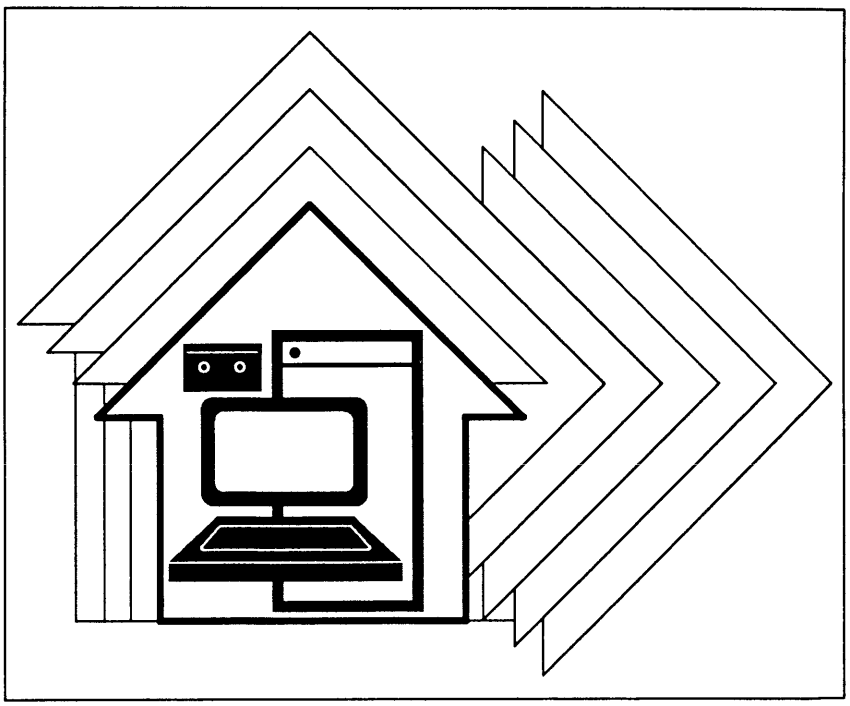
TERMINAL CONCENTRATOR

INSTALLATION AND OPERATION



TEXAS INSTRUMENTS

TERMINAL CONCENTRATOR INSTALLATION AND OPERATION

NOTICE TO U.S.A. USERS: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

NOTICE TO CANADIAN USERS: This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Réglement sur le brouillage radioélectrique édicté par le ministere des Communications du Canada.

MANUAL REVISION HISTORY

Terminal Concentrator Installation and Operation (2557938-0001)

Original Issue	December 1988
Revision A	October 1989
Revision B (Drawing change only)	January 1990
Revision C	February 1990
Revision D	July 1990

The system-defined windows shown in this manual are examples of the software as this manual goes into production. Later changes in the software may cause the windows on your system to be different from those in the manual.

Texas Instruments Incorporated
ATTN: Information Technology Group, M/S 2151
P.O. Box 149149
Austin, Texas 78714-9149

Produced by the Publishing Center
Texas Instruments Incorporated
Information Technology Group
Austin, Texas

ABOUT THIS MANUAL

Purpose

This manual provides installation and operation information for the terminal concentrators that provide multiple terminal connections for Texas Instruments host computer systems.

Contents of This Manual

This manual is organized into two major parts, each identified by a title page. Each part contains a detailed table of contents, one or more sections, and an individual index. A general outline of the manual is as follows:

Title	Contents
CK802/CK803 Multidrop Terminal Concentrator (MTC)	Section 1, MTC Introduction Section 2, MTC Site Preparation and Unpack/Inventory Section 3, MTC Installation Section 4, MTC Operation Section 5, MTC Diagnostics
Network Terminal Concentrator (NTC)	Section 1, NTC Introduction Section 2, NTC Site Preparation and Unpack/Inventory Section 3, NTC Installation Section 4, NTC Operation Section 5, NTC Diagnostics

NOTE: The CK803 remote MTC that is included in this manual will be available at a later date. When using this manual, disregard the CK803 remote MTC information at this time.

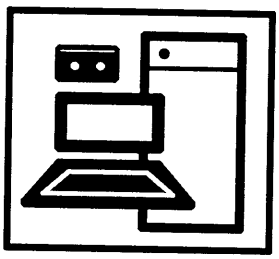
NOTE: In this manual, the terms single-board computers and multiboard computers are used. Single-board computers refer to System 1505 type computer chassis that do not have a backplane. Multiboard computers refer to computer chassis, such as the 7-slot and 16-slot type computer chassis, that have a backplane.

References

The following documents are listed for reference information:

Title	TI Part Number
Introduction	2555463-0001
System Operation	2557949-0001
Computer System Site Preparation	2558023-0001
System Maintenance Terminal Operating Parameters	2558022-0001
Computer Enclosure Installation and Operation	2557942-0001
Peripheral Enclosure Installation and Operation	2557943-0001
System Board Installation and Operation	2557941-0001
Mass Storage Unit (MSU IIA) Installation and Operation	2557935-0001
WD1200 Disk Drive Installation and Operation	2557944-0001
Terminal Concentrator Installation and Operation	2557938-0001
Terminal/Printer Information	2557939-0001
Installation and Operation Appendixes	2557946-0001
DB380 Disk Drive Field Maintenance Supplement	2557953-0001
DB760 Disk Drive Field Maintenance Supplement	2555402-0001
CT150 Tape Drive Field Maintenance Supplement	2558007-0001
CT2000 Tape Drive Field Maintenance Supplement	2557951-0001
WD1200 Disk Drive Field Maintenance Supplement	2557952-0001
Computer Enclosure/Peripheral Enclosure Field Maintenance Supplement	2557961-0001
68030 Symmetric Processor Field Maintenance Supplement	2558002-0001
16/32-Megabyte Data Buffer Board Field Maintenance Supplement	2558003-0001
NUPI-2 Board Field Maintenance Supplement	2564103-0001
NuBus Systems System 1500 Field Maintenance Handbook	2549258-0001

CK802/CK803 MULTIDROP TERMINAL CONCENTRATOR (MTC)



NOTE: The CK803 remote MTC that is included in this manual will be available at a later date. When using this manual, disregard the CK803 remote MTC information at this time.

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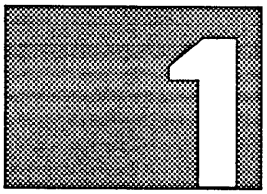
MTC INTRODUCTION



Introduction

1.1 This section describes the features and specifications of the eight-channel multidrop terminal concentrator (MTC). The MTC contains a CK802 terminal concentrator board for local operation or a CK803 terminal concentrator board for remote operation. This section provides the following information:

- Features
- Reference information
- Specifications

The basic CK802 equipment (Figure 1-1) provides a local interface with the host computer over multidrop twisted-pair cables. The basic CK803 equipment (Figure 1-2) provides a remote interface with the host computer through modems. Each board provides eight asynchronous serial full-duplex Electronic Industries Association (EIA) channels for interface connections to terminals or printers.

NOTE: The CK803 remote MTC that is included in this manual will be available at a later date. When using this manual, disregard the CK803 remote MTC information at this time.

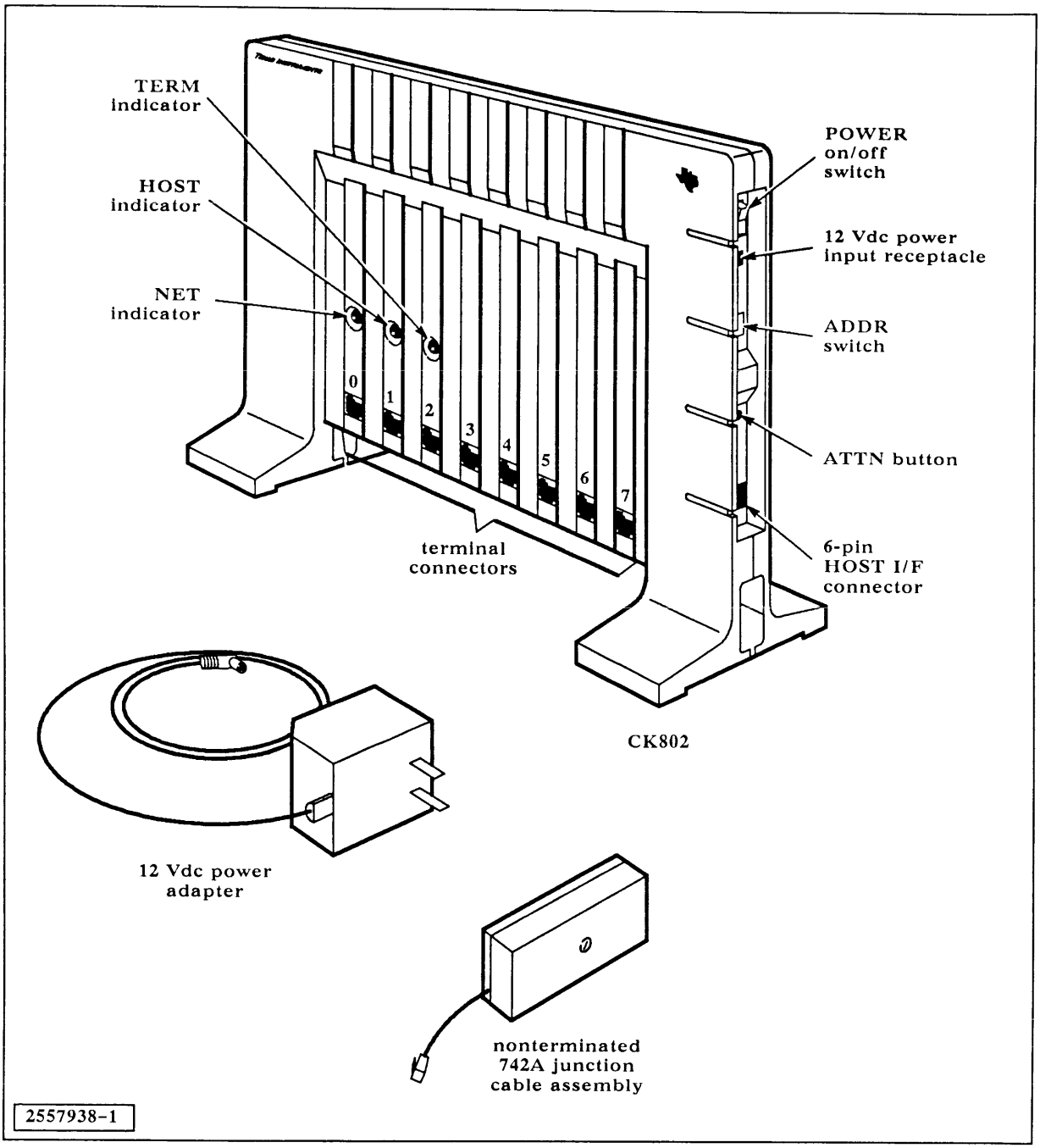
Features

1.2 Features of the CK802 and CK803 are as follows:

- A 16-bit microprocessor operating at 9.8304 MHz
- An eight-channel universal asynchronous receiver/transmitter (UART)
- A serial communications controller (SCC)
- A Manchester encoder (for the CK802 only)
- 32K or 64K bytes of read-only memory (ROM)
- Zero wait state random access memory (RAM)
- Three light-emitting diode (LED) indicators that show host/terminal activity
- Input power from a 12-volt dc adapter
- A 16-position decimal-address rotary selection switch
- An attention push-button switch to interrupt the microprocessor

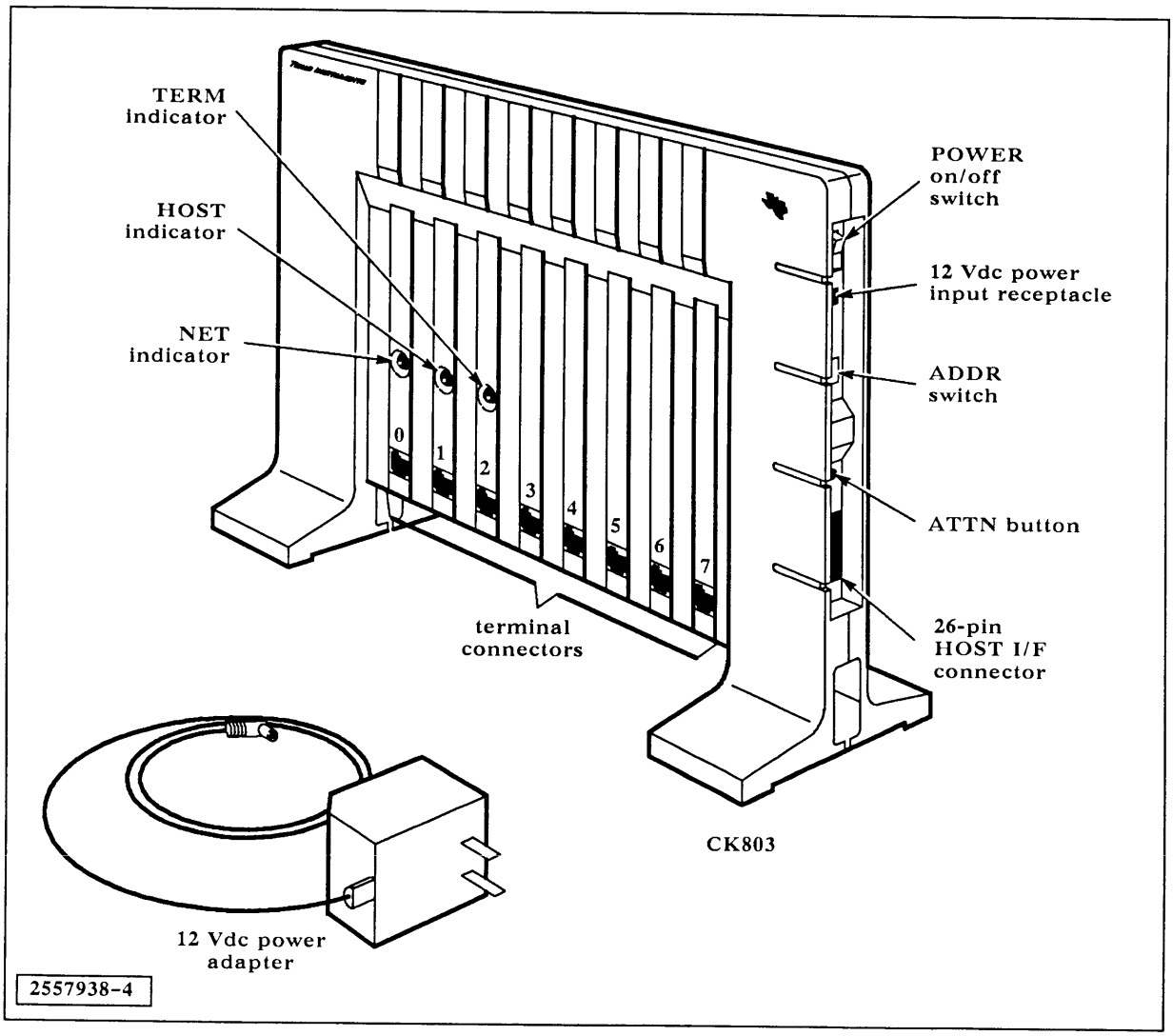
- Eight asynchronous serial 4-wire full-duplex EIA channels using 6-pin modified modular jack (MMJ) connectors for interface connections to terminals or printers
- A CK802 interface with the host computer through a standard 6-pin modular connector over differential Manchester-encoded multidrop twisted pairs
- A CK803 interface with the host computer through a 26-pin connector and EIA-232-D or V.35 modems

Figure 1-1 Basic CK802 Equipment



NOTE: In this module, the terms single-board computers and multiboard computers are used. Single-board computers refer to System 1505 type computer chassis that do not have a backplane. Multiboard computers refer to computer chassis, such as the 7-slot and 16-slot type computer chassis, that have a backplane.

Figure 1-2 Basic CK803 Equipment



Reference Information

1.3 Refer to Table 1-1 for a list of reference documents associated with the CK802 and CK803 terminal concentrators.

Table 1-1 Reference Documents

Document	TI Part Number
TI System V Terminal Concentrator Software	2564122-0001
Diagnostics User's Guide	2534850-0001
System 1000 Series, NuBus™ Systems Installation and Operation (modular kit)	2557936-0001
System 1000 Series, System 1500 Installation and Operation	2534829-0001
NuBus Systems System 1500 Field Maintenance Handbook kit	2549260-0001
924 VDT User's Guide	2544365-0001
928 VDT User's Guide	2561031-0001
928 VDT Reference	2561032-0001
955 Workstation User's Guide	2552476-0001
Model 810 Printer Operator's Manual	0994353-9701
Model 810 Printer Installation and Operation Manual	2311356-9701
Model 855 Printer Operator's Manual	2225911-0001
Model 855 Printer Technical Reference Manual	2232822-0001
Model 865 Printer Operator's Manual	2239405-0001
Model 860/865 Printer Technical Reference Manual	2239407-0001
Model 875 Printer/Model 877 Printer User's Manual	2550268-0001
Printer Models 875 and 877 Installation Guide	2555210-0001
Model 880 Printer User's Manual	2222627-0001
Model 885 Printer User's Manual	2546047-0001
Model 885 Printer Installation Guide	2555211-0001
OmniLaser™ 2015 Page Printer Operator's Manual	2539178-0001
OmniLaser 2106 Page Printer Operator's Manual	2550477-0001
OmniLaser 2108 Page Printer Operator's Manual	2546348-0001
OmniLaser 2115 Page Printer Operator's Manual	2539344-0001
Printer Models 2015, 2108, 2106, and 2115 Installation Guide	2549443-0001

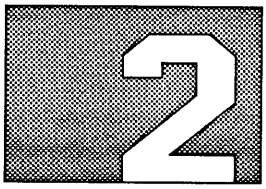
Specifications

1.4 Table 1-2 summarizes the performance, physical, environmental, and power specifications for the CK802 and CK803 terminal concentrators.

Table 1-2 CK802/CK803 Specifications

Item	Specification
Terminal interface	Eight independent asynchronous EIA serial 4-wire full-duplex channels (6-pin MMJ connectors). Each channel is programmable for 50 to 19,200 baud.
Host computer interface	
CK802	Differential Manchester-encoded multidrop twisted pairs (6-pin connector)
CK803	EIA-232-D or V.35 modem protocols (26-pin connector)
Dimensions	
Height	318 mm (12.5 in)
Width	117 mm (4.6 in) at base
Length	343 mm (13.5 in) with cover
Weight (approximate)	1.2 kg (2.5 lb)
Temperature	
Operating	0 to 40 degrees C (32 to 104 degrees F)
Nonoperating	−40 to 65 degrees C (−40 to 149 degrees F)
Relative humidity	
Operating	8% to 89% (noncondensing)
Nonoperating	5% to 95% (noncondensing)
Altitude	
Operating	−1,000 to 6,500 feet
Nonoperating	−1,000 to 10,000 feet
Cooling	Cooled by natural convection
12 Vdc adapter	
Power input	120 Vac ± 10%, 47–63 Hz 18 watts, or 220/240 Vac ± 10%, 47–63 Hz
Power output	12 Vdc at a maximum of 1 A
Electromagnetic Interference (EMI) compliance	Meets Federal Communications Commission (FCC) limits for a Class A computing device (Part 15, subpart J of FCC Rules and Regulations) and West German equivalent of U.S. Underwriter's Laboratories (VDE) 0871 Level B limits

MTC SITE PREPARATION AND UNPACK/INVENTORY



Introduction

2.1 This section provides the following information:

- Site preparation
- Unpacking and inventory
- Hardware equipment

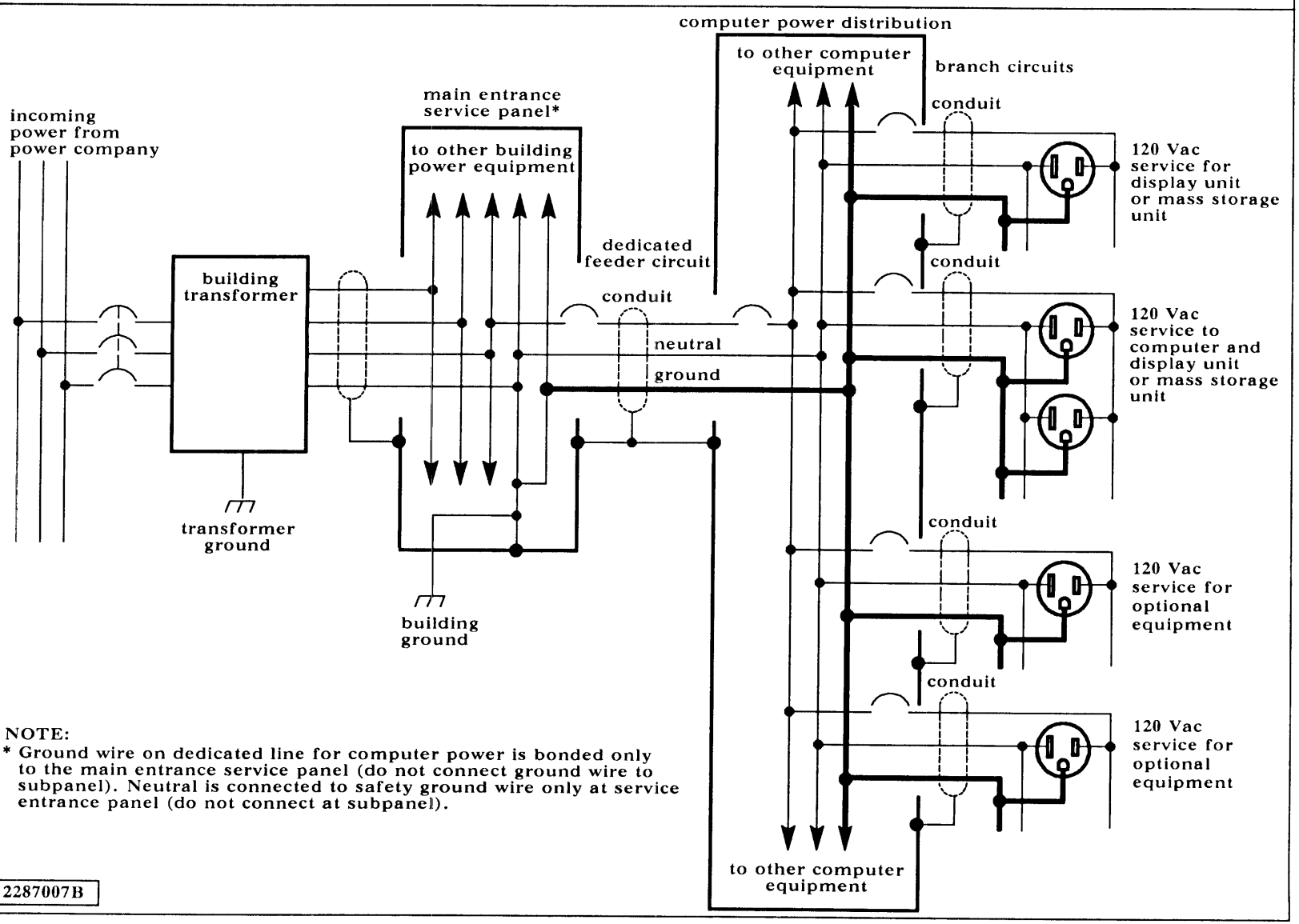
Site Preparation

2.2 Power and environmental requirements for the installation of the multidrop terminal concentrator (MTC) are listed in Table 1-2. Figure 2-1 shows an example of a properly wired 120-volt power distribution system for computer equipment. For more detailed information on power requirements, refer to the system installation manual for the computer system associated with your MTC.

Ensure that conditions at the MTC site meet the following requirements:

- Check that the environmental conditions meet the requirements specified in Table 1-2. If there is a conflict between the requirements of Table 1-2 and the site requirements of your computer system, follow the requirements in Table 1-2.
- Make sure that the ac power outlet and the interface connections are conveniently available to the MTC.

Figure 2-1 Recommended Power Service for Domestic 120V System



Unpacking and Inventory

2.3 To unpack the MTC, refer to Figure 2-2 and proceed as follows:

1. Visually inspect the MTC shipping container for damage. If the container is damaged, contact the carrier for instructions on filing a claim. The carrier, not Texas Instruments, is responsible for damage during shipment.

2. If the container has significant damage, contact the traffic department at the Texas Instruments site that shipped the equipment. Resolve all problems related to damage before proceeding with the installation.

