INSTALLATION AND OPERATION

EI990 Interface to Ethernet®

Part No. 2234392-9701 *A
December 1985

TEXAS INSTRUMENTS

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EI990 Interface to Ethernet® Installation and Operation (2234392-9701 *A)

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This Document: 2540205-0001

Preface

This manual contains the information necessary to install and operate the EI990 interface to Ethernet® in a Texas Instruments computer with TILINE™, or in a TILINE expansion chassis. The Ethernet interface is called the EI990 throughout this manual. The information in this manual is organized into two major sections and one appendix:

Section

1 General Description — Provides an overview of the purpose, features, and interfaces of the EI990.

2 Installation — Provides instructions for installing the EI990 in a Business System 600 or 800 computer, a Model 990 Computer with TILINE, or a TILINE expansion chassis and checking it for proper operation after installation.

Appendix

A Ethernet Planning and Installation — Provides an overview of Ethernet local area networks and describes the components required to fabricate a network. Also contains guidelines for installing the network.

The following documents contain helpful information for programming, operating, troubleshooting, and repairing the EI990:

Title	Part Number
EI990 Ethernet Interface Maintenance Manual	2234393-9701
EI300/EI990 Ethernet Interface Programming Manual	2234394-9701
DNOS Distributed Network I/O (DNIO) User's Guide	2308793-9701
EI990 Family Tree	2239140-0001
EI990 Specification	2239139-0001
"The Blue Book" *The Ethernet, A Local Area Network, Data Link and Physical Layer Specifications*, Version 2.0, November 1982	Digital Equipment Corporation, Intel Corporation, and Xerox Corporation

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General Description

1.1 GENERAL

This section contains physical and functional descriptions of the Texas Instruments interface to Ethernet for Texas Instruments computers with TILINE (Figure 1-1). The Ethernet interface is called the EI990 throughout this manual.

CAUTION

The EI990 contains static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing the EI990 from its protective package and handling it.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These items are commercially available. If you do not have access to a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling the EI990. Then, as a further precaution, place the EI990 on a grounded work surface after removing it from the protective package.

Always return the EI990 to its protective storage bag before transporting or storing it.

1.2 PHYSICAL DESCRIPTION

The EI990 is implemented on a printed wiring board (PWB) that is 362 millimeters (14.25 inches) wide and 274.3 millimeters (10.80 inches) high. Connectors P1 and P2 are 80-pin male connectors that mate with 80-pin female connectors on the backplane of the host computer to provide the connection to the host computer TILINE. Connector P3 is a 20-pin connector that connects to an optional Business System computer front panel to allow monitoring and maintenance of the EI990. Connector P4 is an 18-pin shielded connector that mates with the EI990-to-transceiver cable.

The red fault indicator located beside connector P3 indicates when onboard self-test routines are executing and when a problem in the EI990 occurs. The seven pencil switches located near the center of the EI990 set the TILINE slave base address of the EI990. Section 2 has more information on the fault indicator and on setting the pencil switches.

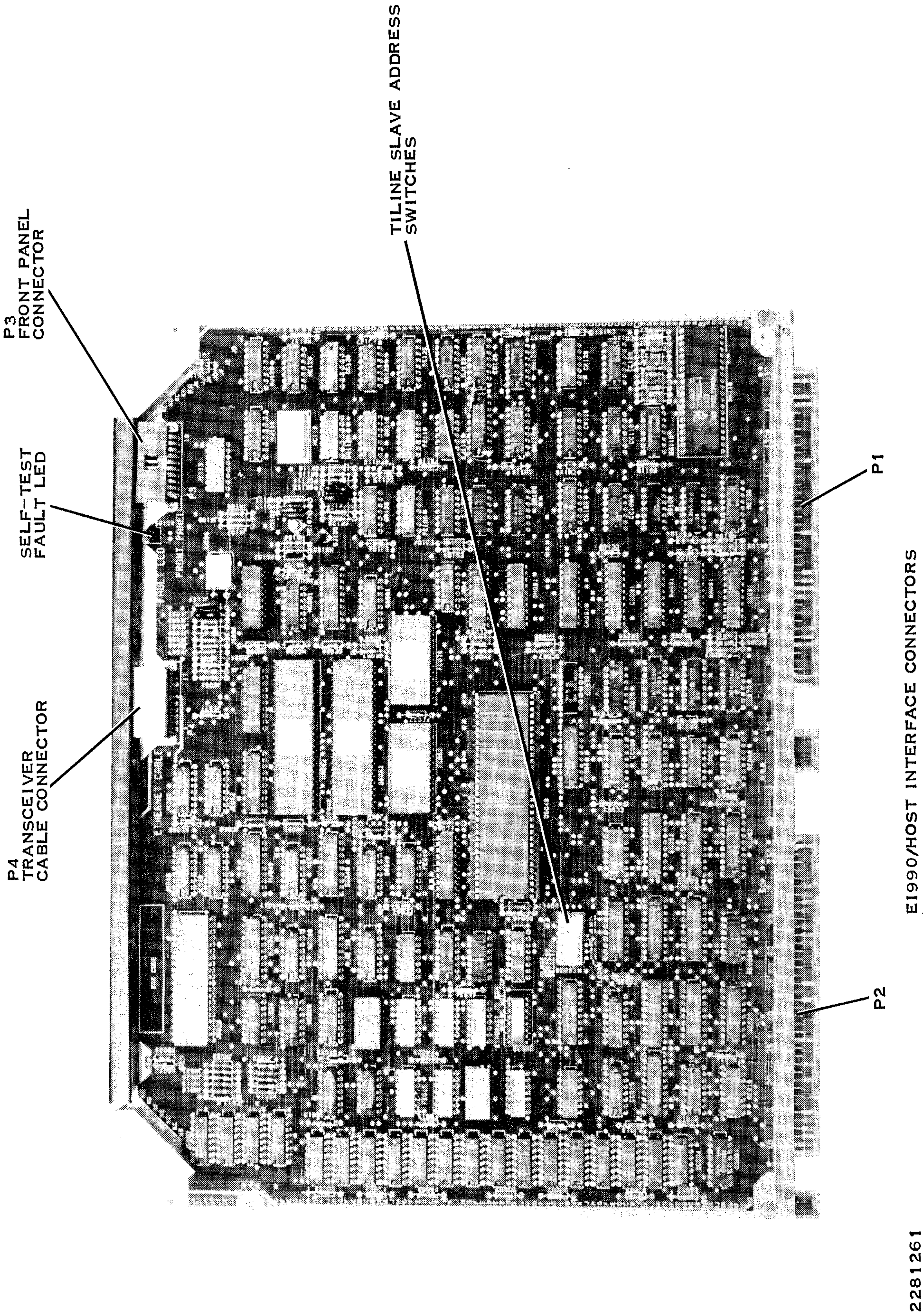


Figure 1-1. EI990 Ethernet Interface

1.3 PURPOSE OF THE EI990

The EI990 provides the hardware interface that allows any Texas Instruments computer with TILINE to communicate in an Ethernet network when the EI990 is installed in the computer chassis and connected to an Ethernet. You must also have the appropriate TI-supplied or customer-provided software to communicate in an Ethernet network. The TI software is described later in this section. You can install the EI990 in a Business System 600 or 800 Series computer, a Model 990 computer with TILINE, or in a TILINE expansion chassis connected to any of these computers. The EI990 connects to the Ethernet through an external transceiver and a transceiver cable as shown in Figure 1-2. The external transceiver contains logic to transmit and receive data on the Ethernet and to detect collisions that occur when more than one device tries to use the Ethernet at the same time.

A 10-meter (32.8-foot) EI990-to-transceiver cable is supplied with the EI990. You can connect additional standard transceiver cables to the EI990-to-transceiver cable to extend the distance between the EI990 and the transceiver up to a maximum of 50 meters (164 feet).

Data transfers between devices connected to an Ethernet network at 10 million bits per second (bps). The EI990 provides Ethernet data link control and buffers the transmit and receive data to allow a Texas Instruments computer to send and receive data at this high rate of speed. While data transfers on the network at 10 million bps, the actual end-to-end transfer rate depends upon the system in the computers at each end.

Appendix A describes Ethernet rules and specifications and provides guidelines for planning your installation.

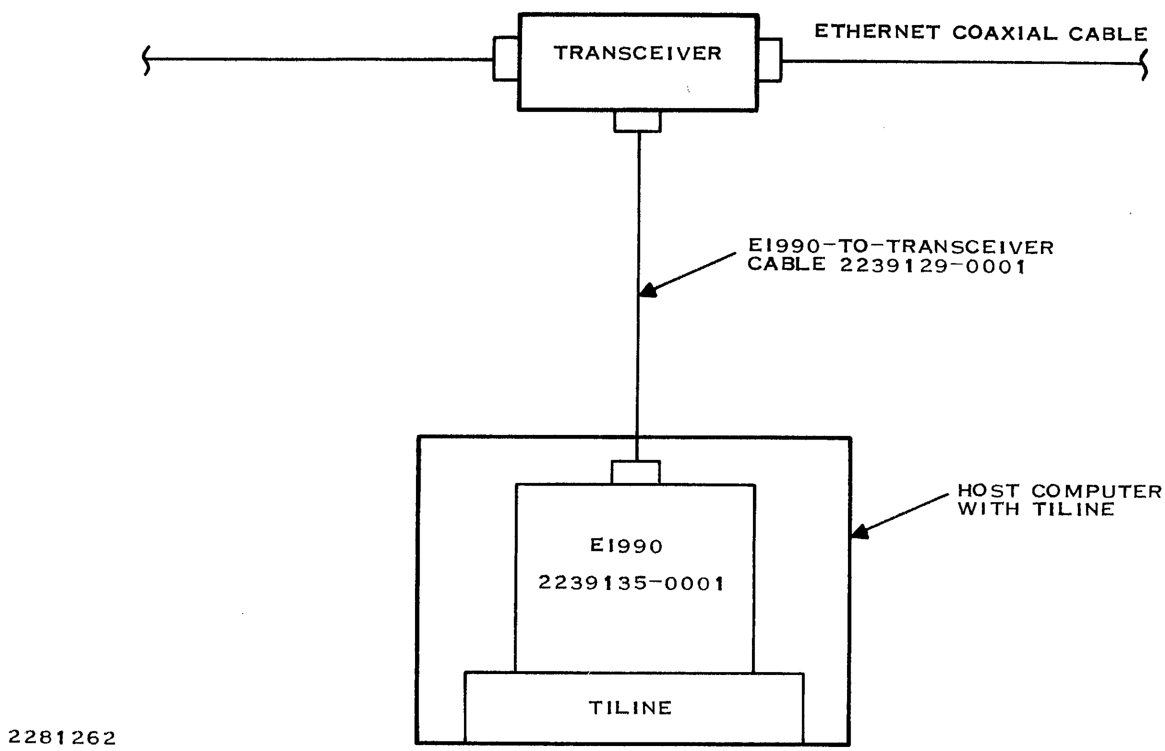


Figure 1-2. EI990 Connection to Ethernet

1.4 EI990 KITS

Table 1-1 lists the part number and contents of the EI990 kit and the optional maintenance kit for the EI990. Appendix A contains a table that lists part numbers of other Ethernet components that you may need for fabricating your network.

Table 1-1. EI990 Kits

Part Number	Description
	EI990 Kit, part number 2239125-0002
2239135-0001	EI990 Ethernet interface
2239129-0001	EI990-to-transceiver cable, 10 meters (32.8 feet)
2234392-9701	The EI990 installation and operation manual
	EI300/EI990 Maintenance Kit, part number 2239131-0001
2239148-0001	N-series male terminator, ungrounded
2303065-0001	18-pin loopback assembly (for EI990 only)
2239709-0001	15-pin loopback connector
2532884-0001	25-pin loopback connector
2244731-0001	Cable assembly, thick Ethernet, female-to-female

1.5 EI990 INTERFACES

Figure 1-3 shows the EI990 interfaces with the host computer TILINE, the computer front panel, and the external Ethernet transceiver. The paragraphs and tables following the figure describe the interfaces and list the pin assignments in all of the EI990 connectors.

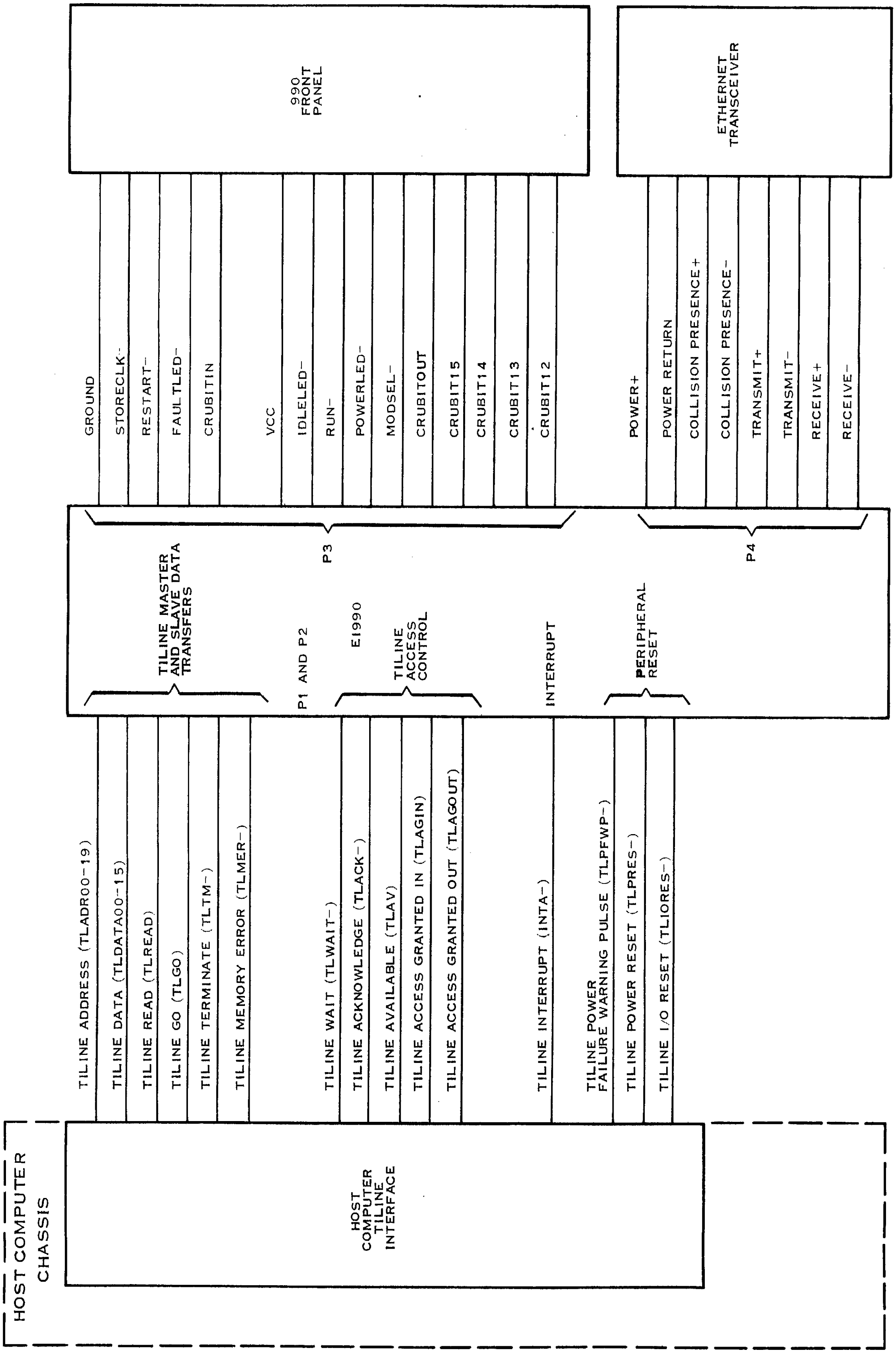


Figure 1-3. EI990 Interfaces

1.5.1 EI990 to TILINE Interface

The EI990 connects to the TILINE interface of the host computer where it shares access to the TILINE bus with other high-speed peripheral controllers, and the central processing unit (CPU) of the host computer. The TILINE bus, which is a high-speed, bidirectional, 16-bit data bus with associated address and control lines, transfers data between all high-speed system elements.

Most of the devices connected to the TILINE can function as both TILINE masters and TILINE slaves. For example, when the EI990 requests and is granted access to the TILINE to transfer data to the main memory in the host computer, it functions as a TILINE master and the main memory is a TILINE slave. When the host computer has control of the TILINE to transfer data or commands to the EI990, the host computer is the master and the EI990 is the slave.

The devices connected to the TILINE compete for access to the bus through a positional priority scheme established by their location in the chassis of the host computer or expansion chassis. The high-speed peripherals are usually assigned highest priority and the CPU of the host computer is assigned the lowest. Section 2 provides instructions on how to install the EI990 in the host computer and establish a TILINE priority for the EI990.

Table 1-2 lists the pin assignments and functions of the TILINE interface signals.

Table 1-2. TILINE Interface Connector (P1 and P2) Pin Assignments

Signal Signature	Pin Number	Function
TLGO-	P1-25	TILINE Go: From master to slave, initiates a data transfer on transition from high to low.
TLREAD	P1-11	TILINE Read Control: From master to slave, high for read, low for write.
TLADR00-	P2-55	TILINE Address: From master to slave, defines the location of data during a fetch or store operation.
01-	P2-44	
02-	P2-51	
03-	P2-53	
04-	P2-57	
05-	P2-59	
06-	P2-47	
07-	P2-49	
08-	P2-17	
09-	P2-19	
10-	P2-10	
11-	P2-12	
12-	P2-11	
13-	P2-13	
14-	P2-8	
15-	P2-9	
16-	P2-29	
17-	P2-27	
18-	P2-25	
TLADR19-	P2-31	
TLDAT00-	P2-67	TILINE Data: Bidirectional data bus between master and slave.
01-	P2-69	
02-	P2-35	
03-	P2-37	
04-	P2-61	
05-	P2-63	
06-	P2-43	
07-	P2-45	
08-	P2-21	
09-	P2-33	
10-	P2-23	
11-	P2-20	
12-	P1-27	
13-	P1-28	
14-	P1-30	
TLDAT15-	P1-31	

Table 1-2. TILINE Interface Connector (P1 and P2) Pin Assignments (Continued)

Signal Signature	Pin Number	Function
TLTM-	P1-20	TILINE Terminate: From slave to master, indicates termination of a data transfer.
TLMER-	P1-55	TILINE Memory Error: From slave to master, indicates a memory parity error.
TLAGIN- TLAGOUT-	P2-6 P2-5	TILINE Access Granted: From master to master, establishes master priority.
TLAK-	P1-71	TILINE Access Granted Acknowledge: From master to master, controls master access to TILINE.
TLAV	P1-58	TILINE Available: From master to master, indicates that the TILINE is available.
TLIORES-	P2-14	TILINE Input/Output Reset: CPU to all modules, indicates power failure or CPU programmed device reset.
TLPRES-	P2-13	TILINE Power Reset: Reset signal generated by the host computer power supply when power starts to fail and until voltages are stable during power-up.
TLPFWP-	P2-16	TILINE Power Failure Warning Pulse: A pulse that precedes TLPRES- to warn the peripheral device that power is going down.
TLWAIT-	P1-63	TILINE Wait: When low, suspends all TILINE master devices from using the TILINE bus. Generated by bus couplers to allow them to use the bus as the highest-priority user.
EXTINT-	P2-66	External Interrupt: Interrupt from the EI990 to the host computer.
+ 12 Vdc	P1-39,40 P2-39,40	
+ 5 Vdc	P1-3,4,77,78	
Ground	P1-1,2,12,15,17,19,21,24,26,57,59,79,80 P1-1,2,7,24,30,58,79,80	

1.5.2 EI990 to Front Panel Interface

The signals in connector P3 allow you to connect a 990A13 programmer panel or a maintenance unit programmer panel to the EI990 to monitor functions and interact with the logic on the EI990 for troubleshooting purposes. Firmware in the EI990 allows the EI990 to emulate the front panel interface of a Business System 600 or 800 or Model 990 computer so existing hardware and software can be used to check the EI990. Table 1-3 describes the pin assignments and signal functions in connector P3.

