



communicating through generations



APPLICATION NOTE

Fiber Optic testing of RFL T1/E1 systems with Code Mark Inversion (CMI)

Application Note: AN 2000-001

Date: July 2005

Scope:

- IMUX2000 chassis with CM4 Modules with T1/E1 optical I/O
- 8-port Redundant DACS chassis with optical T1/E1 I/O

Condition:

Existing T1/E1 Communications analyzers will report continual communications errors when monitored through the front panel bantam jacks.

This condition will only occur with CM-4 modules or 8-Port Redundant DACS configured with Optical Interface Adapters (OIAs) that use a “Code Mark Inversion” (CMI) coder/decoding scheme for the optical interface.

Technical Discussion:

The reliability of the Optical Interface Adapters (OIAs) used with the CM-4 and 8-Port DACS was improved by utilizing “CMI coding” on the CM-4 and 8-Port DACS. This change reduced the component count on the OIAs to simplify their design. Since CMI encoded data differs from typical T1/E1 encoded data, CMI encoded data cannot be monitored with an industry standard T1/E1 test set. The monitoring of T1/E1 signals through the test jacks labeled “T1 OUT MON” or “T1 IN MON” on the CM-4 or 8-Port Redundant DACS require an RFL “CMI Converter”. CMI encoding is only used with the associated RFL T1/E1 optics – this condition will **not** exist with electrical T1 or E1 interfaces, since they do not use an optical interface.

Recommendations:

The RFL CMI Converter product converts the CMI encoded data back into typical T1/E1 data readable by industry-standard test equipment. This device is portable, easy to use, and offers a simple solution for testing CMI encoded data with a standard T1/E1 test set. Please refer to the attached CMI Converter Instruction Data Sheet for additional information.

Please contact RFL Customer Service at 973-334-3100, x226 or via email at customerservice@rfelect.com with questions concerning this Note or to enquire about acquiring the CMI Converter (P/N 107660-X00, where “X” is dependent on optics type).



RFL Electronics Inc.

INSTRUCTION DATA

RFL CMI Converter

107660-200

107660-300

107660-400

107660-500

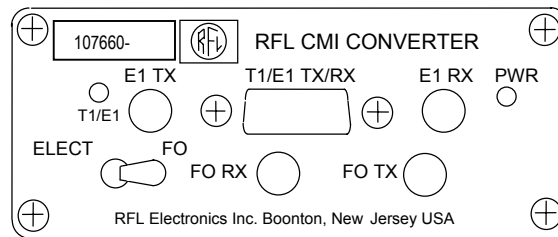


Figure 1. Typical RFL CMI Converter, Front Panel view

DESCRIPTION

The RFL CMI Converter is an AC/DC powered, environmentally hardened CMI to T1/E1 converter. This device can be electrically or optically interfaced to an RFL CM4 common logic module to convert CMI encoded data to a non-CMI format. This allows a standard T1 or E1 test set to interface with a CMI T1 or E1 signal. The characteristics of each of the four types of CMI converters, is shown in Table 1. Mounting dimensions are shown in Figure 7.

Table 1. CMI Converter Characteristics

Assembly Number	Type	Wavelength/	Mode
107660-200	LED Emitter/Detector	1300nm	Single mode
107660-300	LED Emitter/Detector	1300nm	Multi mode
107660-400	LASER Emitter/Detector	1300nm	Single mode
107660-500	LASER Emitter/Detector	1500nm	Single mode

Note: The characteristics in Table 1 are applicable to the fiber optic transmitters only. The fiber optic receivers in all CMI converters are identical.

WARNING

YOUR T1/E1 CMI CONVERTER IS EQUIPPED WITH FIBER INPUT/OUTPUT MODULES THAT HAVE FIBER OPTIC EMITTER HEADS. FIBER OPTIC EMITTER HEADS USE A LASER LIGHT SOURCE THAT PRODUCE INVISIBLE RADIATION. FIBER OPTIC COMMUNICATION SYSTEMS ARE INHERENTLY SAFE IN NORMAL OPERATION BECAUSE ALL RADIATION IS CONTAINED IN THE SYSTEM. IT IS POSSIBLE DURING MAINTENANCE TO EXPOSE THE RADIATION BY REMOVING OR BREAKING THE FIBER. STARING DIRECTLY INTO THE LIGHT BEAM MAY RESULT IN PERMANENT EYE DAMAGE AND/OR BLINDNESS. NEVER LOOK DIRECTLY INTO THE LIGHT BEAM AND BE CAREFUL NOT TO SHINE THE LIGHT AGAINST ANY REFLECTIVE SURFACE.

THE LASER SOURCE IS A CLASS I LASER PRODUCT WHICH COMPLIES WITH APPLICABLE FDA, OSHA AND ANSI STANDARDS.

WARNING

THE "FO RX" AND "FO TX" PORTS MUST BE COVERED WITH THE SUPPLIED PROTECTIVE CAPS WHEN NOT CONNECTED TO FIBER OPTIC CABLES. THESE CAPS MUST BE INSTALLED PRIOR TO POWERING UP UNIT.

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL CMI Converter. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Fiber Optic Cable Type: 50 μ m or 62.5 μ m core diameter optical fiber.