3. Place the MTC shipping container on the floor in the upright position.

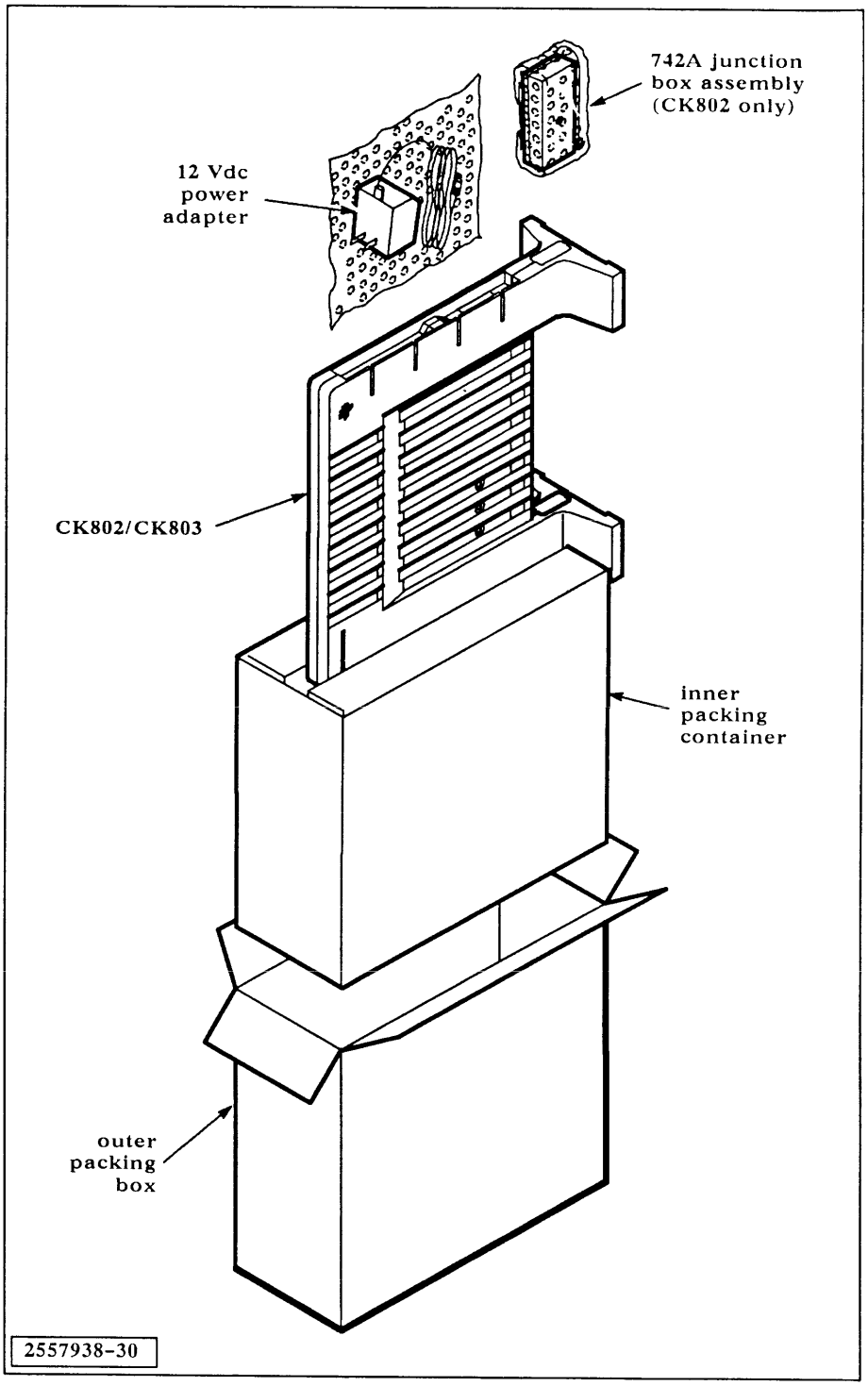
4. Cut the shipping container sealing tape.

5. Remove the 12 Vdc power adapter and the multidrop cable assembly from the inner packing container.

6. Remove the MTC from the inner packing container.

7. Check the MTC and associated components for damage. If you find damage, contact your carrier agent. After the carrier agent inspects the damage, contact a Texas Instruments field service office. Resolve all problems related to damage before proceeding with the installation.

Figure 2-2 MTC Shipping Container



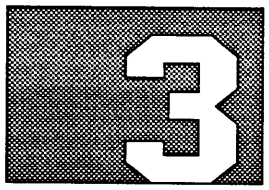
Hardware Equipment

2.4 Table 2-1 lists the hardware equipment associated with the MTC. Use this table to verify that you have received the hardware that you need for your system. Refer to the price list or contact your Texas Instruments representative for additional information.

Table 2-1 Hardware Equipment

Item	TI Part Number
CK802 Equipment	
CK802 MTC enclosure assembly	2554854-0002
CK802 MTC board	2554865-0002
12 Vdc adapter (120 Vac input)	2248371-0001
12 Vdc adapter (220/240 Vac input)	2562976-0001
Multidrop twisted-pair starter cable assembly, 9 m (30 ft)	2554926-0001
742A junction box assembly	2248376-0001
CK803 Equipment	
CK803 MTC enclosure assembly	2554898-0002
CK803 MTC board	2554870-0002
12 Vdc adapter (120 Vac input)	2248371-0001
12 Vdc adapter (220/240 Vac input)	2562976-0001
RS-232 modem interface cable, 3 m (10 ft)	2554896-0001
V.35 modem interface cable, 3 m (10 ft)	2554897-0001
Miscellaneous Interface Equipment and Tools	
CK202 host option board (multiboard computers)	2554910-0001
CC202 host option board (single-board computers)	2561115-0001
Multifunction cable adapter (MFA)	2535585-0001
Multidrop cable adapter (MDA)	2554905-0001
V.35 cable adapter	2535605-0001
Modified modular jack (MMJ) terminal cable, 7.6 m (25 ft)	2554927-0001
Terminal or serial printer cable	2230504-0001
Male terminal cable adapter	2554900-0001
Serial printer cable adapter (SRTS-11)	2554900-0002
Modem cable adapter	2554900-0003
Female terminal cable adapter	2554900-0004
Serial 810 printer cable	2308663-0001
742A junction box assembly	2248376-0001
Bulk plenum cable, 24 AWG solid, 3 pair, 305 m (1000 ft)	2554938-0001
Bulk terminal cable, 6-conductor flat telephone (terminal)	2554939-0001
MMJ crimp on plugs	2554935-0001
MMJ crimp tool	2554934-0001
Wire stripper (host cable)	2554940-0001
Test box (host interface cable)	2554937-0001
Loopback adapter (MMJ cable and CK802/CK803)	2554936-0001
Terminator resistor, 100 ohms, 0.25 W, 5%	0972946-0001

MTC INSTALLATION



Introduction

3.1 This section includes installation instructions and other information on the CK802 and CK803 multidrop terminal concentrator (MTC) equipment. This section contains the following information:

- Configuring the CK802/CK803
- Planning your CK802/CK803 installation
- Adding cable drops to the multidrop cable assembly
- Adding plenum cable to the multidrop cable assembly
- Installing the CK802
- Installing the CK803

CK802/CK803 Configurations

3.2 Sample configuration information for the CK802 and CK803 is shown in the following illustrations:

- Figure 3-1, CK802 basic local configuration
- Figure 3-2, CK802 local one-way multidrop cabling diagram
- Figure 3-3, CK802 local bidirectional multidrop cabling diagram
- Figure 3-4, CK803 basic remote configuration
- Figure 3-5, CK803 remote configuration

The CK802 configuration is intended for local operation. Local operation in this case means the CK802 and the associated host computer are connected together by the multidrop terminated cable. The CK803 configuration is intended for remote operation. Remote operation means the CK803 connects to the host computer through a modem and telephone switching equipment.

In the host computer, the CK202 option board is used with multiboard computers and the CC202 option board is used with single-board computers.

Figure 3-1 CK802 Basic Configuration

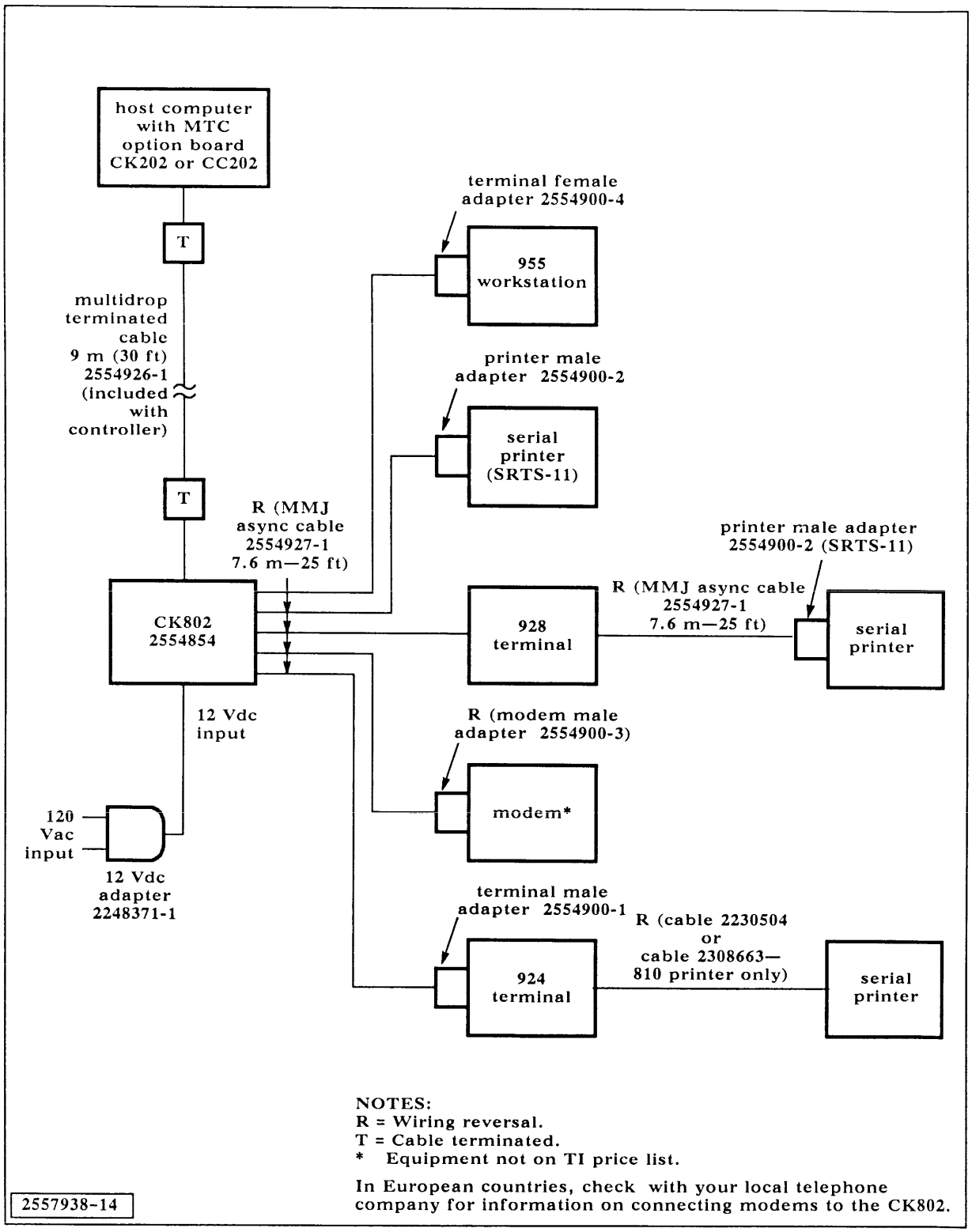


Figure 3-2 Typical One-Way Multidrop Terminated Cabling Diagram

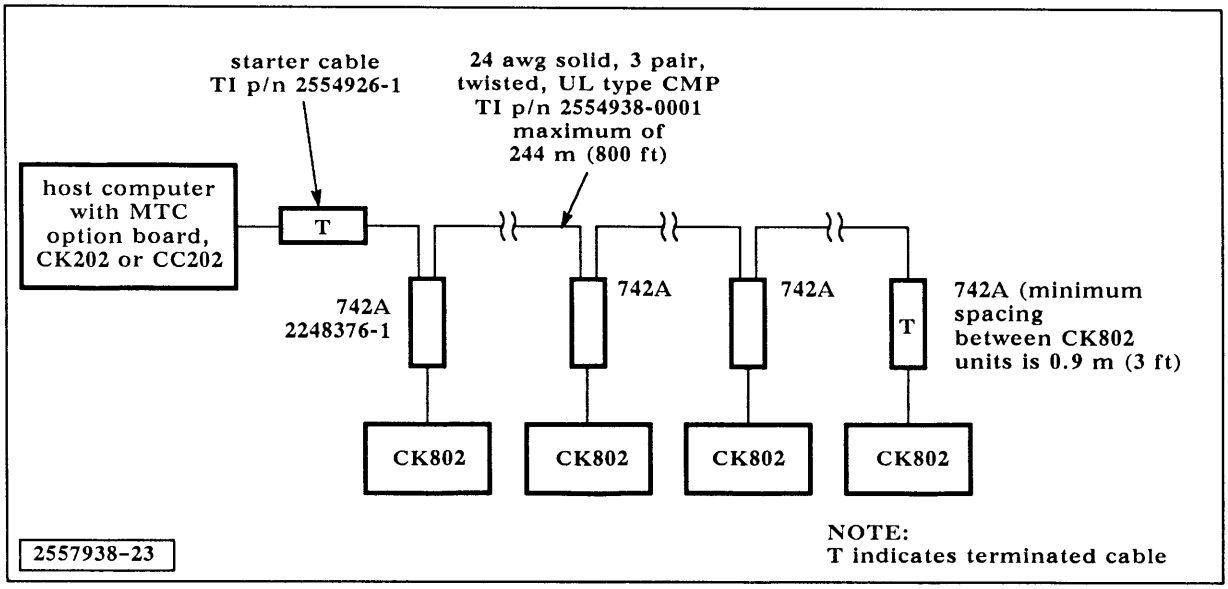


Figure 3-3 Typical Bidirectional Multidrop Terminated Cabling Diagram

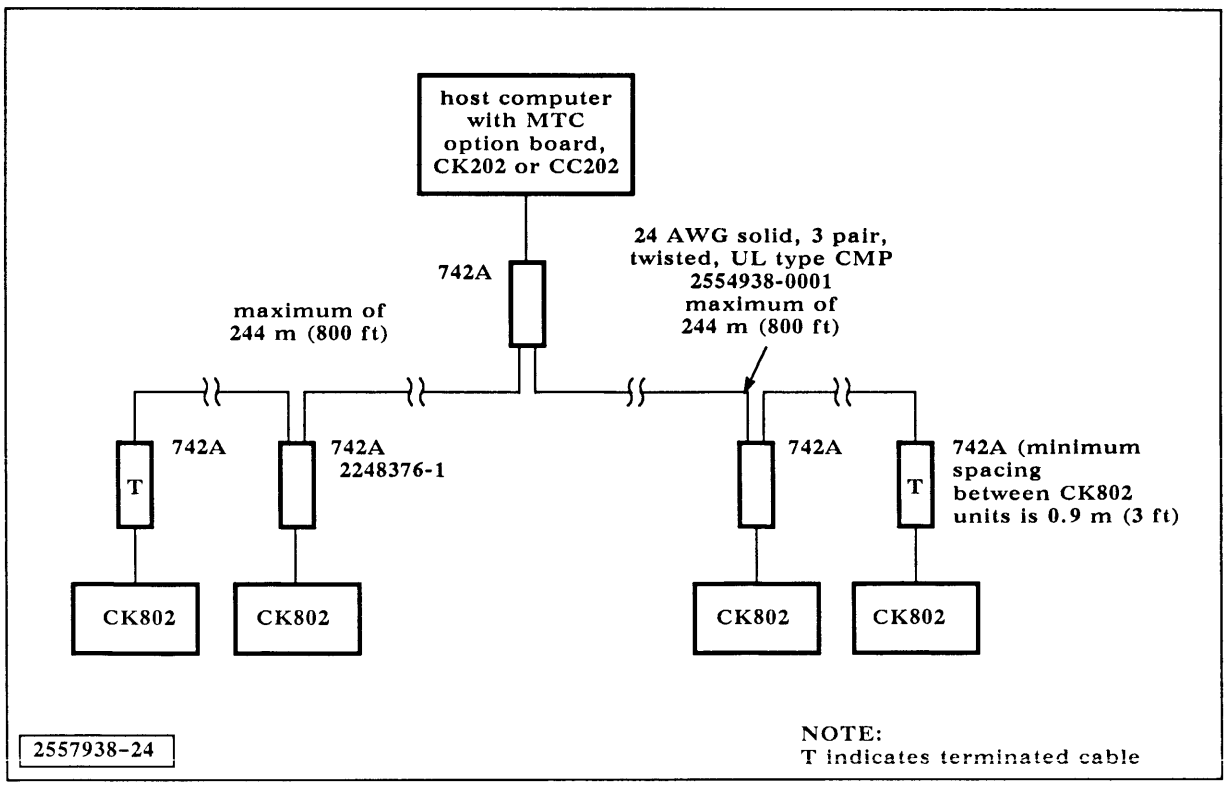
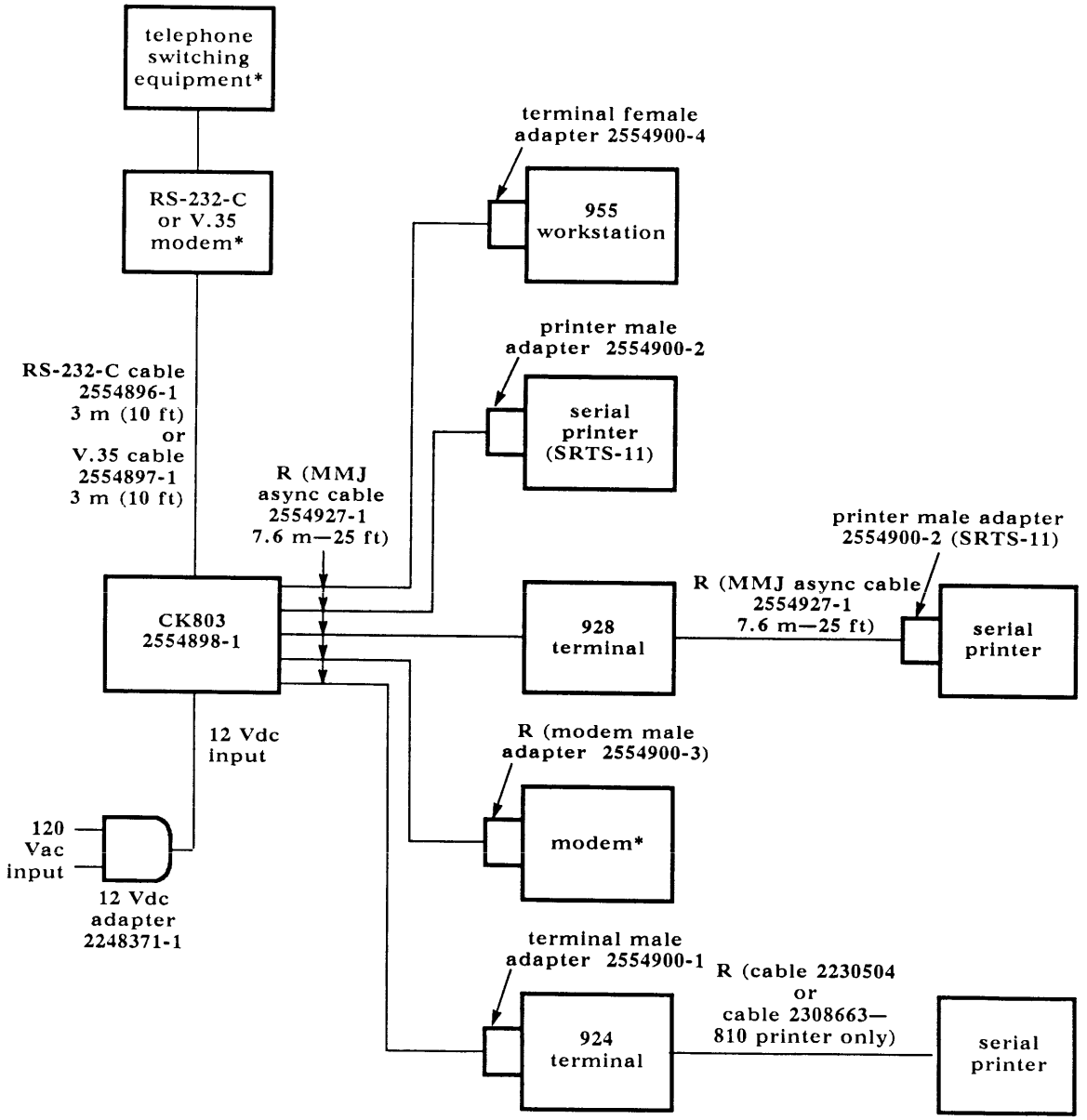


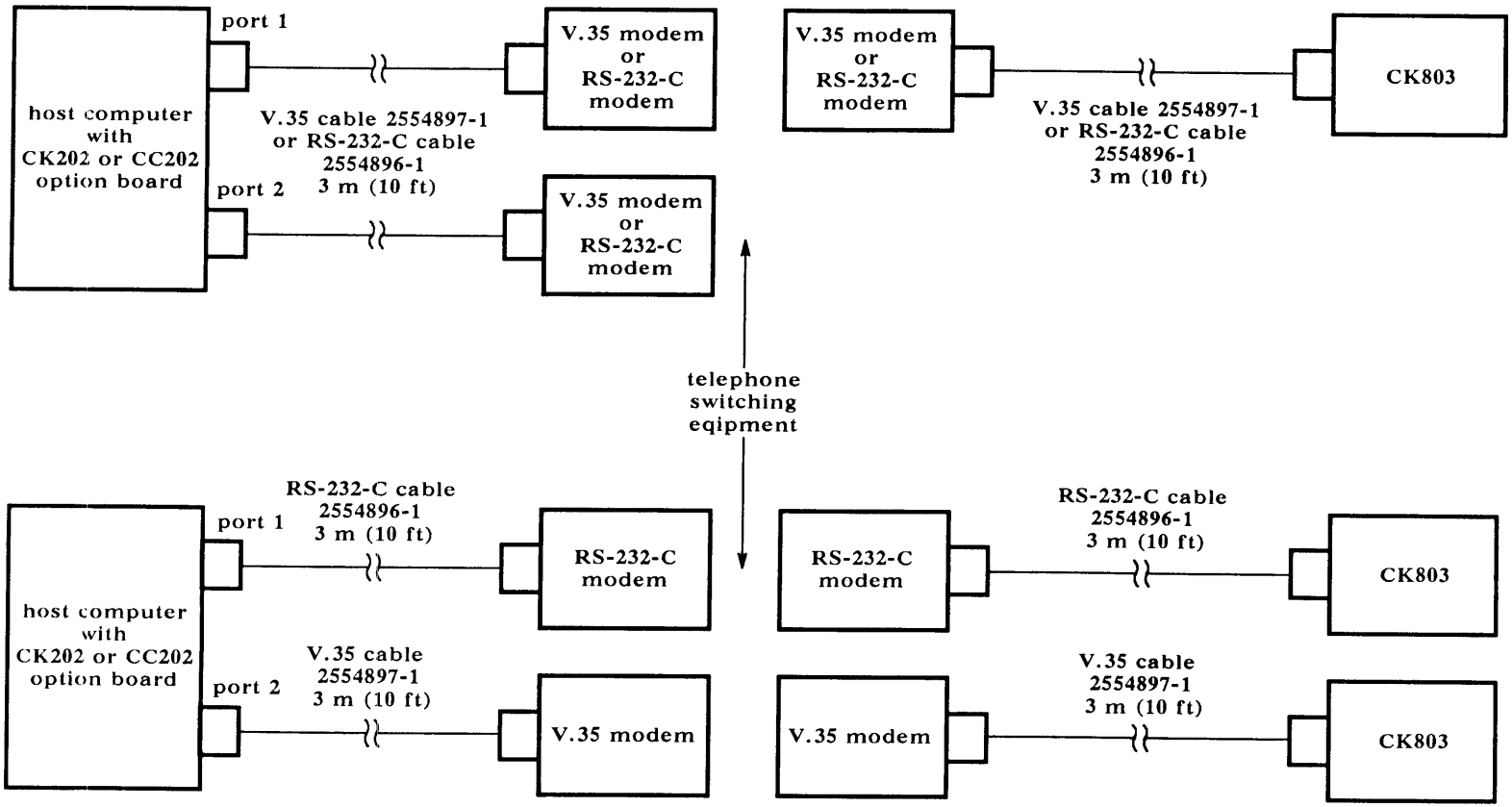
Figure 3-4 CK803 Basic Configuration



NOTES:
R = Wiring reversal
* Equipment not on TI price list

In European countries, check with your local telephone company for information on connecting modems to the CK803.

Figure 3-5 Typical CK803 Remote Configurations



NOTE: The modems and telephone switching equipment are not on the TI price list.

Planning Your CK802/CK803 Installation

3.3 Unless your installation is a small and simple arrangement, you will need to make a floor plan of your entire installation. This installation plan is necessary so that you can determine the most efficient and practical placement of your equipment and cables. Use the following guidelines to prepare your floor plan.

1. Refer to Figure 3-6 for a sample installation plan for the CK802(s). If you plan to have a remote site, refer to Figure 3-7 for a sample installation plan for the CK803(s). Include in your layout plan all host computers, terminals, and printers associated with each CK802 and/or CK803.

2. Place the CK802(s) and/or CK803(s) at the locations where all the terminals and printers can easily be connected to their associated CK802(s) and CK803(s). Consider the following additional restrictions when locating the CK802(s) and CK803(s):

   - If you have a remote site, all modems must be located within 3 m (10 ft) of the CK803(s) and the host computer.

   - The locations of ac power outlets for the 12-Vdc adapters must be within the length of the power cord. The power cord length on each 12-Vdc adapter is 1.8 m (6 ft).

WARNING: For safe operation, use only the adapter supplied by Texas Instruments for the CK802 and/or CK803.

