PRIZM™

4-Port Ethernet Interface Board

Part Number 200600-xxx

User's Manual

And

Troubleshooting Guide

February 24, 2009

Rev. G

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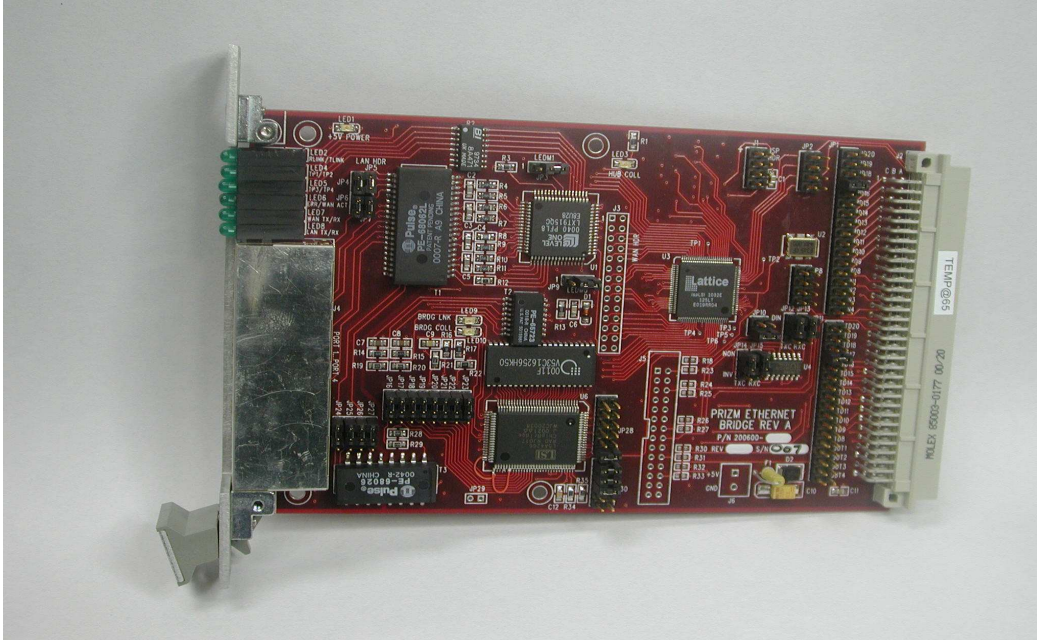# 1   4-Port Ethernet Interface Board, Part Number 200600-xxx

Figure 1 4-Port Ethernet Board Photograph

The 4-port 10BASE-T Ethernet interface board provides the user with a direct network connection between networked computers on the surface and in the ROV. The 4-port Ethernet interface board integrates a 4-port 10BASE-T hub and a WAN-LAN (wide area network-local area network) bridge onto a single board. The 4-port hub has a quad RJ-45 connector for connectivity to 10BASE-T networks. Each of the ports is connected to a hub integrated circuit (IC) for packet regeneration, link status detection and other hub functions. Any of the ports can be used for connection to the customer's network cables. Any network traffic destined for a computer at the other end of the Prizm fiber optic link is converted from the LAN format to a more efficient WAN format before it is transferred over the fiber optic cable. At the other end of the link, the WAN traffic is converted back to LAN format and passed to the 4-port hub chip for dissemination to the 10BASE-T ports.

Note: This board will ONLY support 10 Mbps Ethernet. 100 Mbps Ethernet will NOT work through this board.

Note: This board can be configured to function in any of the Prizm Systems, whether it is a Video 1, Video 2 or a Video 3 System. Please consult the factory before plugging this board into a new system to determine any special jumper configurations.

10BASE-T Ethernet is typically specified to have a 100-meter maximum point-to-point segment length and a 2.8 kilometer (1.7 miles) maximum network span. With a fiber optic

extension, such as provided by this board, the umbilical length is limited only by the optical budget. A practical limit with current ROV umbilicals is probably 10 kilometers (6.2 miles).

The 4-Port Ethernet board connects to the Prizm System by plugging directly into a card slot. A ribbon cable is typically not used, but can be optionally provided to support an older Prizm System. In the typical installation, the 4-Port Ethernet board communicates directly through the VME bus using one bi-directional data channel and the synchronous data clocks.

1.1 4-Port Ethernet Interface Board Revision History:

The 4-Port Ethernet board has gone through the following printed circuit board (PCB) and Assembly revisions:

PCB Revision A/Assembly Revision A Original design.