Fiber Optic Cable Length: 90 km max (depending on assembly number)

Fiber Optic Connector: Type ST

Wavelength: 1300nm or 1500nm

Mode: singlemode or multimode

Signal Connector Type:

15-pin male type D subminiature for T1 or E1, or dual BNCs for E1

Data Rate:

T1: 1.544 Mb/sec

E1: 2.048 Mb/sec

Input Power Connector:

Hard-wired AC cable and plug

Input Power Requirements:

38 to 150 Vdc or 96 to 132 VAC @ 6W

Operating Temperature:

-20^oC to +60^oC (-22^oF to +140^oF)

Relative Humidity: 95 percent @ 40^oC, non-condensing.

Dimensions:

Width: 5.13 inches (13 cm)

Height: 1.77 inches (4.5 cm)

Depth: 11.14 inches (28.3 cm)

Mounting Dimensions: In accordance with Figure 10.

INSTALLATION

Installation involves mounting the CMI Converter module in its desired location, connecting all signal, coaxial and power cables, and programming the module configuration settings, using jumpers and switch settings as required.

To install the module, proceed as follows:

1. Carefully inspect the module for any signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number given at the bottom of this page.
2. Check the assembly number on the front panel of the module to make sure the unit is compatible with your interface requirement as shown in Table 1.
3. Use Table 6 as a wiring guide for the D subminiature connector if your interface is 120 ohm E1. Use Table 7 as a wiring guide for the BNC connectors if your interface is 75 ohm T1 or E1. When fastening the D subminiature connector, make sure that the screws on both ends of the mating connector are tightened to secure the connector to the FSU front panel.

A special test cable with labeled bantam plugs is provided with the RFL CMI Converter. The bantam plug labeled "TO CM4" must be connected to a monitor bantam jack on the CM4 multiplexer shelf. The bantam plug labeled "TO TEST SET" must be connected to the RX connector of the T1/E1 test set. Some E1 test sets use BNC connectors instead of bantam plugs. In this case connect a 75 ohm BNC cable from the "E1 TX" connector on the CMI Converter to the RX connector on the test set.

NOTE

ALL CABLING TO AND FROM THE CMI CONVERTER MUST UTILIZE SHIELDED TWISTED PAIR OR COAXIAL CABLE TO MINIMIZE CROSSTALK AND INTERFERENCE FROM EXTERNAL SOURCES.

CAUTION

BEFORE ATTEMPTING TO MAKE POWER CONNECTIONS TO THE CMI CONVERTER, MAKE SURE THAT YOUR POWER SOURCE IS COMPATIBLE WITH THE FSU. IF THE IMPROPER VOLTAGE IS CONNECTED TO THE CMI CONVERTER, COMPONENT DAMAGE MAY RESULT.

4. Fiber optic cables with type ST series bayonet fiber optic connectors must be connected to the fiber optic heads on the front panel of the CMI Converter module and to the far end chassis. When connecting fiber optic cables, make sure the connectors are properly aligned before tightening, and then fully tighten them. This will help minimize losses in the connector.
5. Set switches SW1-1 and SW1-2 to select the Loopback mode in accordance with Table 3.
6. Set switches SW1-3 and SW1-4 to select the Receive Termination in accordance with Table 3.

7. Set switch SW1-5 to select the Receive Sensitivity in accordance with Table 3. Note that the settings are different for T1 and E1 systems.
8. Set switches SW1-6, SW1-7 and SW1-8 to the down position. Note that the settings are different for T1 and E1 systems. Set jumpers J6 and J7 to position “A”.
9. Set switches SW1-9 and SW1-10 to select the Transmit Data Source in accordance with Table 3.
10. Set switch SW2-1 to select the Electrical Phase Locked Loop for T1 or E1 in accordance with Table 4.
11. Set switch SW2-2 to select the Fiber Optic Phase Locked Loop for T1 or E1 in accordance with Table 4.
12. Set switch SW2-3 to select the Transceiver for T1 or E1 in accordance with Table 4.
13. Set switch SW2-4 to enable or disable HDB3/B8ZS in accordance with Table 4.
14. Set switch SW2-5 to enable or disable the Internal Timing in accordance with Table 4.
15. Set switch SW2-6 to enable or disable the Jitter Attenuator in accordance with Table 4.
16. Set switch SW2-7 to select whether the Jitter Attenuator is in the Tx path or Rx path.
17. Set switch SW3 away from “FO RX” for electrical testing (signal out of CM4). Set switch SW3 towards “FO RX” for fiber optic testing. For fiber optic testing, remove fiber optic cable from RX connector on the OIA module, connect it to the RX connector on the CMI converter, remove the bantam cable from the monitor jack on the CM4.
18. Connect the power plug to a 115VAC power source. The CMI Converter is now installed and powered up. The CMI Converter has no power ON/OFF switch. It is powered up as soon as power is connected. For more information consult the Instruction Manual for the RFL IMUX 2000 or the other T1/E1 compliant device as applicable.

WARNING

**INSURE THAT ALL FIBER OPTIC CABLES ARE CONNECTED OR PROTECTIVE
COVERS ARE INSTALLED BEFORE POWERING-UP THE CMI CONVERTER**

CONTROLS AND INDICATORS

The RFL CMI Converter has user controls and indicators as shown in Figure 2. The figure shows the location of all controls, indicators and connectors on the front, rear and side panels of the CMI Converter module. Figures 3 and 4 show the location of controls and indicators on Board A and Board B. The function of all controls and indicators are described in Tables 2 through 5, and Table 8.

