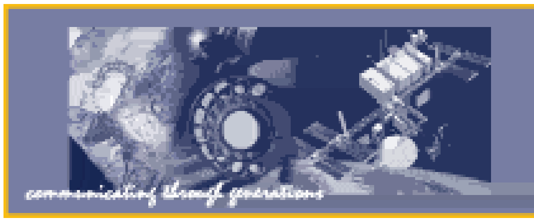


LITERATURE

RFL 9720
Digital Pilot Wire Interface

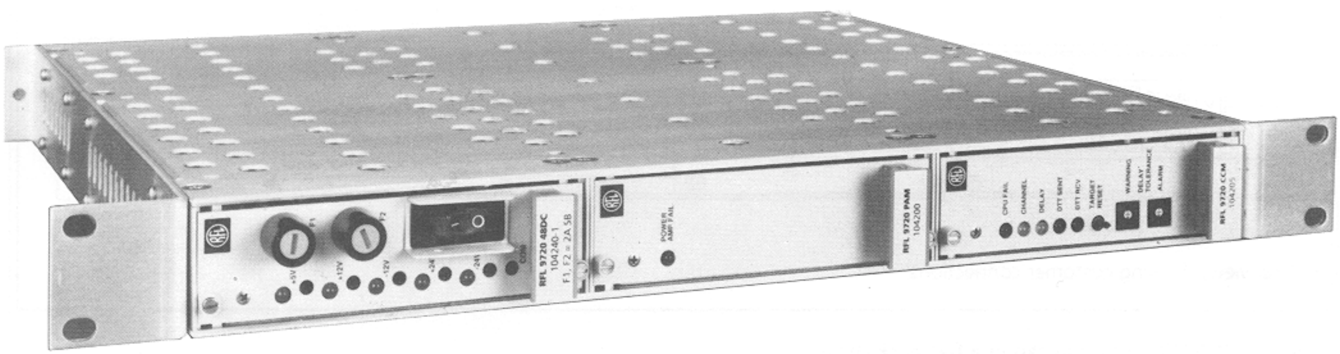
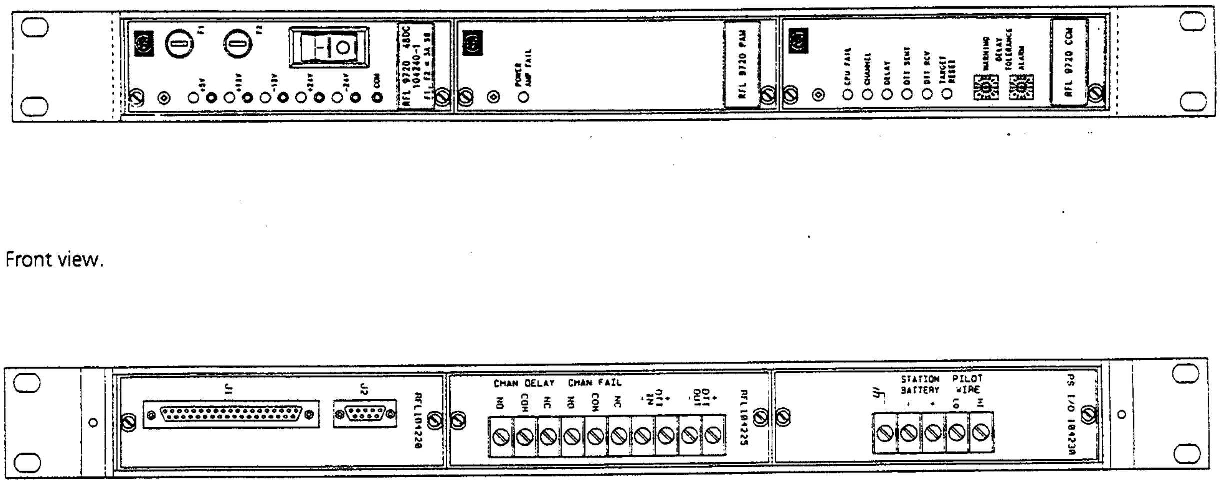


Figure 1. RFL 9720 Digital Pilot Wire Interface

Designed for the harsh substation environment, the RFL 9720 Digital Pilot Wire Interface is a stand-alone unit that digitizes the 60-Hz signal from a current differential relay and transmits it with its own specially-encoded message. The coding structure is based on the proven data format of the RFL 9700 Digital Protection System; this allows it to yield to the same level of security. Because the RFL 9720 is a stand-alone unit, all of its security and self-check features are an integral part of its hardware, and not dependent upon handshake or alarm signals from its communications host. Also included in the design are a number of standard features that enhance the relay system's capabilities. A typical RFL 9720 is shown in Figure 1.

The RFL 9720 can communicate over a 56-Kbps RS-449 synchronous interface; as an alternate, a wide range of fiber heads are available for communication over multimode or singlemode fiber. The RFL 9720 is designed with the protection engineer in mind, offering extensive diagnostics and delay monitoring not found in plug-in current differential modules.

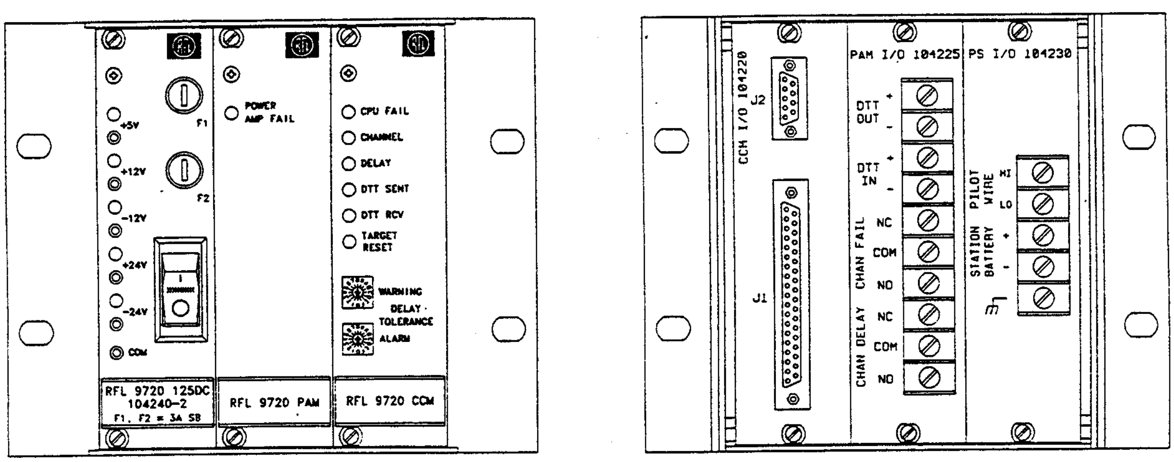
Each RFL 9720 unit consists of three main circuit board modules: the Communications And Control Module (CCM), the Power Amplifier Module (PAM), and the Power Module (PM). Connections to each module are made through I/O modules, which are mounted at the rear of the chassis. The RFL 9720's modular construction allows for a variety of packaging arrangements. For example, a single RFL 9720 unit can be mounted in a flat-pack chassis that is one rack-unit high (1.75 inches, or 4.45 cm), as shown in Figure 2. It can also be mounted in panel-mount chassis that is 5.25 inches high and 6.4 inches wide (13.34 cm x 16.25 cm), as shown in Figure 3. Up to four RFL 9720 units can be mounted in a rack-mount 3U chassis (5.25 inches, or 13.34 cm), as shown in Figure 4.



a. Front view.

b. Rear view, showing customer connections.

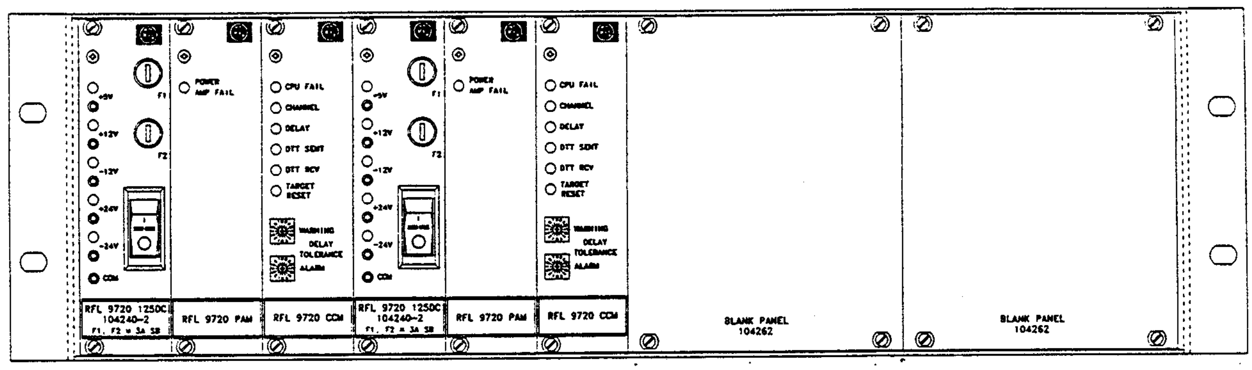
Figure 2. RFL 9720 unit mounted in a flat-pack chassis



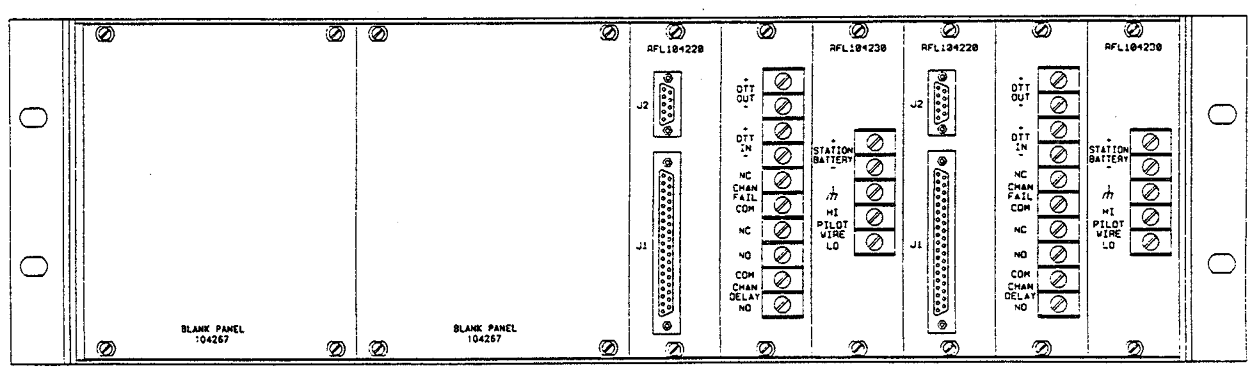
a. Front view.

b. Rear view, showing customer connections.