Table 1-3. Front Panel Connector (P3) Pin Assignments

Signal Signature	Pin Number	Function
GND	1,3,4,17	Ground.
STORECLK-	2	When active low, it generates a strobe clock for the write enable logic in the programmer panel.
RESTART-	5	RESTART- is generated at the programmer panel by pressing the HALT/SIE switch on the panel. When in active low, it generates a halt signal to the EI990.
FAULTLED-	6	FAULTLED- is generated by the EI990 to indicate the results of a test. It lights the FAULT LED on the programmer panel.
CRUBITIN	7	Serial input data line from the programmer panel to the EI990. It is enabled when MODSEL- is active low, indicating that the programmer panel is the selected device.
SPAREIO	8	Reserved for future use.
VCC(+5V)	9,10	Supplies +5 volt power to the programmer panel.
IDLELED-	11	When active low, it lights the IDLE LED on the programmer panel, indicating that the EI990 is idle.
RUN-	12	RUN- is generated by the EI990 to indicate that the EI990 is in the run mode. It causes the RUN LED on the programmer panel to light.
MODSEL-	13	When active low, it indicates that the programmer panel is the selected device.
CRUBITOUT	15	Serial data line from the EI990 to the programmer panel. The programmer panel samples data on this line when STORECLK- goes low.
CRUBIT15 CRUBIT14 CRUBIT12 CRUBIT13	16 18 19 20	CRU bits 12 through 15 address a specific bit in the programmer panel. For read operations, they address the bit that will be read by the EI990. For write operations, they are used to generate control strobes in the programmer panel.

1.5.3 EI990 to Ethernet Transceiver Interface

The EI990 connects to transceiver cable 2239129-0001 at 18-pin male board-edge connector P4. One end of the transceiver cable has an 18-pin female connector that mates with P4. The other end is a 15-pin female connector that mates with the Ethernet transceiver or with standard Ethernet transceiver cables if you wish to add extension cables. Table 1-4 lists the pin assignments in both ends of the transceiver cable. Table 1-5 describes the functions of the signals at connector P4.

The pin assignments in connector P4 were chosen to be compatible with an existing loopback connector, part number 2303065-0001.

Table 1-4. Transceiver Cable Pin Assignments

Pin Number	18-Pin Connector (Mates With P4)	15-Pin Connector (Mates With Transceiver)
1	No connection	Shield (connect to shell)
2	No connection	Collision presence +
3	No connection	Transmit +
4	No connection	No connection
5	No connection	Receive +
6	No connection	Power –
7	No connection	No connection
8	No connection	No connection
9	Collision presence +	Collision presence –
10	Collision presence –	Transmit –
11	Power +	No connection
12	Power –	Receive –
13	Receive +	Power +
14	Receive –	No connection
15	Transmit +	No connection
16	Transmit –	—
17	No connection	—
18	Connector key	—

Table 1-5. Transceiver Interface Signal Descriptions

Signal Name	Function
Transmit + Transmit –	The transmit pair carries Manchester-encoded data from the EI990 to the Ethernet transceiver.
Receive + Receive –	The receive pair carries Manchester-encoded data from the transceiver to the EI990.
Collision presence + Collision presence –	The transceiver generates a signal that indicates the presence of a collision on the network. A collision occurs when two or more stations try to transmit at the same time.
Power + Power –	The power pair supplies + 12 Vdc to the transceiver.

1.6 COMPATIBLE SOFTWARE

The EI990 operates with the Texas Instruments Distributed Network Input/Output (DNIO) software package, release 2.0 or later and the Distributed Network Operating System (DNOS), release 1.2.1 or later. The DNIO software is not compatible with the DX10 operating system.

The DNIO software package provides the necessary device service routine (DSR) for the EI990 and allows you to communicate in an Ethernet network. DNIO also provides the capability of communicating in packet switching networks that conform to the Consultative Committee on International Telephone and Telegraph (CCITT) recommendation X.25. Refer to the *DNOS Distributed Network I/O (DNIO) User's Guide*, part number 2308793-9701, for details on using the software. The *DNOS Distributed Network I/O (DNIO) Object Installation Guide*, part number 2308791-9701, defines networks.

1.7 FUNCTIONAL OVERVIEW

Figure 1-4 is a highly simplified functional block diagram of the EI990. The major functional areas are the TILINE master and slave interface with the host computer, the microprocessor, the onboard memory, and the Ethernet control logic.

The principal function of the EI990 is to transmit data supplied by the host computer to other stations on the Ethernet and to receive data addressed to the host computer from other stations on the Ethernet.

The host computer and the EI990 synchronize communications through four slave words that are located in the host computer's TILINE peripheral control space (TPCS). The TPCS is a group of memory locations reserved for communications between the host computer and TILINE peripheral controllers, such as the EI990. The base (beginning) address of the four-register file containing the four slave words can be set between >1FF800 and >1FFBF8. The > symbol indicates hexadecimal values throughout this manual. Section 2 describes how to set the base address, using the seven pencil switches on the EI990.

The first two slave words contain interrupt, status, lock, and attention information that the host and the EI990 use to synchronize communications. The host uses the third and fourth slave words to pass TILINE memory addresses to the EI990. The memory addresses in the third and fourth slave words point to the location of shared data structures that are used to transfer transmit and receive data, status, or additional control information between the host and the EI990. The EI990 also returns self-test status and error messages in the third and fourth slave words.

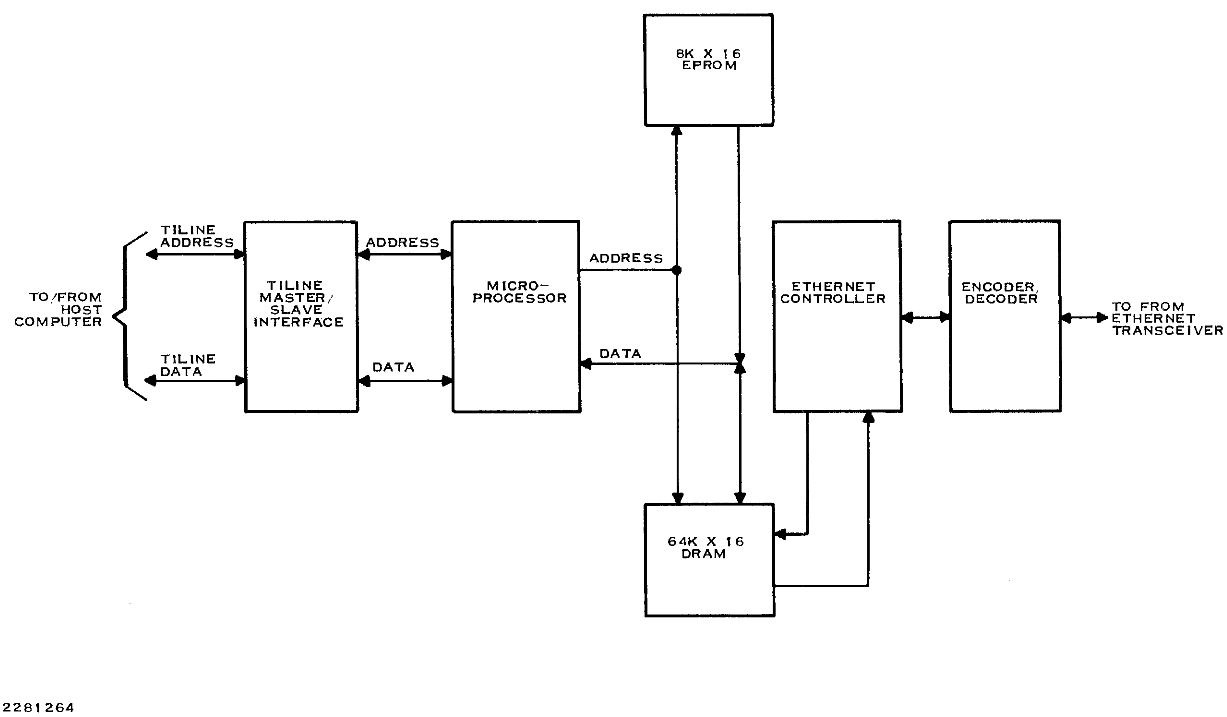


Figure 1-4. EI990 Functional Block Diagram

The microprocessor is responsible for performing all onboard self-testing, managing the onboard memory, communicating with the host computer, and managing the Ethernet devices. It is also capable of supporting high-level data protocols, using downloaded programs. The microprocessor is also responsible for moving transmit data from host memory to EI990 memory and receive data from buffers in EI990 memory to host memory.

The 16K (K equals 1024) bytes of erasable programmable read-only memory (EPROM) on the EI990 contain self-test programs, primitive code, and front panel code. The EPROM also contains data link code that is copied to RAM for execution when the EI990 is initialized.

The 128K bytes of dynamic random-access memory (DRAM) are used by the microprocessor as needed. Normal uses are for scratch memory, downloaded code, command queues, data structures, and buffering transmit and receive data frames.

The Ethernet controller and the encoder/decoder handle the data link and physical layers of Ethernet protocol, corresponding to layers 1 and 2 of the 7-layer Open Systems Interconnect (OSI) model developed by the International Standards Organization (ISO). Some of the functions that the Ethernet controller performs are as follows:

- Controls access to the Ethernet
- Performs serial-to-parallel conversion of receive data
- Performs parallel-to-serial conversion of transmit data
- Recognizes the station address on incoming messages
- Detects collisions on the Ethernet and calculates back-off time
- Generates the cyclic redundancy check (CRC) character on transmit frames and transmits it with the frame; calculates a CRC on receive frames and compares it with the CRC in the frame
- Performs error detection and reporting
- Reports status of transmit and receive frames

Some of the functions provided by the encoder/decoder are as follows:

- Provides Ethernet transceiver cable drivers and receivers
- Manchester-encodes transmit data and decodes receive data
- Synchronizes its internal clock to the timing of the incoming receive data in a phase-locked loop (PLL) and provides a receive clock to the Ethernet controller that is synchronous with the receive data
- Informs the Ethernet controller of activity on the collision presence pair
- Provides a 25-millisecond watchdog timer to prevent tying up the Ethernet

2

Installation

2.1 GENERAL

This section describes how to unpack, install, and perform initial checkout of the EI990. It also includes the power and environmental requirements of the EI990 to help you plan your installation.

NOTE

All values in this section preceded by the greater than (>) symbol are hexadecimal.

2.2 UNPACKING AND INSTALLATION

The EI990 ships either in a kit (part number 2239125-0002) or as a part of a system where it is already installed in a Business System Series 600 or 800 computer. If the EI990 is already installed in a computer, you should use the unpacking and inspection instructions in the *Model 990A13 Chassis Maintenance Manual, General Description*, part number 2308774-9701, shipped with each Business System Series 600 or 800 computer.

The EI990 kit is shipped in a cardboard container with the EI990 board enclosed in a conductive anti-static bag and wrapped in bubble-pack. Unpack the kit and inspect it as follows:

CAUTION

The EI990 contains static-sensitive electronic components. To avoid damage to these components, ensure that you are well grounded before removing the EI990 from its protective package and handling it.

The recommended method is to use a static-control system consisting of a static-control floor or table mat and a static-control wrist strap. These items are commercially available. If you do not have access to a static-control system, you can discharge any accumulated static charge by touching a grounded object prior to handling the EI990. Then, as a further precaution, place the EI990 on a grounded work surface after removing it from the protective package.

Always return the EI990 to its protective storage bag before transporting or storing it.

1. Before unpacking the cardboard container, inspect it for damage, such as crumpled corners, tears, water stains, and so on.

2. Open the cardboard container and remove the contents.

3. Inventory the contents. Table 1-1 lists the part numbers and describes each item that you should receive in the EI990 kit.

4. Ensure that you are grounded or have touched a grounded object, then remove the board from its protective package. Verify that the part number of the board matches the part number in Table 1-1.

5. Inspect the board for any cracks, loose or damaged components, or loose material lodged between components that could cause a short circuit.

6. If you ordered additional cables or parts for your Ethernet, verify that their part numbers match the part numbers on the shipping list and inspect them carefully for damage.

2.3 PLANNING

The EI990 board requires one full-slot location in the host computer chassis or in a TILINE expansion chassis. The power requirements of the EI990 are as follows:

4.0 amperes at +5 Vdc ±0.25 Vdc
0.5 amperes at +12 Vdc ±0.60 Vdc

Table 2-1 lists the environmental requirements for the EI990.

Table 2-1. EI990 Environmental Requirements

Operating temperature	+10° C (50° F) to +40° C (104° F)
Operating temperature (extreme)	+55° C (131° F) for 2 hours without damage
Shipping temperature	−40° C (−40° F) to +65° C (149° F)
Humidity (operating)	15% to 80% noncondensing
Humidity (shipping)	5% to 95% noncondensing
Shock (operating)	1 g
Shock (shipping)	15 g to shipping container
Vibration (operating)	1 g; 5 Hz to 80 Hz 0.3 g; 80 Hz to 500 Hz
Altitude (operating)	0 m to +2000 m (0 ft to 6560 ft)

2.4 INSTALLATION

Before installing the EI990 in a host computer chassis or a TILINE expansion chassis, you must do the following:

- Select a suitable chassis slot for the EI990.
- Configure the interrupt level jumpers or switches in the computer chassis to allow proper interrupt processing between the software in the host computer and the EI990.
- Remove the TILINE access-granted jumper for the slot in which you install the EI990.
- Set the EI990 TILINE base address switches.
- Install the DNIO software and then regenerate the system to inform the system software of the TILINE base address and interrupt level selected for the EI990. You can perform this step after you install the board if you wish.

The following paragraphs explain how to accomplish these tasks.

CAUTION

Always turn off power to the computer when installing or removing any circuit board from the chassis to prevent damage to the computer or to the circuit board.

2.4.1 Selecting a Chassis Slot

The general guideline for selecting a slot for the EI990 is to use the first available slot in the chassis, starting with the slot that has the lowest TILINE priority (closest to the CPU) and the lowest interrupt priority (highest-numbered interrupt). Use the following guidelines if they apply to your installation:

- For a Business System 600, use the following slots:
  - If the chassis has no memory expansion, use slot 2 at interrupt level >F.
  - If the chassis has memory expansion, use slot 4 at interrupt level >C.
- For Business System 800, 990/10 systems, and 990/10A systems with memory expansion, select a slot as follows:
  - Slots 1 through 4 are normally occupied. Slot 6 shares the interrupt level of slot 10 and should not be used.
  - If slot 8 is empty and slot 7 contains a TILINE peripheral bus interface (TPBI), use slot 8 and set the interrupt jumper to >E (slot 12, P1, must be empty also).
  - If slot 8 is empty and slot 7 contains a TILINE board other than a TPBI, use slot 8 with interrupt 9.
  - If slot 8 is not empty, use slot 11 with interrupt level >7.

If you install the EI990 in a TILINE expansion chassis, the expansion chassis must be set up for TILINE master devices. TILINE expansion chassis are normally shipped from the factory set up for TILINE slave devices only. For details on configuring a TILINE expansion chassis, refer to the *Model 990 Computer TILINE Coupler User's Guide*, part number 2268688-9701.

Be sure to update the configuration label on the chassis after you select a slot and install the board.

2.4.2 Modifying Interrupt Connections

Interrupt connections required to interface peripheral equipment to a Business System 600 or 800 computer are usually made before the system is shipped to the customer. These interrupt assignments are coordinated with the software supplied with the system so that the software can communicate with and control the peripheral device. If you purchase the EI990 as a kit, you may need to modify the interrupt connections as part of the board installation.

The method of modifying the interrupts varies with the chassis in which you install the EI990. You can install the EI990 in a 6-slot, 13-slot, or 17-slot chassis used with earlier TI computer systems, or in the 13-slot 990A13 chassis introduced in 1982 with the Business System 600 and 800 computers. TI ships a manual describing how to modify interrupts for installation of boards with each of the different chassis. Select the appropriate manual from the following list:

- If you are installing the EI990 in a 6-slot or 13-slot chassis, refer to the *Model 990/10 Computer System Hardware Reference Manual*, part number 945417-9701.
- If you are installing the EI990 in a 17-slot chassis, refer to the *Model 990/12 Computer Hardware User's Manual*, part number 2264446-9701.
- If you are installing the EI990 in a 990A13 chassis, refer to the *Model 990A13 Chassis Maintenance Manual, General Description*, part number 2308774-9701.

NOTE

It is possible to install more than one EI990 in a chassis, such as in a gateway installation connecting two Ethernet networks. EI990s cannot share a TILINE interrupt unless the user writes special code to allow shared interrupts.

2.4.3 Removing TILINE Access-Granted Jumpers

A priority system based on slot location prevents two TILINE masters from getting access to the TILINE at the same time. The highest-numbered slot in the chassis (6, 13, or 17) has the highest priority. Slot 1 has the lowest priority. The TILINE access-granted signal goes through all TILINE masters and is jumpered around each slot that does not have a TILINE master installed. You must remove the TILINE access-granted jumper from the slot that you select for the EI990 to allow the EI990 to contend for access with the other TILINE masters. The 17-slot chassis has switches instead of jumpers. When you install the EI990 in a 17-slot chassis, you must set the switch to the OFF position for the selected slot.

The manuals shipped with each chassis contain a detailed description of how to remove the TILINE access-granted jumpers or position the switches for the particular chassis. Refer to the manuals listed in paragraph 2.4.2 for instructions.