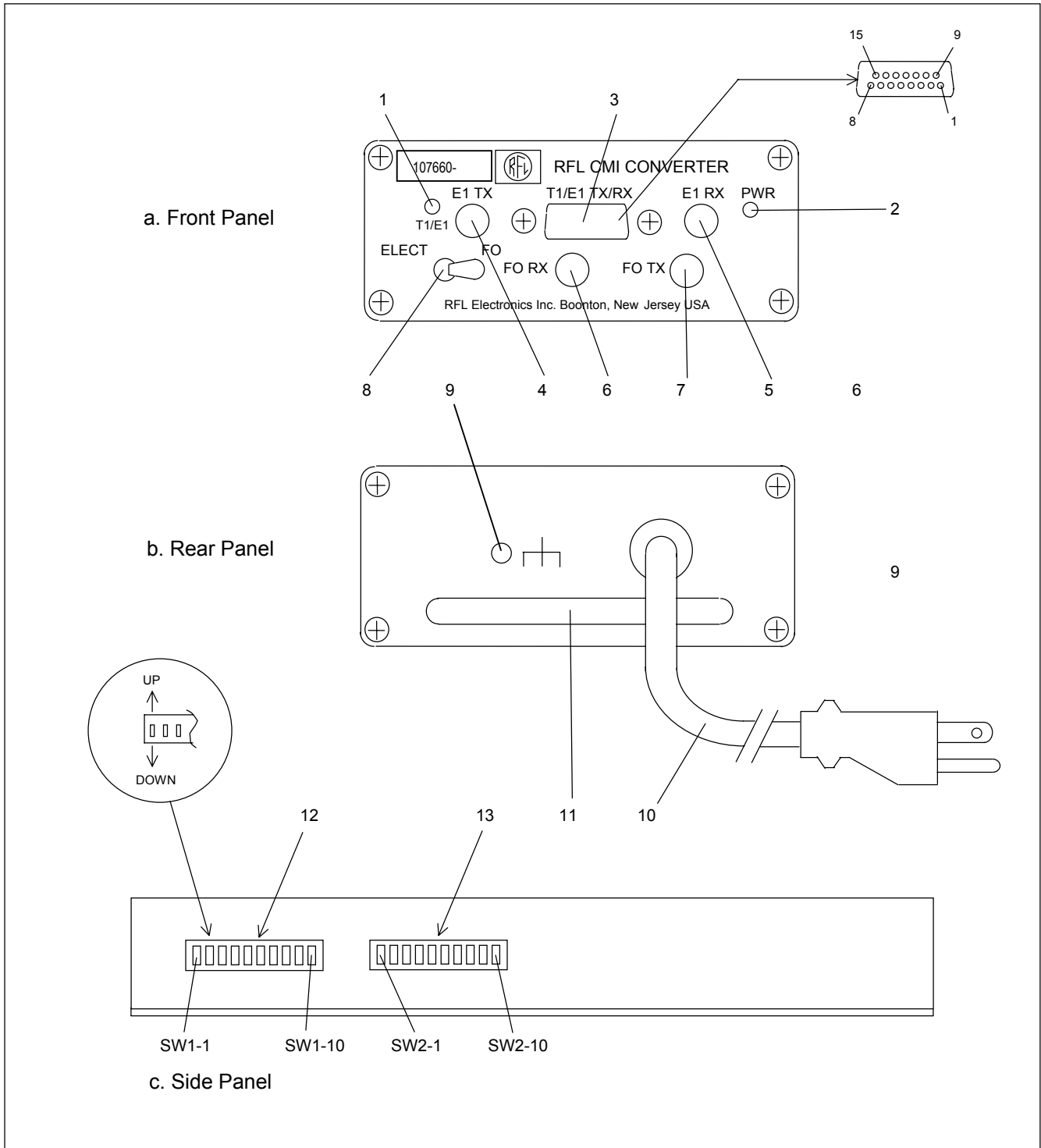


Figure 2. CMI Converter, front, rear, and side panel controls and indicators

Table 2. CMI Converter Controls and Indicators

Item Number	Reference Designation	Description	Function
1	DS2	T1/E1 LED	T1/E1 status indicator. Lights “green” when electrical data is being received..
2	DS3	Power LED	Power status indicator. Lights “green” when power is applied to the input power terminals.
3	J5	T1/E1 Tx/Rx Port	120 Ohm, DB-15 male T1/E1 Tx/Rx connector
4	J1	E1 Tx Port	75 Ohm E1 Tx connector (BNC)
5	J2	E1 Rx Port	75 Ohm E1 Rx connector (BNC)
6	CR1	Fiber Optic Detector	Fiber optic detector with type ST connector
7	CR2	Fiber Optic Emitter	Fiber optic emitter with type ST connector
8	SW3	Toggle Switch	Set toward FO to test fiber optic CMI data. Set toward ELECT to test electrical CMI data.
9	---	Ground Stud	Earth ground connection
10	---	Power Cable and Plug	Provides 115VAC power to CMI Converter
11	---	---	Carrying handle
12	SW1	10-pole DIP switch	Used to set operating parameters in accordance with Table 3
13	SW2	10-pole DIP switch	Used to set operating parameters in accordance with Table 4

ENCODING PRECAUTIONS

The CMI Converter *optical* interface and its bantam plug labeled “TO CM4” supports CMI encoding only. It does not support HDB3 or B8ZS encoding. SW2-4 selects the encoding of the “TO TEST SET” interface only.