   - The multidrop terminated cable assembly you received with your equipment has a 9 m (30 ft) long twisted-pair cable that is Underwriters' Laboratories (UL) rated and is intended for use as interior building wiring. If this cable needs to be routed in a riser or plenum (air handling space), then an appropriate UL rated cable must be used instead.

CAUTION: If you route the twisted-pair cable of the multidrop terminated cable assembly through a wall or plenum, consult your local building codes and the National Electrical Code to determine the correct cable rating required.

NOTE: Plenum rated cable is available through TI Express under part number 2554938-0001. This cable comes as 24 AWG solid, 3-pair bulk cable, in 305 m (1000 ft) lengths.

- The 9 m (30 ft) long twisted-pair cable supplied with the multidrop terminated cable assembly can be replaced with a cable of up to 244 m (800 ft) for a one-way installation, as shown in Figure 3-2, and an additional 244 m (800 ft) for a bidirectional installation, as shown in Figure 3-3.

3. Measure and note on your layout drawing all the distances between all the host computer(s), terminal(s), and printer(s) used in your planned system.

NOTE: You can fabricate your own modified modular jacks (MMJ) terminal cables when necessary due to longer lengths that you might need. For consulting services on cable lengths, call 1-800-847-5757.

NOTE: Shielded cables are available for the MMJ terminal cables when the MTC is used in Europe.

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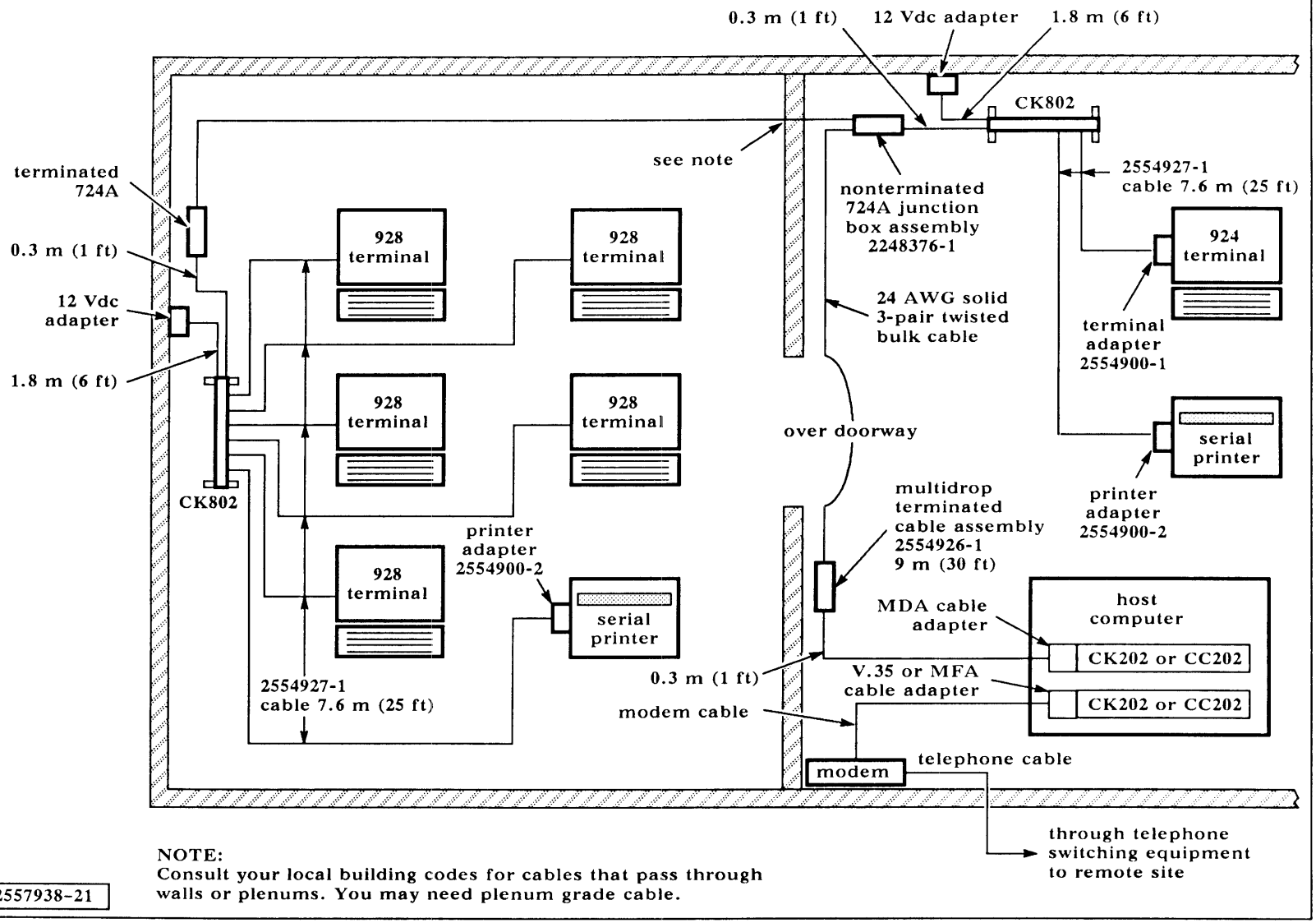
4. Study your layout drawing for possible rearrangements to reduce the distance between devices and to make your system layout connections more efficient.

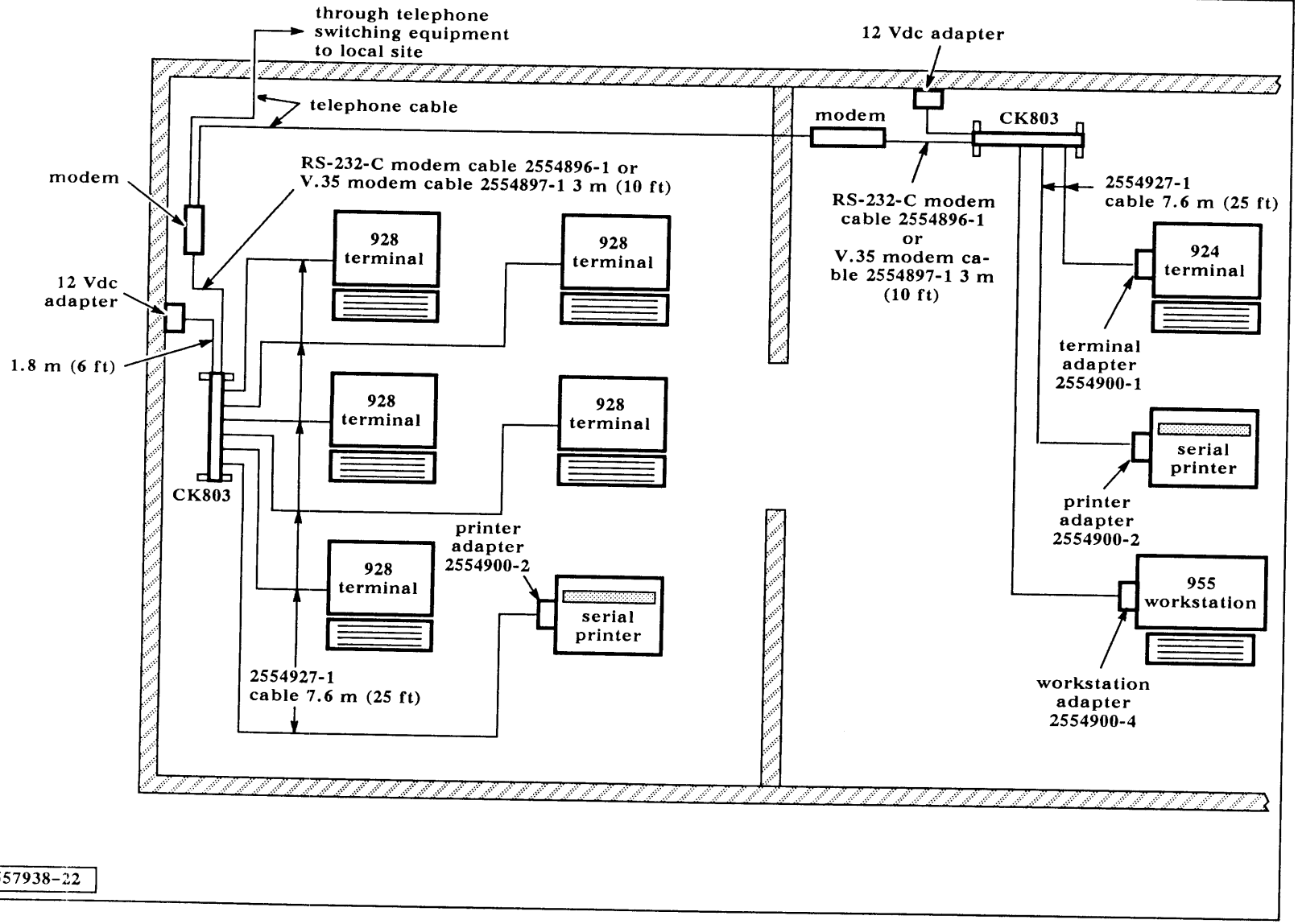
5. Make a new clean drawing of the final layout plan of your system. Use this drawing as a guide during the actual installation of your multiterminal system.

Figure 3-6 Sample CK802 Installation Plan



NOTE:
Consult your local building codes for cables that pass through walls or plenums. You may need plenum grade cable.

Figure 3-7 Sample CK803 Installation Plan



Adding Cable Drops to the Multidrop Cable Assembly

3.4 Perform the following procedure to add cable drops to the multidrop terminated cable assembly:

1. Locate the point on the twisted-pair cable where you want to install the nonterminated 742A junction box, and cut the cable at this point. Using a special wire stripper, part number 2554940-0001, strip away approximately 75 mm (3 inches) of outer covering from both ends of the cable you just cut. Use care not to damage the insulation on individual wires that are exposed at the end of the cables.

NOTE: Do not strip away any insulation on the individual wires in the twisted pair cable. The wire clamp makes electrical contact with the wires by cutting through the wire insulation when the clamp is tightened down on the plastic wire holder.

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2. Open the nonterminated 742A junction box that you are adding by loosening the cover screw and removing the cover. Refer to Figure 3-8. Use a screwdriver to remove two breakout tabs at the end of the junction box.

3. Using a flat-bladed screwdriver, loosen the clamp securing screw to raise the wire clamp at the position labeled BLACK on the 742A junction box. Insert the blue/white wires from the cable you cut in step 1 through outer holes in the plastic wire holder, and tighten the clamp securing screw to secure the blue/white wires in the wire clamp. Cut off the excess wire that extends from the plastic wire holder. Refer to Figure 3-9 and Figure 3-10.

4. Repeat step 3 to connect the white/blue, orange/white, and white/orange wires to the YELLOW, RED, and GREEN positions, respectively, on the 742A junction box. Check that the wire colors match the color-coded positions as follows:

Wire Color	Color-Coded Position
Blue/white	BLACK
White/blue	YELLOW
Orange/white	RED
White/orange	GREEN

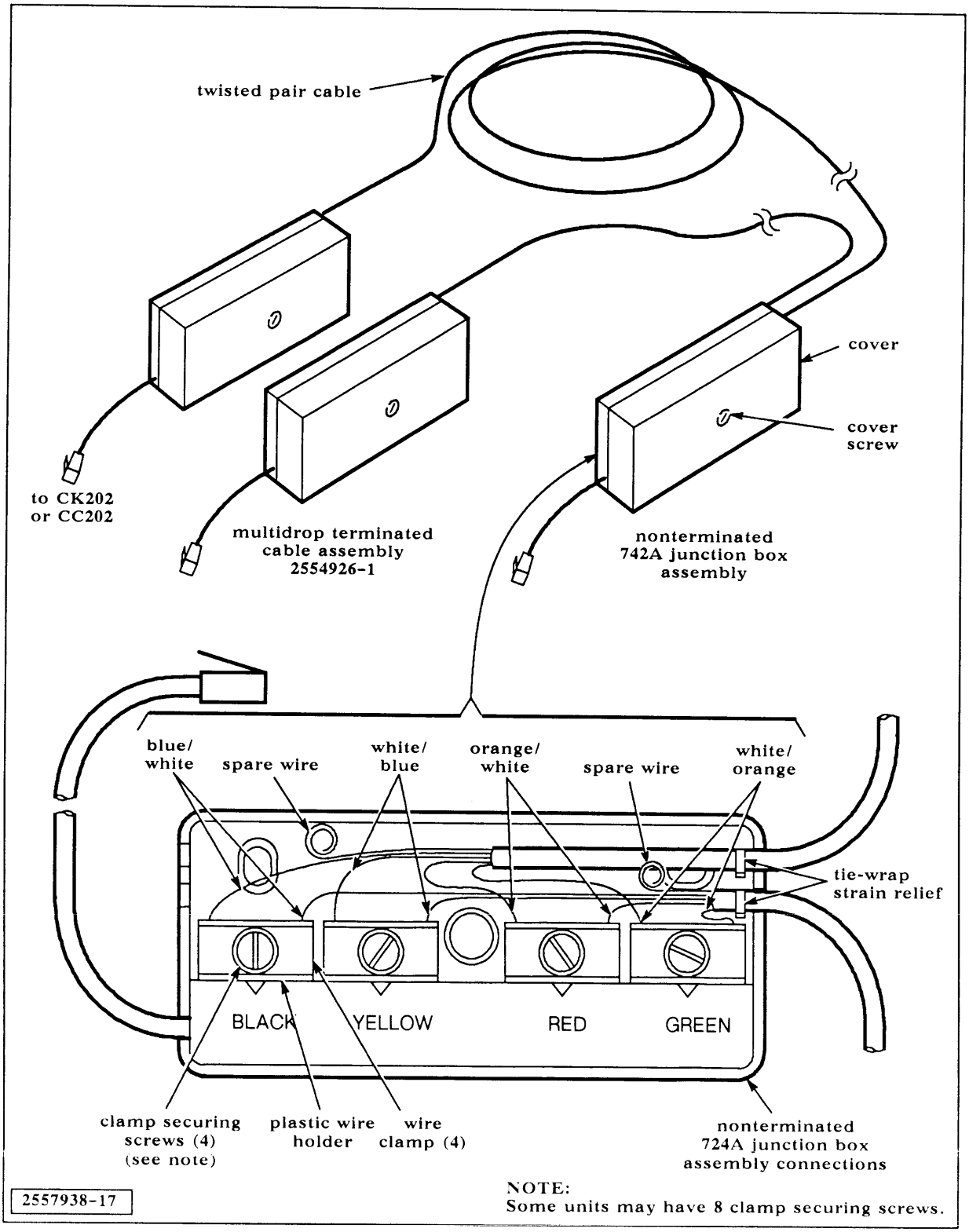
5. Install a tie-wrap strain relief on each cable as shown in Figure 3-8 and Figure 3-9.

6. Coil the green/white wire and the white/green wire so that they can be stored as spare wires in the nonterminated 742A junction box.

7. Reinstall the cover on the nonterminated 742A junction box.

NOTE: If you reconfigure your system from a one-way multidrop cable configuration (Figure 3-2) to a bidirectional multidrop cable configuration (Figure 3-3), it will be necessary to relocate the toroidal core from a terminated 742A junction box to a nonterminated 742A junction box.

Figure 3-8 Multidrop Terminated Cable Assembly With One Drop Cable Installed



NOTE:
Some units may have 8 clamp securing screws.

Figure 3-9 Typical 742A Junction Box Assembly Wiring

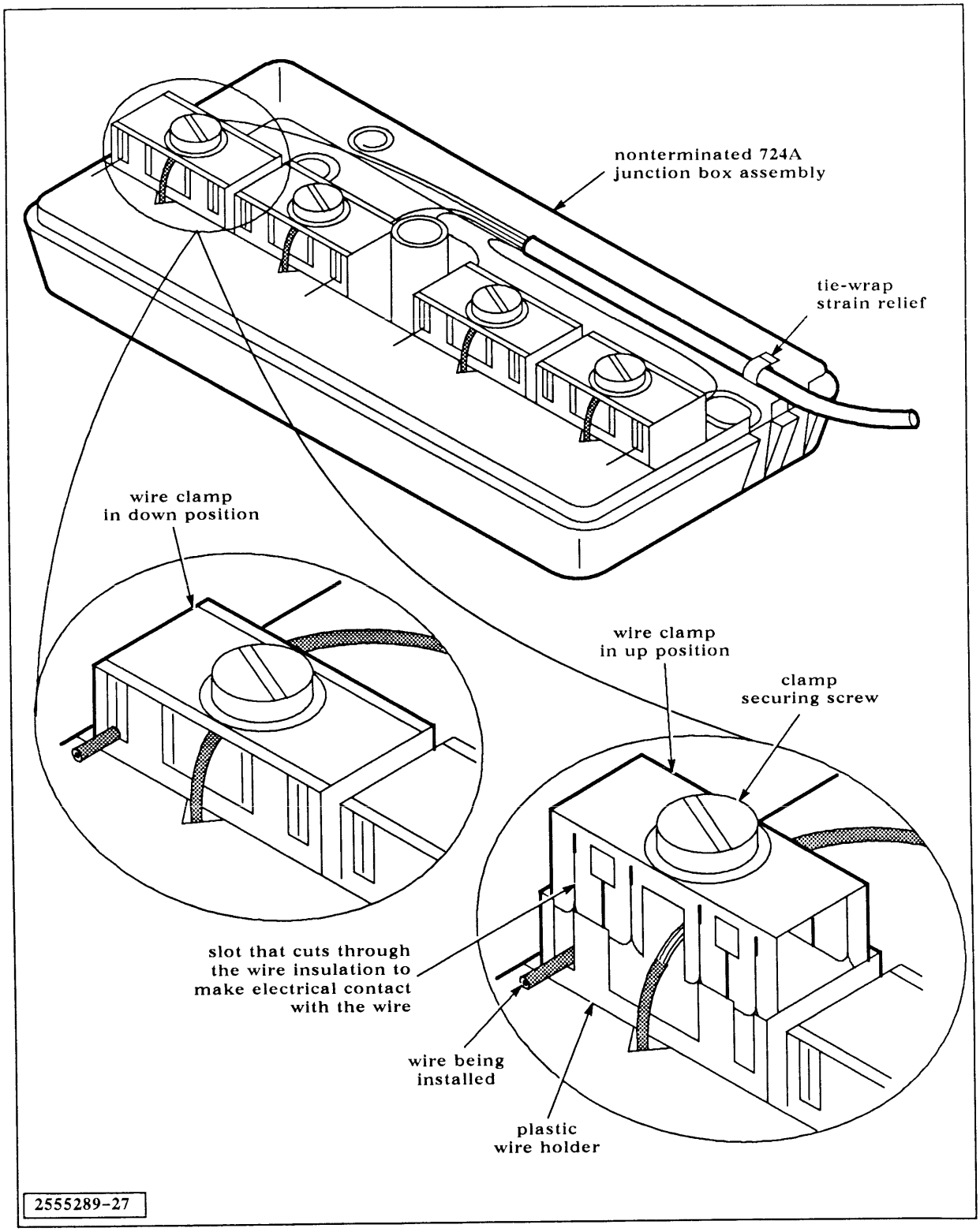
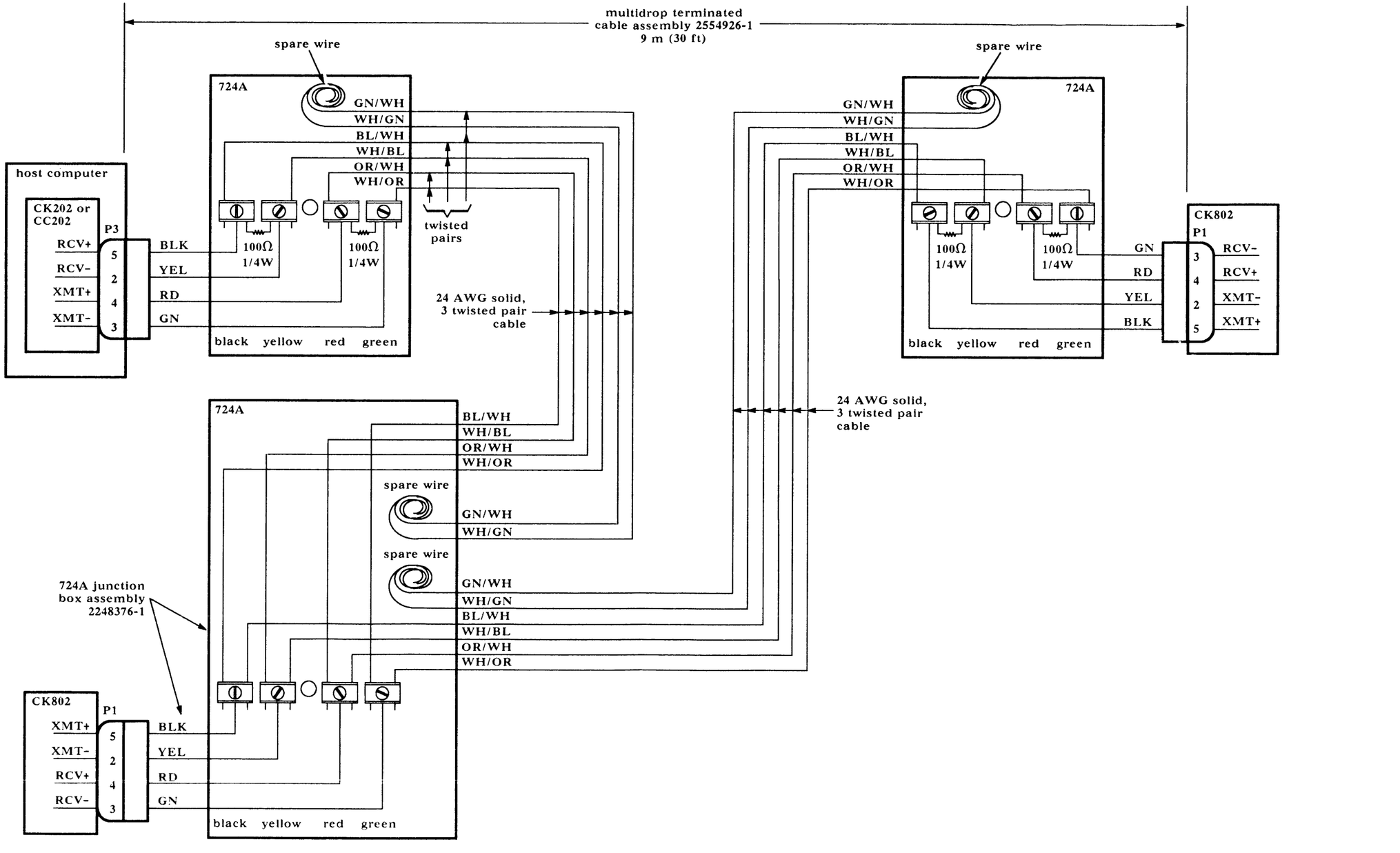


Figure 3-10 Multidrop Terminated Cable Assembly Wiring Diagram With One Drop Cable Installed



2557938-20

Adding Plenum Cable to the Multidrop Cable Assembly

3.5 Perform the following procedure to add plenum cable to the multidrop terminated cable assembly:

1. Open the terminated 742A junction box by loosening the cover screw and removing the cover. Refer to Figure 3-11 and Figure 3-12.

2. Using a flat-bladed screwdriver, loosen the four clamp-securing screws approximately two complete turns to raise the wire clamps on the 742A junction box. See Figure 3-9. Press down on the each wire to release it from the wire clamp, and then pull the wires from the holes in the plastic wire holders. Do not disturb the terminating resistors if they are present.

3. Determine the length of plenum cable that you need, and then cut the correct length of cable from the bulk plenum cable supplied.

4. Using a special wire stripper, part number 2554940-0001, strip away approximately 75 mm (3 inches) of the outer covering from both ends of the plenum cable that you cut in step 3. Use care not to damage the insulation on individual wires that are exposed at the end the cables.

NOTE: Do not strip away any insulation on the individual wires in the plenum cable. The wire clamp makes electrical contact with the wires by cutting through the wire insulation when the clamp is tightened on the plastic wire holder.

---

5. Insert the blue/white wire of the plenum cable through outer holes in the plastic wire holder, and tighten the clamp securing screw to secure the blue/white wire in the wire clamp. If the terminating resistor is present, make sure that it is still in the proper position. Cut off the excess of the blue/white wire that extends from the plastic wire holder.

6. Repeat step 5 to connect the blue/white, orange/white, and white/orange wires to the YELLOW, RED, and GREEN positions, respectively, on the 742A junction boxes. Check that the wire colors match the color coded positions as follows:

Wire Color	Color Coded Position
Blue/white	BLACK
White/blue	YELLOW
Orange/white	RED
White/orange	GREEN

7. Install a tie-wrap strain relief on each cable as shown in Figure 3-9.

8. Coil the green/white wire and the white/green wire so that they can be stored as spare wires in the 742A junction boxes.

