FLUKE®
Biomedical

Installation, Operation, and Maintenance

COMMUNICATIONS ISOLATOR
Model 960CI-200

Instruction Manual

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Fluke Biomedical
Radiation Management Services

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Section 1
Introduction

1.1 General Description

The 960CI-200 series Communications Isolator is designed for use in Victoreen's 960 Digital Radiation Monitoring System for Class 1E applications. Its function is to isolate the safety related monitor from a commercially rated computer both electrically and mechanically. The monitor transmits data serially to the 960CI isolator through a fiber optic cable. Figure 1-1 is a block diagram of the Communications Isolator Module.

1.2 Application

The 960CI-200 series Communications Isolator Module is used for communication isolation whenever a safety related monitor needs to be connected to a computer. This isolation is for the serial asynchronous communication link. The 960CI is designed for use with the 960IC Card Cage Assembly, which holds up to 8 960CI modules.

1.3 Specifications

General specifications for the 960CI-200 Communications Isolator Module are listed below. The module (960CI-200) is only available rated for nuclear safety-related applications. However, the module may also be used in commercial applications.

The 960CI-200 module is assembled by techniques and with parts selected for the reliability required in a nuclear application. Any repairs made to the nuclear rated module will void its safety-related rating. The module (960CI-200) must be returned to the factory for authorized qualified ANSI 45.2.6, 1978, Skill
Level II service.

Specifications:

Dimensions (H x W x D)	12in x 6.5in x 1in (304.8mm x 156.2mm x 25.4mm)
Weight	1 lb., 9 oz. (708.74g)
Operating Temperature	32° to 122°F (0° to 50°C)
Relative Humidity	0 to 95% noncondensing
Power	+ 5 VDC @ 500mA, 115 VAC
Isolation	Optical, 50 kV minimum
Processor	Motorola 6809
Data Bus	8 internal data lines D0 through D7
Address Bus	16 internal address lines A0 through A15
Control & Timing	01, 02 two phase 1 MHz clock R/W, short 02 early 0 for WRITE reset
Channel ID	32 codes, switch selectable
Communication	One way optical serial line to a safety related monitor; two way serial link to a computer
Baud Rates	See Table 4-2
Memory	32K x 8 PROM, 24 x 8 RAM