Table 3. SW1 Switch Positions

Switch	Function					
SW1	SW1-1 and SW1-2 Loopback Select					
	<u>SW1-1</u>	<u>SW1-2</u>	<u>Mode</u>			
	Down	Down	No Loopback (factory setting)			
	Up	Up	T1/E1 Loopback (data entering the electrical interface is looped back)			
	Up	Down	Fiber Optic Loopback (data entering the fiber optic interface is looped back)			
	SW1-3 and SW1-4 Receive Termination					
	<u>SW1-3</u>	<u>SW1-4</u>	<u>Termination</u>			
	Up	Up	75 Ohms			
	Down	Up	100 Ohms			
	Up	Down	120 Ohms			
	SW1-5 T1/E1 Receive Sensitivity					
	<u>SW1-5</u>	<u>T1 Receive Sensitivity</u>				
	Up	-30 dB (limited long haul)				
	<u>SW1-5</u>	<u>E1 Receive Sensitivity</u>				
	Down	-12 dB (short haul)				
SW1-6, SW1-7 and SW1-8 T1 Line Buildout Select						
<u>SW1-6</u>	<u>SW1-7</u>	<u>SW1-8</u>	<u>Jumper J6*</u>	<u>Jumper J7*</u>	<u>T1 Line Buildout</u>	
Down	Down	Down	A	A	0-133 feet	
SW1-6, SW1-7 and SW1-8 E1 Line Buildout Select						
<u>SW1-6</u>	<u>SW1-7</u>	<u>SW1-8</u>	<u>Jumper J6*</u>	<u>Jumper J7*</u>	<u>E1 Line Buildout</u>	
Down	Down	Down	A	A	75 Ohm normal	
Up	Down	Down	A	A	120 Ohm normal	
SW1-9 and SW1-10 Transmit Data Source						
<u>SW1-9</u>	<u>SW1-10</u>	<u>Transmit Data</u>				
Down	Down	Received Fiber Data (factory setting)				
Up	Up	All Ones Pattern				
Down	Up	Alternating Ones and Zeroes				

*See Figure 3 for jumper locations

Table 4. SW2 Switch Positions

Switch	Function
SW2	SW2-1 Electrical T1/E1 PLL Select <u>SW2-1</u> <u>Mode*</u> Up T1 Down E1
	SW2-2 Fiber Optic T1/E1 PLL Select <u>SW2-2</u> <u>Mode*</u> Up T1 Down E1
	SW2-3 Transceiver T1/E1 Select <u>SW2-3</u> <u>Mode*</u> Up T1 Down E1
	SW2-4 AMI or B8ZS/HDB3 Select (electrical interface only) <u>SW2-4</u> Up AMI Down B8ZS/HDB3
	SW2-5 Internal Timing Enable <u>SW2-5</u> Up disable Down enable
	SW2-6 Jitter Attenuator Enable (electrical interface only) <u>SW2-6</u> Up disable Down enable
	SW2-7 Jitter Attenuator Select <u>SW2-7</u> Up Tx Path Down Rx Path
	SW2-8 Not Used
	SW2-9 Not Used
	SW2-10 Not Used

* Switches SW2-1, SW2-2 and SW2-3 must all be in either the T1 position or the E1 position.