Figure 3. RFL 9720 unit mounted in a panel-mount chassis



a. Front view.



b. Rear view, showing customer connections.

Figure 4. Two RFL 9720 units mounted in a rack-mount chassis

FEATURES

IDEALIZED PILOT CIRCUIT

The RFL 9720 offers various I/O modules to adapt it to many different relay types. Each I/O module is impedance-matched to that relay, giving the representation of an ideal pilot wire circuit. In addition, RFL's technique of using an active hybrid transformer circuit (Patent Applied For) greatly reduces or eliminates any effect from the local signal (feedback). The local end sees a truer representation of the remote end, for a more accurate comparison of the two signals. Because of this accuracy, the RFL 9720 can tolerate longer channel delays than competitive products can. This is a major advantage when applying current differential relaying in networks where propagation delays can become prohibitive.

REMOTE DIAGNOSTICS

You can remotely access the RFL 9720 through its RS-232 port. Software routines can be performed to determine the latest channel delay values, communications integrity, switch settings, system status, and DTT. Diagnostic tests and watchdog timer tests can also be initiated through this port.

AUTOMATIC DELAY MEASUREMENT

The RFL 9720 includes channel delay measurement as part of its checkback testing. This is done because pilot wire relays are sensitive to propagation delay. Two delay alarm outputs are available: CHANNEL DELAY and CHANNEL FAIL.

The CHANNEL DELAY alarm is a warning that the amount of time required for a signal to propagate through the communications channel has become too long for dependable relay operation. This alarm is programmable for any period from 400 µs to 1.15 ms, in 50-µs increments.

The CHANNEL FAIL alarm shows that the RFL 9720's pilot wire output is being squelched. Squelch can be caused by excessive channel delay, corrupted data, power supply failure, amplifier failure, or microprocessor failure. This alarm is programmable for one of 16 different channel periods, from 400 µs to 2900 µs.

When a CHANNEL FAIL alarm occurs, the RFL 9720 can be configured to either short or open the pilot wire circuit. This allows the relay to operate in either trip inhibit or overcurrent mode.

DIRECT TRANSFER TRIP (DTT)

The RFL 9720 also includes a Direct Transfer Trip (DTT) feature. This allows for bi-directional transfer trip signals to be sent and received between RFL 9720 units. TRIP SEND and TRIP RECEIVED indicators on the RFL 9720 CCM Communications And Control Module seal in when the DTT function is sent or received.

UNBLOCK TIMER

If desired, an optional unblock timer can be used along with the RFL 9720's squelch function. This will allow the pilot wire relay to operate in the overcurrent mode for 150 ms after a channel failure before it is placed in trip inhibit.

MODULAR DESIGN

The RFL 9720 incorporates a mid-plane motherboard design. Modules plug into the front of the unit, and matching I/O Modules plug into the rear. This eliminates the need for internal wiring or harnesses when adding new additional interfaces to rack-mount chassis. Upgrading is simplified, and downtime kept to a minimum.

DIGITAL INTERFACE CAPABILITIES

When applying the RFL 9720 to digital circuits, less bandwidth is required because the RFL 9720 communicates in a single 56-Kbps time slot. All RFL 9720 terminals are equipped with an RS-449 interface. When supplied with a digital I/O, the RFL 9720 acts as "Data Terminal Equipment" (DTE), requiring clock synchronization from the "Data Communications Equipment" (DCE) in which it operates.

FIBER OPTIC CAPABILITIES

The RFL 9720 can be adapted to all fiber optic requirements; 850 nm or 1300 nm, LED or laser source, singlemode or multimode. Plug-in fiber optic emitter and detector heads make for simple, trouble-free, field configuration changes. These heads are mounted at the rear of the chassis, allowing them to be removed without drawing the fiber through the chassis.

Figure 5 shows two RFL 9720 terminals equipped with single-channel fiber optic modules. The RFL 97 FO INTX transmitter modules convert RS-422 signals into drive signals for the fiber optic emitter heads. Each emitter head converts the drive signal it receives into an infrared light signal for optic transmission. At the other end of the fiber, a fiber optic detector head converts the light signal into a receiver input signal. This signal is passed to an RFL 97 FO INRX receiver modules and converted back into an RS-422 signal.

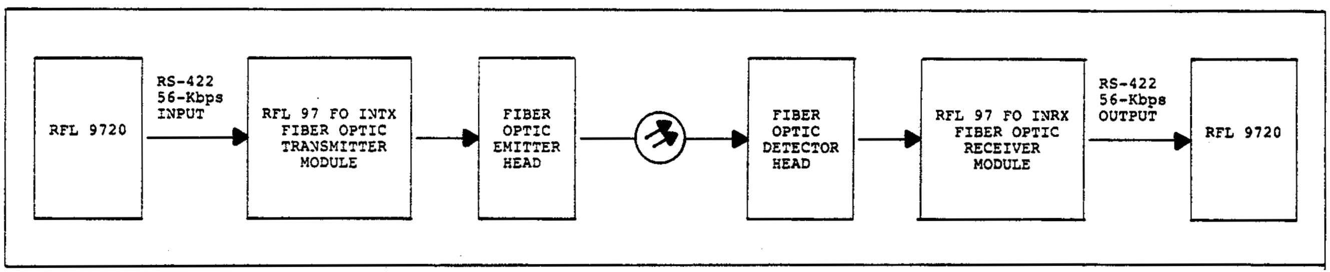


Figure 5. Single-channel RFL 9720 fiber optic system

INTEGRATED FIBER OPTIC MULTIPLEXER (Mini-Mux)

The RFL 9720 terminals can be supplied with eight-input fiber optic transmitters, and eight-output fiber optic receivers. This allows additional functions (such as voice and data) to share the optic path used by the RFL 9720.

In Figure 6, RFL 97 FO INTX-1 and RFL 97 FO INRX-1 eight-channel fiber optic modules are used at each terminal to create a system where eight 56-Kbps channels can be multiplexed and transmitted over a single fiber. One channel is used by the RFL 9720; the other seven channels are available for use by the various voice, data, or RS-449 multiplex options. (See next page.)

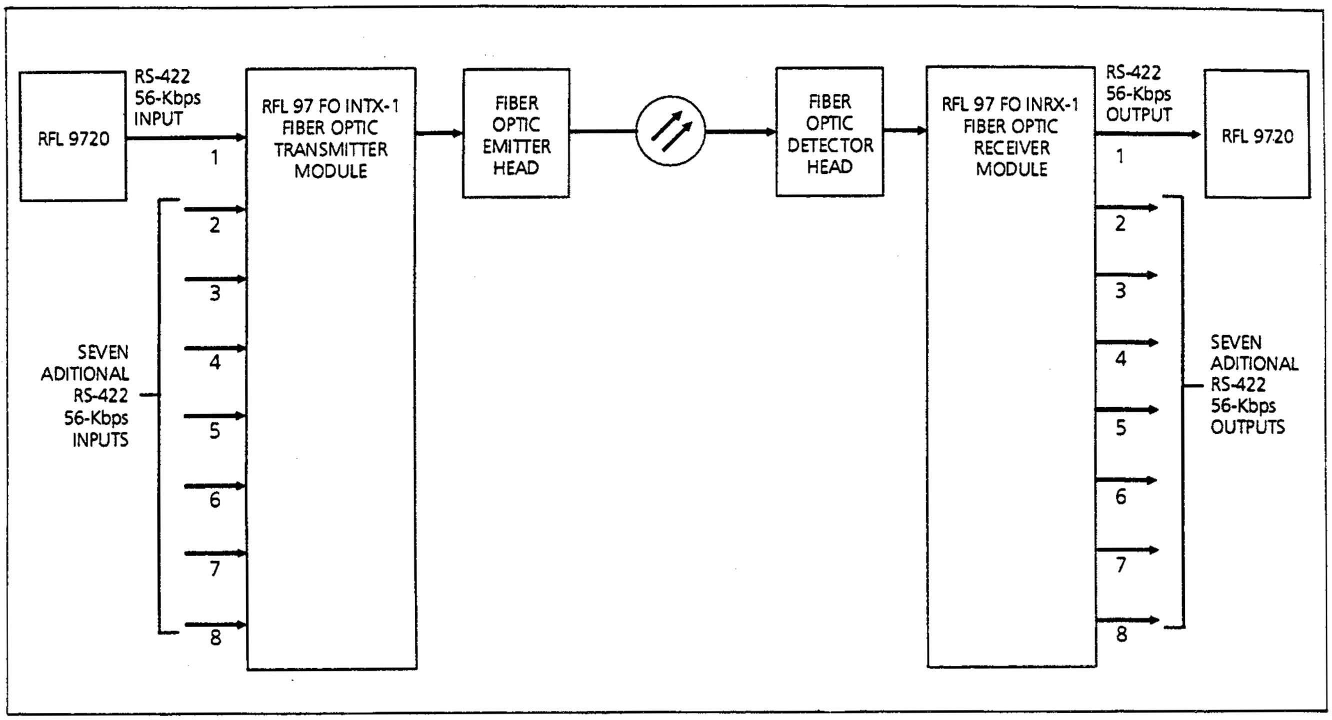


Figure 6. Eight-channel RFL 9720 fiber optic system

VOICE, DATA, AND RS-449 MULTIPLEX OPTIONS

Accessory modules are available for use with RFL 9720 terminals equipped with eight-channel fiber optic modules. These accessory modules allow voice, asynchronous data and synchronous 56-Kbps RS-449 signals to be sent along the fiber optic line along with the current differential signals generated by the RFL 9720. Additional information on RFL 9720 options can be found on page 19 of this Product Information Sheet.