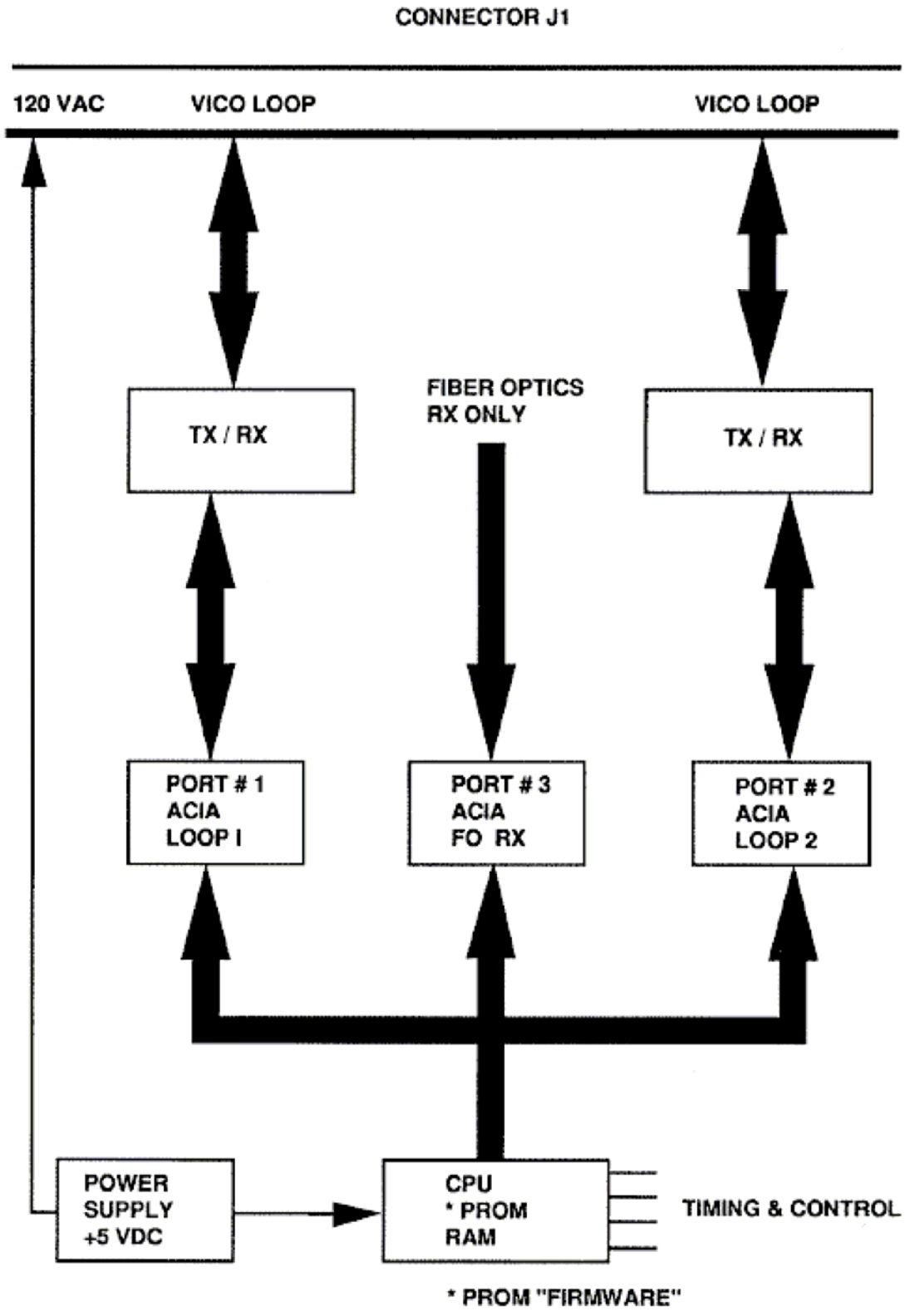

Figure 1-1. 960CI-200 Communications Isolator Functional Block Diagram

Section 2
Receiving Inspection and Storage

2.1 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 RMS Customer Service Department.

FLUKE BIOMEDICAL, RMS
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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 RMS Customer Service Department.

2.2 Storage

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

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

Storage of Victoreen instruments must comply with the following:

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

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

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

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

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Section 3
Installation

3.1 Installation

Communications Isolator Module 960CI-200 is supplied as part of a radiation monitoring system or as a replacement part for an existing monitoring system. When the module is shipped as part of a system, it is installed at the factory.

When a module is shipped as a replacement part, verify that jumper addresses and PROM's are in the same configuration as the module, which is being replaced.

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Section 4
Theory of Operation

4.1 Theory of Operation

Figure 1-1 is the block diagram for the 960CI-200 Communications Isolator. The circuitry is explained in the following paragraphs. Refer to the schematic diagrams in Appendix B to understand the circuit explanations.

4.2 Address Allocation

Table 4-1 lists the address allocations for the internal circuitry of the isolator.

Table 4-1. Address Allocations

Address	Allocation
300	Loop 1 (to computer)
400	Loop 2 (to computer)
500	Loop 3 (from computer)
200	Channel ID
2000 – 7FFF	RAM
8000 – FFFF	PROM

4.3 Isolator

Refer to schematic 960CI-200-13

REG1 is the +5 VDC power supply that provides power. The customer supplies the 120 VAC input power. SW4 is the 120 VAC power switch. Surge and spike protection is provided by D1.

Optical receiver F01 and IC U21 provides a TTL level signal to the RX input of U17. IC U17 is used strictly for receiving (RX). The transmit (TX) line is not active or connected. The signal input for U21 is the optically isolated serial data from the safety related monitor (SRD). Signal decoding for the communications isolator comes from U6. The decoded instructions are used to generate the enable signals for the three communication ports.

4.4 Channel ID

SW3 is an array of 6 switches that are used to set the channel identification code. It can be set from 00 HEX to 3F HEX (64 settings). U15 is an octal buffer chip with a 3 state output. It is enabled for reading the CHANNEL ID.