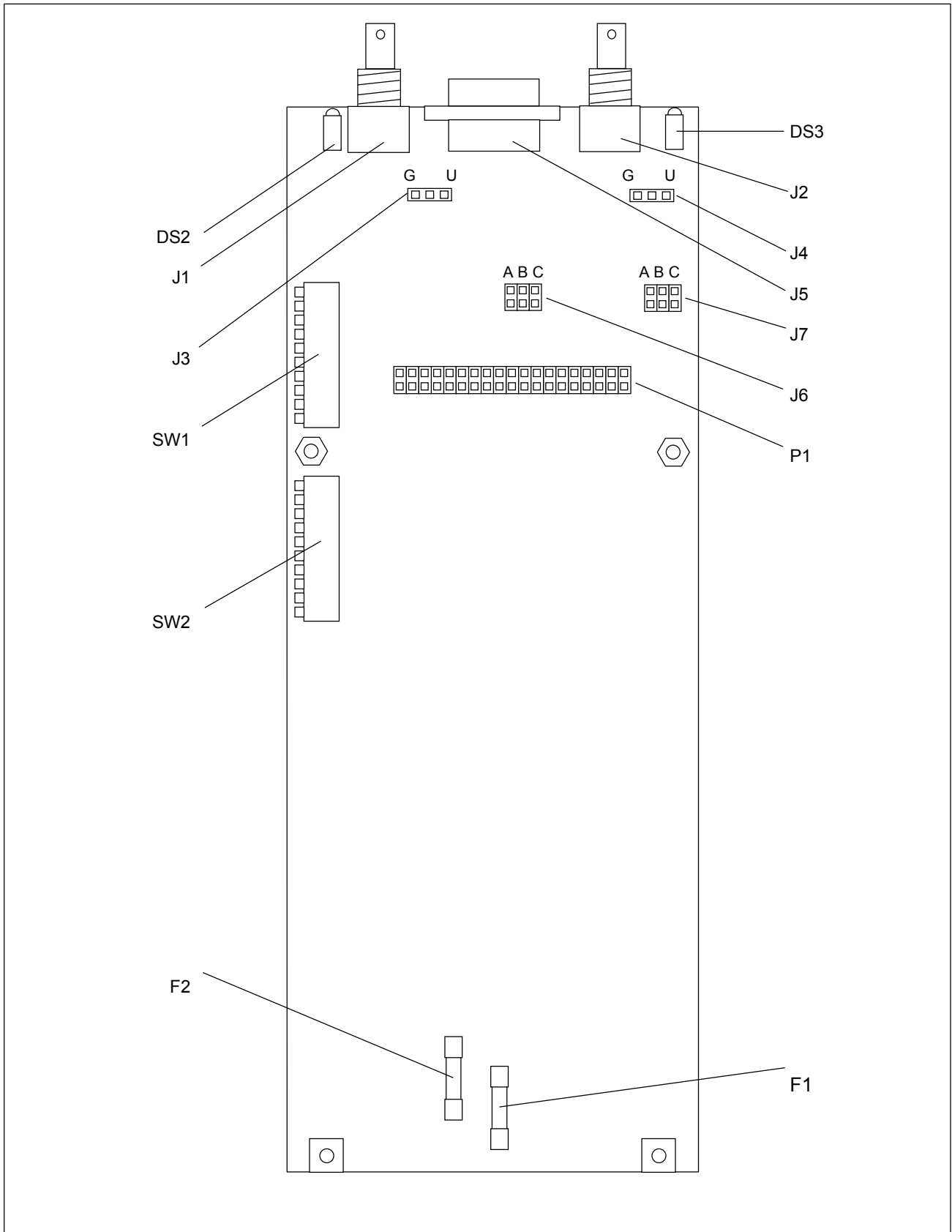


Figure 3. Controls and indicators, T1/E1 Fiber Converter board (Board A)

Table 5. Controls and indicators, T1/E1 Fiber Converter board (Board A)

Reference Designation	Function
DS2	T1/E1 Status indicator
DS3	Power Status indicator
SW1	10-pole DIP switch for setting up module parameters
SW2	10-pole DIP switch for setting up module parameters
J1	Fiber Optic emitter
J2	Fiber Optic detector
J3, J4	Programmable jumpers used to ground the outer conductor of the BNC connectors when necessary. Both jumpers should be set to "U" when using the DB-15 T1/E1 port.
J5	DB15 subminiature connector
J6	Programmable jumper (See Table 3 for jumper functions)
J7	Programmable jumper (See Table 3 for jumper functions)
P1	Connects signals from board A to board B
F1	Fuse (1)
F2	Fuse (1)

Note 1: RFL part number 104545, 0.25A, 250V, slo-blow, 5x20mm.

Table 6. T1/E1 120 Ohm Interface Connections

Signal	Pin Number
TX Data +	9
TX Data -	1
RX Data +	11
RX Data -	3
CMI electrical data +	12
CMI electrical data -	4
Chassis	7