1.2 4-Port Ethernet Interface Board Dash (-) Numbers*:*

The 4-Port Ethernet board has a Dash Number appended to the part number. This Dash Number identifies the specific board configurations:

-001 configuration for a Video 1, 2 or 3 System that does not use ribbon cables

-002 configuration for an early Video 1 or 2 System requiring a ribbon cable connection.

1.3 4-Port Ethernet Interface Board Operation:

Refer to Figure 2 for a functional block diagram of the 4-Port Ethernet board.

The programmable logic portion of the diagram provides the direct connection of the WAN-LAN bridge to the Prizm backplane. The WAN synchronous connection does not run directly at the full 62.5MHz clock rate available on the backplane so the programmable logic is used to lower the WAN speed to 12.5 MHz.

The board has two daughterboard connectors for future expansion. One daughterboard connector will provide expanded 10BASE-T Ethernet networking by supporting a total of 4 independent WAN-LAN bridges mounted on the base motherboard. A second daughterboard connector will allow a 10BASE-T to 100BASE-T switch to be plugged onto the motherboard to support higher bandwidth networks.

There are two main functional blocks within each Ethernet board: a WAN-LAN bridge function and a 4-port 10BASE-T hub function.

The WAN-LAN Bridge

The WAN-LAN bridge function takes the 10BASE-T Ethernet LAN traffic that is asynchronous and bursty by nature and converts the traffic to a format that is synchronous (specifically HDLC) for efficient transport over the WAN port. To convert the LAN to WAN, the LAN packets (frames) must be stored temporarily in DRAM (dynamic random access memory) to support the differences in data rates between the LAN and the WAN and for packet re-transmittal.

The bridge keeps a table of current IP addresses that are found on the LAN side and only transfers frames across the WAN connection that are NOT local to the LAN. An address table is kept up-to-date by the bridge in the DRAM. An "aging" of the address automatically deletes the table entry if, after 5 minutes, no frames are received from an address. This filtering function can be disabled if needed by the application.

The WAN port is the synchronous Prizm backplane interface while the LAN port is the 10BASE-T network port.
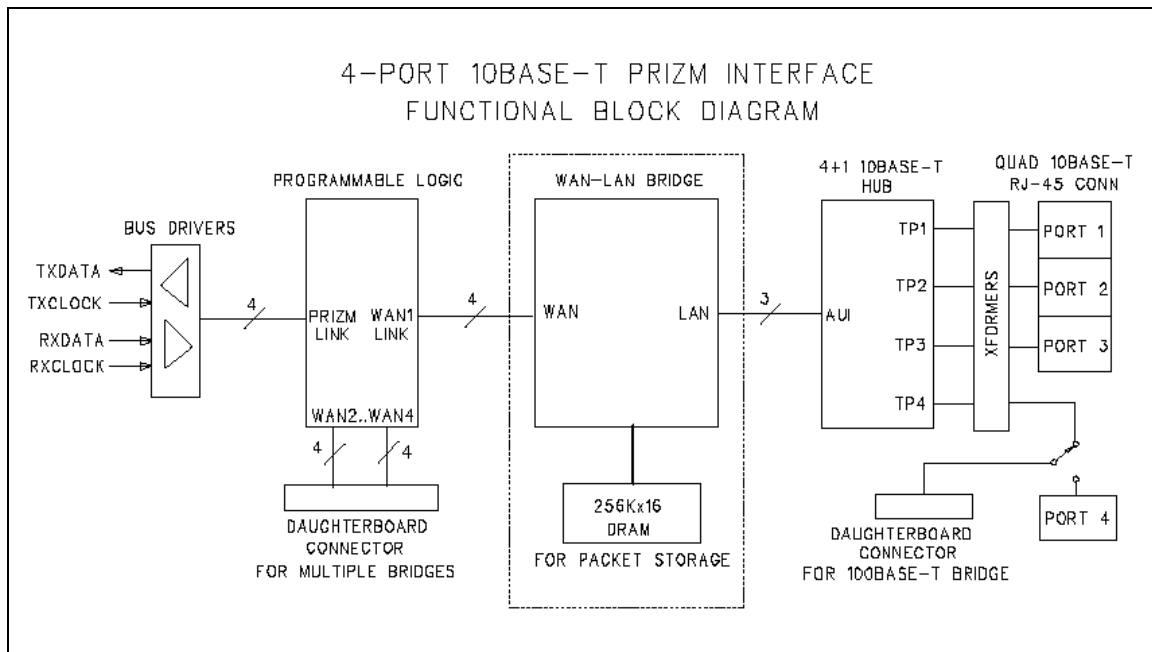
Figure 2 4-Port Ethernet Board Functional Block Diagram

The 4-port 10BASE-T Hub

The 10BASE-T hub chip supports four independent 10BASE-T twisted-wire-pair (TWP) ports and an additional AUI port, as shown in Figure 2. The AUI port is used to connect the single LAN port of the WAN-LAN bridge to the hub leaving free the four 10BASE-T ports. A quad RJ-45 connector is mounted on the board faceplate for the four Ethernet ports.