MEETS ANSI SWC AND FAST-TRANSIENT REQUIREMENTS

The RFL 9720 meets the Surge Withstand Capability (SWC) requirements of IEEE 472-1978 (ANSI C.37.90-1978). It also meets the Fast Transient requirements of ANSI-IEEE C.37.90.1.

MEETS EMI/RFI REQUIREMENTS

The RFL 9720 meets the EMI/RFI requirements of IEC 801-3 (1984), BS 6667 Part 3 (1985), and ANSI C.37.90.2 (Trial-Use Standard, 1989).

TYPICAL APPLICATIONS

The following paragraphs describe some typical applications for the RFL 9720. For more information on these or other possible applications, contact the factory or an RFL Sales Representative.

COMMUNICATIONS INTERFACE

The RFL 9720 is suitable for a variety of communications mediums, such as T1 carrier (Fig. 7a), digital microwave (Fig. 7b), or fiber (Fig. 7c).

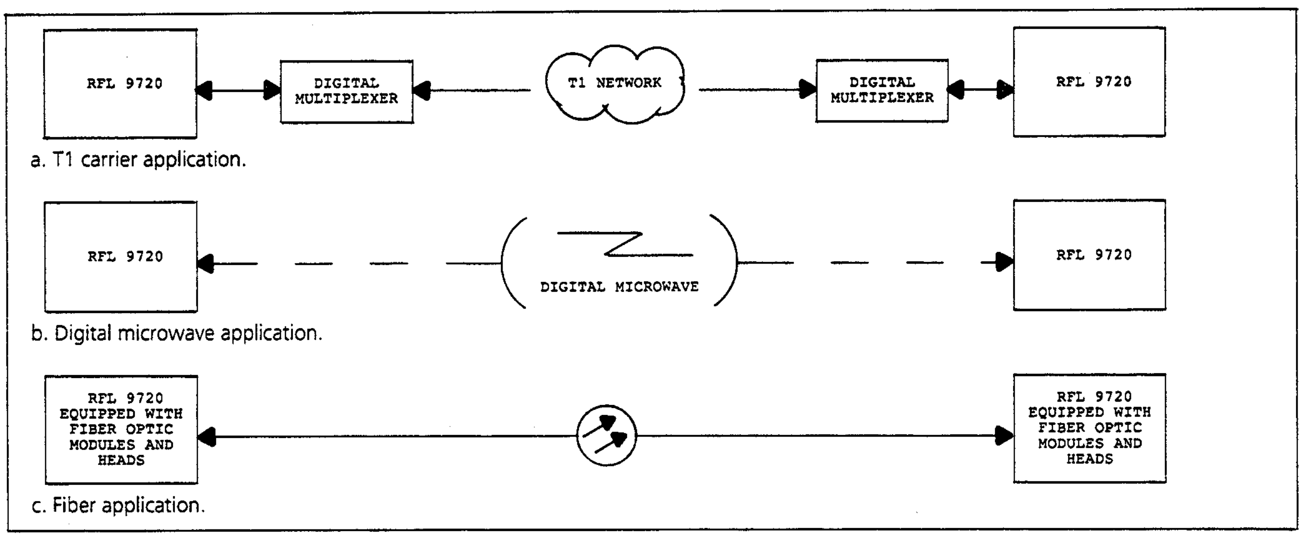


Figure 7. Typical communication interface applications

Optional fiber optic modules allow the RFL 9720 to be applied directly to dedicated fibers. The fiber optic modules fit in the same chassis as the RFL 9720, allowing for maximum utilization of panel space.

T1 CARRIER

The RFL 9720 can operate over a 56-Kbps channel of an RFL 9001 Intelligent T1 Multiplexer, as shown in Figure 8. By using the RFL 9001 system as the communications medium for the RFL 9720, you now have the added flexibility of the RFL 9001's drop/insert capabilities.

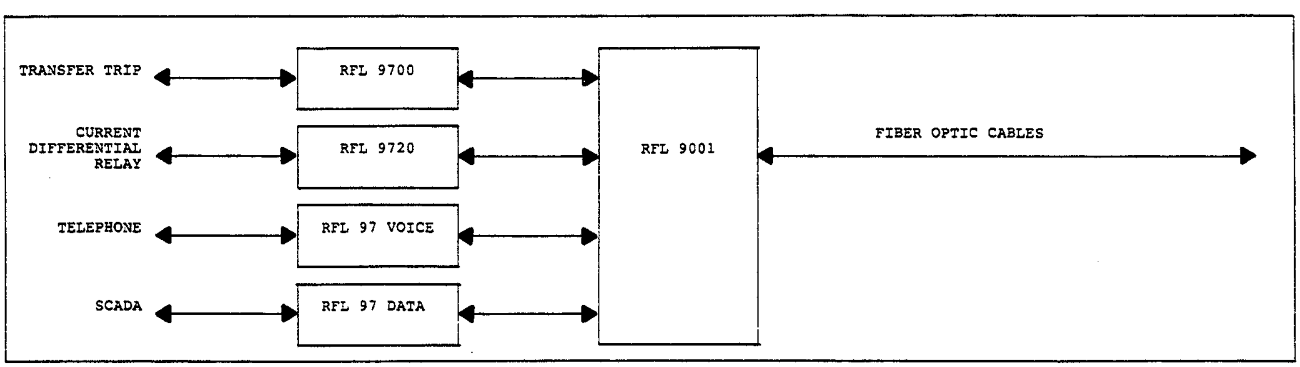


Figure 8. Interfacing the RFL 9720 to an RFL 9001 Intelligent T1 Multiplexer

RFL 9700 APPLICATION

The RFL 9720 can be used to add current differential relays to new or existing RFL 9700 fiber optic transfer trip systems, as shown in Figure 9. If the existing RFL 9700 is equipped with a multiplexer option, the RFL 9720 simply plugs in. If the RFL 9700 was not originally equipped with the multiplexer option, it can be easily upgraded for use with the RFL 9720 by replacing the single-channel fiber optic interface modules with eight-channel modules; no wiring changes are required.

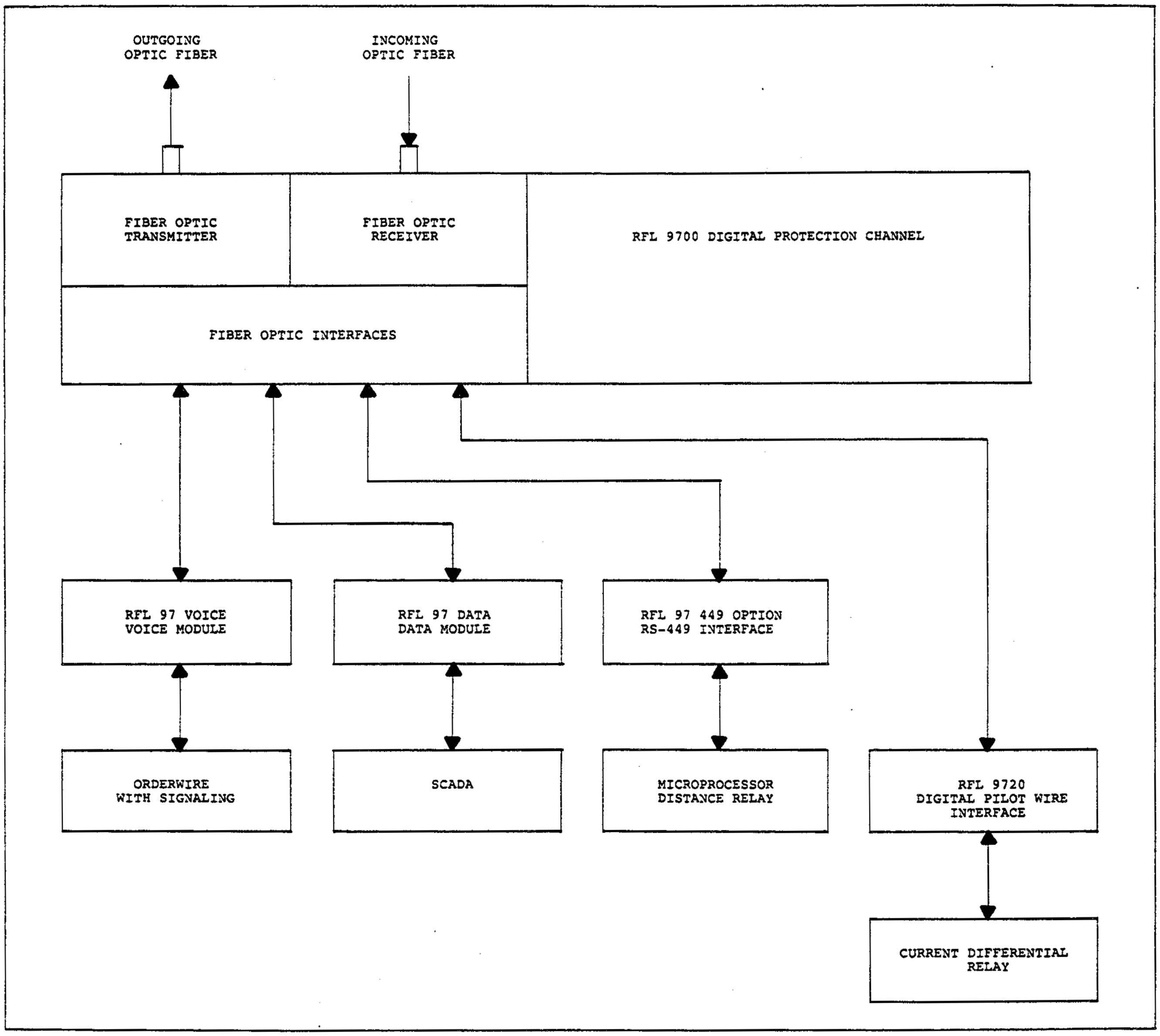


Figure 9. Interfacing the RFL 9720 to an RFL 9700 Digital Protection Channel

FIBER OPTIC MULTIPLEXING

Figure 10 is a block diagram of a typical substation using some of the RFL 9720's fiber optic multiplexing capabilities. Current differential relaying is provided through the RFL 9720, over an RS-449 port on the fiber optic multiplexer. Transfer trip protection is provided by the RFL 9700 Digital Protection Channel, and orderwire is provided over a voice channel. SCADA and distance relay communications are provided over the RS-232 ports of the data channel.