Table 7. E1 75 Ohm Interface Connections

Signal	Connector
TX	J1
RX	J2

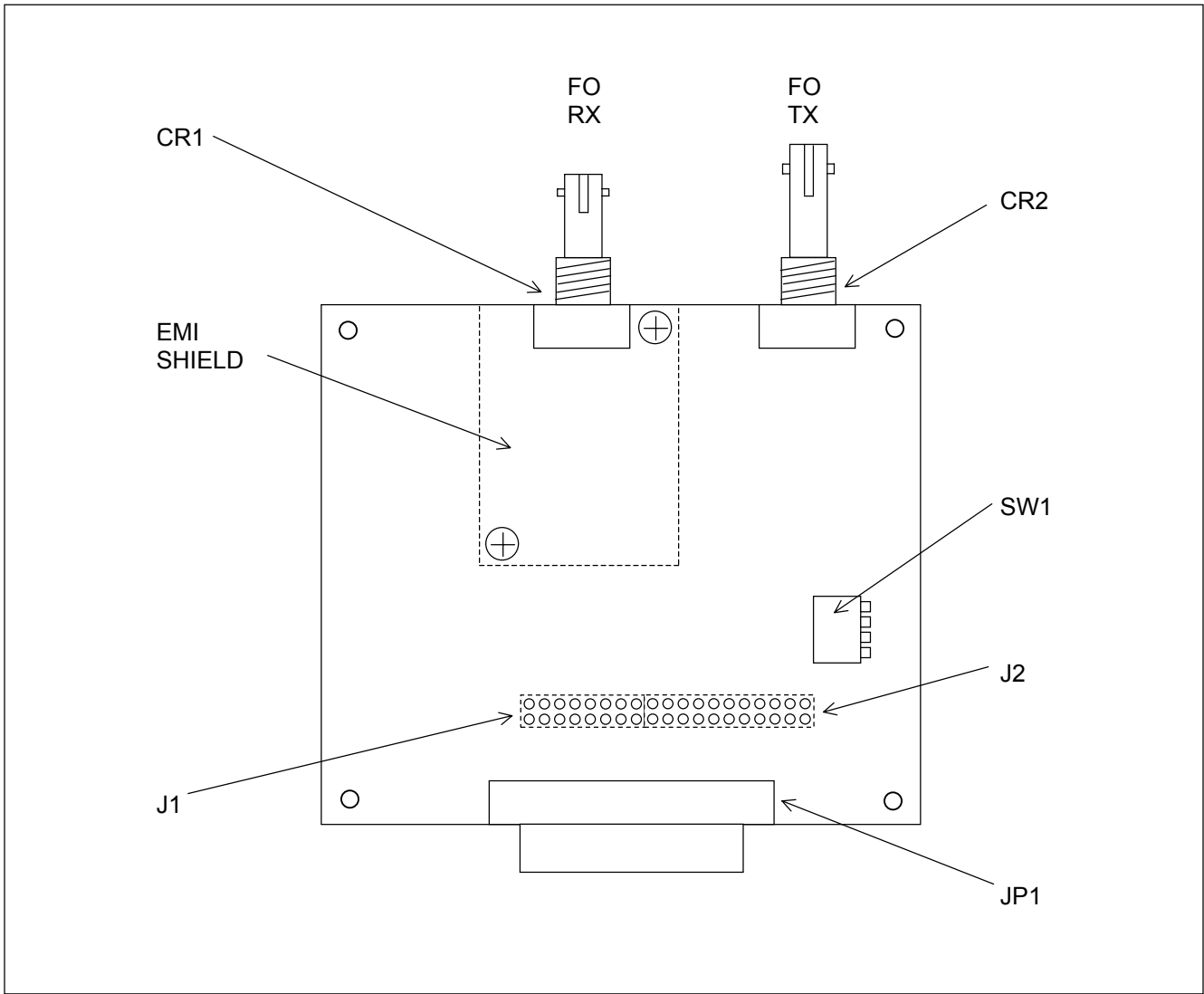


Figure 4. Controls and indicators, typical optical board (Board B)

Table 8. Controls and indicators, typical optical board (Board B)

Reference Designation	Function
CR1	Fiber optic detector
CR2	Fiber optic emitter
J1	Connects signals to board A
J2	Connects signals to board A
JP1	Not used in this application
SW1	Not used in this application

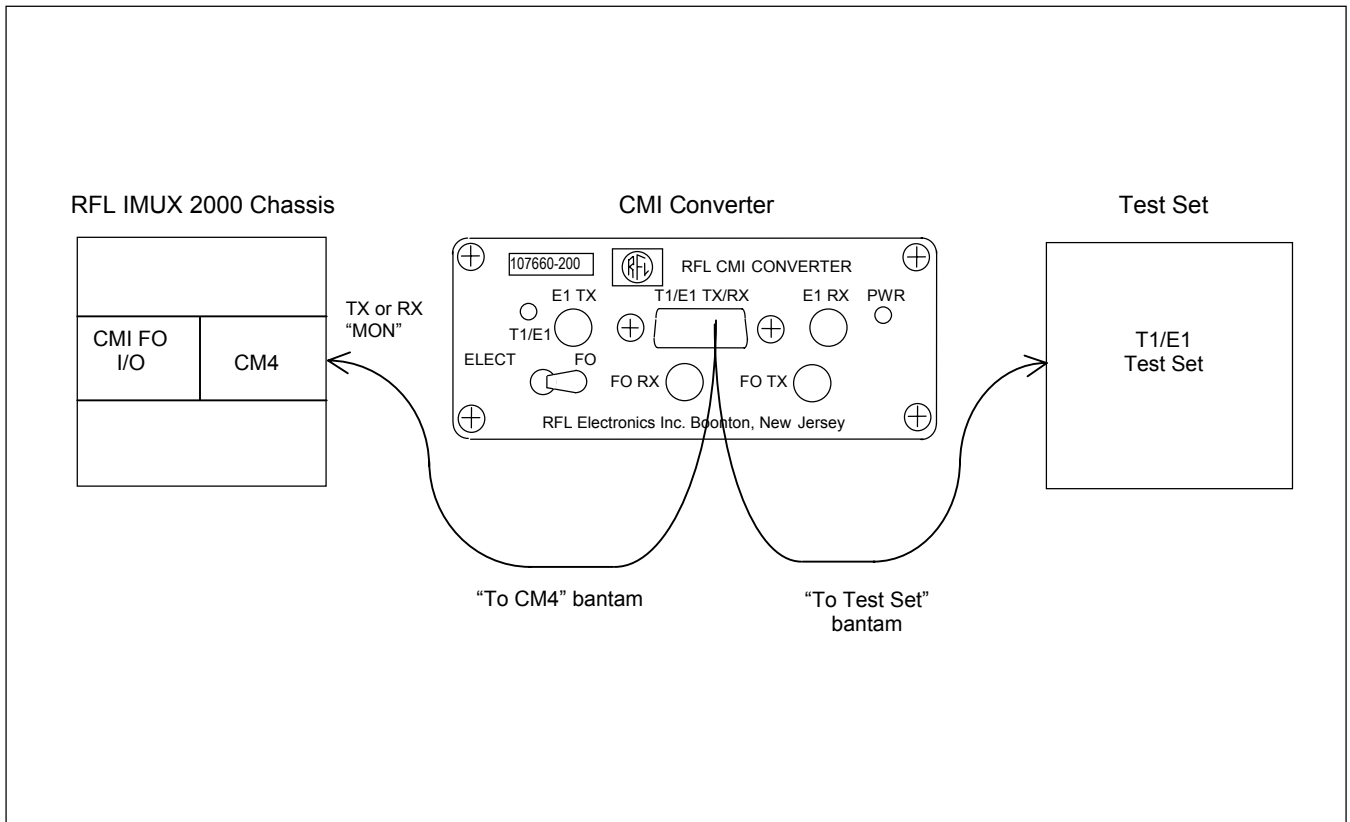


Figure 5. Connecting a CMI Converter to a CM4 and a test set using bantam connectors.