The 10BASE-T interface requires isolation transformers, as noted on the block diagram. The forth port is shown with a switch (actually implemented as jumper posts) that directs the signal either to the faceplate connector or to an expansion daughterboard connector. This connection will allow an additional hub to be attached above the motherboard if a future customer requires more ports. In addition, a 10BASE-T to 100BASE-T hub could be plugged in to adapt the 10BASE-T traffic to/from a 100BASE-T computer [currently in product development].

Each RJ-45 connector has the following signal:

PIN	Signal	Signal Direction
1	TXOb+	OUTPUT
2	TXOb-	OUTPUT
3	RXIb+	INPUT
4	not used	
5	not used	
6	RXIb-	INPUT
7	not used	
8	not used	

Note: Pin 1 is located on each connector at the top of each connector if the board is positioned vertically in the rack.

1.3.1 4-Port Ethernet Interface Board Indicators:

There are several diagnostic status LEDs on this board: some are surface mount device (SMD) LEDs and others are front panel LEDs. Refer to Figure 3 for the location of the front panel LEDs as viewed from the front of the board.
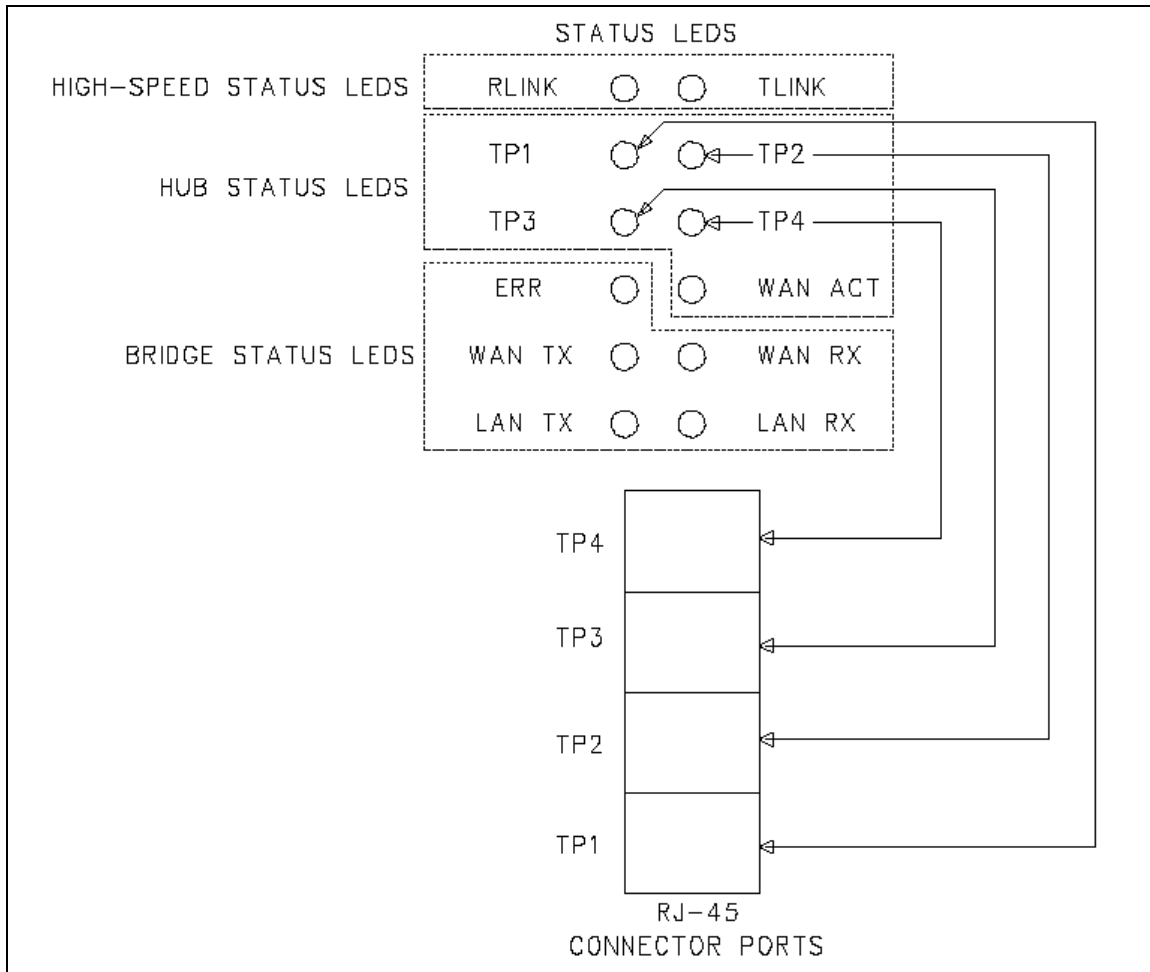
Figure 3 4-Port Ethernet Board LEDs and Ports