2.4.4 Setting the TILINE Base Address Switches

The TILINE base address switches are located near the center of the EI990 board. Logic on the EI990 compares pencil switches 1 through 7 to bits 11 through 17 of the 20-bit TILINE address from the host computer (as shown in Figure 2-1) to determine when the host is addressing the EI990. Figure 2-1 contains a table that lists TILINE addresses within the legal range of >FFC00 to >FFDFC and shows the switch settings for each address. The table also lists the 16-bit CPU byte address that maps to each 20-bit TILINE address as an aid to programmers.

The preferred address for the EI990 is >FFC70 (CPU byte address >F8E0); however, you can assign it any address within the legal range as long as the address is compatible with the system software.

2.4.5 Installing the EI990

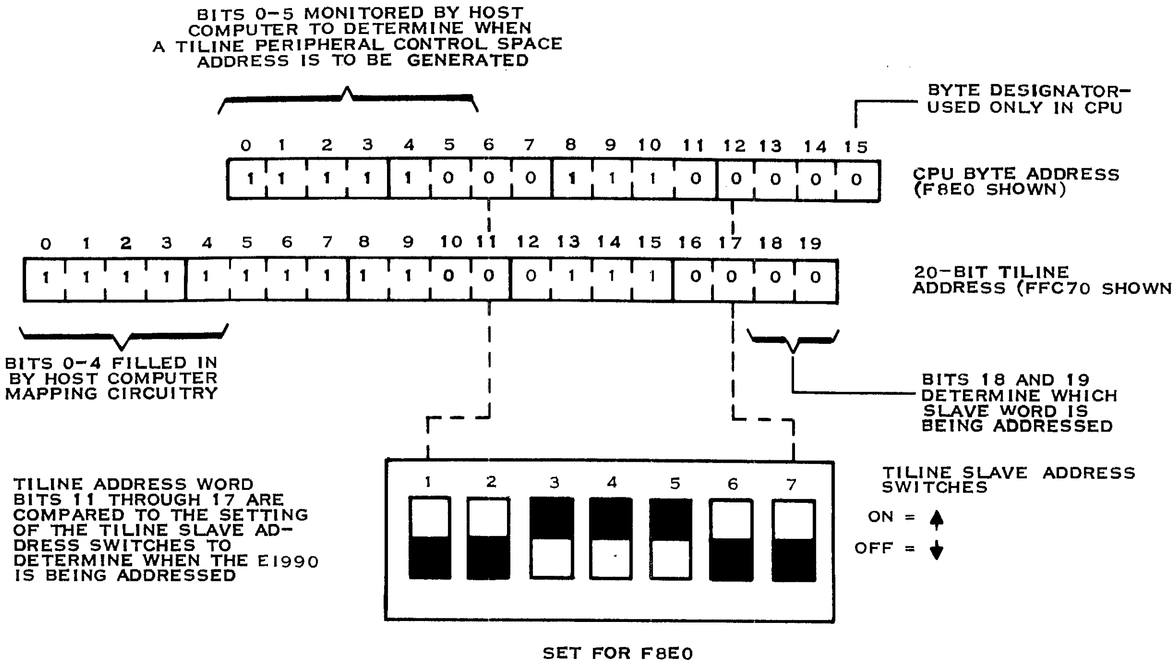
By now you should have accomplished the following:

- Selected a chassis slot for the EI990
- Modified the interrupts
- Removed the TILINE access-granted jumper (or set the switch off) for the slot where you are going to install the EI990
- Set the TILINE base address switches

In some cases, you will need to remove the insulator sleeve from the shield-stiffener on the board before installing the EI990. Installation in some chassis requires that you clip the ejector tabs to get the board to seat properly. Read the next two paragraphs to see if you need to remove the insulator or clip the ejector tabs on the board, then install the EI990 in the selected slot.

The EI990 is shipped from the factory with an insulator sleeve installed on the upper lip of the shield-stiffener. If you install the EI990 in a chassis with conventional (unshielded) boards, leave the insulator in place to protect the board above the EI990 from shorting to the metal shield. When you install the EI990 in a chassis with other shielded boards, remove the insulator from the upper lip of the shield by sliding it off as shown in Figure 2-2.

Boards equipped with ejectors such as those on the EI990 sometimes are hard to seat properly, especially in the 17-slot chassis. If you encounter difficulty seating the EI990, clip the tabs off the ejectors as shown in Figure 2-3.



HEXADECIMAL ADDRESS		TILINE ADDRESS SWITCHES
CPU BYTE	TILINE	1 2 3 4 5 6 7
F800	FFC00	0 0 0 0 0 0 0
F808	FFC04	0 0 0 0 0 0 X
F810	FFC08	0 0 0 0 0 X 0
F818	FFC0C	0 0 0 0 0 X X
F820	FFC10	0 0 0 0 X 0 0
F828	FFC14	0 0 0 0 X 0 X
F830	FFC18	0 0 0 0 X X 0
F838	FFC1C	0 0 0 0 X X X
F840	FFC20	0 0 0 X 0 0 0
INCREMENTS OF 8_{16}	INCREMENTS OF 4_{16}	STRAIGHT BINARY SEQUENCE
F8E0	FFC70	0 0 X X X 0 0
F8E8	FFC74	0 0 X X X 0 X
F8F0	FFC78	0 0 X X X X 0
F8F8	FFC7C	0 0 X X X X X
F900	FFC80	0 X 0 0 0 0 0
F908	FFC84	0 X 0 0 0 0 X
F910	FFC88	0 X 0 0 0 X 0
F980	FFCC0	0 X X 0 0 0 0
FBE0	FFDF0	X X X X X 0 0
FBE8	FFDF4	X X X X X 0 X
FBF0	FFDF8	X X X X X X 0
FBF8	FFDFC	X X X X X X X

X = ON
0 = OFF

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Figure 2-1. EI990 TILINE Base Address Switches

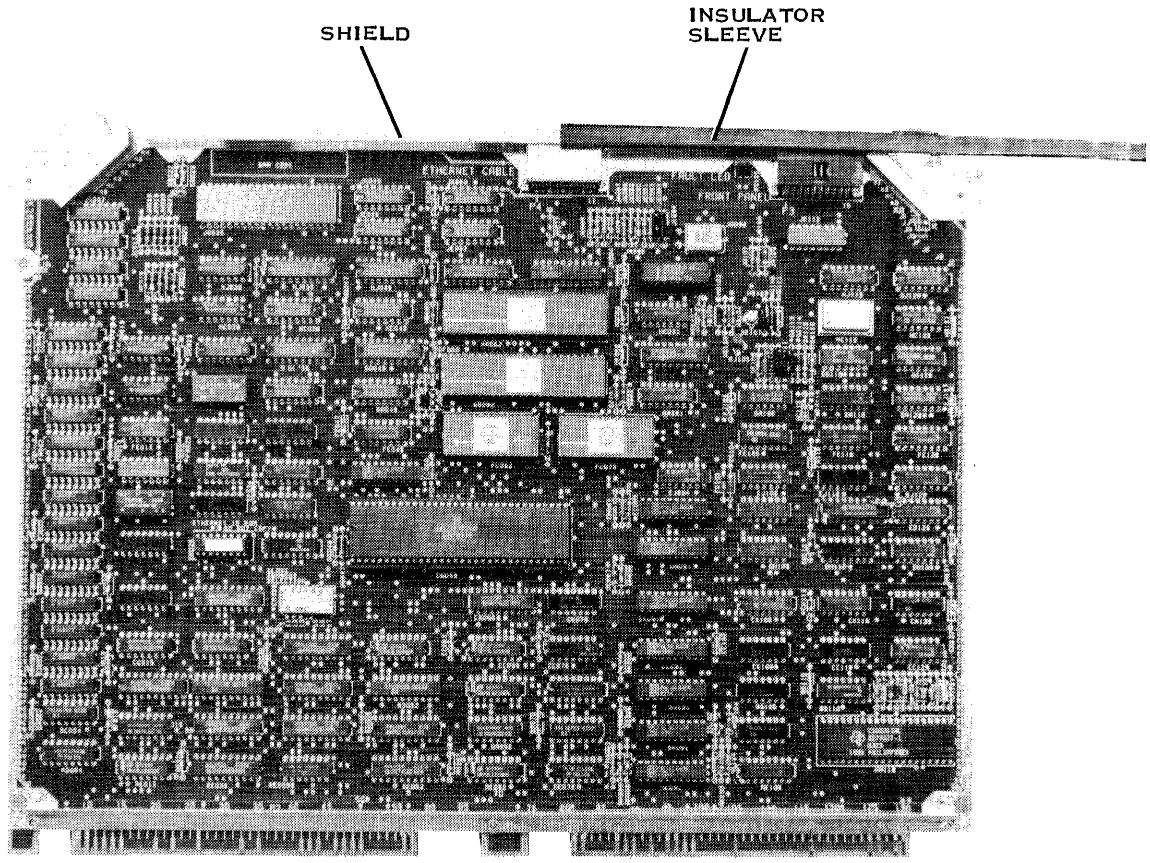

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Figure 2-2. Removing the Insulator From the EI990

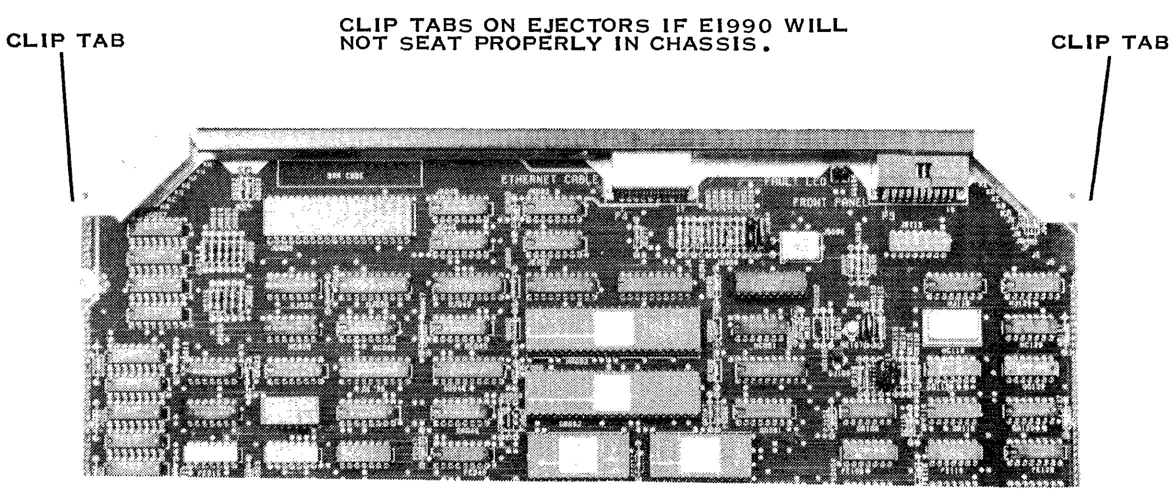

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Figure 2-3. Clipping the Ejector Tabs

2.4.6 Software Considerations

You must load the DNIO software according to the instructions in the object installation guide referenced in paragraph 1.5. After loading the DNIO software, regenerate the system (sysgen) so you can input the TILINE base address and interrupt level selected for the EI990. Refer to the software manuals shipped with your system software for information on adding controllers to your system and regenerating the system.

2.5 CABLE CONNECTIONS

Once you have installed the EI990 in the selected slot, you are ready to connect it to the Ethernet. The 10-meter (32.8-foot) EI990-to-transceiver cable (part number 2239129-0001) has an 18-pin connector on one end and a 15-pin connector on the other end. Connect the 18-pin connector to P4 on the EI990. P4 is keyed so the connector cannot be reversed. Connect the 15-pin connector to the Ethernet transceiver, or if you need extension cables, connect the 15-pin connector to an extension cable and then connect the extension cable to the Ethernet transceiver. The maximum length of transceiver cable between the EI990 and the transceiver is 50 meters (164 feet). Extension cables are available in the following lengths:

Part Number	Length
2239133-0001	10 meters (32.8 feet)
2239133-0002	20 meters (65.6 feet)

Figure 2-4 shows how the EI990 connects to a 3Com transceiver with the EI990-to-transceiver cable.

There are three separate ground systems in the Ethernet network: the chassis ground, dc power return, and the coaxial cable shield. Chassis ground is common to the Ethernet transceiver case when the EI990 is connected to the transceiver. The coaxial cable shield is isolated from the transceiver case at the coaxial connector on the transceiver. The dc power return on pin 6 of the 15-pin transceiver cable connector is isolated from the chassis ground and the coaxial cable shield.

When you install your Ethernet transceiver, ensure that it is insulated from any metal in the building. You must also take care to insulate any connectors that you install on the coaxial cable to prevent the coaxial shield from contacting building metal. If the cable shield and the transceiver case both contact building metal, ground loop problems and intermittent operation of the Ethernet can occur.

Refer to Appendix A for Ethernet rules and information on installing Ethernet transceivers and the coaxial cable.

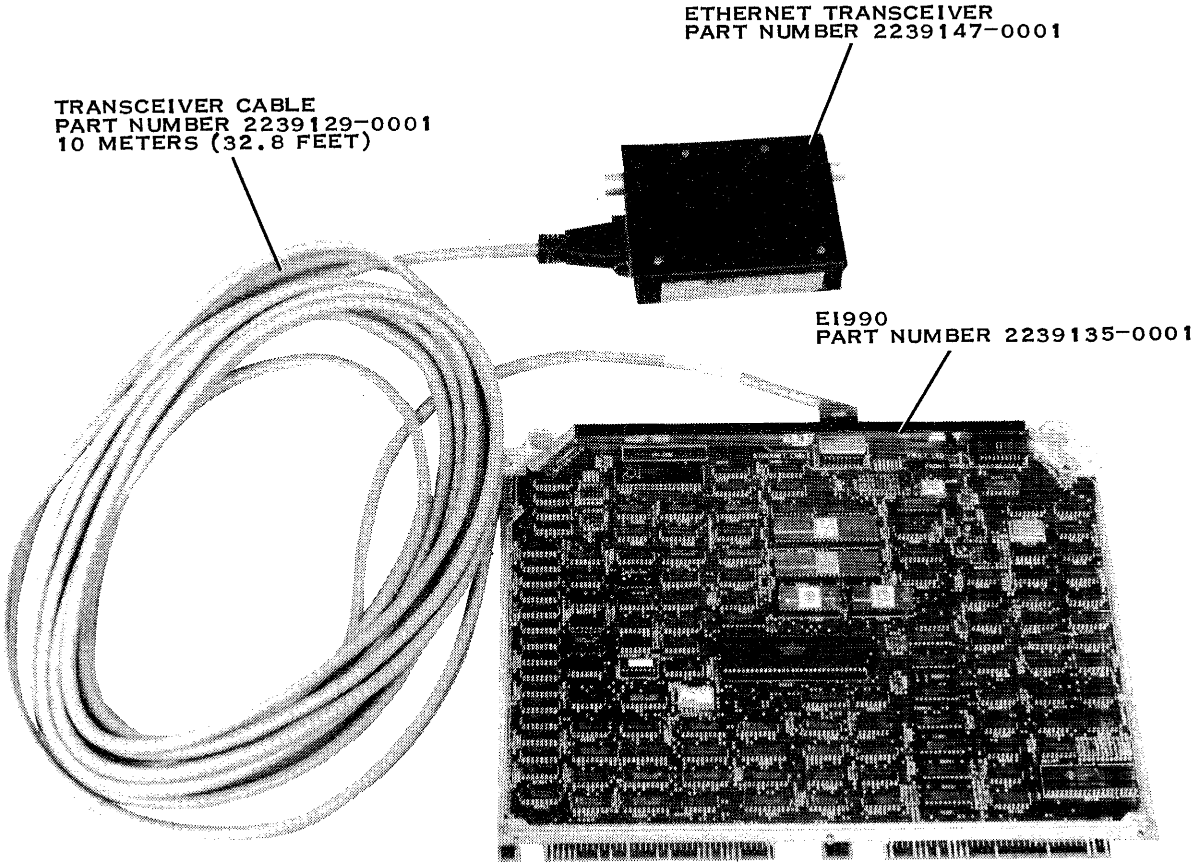

Figure 2-4. Connecting the EI990 to the Ethernet

2.6 CHECKOUT

After you have installed the EI990 in the host computer chassis and connected it to the Ethernet as described earlier in this section, you are ready to check it for proper operation. The first level of checkout is to execute the built-in self-test program. The self-test program checks most of the logic on the EI990, the transceiver cable, and the transceiver.

If checkout with self-test indicates problems, you can perform a few simple checks to determine whether the problem is in the EI990 or in the transceiver cable, the transceiver, or the network. You need to load the EI990 diagnostic and use it for extensive checking. You will also need the loop-back connectors from the maintenance kit to thoroughly check the drivers and receivers on the EI990 and to check the transceiver cable.

Two loopback connectors are available for testing the EI990. They mate with the EI990 and transceiver cable as shown in Figure 2-5. Loopback connector 2303065-0001 mates with P4 on the EI990 and allows you to use the external loopback test to check the transmitting and receiving logic on the EI990, including the drivers and receivers in the encoder/decoder chip. It does not check the collision circuit. Loopback connector 2239709-0001 mates with the 15-pin connector on the transceiver cable and allows you to include the cable in the external loopback test.

The following paragraphs describe how to check the EI990 with self-test and with the diagnostic.

2.6.1 Checkout With Self-Test

The built-in EI990 self-tests execute any time you power up the computer or reset the EI990. If your computer has a programmer panel, you can execute the self-tests, using the front panel. If your computer does not have a programmer panel, you must remove and reapply computer power to cause the self-tests to execute. The RESET switch on the computer does not reset the EI990 and will not cause the self-tests to execute.

The following paragraphs describe how to check your EI990 installation with or without a programmer panel. If your computer does not have a programmer panel, skip to the paragraph titled Executing Self-Tests Without a Programmer Panel.

2.6.1.1 Executing Self-Tests With a Programmer Panel. If your computer has a programmer panel, use the following procedure to execute the self-tests and verify your EI990 installation.

1. Press HALT.

2. Enter the TILINE address of the EI990 (usually >F8E0) by pressing the appropriate data entry switches.

3. Press ENTER MA.

4. Enter >0200 on the data entry switches. This value sets the master reset bit for the EI990 when you write it to the TILINE address of the EI990 in the next step.