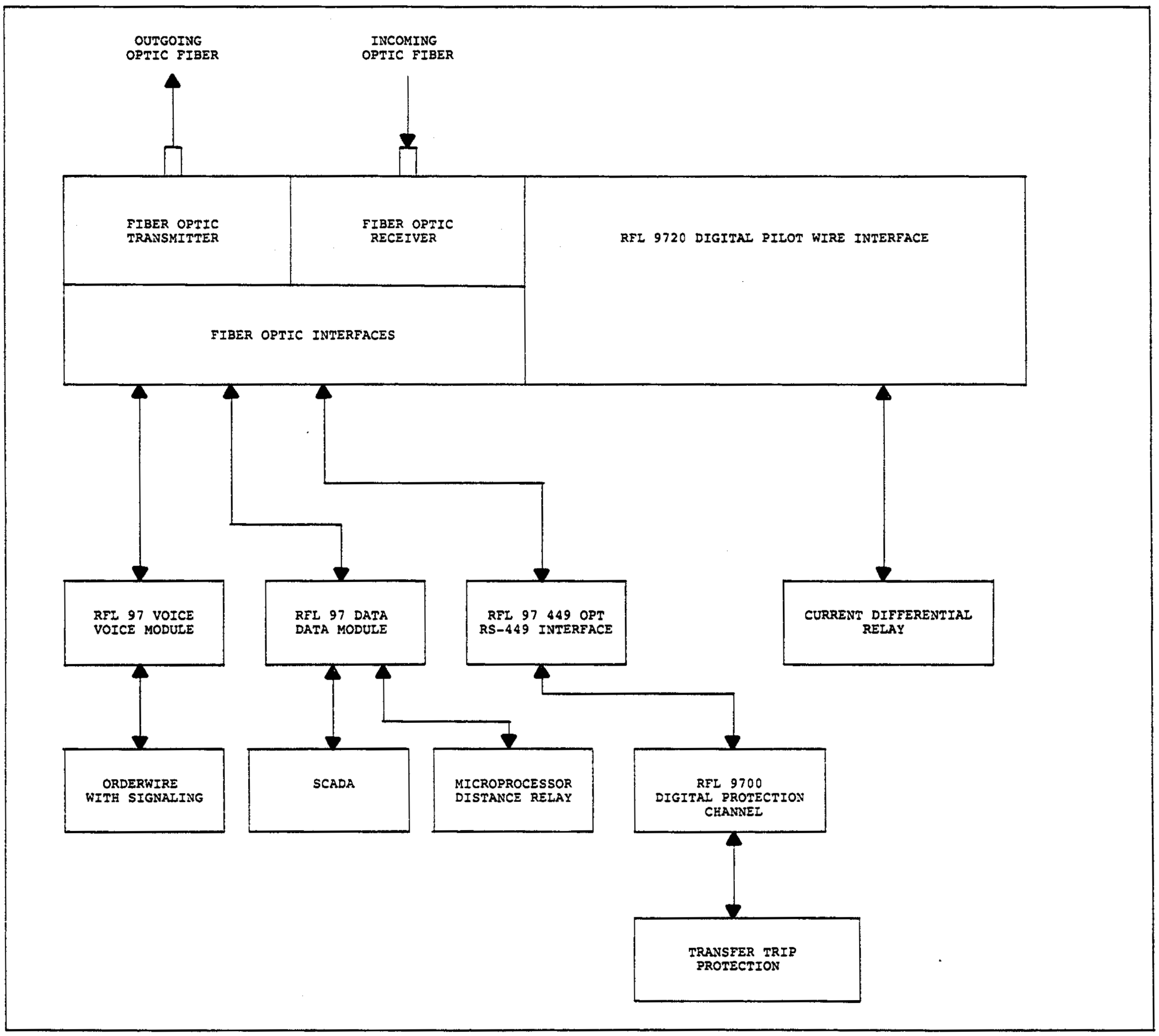


Figure 10. Typical fiber optic multiplex application

SYSTEM PERFORMANCE

The following paragraphs describe tests that were run on RFL 9720 equipment to verify performance. Figures 11 through 14 are curves that show **typical** results. All tests were run using single-phase current connected to the relay's A-G input terminals. Standard non-modified RFL 9720 circuit boards and I/O modules were used for all tests. "Channel delay" is defined as the actual delay in the communications equipment connected to the RFL 9720; this excludes any delay added by the RFL 9720. When two RFL 9720 terminals are connected back-to-back, there is zero channel delay. The delay causes an effective phase shift of the pilot wire current generated by the far end relay. This shift is compared to the non-shifted line current in the relay at the near end.

INTERNAL FAULT TRIP LEVELS

Figure 11 shows the change in internal-fault tripping levels as a function of channel delay. The line current is shown on the vertical axis, and is normalized to the trip current at zero channel delay for each relay type. The graphs show that as channel delay increases, all relays become less sensitive.

When using an HCB relay (for example), the local and remote signals with zero channel delay are in-phase during an internal fault condition. Current will be circulating through the operate coils, with no current circulating in the pilot wires. Since the signals are in-phase, the peak composite of the two yields a higher signal level. As channel delay increases, the local and remote signals begin to move out-of-phase. This reduces the peak composite, and more current is required to trip. With additional delay increases and phase shifts, the signal appears more like an external fault; the RFL 9720 units become less likely to trip, and less dependable.

The graph in Figure 11 is provided so the user can determine if the resultant fault trip level is acceptable for the specific application. Note that some current differential relays (such as the CPD) operate with the opposite principles of the HCB. However, the channel delay will have the same effect.

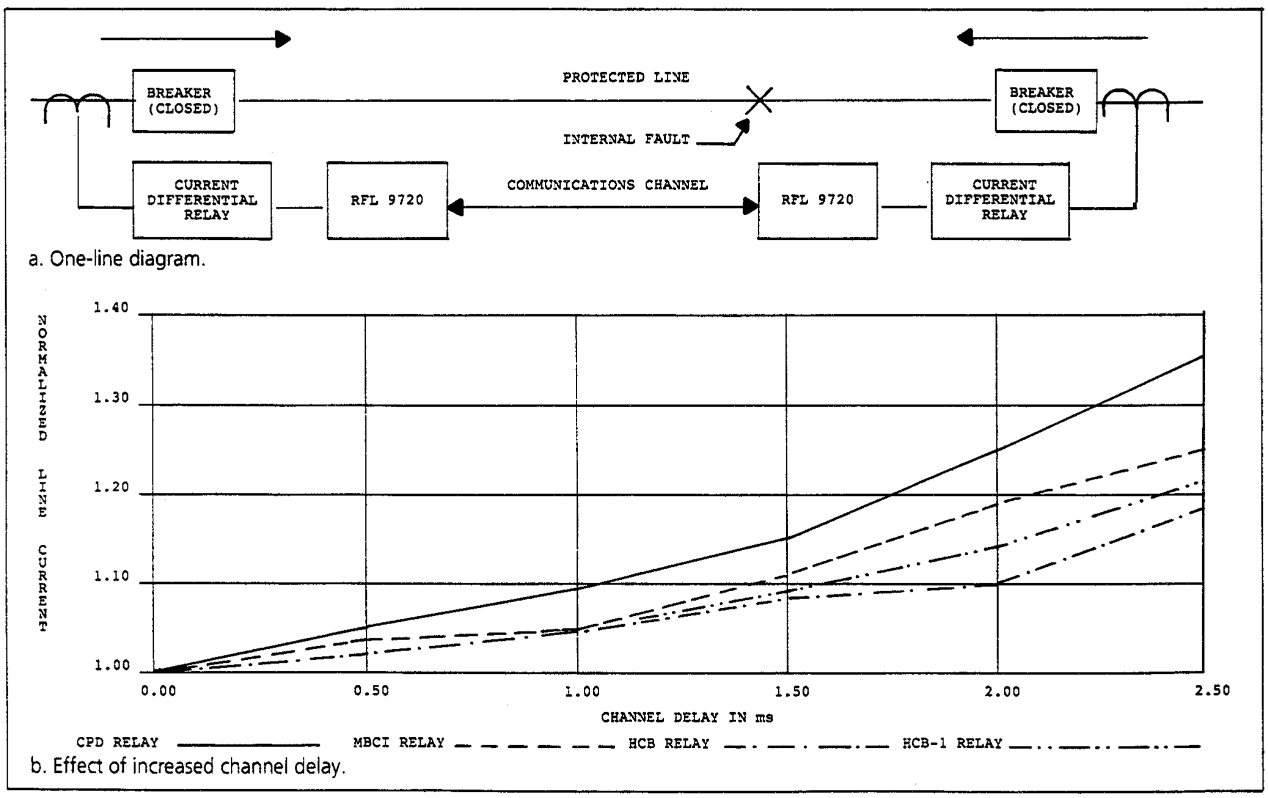


Figure 11. Typical internal fault trip levels, RFL 9720 Digital Pilot Wire Interface