When U7 receives a READ instruction, data will be transferred to the microprocessor.

4.5 Address Decoding

The address decoding is done by U9, U8, U11, and U6. Logic array U6 is programmed to provide the following enable signals:

$\overline{\text{ACIA1}}$	- for address 300 through 3FF
$\overline{\text{ACIA2}}$	- for address 400 through 4FF
$\overline{\text{ACIA3}}$	- for address 500 through 5FF
$\overline{\text{RAM1}}$	- for memory RAM 2000 – 3FFF
$\overline{\text{RAM2}}$	- for memory RAM 4000 – 5FFF
$\overline{\text{RAM3}}$	- for memory RAM 6000 – 7FFF
PROM	- for memory PROM 8000 – FFFF

U6 provides a control signal to the internal data bus transceiver to route data to and from memory to the processor. Under a READ command the processor reads from memory. Under a WRITE command the processor writes to memory. U9 provides the CHAN ID signal that enables U15 and read the channel identification.

4.6 Communication Loops

The 960CI-200 has three communication loops. Loops 1 and 2 are used for two-way communications with the computer, while loop 3 is a receive only one-way communications loop to the monitor.

Only loop 1 will be discussed here since loop 2 circuitry is identical in operation. (ACIA1, U16 is loop 1) & (ACIA2, U17 & Z9 is loop 2). The ACIA's have the following signal inputs and outputs:

CONTROL:	T2 L02 R/$\overline{\text{W}}$, A0, UB BIT RATE, ACIA $\overline{1,2,3}$, IRQ, and UB BIT RATE (determines data baud rate)
DATA:	Parallel D0 through D7, Serial TX & Serial RX, T2, 02. All data transfers occur on falling edge of 02.
R/$\overline{\text{W}}$:	HI for read and LO for write operations.
A0:	Part of the address decoding, A0 = 0 for data and A0 = 1 for control
ACIA $\overline{1,2,3}$:	Selected when low
$\overline{\text{IRQ}}$:	Output that goes to the processor to cause an interrupt when receiving data and the buffer is full.
$\overline{\text{D0}}$ – $\overline{\text{D7}}$:	Parallel data bus (internal data bus)
TX:	Transmit (Serial data)

RX: Receive (Serial data)

When address 300 is decoded, ACIA1 goes low and enables U16. Data can then be READ from or WRITTEN to the ACIA. For detailed operation of a 6850 ACIA refer to the Motorola manual.

U19 is a watchdog timer for the time-out circuit. IC U9 is a dual re-triggerable one-shot chip. It is trailing edge triggered and has a fixed output of 100 ms. when timed out, Q1 will be high and LOOP 1 TX DATA will be high also. This condition is necessary because LOOP 1 TX could be low at that time due to a condition on ACIA 1, which could cause it to latch low. During the next transmission, transistor Q1 will be low and LOOP 1 TX will pass through OR gate U20.

Serial data is communicated between two monitors or between a monitor and a minicomputer through connector J2. Refer to figure 4-1 for the loop diagram.

Zener diode D6 and resistor R24 regulate the voltage to the 5 VDC required to operate the optical isolator's transistor, (part of U22). The +VL1 and –VL1 voltage for the communication loop is a floating 30 VDC. +VL2 voltage equals + 15 VDC and –VL2 equals –15 VDC. When the signal LOOP 1 TX DATA is low (logic 0), transistor Q3 turns on. As Q3 conducts, it supplies +5 VDC to pin 1 of U22 turning on the LED. This will cause the transistor in U22 to turn on. U22's output at pin 5 will go low (toward –VL, -15 VDC), causing transistor Q5 to turn off. When Q5 is turned off, its output at the collector goes high. This will turn on both Q7 and Q11. Q11 conducts and TX-1 line will be pulled to –VL1. Transistor Q7 also conducts, causing Q9 to turn on. This pulls TX+1 to +VL1.

When the LOOP 1 TX DATA signal is high, the process is reverted. The voltages at TX+1 and TX-1 will in effect change polarity. The TX-1 goes to VL+1 and TX+1 goes to VL-1 through resistors R42 and R44.