5. Press MDE.

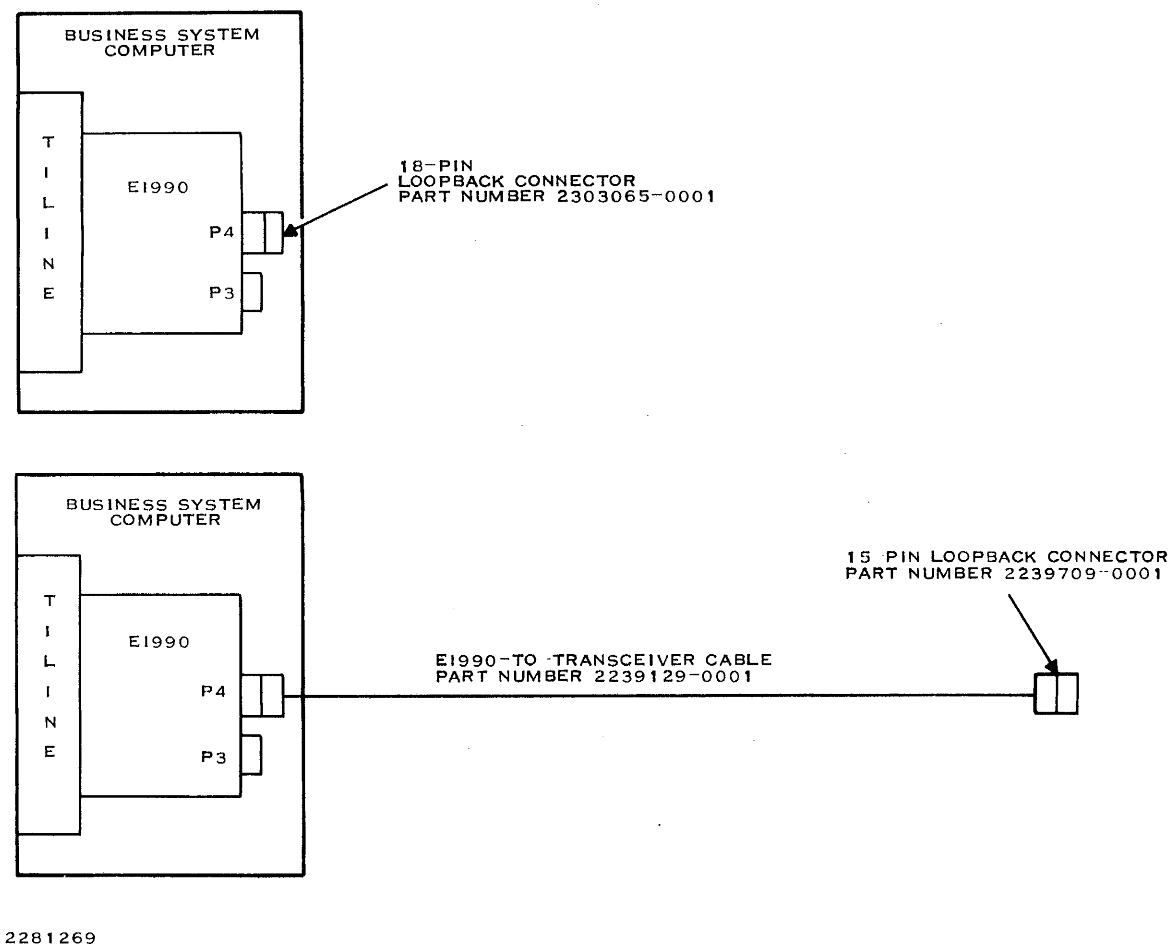

Figure 2-5. EI990 Loopback Connectors

6. Press MDD. Data LED 7 on the front panel should light while the self-tests execute. Wait a minimum of 15 seconds, then press MDD again. LED 7 should extinguish and LED 4 should light. If LED 7 does not extinguish, it indicates that one of the self-tests detected a problem in the EI990.

7. To determine which self-test failed, press MAI twice, then press MDD. The data LEDs display the hexadecimal test number of the self-test that failed and a status code. LEDs 0 through 7 contain the hexadecimal test number and LEDs 8 through 15 contain the status code. Table 2-2 lists the self-test numbers and describes the area of the EI990 that each one tests. Any status code greater than >80 indicates a test failure.

8. If the failing self-test number is >07 or >08, remove power from the computer and check the following:

   a. Ensure that you have set the TILINE base address switches to the correct base address and that no other TILINE controller in the chassis has the same base address.

   b. Ensure that you have removed the TILINE access-granted jumper or set the switch to the off position for the slot where you installed the EI990. Also check all empty slots between the highest TILINE master location and slot 1 to ensure that there is a jumper installed in each slot.

   c. Reseat the board in the chassis and check the transceiver cable connection.

   d. Power up the computer and execute the self-tests again to determine if you corrected the problem. If test >07 still fails, replace the EI990.

9. If the failing self-test number is >10, proceed as follows:

   a. Remove power from the computer.

   b. Disconnect the Ethernet transceiver cable from the transceiver.

   c. Install loopback connector 2239709-0001 on the transceiver-end of the transceiver cable.

   d. Reapply power and repeat the self-tests. If test >10 passes, the problem is in the transceiver or the Ethernet. Refer to the EI990 maintenance manual for information on troubleshooting network problems.

   e. If test number >10 still fails, remove computer power, disconnect the transceiver cable from P4 on the EI990 and install loopback connector 2303065-0001 on P4.

   f. Reapply computer power and execute the self-tests again.

   g. If test >10 passes this time, the transceiver cable is probably bad. Replace it and test again.

   h. If test >10 still fails, replace the EI990 and test again.

10. If the self-tests fail on any test other than those discussed here, you can replace the EI990 and test again or load the EI990 diagnostic to isolate the fault.

Table 2-2. EI990 Self-Test Routines

Test Number	Test Name	Test Description
>00	Self-test all	Performs all power-up tests
>01	EPROM checksum	Tests the firmware EPROMs
>02	RAM test #1	Tests DRAM for ability to hold data
>03	RAM test #2	Tests DRAM for addressing faults
>04	RAM test #3	Tests DRAM for pattern sensitivity
>05	PIT/interrupt-timer	Tests the parallel interface timer I/O, interrupt, and timer logic
>06	RAM test #4	Tests DRAM parity logic
>07	TILINE master W2, W3	Tests read/write of slave words 2 and 3
>08	TILINE master W0, W1	Tests read/write of slave words 0 and 1
>09	Programmer error	Tests programmer error detection logic
>0A	ID ROM checksum	Tests ID ROM data integrity
>0B	Ethernet controller timer self-test	Activates the Ethernet controller and checks its internal timers with an internal self-test
>0C	Ethernet controller loopback	Loops back data at the Ethernet controller output; does not test the encoder/decoder
>0D	Encoder/decoder loopback and address reject	Loops back data at the output of the encoder/decoder chip and tests the Ethernet controller's ability to reject addresses
>0E	Multicast receive	Tests the Ethernet controller's ability to receive multicast messages
>0F	Ethernet controller CRC logic test	Tests the Ethernet controller's CRC generation and checking logic
>10	External loopback	Tests Ethernet communication offboard

2.6.1.2 Executing Self-Tests Without a Programmer Panel. If your computer does not have a programmer panel, you must remove and reapply computer power to cause the self-tests to execute. The self-test/fault LED on the EI990 lights while the tests are executing and extinguishes when the tests complete successfully, in approximately 15 seconds. If the tests encounter a problem, the LED remains lighted.

Apply power to the computer to execute the self-tests. If the fault LED remains lighted after 15 seconds, proceed as follows:

1. Remove computer power.

2. Disconnect the Ethernet transceiver cable from the transceiver.

3. Install loopback connector 2239709-0001 on the transceiver-end of the transceiver cable.
4. Reapply computer power to execute the self-tests again.
5. If the fault LED extinguishes after 15 seconds, the problem is in the Ethernet transceiver or the Ethernet. Refer to the EI990 maintenance manual for information on troubleshooting network problems.
6. If the fault LED remains lighted, power down the computer and remove the transceiver cable from P4 on the EI990.
7. Install loopback connector 2303065-0001 on P4.
8. Reapply computer power to execute the self-tests again.
9. If the fault LED extinguishes at the end of the tests, the transceiver cable is probably bad. Replace the transceiver cable and retest to verify that a new transceiver cable fixed the problem.
10. If the fault LED still remains lighted with the loopback connector on P4, turn off computer power and check the following:
    a. Ensure that you have set the TILINE base address switches to the correct base address and that no other TILINE controller in the chassis has the same base address.
    b. Ensure that you have removed the TILINE access-granted jumper or set the switch to the off position for the slot where you installed the EI990. Also check all empty slots between the highest TILINE master location and slot 1 to ensure that there is a jumper installed in each slot.
    c. Reseat the board in the chassis and plug loopback connector 2303065-0001 onto P4.
    d. Power up the computer and execute the self-tests again. If the fault LED remains lighted after the self-tests complete, replace the EI990 and retest.
    e. If the fault LED extinguishes after the self-tests complete, power down the computer and reconnect the transceiver cable and transceiver. Apply power to the computer and allow the self-tests to execute to verify that there are no additional problems in the transceiver cable, transceiver, or the Ethernet.

2.6.2 Checkout With the Diagnostic

The diagnostic for the EI990 is ENETST. You can find instructions for loading the diagnostic in the *Model 990 Computer Unit Diagnostics Handbook*, *Volume 1*, part number 945400-9701. Volume 6 of the diagnostics handbook, part number 945400-9706, contains a program description of ENETST and explains how to use the tests included in the diagnostic. ENETST uses all of the self-tests that are executed on power-up and allows you to execute them individually so you can use the status and error messages to help locate problems. Table 2-2 lists the self-tests that are accessed by ENETST.

Notice that there are three loopback tests in the table, >0C, >0D, and >10. Two of them perform internal loopback tests; the third is an external loopback test. The Ethernet controller loopback test (>0C) loops serial data back inside the Ethernet controller to verify everything on the board except the encoder/decoder. The encoder/decoder loopback test (>0D) loops encoded data back inside the encoder/decoder while also checking the Ethernet controller's ability to reject addresses. Test >0D checks all of the transmitting/receiving logic on the board except the Ethernet drivers and receivers in the encoder/decoder.

The external loopback test (>10) causes the EI990 to generate and transmit self-addressed frames. Since the frames contain the station address of the EI990 in their destination field, the receiving circuits on the EI990 receive the frames. This test checks the EI990 transmitting and receiving logic, the transceiver cable, the transceiver, and the Ethernet. If the test fails, you can install the 15-pin loopback connector (part number 2239709-0001) on the transceiver-end of the EI990-to-transceiver cable and repeat the test to determine if the problem is in the Ethernet or in the EI990 and cable. If it still fails, you can install loopback connector part number 2303065-0001 on connector P4 to loop back signals at the board. If the test passes at this point, the problem is in the Ethernet or the transceiver cable. If it still fails but the internal encoder/decoder loopback test (>0D) passes, the Ethernet drivers or receivers in the encoder/decoder are faulty or the connector is bad.

When the diagnostic indicates failures from any of the tests except the TILINE tests (>07 and >08), you should replace the EI990 board with another board and repeat the tests. In the case of failure of one or both of the TILINE tests, you should check the following:

- Check the setting of the TILINE base address switches to ensure that they are set correctly and check the base address of the other TILINE boards in the chassis to ensure that there are no addressing conflicts.
- Check to be sure that you removed the TILINE access-granted jumper or set the switch to off for the EI990's slot. Also check the access-granted jumpers or switches on all other slots (even empty slots) to be sure that they are configured properly.
- Check to be sure that P1 and P2 are seated properly in the chassis connectors.
- If the TILINE tests still fail, try another chassis slot.
- If they still fail, execute the diagnostics for the host computer CPU and the other peripheral controllers in the chassis to be sure that there is not a CPU problem or a chassis problem.
- If the diagnostics for the CPU and other peripheral controllers pass, replace the EI990.

Appendix A

Ethernet Planning and Installation

A.1 WHAT IS ETHERNET?

Ethernet is a local area network (LAN) that conforms to a joint specification produced by Digital Equipment Corporation (DEC), Intel Corporation, and Xerox Corporation.

An Ethernet network provides the physical communication facility for high-speed data exchange between computer and terminal equipment in a moderate-sized area. The Ethernet specification defines the physical media and the data link protocol required to send and receive packets of information in an Ethernet network. This corresponds to layers 1 and 2 of the 7-layer Open Systems Interconnect (OSI) model developed by the International Standards Organization (ISO). The Ethernet specification does not define the higher-level protocols needed to provide a complete network architecture. Texas Instruments software products designed to work with Ethernet controllers contain the necessary high-level protocol.

The main purpose of the Ethernet specification is compatibility of the equipment on the network. The intent is for every device on the network to be able to exchange data with all other devices on the network. Adherence to the Ethernet specification ensures that the hardware on the network is compatible, but the ability of stations to exchange data is dependent upon the compatibility of their higher-level protocols.

When the higher-level protocols of the stations are compatible, any station can transmit a message to a specific destination station, to all of the stations on the network, or to a selected group of stations on the network. Ethernet data-link protocol provides best-effort delivery of data packets. The higher-level protocol provides the intelligence to ensure reliable delivery of information between stations.

A.1.1 Ethernet Characteristics

Some of the important characteristics of the Ethernet are listed here. If you need additional details or complete specifications on the Ethernet, refer to the specification produced by DEC, Intel, and Xerox: *The Ethernet, A Local Area Network, Data Link and Physical Layer Specifications*, Version 2.0, November 1982. This specification is normally called "the Blue Book."

Data rate:	10 million bits per second
Transmission medium:	Shielded baseband coaxial cable
Topology:	Bus (branching, nonrooted tree)
Number of stations:	1024 maximum
Length of a segment:	500 meters (maximum)
Length of network:	1500 meters (maximum) with local repeaters 2500 meters (maximum) with remote repeaters

Media access:	Carrier sense multiple-access with collision detection (CSMA/CD)
Packet size:	72 bytes (minimum), 1526 bytes (maximum)
Frame check sequence:	32-bit CRC

A.1.2 Ethernet Message Format

Figure A-1 shows the format of an Ethernet message. A complete message is called a packet or a frame. A packet consists of a minimum of 72 eight-bit bytes and a maximum of up to 1526 eight-bit bytes. All of the fields in a packet are fixed-length except the data field, which can vary in length from 46 to 1500 bytes. Bytes in the packet are transmitted least-significant bit first. The minimum spacing between packets on the Ethernet is 9.6 microseconds. The following paragraphs describe the contents of each field in the packet.

A.1.2.1 Preamble. The preamble is a 64-bit synchronization pattern of alternating ones and zeros, beginning with a one and ending with two consecutive ones. It allows the receiving station to synchronize its local clock on the incoming message. The preamble is a 5 Mhz signal with transitions only in the center of each bit cell.

A.1.2.2 Destination Address Field. The destination address is an six-byte field that specifies the station or stations to which the packet is being transmitted. Every station on the network examines the destination address in each packet placed on the network to see if it should accept the packet. The first bit in this field indicates the type of address. If the first bit is a zero, the remaining bits define the unique address of one destination station. If the first bit is a one, the address is a multicast address, indicating that the message is for a group of destination stations. In this case, the remaining bits define the address of the group of stations.

There is a special case of the multicast address called a broadcast address, where the message is intended for all stations on the network. All of the bits in a broadcast address are ones.

A.1.2.3 Source Address Field. The source address is a six-byte field that defines the unique address of the station transmitting the packet.

A.1.2.4 Type Field. The type field is a two-byte field that identifies the high-level protocol used in the data field. An example of a high-level protocol is Xerox Network Services (NS) Internet Protocol.

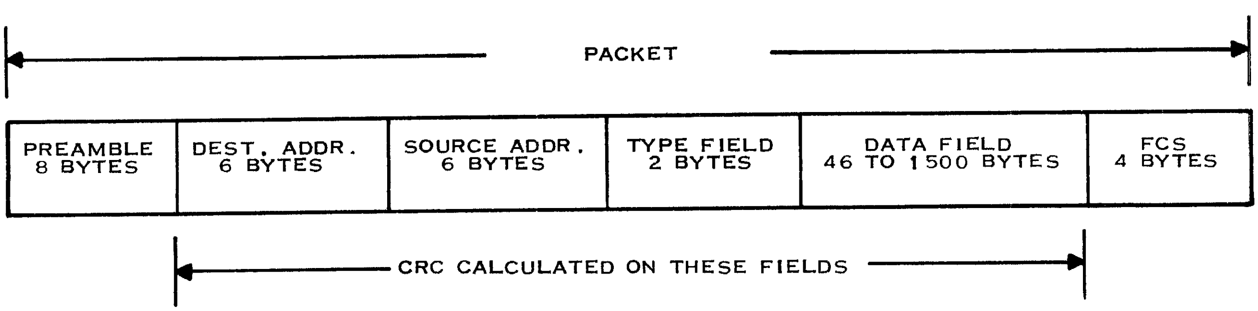

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Figure A-1. Ethernet Message Format

A.1.2.5 Data Field. The data field can contain from 46 to 1500 bytes of data. This field must be at least 46 bytes in length to ensure that the receiving station can distinguish valid packets from collision fragments.

A.1.2.6 FCS Field. The frame check sequence (FCS) field is a four-byte field containing the cyclic redundancy check (CRC) character.

A.1.3 Data Encoding Method

All information transmitted on the Ethernet is Manchester-encoded (Figure A-2). This method of encoding data translates physically separate clock and data signals into a single serial bit stream suitable for transmission on the coaxial cable. The receiving controller synchronizes on this encoded bit stream and decodes it to produce separate clock and data signals.

Manchester-encoding ensures a transition in the center of each bit cell. The first half of the bit cell contains the complement of the value of the bit; the second half of the bit cell contains the true value of the bit. Each bit cell is 100 nanoseconds long, resulting in a data rate of 10 million bits per second.

A.1.4 Transmit Control Procedure

The Ethernet uses a channel-access discipline called carrier-sense multiple-access with collision detection (CSMA/CD). This discipline defines when a station can transmit on the Ethernet and resolves the problem of more than one station contending for access to the Ethernet at one time. The major points in the control discipline are as follows:

- A station must wait (defer) if there is a carrier present on the Ethernet and must continue waiting for at least 9.6 microseconds (minimum interpacket gap) after the loss of carrier before it can transmit.
- A station can transmit if it is not deferring. It can continue to transmit until it reaches the end of the packet or until a collision occurs. A station must contend for access after each packet.
- When a transmitting station detects a collision, it must terminate transmission of the packet and transmit a jam signal of four to six bytes of arbitrary data to ensure that all other stations involved in the collision recognize the collision.