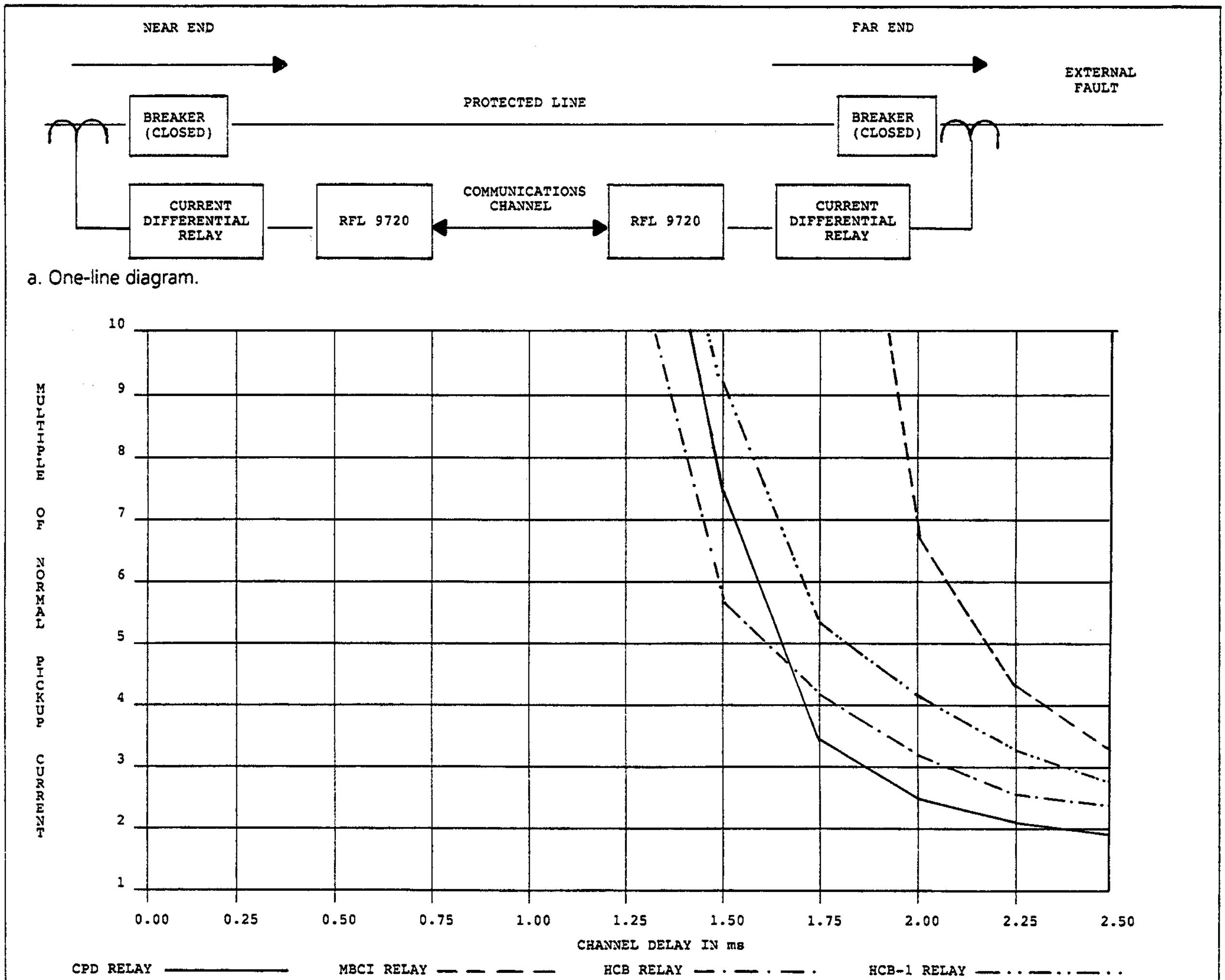
EXTERNAL FAULT TRIP LEVELS

Figure 12 shows the trip levels for external faults with large amounts of channel delay. The line currents on the vertical axis are normalized to the typical pickup levels for each relay type. As channel delay increases, less line current is required to cause a false trip. For delays less than where the curve becomes nearly vertical, the relay will not false trip. For safe operation, channel delay times must be kept well below this threshold.

When using an HCB relay (for example), the local and remote signals with zero channel delay are 180 degrees out-of-phase during an external fault. Current will be circulating through the pilot wires, with no current passing through the operate coils. Because the signals are out-of-phase, there is no peak composite (restraint).

As channel delay increases, the local and remote signals begin to move in-phase, so current becomes present in the relay operate coils. The more in-phase the signals appear, the more the peak composite appears like an internal fault. The probability of false trips increases, and the units become less secure.

Note that some current differential relays (such as the CPD) operate with the opposite principles of the HCB. However, the channel delay will have the same effect. When using HCB relays, delay times greater than 1.25 ms are not recommended.



a. One-line diagram.

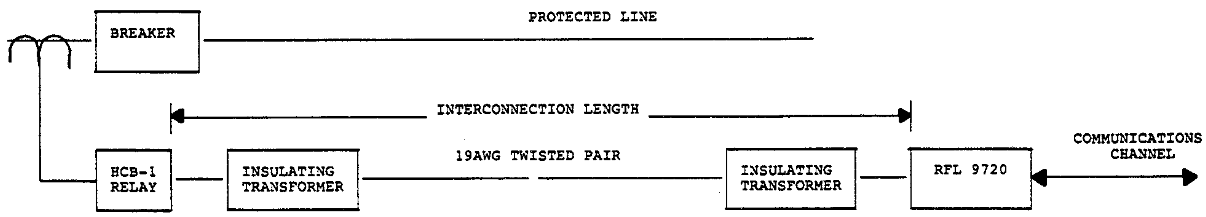
b. Effect of increased channel delay.

Figure 12. Typical external fault trip levels, RFL 9720 Digital Pilot Wire Interface

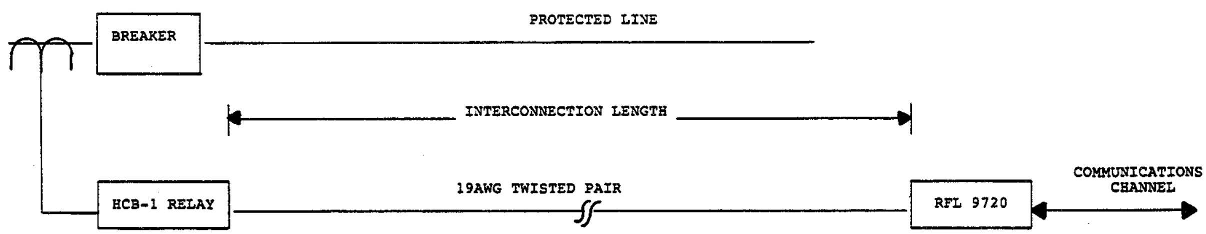
INTERFACE UNBALANCE (HCB-1 relays only)

Figure 13 shows the effect of long interconnections between an HCB-1 relay and the RFL 9720. The interconnection is assumed to be 19AWG twisted pair cable, which is normally used for pilot wire lines. The vertical axis shows the amount of unbalance in the hybrid interface to the relay. Excessive unbalance will greatly modify the apparent pilot wire characteristics, and affect relay performance.

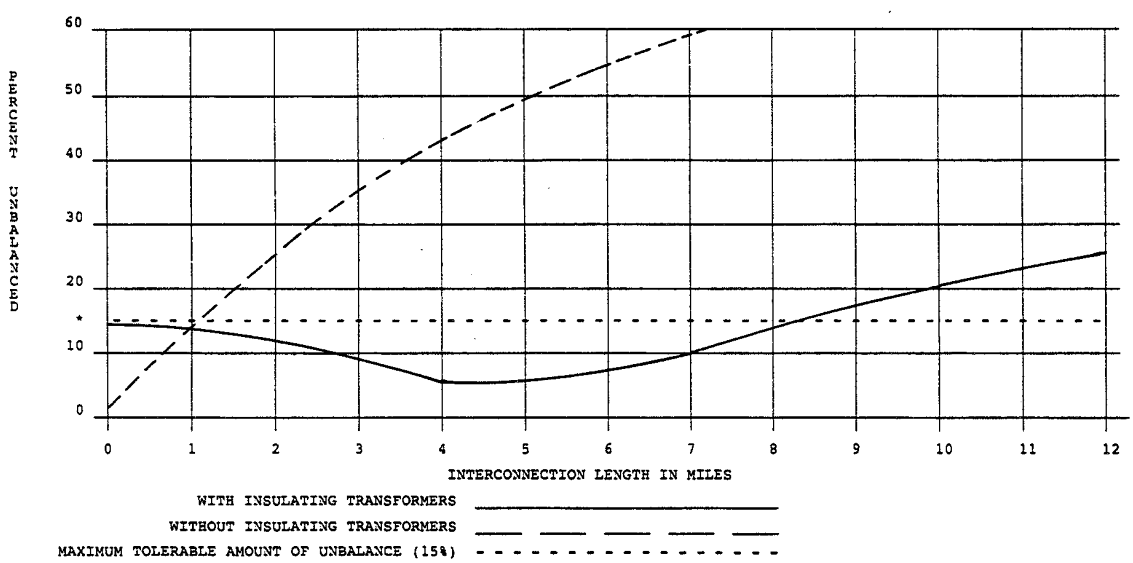
Two curves are shown in Figure 13c: one for interconnections using insulating transformers (as shown in Fig. 13a), and one without transformers (as shown in Fig. 13b). The unbalance on the transformerless interconnection increases from about 2 percent to almost 15 percent at one mile (1.6 km), with greater unbalances for longer distances. If insulating transformers are used at each end, the unbalance remains less than 15 percent for distances between 1 and 8.5 miles (1.6 to 13.7 km).



a. One-line diagram with insulating transformers between HCB-1 relay and RFL 9720.



b. One-line diagram with no transformers between HCB-1 relay and RFL 9720.



c. Effect of increased distance between HCB-1 relay and RFL 9720.

Figure 13. Typical effect of long interconnections between an HCB-1 relay and the RFL 9720 Digital Pilot Wire Interface

Figure 14 demonstrates the effect unbalance has on external fault trip levels. The five curves represent different amounts of unbalance due to long interconnections between the RFL 9720 and the HCB-1 relay.