The RX section of the loop receives a signal from a transmit loop. When RX+ is at –VL and RX- is at +VL, U24 will be on to transmit logic 0 to ACIA 1 through LOOP 1 RX DATA. When RX+ is at +VL and RX- is at –VL, U24 will be off and ACIA 1 will receive logic 1 (R48 is a pull-up resistor to +5 VDC).

4.7 Clock Circuitry

XTAL 1 is a 4 MHz crystal from which the basic clock frequency is derived. Pin 34 of U1 is used for TTL 02. U9 and U8 generate SHORT 02, which is used for early write in a write cycle.

4.8 Baud Rate Generator

U12 is a CMOS programmable bit rate generator. Base crystal frequency is 2.4576 MHz, connected between pins 6 and 7. Output is at pin 10. Bit rate programming is done by switch setting on SW2 (refer to table 4-2 for baud rate selection). Pin 15 and pin 3 are shorted and give a base frequency of 302700 Hz to generate NMI and FNMI signals.

Table 4-2. Baud Rate Settings

SW2 (Baud Rate)	Pin 1 to 8 (S3)	Pin 2 to 7 (S2)	Pin 3 to 6 (S1)	Pin 4 to 5 (S0)
110.0	OP	OP	OP	OP
150.0	OP	OP	OP	CL
300.0	OP	OP	CL	OP
2400.0	OP	OP	CL	CL
1200.0	OP	CL	OP	OP
1800.0	OP	CL	OP	CL
4800.0	OP	CL	CL	OP
9600.0	OP	CL	CL	CL
600.0	CL	OP	OP	CL
50.0	CL	CL	OP	CL
75.0	CL	CL	OP	OP
200.0	CL	OP	CL	OP
134.5	CL	OP	CL	CL

NOTE: OP = Open CL = Closed

4.9 NMI and FNMI

Clock generator U13 is a CMOS programmable bit rate generator that gets 302700 Hz at its CP (pin 5) input and is set with S0 = high, S1 = low, S2 = high, and S3 = low to generate a frequency output at pin 10 that is sent to dual decade counter U14. U14 pin 7 has 4 Hz NMI, while pins 12 & 13 have 100 Hz FNMI.

4.10 Memory

The 960CI-200 Communications Isolator has 32K of memory using one 32K x 8 chip. One memory socket is used for a PROM (address 8000 through FFFF) and three sockets are used for RAM memory (address 2000 through 7FFF). When memory is accessed, U6 will have four chips enable signals (CE) on its output, depending on the address as shown in table 4-3.

Table 4-3. Address Decoding For Memory

Address					Line			
	A13	A12	A11	TYPE	$\overline{\text{PROM}}$	$\overline{\text{RAM 1}}$	$\overline{\text{RAM 2}}$	$\overline{\text{RAM 3}}$
2000 – 3FFF	0	0	0	RAM	1	0	1	1
4000 – 5FFF	0	0	1	RAM	1	1	0	1
6000 – 7FFF	0	1	0	RAM	1	1	1	0
8000 – FFFF	1	0	1	PROM	0	1	1	1

ICs U3, U4, U5 are RAM and U2 is PROM.