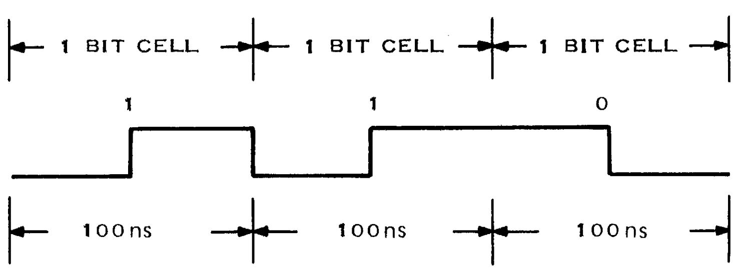

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Figure A-2. Manchester-Encoded Data Format

- When a transmitting station detects a collision and aborts, it must wait for a random period of time (called the backoff time) before attempting to retransmit the packet.
  - The backoff time that a station must wait is based on an algorithm that computes a random number of time units for the station to wait before attempting to retransmit. One time unit is 512 bit times (51.2 microseconds). The maximum waiting period is 52.4 milliseconds.
  - After 16 successive collisions, a station ceases its attempts to retransmit a message.

A.1.5 Receive Control Procedure

Ethernet stations receive packets according to the following rules:

- The physical layer synchronizes on the 64-bit preamble and produces the carrier sense signal. The carrier signal remains active until the transmission terminates or until a collision occurs.
- The Ethernet controller determines frame boundaries by the presence or absence of the carrier signal. When carrier terminates, the controller recognizes the end of a frame.
- All stations on the network examine the destination address to determine if they should accept the message. A station receives the rest of the frame if the destination address is its own unique physical address or if it is a multicast address that the station is programmed to accept. All stations accept broadcast messages unless programmed not to do so.
- The CRC in the FCS field of the message must be equal to the CRC computed by the receiving station for the message to be valid.
- The Ethernet data link procedures do not provide an acknowledgement of received data packets. The higher-level protocol must provide the acknowledgement to ensure reliable exchange of data between stations.

A.2 NETWORK RULES AND COMPONENT DESCRIPTIONS

Figure A-3 is a block diagram that shows most of the components used to build an Ethernet network. Notice that part of the network is connected with thick coaxial cable and part of it is connected with thin cable. This is not necessarily a typical Ethernet network, but is intended to show that a single network can contain both thick and thin Ethernet cable.

The thick cable is N-series coaxial cable, the standard cable for fabricating Ethernet networks. It is manufactured specifically for Ethernet use. Thin Ethernet is a special adaptation of Ethernet developed by the 3Com Corporation of Mountain View, California. It uses standard RG58 A/U coaxial cable. Thin Ethernet provides a less costly method of implementing an Ethernet but diminishes the maximum length of segments and the overall network length. Both the thick and thin cables have a 50-ohm characteristic impedance.

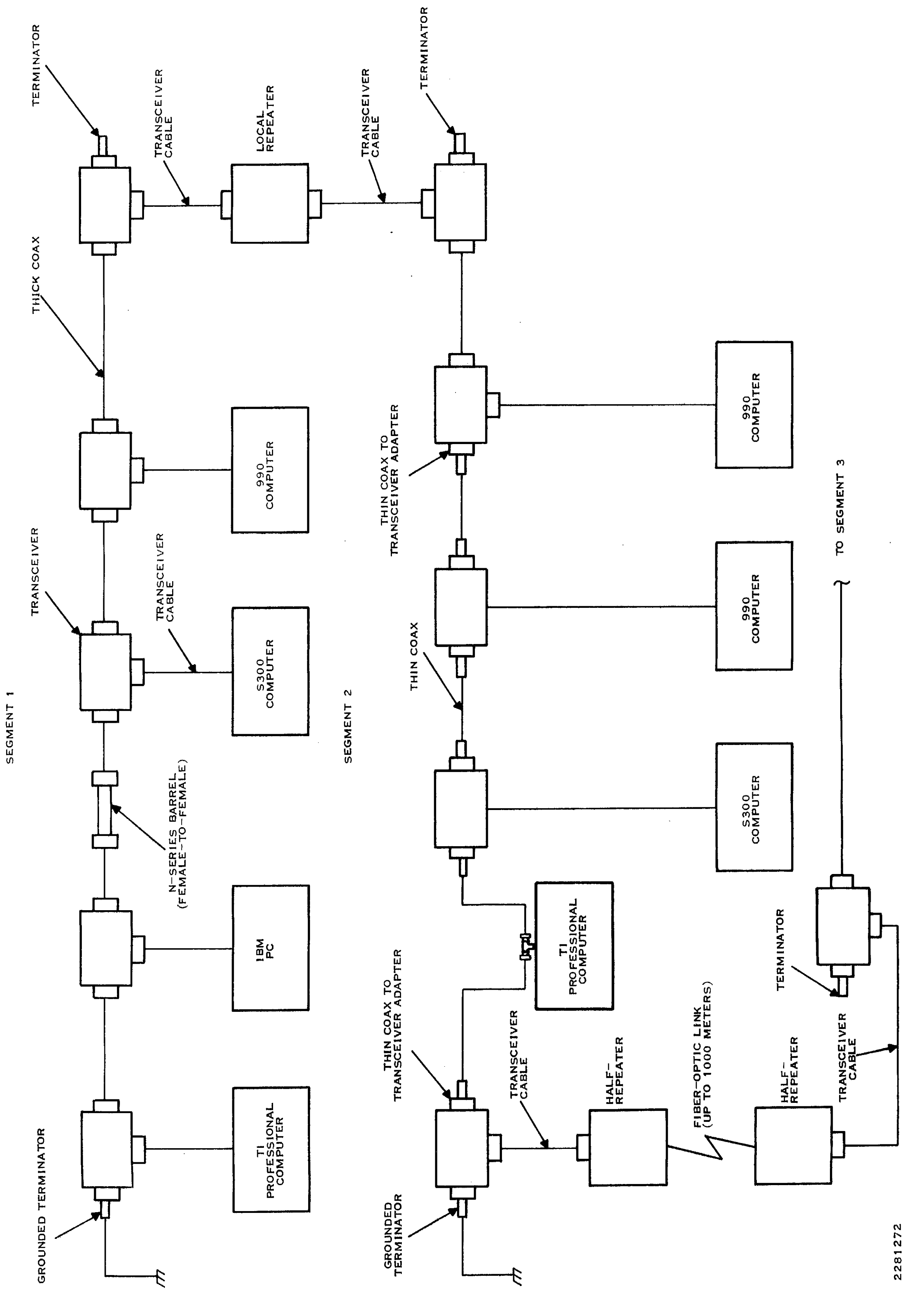

Figure A-3. Example Ethernet Network

If you are connecting a small number of computers and/or microcomputers such as the TI Professional Computer and the IBM® PC into an Ethernet, it is usually easier and less expensive to connect them with thin Ethernet. You can also join clusters on a thin Ethernet to a larger Ethernet with thin-to-thick cable adapters or with transceivers and local repeaters. Figure A-4 shows the components required for adapting from thin to thick cable. It also shows how you can change from thin to thick cable at a transceiver.

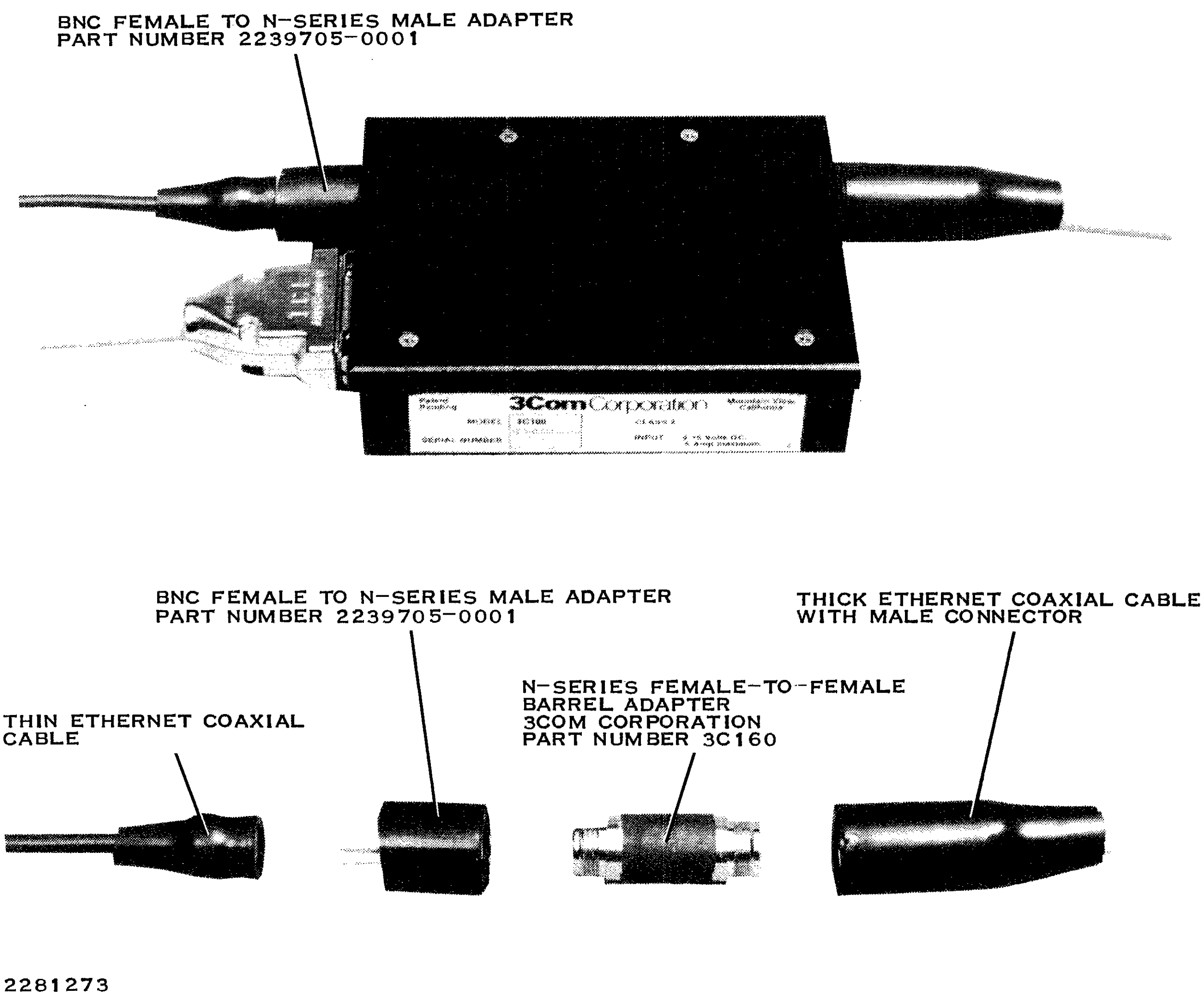

Figure A-4. Adapting From Thin to Thick Ethernet Cable

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A summary of the Ethernet rules for cable lengths and transceiver spacing follows:

1. The maximum length of a thick Ethernet cable segment is 500 meters (1640 feet).
2. The maximum length of coaxial cable between any two stations on the network is 1500 meters (4920 feet), excluding point-to-point links. Point-to-point links are links using remote repeaters.
3. You can install up to 100 transceivers on a cable segment spaced at least 2.5 meters (8.2 feet) apart.
4. The maximum number of stations on an Ethernet is 1024.
5. A maximum aggregate of 1000 meters (3280 feet) of point-to-point links are allowed between any two stations on the network.
6. The maximum length of transceiver cable allowed between any station and its transceiver is 50 meters (164 feet).
7. A maximum of two repeaters in the path between any two stations are allowed. Two half-repeaters in a remote repeater link count as one repeater.
8. Minimum spacing between transceivers on the thick Ethernet is 2.5 meters (8.2 feet).
9. The maximum length of a thin Ethernet cable segment is 300 meters (984 feet) if 3Com transceivers are used or 150 meters (492 feet) with other manufacturer's transceivers.
10. Minimum station spacing on the thin Ethernet is 1 meter (3.28 feet).
11. Stations attach to the thin Ethernet cable with a BNC T connector.
12. Both ends of a cable segment (thick or thin) must be terminated with 50-ohm terminators.
13. Thick and thin Ethernet cable can be interconnected with adapters. The part numbers are listed in Table A-1.

The following paragraphs briefly describe the major components of thick and thin Ethernet networks. Table A-1, following the descriptions, lists the part numbers for most of the components.

NOTE

Several manufacturer's products are described in the following paragraphs to provide you with an overview of components that are available for fabricating a network. Inclusion of a product does not imply that TI has tested or recommends the product. You should evaluate each product carefully to see that it meets your needs before purchasing it.

A.2.1 Thick Ethernet Cable

Thick Ethernet cable is manufactured specifically for use in an Ethernet network. It is marked "Ethernet" and has annular marks (usually black bands) at 2.5-meter (8.2-foot) increments, indicating where transceivers or connectors should be installed.

There are two basic types of thick Ethernet coaxial cable, identified by the dielectric material used in manufacturing the cable. The two dielectric materials are polyvinyl chloride (PVC), and Teflon®. The cable made with PVC is usually yellow in color; the cable made with Teflon is usually orange. The choice between the two types of cable is usually determined by local fire and building codes.

The physical properties of both types of thick Ethernet cable are as follows:

Dimensions:	Jacket outside diameter 0.365 inches minimum, 0.415 inches maximum.
Center conductor:	0.085 inch diameter solid copper.
Impedance:	50 ohms ± 2 ohms average.
Attenuation:	The attenuation per cable segment should not exceed 8.5 dB at 10 Mhz or 6.5 dB at 5 Mhz.

A.2.2 Thin Ethernet Cable

The thin Ethernet cable is standard 50-ohm RG58 A/U coaxial cable.

A.2.3 Coaxial Connectors

Figure A-5 shows the N-series coaxial connectors commonly used in fabricating a thick Ethernet. Cable sections are terminated with male plugs and can be joined with female-to-female barrels. Connectors on the type of transceivers that are connected inline with the coaxial cable are female. Transceivers that have female connectors can be daisy-chained together with male-to-male N-series connectors as shown in Figure A-6. All cable segments must be terminated with 50-ohm terminators. Terminators are available with either male or female connectors.

Thin Ethernet connectors (Figure A-7) are standard BNC components. Cable ends are male and can be connected with female-to-female barrels. The connection to the thin Ethernet controller is made with a BNC T connector. Thin Ethernet segments can be connected to thick Ethernet at a transceiver with a thin cable-to-transceiver adapter or you can use a thin-to-thick adapter that allows thin and thick cables to be interconnected.

Teflon is a registered trademark of E.I. du Pont de Nemours & Co.