The best system performance for HCB-1 relays (about 5 percent or less unbalance) is achieved when using transformerless interconnections up to 2000 feet long (610 meters), or transformer-isolated interconnections that are 4 to 5 miles long (6.4 to 8.0 km). As a result, the following guidelines should be used:

1. Do not use transformers on interconnections less than one mile long (1.6 km).

2. Use transformers on interconnections from 1 to 8.5 miles long (1.6 to 13.7 km).

3. Do not use interconnections longer than 8.5 miles (13.7 km).

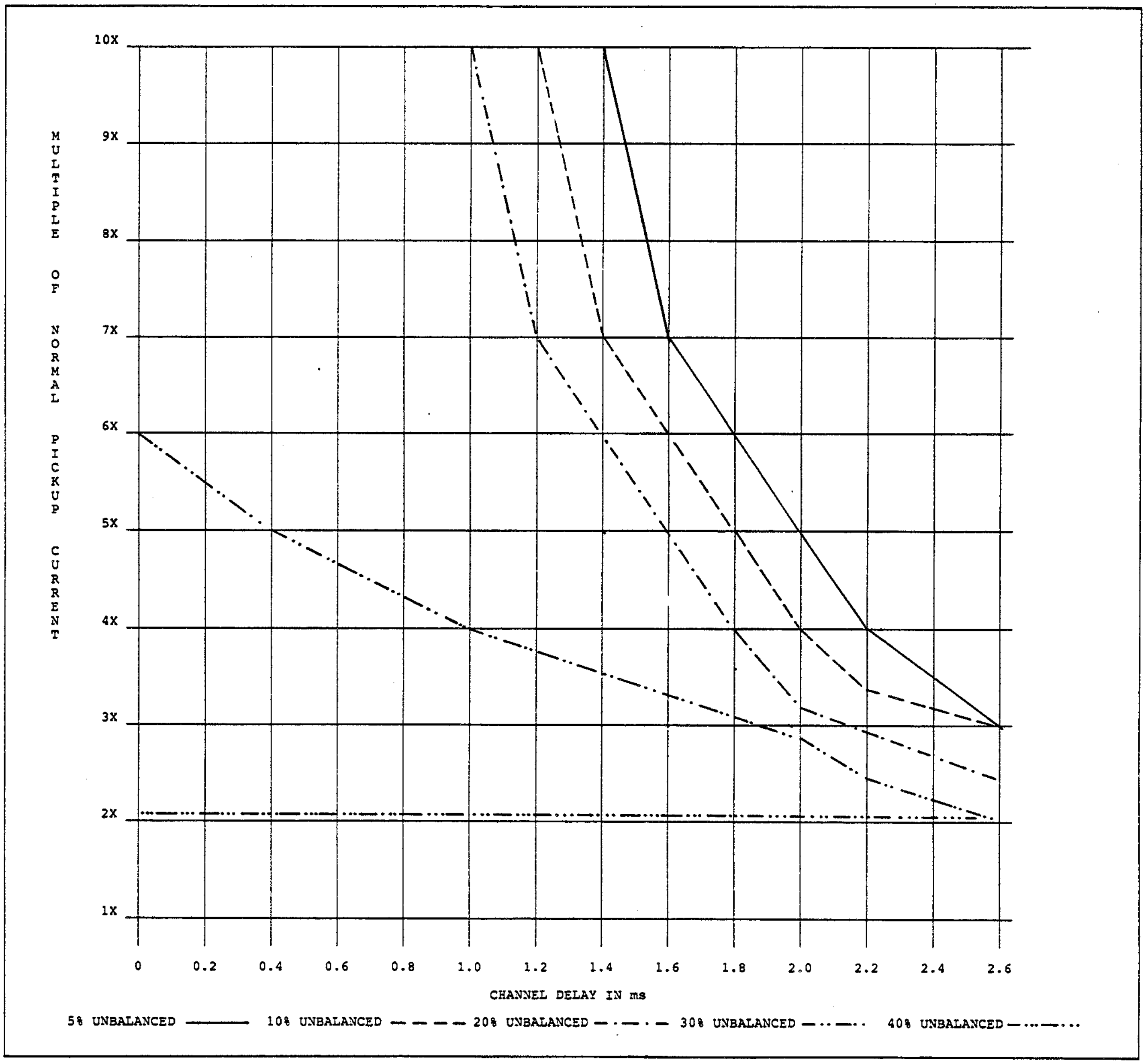


Figure 14. Typical effect of interface unbalance between an HCB-1 relay and the RFL 9720 Digital Pilot Wire Interface

SPECIFICATIONS

Communications Interface:

Data Rate:	56-Kbps synchronous, as noted in EIA Standard RS-422.
Data Connector:	37-pin D-subminiature connector (DC-37), wired as noted in EIA Standard RS-449. The RFL 9720 is also equipped with a 9-pin D-subminiature connector (DE-9) for RS-232 interfacing, and an eight-pin ribbon cable connector for direct interface to RFL 9700 fiber optic multiplex equipment.
Compatible Relays:	ABB Types HCB and HCB-1, GEC Type MBCI, and General Electric Type CPD. Relay connections are made according to the standard pilot wire connections for each relay type; no modifications need to be made to the relays themselves.
Channel Time:	350 μs, exclusive of channel propagation delay.
DTT KEY Input:	42 Vdc to 150 Vdc, 18 mA maximum.
DTT Output:	Solid-state Form A (SPST); 4 Vdc to 200 Vdc, 10 mA to 1 ampere. The transient power dissipation is 400 watts for 1 ms (non-recurring). Surge current is 5 amperes for one second.
DTT Response Time:	Less than 2.5 ms, exclusive of channel delay.
Alarm Relay Outputs:	Two (CHANNEL DELAY and CHANNEL FAIL). Each relay has one set of Form C (SPDT) contacts, rated for 125 Vdc maximum @ 1 ampere.
Interface Dielectric Strength:	The RFL 9720 meets the Surge Withstand Capability (SWC) requirements of ANSI C.37.90-1978. It also meets the fast-transient requirements of ANSI C.37.90.1.
EMI/RFI Interference:	The RFL 9720 meets the EMI/RFI requirements of IEC 801-3 (1984), BS 6667 Part 3 (1985), and ANSI C.37.90.2 (Trial-Use Standard, 1989).

Temperature:

Operating:	-20°C to +55°C (-4°F to +131°F).
Storage:	-30°C to +70°C (-22°F to +158°F).

Relative Humidity: Up to 95 percent @ +40°C (+104°F), non-condensing.

Input Power Requirements:

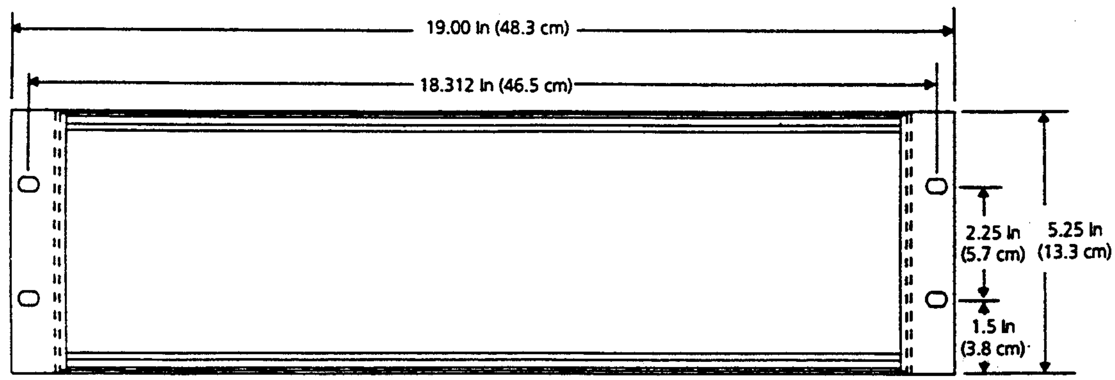
48-Volt Systems:	42 to 58 Vdc, 500 mA nominal. 143 watts peak power consumption (24 watts continuous).
129-Volt Systems:	95 to 150 Vdc, 200 mA nominal. 143 watts peak power consumption (24 watts continuous).

Chassis Dimensions:

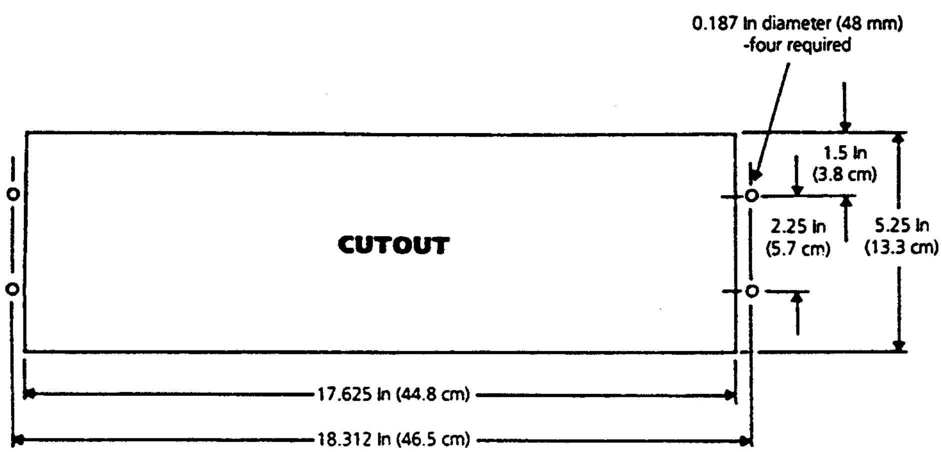
3U Chassis (Fig. 15):	
Height:	5.25 inches (13.4 cm).
Width:	19 inches (48.3 cm).
Depth:	15.18 inches (38.6 cm).
1U Chassis (Fig. 16):	
Height:	1.75 inches (4.45 cm).
Width:	19 inches (48.3 cm).
Depth:	15.18 inches (38.6 cm).
Panel-Mount Chassis (Fig. 17):	
Height:	5.25 inches (13.4 cm).
Width:	6.4 inches (16.25 cm).
Depth:	15.18 inches (38.6 cm).

All chassis dimensions (including mounting hole centers) conform to EIA specifications.