The SMD LEDs are meant for board level troubleshooting but may be of some limited use to the user in diagnosing a problem. The SMD LEDs are as follows:

LED1 - labeled "+5V POWER"
- ON if +5VDC is present on board
Note: At least one of the front panel LEDs will be lit if +5VDC power is available on the board so LED1 is somewhat redundant.

LED3 - labeled "HUB COLL"
- ON if the 4-port hub chip (U1) detects an Ethernet LAN collision.
Note: Ethernet collisions happen on any network when the network traffic gets severe. If this LED becomes active the user may have to reduce the network traffic.

LED9 - labeled "BRDG LNK"
- ON if there is a link between the hub chip (U1) and the bridge chip (U6).
Note: In normal operation, this LED will always be ON.

LED10 - labeled "BRDG COLL"
        - ON if the bridge chip (U6) detects an Ethernet LAN collision.
Note: Ethernet collisions happen on any network when the network traffic gets severe. If this LED becomes active the user may have to reduce the network traffic.

The six front panel mounted diagnostic LED statuses are defined as follows (in order of position from the top of the front panel):

Note: LED2 is a status LED only pertaining to the programmable logic device (U3).

LED2 - labeled "RLINK/TLINK"
        - Left (or bottom) RLINK LED - ON if board is receiving a high-speed link   from the other 4-Port Ethernet board at the other end of the fiber link
        - Right (or top) TLINK LED - ON if board is transmitting a high-speed link   to the other 4-Port Ethernet board at the other end of the fiber link
Note: The TLINK LED will always be ON unless the Modem board is not plugged into the rack as it is the source of the Ethernet board's transmit clock. The RLINK LED will only be lit if the complete fiber link is active and the remote Ethernet board is plugged in.

Note: LED4, LED5 and the right (or top) LED in LED6 are status LEDs only pertaining to the hub chip (U1).

LED4 - labeled "TP1/TP2"
        - Left (or bottom) TP1 LED - ON if an Ethernet device is plugged into twisted pair port 1 (TP1) and the device is powered up.
        - Right (or top) TP2 LED - ON if an Ethernet device is plugged into twisted pair port 2 (TP2) and the device is powered up.
Note: These two LEDs are hub status LEDs and will be ON solid if an Ethernet device is plugged into the twisted pair port and the device is powered up or it will blink if traffic (data) is being sent or received on that port.

LED5 - labeled "TP3/TP4"
        - Left (or bottom) TP3 LED - ON if an Ethernet device is plugged into twisted pair port 3 (TP3) and the device is powered up.
        - Right (or top) TP4 LED - ON if an Ethernet device is plugged into twisted pair port 4 (TP4) and the device is powered up.
Note: Same as LED4.

LED6 - labeled "ERR/WAN ACT"
        - Left (or bottom) ERR LED - Red, ON if the bridge chip (U6) detects an internal hardware error.

- Right (or top) WAN ACT LED - Green, blink if traffic (data) is being sent or received on the AUI port between the hub (U1) and bridge (U6) chips.

Note: If the red ERR LED is ON there is probably a problem with the bridge chip. Replace the board. The WAN ACT LED will blink if traffic (data) is being sent or received by either the hub or bridge chips.

Note: LED7, LED8 and the left (or bottom) LED in LED6 are status LEDs only pertaining to the bridge chip (U6).

LED7 - labeled "WAN TX/RX"
- Left (or bottom) WAN TX LED - ON if the bridge chip (U6) is sending an Ethernet frame through the high-speed link to the remote Ethernet board.
- Right (or top) WAN RX LED - ON if the bridge chip (U6) is receiving an Ethernet frame through the high-speed link from the remote Ethernet board.

Note: If the WAN TX LED is ON then the LAN RX LED should also be ON. If the WAN RX LED is ON then the LAN TX LED should also be ON.