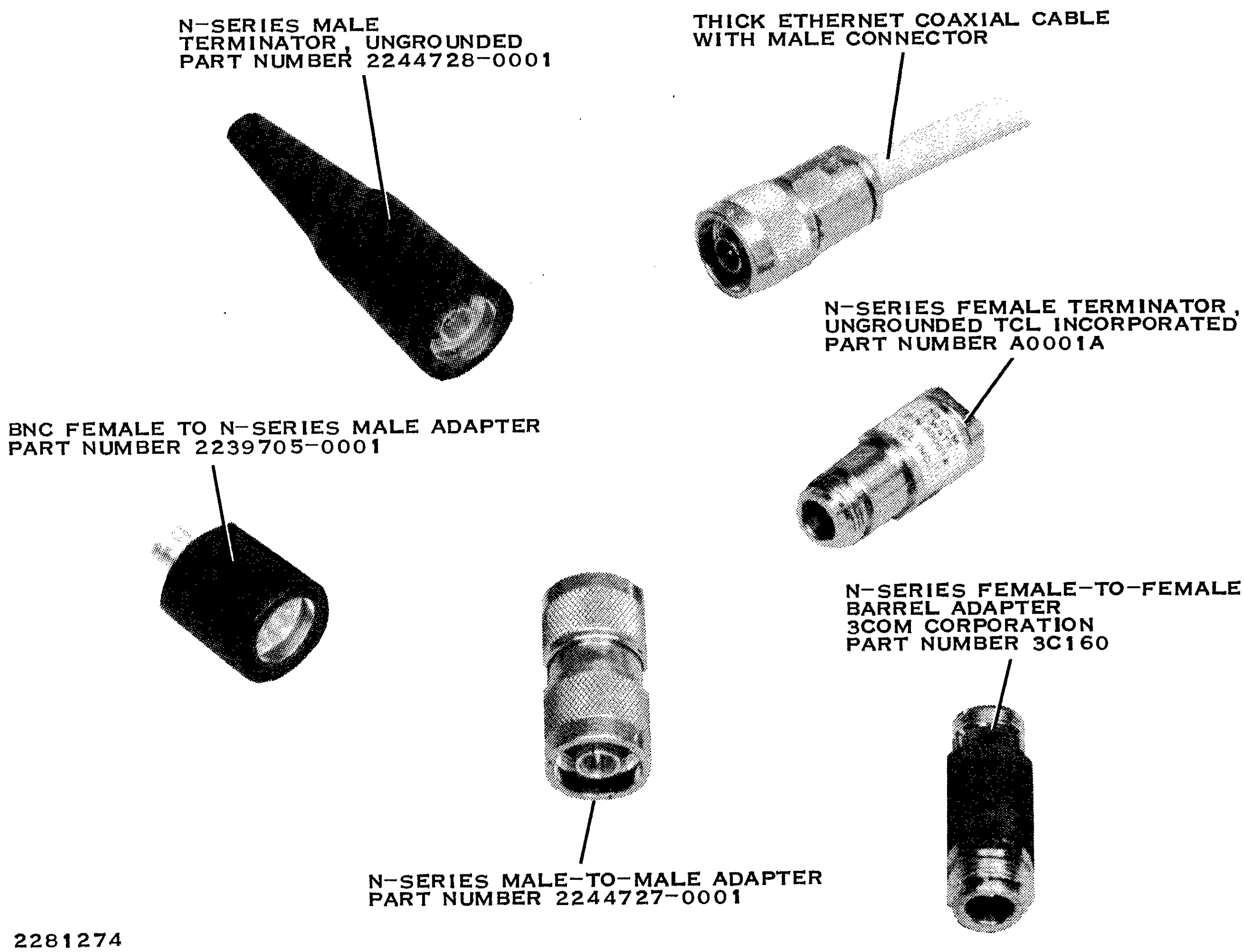

Figure A-5. N-Series Ethernet Coaxial Connectors

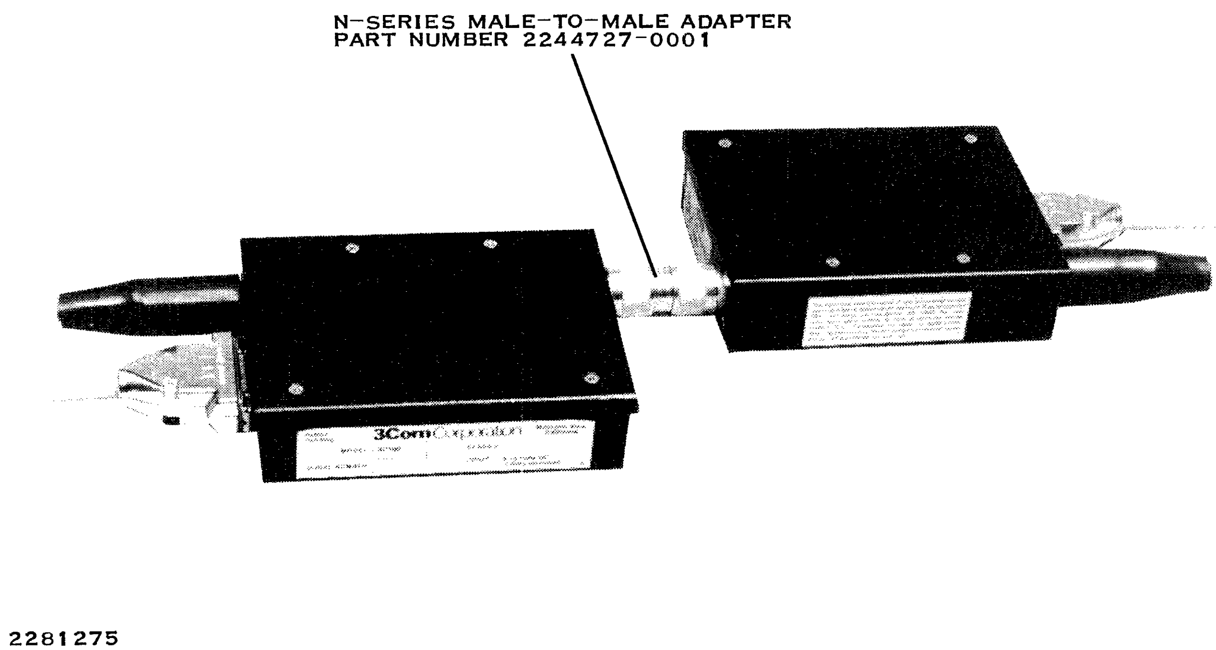

Figure A-6. Daisy-Chaining Transceivers

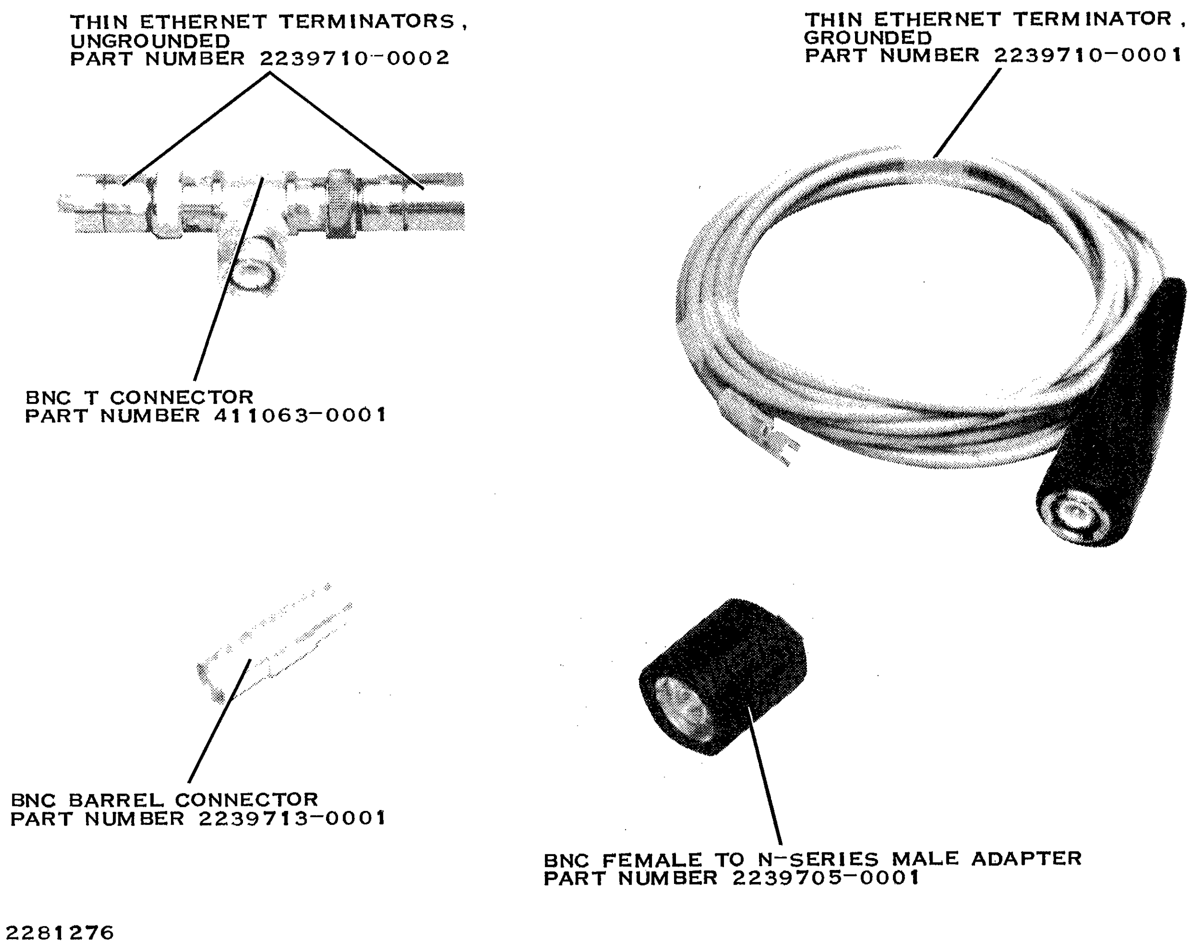

Figure A-7. BNC Series Ethernet Coaxial Connectors

A.2.4 Terminators

Both ends of each segment of Ethernet (thick or thin) must be terminated with 50-ohm terminators. The purpose of the terminator is to provide a termination impedance that is equal to the characteristic impedance of the cable to prevent signal reflection at impedance discontinuities. One of the terminators on each cable segment must be attached to earth ground. Figure A-8 shows a grounded terminator installed on a thin cable and an ungrounded terminator installed on a transceiver. You should insulate any ungrounded terminators that you install to prevent them from making contact with building metal.

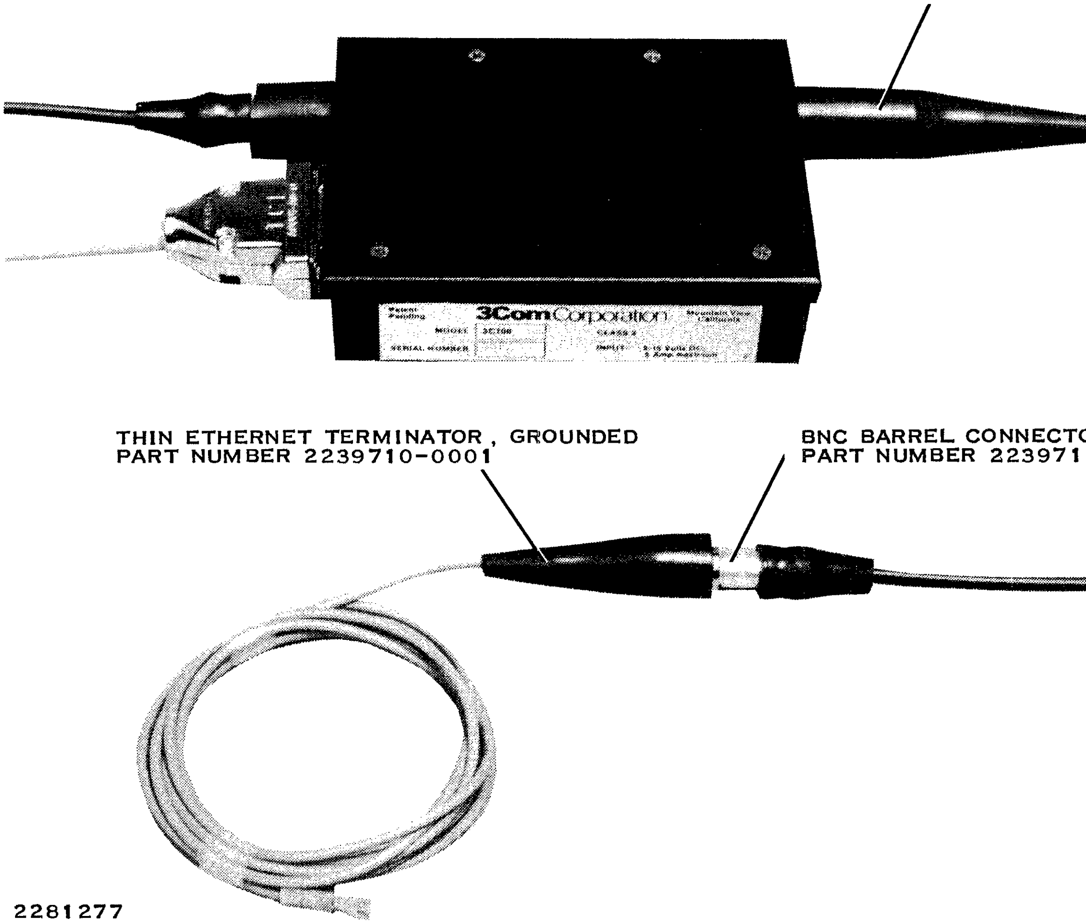

Figure A-8. Terminator Installations

A.2.5 Coaxial Cable Section

A coaxial cable section is an unbroken length of coaxial cable terminated with coaxial cable connectors on each end. Cable sections are used to build up cable segments.

A.2.6 Coaxial Cable Segment

A coaxial cable segment is a length of coaxial cable made up of cable sections and terminated with 50-ohm terminators at each end. The maximum length for a thick Ethernet segment is 500 meters (1640 feet). The maximum length for a thin Ethernet segment is 300 meters (984 feet) with 3Com transceivers or 150 meters (492 feet) with other manufacturer's transceivers.

A.2.7 Transceivers

Transceivers connect directly to the thick Ethernet cable and provide the electronics to transmit and receive Manchester-encoded data on the Ethernet. They also provide electrical isolation, to isolate the station from the network. Figure A-9 shows three different manufacturer's thick Ethernet transceivers.

A.2.8 Transceiver Cable

A transceiver cable is a shielded cable with four pairs of wires in it and 15-pin D-type connectors on each end. One of the wire pairs carries power from the Ethernet controller in the computer to the transceiver. The other three pairs carry transmit data, receive data, and the collision detected signal. Transceiver cables are not required with thin Ethernet if you use the Ethernet controller that fits in the TI Professional Computer or the IBM PC.

A.2.9 Stations

A station is an addressable device attached to the Ethernet. It can be a device that transmits and receives data or a receive-only device. An example of a station is a TI Model 990 computer with an EI990 Ethernet controller attached to the Ethernet via a transceiver and transceiver cable.

A.2.10 Node

A node is a point where a device attaches to the Ethernet. The term node can mean just the transceiver where a station is attached or it can include the transceiver and attached station.

A.2.11 Repeaters

Repeaters are devices used to connect two coaxial cable segments together to extend the length and topology of a network. There are two types of repeaters, local and remote. Figure A-10 shows one manufacturer's local repeater. Local repeaters are single units used to connect two coaxial segments that are located within 100 meters (328 feet) of each other. Local repeaters attach to each coaxial cable segment through a transceiver and transceiver cable.

A remote repeater consists of two units called half-repeaters. Each half-repeater connects to the coaxial cable through a transceiver. The connection between the half-repeaters is usually a duplex fiber-optic cable, which can be up to 1000 meters (3280 feet) long. Two half-repeaters count as one repeater in the Ethernet rules governing maximum distance and number of repeaters between stations. The remote repeater link is typically called a point-to-point link.

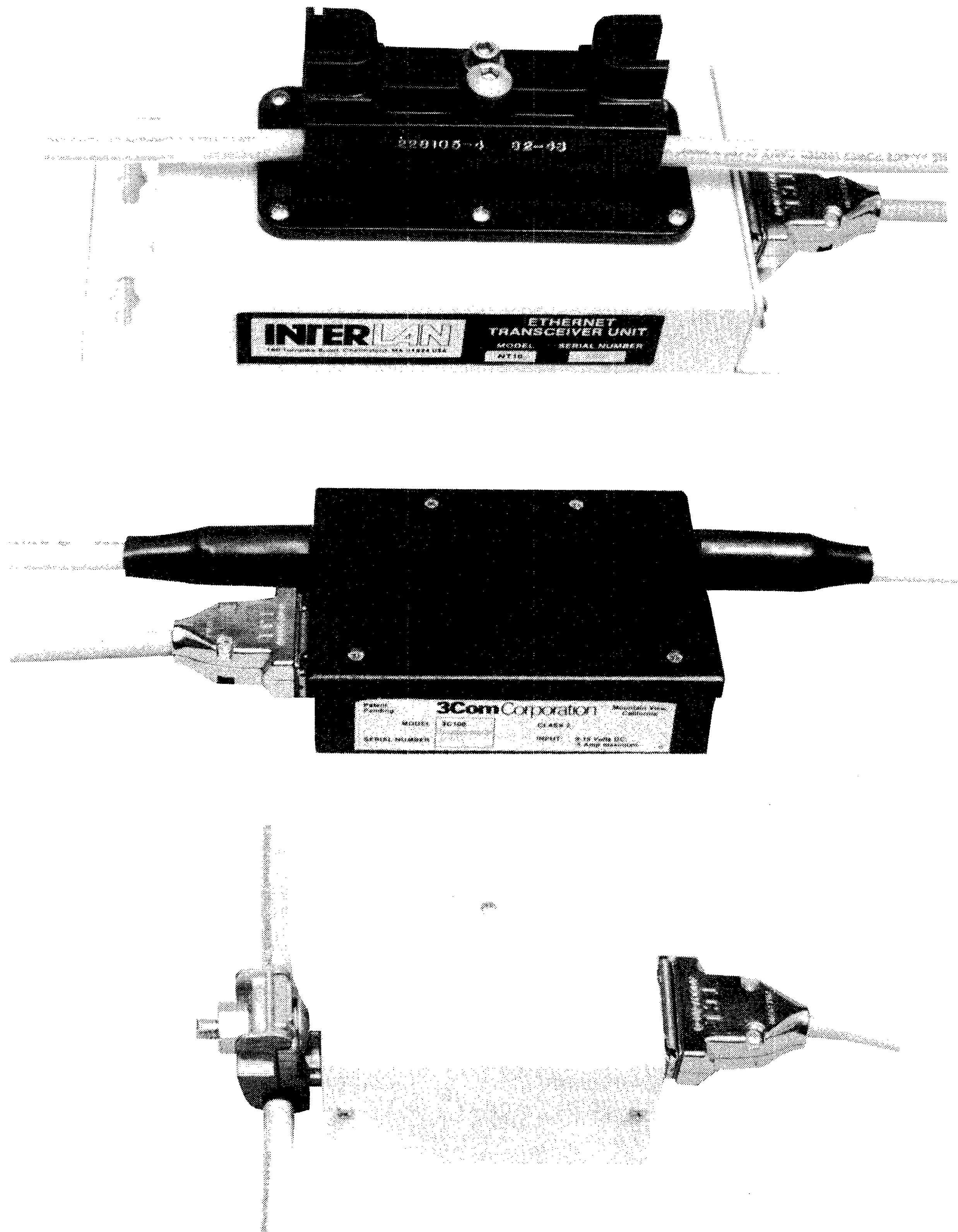

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Figure A-9. Transceivers for Thick Ethernet

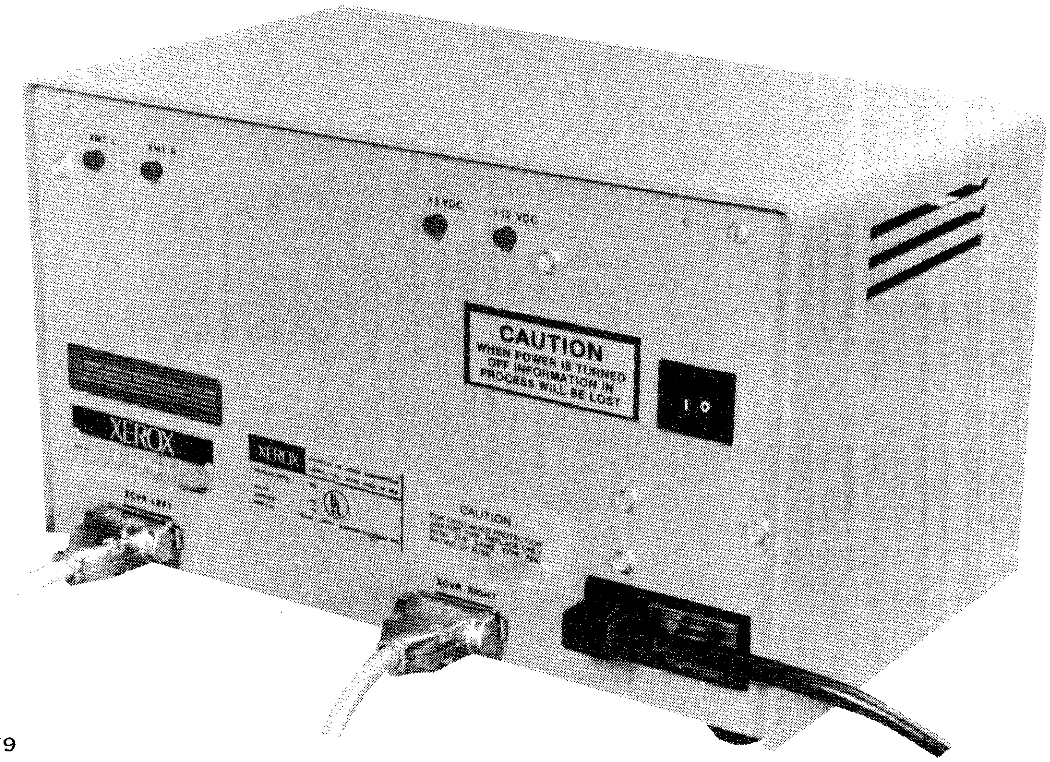

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Figure A-10. Local Repeater

A.3 ETHERNET PARTS LIST

Table A-1 lists part numbers for the Ethernet components that TI markets. It also lists part numbers and manufacturer's names for items that are compatible with TI products in an Ethernet network.

NOTE

The listing of other manufacturer's products does not imply that TI recommends the product or has evaluated it in any way. They are listed to provide a source of information that may be helpful when you are fabricating your Ethernet.

Refer to the latest TI price list for new items that are added from time to time.