9. Reinstall the cover on the nonterminated 742A junction box.

Figure 3-11 Multidrop Terminated Cable Assembly 2554926-0001

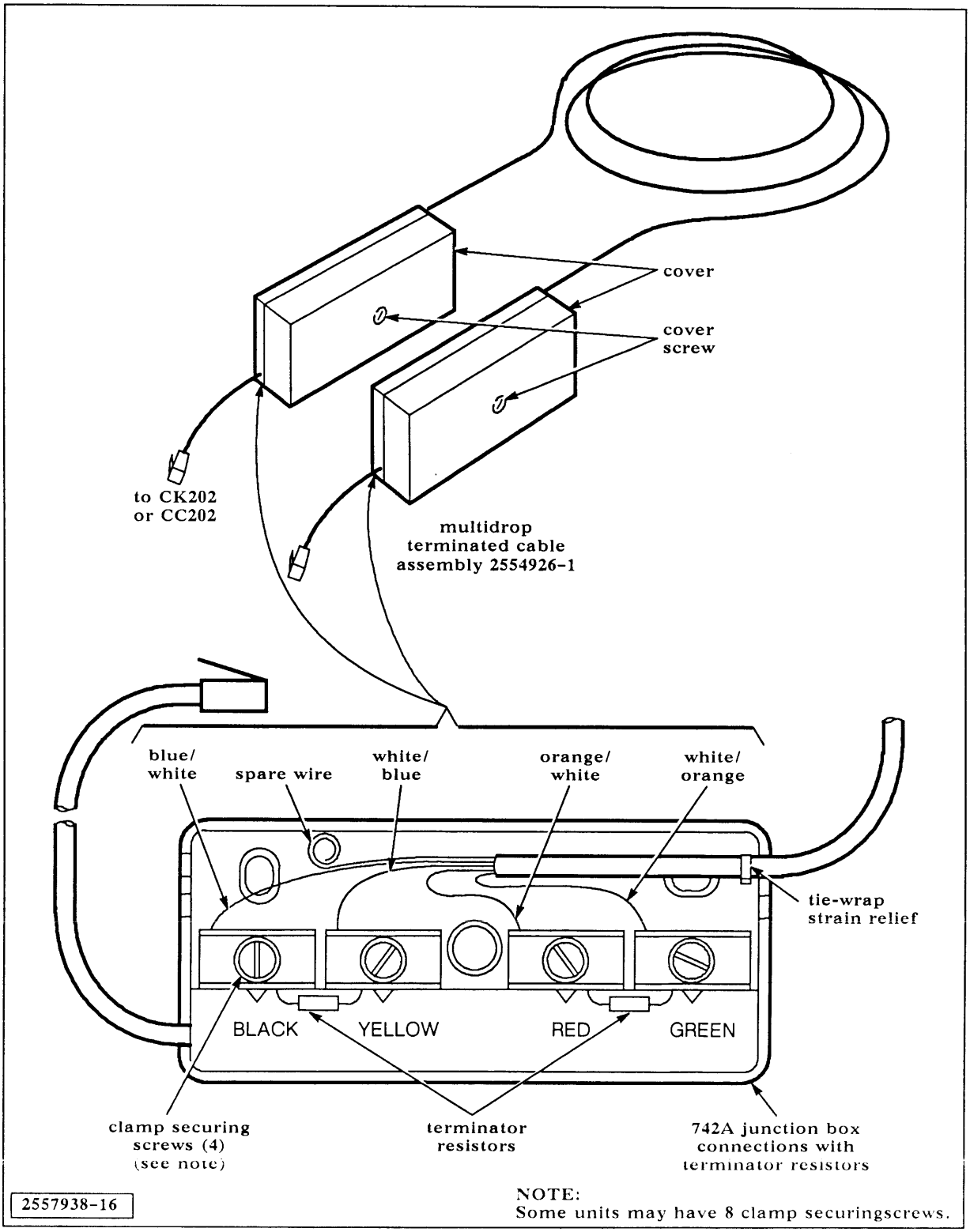
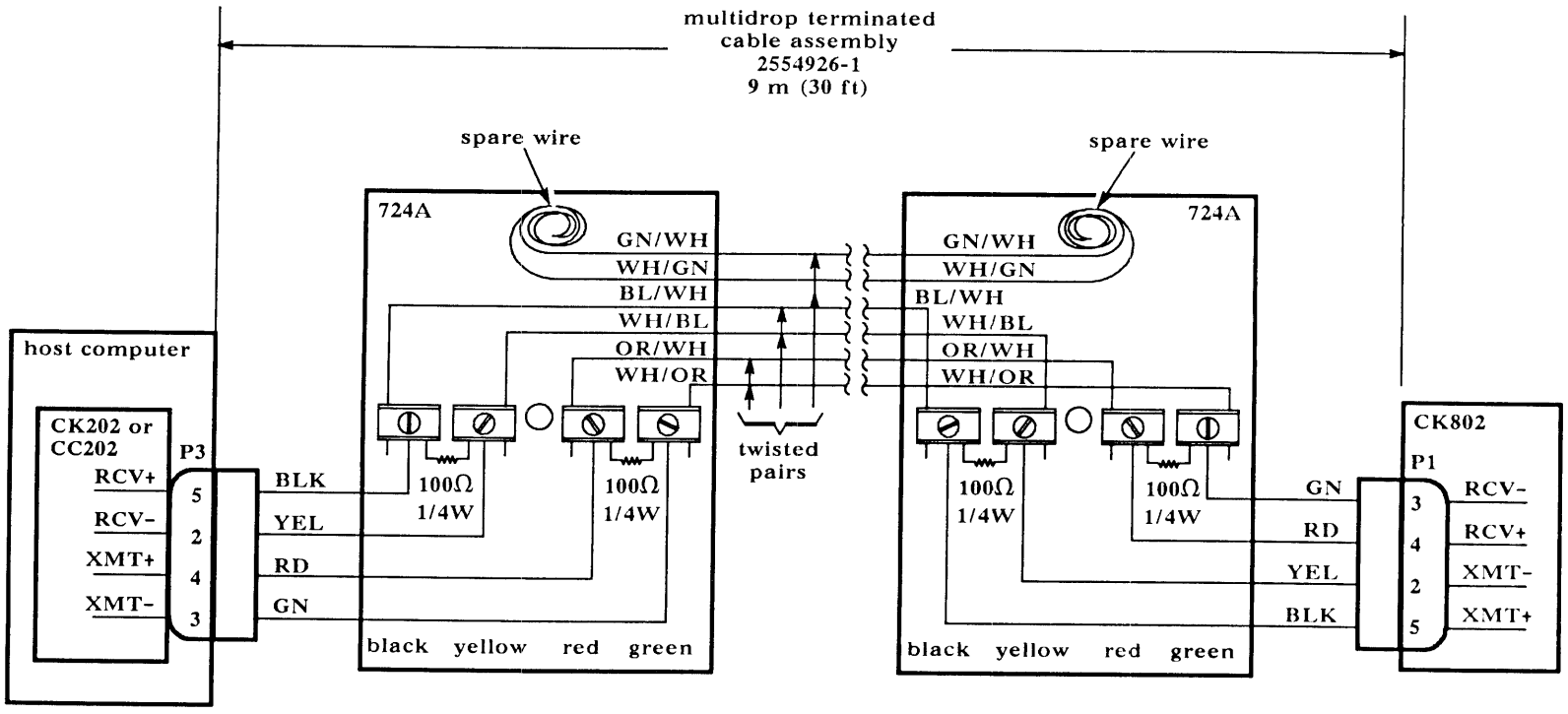


Figure 3-12 Multidrop Terminated Cable Assembly Wiring



Installing the CK802

3.6 Perform the following procedure to install the CK802:

1. Place the CK802(s) at the locations indicated on your installation floor plan.

2. Set the power switch on the CK802(s) to off.

3. Connect the lead on the 12 Vdc adapter to the CK802(s). Loop the lead through the strain relief on the CK802(s), and then plug the adapters into the appropriate wall outlets.

4. Place the multidrop terminated cable assembly in position between the CK802(s) and the host computer.

5. Connect the multidrop terminated cable assembly to the standard 6-pin host interface connector on the CK802.

6. Connect the multidrop terminated cable assembly to the standard 6-pin modular host interface connector on the multidrop cable adapter (MDA) cable adapter for the CK202 in the host computer.

7. Connect the terminal interface cables (Figure 3-13) and the appropriate cable adapters (Figure 3-14 and Figure 3-15) between the CK802(s) and the terminals and/or printers. Refer to Figure 3-1 for additional information on where to use the terminal interface cables and adapters.

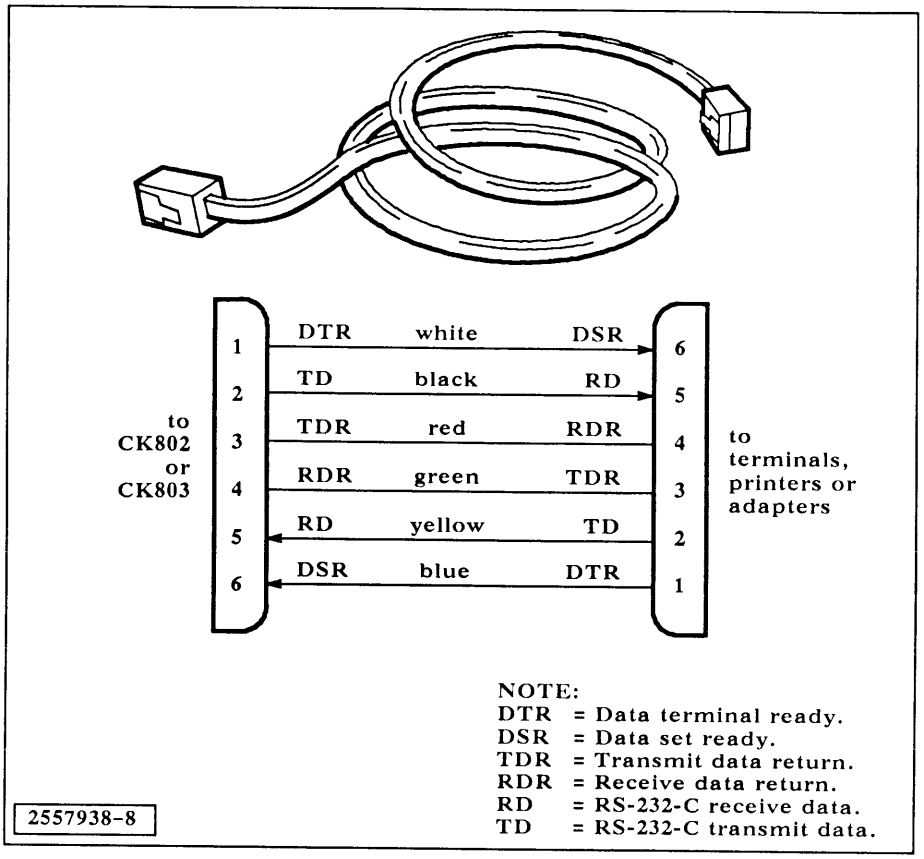
NOTE: Refer to Table 1-1 in Section 1 for the part numbers of the installation and operation manuals associated with the terminals and/or printers.

---

8. Set the power switch on the CK802(s) to on.

9. Refer to Sections 4 and 5 of this manual to check the operation of the CK802(s).

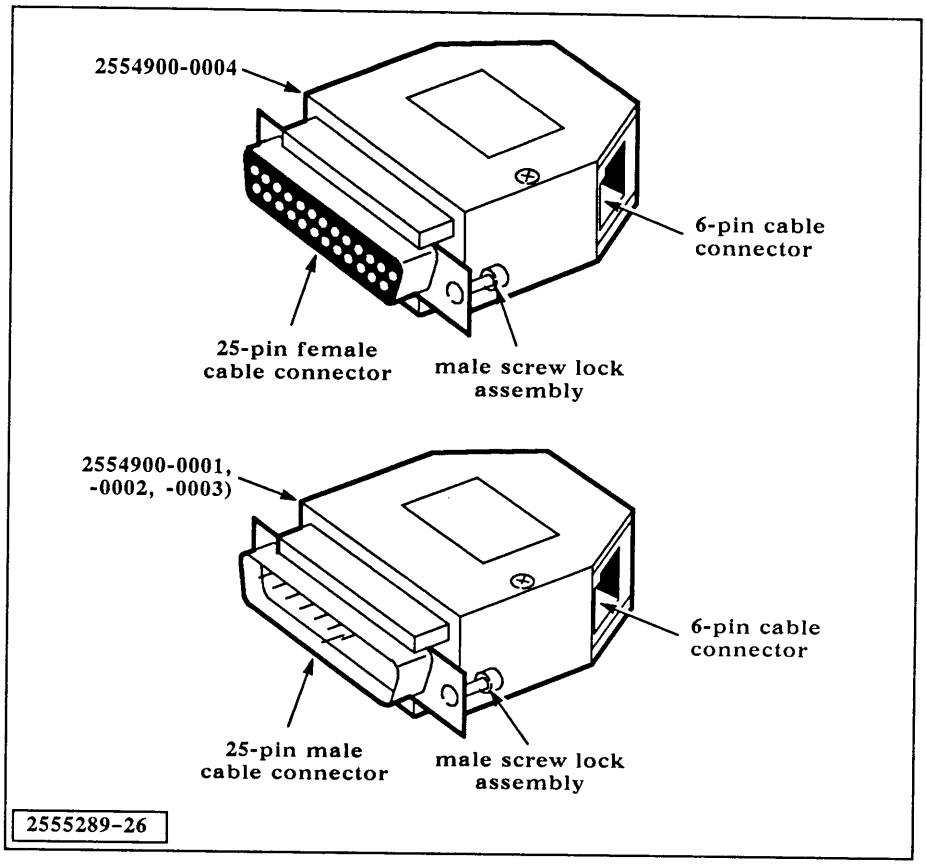
Figure 3-13 Terminal Interface Cable 2554927-0001



NOTE: Refer to Figure 3-1 for information on where to use this cable.

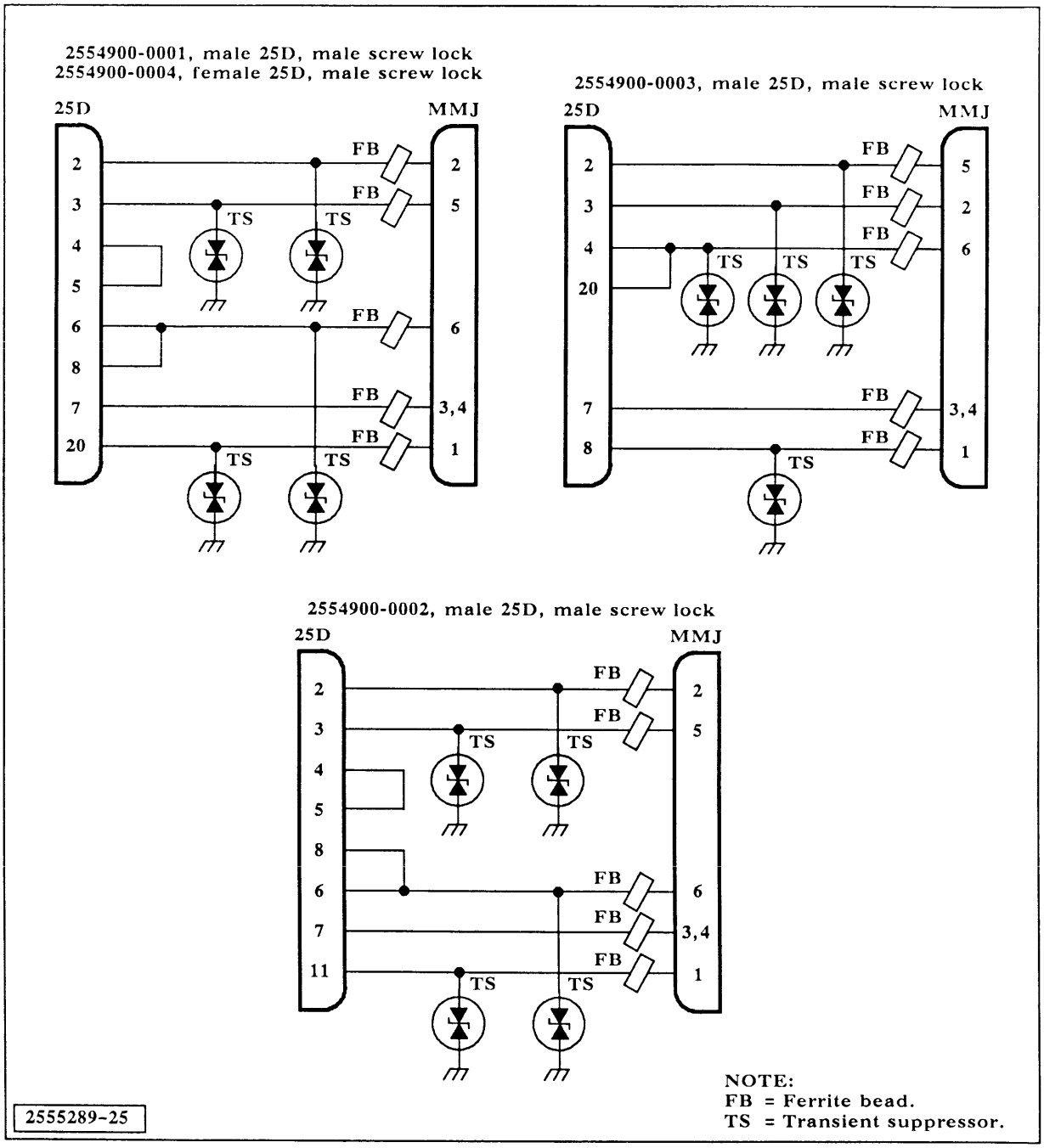
Figure 3-14

Cable Adapters 2554900-0001 through -0004



NOTE: Refer to Figure 3-1 for information on where to use these cable adapters.

Figure 3-15 Cable Adapter Wiring Diagrams



NOTE: Refer to Figure 3-1 for information on where to use these cable adapters.

Installing the CK803

3.7 Perform the following procedure to install the CK803(s):

1. Place the CK803(s) at the locations indicated on your installation floor plan.

2. Set the power switch on the CK803(s) to off.

3. Connect the lead on the 12 Vdc adapter to the CK803(s). Loop the lead through the strain refief on the CK803(s), and then plug the adapter(s) into the appropriate wall outlet(s).

4. Arrange for the installation of the following equipment not supplied by Texas Instruments:

   a. Have the RS-232-C or V.35 modems installed in the locations indicated on your installation floor plan.

   b. Have the telephone cables installed as indicated on your floor plan.

5. Connect the terminal interface cables (Figure 3-13), part number 2554927-0001, and the appropriate cable adapters (Figure 3-14 and Figure 3-15) between the CK803(s) and the terminals and/or printers. Refer to Figure 3-4 for additional information on where to use the terminal interface cables and adapters.

NOTE: Table 3-1 provides information on interface signals. Refer to Table 1-1 in Section 1 for the part numbers of the installation and operation manuals associated with the terminals and/or printers.

---

6. Connect the RS-232-C modem cable (Figure 3-16), part number 2554896-0001, or the V.35 modem cable (Figure 3-17), part number 2554897-0001, between the modems and the CK803(s). Refer to Table 3-1 for information on interface signals.

7. Connect the RS-232-C modem cable (Figure 3-16), part number 2554896-0001, or the V.35 modem cable (Figure 3-17), part number 2554897-0001, between the modems and the remote adapter in the host computer.

8. Set the power switch on the CK802(s) to on.

9. Refer to Sections 4 and 5 of this manual to check the operation of the CK802(s).

Figure 3-16 RS-232-C Modem Interface Cable 2554896-0001

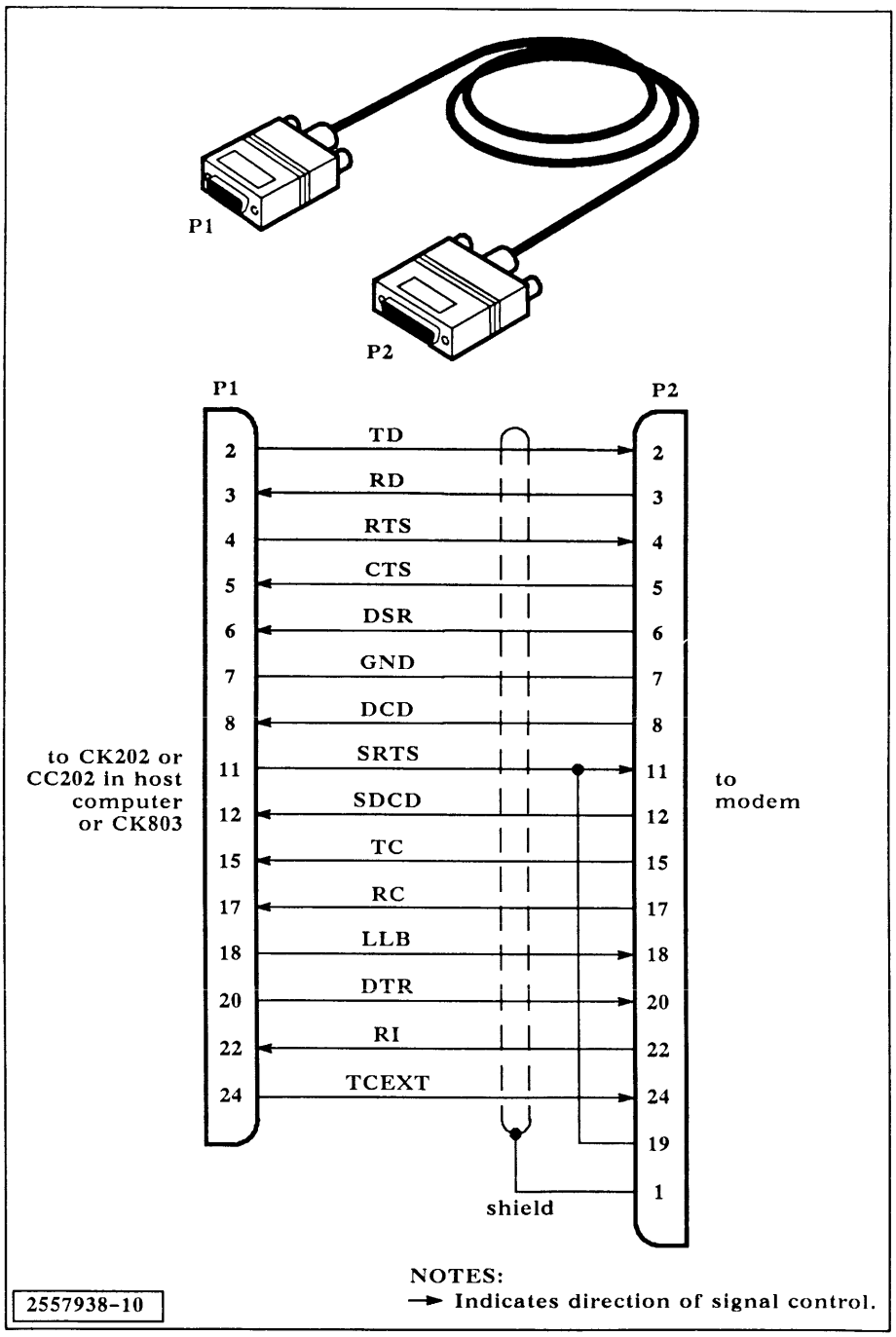


Figure 3-17 V.35 Modem Interface Cable 2554897-0001

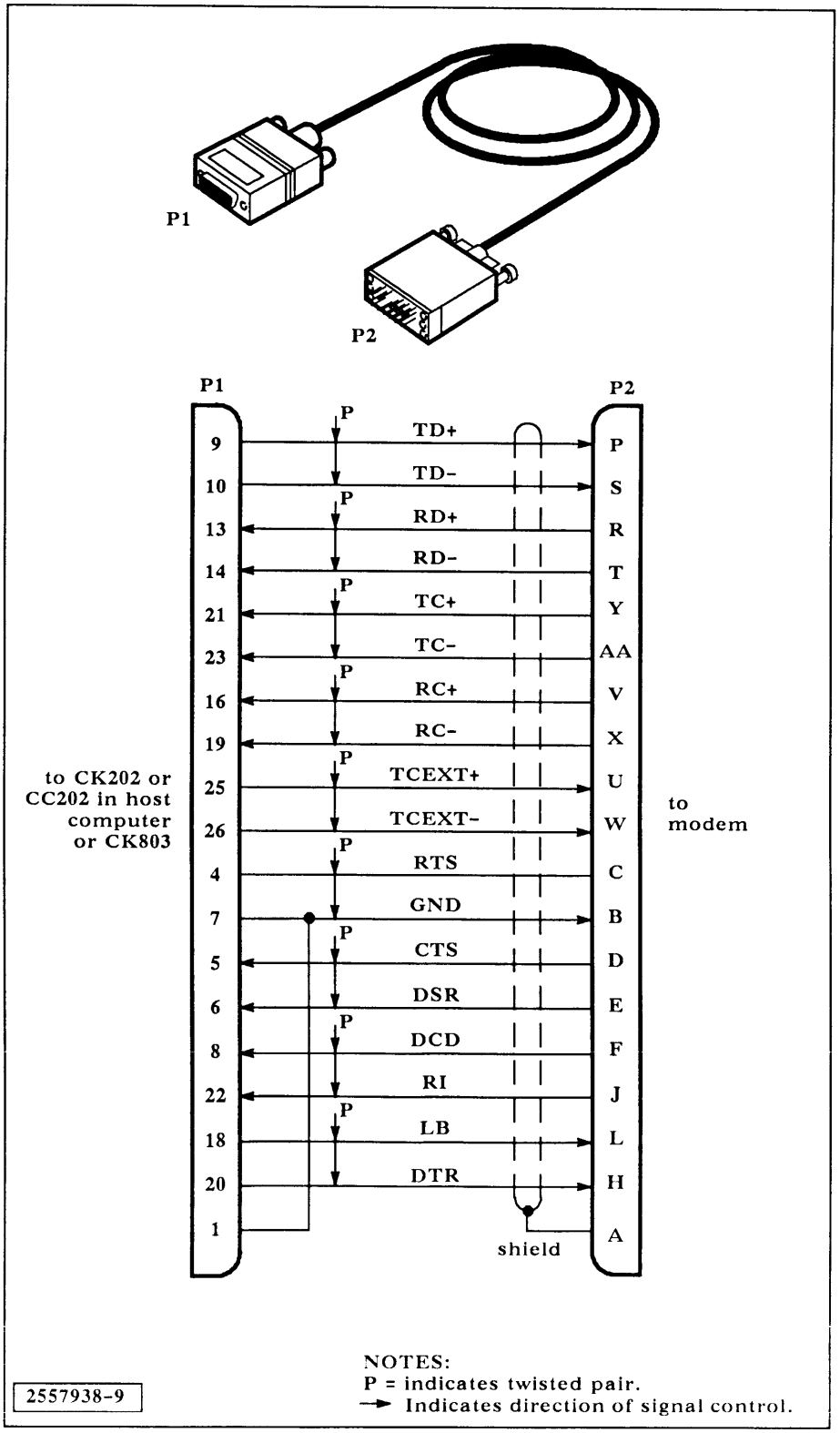


Table 3-1 Interface Connector Signals at CK803 or Host Computer Controller

Signal Designation	Pin Number	Signal Direction	Meaning/Function
EIA	1	Input	Interface select
TD	2	Output	EIA transmit data
RD	3	Input	EIA receive data
RTS	4	Output	Request to send
CTS	5	Input	Clear to send
DSR	6	Input	Data set ready
GND	7	Ground	Signal ground
DCD	8	Input	Data carrier detect
TD+	13	Output	V.35 transmit data +
TD–	14	Output	V.35 transmit data –
SRTS*	11	Output	Secondary request to send
SDCD*	12	Input	Secondary data carrier detect
RD+	9	Input	V.35 receive data +
RD–	10	Input	V.35 receive data –
TC	15	Input	EIA transmit clock
RC+	21	Input	V.35 receive clock +
RC	17	Input	EIA receive clock
LLB	18	Output	Local loopback
RC–	23	Output	V.35 receive clock –
DTR	20	Output	Data terminal ready
TC+	16	Input	V.35 transmit clock
RI	22	Input	Ring indicator
TC–	19	Input	V.35 transmit clock –
TCEXT	24	Output	EIA transmit clock out
TCEXT+	25	Output	V.35 transmit clock out +
TCEXT–	26	Output	V.35 transmit clock out –

Notes:

* indicates signals not used on CK803.