LED8 - labeled "LAN TX/RX"
- Left (or bottom) WAN TX LED - ON if the bridge chip (U6) is sending an Ethernet frame through the high-speed link to the remote Ethernet board.
- Right (or top) WAN RX LED - ON if the bridge chip (U6) is receiving an Ethernet frame through the high-speed link from the remote Ethernet board.

Note: If the WAN TX LED is ON then the LAN RX LED should also be ON. If the WAN RX LED is ON then the LAN TX LED should also be ON.

1.3.2 4-Port Ethernet Interface Board Specifications:

Number of Channels: 4 10BASE-T ports
Cable type supported: Category 5 (CAT 5) with RJ-45 connector
Data rates supported: 10.0Mbps

Note: This board will ONLY support 10 Mbps Ethernet. 100 Mbps Ethernet will NOT work through this board.

1.3.3 4-Port Ethernet Interface Board Dimensions:

VME 3-U format - 100 mm wide x 160 mm long x 20 mm thick
(3.937 in x 6.299 in x 0.80 in)

VME 3-U PCB and faceplate in rack: 20 mm wide x 128 mm high (0.8 in x 5.05 in)

1.3.4 4-Port Ethernet Interface Board Power Requirements:

The board requires +5VDC at 470 milliamps.

1.4 4-PORT ETHERNET INTERFACE BOARD INSTALLATION AND CHECKOUT

The 4-Port Ethernet board can be configured to function in any Prizm System, whether it is a Video 1, Video 2 or a Video 3 System. Refer to the supplied system manual for the correct jumper configuration for your particular system.

A typical 10BASE-T Ethernet network has at least two PCs either linked directly together with a single Category 5 (CAT 5) cable (refer to Figure 4). The CAT 5 cable has four twisted pairs: one for 10BASE-T transmit, one for 10BASE-T receive and two unused pairs. The CAT 5 cable will have an RJ-45 (8-pin) jack at each end. There are two types of CAT 5 cables: a straight cable and a cross-over cable. The straight cable has the RJ-45 connector's transmit pair at one cable end connected to the transmit pair at the other end and the receive pair connected to the receive pair. The cross-over cable has the RJ-45 connector's transmit pair at one cable end connected to the receive pair at the other end and the receive pair connected to the transmit pair. If a PC is directly connected to another PC a cross-over cable must be used to connect the transmit signal from one PC to the receive pins of the other PC. If a PC is connected directly to a hub then a straight cable is used as the hub's port connector is wired to cross the transmit and receive signals.
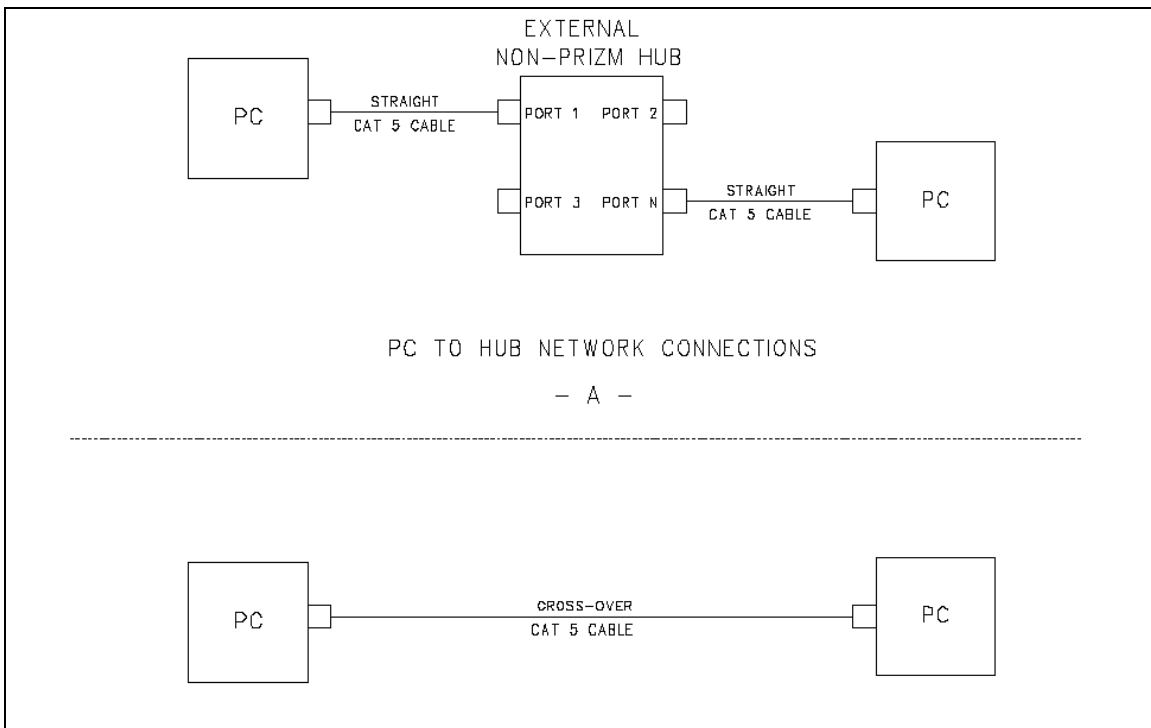