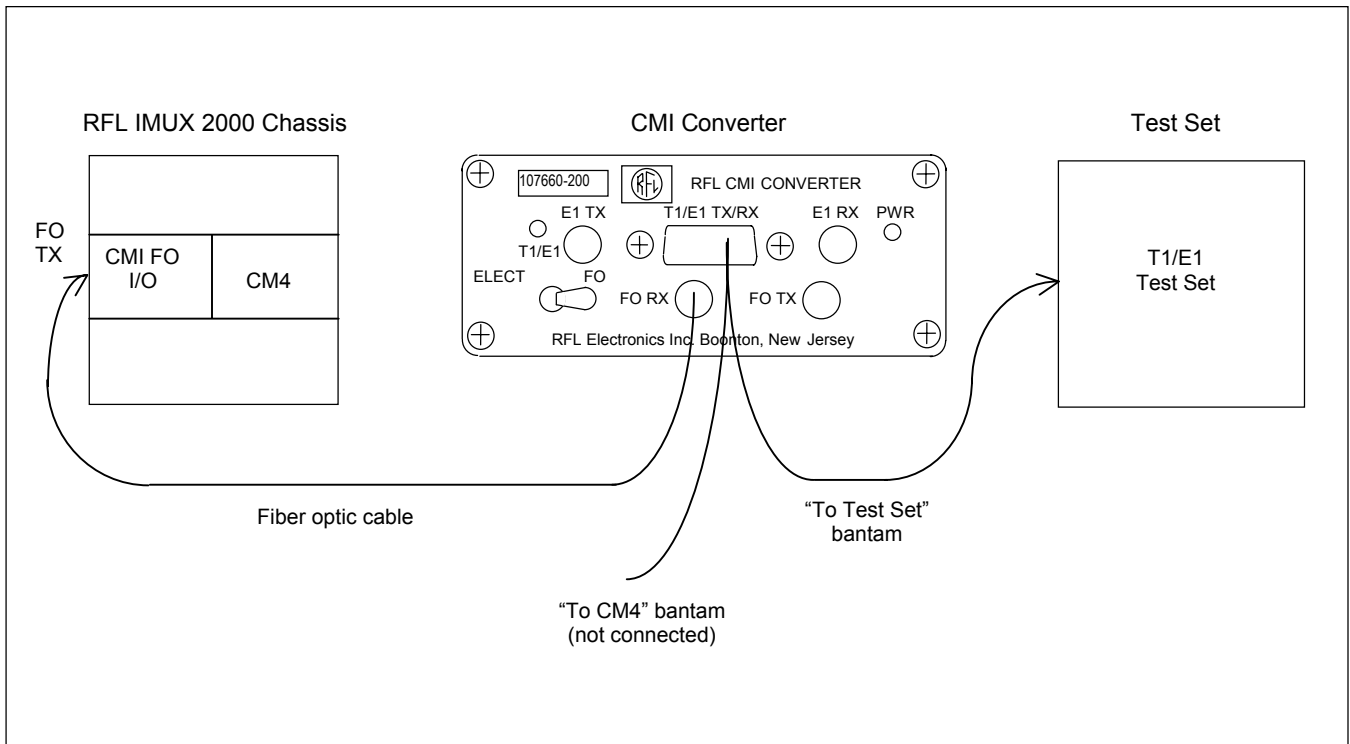


Figure 6. Connecting a CMI Converter to a fiber optic interface and a test set using a bantam connector.