Weight: Approximately 8 lbs (3.6 kg).



a. Rack or cabinet mounting.



b. Panel mounting.

Figure 15. Mounting dimensions, 3U chassis for RFL 9720 Digital Pilot Wire Interface

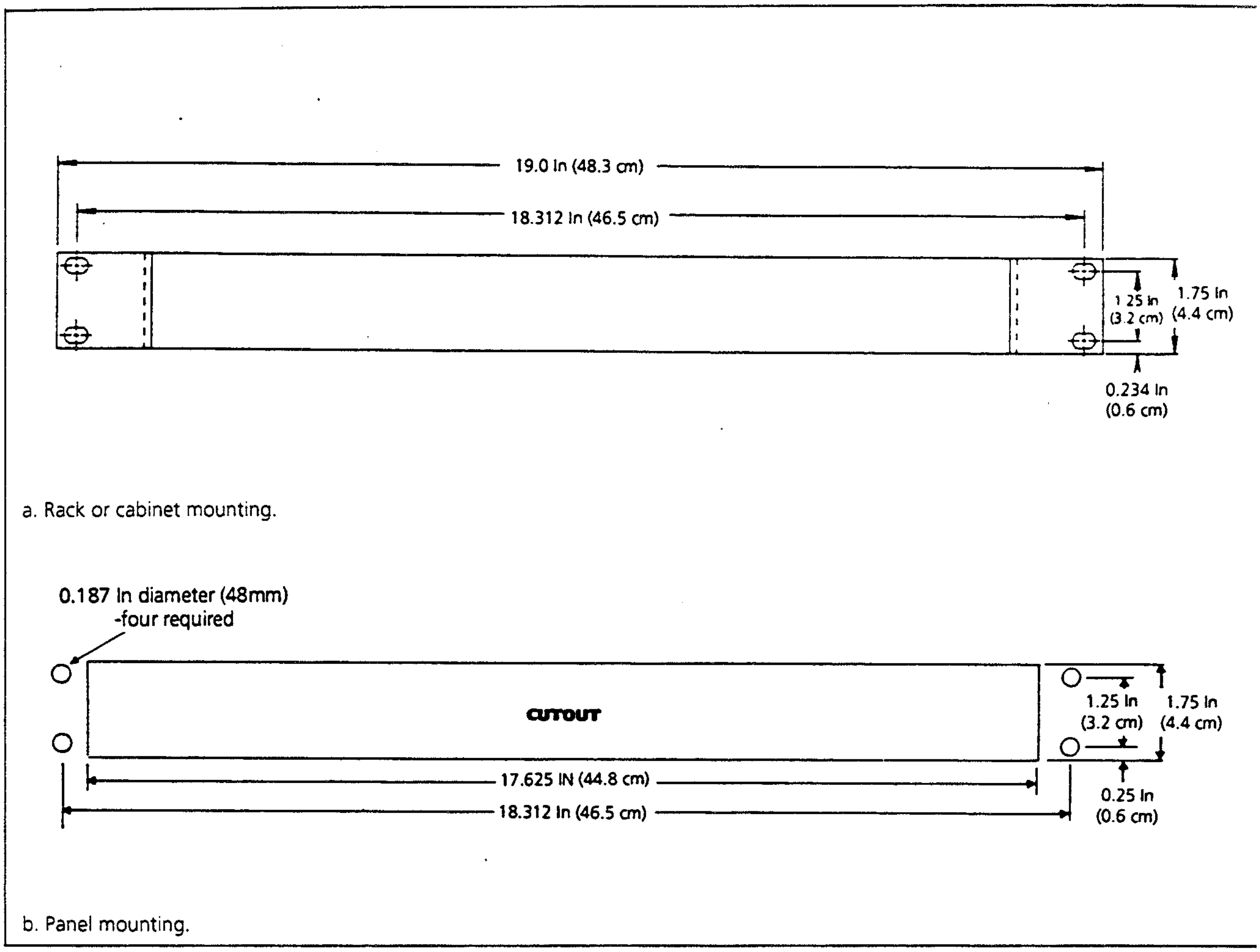


Figure 16. Mounting dimensions, 1U chassis for RFL 9720 Digital Pilot Wire Interface

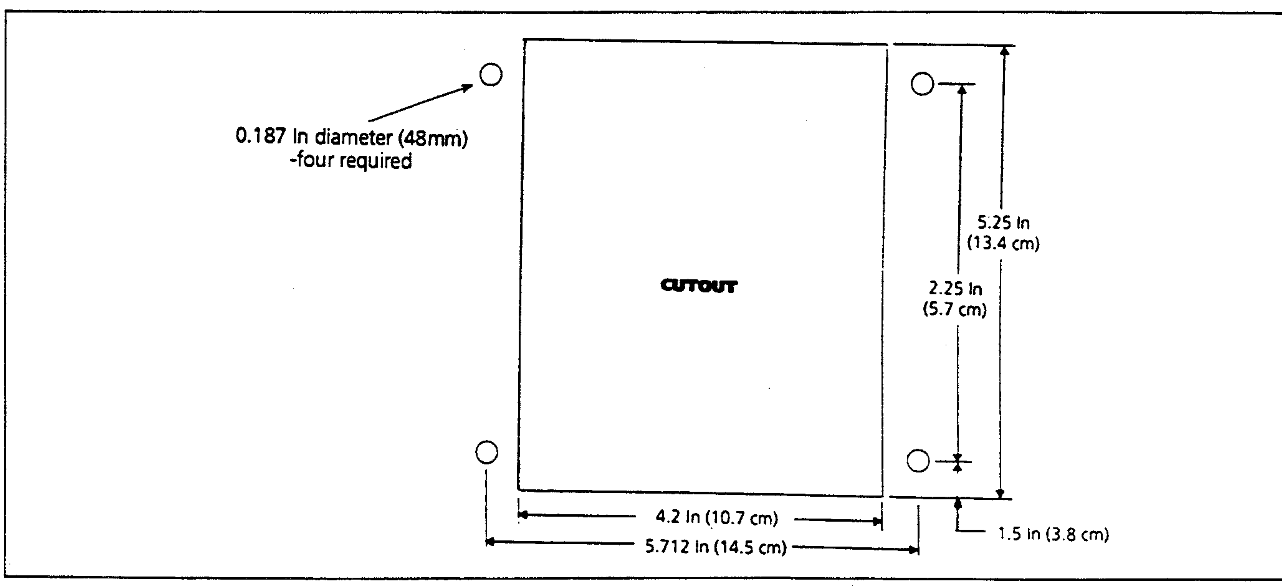


Figure 17. Mounting dimensions, panel-mount chassis for RFL 9720 Digital Pilot Wire Interface

ORDERING INFORMATION

RFL 9720 units are ordered by specifying the chassis style, station battery voltage, and type of relay interface required. These choices are specified by using the following part number scheme.

			Pos. 1	Pos. 2 (1)	Pos. 3 (1)	Pos. 4 (1)
9720 -	3	1	H	0	0	C

Chassis Style:

1U Chassis	1
3U Chassis	3
Panel-Mount Chassis	P

Station Battery Voltage:

48 Vdc (nominal)	4
125 Vdc (nominal)	1

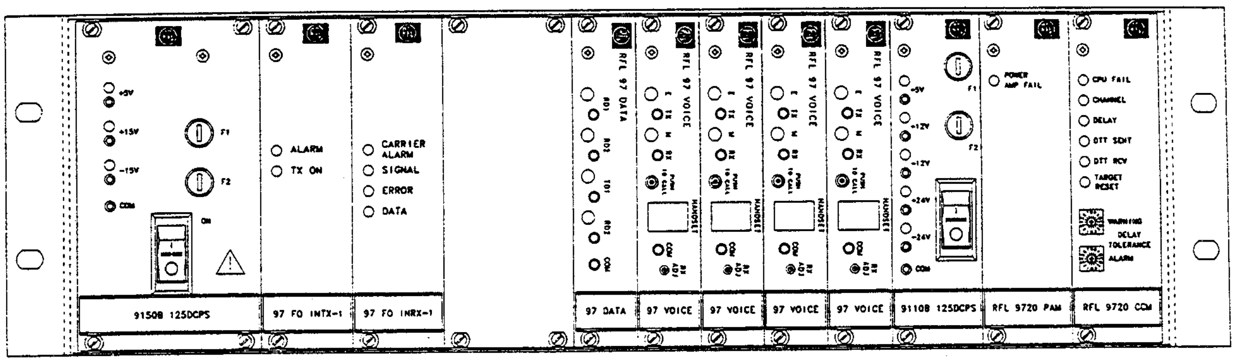
Relay Interface:

HCB-1	H
CPD	C
HCB	S
MBCI (2)	M
Open Position	0

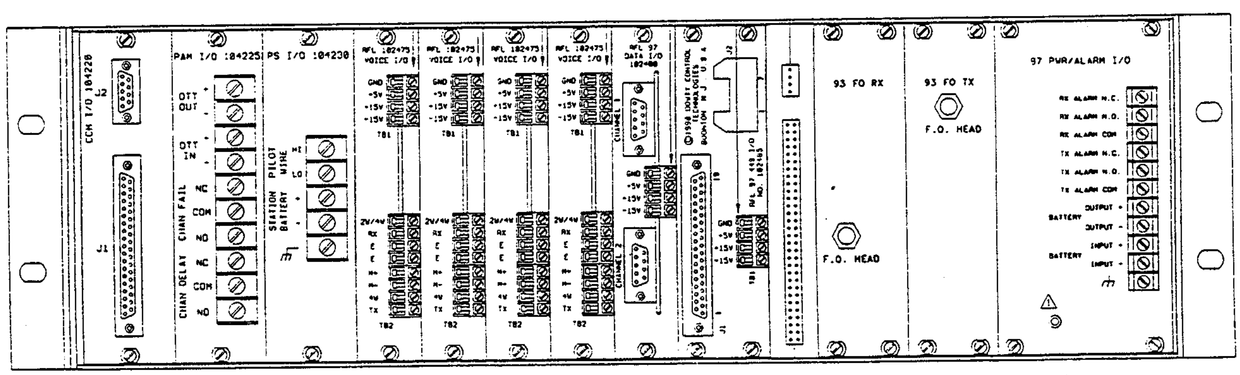
1. Only available when a 3U chassis is specified. If a 1U or panel-mount chassis is being specified, these portions of the ordering number must be set to zero.
2. Specify MBCI Model 01 or Model 02 when ordering.