Figure 4 Typical Ethernet Network Connections

The 4-Port Ethernet board, as discussed in Section 1, has a 4-Port hub implemented within the board. When connecting network cables to this board the user must remember to use the correct CAT 5 cable as shown in Figure 5.
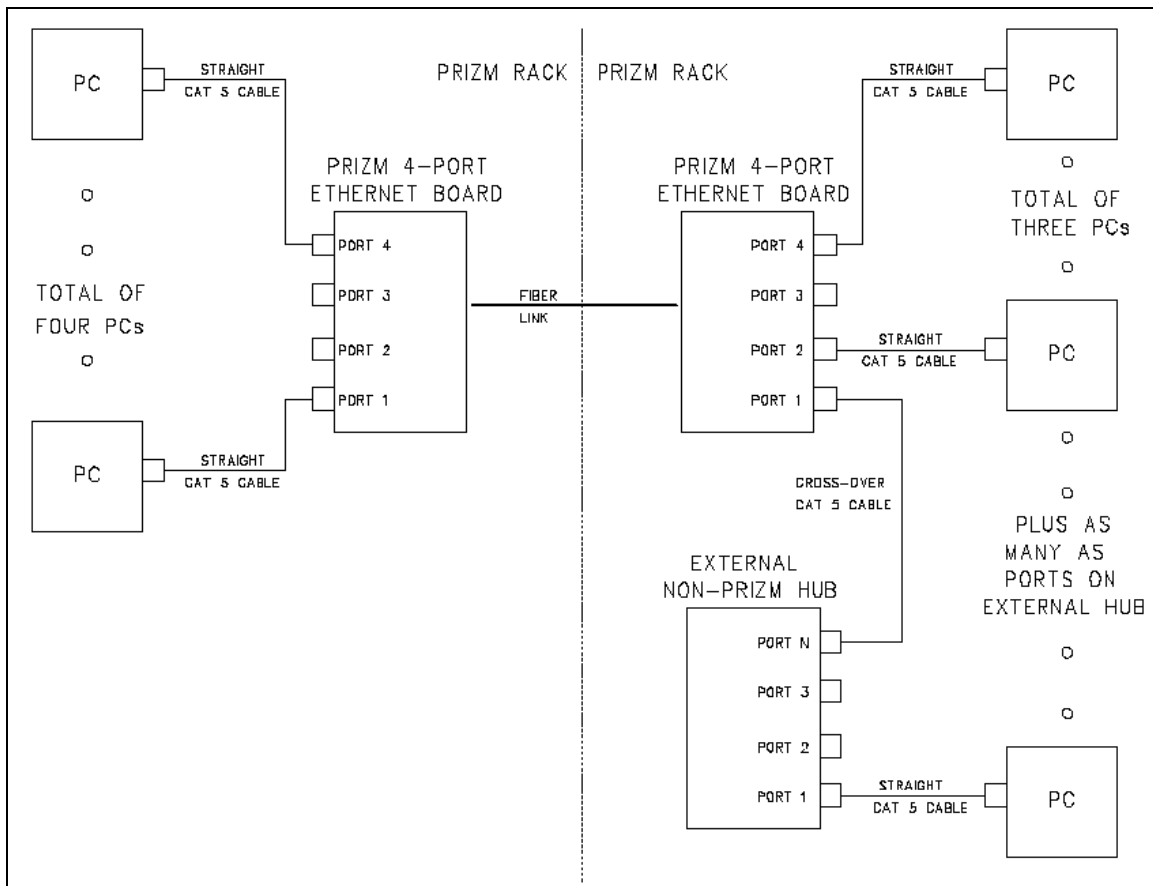

Figure 5 Typical Prizm Ethernet Network Connections

To begin the checkout of the 4-Port Ethernet board, ensure that the Prizm System is functioning correctly (i.e. fiber is connected, the Modems are linked without optical errors, all boards are correctly jumpered and installed, etc.). Pay particular attention to the high-speed channel assignments (i.e. TD20/RD20, TD19/RD19, etc.) to ensure that two different boards are not occupying the same channel.