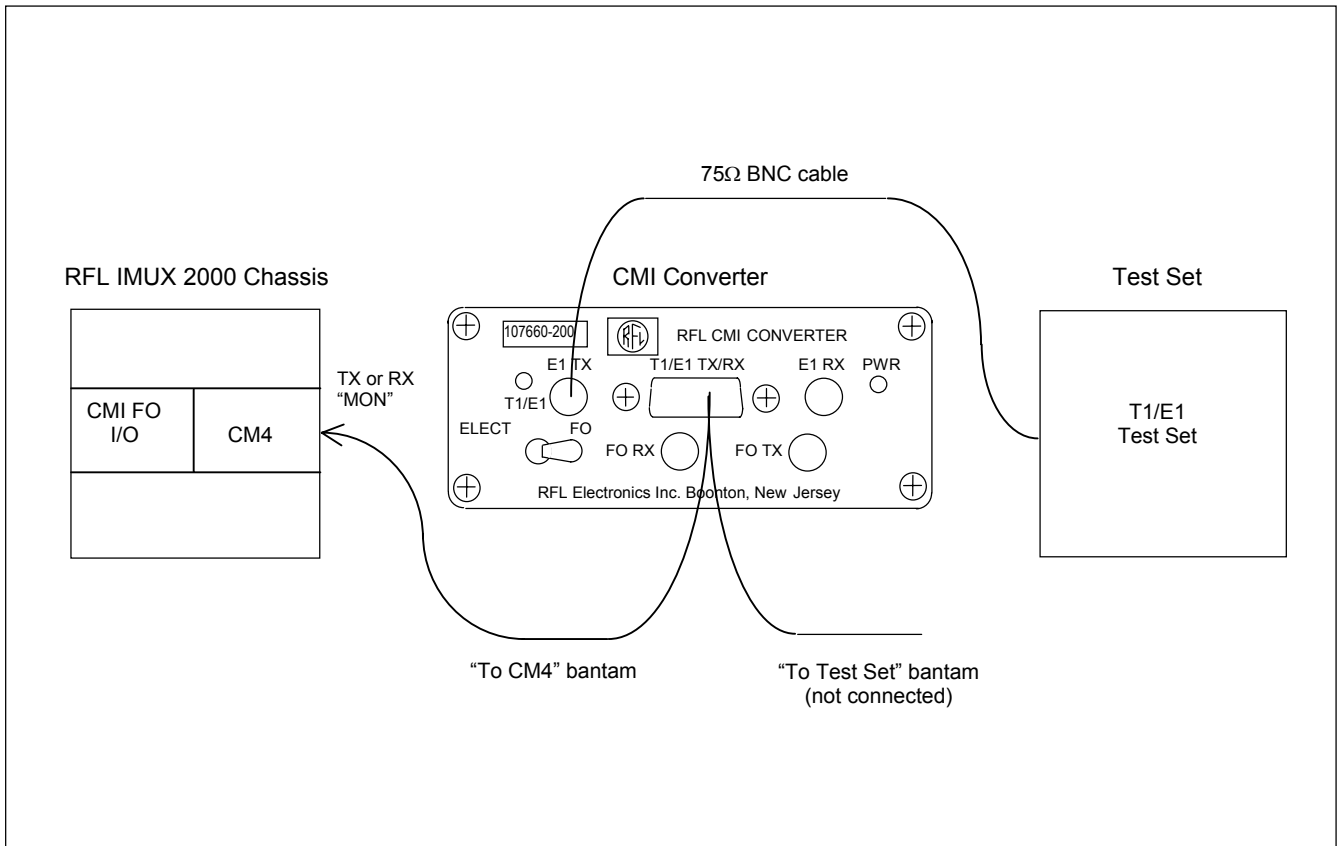


Figure 7. Connecting a CMI Converter to a CM4 and a test set using a BNC cable.

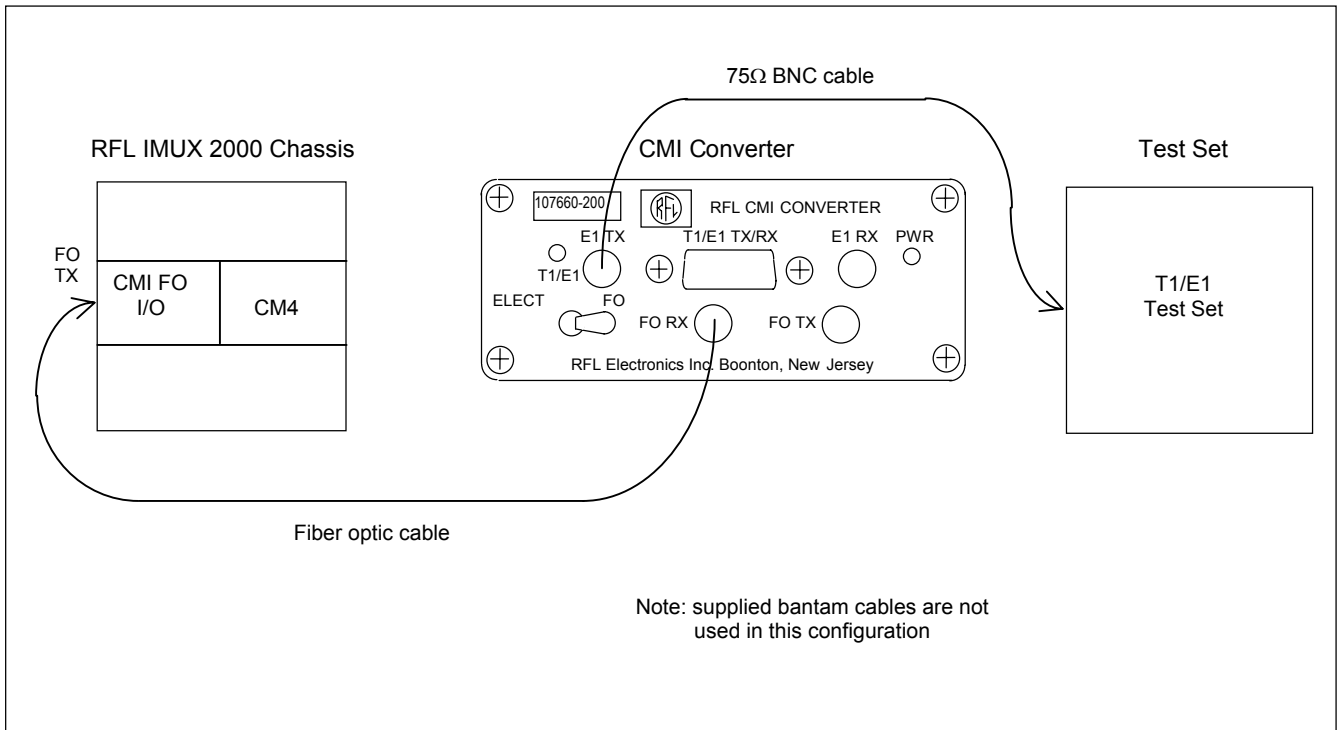


Figure 8. Connecting a CMI Converter to a fiber optic interface and a test set using a BNC cable.

NOTES

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