Table A-1. Ethernet Network Components

Part Number	Description
TI Part Number	**Thick Ethernet Components**
2239149-0001	Ethernet transceiver, 3C100
2239133-0001	Ethernet transceiver cable, 10 m (32.8 f)
2239133-0002	Ethernet transceiver cable, 20 m (65.6 f)
2244725-0001	Thick Ethernet male terminator kit, includes: 2239148-0001 Male ungrounded terminator 2239148-0002 Male grounded terminator
2244727-0001	N-series male-to-male barrel adapter
TI Part Number	**Thick-to-Thin Ethernet Adapters**
2239704-0001	Adapter, thin Ethernet cable to thick Ethernet cable, BNC female to N-series female
2239705-0001	Adapter, thin Ethernet cable to transceiver BNC female to N-series male
2239131-0001	EI300/EI990 Maintenance kit, includes: 2239148-0001 N-series male terminator, ungrounded (2 each) 2303065-0001 18-pin loopback assembly (for EI990 only) 2239709-0001 15-pin loopback connector 2532884-0001 25-pin loopback connector 2244731-0001 Cable assembly, thick Ethernet, female-to-female
TI Part Number	**Thin Ethernet Cables and Accessories**
2239703-0001	Thin Ethernet cable assembly with BNC connector on each end, 7 meters (23 feet)
2239703-0002	Thin Ethernet cable assembly with BNC connector on each end, 15 meters (49 feet)
2239703-0003	Thin Ethernet cable assembly with BNC connector on each end, 30 meters (98 feet)
2239703-0004	Thin Ethernet cable assembly with BNC connector on each end, 100 meters (321 feet)
2239130-0001	Thin Ethernet terminator kit, includes: One 2239710-0001 grounded 50-ohm terminator One 2239710-0002 ungrounded 50-ohm terminator
2239713-0001	Thin Ethernet BNC barrel connector
411063-0001	Thin Ethernet BNC T connector

Table A-1. Ethernet Network Components (Continued)

Part Number	Description
2239708-0001	Thin Ethernet loopback plug
2239707-0001	TI Professional Computer network maintenance kit, includes: 2239703-0002 15-meter coaxial cable 2239130-0001 Terminator kit 2239708-0001 Loopback connector (BNC) 2239709-0001 15-pin loopback connector
	3Com Corporation Products
3Com Model Numbers	**Description**
3C100	Ethernet transceiver
3C110-005	Transceiver cable, 5 meters (16 feet)
3C110-010	Transceiver cable, 10 meters (32 feet)
3C110-015	Transceiver cable, 15 meters (49 feet)
3C130	Thick cable terminator, 50-ohm N-series
3C160	Thick cable barrel connector (N-series)
3C531-xxx	Bulk thin Ethernet cable, xxx meters, no connectors, minimum length 200 meters
3C531-xxx	Bulk thick Ethernet cable, xxx meters, no connectors, minimum length 100 meters
3C150	Insulated connector for thick Ethernet, N-series male clamp-type connector
3C542	Insulated connector for thin Ethernet, BNC male clamp-type connector
	Bulk Thick Ethernet Cable (Without Connectors) (Manufactured and sold by Belden)
Belden Part Number	**Description**
9880	Thick Ethernet cable with PVC jacket, available in 500-, 1000-, and 1640-foot lengths (152, 305, and 500 meters)
89880	Thick Ethernet cable with Teflon jacket, available in 100-, 500-, 1000-, and 1640-foot lengths (31, 152, 305, and 500 meters)
9891	Transceiver cable, available in 100-, 500-, and 1000-foot lengths (31, 152, and 305 meters)

Table A-1. Ethernet Network Components (Continued)

Part Number	Description
	Transceivers and Repeaters
UN-NT10	InterLan Ethernet transceiver
2010EC	TCL Ethernet transceiver with energy stinger and improved tap block (no heartbeat)
2110	TCL multiport transceiver, connects up to 8 stations
T-28	Xerox local repeater
5203A	Ungerman-Bass local repeater
5221A	Ungerman-Bass remote repeater

A.4 INSTALLATION GUIDELINES

The following paragraphs present some helpful guidelines and ideas for planning and installing your Ethernet network. Detailed installation instructions are not provided; you should read and follow the manufacturer's recommendations for installing each component.

A.4.1 Planning

Try to plan your network so that you can minimize the number of cable sections in a cable segment. Each point where you join two sections of cable can be a source of reflections due to the impedance discontinuity between different batches of cable. Cable impedance varies between cable batches even when purchased from the same manufacturer. If you must use several cable sections to make up a cable segment, you will have less impedance discontinuity if you ensure that all cable sections are from the same manufacturer and from the same batch or lot of cable. The following recommendations are offered to help you plan the cabling for an optimum network.

- Whenever possible, a cable segment should be one continuous length of cable.
- If you must make up a segment with several sections of cable, be sure that the sections are all from the same manufacturer and cable lot.
- Carefully plan the network so you will have access to all of your transceivers, connectors, terminators, and so on for ease of replacement or troubleshooting.
- When you have areas where several stations will be attached to the coaxial cable, you can daisy-chain transceivers to minimize cutting the cable and reduce the number of connectors that you must install. A male-to-male N-series connector will connect two nonintrusive-type transceivers together.

- If you have areas where the coaxial cable will be inaccessible, install your transceivers where they are accessible and run longer transceiver cables. You can also install one transceiver in an accessible location and then run a transceiver cable to a multiport transceiver to service several stations in the area where the coaxial cable is not accessible.

- Draw a topology map of your network as you install it. Include cable lengths and the location of transceivers and other components. Use building coordinates to identify the location of components for ease of locating and troubleshooting them in the future.

A.4.2 Thick Coaxial Cable Routing

You should plan your cable installation carefully to provide easy access to connectors, transceivers, and components that may require service. Route the cable in a way that minimizes the amount of transceiver cable required between the stations and associated transceivers. The minimum bend radius in thick Ethernet cable is 6 inches (152.4 millimeters), but bend radii of no less than 12 inches (305 millimeters) are desirable. It is very important to install the cable so that it will not be accidentally bent, kinked, or stepped on. Bends, kinks, and dents in the cable can produce reflections that generate data errors.

If your Ethernet is located in an area with raised computer flooring, it is a good idea to route the cable under the floor. An underfloor installation prevents the cable from being damaged by foot traffic and provides a safe place for the transceivers installed on the cable.

When you route cable through open rooms, it is a good idea to install overhead cable trays and route the cable in the trays. Transceivers can be installed on the cable and the transceiver cable secured to the cable tray before being dropped down to the stations. Cable trays should be at least 152.4-millimeters (6-inches) wide to allow room for the transceivers. You should not install other cables in the same tray with the Ethernet cable except on long runs where there will be no transceivers.

After routing the cable and installing the transceivers, do not forget to install 50-ohm terminators on the ends of each cable segment and to ground the terminator to earth ground on one (and only one) end of the segment. The screw in the center of an ac wall outlet is an acceptable earth ground.

A.4.3 Thin Coaxial Cable Routing

In a thin Ethernet installation using Ethernet controllers with onboard transceivers, there are no transceivers on the cable, so you must install the cable in such a manner that it can be routed directly to the back of each computer and attached with a BNC T connector. If you are using EI990 or EI300 Ethernet controllers with transceivers on a thin network, you can install the cable in the same manner as thick cable.

All stations on the cable must be in series with no branches off the cable. The cable must have two ends (it cannot be connected in a loop) and you can have a maximum of 100 computers connected to a single cable. The total length of thin cable connecting all computers in a thin Ethernet network cannot exceed 300 meters (984 feet) with 3Com transceivers or 150 meters (492 feet) with other manufacturer's transceivers. Minimum spacing between stations on the cable is 1 meter (3.28 feet).

After installing the cable and connecting the stations, you must terminate both ends of each cable segment with 50-ohm terminators. One of the terminators in the TI terminator kit (part number 2239130-0001) has a ground wire attached. Install the grounded terminator on one end of the cable segment and attach the ground wire to earth ground. The screw in the center of an ac wall outlet is an acceptable connection to earth ground.

A.4.4 Transceiver Installation

Transceivers should be installed at the 2.5-meter annular marks on the coaxial cable, with minimum spacing between transceivers of at least 2.5 meters (8.2 feet)

Most transceivers support only one station; however, you can purchase multiport transceivers that support several stations. The multiport transceivers attach to the coaxial cable with a standard single-station transceiver and transceiver cable. You can use multiport transceivers to minimize the number of taps on the cable, provide better access to the transceiver, and reduce the cost per station if you are installing several stations within a short distance of each other.

Transceivers currently on the market are classed as intrusive and nonintrusive types. You should follow the manufacturer's instructions to install each type of transceiver.

The instrusive type of transceiver requires cutting the coaxial cable, installing connectors on the cable, then connecting the transceiver inline. This type of installation provides a more secure connection to the coaxial cable than the nonintrusive type but disrupts network service while being installed.

The nonintrusive type of transceiver does not require cutting the cable; it is installed by tapping the cable. Cable taps are made by installing a tap block on the cable, drilling a hole in the cable with a special tool, then installing the transceiver in the tap block. This type of installation causes only momentary disruption of network service but is more likely to be damaged when bumped or mishandled.

A.4.5 Transceiver Cable Installation

Transceiver cables should be routed so that they are not in traffic patterns and should be as short as possible. EI990 and EI300 transceiver cables have slide-type connectors that allow you to secure them to the transceiver. You can extend EI990 transceiver cables by connecting two or more standard Ethernet transceiver cables together to form a longer cable (up to 50 meters maximum). The shield of the transceiver cable (on pin 1) must be terminated to the connector shell and must be connected to the chassis of the device housing the Ethernet controller board.

Pin assignments for the transceiver cable are as follows:

Pin	Function	Pin	Function
1	Shield (note)	9	Collision –
2	Collision +	10	Transmit –
3	Transmit +	11	No connection
4	No connection	12	Receive –
5	Receive +	13	Power +
6	Power return	14	No connection
7	No connection	15	No connection
8	No connection		

Note:

The shield must be terminated to the connector shell.

A.4.6 Installing N-Series Coaxial Connectors

All connectors used on the thick Ethernet are N-series, coaxial connectors with 50-ohm characteristic impedance. All cable sections have male connectors on each end. Cable sections are joined with female-to-female barrel connectors. Terminators are female jacks that connect to the male connectors on the ends of the cables.

When you install connectors, you should cut the coaxial cable only at the points marked with annular rings. You should insulate all connectors that you install to prevent them from making contact with any metal in the building. A rubber boot or shrink tubing is suitable insulation. Refer to the manufacturer's instructions for details on installing the connectors that you purchase.

A.4.7 Installing BNC Coaxial Connectors

All connectors used on the thin Ethernet are BNC-series coaxial connectors with 50-ohm characteristic impedance. All cable sections are terminated with male connectors. You can join cable sections with female-to-female barrel connectors. Terminators for the thin Ethernet are female jacks that connect to the male connectors on the cable ends.

Use rubber boots or shrink tubing to insulate all connectors that you install to prevent them from making contact with any metal in the building.

A.4.8 Installing Terminators

One 50-ohm terminator is required on each end of a coaxial cable segment. The terminator on one end of the cable segment should be tied to an earth ground, such as the screw in the center of an ac wall outlet. The ungrounded terminator should be insulated to prevent it from making contact with any building metal.

The end of the cable segment where terminators will be installed should be in an easily accessible but secure area to allow access for troubleshooting and maintenance. It may be necessary to remove the terminator and attach test equipment to the cable segment to troubleshoot network problems sometime in the future.

A.4.9 Installing Local Repeaters

You can use a local repeater to connect two cable segments that are within 100 meters (328 feet) of each other. You must install a transceiver in each cable segment and then connect the repeater between the transceivers with transceiver cables.

Follow the rules in the paragraph on transceiver placement when installing the transceivers for the repeaters. Take care in planning your network so that there are no more than two repeaters in the path between any two stations on the network. The repeater requires ac power and should be installed in a location with access to power. The location should also be easily accessible for troubleshooting or replacement in case the repeater fails. If you install the transceiver on the end of a cable segment, be sure to install a terminator on the unused transceiver port.

A.4.10 Installing Remote Repeaters

A remote repeater link (also called a point-to-point link) consists of two half-repeaters, each connected to a cable segment with a standard transceiver and transceiver cable. The link between the two half-repeaters is usually a duplex fiber-optic cable, up to 1000 meters (3280 feet) long. Keep in mind that the maximum aggregate length of point-to-point links between any two stations on a network is 1000 meters (3280 feet). For example you could have three cable segments linked together with two point-to-point links of 500 meters (1640 feet) each and still meet the Ethernet requirements. The two half-repeaters in one point-to-point link count as one repeater when you are planning your network.

You can order half-repeaters that operate from any of the standard supply voltages (117, 220, and so on). The location that you select for each of the half-repeaters should have access to the required power and should be easily accessible for troubleshooting or replacement.

A.5 3C101 TRANSCEIVER SPECIFICATIONS

The 3C101 transceiver meets the communications requirements for a baseband local area network (LAN) as set forth in the Ethernet/IEEE 802.3 specification. Meeting this standard allows for the mixing of multiple-vendor equipment on an Ethernet network or network segment.

The 3C101 transceiver, in addition to meeting the original Ethernet specification, incorporates three new optional features of IEEE 802.3. These features are heartbeat, jabber, and halfstep signaling.

- *Heartbeat:* This feature sends a signal from the transceiver to the controller after every successful transmission. This signal confirms the transmission and verifies the integrity of the collision signal path.
- *Jabber:* This feature has the transceiver stop the transmission if the controller tries to transmit a packet longer than the specified length (12 144 bits plus the preamble). This function keeps a station from locking the network due to a controller failure.
- *Halfstep signaling:* This feature allows the transceiver to work with ac-coupled input/output controller circuits.

Table A-2 lists the basic 3C101 transceiver specifications.

Table A-2. 3C101 Specifications

Item	Specification
Transceiver Cable Interface	
Connector type	Cinch DASM-15
Connector pins:	
transmit	3, 10
receive	5, 12
collision	2, 9
shield	1, 4, 8, 11, 14 (capacitor coupled to 6)
Power:	
Voltage at station end	11.4 to 16 V
Voltage at transceiver	9 to 16 V
Transceiver Housing	
Physical:	
Length	10.75 in (27.3 cm)
Height	3.75 in (9.5 cm)
Depth	1.25 in (3.2 cm)
Weight	21 oz (600 gm)

A.5.1 Thick Ethernet Cable

The 3C101 transceiver works with thick Ethernet cable that is manufactured specifically for use in an Ethernet network. This cable is marked *Ethernet* and has annular marks (usually black bands) at 2.5-meter (8.2-foot) increments, indicating where to install transceivers or connectors.

There are two basic types of thick Ethernet coaxial cable, identified by the dielectric material used in manufacturing the cable. The two dielectric materials are polyvinyl chloride (PVC) and Teflon™. The cable made with PVC is usually yellow. The cable made with Teflon is usually orange. The choice between the two types of cable is usually determined by local fire and building codes.

The physical characteristics of both types of thick Ethernet cable are as follows:

Item	Characteristic
Dimensions	Jacket outside diameter — 0.93 centimeters (0.365 inches) minimum, 1.05 centimeters (0.415 inches) maximum
Center conductor	0.22 centimeters (0.085 inches) diameter solid copper
Impedance	50 ohms ± 2 ohms average
Attenuation	Attenuation per cable segment — 8.5 dB at 10 mHz or 6.5 dB at 5 mHz maximum

Table A-3 lists both of the Ethernet thick coaxial cables and their specifications. The cables are manufactured by Belden and the Belden part numbers are listed.

Table A-3. Thick Ethernet Cables

Description	Belden Part Number
Thick Ethernet cable with PVC jacket, available in lengths of 152, 305, and 500 meters (500, 1000, and 1640 feet)	9880
Thick Ethernet cable with Teflon jacket, available in lengths of 30, 152, 305, and 500 meters (100, 500, 1000, and 1640 feet)	89880
Transceiver cable, available in lengths of 30, 152, and 305 meters (100, 500, and 1000 feet)	9891

Teflon is a trademark of E.I. du Pont de Nemours & Company, Inc.

A.6 3C101 TRANSCEIVER KIT

The 3Com nonintrusive transceiver kit contains the parts shown in Table A-4.

Table A-4. 3C101 Transceiver Kit

Description	3Com Part Number	AMP Part Number	Texas Instruments Part Number
Transceiver kit	3C101	N/A	2236665-0001
Tap block	3C138	228752-1	2236669-0001
Probe	3C136	228766-1	2236667-0001
Two shield connectors	3C137	227959-7	2236668-0001

A.7 3C101 INSTALLATION KIT

The installation kit for the 3Com 3C101 transceiver contains the parts shown in Table A-5.

Table A-5. 3C101 Installation Kit

Description	3Com Part Number	AMP Part Number	Texas Instruments Part Number
Installation kit	3C135	N/A	2236666-0001
Phillips-head #1 screwdriver		Commercially available	
1/8-inch Allen wrench		Commercially available	
Cable drill with ½-inch hollow socket	In kit only	221058-1	In kit only

A.8 INSTALLATION

The 3Com nonintrusive piercing tap transceiver should be installed in accordance with the following instructions. Before beginning the installation procedure, unpack and inspect the 3C101 transceiver kit.

1. Transceiver kit parts

   a. One 3Com transceiver (3C101)

   b. One tap block (two parts)

   c. One probe

   d. Two shield connectors

2. Installation tools

   a. One number 1 Phillips-head screwdriver

   b. One 1/8-inch Allen wrench

   c. One cable drill (AMP)

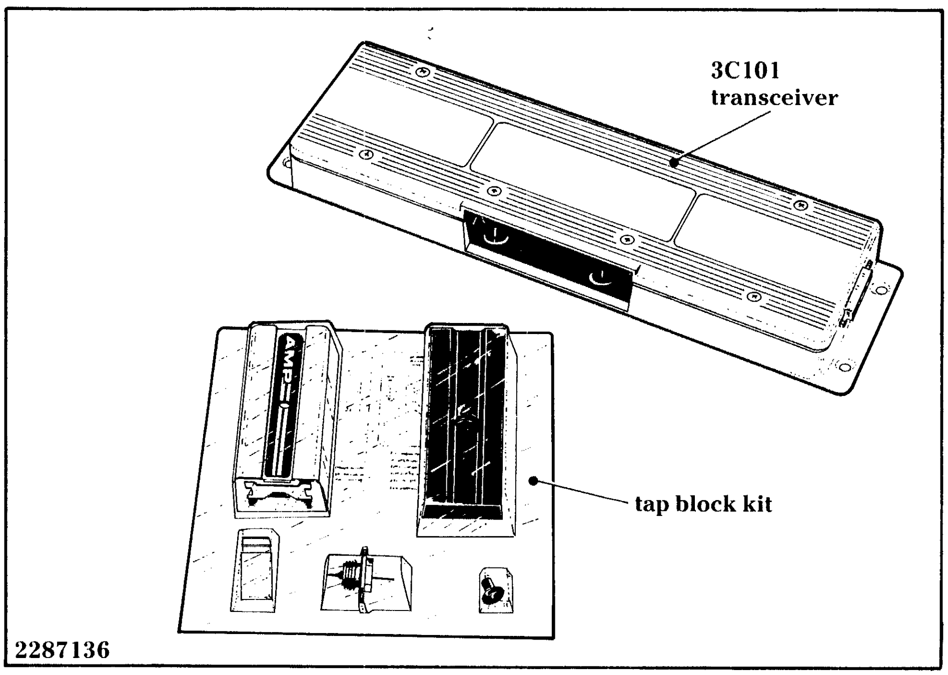


Figure A-11. 3C101 Transceiver Kit

3. Network cable

   a. The network cable is marked at 2.5 meters (8.2 feet).

   b. Locate one of the marks on the network cable so that the transceiver cable (the cable from the system to the transceiver) is long enough to reach the transceiver cable connector on the transceiver.