MTC OPERATION

Introduction

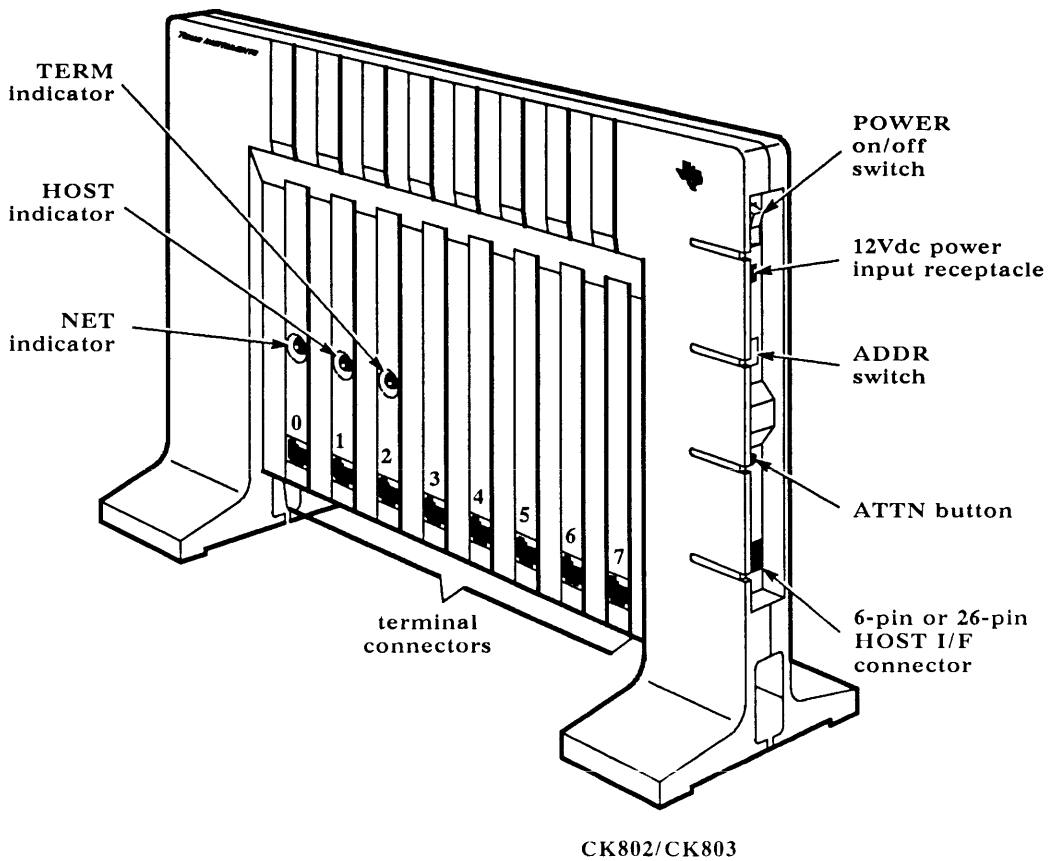
4.1 This section describes multidrop terminal concentrator (MTC) operating procedures. Topics in this section are:

- Operating controls and indicators
- Power-up procedure
- Power-down procedure

Operating Controls and Indicators

4.2 The locations of the operating controls and indicators for both the CK802 and the CK803 are shown in Figure 4-1.

Figure 4-1 Location of Operating Controls and Indicators

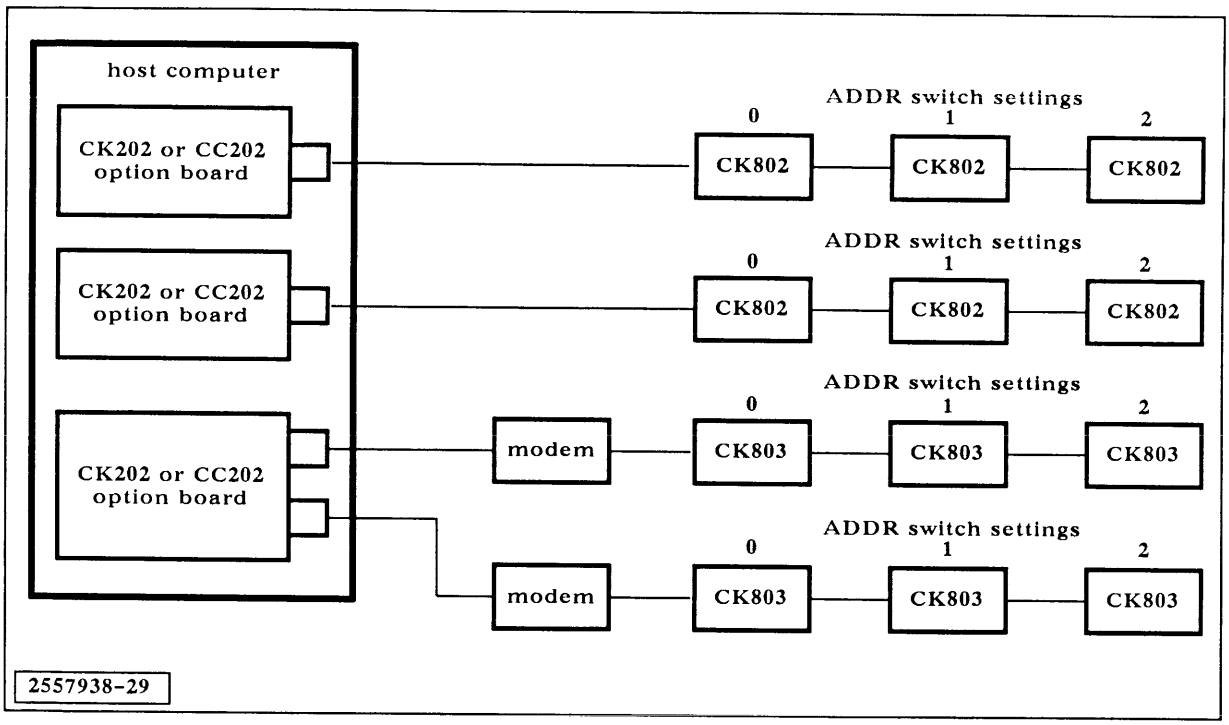


ADDR Switch

4.2.1 The ADDR switch is a sixteen-position rotary switch that selects the address for each MTC. The sixteen positions of the switch are labeled from 0 through 15.

Set the ADDR switch to 0 on the first MTC, to 1 on the second MTC, to 2 on the third MTC, and so on for all the MTCs on each multidrop cable. Figure 4-2 shows a sample of the ADDR switch settings on a large MTC installation.

Figure 4-2 Sample of the ADDR Switch Settings for a Large MTC Installation



Operating Status Indicators

4.2.2 The operating status indicators are light-emitting diodes (LEDs) that monitor system activity during power-up, self-testing, and downloading of the MTC. These indicators operate as a group to display a three-digit binary code. All LED indicators are green when lit. These codes are explained in Table 4-1.

Table 4-1 Status Indicator Codes

NET	HOST	TERM	Indicator Codes
Power-up Initialization			
On	On	On	Initial power-up and self-test executing
Blinking	Blinking	Blinking	In diagnostic mode and searching for a terminal (all LEDs blink together)
On	Off	On	Boot mode requesting download file
On	Blinking	On	File downloaded successfully and is executing
Normal Operation			
*On/Blinking	Not relevant	Not relevant	Host computer active
On/Blinking	*On/Blinking	Not relevant	Host computer addressing MTC
On/Blinking	Not relevant	*On/Blinking	Terminal activity (keyboard input)

Note:
* Important LEDs for normal operation.

ATTN Button

4.2.3 The ATTN button controls the execution state of the MTC for troubleshooting and diagnostic purposes. Pressing this button once returns the MTC to the power-up entry state in the self-test ROM mode.

Pressing the ATTN button twice within two seconds always returns you to the diagnostic monitor ROM mode.

Refer to Section 5 for more information on the ATTN button operation.

Power Switch

4.2.4 The ac power button is a two-position rocker-type mechanical switch labeled 0 and 1. The power-off position is 0; the power-on position is 1.

Power-Up Procedure

4.3 When the MTC and all associated peripherals are properly connected, power up the MTC and check that the self-test and the download of the software complete correctly. This assumes the appropriate software is installed in the host computer. Refer to the *System 1500 Terminal Concentrator Software* manual for information on software installation. Refer to Table 4-1 for an explanation of the status indicator codes during power-up.

Under normal circumstances, the power-up self-tests will complete within 30 seconds after power is applied. If the HOST indicator remains on longer than 30 seconds, the MTC board has a problem but may still be usable. For example, a board with a bad data channel still has seven good channels. For this reason, the ROM code allows the self-tests to complete and the MTC to enter the download mode, thus allowing limited operation. More serious failures that do not disable the processor could cause reliability problems. For failures in this category, the MTC would not attempt a download but would enter the terminal search mode so that extended diagnostics can be executed to learn more about the failure.

Power-Down Procedure

4.4 To power down the MTC, set the power on/off switch to off.

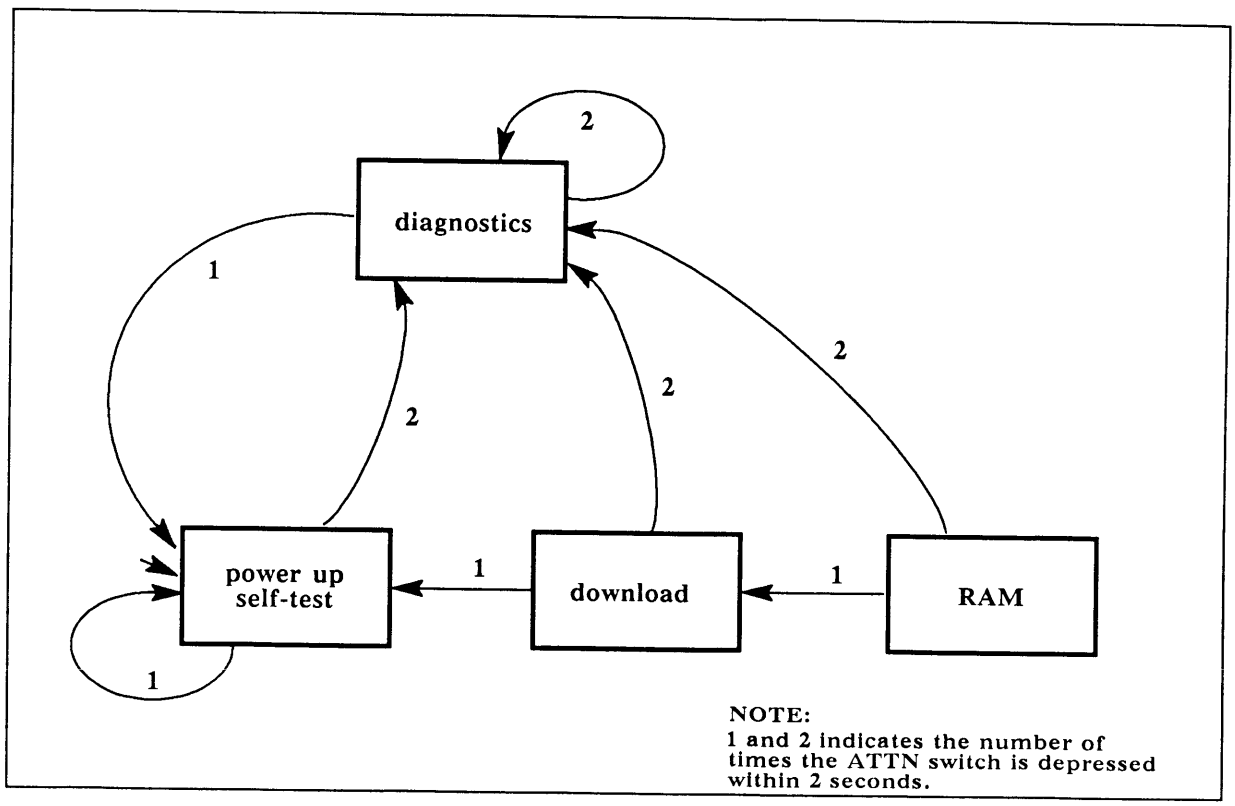
CAUTION: When you power down one MTC, you are cutting off as many as eight terminal users from access to the host computer. Notify these users prior to power down so that they can log off the system.

MTC DIAGNOSTICS

Introduction

5.1 The CK802/CK803 multidrop terminal concentrator (MTC) features powerful on-board diagnostics that are activated at two levels. The MTC automatically executes a power-up self-test that quickly tests as much of the logic as it can in the time allotted using internal loopback capabilities. The power-up self-test automatically executes when power is applied to the MTC. The MTC also has extended on-board diagnostics that you can invoke interactively. You can control the testing via the ATTN button. Figure 5-1 shows a state diagram of ATTN button operation.

Figure 5-1 State Diagram of ATTN Switch Test Operation



The MTC can be in three states: power-up self-test, download, or RAM. In power-up self-test state, the MTC checks itself, and after successful completion of the self-tests, downloads its operating software from the host computer system. When the operating software has been downloaded, the MTC is in the RAM state, running from the program loaded in the MTC memory.

ATTN Button Operation

5.2 The operation of the ATTN button is as follows:

- If the ATTN button is pressed once during the power-up self-test state, the MTC restarts the self-test.
- If the ATTN button is pressed once when the MTC is in the download state, the MTC restarts the self-test and downloads again.
- If the ATTN button is pressed once when the MTC is in the RAM state, the MTC again downloads from the host computer system.
- Enter the MTC diagnostic monitor state by applying power to the MTC and immediately (within 2 seconds) pressing the ATTN button twice. To exit the MTC diagnostic monitor state, press the ATTN button one time. The power-up self-test will then be reinitiated.

MTC Diagnostic Monitor

5.3 The MTC has an extensive set of ROM-resident tests that are used to test the MTC, the EIA ports, and the cable that connects the MTC to the host computer. These tests are called the MTC diagnostic monitor because the test menus are displayed and the tests are controlled from any video display terminal (VDT) attached to the MTC. When entering the test mode, the diagnostic monitor test program scans the eight EIA ports of the MTC. The first VDT that transmits uppercase U's becomes the initial control VDT for the tests.

MTC Entry Into the Diagnostic Monitor

5.3.1 If the self-tests complete without error, the MTC enters the download mode of the ROM code. If a kernel or network interface error occurs, the MTC automatically enters the Diagnostic Monitor mode. Any channel on the MTC can be used as the monitor as long as it meets the configuration requirement of 7-bit odd or 8-bit no parity and one of the standard VDT baud rates of 1200, 2400, 4800, 9600, or 19200 bits per second.

Once the MTC enters the diagnostic monitor mode, all three LEDs flash, signaling that the ROM code is looking for an active VDT. The ROM code scans all the channels of the MTC looking for keyboard data. When an active channel (receive data ready) is found, the receive data is checked for the character stream of the uppercase U's. If U's are received, the channel becomes the VDT interface.

If the MTC is connected to the host and the host is active, the NET LED may be on. If this is the case, the NET LED will not flash.

Initial Diagnostic Monitor Display and Main Menu

5.3.2 The initial diagnostic monitor display and the main menu are shown in the following example:

```
MTC DIAGNOSTIC MONITOR          KRYSTAL                VERSION 027.89
BOARD ID = 8
MULTIDROP MODE
MEMORY SIZE = XXX KB STATIC RAM
MONITOR # 6

      DIAGNOSTIC MONITOR MAIN MENU

0 ->  SCAN FOR MONITOR
1 ->  TEST MODE
2 ->  LINE MONITOR MODE
3 ->  DOWNLOAD MODE
4 ->  DEBUG MODE

 ENTER SELECTION NUMBER ->
```

NOTE: The memory size can be 128 or 512 KB static RAM.

The main menu allows you to enter the following information:

- Enter 0 to display the following SCAN FOR MONITOR prompt:

```
** ENTER AN UPPER CASE U AT ANY TERMINAL TO REINITIALIZE THE MONITOR **
```

NOTE: You may need to enter several uppercase U's to reinitialize the monitor.

The SCAN FOR MONITOR prompt allows you to select another VDT on the same MTC for displaying and running the diagnostics. After you enter 0, the MTC monitors the input of all channels and flashes all three LEDs. The first VDT that sends a stream of uppercase U's is selected to display and control the diagnostics.

Once the MTC is in Diagnostic Monitor mode, you can call any test from any of the test menus without returning to the main menu. For example, you can enter 13 to run the Memory test, 21 to run the Transit Frames routine, or 41 to run the electromagnetic interference (EMI) test.

- Enter 1 to display the following TEST MODE menu:

```
      TEST MENU

0 ->  RETURN TO MAIN MENU
1 ->  EXECUTE ALL TESTS
2 ->  EXECUTE ONE SELF-TEST
3 ->  TEST MEMORY
4 ->  TEST SCC
5 ->  TEST OCTAL
6 ->  SET OPTIONS
7 ->  DUMP DATA AREA
```

- Enter 2 to display the following LINE MONITOR MODE menu:

```
      LINE MONITOR MENU

0 ->  RETURN TO MAIN MENU
1 ->  TRANSMIT FRAMES
2 ->  ECHO SERVER
3 ->  MONITOR LINE
```

- Enter 3 to display the following DOWNLOAD MODE menu:

```
      DOWNLOAD MENU

0 ->  RETURN TO MAIN MENU
1 ->  DOWNLOAD VIA NET
2 ->  DOWNLOAD VIA EIA CHANNEL
```

- Enter 4 to display the following DEBUG MODE menu:

```
      DEBUG MENU

0 ->  RETURN TO MAIN MENU
1 ->  EMI TEST HS
2 ->  RESET BOARD
3 ->  DUMP MEMORY
4 ->  EMI TEST BARBER POLE
```

Each mode is explained in the following paragraphs.

Test Mode

5.3.3 To execute the TEST MODE, enter 1 when the main menu is displayed. The Test menu is displayed as follows:

```
      TEST MENU

0 ->   RETURN TO MAIN MENU
1 ->   EXECUTE ALL TESTS
2 ->   EXECUTE ONE SELF-TEST
3 ->   TEST MEMORY
4 ->   TEST SCC
5 ->   TEST OCTAL
6 ->   SET OPTIONS
7 ->   DUMP DATA AREA
```

- Enter 1 to show the following EXECUTE ALL TESTS sample display:

```
EXECUTE ALL TESTS

CRC TEST                      PASS
MEMORY TEST                   PASS
80C186 PERIPHERALS TEST       PASS
OCTAL REGISTER TEST           PASS
OCTAL TX RX TEST              PASS
OCTAL INTERRUPT TEST          PASS
SCC REGISTER TEST             PASS
SCC 85C30 LOOPBACK TEST       PASS
SCC MK5033 LOOPBACK TEST      PASS
```

- Enter 2 to show the following EXECUTE ONE SELF-TEST menu:

```
EXECUTE ONE SELF-TEST

SELF-TEST MENU

0 -> CRC TEST
1 -> MEMORY TEST
2 -> 80C186 PERIPHERALS TEST
3 -> OCTAL REGISTER TEST
4 -> OCTAL TX RX TEST
5 -> OCTAL INTERRUPT TEST
6 -> SCC REGISTER TEST
7 -> SCC 85C30 LOOPBACK TEST
8 -> SCC MK5033 LOOPBACK TEST

 ENTER SELECTION NUMBER
 ->
```

- Enter 3 to show the following TEST MEMORY sample display:

```
TEST MEMORY

MEMORY TEST                   PASS
```

- Enter 4 to show the following TEST SCC sample display:

```
TEST SCC

SCC REGISTER TEST              PASS
SCC 85C30 LOOPBACK TEST        PASS
SCC MK5033 LOOPBACK TEST       PASS
```

- Enter 5 to show the following TEST OCTAL sample display:

```
TEST OCTAL

OCTAL REGISTER TEST            PASS
OCTAL TX RX TEST TEST          PASS
OCTAL INTERRUPT TEST           PASS
```

- Enter 6 to show the following SET OPTIONS menu:

```
SET OPTIONS

DISPLAY ERRORS?  (Yes OR No)  DEFAULT = N
PAUSE ON FIRST ERROR?  (Yes OR No)  DEFAULT = N
EIA LOOPBACK CONNECTORS INSTALLED?  (Yes OR No)  DEFAULT = N
HOST INTERFACE LOOPBACK CONNECTOR INSTALLED? (Y/N) DEFAULT = N
IGNORE LOSS DSR?  (Yes OR No)  DEFAULT = N
EXTENDED MODE?  (Yes OR No)  DEFAULT = N
LOOP MODE?  (Yes OR No)  DEFAULT = N
DISPLAY HEADER INFORMATION?  (Yes OR No)  DEFAULT = Y
```

- Enter 7 to show the following DUMP DATA AREA sample display:

```
DUMP DATA AREA

0060:0000  0000  0004  0000  0000  0000  0000  0000 0000 ..........
0060:0010  0080  0040  0000  0030  0804  0804  0000 0000 ..@..0....
0060:0020  0000  0000  0000  0000  0000  0000  0000 0000 ..........
0060:0030  0000  0000  0000  0000  0000  0000  0000 0000 ..........
0060:0040  24A9  0000  0000  0230  0000  0000  0000 0000 $....0....
0060:0050  8181  0000  0007  0000  0000  0000  0000 0000 ..........
0060:0060  FFFF  0200  0200  0100  00FB  00EE  0000 007F ..........
0060:0070  0000  0000  0000  0000  0000  0000  0000 0000 ..........
```

Line Monitor Mode

5.3.4 To execute the LINE MONITOR MODE, enter 2 when the main menu is displayed. The LINE MONITOR MENU is as follows:

```
      LINE MONITOR MENU

0 ->  RETURN TO MAIN MENU
1 ->  TRANSMIT FRAMES
2 ->  ECHO SERVER
3 ->  MONITOR LINE
4 ->  DISPLAY FRAMES
```

- Enter 1 to show the following TRANSMIT FRAMES display example:

```
NUMBER OF TRANSMITTED FRAMES = 0400 NUMBER OF RECEIVED FRAMES = 0400
```

- Enter 2 to show the following ECHO SERVER display example:

```
No Information displayed
```

- Enter 3 to show the following MONITOR LINE sample display:

```
Display receive data? (Y/N) DEFAULT = N
```

The default N displays the following MONITOR LINE sample pattern where XXXX = frame address and YYYY = frame length:

```
XXXX YYYY  XXXX YYYY  XXXX YYYY  XXXX YYYY  XXXX YYYY  XXXX YYYY
```

If you enter Y to the Display receive data? (Y/N) DEFAULT = N prompt, the following display appears:

```
Display when buffer full? (Y/N)
```

If you enter Y, the system waits until the receive buffer is full and then displays receive frames.