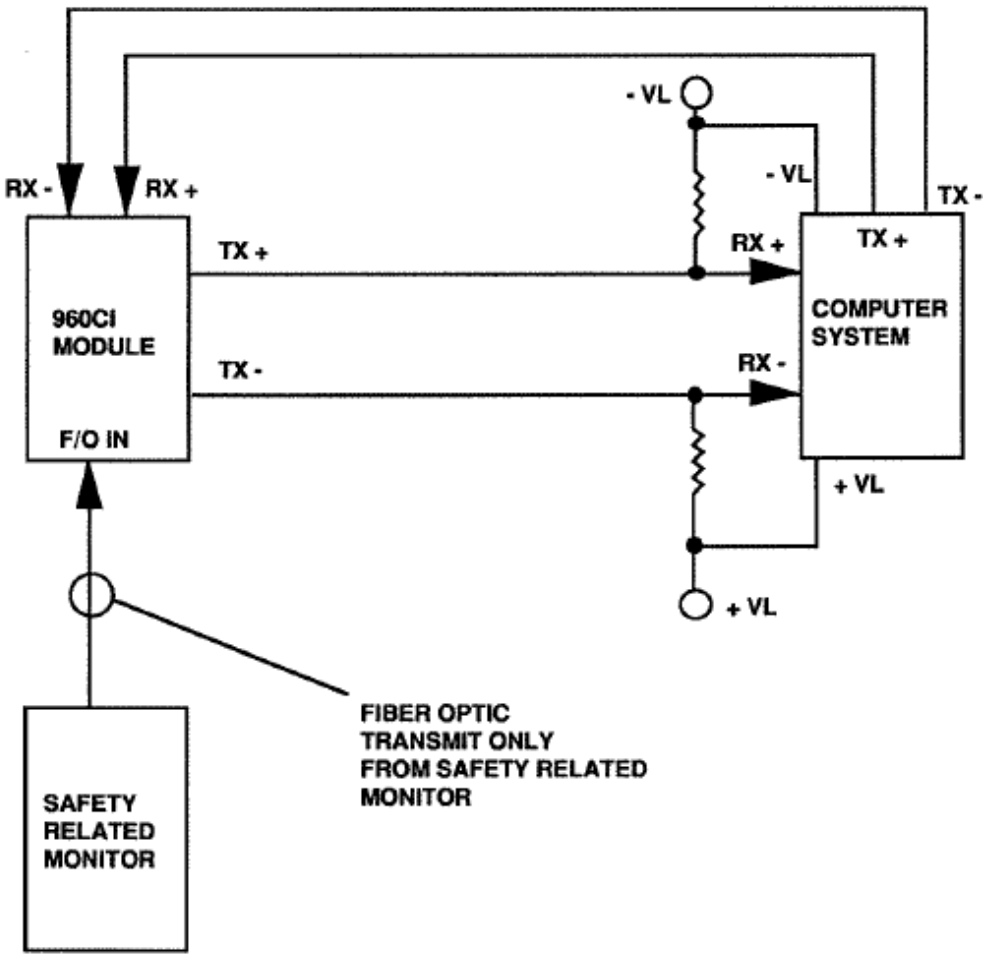

Figure 4-1. 960CI-200 Loop Diagram

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Section 5
Maintenance

5.1 Maintenance

No periodic maintenance is required for this module.

NOTE

If a maintenance question arises and cannot be resolved by using this manual, please contact the Fluke Biomedical RMS Customer Service Department at (440) 498-2564 for assistance.

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Section 6
Calibration

6.1 Calibration

The 960CI-200 module does not require any calibration.

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Section 7
Troubleshooting

7.1 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 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 for drawings.

The 960CI-200 Communications Isolator Module must be returned to the factory for service if troubleshooting of the module is necessary.

NOTE

If a problem cannot be resolved by using the drawings in Appendix B while applying the troubleshooting instructions found in this manual, please contact the Fluke Biomedical RMS Customer Service Department at (440) 498-2564 for assistance.

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Appendix A
Connector Designations

J2 PIN DESIGNATION

Pin	Description	Pin	Description
1	Line (120 VAC)	14	Line (120 VAC)
2	Neutral (120 VAC)	15	Neutral (120 VAC)
3	Ground (chassis)	16	Ground (chassis)
4-7	Not Used	17-19	Not Used
8	-VL1	20	-VL2
9	+VL1	21	+VL2
10	-RX1	22	-RX2
11	+RX1	23	+RX2
12	-TX1	24	-TX2
13	+TX1	25	+TX2

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Appendix B
Applicable Drawings And Bill of Materials

DRAWINGS:

DRAWING	DESCRIPTION
960CI-200-13	Schematic Diagram, Communications Isolator Module
960CI-200-10	Communications Isolator Module Printed Circuit Assembly

BILL OF MATERIALS:

DOCUMENT	DESCRIPTION
960CI-200-10	Bill of Materials, Communications Isolator Module Printed Circuit Assembly

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