posn/78 Posn	.190-.470	745175-4	747098-7	748678-5

Fig. 14

AN 780121 P7

REVISED PER EON B06368	DATE 7-90	BY MAD	CHKD MAD	APPROV MAD	DRAWING NO 745833
REVISED PER EON B06368	DATE 7-90	BY MAD	CHKD MAD	APPROV MAD	DRAWING NO 745833

SIZE IDENT LETTER	BULK PACKED KIT NO	INDIVIDUAL KIT NO
D	1-745833-0	745833-9
G	745833-8	745833-7
K	745833-6	745833-5
H	745833-4	745833-3
P	745833-2	745833-1

REMARKS:
△ ALL PARTS PACKAGED UNASSEMBLED.
△ AS SHOWN ABOVE, THIS KIT CONSISTS OF 2 STRAIN RELIEF HALVES, 2 #4-40 SCREWS, 2 #4-40 NUTS & 2 #4-40 MOUNTING SCREWS.
△ SAME AS SHOWN EXCEPT, EACH PART IS INDIVIDUALLY BULK PACKED FOR MULTIPLE KIT ORDERS.
△ OBSOLETE.

OR 7-25-90 CXC 7 SALLOTT 16 CXC 7 JACKLINTON APPD 7-10-90 APPD 7-11-90 J. MASTRI PRODUCT SPEC	AMP INCORPORATED 1000 W. 100th St. J. JACKLINTON J. MASTRI PRODUCT SPEC	CABLE CLAMP KIT, SIZE 3, 25 POSN, 180°, AMPLIMITE™ SERIES, PLATED PLASTIC
FINISH SEE CALLOUT	APPLICATION SPEC SEE CALLOUT	SCALE 2:1
SHEET NO 00779		SHEET 1 OF 1

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Appendix E Modification Sheets, Engineering Instructions

E.1 Modification Sheets, Engineering Instructions

P/N	Description
942A-200L-M4MS	Modification Instruction, UDR with Trip Test and SCA/Gross select
942A-200L-M5MS	Modification Instruction, UDR with Trip Test
942-200-90-M1MS	Modification Instruction, SCA Board
942-200-95-M1MS	Modification Instruction, Dual Analog Output Option Board

Reference Manuals:

942A-200L-M4:	
942-100-90D	Instruction Manual, SCA Option Board
942-200-95D	Instruction Manual, Analog Output Option Board
942A-200L-M5:	None

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