If you enter N, the system displays frames as received.

- Enter 4 to display each frame in the receive buffer.

Download Mode

5.3.5 To execute the DOWNLOAD MODE, enter 3 when the main menu is displayed. The Download Menu is as follows:

```
      DOWNLOAD MENU

0 ->  RETURN TO MAIN MENU
1 ->  DOWNLOAD VIA NET
2 ->  DOWNLOAD VIA EIA CHANNEL
```

- Enter 1 to show the following DOWNLOAD VIA NET sample display:

```
DOWNLOAD IN PROGRESS
```

- Enter 2 to show the following DOWNLOAD VIA EIA CHANNEL sample display:

```
Not installed yet
```

Debug Mode

5.3.6 To execute the DEBUG MODE, enter a 4 when the main menu is displayed. The Debug Menu is as follows:

```
      DEBUG MENU

0 ->  RETURN TO MAIN MENU
1 ->  EMI TEST H's
2 ->  RESET BOARD
3 ->  DUMP MEMORY
4 ->  EMI TEST BARBER POLE
```

- Enter a 1 to show the following EMI TEST sample display:

```
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
```

- Enter a 2 to show the following RESET BOARD sample display:

```
No display
```

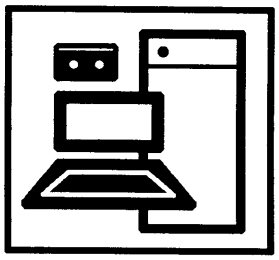
- Enter a 3 to show the following DUMP MEMORY sample display:

```
DISPLAY FORMAT Words/bytes DEFAULT = bytes

SEGMENT = 0000

OFFSET = 0000

0000:0000 0A 0E 00 F0 00 0E 00 F0 1E 0E 00 F0 00 0E 00 F0 ................
0000:0010 00 0E 00 F0 00 0E 00 F0 00 0E 00 F0 14 0E 00 F0 ................
0000:0020 16 0E 00 F0 0A 0E 00 F0 B1 0E 00 F0 A0 0C 00 F0 ................
0000:0030 C9 0E 00 F0 00 0E 00 F0 75 0E 00 F0 02 0D 00 F0 ....u...........
0000:0040 0A 0E 00 F0 0A 0E 00 F0 20 0E 00 F0 2A 0F 00 F0 ........ ...*....
0000:0050 0A 0E 00 F0 0A 0E 00 F0 0A 0E 00 F0 0A 0E 00 F0 ................
0000:0060 0A 0E 00 F0 0A 0E 00 F0 0A 0E 00 F0 0A 0E 00 F0 ................
0000:0070 0A 0E 00 F0 00 0E 00 F0 0A 0E 00 F0 0A 0E 00 F0 ................

ENTER ANY CHARACTER TO CONTINUE OR
ENTER ANY A "." TO EXIT.
```

- Enter a 4 to show a typical barber pole display.

INDEX

NETWORK TERMINAL CONCENTRATOR (NTC)



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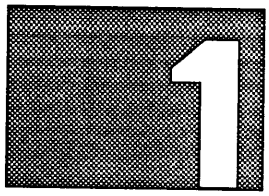


Introduction

1.1 This section describes the features and specifications of the network terminal concentrator (NTC) and related hardware options. The NTC is a terminal expander that allows multiple RS-232 terminals and printers to operate over a local area network (LAN). The NTC operates with Texas Instruments host computer systems that have character-based terminals.

NOTE: In this module, the terms single-board computers and multiboard computers are used. Single-board computers refer to System 1505 type computer chassis that do not have a backplane. Multiboard computers refer to computer chassis, such as the 7-slot and 16-slot type computer chassis, that have a backplane.

Network Terminal Concentrator

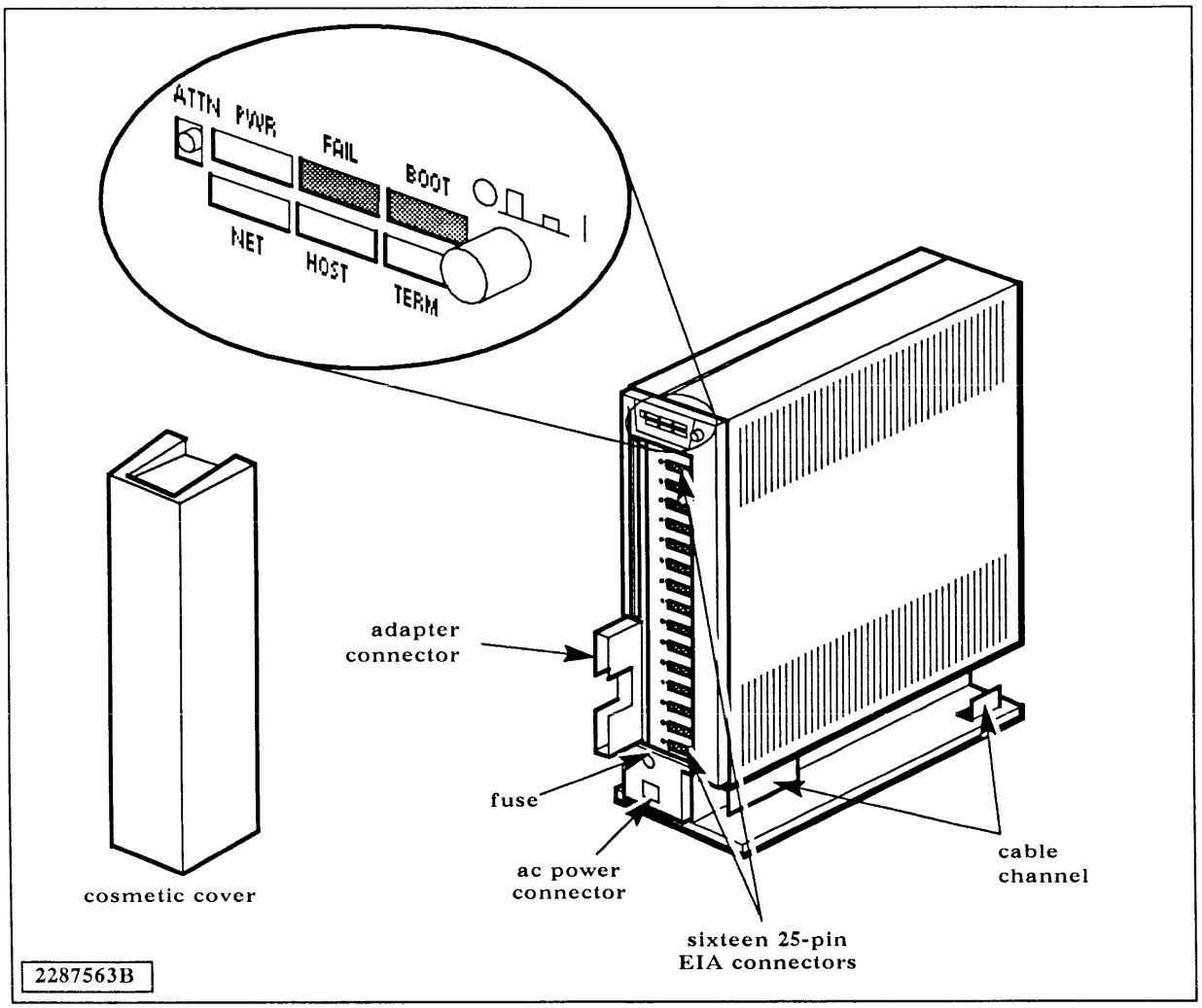
1.2 The NTC (Figure 1-1) is an intelligent control and data multiplexer that supports remote clusters of up to 16 Electronic Industries Association (EIA) devices. The NTC typically operates a cluster of RS-232 terminals and printers that are remote from the host computer. The NTC communicates with the host computer over a medium to high-speed network or data link.

Features of the NTC include the following:

- A microprocessor-based intelligent controller with onboard memory operates with fixed and downloaded software for versatile protocol selection and to reduce the host system processing load.
- NTC-to-host network connection allows remote placement of NTC from host computer system, up to the limits imposed by the network. Clustering terminals around the NTC can provide significant reductions in cable length, cost, weight, and installation effort.
- Multiple NTCs on a network allow very large numbers of terminals on a system while limiting the number of cables that exit the system enclosure.
- Choice of replaceable network adapters provides flexible network selection, including:
  - LAN 802.3 (Ethernet®)
  - V.35 bit-oriented protocol (BOP)
- Network data rates are determined by the type of network selected, up to 10 MHz for LAN 802.3.
- Terminal data rates up to 38,400 baud are individually-selectable for each of the 16 NTC terminal connections.

Ethernet is a registered trademark of Xerox Corporation.

Figure 1-1 Network Terminal Concentrator With Front Cover Removed



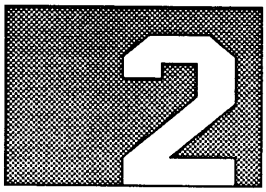
Specifications

1.3 Table 1-1 summarizes the performance, physical, environmental, and power specifications for the NTC.

Table 1-1 **Network Terminal Concentrator Specifications**

Item	Specification
Terminal I/O channels:	
Number	16 independent full-duplex channels
Type	EIA RS-232, with RS-423 drivers
Data rate	Selectable per channel, 18 fixed rates from 50 to 38 400-baud (asynchronous)
Format	Serial, 5 to 8 data bits plus parity and 1, 1-1/2, or 2 stop bits, selectable per channel
Error checking	Parity, frame, overrun, false start, and mid-character break detection
Connector	Shielded 25-pin D female, with 7 pins wired (does not include full modem support)
Network I/O:	Determined by network selected. Uses cable adapter boards compatible with communications carrier board (CCB)
Dimensions:	
Height	19.5 in (49.5 cm)
Width	9.8 in (25 cm) at base
Depth	19.25 in (49 cm) with cover
Weight:	33 lb (15 kg)
Temperature:	
Operating	5 to 45 degrees C (41 to 113 degrees F)
Nonoperating	-40 to 65 degrees C (-40 to 149 degrees F)
Relative humidity:	
Operating	8% to 89% (noncondensing)
Nonoperating	5% to 95% (noncondensing)
Altitude:	
Operating	-1000 to 6500 feet
Nonoperating	-1000 to 10,000 feet
Acoustic noise:	None (cooled by natural convection)
Power input:	120 Vac, ± 10%, 47-63 Hz, 100 watts or 220/240 Vac, ± 10%, 47-63 Hz, 100 watts (NTC includes a regulated dc power supply)
Site power outlet:	National Electrical Manufacturers Association (NEMA) 5-15R for USA domestic sites: other sockets as required for international use
EMI compliance:	Meets Federal Communications Commission (FCC) limits for a Class A computing device (Part 15, subpart J of FCC Rules and Regulations) and West German equivalent of Underwriters' Laboratories (VDE) 0871 Level A limits

NTC SITE PREPARATION AND UNPACK/INVENTORY



Introduction

2.1 This section describes the following procedures:

- Site preparation for the network terminal concentrator (NTC)
- Unpacking the NTC

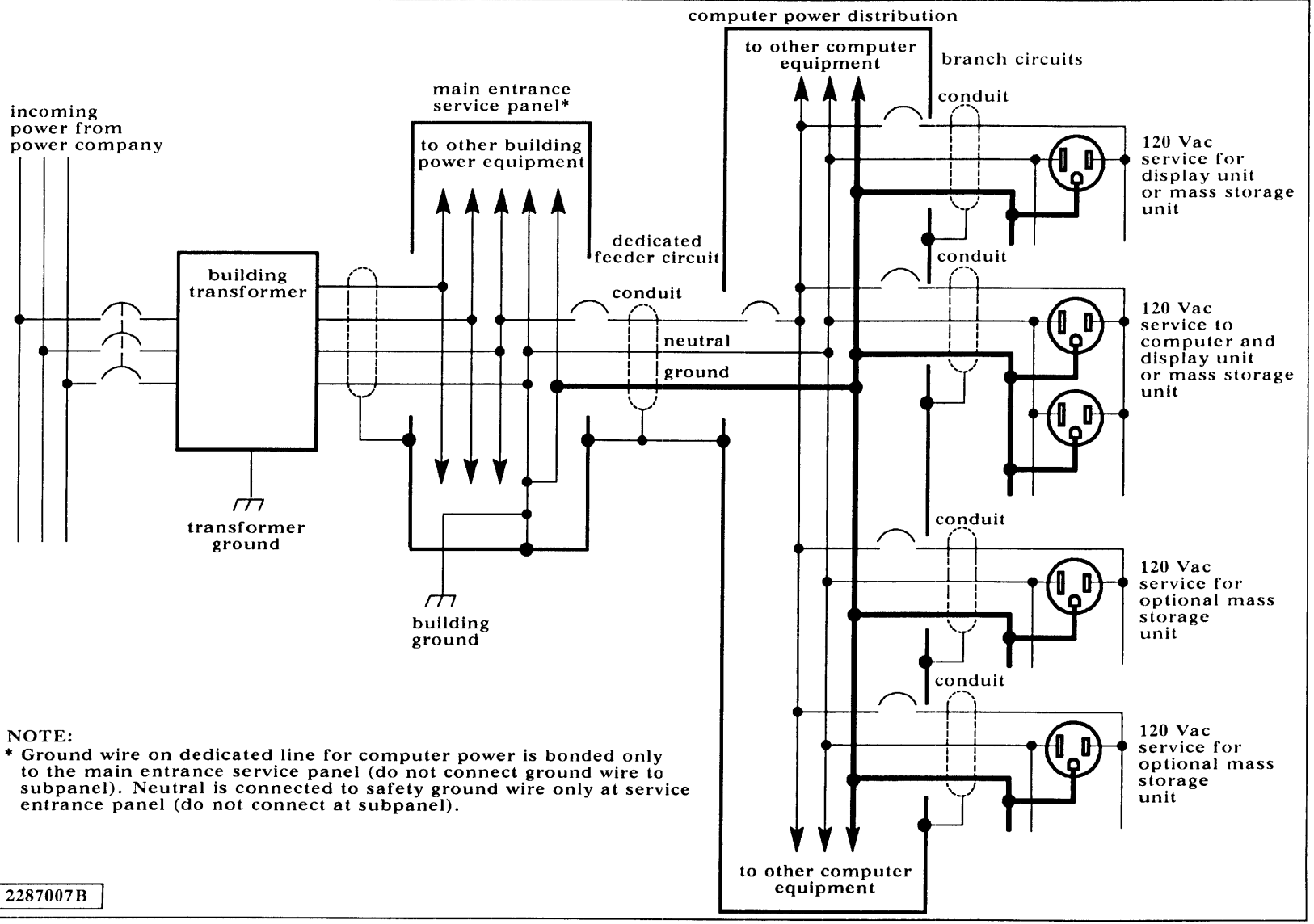
Preparing the Site for the NTC

2.2 Power and environmental requirements for the installation of the NTC are listed in Table 1-1. Figure 2-1 shows an example of a properly wired 120-volt power distribution system for computer equipment. For more detailed information on power requirements, refer to the system installation manual for the computer system associated with your NTC.

Ensure that conditions at the NTC site meet the following requirements:

- Make sure there is sufficient space for air circulation around the NTC. The NTC cools via natural convection through grillwork at the sides of the enclosure. Do not block airflow through the grillwork or install the NTC in an enclosed area.
- Check that the environmental conditions meet the requirements specified in Table 1-1. If there is a conflict between the requirements of Table 1-1 and the site requirements of your computer system, the requirements in Table 1-1 should be followed.
- Make sure that the network connection is conveniently available to the NTC.

Figure 2-1 Recommended Power Service for Domestic 120-Volt System



Unpacking the NTC

2.3 To unpack the NTC, refer to Figure 2-2 and proceed as follows:

1. Visually inspect the NTC shipping container for damage. If the container is damaged, contact the carrier for instructions on filing a claim. The carrier, not Texas Instruments, is responsible for damage during shipment.

2. If the container has significant damage, contact the traffic department at the Texas Instruments (TI) site that shipped the equipment. Resolve all problems related to damage before proceeding with the installation.

3. Place the NTC shipping container on the floor in the upright position.

4. Cut the shipping container sealing tape.

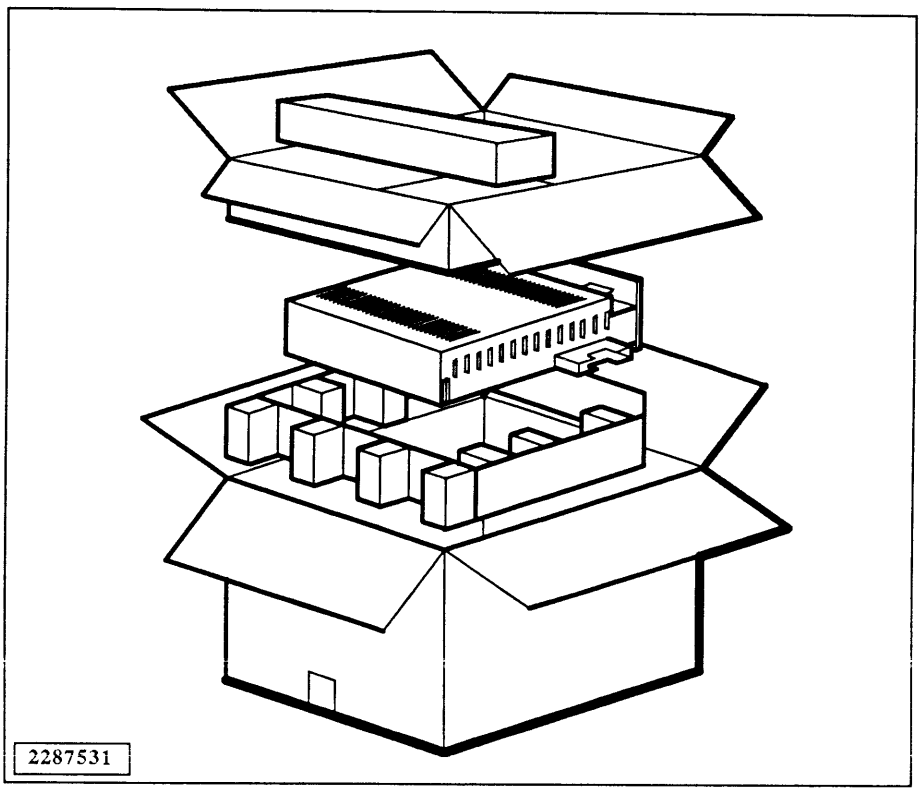
5. Remove the NTC from its container.

6. Remove the protective packing from the NTC.

7. Check the NTC for damage. If it is damaged, stop unpacking and contact your carrier agent. After the carrier agent inspects the damage, contact a Texas Instruments field service office. Resolve all problems related to damage before proceeding with the installation.

8. Place the NTC in the area where it will be used.

Figure 2-2 **Network Terminal Concentrator Shipping Container**



System Inventory

2.4 Once you have unpacked all units of your system and inspected them for shipping damage, list the description, part number, and serial number of each item on inventory sheets. Keep these inventory sheets for future reference.

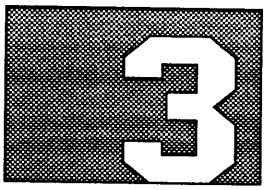
Hardware Kits for the NTC

2.5 Table 2-1 lists the hardware kits available for the NTC. Use this table to verify that you have received the hardware that you need for your system. Refer to the price list or contact your Texas Instruments representative for additional information.

Table 2-1 Network Terminal Concentrator Hardware Kits and Components

Kit	TI Part Number
16-Channel Ethernet Starter Kit (802.3 for Multiboard Computers)	
CK1601 sixteen-channel Ethernet starter kit including instructions and:	2542984-0001
Network terminal concentrator (120 V)	2537305-0001
LAN 802.3 option board assembly	2535590-0001
LAN 802.3 adapter assembly (2 ea)	2535600-0001
Ethernet transceiver kit (2 ea)	2244733-0001
LAN/Ethernet transceiver cable	2239129-0001
Thin Ethernet cable assembly, 30-meter	2239703-0003
Thin Ethernet cable terminator kit	2239130-0001
Type BNC to N-series coaxial adapter (4 ea)	2239705-0001
16-Channel Ethernet Starter Kit (802.3 for Single-Board Computers)	
CC1601 sixteen-channel Ethernet starter kit including instructions and:	2561371-0001
Network terminal concentrator (120 V)	2537305-0001
LAN 802.3 option board assembly	2561105-0001
LAN 802.3 adapter assembly	2535600-0001
Ethernet transceiver kit (2 ea)	2244733-0001
LAN/Ethernet transceiver cable	2239129-0001
Type BNC T connector (used in cheapernet)	0411063-0001
Thin Ethernet cable assembly, 30-meter	2239703-0003
Thin Ethernet cable terminator kit	2239130-0001
Type BNC to N-series coaxial adapter (4 ea)	2239705-0001
16-Channel Ethernet Expansion Kit (802.3 for Multiboard and Single-Board Computers)	
CK1602 sixteen-channel Ethernet expansion kit including instructions and:	2542985-0001
Network terminal concentrator (120 V)	2537305-0001
LAN 802.3 adapter assembly	2535600-0001
Ethernet transceiver kit	2244733-0001
LAN/Ethernet transceiver cable	2239129-0001
Thin Ethernet cable assembly, 30-meter	2239703-0003
Thin Ethernet cable terminator kit	2239130-0001
Type BNC to N-series coaxial adapter (2 ea)	2239705-0001
16-Channel V.35 (For Multiboard Computers)	
CK1602-V.35 sixteen-channel V.35 remote kit including instructions and:	2535618-0001
Network terminal concentrator (120 V)	2537305-0001
LAN 802.3 option board assembly	2535590-0001
V.35 adapter assembly (2 ea)	2535605-0001
V.35 modem cable, 10-foot (2 ea)	2537301-0001

NTC INSTALLATION



Introduction

3.1 This section includes a brief description of the network terminal concentrator (NTC), which allows the use of multiple Electronic Industries Association (EIA) terminals and printers on character-oriented computing systems. The section also includes installation procedures for the NTC.

Description

3.2 The NTC (Figure 3-1) is an intelligent, microprocessor-controlled interface that connects the system enclosure and 8 EIA devices via a network or a data link. The NTC is a compact, standalone tower with an internal power supply, a multiconnector front panel with cosmetic cover, and an intelligent controller logic board. The intelligent controller executes downloaded 68010 native code or interprets primitive code based on read-only memory (ROM) program sequences.

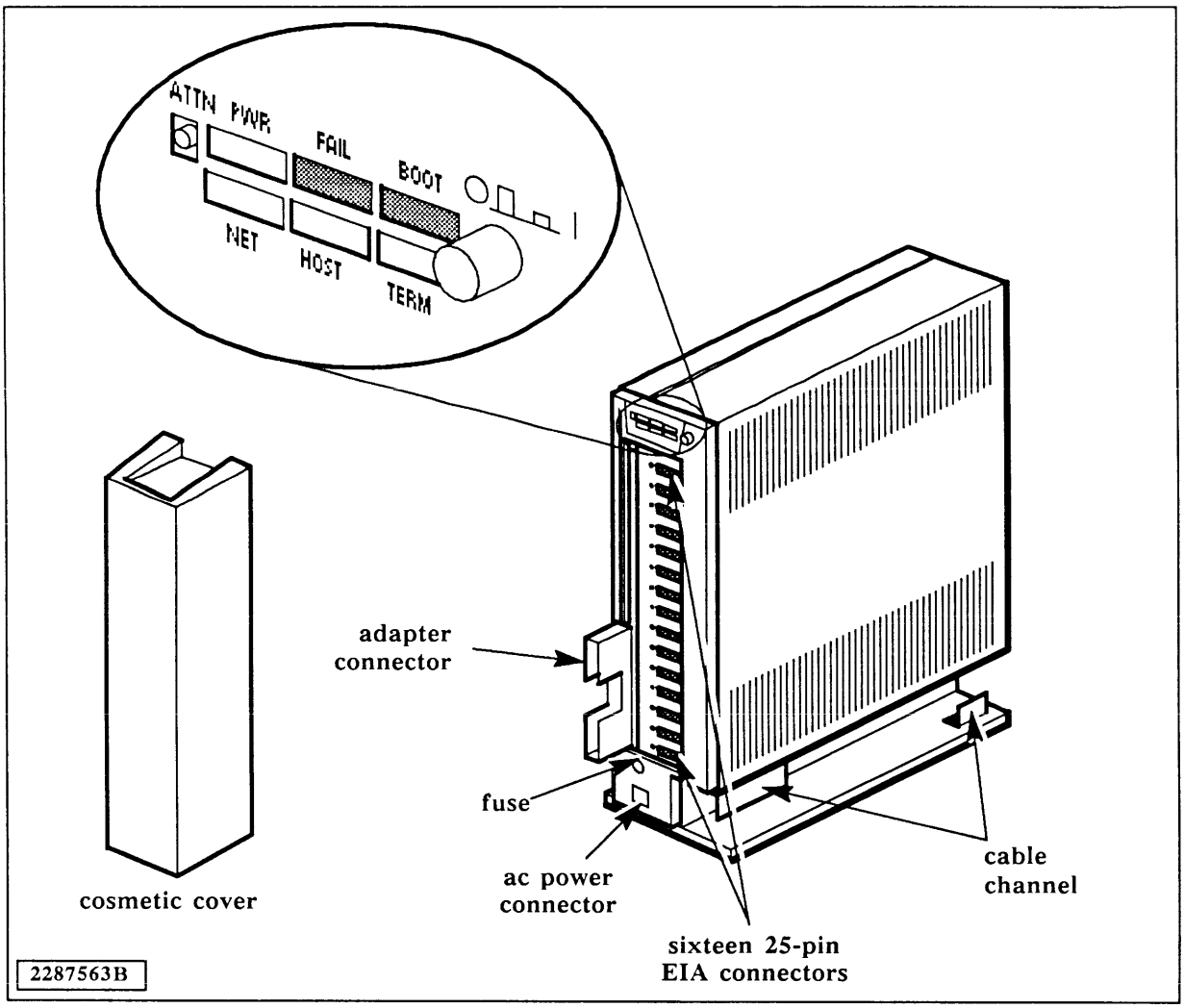
WARNING: Only trained service personnel are to remove and install components within the NTC enclosure. Refer NTC hardware problems to your TI customer representative or other TI authorized service personnel.

