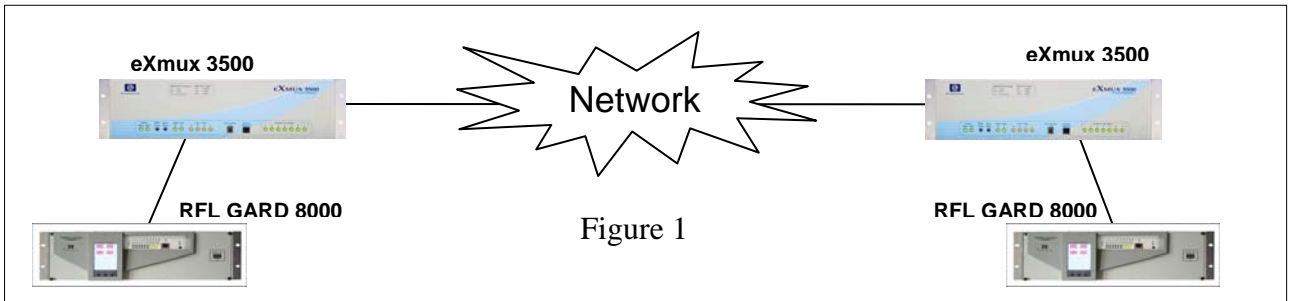


**RFL GARD 8000 Digital Channel over the RFL eXmux 3500 IP Access Multiplexer**

The RFL eXmux 3500 is a hardened IP Access Multiplexer engineered for mission critical infrastructures that seamlessly transport voice, serial, video and Ethernet data communications over Ethernet/IP or MPLS networks. The eXmux 3500 is a Layer 2 device with an integrated managed Ethernet switch which allows the eXmux 3500 to be used either in a private network with other eXmux 3500's or as part of a larger Ethernet/IP/MPLS network. Both fiber (using SFPs) and RJ-45 connections are available for the eXmux 3500; uplink speeds of up to a Gigabit are possible.

Figure 1 below depicts the eXmux 3500 as the communications system providing a point-to-point digital communications circuit between a pair of RFL GARD 8000's. The network cloud is a general representation of an IP network and does not imply a direct point-to-point connection. The digital communications protocol interface options for the RFL GARD 8000 over the eXmux 3500 are C37.94 Short Haul Fiber, synchronous RS-422/449, X.21, V.35 or G.703. Refer to the following table for the correct eXmux 3500 Interface Unit (IU) required for the appropriate GARD 8000 protocol interface. (Refer to application note 3500-0014 for T1/E1 channel GARD 8000 or 3500-0015 for audio channel GARD 8000)

<b>RFL GARD 8000 Communications Interface</b>	<b>eXmux 3500 Interface Unit (IU)</b>
C37.94 SHF	4-Port C37.94 IU
RS-422/449, V.35, X.21	4-Port Synch. Multi-Protocol IU
G.703	4-Port G.703 Synch. IU



**Network Performance Consideration**

Latency issues should always be considered when installing a teleprotection channel over any kind of multiplexer. The eXmux 3500 when applied over direct fiber connection with minimum jitter buffer delay settings (also referred to as Packet Delay Variation (PDV)) of 1-2ms, will yield a back-to-back communication channel delay of <5ms. In addition to the low latency, when setup in a redundant path configuration the eXmux 3500 has a unique Hitless Switching feature that guarantees no data is lost during any single path failure. For a network with anticipated traffic usage beyond 90% of bandwidth capacity, Quality of Service (QoS) features can always be used to ensure that TDM data has the highest priority.

The network topology should be designed with a minimum number of nodes between the two ends of any teleprotection channel to minimize the jitter buffer delay setting; this will minimize the overall latency. By using the VLAN capability of the eXmux 3500, a secure and direct bidirectional communications channel can be created for the GARD 8000 circuit.

### **eXmux 3500 Interface Unit Settings:**

This application note assumes familiarity with the operation of the eXmux 3500 and the RFL GARD 8000. The appropriate eXmux 3500 Interface Unit to be used for this circuit should be programmed before mapping. Refer to the eXmux 3500 manual for mapping procedures and specific interface wiring information for each of these IU's.

#### ***eXmux 3500 C37.94 IU settings***

1. On desired Port tab, set RX Data-Out Polarity and TX Data-In Polarity to **NORMAL**.
2. On Bandwidth tab, set desired Port Bandwidth (64 - 768kbps).

A multimode fiber cable with ST connector is used to connect the RFL GARD 8000 C37.94 I/O to the eXmux 3500 C37.94 IU.

#### ***eXmux 3500 Multi-Protocol Synch IU settings (RS-449, V.35 or X.21)***

1. On General tab, set choose RS-422, V.35 or X.21 Protocol as desired.
2. On desired Port tab, set P(x) Interface Mode to **DCE**. Handshaking Delay **Disable**. RX Data-Out Polarity and TX Data-In Polarity to **NORMAL**. RX Clock Polarity and TX Clock Polarity to **NORMAL**.
3. On Bandwidth tab, set desired Port Bandwidth to **1** (64kbps).

A DB-37F to DB-25M cable is used to connect the RFL GARD 8000 RS-449 I/O to the eXmux 3500 Synch IU. Refer to the chart below and the GARD 8000/eXmux 3500 manuals for cabling pin out information.

<b>GARD 8000 RS-422, V.35 DB-37M</b>	<b>GARD 8000 X.21 DB-37M</b>	<b>eXmux 3500 Sync IU DB-25F</b>	<b>GARD 8000 Signal</b>
1	1	1	Chassis Gnd
4	4	2	TX Data Out +
22	22	14	TX Data Out -
17		15	Send Timing +
35		12	Send Timing -
6	6	3	RX Data In +
24	24	16	RX Data In -
8	8	17	Receive Timing +
26	26	9	Receive Timing -
19	19	7 or 23	Signal Gnd

#### ***eXmux 3500 G.703 Synch IU settings***

1. On desired Port tab, check enable. Octet Timing **DISABLE**. Loopback **NONE**. RX Data-Out Polarity and TX Data-In Polarity to **NORMAL**.

A DB-15F to DB-15M cable is used to connect the RFL GARD 8000 G.703 I/O to the eXmux 3500 G.703 Synch IU.

Refer to the chart below and the GARD 8000/eXmux 3500 manuals for cabling pin out information.

<b>GARD 8000 G.703 DB-15M</b>	<b>eXmux 3500 G.703 Sync IU DB-15F</b>	<b>GARD 8000 Signal</b>
1	1	Chassis Gnd
2	2	TX Data (A)
9	9	TX Data (B)
4	4	RX Data (A)
11	11	RX Data (B)

This application note may not apply to other vendors Teleprotection Equipment as some settings may be different. Check with the vendor of the device you are using to determine the required eXmux 3500 settings. Contact RFL Electronics at 973-334-3100 for further assistance.