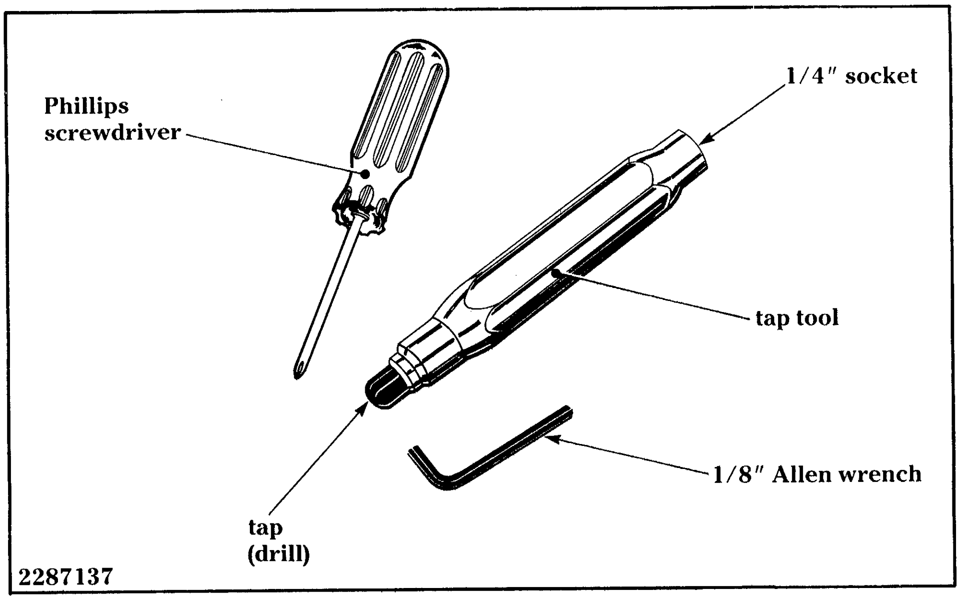


Figure A-12. Transceiver Installation Kit

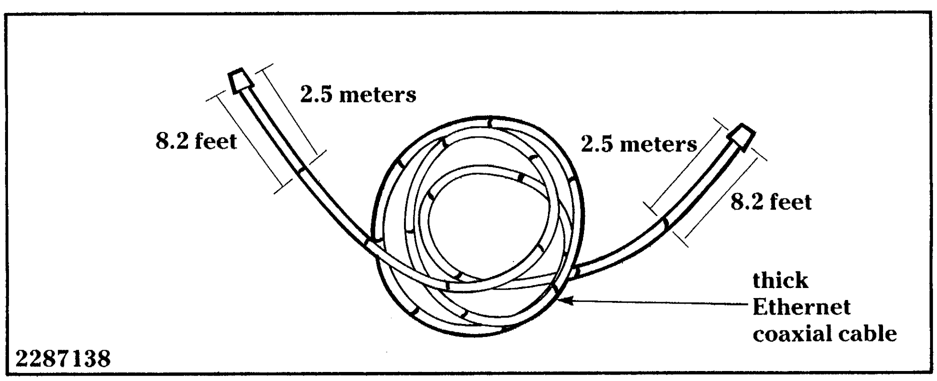


Figure A-13. Thick Ethernet Cable

4. Tap block installation

   a. Screw the tension screw in the clamp assembly.

   b. Insert the two braid terminators into the tap block.

   c. Position the tap block over the network cable. Align the 2.5-meter mark with the probe hole of the tap block.

   d. Slide the pressure block into the shield body.

   e. Using the 1/8-inch Allen wrench, screw the pressure block to the network cable until the cable is firmly clamped. Be careful not to overtighten the screw because doing so could break off the screw head.

5. Tapping the network cable

NOTE

The leads of the braid terminators are exposed. Take extreme care not to bend or break these leads.

   a. Remove the protective cover.

   b. Insert the tap tool into the probe hole. Turn the tap tool clockwise to drill the probe hole. The tap tool has depth stop; turn the tap tool until the stop is against the network cable.

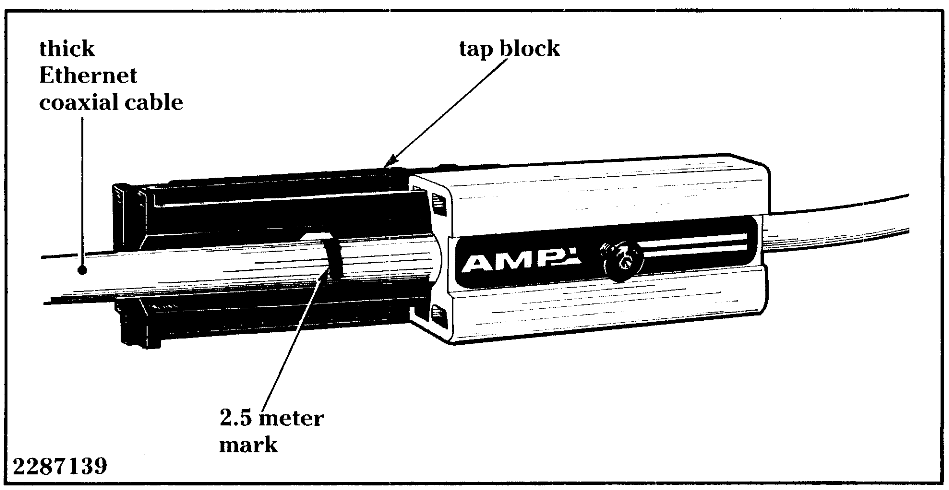


Figure A-14. Clamp Block

c. Remove the tap tool by turning it counterclockwise.

d. Clean and inspect the probe hole in the network cable. Carefully remove any foreign particles in the hole. Check that no ground shield wire (braid) is in the probe hole or touching the center conductor of the network cable.

e. Replace protective cover.

6. Probe insertion

a. Carefully start the probe into the probe hole in the tap block.

b. Using the wrench end of the tap tool or a ½-inch socket, tighten the probe into the tap block.

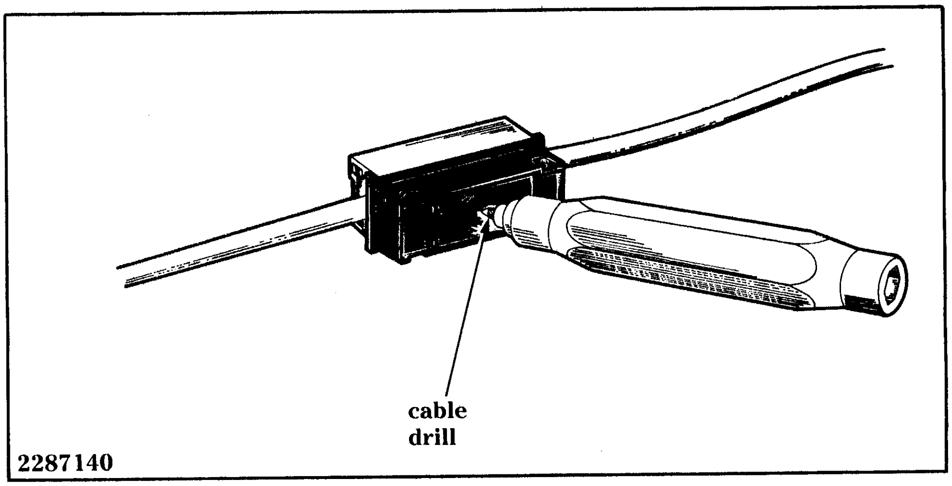


Figure A-15. Tapping the Cable

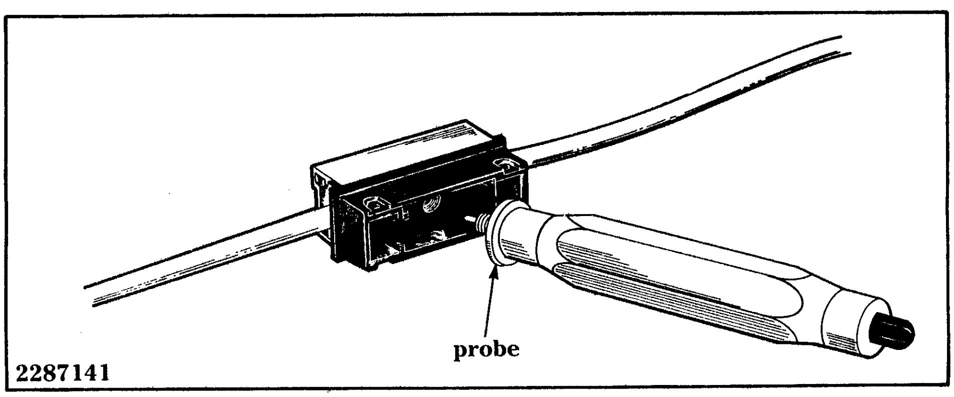


Figure A-16. Probe Installation

7. Installing the tap block

   a. Remove the two Phillips-head screws for mounting the tap block, located at each end of the connector, on the transceiver's printed circuit board.

   b. Carefully align the two braid-terminator leads and the one probe lead from the tap block to the connector.

   c. Press the leads into the connector until the retaining holes in the tap block align with the holes in the transceiver's protective cover.

   d. Insert and tighten the two retaining screws.

8. Transceiver cable installation

   a. Insert the 15-pin transceiver cable into the transceiver connector.

   b. Slide the cable connector locking clamp over the locking pins on the transceiver.

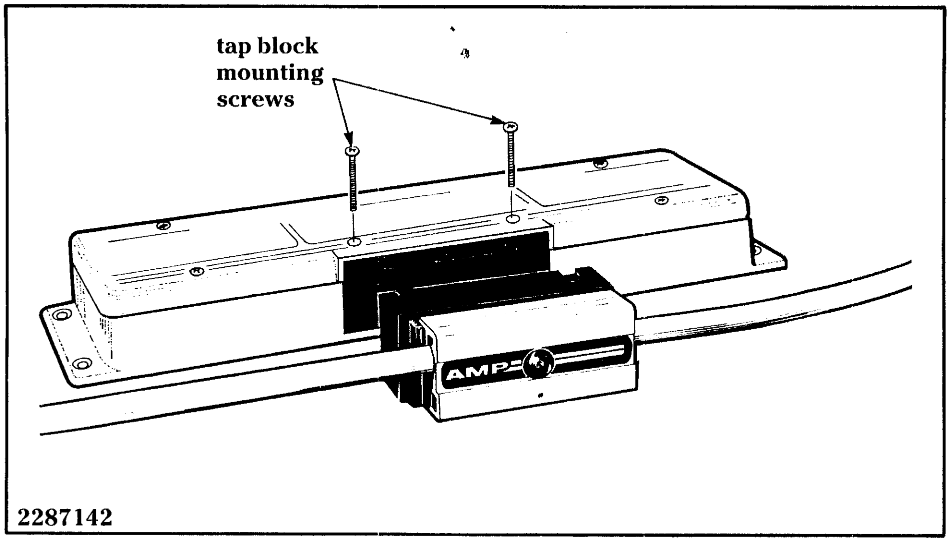


Figure A-17. Tap Block Installation

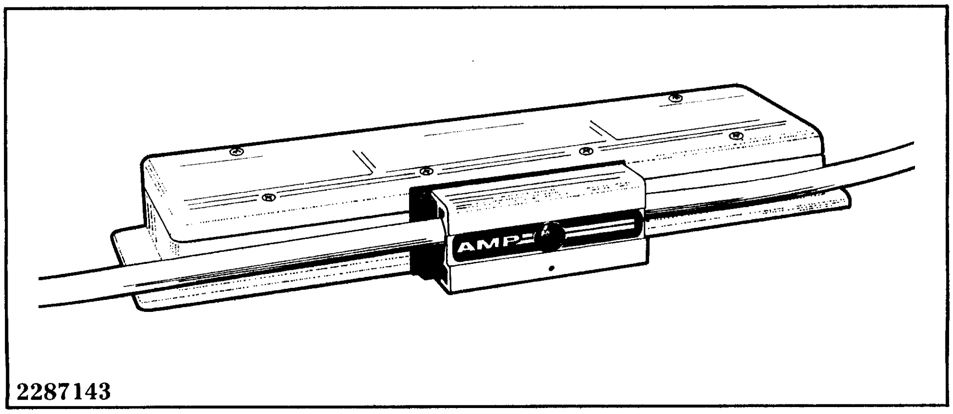


Figure A-18. Completed Installation

A.9 TESTING THE TRANSCEIVER INSTALLATION

To test the 3C101 transceiver, turn on the system it is connected to. Follow normal system procedures to boot up the system. The Nubus Ethernet controller board self-test executes during the system boot and tests the installation to the transceiver.

NOTE

If the transceiver cable is connected after the system is powered up, the system may reboot itself. This rebooting is caused by the initial current drain of the transceiver. Once the transceiver cable is permanently connected, this condition should not occur.

When the system is operational, the loopback test can be run to further test the transceiver installation. The following commands are used to execute the loopback test.

1. Access the system menu
2. Access the network menu
3. Access the diagnostic menu
4. Run the loopback test

The loopback test checks the NuBus Ethernet controller board, the adapter board, the transceiver cable, and the transceiver.

After successfully completing the loopback test, do a Host Status (HOSTAT) or press the TERM H keys. This accesses information from the network and verifies the network cable connection.

The Peek command allows you to inspect the network performance. This command monitors data and logs packets sent, received, and lost.

A.10 PROBLEM CORRECTION

Table A-6 lists some problems that may occur during transceiver installation. The table also lists the suggested correction for each problem.

Table A-6. Installation Problems

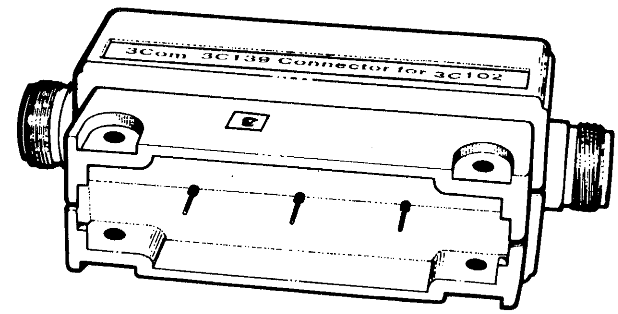
Condition	Problem	Correction
System power-up	Controller fault LED on	Replace controller
Loopback test to transceiver	Test failed	Install loopback connector on transceiver cable
Loopback test to cable end	Test failed	1. Replace cable 2. Replace adapter card
Network test	Complete network not working	Check network connector for shield to center conductor short
Network test	No network message received	Replace transceiver

A.11 3COM 3C102 TRANSCEIVER

To use the 3Com C3102 transceiver on a network with thick Ethernet cable, the 3C139 adapter is required. The combination of the 3C102 transceiver and the 3C139 adapter replace the original 3Com 3C100 transceiver. Figure A-19 shows the 3C139 adapter. This adapter connects to the network cable with N-series connectors. Three pins from the adapter provide signal connections to the 3C102 transceiver.

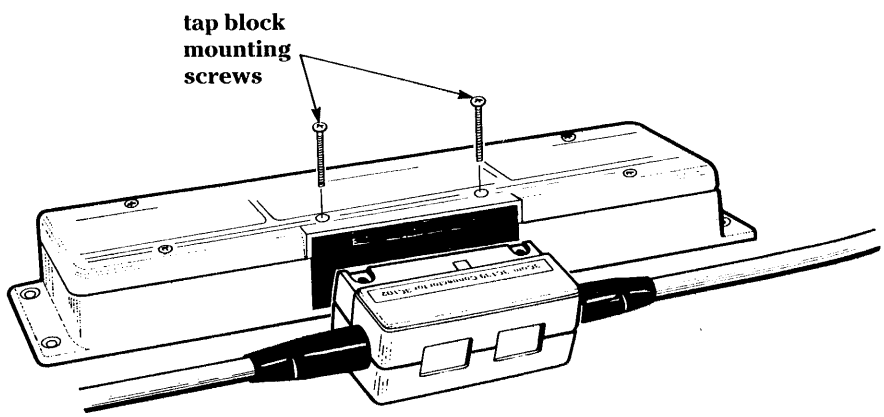
To attach the 3C139 adapter to the 3C102 transceiver, first remove the two screws as shown in Figure A-20.

Carefully insert the 3C139 adapter into the opening on the side of the 3C102 transceiver, making sure that the pins of the adapter align with the connector of the transceiver. Secure the adapter to the transceiver with the two screws you removed.



2287310

Figure A-19. 3Com 3C139 Adapter



2287311

Figure A-20. 3C139 Adapter Installation

Index

This index lists key topics of this manual and specifies where each topic appears, as follows:

- Sections — Section references appear as *Section n*, where *n* represents the section number.

- Appendixes — Appendix references appear as *Appendix Y*, where *Y* represents the appendix letter.

- Paragraphs — Paragraph references appear as alphanumeric characters separated by decimal points. The first character refers to the section or appendix containing the paragraph, and any other numbers indicate the sequence of the paragraph within the section or appendix. For example:

  — *3.5.2* refers to Section 3, paragraph 5.2.

  — *A.2* refers to Appendix A, paragraph 2.

- Figures — Figure references appear as *Fn-x* or *FY-x*, where *n* represents the section and *Y* represents the appendix containing the figure; *x* represents the number of the figure within the section or appendix. For example:

  — *F2-7* refers to the seventh figure in Section 2.

  — *FG-1* refers to the first figure in Appendix G.

- Tables — Table references appear as *Tn-x* or *TY-x*, where *n* represents the section and *Y* represents the appendix containing the table; *x* represents the number of the table within the section or appendix. For example:

  — *T3-10* refers to the tenth table in Section 3.

  — *TB-4* refers to the fourth table in Appendix B.

- See and See also references — *See* and *See also* direct you to other entries in the index. For example:

  Logical Unit Number . . . . *See* LUNO

  Device . . . . *See also* individual device names or numbers

Page numbers that correspond to these index references appear in the Table of Contents.

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