To properly check out the 4-Port Ethernet boards the user must have at least two PCs with 10BASE-T boards installed and operational. These PCs must be correctly configured to communicate via 10BASE-T with each other (correct IP addresses, etc.) and have the appropriate network software installed (Windows 98 for example). Verify that the PCs can communicate between themselves by attaching them through your own hub or switch or directly (refer to Figure 4). 10BASE-T test software is helpful but simply PINGing at the DOS level is adequate for checking network connectivity. Once you are sure your test network is operational follow these steps to insert the Prizm System into your network and to prove that the Prizm System is correctly carrying the network traffic.

1. Install all required Prizm boards in the Prizm System racks.
2. Install the appropriate fiber optic cables between the Modem boards.
3. Power up the surface and vehicle rack.
4. Verify that all boards power up correctly and show the appropriate status LED indications.
5. Verify that the Modem boards are linked via the fiber cables and that no optical errors are being reported.
6. With <u>no</u> Ethernet cables attached to either of the 4-Port Ethernet boards, verify that both boards have only the top two LEDs lit (RLINK and TLINK).

FOR BENCH TESTING, DO STEP 7, FOR IN-FIELD TESTING SKIP TO STEP 8:

Note: Refer to Section 1.5 for status LED and RJ-45 port locations on the front panel and to Figure 5 for network connectivity.

7. If your test configuration has both ends of the Prizm System in close proximity you can first test that the hub within one of the 4-Port Ethernet boards is working properly. Plug the Ethernet cable from one of the test PCs into the bottom RJ-45 connectors (TP1) on ONE 4-Port Ethernet board and plug the Ethernet cable from a second test PC into the next-to-the-bottom RJ-45 connectors (TP1) on SAME 4-Port Ethernet board. Verify that the TP1 and TP2 LEDs are lit constantly on that 4-Port Ethernet board (refer to Section 1.5 for physical LED locations) and no LEDs are lit on the other 4-Port Ethernet board. The TP1 and TP2 LEDs show that the hub on the 4-Port Ethernet board has recognized the link pulses on the receive port that were generated by the PC network card. The other LEDs for TP3 and TP4 should be not lit.

FOR BENCH TESTING, NOW SKIP TO STEP 9:

FOR IN-FIELD TESTING, DO STEP 8:

Note: Refer to Section 1.5 for status LED and RJ-45 port locations on the front panel and to Figure 5 for network connectivity.

8. Plug the Ethernet cables from two of the test PCs into the bottom RJ-45 connectors (TP1) on each board and verify that the TP1 LED is lit constantly on both 4-Port Ethernet boards (refer to Section 1.5 for physical LED locations). This shows that the hub on the 4-Port Ethernet board has recognized the link pulses on the receive port generated by the PC network card. The other LEDs for TP2, TP3 and TP4 should not be lit.

FOR ALL TESTING, CONTINUE WITH STEP 9:

9. Attempt to PING from one test PC to another test PC. The PING program should show that there was a reply from the PINGed PC and the round-trip time in milliseconds. If the PING was unsuccessful, the displayed message will be that the request timed-out. If successful, the round-trip time will be displayed and should be in the range of 3 milliseconds to 5 milliseconds with small PING data packets.

1.5 4-PORT ETHERNET INTERFACE BOARD TROUBLESHOOTING

In normal operation the following LED status should be observed (from top of board to bottom) with the Ethernet board plugged into a rack but with <u>no network cables attached</u>:

The SMD LEDs are as follows:

>   LED1 - ON
>
>   LED3 - OFF
>
>   LED9 - ON
>
>   LED10 - OFF

The front panel LEDs are as follows:

>   LED2 - Left (or bottom) RLINK LED - ON
>   - Right (or top) TLINK LED - ON
>
>   LED4 - Left (or bottom) TP1 LED - OFF
>   - Right (or top) TP2 LED - OFF
>
>   LED5 - Left (or bottom) TP3 LED - OFF
>   - Right (or top) TP4 LED - OFF
>
>   LED6 - Left (or bottom) ERR LED - OFF
>   - Right (or top) WAN ACT LED - OFF
>
>   LED7 - Left (or bottom) WAN TX LED - OFF
>   - Right (or top) WAN RX LED - OFF
>
>   LED8 - Left (or bottom) LAN TX LED - OFF
>   - Right (or top) LAN RX LED - OFF

The LED status conditions of the 4-Port Ethernet boards are detailed for several scenarios assuming two test PCs.   The statuses are as follows:

Note: The "Local" board denotes the 4-Port Ethernet board on end of the Prizm System and "Remote" board refers to the other end of the Prizm System. The "Local" and "Remote" identifiers are arbitrary.