Examples:

3U chassis, 48-Vdc station battery voltage, with four HCB-1 relay interfaces	**9720-3 4 H H H H**
1U chassis, 125-Vdc station battery voltage, with one HCB relay interface	**9720-1 1 S 0 0 0**
Panel-mount chassis, 125-Vdc station battery voltage, with one CPD relay interface	**9720-P 1 C 0 0 0**



a. Front view.



b. Rear view, showing customer connections.

Figure 18. Typical RFL 9720 MINI-MUX

The RFL 9720 MINI-MUX (Fig. 18) allows up to seven additional 56-Kbps ports to be interfaced onto the same fiber as the RFL 9720 signals. These ports can be used for voice, data, or RS-449 interfaces. Up to seven accessory modules can be housed in the same rack-mount chassis as the RFL 9720, and connected to its multiplex fiber optic modules through power and data cables.

RFL 97 VOICE OPTION (P/N 103510)

DESCRIPTION

The RFL 97 VOICE OPTION allows voice signals to be interfaced to the RFL 9720 Digital Pilot Wire Interface. Voice signals are converted to digital data at the sending end, and changed back into voice signals at the receiving end. The RFL 97 VOICE OPTION can be used with data modems operating at baud rates up to 1.2 Kbps. It can be strapped for orderwire, four-wire E&M, or two-wire E&M operation.

The RFL 97 VOICE OPTION includes the following items:

Quan.	Description	Model No.	P/N
1	Voice Module	RFL 97 VOICE	102465
1	I/O Module	RFL 97 VOICE I/O	102475
1	Interconnect Harness	. . .	30374
1	Telephone Handset	. . .	32935

The RFL 97 VOICE Voice Module (Fig. 19) performs all voice-to-data and data-to-voice conversions. It has a modular connector on its front panel to accept a telephone-type handset, and a PUSH TO CALL switch to signal the receiving terminal.

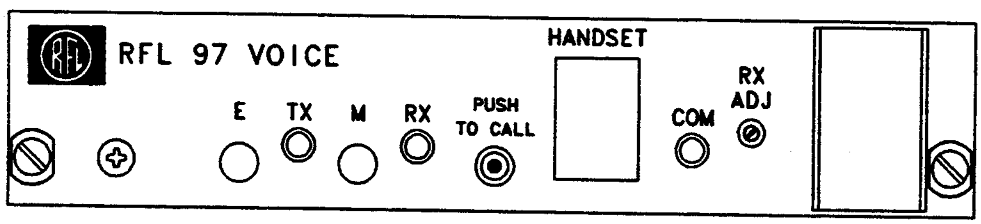


Figure 19. RFL 97 VOICE Voice Module

The RFL 97 VOICE occupies one module space in an RFL 9720 rack-mount chassis. Input power is supplied by the power supply used to power the fiber optics, through a power harness that plugs into a mating connector on the RFL 9720's rear panel. Data connections between the RFL 97 VOICE and the fiber optic modules are made through a ribbon cable that plugs into a mating connector on the RFL 9720's rear panel.

SPECIFICATIONS

Input Levels:

Transmit: -30 dBm to +7 dBm (-16 dBm nominal).

Receive: -19 dBm to +10 dBm (+7 dBm nominal).

Impedance:	600Ω.
Frequency Response:	10 Hz to 3400 Hz.
Echo Return Loss:	28 dB minimum.
Signaling Return Loss:	
HI:	26 dB minimum.
LO:	26 dB minimum.
"M" Input:	42 to 56 Vdc (48 Vdc nominal) @ 17 mA (22 mA maximum).
"E" Relay Contacts:	One set of Form A contacts (SPST), rated for 10 watts maximum (300 Vdc or 1 ampere).
System Interface:	One multiplexed RS-422 channel @ 56 Kbps.
Temperature Range:	
Operating:	-30°C to +65°C (-22°F to +149°F).
Storage:	-40°C to +75°C (-40°F to +167°F).
Relative Humidity:	Up to 95 percent @ +40°C (+104°F).
Power Requirements:	
+5-Volt Input:	115 mA maximum.
+15-Volt Input:	45 mA maximum.
-15-Volt Input:	10 mA maximum.
	All input power is drawn from RFL 9720 chassis.
Dimensions:	23 mm x 12.8 mm x 2.5 mm (0.91 inches x 0.50 inches x 0.10); occupies one module space in an RFL 9720 MINI-MUX chassis.

RFL 97 DATA OPTION (P/N 103505)

DESCRIPTION

The RFL 97 DATA OPTION allows two asynchronous RS-232 inputs to be interfaced to an RFL 9720. At the sending end, the incoming RS-232 data is converted to the synchronous RS-422 signal levels used by the fiber optics. At the receiving end, the RS-422 signals are changed back into RS-232 levels.

The RFL 97 DATA RS-232 Data Module (Fig. 20) performs all conversions between RS-232 and RS-422 signal levels. Front panel indicators provide visual monitoring of module performance, and test jacks are also provided for making connections to the send and receive lines for both RS-232 channels.

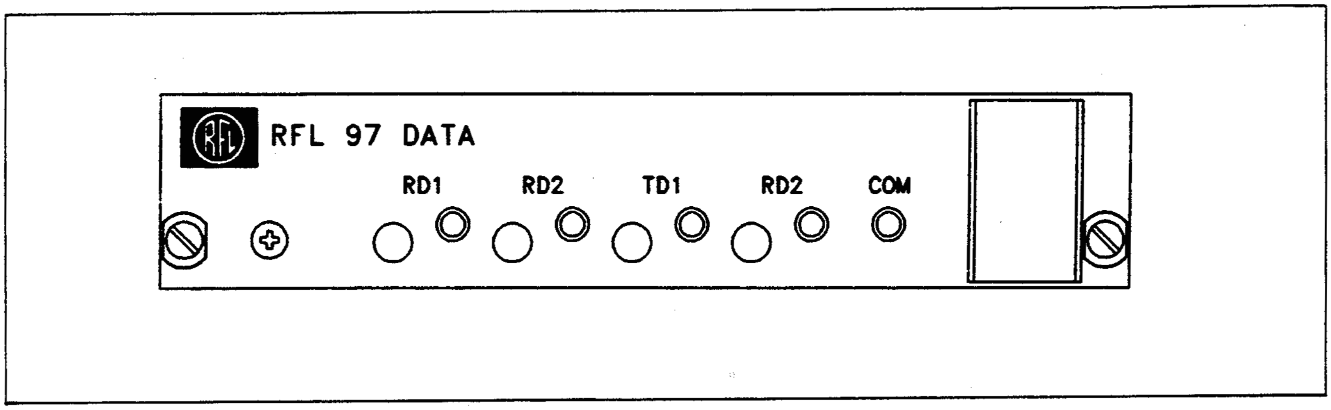


Figure 20. RFL 97 DATA RS-232 Data Module

The RFL 97 DATA OPTION includes the following items:

Quan.	Description	Model No.	P/N
1	Data Module	RFL 97 DATA	102470
1	I/O Module	RFL 97 DATA I/O	102480
1	Interconnect Harness	. . .	30374
2	Connector Adapter	. . .	95573

The RFL 97 DATA occupies one module space in an RFL 9720 rack-mount chassis. Input power is supplied by the power supply used to power the fiber optics, through a power harness that plugs into a mating connector on the RFL 9720's rear panel. Data connections between the RFL 97 DATA and the fiber optic modules are made through a ribbon cable that plugs into a mating connector on the RFL 9720's rear panel.

SPECIFICATIONS

Data Interface:	Two asynchronous full-duplex channels; RS-232C send/receive levels without handshaking.
Jitter:	
Up to 2400 Baud:	1.5 percent maximum.
Up to 4800 Baud:	6.0 percent maximum.
Up to 9600 Baud:	16.7 percent maximum.
System Interface:	Two multiplexed channels.
Temperature Range:	
Operating:	-30°C to +65°C (-22°F to +149°F).
Storage:	-40°C to +75°C (-40°F to +167°F).
Relative Humidity:	Up to 95 percent @ +40°C (+104°F).
Power Requirements:	
+5-Volt Input:	130 mA maximum.
+15-Volt Input:	5 mA maximum.
-15-Volt Input:	5 mA maximum.
	All input power is drawn from RFL 9720 chassis.
Dimensions:	23 mm x 12.8 mm x 2.5 mm (0.91 inches x 0.50 inches x 0.10); occupies one module space in an RFL 9720 MINI-MUX chassis.

RS-449 INTERFACE OPTION (P/N 103515)

The RFL 97 449 OPT converts the ribbon cable connector on multiplex versions of the RFL 9720 to an RS-449 connector. Signal levels meet the requirements of EIA Standard RS-422, and operate as a 56-Kbps synchronous data port.

Specifications subject to change without notice.

ADDITIONAL INFORMATION

For more information about the RFL 9720 Digital Pilot Wire Interface or any of the protective relaying products listed below, please contact the factory or any RFL Sales Representative.

- **RFL 6710 Frequency-Shift Audio Tone Protective Relaying System (single-channel)**
- **RFL 6745 Frequency-Shift Audio Tone Protective Relaying System (dual-subchannel)**
- **RFL 6750 Integrated Transfer Trip System (ITTS)**
- **RFL 9001 Intelligent T1/E1 Multiplexer**
- **RFL 9300 Charge Comparison System (CCS)**
- **RFL 9660 Digital Switch**
- **RFL 9700 Digital Protection Channel**
- **RFL 6720P Checkback System**
- **RFL 6780P Programmable FSK Powerline Carrier System**
- **RFL 6785P Programmable ON/OFF Powerline Carrier System**