Controller Board

3.2.1 The intelligent controller is a microprocessor-based device that is similar to a communications carrier board (CCB) in a multiboard computer with two 8-channel asynchronous EIA adapters. Features of the NTC controller board include the following:

- 68010 16-bit virtual memory microprocessor with full 24-bit addressing capability and both byte and word data transfer capabilities.
- Two-ported 512K-byte dynamic random access memory (DRAM) with versatile access arbitration to optimize performance.
- 8K bytes of fast static random access memory (SRAM) dedicated to the 68010 microprocessor for stacks, control words, and other time-critical code.
- 32K bytes of ROM or erasable programmable read-only memory (EPROM) for storage of NTC firmware.
- 68230 programmable interval timer (PI/T).
- Gate-array interrupt controller chip (ICC) that interfaces with the 68010 7-level interrupt structure. The ICC also provides address-based event handling.

Figure 3-1 Network Terminal Concentrator



Front Panel

3.2.2 The front of the NTC, except for the control panel, is covered by a plastic cosmetic cover. When the cover is removed, the following items can be accessed as shown in Figure 3-1. The exploded view of the control panel is explained in Section 4, NTC Operation.

- 16 EIA connectors
- Network adapter interface
- Ac power cord connector
- Ac line fuse

Network Adapters

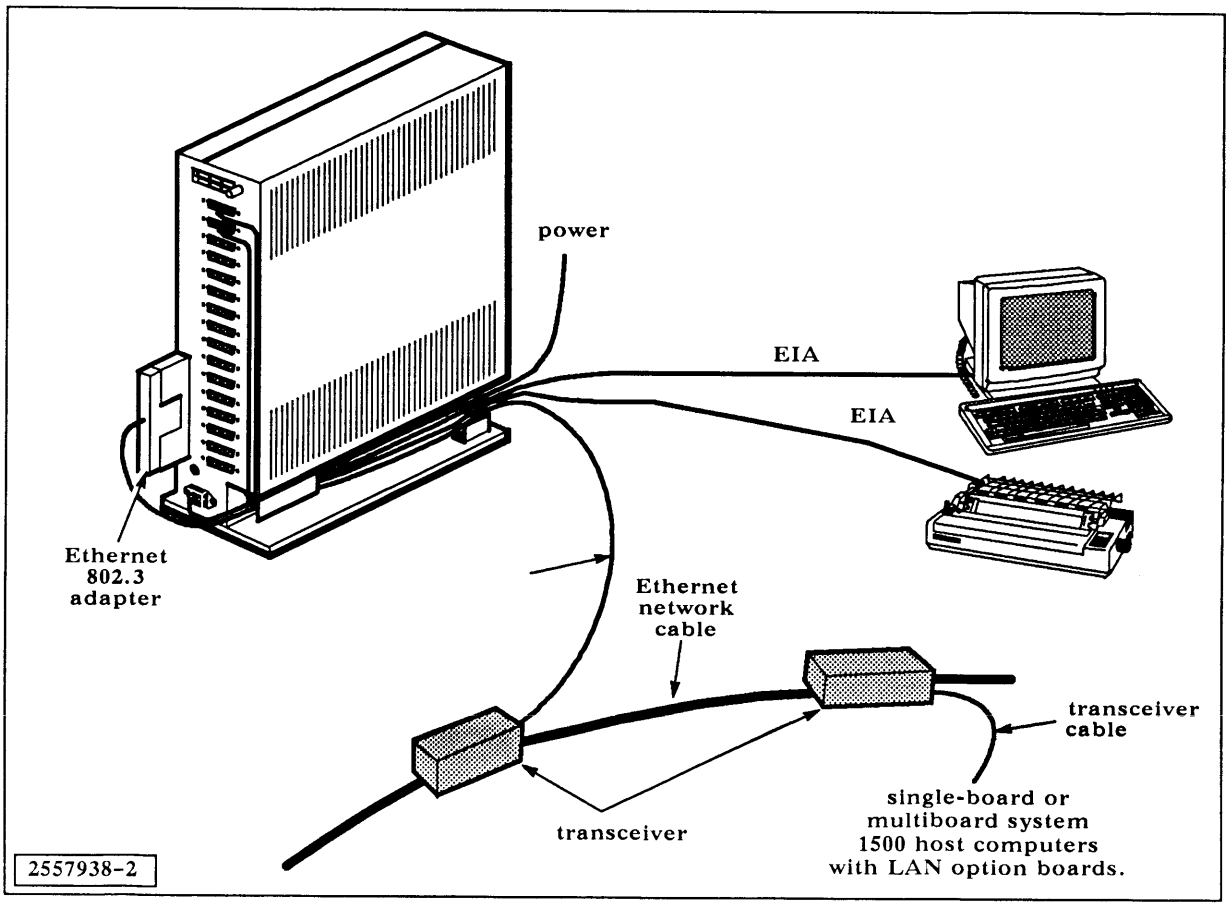
3.2.3 The network adapters available for the NTC are:

- LAN 802.3 Ethernet adapter
- V.35 adapter

The LAN 802.3 Ethernet adapter interfaces the NTC to an Ethernet local area network (LAN). The Ethernet installation requires the Ethernet adapter, the transceiver cable, the transceiver, and the network cable to the host system, as shown in Figure 3-2.

The V.35 installation requires the V.35 adapter, the adapter-to-modem cable, the modem, and the telephone link to the host system.

Figure 3-2 Network Terminal Concentrator Ethernet 802.3 Cabling



EIA Interface Panel

3.2.4 The EIA connectors mounted on the front panel of the NTC support RS-232 devices such as terminals, serial printers, and full-duplex (FDX) modems. Each of the 16 separate 25-pin connectors provides the following EIA signals to the peripherals:

- GND (1) — Ground
- XMT (pin 2) — Transmit data

- RCV (pin 3) — Receive data
- DTR– (pins 4 and 20) — Data terminal ready
- DSR– (pin 6) — Data set ready
- GND (pin 7) — Ground

Cable Routing

3.2.5 All NTC cables connect to the front of the unit; therefore, the cables are easy to install and the installed NTC fits flush against a wall. Two metal guides on the lower right side of the NTC provide a cable tray, routing the cables to the rear of the NTC and then to their respective locations. All cables, EIA data, ac power, and the network interface use this same cable tray.

The NTC is cooled by convection; it has no cooling fan. All cable connections for the NTC are at the front of the unit, allowing the rear of the NTC to be placed against a wall. However, both sides of the NTC must have clearance so that the convection cooling will be effective.

Power Supply

3.2.6 The NTC power supply provides the regulated dc voltages required by the NTC controller board, the different adapter boards, and external devices such as the Ethernet transceiver. The power supply is internal to the NTC enclosure, and is not accessible except by qualified service personnel.

Fuse Data

3.2.7 The NTC power supply ac input fuse is a 5-by-20-millimeter time delay fuse mounted in an approved international fusecap. The specified fuse is UL-listed and Canadian Standards Association (CSA)-certified for use in the USA and Canada. In addition, the fuse meets the requirements of IEC 127, data sheet III to Deutsches Institute fuer Normung, German Institute for Standards (DIN) 41662 for international use. Table 3-1 lists the fuse data, including sources and part numbers.

WARNING: Ensure that the power cable to the site ac power outlet is unplugged prior to accessing the fuse.

Table 3-1 Fuse Data

Power Setting	Fuse Type	Voltage Rating	Current Rating	Source	Part Number
USA or International	F time delay	250 V	2.0 A	Texas Instruments SAN-O Industries	2248068-0023 SD6-3A

Installing the NTC

3.3 The NTC is installed in the general area of the video display terminals (VDTs) and serial printers, to minimize the length of the input/output cables.

WARNING: Do not attempt to open the metal NTC enclosure. Hazardous energy levels are located within this enclosure, and there are no normal installation procedures that require internal access.

To install the NTC:

1. Remove the plastic front cover by grasping the cover on the left and right sides and pulling it up and forward.
2. Locate the NTC connectors and controls:
   - Control panel (just above the area covered by the front cover)
   - 16 EIA connectors for the VDTs and serial printers
   - Input adapter connector
   - Ac line fuse
   - Ac power connector
3. Set the power switch to the off position, and disconnect the ac power cable from the wall outlet and the NTC.
4. Select the Ethernet adapter and transceiver (or other network adapter and cable), and position the adapter so that its cover plate is facing to the left and the 96-pin connector is facing towards the NTC.
5. Align the adapter between the mounting guides of the adapter slot.
6. Slide the adapter into the mating connector in the NTC.
7. Insert the adapter end of the transceiver cable (or other network interface cable) into the connector slot on the adapter board.
8. Route the cable across the bottom front and then along the bottom right side of the NTC.
9. Attach the other end of the transceiver cable to the LAN 802.3 Ethernet transceiver (or connect the network interface cable to the network interface hardware).
10. Install the RS-232 EIA (25-pin) connector to the mating connector on the NTC. As you install each cable, mark its peripheral end with its location (0 through 15) on the NTC so that you can connect the correct peripheral to the cable. The ports on the NTC are numbered from the top (0) to the bottom (15).
11. Using a small flat-bladed screwdriver, tighten the two screws that hold the EIA cable connector to the NTC EIA connector.

12. Route the EIA cables across the bottom front and then along the bottom right side of the NTC, and attach the peripheral end of the EIA cables to the peripheral devices.

13. Install the female end of the ac power cable to the ac power connector of the NTC.

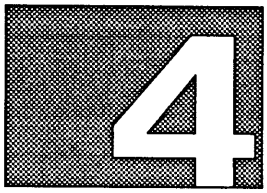
14. Route the ac power cable along the cable tray. Do not connect the ac power cable to the wall outlet at this time.

15. Replace the front cover of the NTC.

16. Plug the ac power cord from the NTC into a properly-wired ac outlet (as described in Section 2 of this manual).

17. Go on to the power-up and operating instructions in Section 4.

NTC OPERATION



Introduction

4.1 This section describes network terminal concentrator (NTC) operating procedures. Topics in this section are:

- NTC controls and indicators
- NTC power-up procedure
- NTC power-down procedure

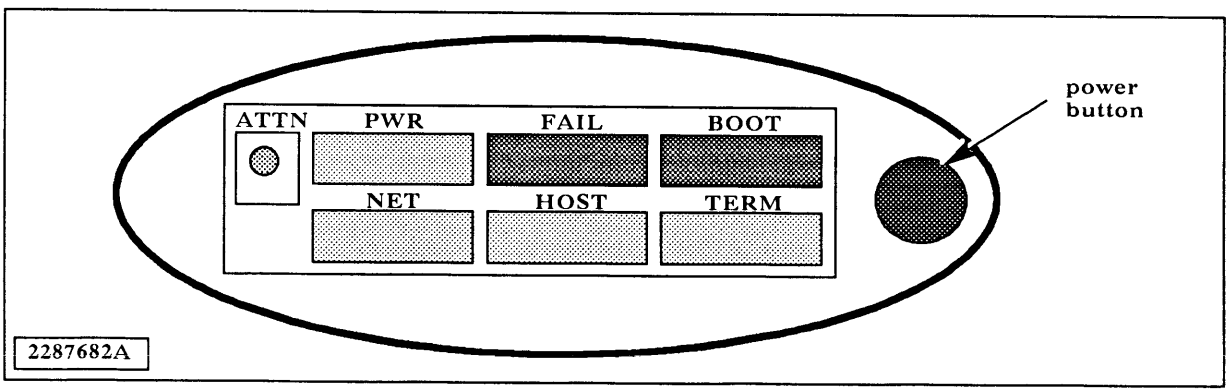
NTC Controls and Indicators

4.2 The NTC operating controls and indicators (Figure 4-1) form a compact control panel at the front of the NTC enclosure, just above the cosmetic cover.

NTC Operating Status Indicators

4.2.1 The NTC operating status indicators are light-emitting diodes (LEDs) that monitor system activity during the self-tests and downloading of the NTC.

Figure 4-1 NTC Controls and Indicators



The LED indicators on the NTC control panel provide the following information:

- PWR (green) — Indicates power on.
- FAIL (yellow) — Indicates that the self-tests are in progress or a fault occurred.
- BOOT (yellow) — Indicates that the NTC is awaiting download of software from the host computer system.

- NET (green) — Flashes whenever any packet is sensed on the local area network (LAN), and indicates a good connection to the LAN and LAN traffic.
- HOST (green) — Flashes to indicate communication with a host whenever a packet is received by the NTC from a System 1000 Series host.
- TERM (green) — Flashes when characters are received from a terminal.

Four of the LEDs (FAIL, BOOT, HOST and TERM) turn on during the self-test and when the ATTN button is pressed. The BOOT LED stays on after the others extinguish upon successful completion of power-up self-test.

ATTN Button

4.2.2 The ATTN button controls the execution state of the NTC for troubleshooting and diagnostic purposes. Pressing this button once has the following effects:

- If the NTC is downloaded and in the random access memory (RAM), the NTC returns to the download read-only memory (ROM) mode and redownloads the operating software.
- If the NTC is in the download state (BOOT LED is on), the NTC returns to the self-test ROM mode.
- If the NTC is in the diagnostic monitor, ROM mode, the NTC returns to the self-test ROM mode.

Pressing the ATTN button twice within two seconds always returns you to the diagnostic monitor ROM mode.

Pressing the ATTN button three times within two seconds enters the RAM debugger mode. This is enabled only if the NTC is downloaded and in the RAM mode. Refer to Section 5 for additional information on the ATTN button, including a state diagram of its operating sequence.

Power Button

4.2.3 The ac power button is a two-position, push-button mechanical switch labeled 0 and 1. In the power-off position (0) the switch is all the way out (disengaged); in the power-on position (1) the switch is all the way in (engaged).

NTC Power-Up Procedure

4.3 When the network and all peripherals are connected, power-up the NTC by pressing the power button on the front panel. Check that the self-test and the download of the software complete correctly.

NOTE: If the self-test completes with no errors, the NTC automatically requests a download. However, the appropriate network and NTC software must be installed in the host computer system.

Power-Up Self-Test

4.3.1 When ac power is applied to the NTC, the PWR LED illuminates immediately. Four additional LEDs labeled FAIL, BOOT, TERM, and HOST light after a slight delay. The LEDs track self-test progress by extinguishing as different subtests are successfully completed.

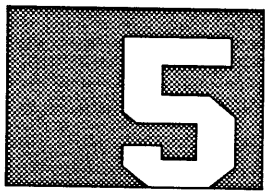
Under normal circumstances power-up self-test will complete within 30 seconds. If the FAIL LED remains on longer than 30 seconds, the NTC board has a problem but may still be usable. For example, a board with a bad data channel still has 15 good channels. For this reason, the ROM code allows the self-test to complete and the NTC to enter the Download mode, thus allowing limited operation. More serious failures that do not disable the processor could cause reliability problems. For failures in this category, the NTC would not attempt a download but can enter the Terminal Search mode so that extended diagnostics can be executed to learn more about the failure.

NTC Power-Down Procedure

4.4 When you power-down the NTC, you are cutting off as many as 8 terminal users from access to the host computer. Notify these users prior to power-down, so they can log off the system.

To power-down the NTC, press the power button so it returns to the out (0) position.

NTC DIAGNOSTICS



Introduction

5.1 The following information is an overview of the operation of the network terminal concentrator (NTC) and its testing capability. For additional information on the test capabilities of the NTC, refer to the diagnostic software manual furnished with the system. Error codes for the NTC used with multiboard computers are listed in *Installation and Operation Appendixes*, TI part number 2557946-0001.

NTC On-Board Test Capabilities

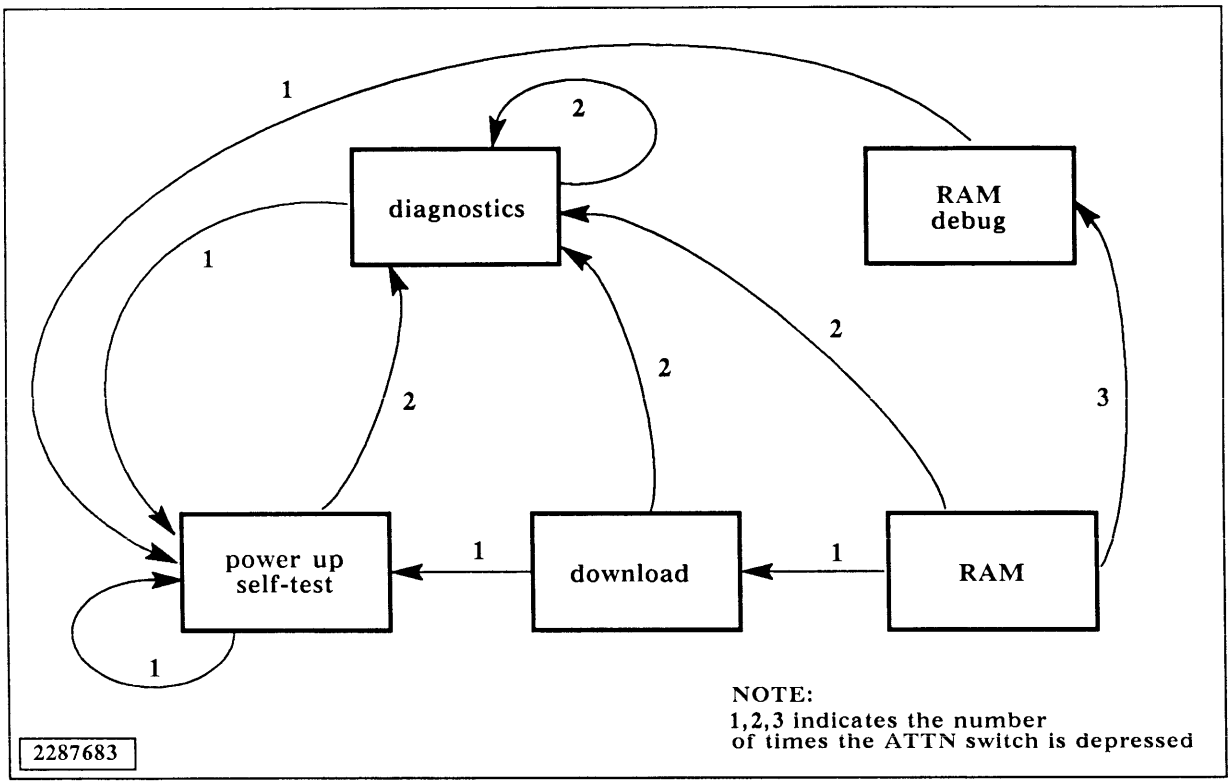
5.2 The NTC controller board features powerful on-board diagnostic capabilities that are activated at two levels. The board automatically executes a power-up self-test that quickly tests as much of the logic as it can in the time allotted using internal loopback capabilities. However, the board also has extended on-board diagnostics that you can invoke interactively. The power-up self-test automatically executes when power is applied to the NTC. You can control the testing via the ATTN button (the recessed red button to the left of the LEDs) on the NTC control panel. Figure 5-1 is the state diagram of ATTN switch operation.

The NTC can be in three states: power-up self-test, download, or RAM. In power-up self-test state, the NTC checks itself and, after successful completion, downloads its operating software from the host computer system. When the operating software has been downloaded, the NTC is in the RAM state, running from the program loaded in NTC memory. If the ATTN switch is pressed once during the power-up self-test state, the NTC restarts the self-test. If the ATTN switch is pressed once when the NTC is in the download state, the NTC restarts the self-test and downloads again. If the ATTN switch is pressed once when the NTC is in the RAM state, the NTC again downloads from the host computer system.

If the ATTN switch is pressed three times while the NTC is in the RAM state, the NTC goes into the RAM debug state, used for debugging machine-level code on the NTC controller board. If you should accidentally get into the RAM debug state, you can return to the RAM state by pressing the Z key on the video display terminal (VDT) connected to the lowest-numbered port (0 through 15) of the NTC, or simply press the ATTN switch once and the NTC will begin its initialization routine.

If the ATTN switch is pressed twice when the NTC is in any of the three operating states (power-up self-test, download, or RAM), the NTC enters the diagnostic state. To exit the diagnostic state of the NTC, press the ATTN switch one time, and the power-up self-test will be initiated. For information on the NTC diagnostic state, refer to the System 1500 *Diagnostic User's Guide*, TI part number 2534850-0001.

Figure 5-1 State Diagram of ATTN Switch Test Functions



NTC Diagnostic Monitor

5.3 The NTC has an extensive set of ROM-resident tests that are used to test the NTC, the EIA ports, the network port, and the network that connects the NTC to the host computer. These tests are called the NTC diagnostic monitor because the test menus are displayed and the tests are controlled from any VDT (monitor) attached to the NTC. When entering the test mode, the diagnostic monitor test program scans the 16 EIA ports of the NTC. The first VDT that transmits uppercase U's becomes the initial control VDT (monitor) for the tests.

NTC Entry Into the Diagnostic Monitor

5.3.1 If the self-tests complete without error, the NTC enters the Download mode of the ROM code. If a kernel or network interface error occurs, the NTC automatically enters the Diagnostic Monitor mode. Any channel on the NTC can be used as the monitor as long as it meets the configuration requirement of 7- or 8-bit characters with odd parity and one of the standard VDT baud rates of 150, 200, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400 bits per second.

Once the NTC enters the Monitor mode, the FAIL LED flashes, signaling that the ROM code is looking for an active monitor. The ROM code scans all the channels of the NTC looking for keyboard data. When an active channel (receive data ready) is found, the receive data is checked for the character stream of the uppercase U's. If U's are received, the channel becomes the monitor interface.

The first items displayed on the monitor are the ROM revision level and the network identification number of the NTC. The ROM revision level is displayed for verification purposes. The Network ID is displayed because it is needed for system configuration and network diagnostic tests. The initial monitor display with the network identification, the ROM revision, and the main menu are shown in the following example.

```
TEXAS INSTRUMENTS DIAGNOSTIC MONITOR
48 Bit address -- checksum 080028000857 -- 7851
ROM Version 329.86 DUGAN

    MAIN MENU

00 Look for monitor
01 Test commands
02 Download commands
03 NET commands
04 Debug commands
```

- `Look for monitor` — Select `00` to enter Terminal Search mode, which allows you to change ports, terminals, and baud rate.

- `Test commands` — Select `01` to display a test menu. The tests may then be executed singly or together, with internal or external loopback. The tests can be run once or put into the loop mode and run as many times as needed.

- `Download commands` — Select `02` to display a Download menu and allow executable code to be downloaded either over the network or by one of the asynchronous channels on the NTC.

- `NET commands` — Select `03` to display a LAN/Net Mode menu. This mode provides for echoing messages, makes the NTC act as an echo server, monitors the network, or allows the operator to display the network ID.

- `Debug commands` — Select `04` to display a DEBUG Mode menu. This mode allows you to display memory, modify memory, write to memory, execute a subroutine, or reset the board.

Each of the above menu entries is discussed in detail in the remainder of this section.

Look for Monitor

5.3.2 The procedure for executing the `Look for monitor` menu entry is as follows:

1. Enter `oo` on the VDT displaying the main menu. This allows you to select another VDT on the same NTC for displaying and running the diagnostics. After you enter `oo`, the NTC monitors the input of all channels and flashes the FAIL indicator. The first VDT that sends a stream of uppercase U's is the one selected as the VDT to display and control the diagnostics.

2. Once the NTC is in the Diagnostic Monitor mode, you can call any test from any of the three test menus without returning to the main menu. For example, if you are working in one of the menus other than `01 Test commands` and you want to display the error block, you do not have to return to the main menu. You can either enter `10`, which displays the `Test command` menu, or you can enter the the subtest number directly. In this case, for calling the error block subtest you would enter `18`. The `1` defines the family of tests, and the `8` defines the subtest in that family.

Test Commands

5.3.3 To execute `Test commands`, enter `01` when the main menu is displayed. The display for these menu entries is as follows:

```
MODE? 01

      TEST MODE

00   Return to main menu
01   Execute all tests
02   Execute one test
03   Execute the kernel tests
04   Execute the ASYNC tests
05   Execute the LAN/NET tests
06   LED test
07   Test ports
08   Display error block
09   Display config
0A   Set options
0B   Test one ASYNC channel
0C   Execute the MULTIFUNCTION tests
```

- `Return to main menu` — Entering `oo` causes the ROM code to exit the Test Mode and enter the Main Diagnostic Monitor menu.