1. The Prizm System is fully functional and each PC is plugged into one of the 4-Port Ethernet boards:

At the "Local" end (with the PC connected and PINGing):
 The appropriate TP1, TP2, TP3, or TP4 LED will be Blinking with PING
 When PINGing from this PC:
  LED2 - Left (or bottom) RLINK LED - ON
   - Right (or top) TLINK LED - ON

  LED6 - Left (or bottom) ERR LED - OFF
   - Right (or top) WAN ACT LED - Blinks with PING

  LED7 - Left (or bottom) WAN TX LED - Blinks with PING
   - Right (or top) WAN RX LED - Blinks with response

  LED8 - Left (or bottom) LAN TX LED - Blinks with response
   - Right (or top) LAN RX LED - Blinks with PING

At the "Remote" end (with the PC connected):
 The appropriate TP1, TP2, TP3, or TP4 LED will be Blinking with PING
 When PINGing that PC:
  LED2 - Left (or bottom) RLINK LED - ON
   - Right (or top) TLINK LED - ON

  LED6 - Left (or bottom) ERR LED - OFF
   - Right (or top) WAN ACT LED - Blinks with PING

  LED7 - Left (or bottom) WAN TX LED - Blinks with response
   - Right (or top) WAN RX LED - Blinks with PING

  LED8 - Left (or bottom) LAN TX LED - Blinks with PING
   - Right (or top) LAN RX LED - Blinks with response

2. The Prizm System is fully functional but at the "Remote" end the Ethernet cable is not plugged in or the PC is not powered up:

At the "Local" end (with the PC connected and PINGing):
 The appropriate TP1, TP2, TP3, or TP4 LED will be Blinking with PING
 When PINGing from this PC:
  LED2 - Left (or bottom) RLINK LED - ON
   - Right (or top) TLINK LED - ON

  LED6 - Left (or bottom) ERR LED - OFF
   - Right (or top) WAN ACT LED - Blinks with PING

  LED7 - Left (or bottom) WAN TX LED - Blinks with PING
   - Right (or top) WAN RX LED - OFF

     LED8 - Left (or bottom) LAN TX LED - OFF
         - Right (or top) LAN RX LED - Blinks with PING

 At the "Remote" end (with the PC NOT connected):
    The appropriate TP1, TP2, TP3, or TP4 LED will be OFF
    When PINGing that PC:
       LED2 - Left (or bottom) RLINK LED - ON
         - Right (or top) TLINK LED - ON

       LED6 - Left (or bottom) ERR LED - OFF
         - Right (or top) WAN ACT LED - OFF

       LED7 - Left (or bottom) WAN TX LED - OFF
         - Right (or top) WAN RX LED - Blinks with PING

       LED8 - Left (or bottom) LAN TX LED - Blinks with PING
         - Right (or top) LAN RX LED - OFF

3. The fiber at the "Local" end is unplugged from the Modem's receive (RX) optical port but each PC is plugged into one of the 4-Port Ethernet boards:

 At the "Local" end (with the PC connected and PINGing):
    The Modem's ERR LED is ON and DATA LED is OFF (if Modem 1 board)
    The Modem's LOC LED is RED and REM LED is RED (if Modem 2 board)

    The appropriate TP1, TP2, TP3, or TP4 LED will be Blinking with PING
    When PINGing from this PC:
       LED2 - Left (or bottom) RLINK LED - OFF
         - Right (or top) TLINK LED - ON

       LED6 - Left (or bottom) ERR LED - Blinks with PING
         - Right (or top) WAN ACT LED - Blinks with PING

       LED7 - Left (or bottom) WAN TX LED - OFF
         - Right (or top) WAN RX LED - OFF

       LED8 - Left (or bottom) LAN TX LED - OFF
         - Right (or top) LAN RX LED - Blinks with PING

 At the "Remote" end (with the PC connected):
    The Modem's ERR LED is ON and DATA LED is ON (if Modem 1 board)
    The Modem's LOC LED is GREEN and REM LED is RED (if Modem 2 board)

    The appropriate TP1, TP2, TP3, or TP4 LED will be ON
    When PINGing that PC:
       LED2 - Left (or bottom) RLINK LED - OFF

      - Right (or top) TLINK LED - ON

LED6 - Left (or bottom) ERR LED - OFF
      - Right (or top) WAN ACT LED - OFF

LED7 - Left (or bottom) WAN TX LED - OFF
      - Right (or top) WAN RX LED - OFF

LED8 - Left (or bottom) LAN TX LED - OFF
      - Right (or top) LAN RX LED - OFF