NOTE: The 3-channel multifunction option board is not supported on the NTC. If you enter `oc` to invoke the 3-channel multifunction option test, an error message is displayed along with the command prompt.

- `Execute all tests` — Enter `01` to execute all the self-tests and display the test results. The following list is displayed as the tests are executed. The data field at the right of the listing `xxxxxxx` shows the result of each test, either as an error code or as passed or skipped.

```
COMMAND? 1
Execute all tests
KERNEL SELF-TEST

ROM CRC                                  xxxxxxx
ICC test                                 xxxxxxx
Parallel interface/timer                 xxxxxxx
RAM pattern test                         xxxxxxx
RAM bit test                             xxxxxxx
RAM address test                         xxxxxxx
RAM parity test                          xxxxxxx
NET ID ROM test                          xxxxxxx
NMI exception test                       xxxxxxx

channel 0 - 7

Read/Write register test                 xxxxxxx
Interrupt test                           xxxxxxx
ASYNC baud rate test                     xxxxxxx
External/Internal loopback test          xxxxxxx
Adapter board test                       xxxxxxx
Read/Write UART test                     xxxxxxx

channel 8 - 15

Read/Write register test                 xxxxxxx
Interrupt test                           xxxxxxx
ASYNC baud rate test                     xxxxxxx
External/Internal loopback test          xxxxxxx
Adapter board test                       xxxxxxx
Read/Write UART test                     xxxxxxx

PORT 2

OPTION : LAN 802.3

ADAPTER : V.35
Timer test                               xxxxxxx
Internal loopback test                   xxxxxxx
Adapter internal loopback test           xxxxxxx
Multicast test                           xxxxxxx
CRC test                                 xxxxxxx
Off board test                           xxxxxxx
```

- Execute one test — Enter 02 to get a prompt that asks for a test number to execute. If you press the Return key without specifying a test number, the terminal displays a menu of available tests. If you select a test that is applicable to either port, you get a request for the port number. The individual tests and their descriptions are listed under the test types that follow. The following list is displayed:

```
COMMAND? 2
Execute one test

Enter test number or
CR to display test list or
 a '.' to exit-
00   ROM CRC
01   ICC test
02   Parallel interface/timer
03   RAM pattern test
04   RAM bit test
05   RAM address test
06   RAM parity test
07   NET ID ROM test
08   NMI exception test

Enter test number or
CR to display test list or
 a '.' to exit-
8 channel ASYNC

10   Read/Write register test
11   Interrupt test
12   ASYNC baud rate test
13   External/Internal loopback test
14   Adapter board test
15   Read/Write UART test

Enter test number or
CR to display test list or
 a '.' to exit-
LAN 802.3

30   Timer test
31   Internal loopback test
32   Adapter internal loopback test
33   Multicast test
34   CRC test
35   Off board test


Enter test number or
CR to display test list or
 a '.' to exit-
```

- Execute the kernel tests — Enter 03 to execute the kernel tests. The kernel tests exercise the NTC board and include the RAM, ROM, and Parallel Interface/Timer (PI/T) tests. The display is as follows:

```
COMMAND? 3
Execute the kernel test
KERNEL SELF-TESTS

ROM CRC                                  xxxxxxx
ICC test                                 xxxxxxx
Parallel interface/timer                 xxxxxxx
RAM pattern test                         xxxxxxx
RAM bit test                             xxxxxxx
RAM address test                         xxxxxxx
RAM parity test                          xxxxxxx
NET ID ROM test                          xxxxxxx
NMI exception test                       xxxxxxx
```

The individual tests accomplish the following:

- ROM CRC — The ROM Checksum test calculates the checksum for both self-test ROMs. The last two bytes of each ROM contain a precalculated checksum, and this is compared to the checksum that is calculated by the self-test. If the two versions of the checksum do not agree, an error is logged to notify the user that a problem exists.

- ICC test — The interrupt control chip (ICC) test verifies that the interrupt chip generates the correct interrupt levels and can handle multiple interrupts.

- Parallel interface/timer — The Parallel Interface/Timer test checks the PI/T registers. The timer logic is checked for correct speed and correct interrupt vector.

- RAM pattern test — The RAM Pattern test writes a pattern to a memory location and reads the data back for comparison. If the data compares favorably, the next pattern is written and compared. If the pattern does not compare, an error code is posted in the error block. This comparison is repeated for twelve different patterns before the test moves on to the next address. This test is not executed at power-up due to the time required to run the complete test.

- RAM bit test — The RAM Bit test writes a pattern to a memory location, rotates the pattern left one bit, and writes the new pattern to the next memory location. This process is repeated until the end of memory. The data is then read by the program, and if the data is in error, an error code is entered in the error block. This RAM test is not executed at power-up time due to the amount of time required for completion of the test.

- RAM address test — The RAM Address test first clears memory and then sets a pointer to the top of memory. The test reads the data at location 100000H (top of memory). This location is compared to zero and, if the data is zero, the test writes a new pattern of DEAD to this location. The test then runs the next loop of the test at the next memory location, 100002H. This process continues until all the memory has been tested.

The next loop does the same thing, except that it starts at the bottom of memory and reads up to the top of memory. The test reads the data and compares it to the test pattern DEAD. If the data compares correctly, then the test replaces this data with FFFF. The address is decremented by two bytes for the next memory address to be tested.

If at any time a compare instruction fails, an error routine is entered. This routine copies the expected data, the received data, and the location that failed the comparison into the error block.

- `RAM parity test` — The RAM Parity test consists of three different checks. The first check verifies that both the most significant byte (MSB) and least significant byte (LSB) can generate the proper parity error exceptions by writing a byte with the Enable Bad Parity bit enabled and then reading the byte back. The read cycle should generate a parity exception. If the parity exception is not generated, then an error code is entered in the error block.

  The second check uses different data patterns to verify that the parity generators can handle both even and odd data patterns. These patterns include 01, which has only one bit set, and 03, which has two bits set, and 07, with three bits set. The rest of the patterns are 07,0F,1F,3F,7F,FF,FE,FC,F8,F0,E0,C0,80. They are written one pattern at a time with the Enable Bad Parity bit enabled, and then read back. If the read cycle does not generate an exception, the test is stopped and the error routine is entered. If the exception is generated, the test continues.

  The third check verifies the addressing of the parity generators by writing bad parity to a location (100000) and reading the rest of dynamic RAM (DRAM). If an exception occurs, the error routine is entered. If the reads complete without an exception, the parity error is corrected and the check points to a new location. The test locations are 100000, 100002, 100004, 100008, 100010, 100020, 100040, 100080, 100100, 100200, 100400, 100800, 101000, 102000, 104000, 108000, 110000, 120000, and 140000.

  The RAM Parity test error routine saves the expected data, received data, and error address in the primitive system command block (PSCB), and it also tries to initialize DRAM by disabling the Enable Bad Parity bit and writing to all of DRAM.

- `NET ID ROM test` — The Network Identification (ID) ROM test calculates the checksum of the Network ID ROM. The last two bytes of the ROM contain a cyclic redundancy check (CRC) value that is compared to the calculated CRC. If the two values are not equal, an error is logged in the error block. To display the error block, enter `08` when the Test Mode menu is displayed.

- `NMI exception test` — The Nonmaskable Interrupt (NMI) test checks the ability of the board to generate three interrupts: timeout, test error, and illegal operation. The RAM Parity test checks the fourth nonmaskable interrupt.

- `Execute the ASYNC tests` — Enter `04` to cause the ASYNC test to check the ASYNC ports of the NTC. The NTC functions the same way as a communications carrier board (CCB) in a multiboard computer with two 8-channel option boards installed. When you invoke the `Execute ASYNC tests`, the display is as follows:

```
COMMAND? 4
Execute the ASYNC tests

channels 0 -- 7

Read/Write register test                    xxxxxxx
Interrupt test                              xxxxxxx
ASYNC baud rate test                        xxxxxxx
External/Internal loopback test             xxxxxxx
Adapter board test                          xxxxxxx
Read/Write UART test                        xxxxxxx

channels 8 -- 15

Read/Write register test                    xxxxxxx
Interrupt test                              xxxxxxx
ASYNC baud rate test                        xxxxxxx
External/Internal loopback test             xxxxxxx
Adapter board test                          xxxxxxx
Read/Write UART test                        xxxxxxx
```

During the tests, the NTC acts as a CCB in a multiboard computer with two 8-channel options cards and two 8-channel adapter cards installed. The ASYNC test checks each channel on the port individually and independently.

To test a single channel, use the `0B Test one ASYNC channel` function.

The individual tests accomplish the following:

- `Read/Write register test` — The Read/Write Register test writes and reads the Mode Register A, Mode Register B, and Interrupt Vector Register on each channel to verify that the registers are operating correctly. The test uses 20 different byte patterns to check the control registers.

- `Interrupt test` — This test contains and automatically runs three subtests: the Internal Interrupt test, the External Interrupt test, and the Counter/Timer test. The Internal Interrupt test checks the transmit and receive interrupts generated with the 68681 chip. The External Interrupt test checks the transmit and receive interrupts generated by the asynchronous option board hardware. The Counter/Timer test checks the dual univeral asynchronous receiver transmitter (DUART) counter against the PI/T counter and verifies that the counter can generate an interrupt. If an error occurs, the error code is entered in the error block.

- ASYNC baud rate test — The ASYNC Baud Rate test checks each baud rate by having the PI/T timer on the main NTC board time the transmission of two characters. A total of four characters is transmitted by the NTC for testing the timing. The timing starts when the second character is loaded in the transmit first-in-first-out (FIFO) and ends when the fourth character is loaded. The timing is checked to be within the tolerance of a predetermined value stored in a table in ROM. If an error occurs, the error code is entered in the error block.

- External/Internal loopback test — The External/Internal Loopback test transmits, receives, and verifies two blocks of 128 characters. One block contains a walking 1s pattern, and the other block contains a walking 0s pattern. If an error occurs, the error code is entered in the error block.

- Adapter board test — This test is valid only for the CCB in a multiboard computer. If the test is run from the NTC, the test returns no error.

- Read/Write UART test — The Read/Write universal asynchronous receiver transmitter (UART) test writes unique byte patterns to the mode register A, mode register B, and interrupt vector register in each of the channels on the port. The data is read and checked to verify that each DUART can be addressed. If an error occurs, the error code is entered in the error block.

- Execute the LAN/NET tests — Enter 05 to cause the LAN/NET command to check the network interface port. When you invoke the LAN/NET test, the display is as follows:

```
COMMAND? 5
Execute the LAN/NET tests

Port 2

OPTION : LAN 802.3

ADAPTOR : 802.3 ETHERNET
Timer test                                  xxxxxxx
Internal loopback test                      xxxxxxx
Adapter internal loopback test              xxxxxxx
Multicast test                              xxxxxxx
CRC test                                    xxxxxxx
Off board test                              xxxxxxx
```

The individual tests accomplish the following:

- Timer test — The network Timer test issues a Configure command to the 82586 LAN coprocessor. Upon completion, the test issues a Diagnose command, which causes the 82586 to execute internal self-test code. If an error occurs, it is logged and the error code is entered in the error block.

- Internal loopback test — The Internal Loopback test configures the network interface chip for internal loopback. Packets are transmitted and received by the NTC. The data is compared and, if it is not equal, an error is logged in the error block.

- `Adapter internal loopback test` — The Adapter Internal Loopback test configures the network interface chip for external loopback and sets the adapter loopback bit, putting the adapter in the loopback mode. The NTC transmits and receives packets and compares the data. If an error occurs, the error code is entered in the error block.

- `Multicast test` — The Multicast test configures the network interface chip for external loopback and sets the adapter loopback bit, putting the adapter in the loopback mode; however, the destination address is set for multicast.

- `CRC test` — The CRC test transmits and receives two packets. The first packet with CRC insertion enabled is transmitted and received. The status is dumped and the CRC receive register is checked against the expected polynomial. The second packet is transmitted with CRC insertion disabled, and an incorrect CRC is inserted. The packet is checked for receive rejection, and the alignment/CRC field is checked for one error. If an error occurs, the error code is entered in the error block.

- `Off board test` — The Off Board test is run only in the Extended mode. For this test to complete without error, the network interface must either be tied to an operating network or the loopback connector must be installed. This test transmits two packets with the network interface chip configured for external loopback and the adapter loopback bit cleared. If both packets are not received, an error is logged in the error block.

- `LED test` — Enter `06` to cause the LED test to blink the FAIL, BOOT, HOST, and TERM LEDs.

- Test a port — Enter 07 to test any combination of the ports. On the NTC there are two 8-channel asynchronous ports, 0 through 7 and 8 through 15, and the network interface port. The menu and data for this test are as follows:

```
COMMAND? 7
Test port 0 (Y/N)?  Y
Test port 1 (Y/N)?  N
Test port 2 (Y/N)?  Y

channels 0 -- 7

Read/Write register test                          xxxxxxx
Interrupt test                                    xxxxxxx
ASYNC baud rate test                              xxxxxxx
External/Internal loopback test                   xxxxxxx
Adapter board test                                xxxxxxx
Read/Write UART test                              xxxxxxx

PORT 2

OPTION  : LAN 802.3

ADAPTER : 802.3 ETHERNET
Timer test                                        xxxxxxx
Internal loopback test                            xxxxxxx
Adapter internal loopback test                    xxxxxxx
Multicast test                                    xxxxxxx
CRC test                                          xxxxxxx
Off board test                                    xxxxxxx
```

- Display error block — Enter 08 to present the error block along with the ROM flag area and primitive system command block (PSCB). The prompts and data displayed are as follows:

```
COMMAND 8
Display error block
0018 1D00   0000 0000 0000 0000 0000 0000 0000 0000  ................
0018 1D10   0000 0000 0000 0000 0000 0000 0000 0000  ................
0018 1D20   0000 0000 0000 0000 0000 0000 0000 0000  ................
0018 1D30   0000 0000 0000 0000 0000 0000 0000 0000  ................
0018 1D40   0818 0000 4222 0138 0100 1000 60FF 0F05  ....B".8....`...
0018 1D50   0000 0000 7900 0000 07FF 00A0 0000 0000  ....y...........
0018 1D60   022B 000C 1180 0000 0008 0000 0000 0000  .+..............
0018 1D70   0018 1C2C 0080 0000 0018 1CEC 0000 0000  ...,............
0018 1D80   0018 1D02 0040 0101 0000 3658 0000 0002  .....@....6X....
0018 1D90   7C06 7C06 7903 0000 00B0 0087 0000 0000  |.|.y...........
0018 1DA0   0000 0000 0000 0041 0000 0000 0000 0000  .......A........
0018 1DB0   0000 0000 0000 0000 0000 0000 0000 0041  ...............A
0018 1DC0   0000 0000 0000 0000 0000 0000 0010 8000  ................
0018 1DD0   0018 1D00 0000 0000 0000 0000 0000 0000  ................
0018 1DE0   0400 0000 FF02 0000 0000 0013 007F 0013  ................
0018 1DF0   0000 0014 0000 0000 0000 0000 0000 0060  ...............`
```

- Display CONFIG — Enter 09 to display information about the ports on the NTC. When invoked, the following menu is displayed:

```
COMMAND 9
Display config

PORT 2

OPTION  : LAN 802.3

Adapter : 802.3 ETHERNET
```

- Set options — Enter 0A to set or clear various flags used by the self-tests and monitor. The following menu is displayed when this command is invoked. Enter Y after the prompt to set a bit; entering N after the prompt causes the bit not to be set.

```
COMMAND? A
Set options
Modify flags with each command (Y/N)? N
Extended mode (Y/N)? N
Loop mode (Y/N)? N
Display header test (Y/N)? Y
Pause on error (Y/N)? N
Ignore loss of DSR (Y/N)? N
ANSI terminal (Y/N)?N
Loopback connector installed on all channels (Y/N)? N

COMMAND?
```

  - Modify flags with each command — Setting this bit causes these options to be presented before every command is executed.
  - Extended mode — Setting this bit causes some of the self-tests to run a longer, more complete version of the self-test. Other tests do not execute unless this bit is set. Use the Extended mode prompt to set this bit, and then execute the self-test.
  - Loop mode — Setting this bit causes the self-tests to loop.
  - Display header — Setting this bit causes header messages or passed/failed messages to be displayed.
  - Pause on error — Setting the Pause on error bit causes the self-test code to stop executing with the first error, prompting with the option to continue with the tests or end the tests and return to the monitor. If this bit is not set, the error is logged to the error block, and processing continues.
  - IGNORE LOSS OF DSR — Setting this bit permits the Diagnostic Monitor terminal to be unplugged or turned off without affecting the execution of any of the self-tests

NOTE: Exercise care when disconnecting or connecting the monitor cable while tests are executing. Occasionally, a character is generated when the cable is disconnected or connected, and this character may initiate a break function.

- ANSI terminal — Setting this bit causes the output to be conditioned for an ANSI device.
- Loopback connector installed on all channels — Set this bit to Y only when all the loopback connectors are in place. Some self-tests check this bit and expect an installed loopback connector if the bit is set.

■ OB Test one ASYNC channel — Enter OB to get a prompt that asks for a channel to be tested. Once you answer the prompt, the channel bit you selected is set and the tests are executed. You must use the hexadecimal channel address (0 through F) to select the desired channel. You must use the leading zero in the hexadecimal channel address. The prompt and the displayed results of this test are as follows:

```
COMMAND? B
Test one ASYNC channel
Which channel? 04

channels 0 -- 7

Read/Write register test                    xxxxxxx
Interrupt test                              xxxxxxx
ASYNC baud rate test                        xxxxxxx
External/Internal loopback test             xxxxxxx
Adapter board test                          xxxxxxx
Read/Write UART test                        xxxxxxx
```

Download Commands

5.3.4 The download commands enable the NTC to be downloaded from the network interface or through one of the asynchronous channels. The following menu is displayed for the download commands:

```
00  Return to main menu
01  Download via NET
02  Download via ASYNC port
```

■ Return to main menu — Entering 00 returns the NTC test program to the main menu.

■ Download via NET — Entering 01 allows the NTC to download via the network interface, which is the normal mode of downloading the NTC.

■ Download via ASYNC port — Entering 02 provides for downloading code via one of the asynchronous channels of the NTC. This method of loading the NTC software is useful when there is a problem with the network that connects the NTC to the host computer.

Loading the NTC software via an asynchronous channel on the NTC is not standard and is used only for loading the software when the network is not functioning correctly. To download the NTC from an asynchronous device, first connect the device to one of the NTC EIA connectors, power up the device and then enter `02` (`Download via ASYNC port`) on the diagnostic monitor VDT. The NTC and the asynchronous download device react to your command as follows:

1. The NTC transmits a data link escape (DLE) (10H) character to the software load device to request Download mode and 8-bits-per-character mode.

2. The load device sends an acknowledge (ACK) (06H) character to indicate that the load device is now in the Download mode and set for 8-bits-per-character.

3. The NTC requests the download file by sending an enquiry (ENQ) (05H) character.

4. The download device sends the download file, preceded by an start of header (SOH) (02H) character. The downloaded file contains the following information:

   - RAM destination address (longword)
   - Number of words in data (longword)
   - Entry point (words)
   - Data (words)
   - Data (words)
   - Data (ending on longword boundary)
   - MSB of the CRC of the *even* byte(s)
   - MSB of the CRC of the *odd* byte(s)
   - LSB of the CRC of the *even* byte(s)
   - LSB of the CRC of the *odd* byte(s)

   The NTC aborts the download if it detects a Receive/Break character.

5. The NTC stores the download file at the Destination Address, which is the first longword of the file. The second longword is the number of words to be loaded.

6. The NTC waits until all words are downloaded. As always, the download is aborted if a Receive/Break character is detected.

7. The NTC transmits an ACK character to the load device after the device receives a block of 256 characters. This ACK character requests the next character block, and the load device displays the number of ACK character received to give the user a progress report.

8. When the NTC has loaded the specified number of words of the downloaded file (second longword), no further received data will be placed into RAM. The NTC transmits the final ACK character at this time.

9. The NTC does a CRC check on the even address bytes and then on the odd address bytes.

10. After the CRC checks, the NTC transmits a DLE character to the load device to exit the load device Download mode and to restore the previous bit-per-character setting.

11. The load device sends an ACK (06H) character to indicate it has exited the Download mode, and it restores the bits-per-character setting.

12. If the CRC values are valid and the ACK character is received, the NTC code does a subroutine call to the entry point.

13. If the CRC values are invalid and the ACK character is received, the NTC transmits the message CRC error, and the download is aborted.

Network Commands

5.3.5 The network commands allow the diagnostic monitor to transmit or receive packets over the network, show network activity, and display network IDs. The following menu is displayed when `03` is entered at the main menu:

```
00  Return to main menu
01  Echo messages
02  Echo server
03  Monitor NET
04  Display NET ID
05  Monitor NET activity
```

- `Echo messages` — Entering `01` produces a prompt for the number of packets to ECHO and their destination address. When the specified number of packets have been sent, the number of packets echoed from the receiving device is displayed on the VDT that is controlling the test. The prompts and test information are displayed as follows:

```
COMMAND? 1

Echo messages
Number of messages? 100
Destination address ? 08002800011a

PACKETS RECEIVED = 0000100
```

- `Echo server` — Entering `02` executes the download code that echoes packets from the NTC back to the sending device.

- Monitor NET — Entering 03 executes the monitor network command that displays level 0 of the packets, which consists of destination address, source address, and packet type. The system displays the following prompt and information:

```
COMMAND? 3
Monitor NET
08002800012A    080028000102    0600
080028000102    0800280001A5    0600
0800280101EF    0800280102DC    0804
```

- Display NET ID — Entering 04 displays the 48-bit network address along with the checksum, as follows:

```
COMMAND? 4

NET ID is 080028000875 --7857
```

- Monitor NET activity — Entering 05 executes the program that displays the network activity in percent of utilization both numerically and graphically, as follows. Each utilization percentage is calculated from 50,000 samples of network activity.

```
COMMAND? 5

ACTIVITY  04.51 %  :    *          +          +          :
ACTIVITY  05.58 %  :     *         +          +          :
ACTIVITY  07.44 %  :         *     +          +          :
ACTIVITY  07.43 %  :        *      +          +          :
ACTIVITY  06.38 %  :       *       +          +          :
ACTIVITY  05.67 %  :      *        +          +          :
ACTIVITY  06.17 %  :       *       +          +          :
```

Debug Commands

5.3.6 The debug commands allow the user to display or modify memory, reset the board, or enter subroutines. Entering 04 from the Main menu displays the following Debug Command menu.

```
00  Return to main menu
01  Display memory
02  Modify memory (Read/Modify Write)
03  Write to memory
04  Reset
05  Jump to subroutine
```

- Display memory — Entering 01 displays the following set of prompts, which ask for the starting address and the number of bytes to be displayed. After the prompt information is entered, memory addresses and data are displayed as follows:

```
COMMAND 1

Display memory
Word address ? 0
Number of bytes to read? 100
0000 0000   0018 0000 0000 07AE 0000 1A96 0000 1B86    ............
0000 0010   0000 1BA0 0000 1B9A 0000 1A38 0000 1A38    .......8...8
```

- `Modify memory (Read/Modify Write)` — Entering `02` displays the following set of prompts, which ask for either byte or word mode and the starting address. When the prompts are answered, the following information is displayed:

```
COMMAND 2

BYTE MODE (Y/N)? y
Starting address ? 100001
Number of bytes to read? 100
00100001  00  1
00100002  1A  2
00100003  38  3
```

- `Write to memory` — Entering `03` displays a byte address prompt. When the requested address is entered, the data input prompt is displayed. To advance from one memory location to the next, press Return. To quit the program, enter a period (.) at the `Byte address` prompt. Note that this is a byte-mode-only operation.

```
COMMAND 3

Write to memory
Byte address ? 110001
DATA? 23
Byte address ?

DATA? 24
Byte address ?

DATA? 25
Byte address? .
```

- `Reset` — Entering `04` transfers ROM execution to the power-up entry point of the ROM code and resets the board, including all option ports.

- `Jump to subroutine` — Entering `05` transfers ROM control to an address in either DRAM or static random access memory (SRAM). The prompt is as follows:

```
COMMAND 5

Jump to subroutine
Starting address ? 100001
```

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Terminal Concentrator Installation and Operation
Customer Response

Your comments and suggestions
help us improve our products.

Your computer type_____ Date_____

Your name_____

Company name/department_____

Telephone ( )_____ Address_____

City_____ State_____ Zip_____

ABOUT YOUR SYSTEM. . .

Size of memory (RAM)_____ Type of display_____

Other options _____

_____

Check if you have:

☐ One diskette drive ☐ Two diskette drives ☐ Winchester disk

YOUR RESPONSE CONCERNS. . .

☐ Software TI Part No._____

☐ Manual Version No._____

Did you run diagnostics? ☐ Yes ☐ No Serial No. (if any)_____

Error code or message_____

YOUR COMMENTS. . .

If your comments concern a manual, please include applicable page numbers.

Have you attached additional comments? ☐ Yes ☐ No

Date received by TI_____

TAPE EDGE TO SEAL

FOLD

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS PERMIT NO. 7284 DALLAS, TX

POSTAGE WILL BE PAID BY ADDRESSEE

TEXAS INSTRUMENTS INCORPORATED
INFORMATION TECHNOLOGY GROUP
ATTN: SUSTAINING
P.O. BOX 149149 M/S 2201
AUSTIN, TEXAS 78714-9149

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