WIRING GUIDE

NCR Ethernet Communications

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Issue E

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Revision Record

Issue	Date	Remarks
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Chapter 1: Introduction

This book contains guidelines for installing Ethernet network hardware components and Ethernet segment construction and routing.

Cable routing and installation work must be done by qualified personnel. The National Electric Code (NEC), the EIA/TIA 569 standard, EIA/TIA 568-A standard, EIA/TIA 607 standard, and local regulations governing communications wires must be adhered to.

NCR supports only the communication network components that are specified in this document.

Caution: Cables should not be routed near devices such as fluorescent light ballasts, near magnetic devices such as motors found in fans, air compressors, and air conditioners, or in cable trays (Walker ducts) with AC power wiring. Refer to Layout Guidelines.

Prior to work on any cable, check the voltage between the cable conductors and the local earth. If that voltage exceeds 30 volts rms, an electrical fault is indicated; this fault must be corrected before you proceed.

Do not work on network wiring during a lightning storm.

Customer Responsibilities

The customer must:

- Provide to the NCR Customer Service Representative, upon request, drawings that adequately indicate:
  - Location of the NCR equipment.
  - Power and signal site wiring (including paths and lengths).
  - Location of other equipment capable of generating electrical noise, electromagnetic interference, heat, and so forth.
- Make the building alterations that are necessary to meet wiring and other site requirements.
- Provide and install all communications cables, wall jacks, special connectors, and associated hardware.
- Provide and install the necessary power distribution boxes, conduits, grounds, lightning protection, and associated hardware.
- Make sure all applicable codes, regulations, and laws (including, but not limited to, electrical, building, safety, and health) are met.

- Provide and install auxiliary power or other equipment, as required.
- Provide storage or service areas, as required.
- Make sure the environmental requirements of the system/unit are met.
- Provide floor coverings and environment systems that limit or control the buildup or discharge of static electricity.

Layout Guidelines

The following layout guidelines are necessary for proper operation of each NCR device on an Ethernet communications network.

- Cables should not be routed in cable trays (Walker ducts) with AC power wiring.
- Unless grounded metallic conduit is used, the minimum space between the communication cable and fluorescent, neon, incandescent light bulbs, is 30 cm (1 ft).
- Unless grounded metallic conduit is used, the minimum space between the communication cable and electrical equipment and associated power lines, is as shown in the following chart.

Maximum Rated Circuit	Power Cables	
	Unshielded	Shielded
1 kVA	30 cm (1.0 ft)	2.5 cm (1.0 in.)
2 kVA	46 cm (1.5 ft)	5.1 cm (2.0 in.)
5 kVA	61 cm (2.0 ft)	15.2 cm (6.0 in.)
>5 kVA	152 cm (5.0 ft)	30.5 cm (12.0 in.)

If the communication cable is routed through an elevator shaft, it must be enclosed in grounded metallic conduit.

- Each link is for use within a single structure. Cable routing outside of, or between buildings, is not supported.
- Appropriate cable strain relief must be provided.
- Avoid severe bending or kinking of the communication cable (not less than 3.7 " radius for coax cable, 1.0 " for twisted pair).
- All connections must be secure. Loose or faulty connections degrade the system performance.
- Hubs must not be setup in any loop configuration. Do not create a situation where a loop is created by a connection of a Header Hub's out jack to a Low Order Port, or a sequence of hubs where High Order to Low Order ...High Order to Low order is created. This can cause a constant jammed link (a feed-back loop.)

- Do NOT work while network is live.
- Look for potential short at Wall Boxes. Correct before bring-up of Network and test for continuity.

Conduit Requirements

Communication cable must not be installed in conduit that contains power cables.

Communication cables must be run through conduit under certain conditions (See Layout Guidelines), including the following:

- When required by local electrical or labor codes
- When wiring would otherwise be exposed to physical damage or abuse

Greenfield flexible metallic shield and rigid metallic pipe are acceptable. Copper conduit must not be used.

Conduit must be connected to earth ground, at a single point, as close to the primary device as possible. It must be large enough to accommodate the present cables, plus any cables to be added later.

Chapter 2: Ethernet 10Base-2

This chapter shows the assembly, mounting, wiring, and power-up sequence of the hardware and wiring that may be used in an Ethernet 10BASE-2 LAN. It is not intended to explain Ethernet and its many possible configurations.

Before installing any Ethernet component, pay particular attention to the individual warnings about accessibility and protection of each piece of hardware.

Ethernet Board Requirements

Ethernet 10BASE-2 is available only for the 7052/sx Workstation. This workstation requires one of the following PC-AT bus type Ethernet boards:

- NCR Ethernet board (497-0006213)
- Western Digital Ethernet board (WD8003EP)
- Generic off-the-shelf PC-AT bus Ethernet board

Note: Ethernet 10Base-2 wiring is less reliable than 10Base-T wiring because the coaxial connectors can become intermittent where they are crimped onto the cable. This causes a break that can disable the entire network. Upgrade of existing 10Base-2 networks to twisted pair wiring is strongly recommended. The savings from reduced maintenance over time will offset the rewiring costs. Use of category 5 twisted pair provides an upgrade path to 100 Mb/s or faster networks.

Network Layout Guidelines

- BNC jack-to-jack connectors are to be used in all coaxial cable splices.
- • The communication cable shield (where used) must be continuous throughout the link. However, communication cables may supply low level power (less than 1 watt at 24 volts maximum rms).
- • Cable terminators (50 ohms) must be installed at each end of the coaxial cable link.
- • If coaxial cable must be extended, the additional section should be from the same manufacturer's lot.

Caution: The outer shield conductor of Ethernet coaxial cable MUST NOT touch earth ground points. If BNC conductors are inside conduit, wrap them completely with electrical tape to prevent shorting to earth ground.

Using Generic Ethernet Boards

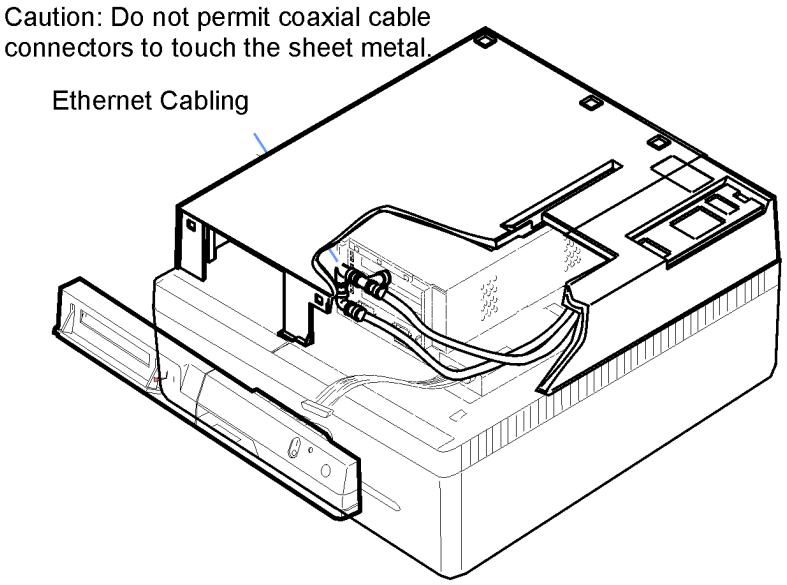
If the NCR or WD boards are not used exclusively:

- The maximum overall network length is
- 185 m (600 ft).
- The maximum number of nodes is 30.

Note: Off-the-shelf generic Ethernet boards must meet the requirements in IEEE Specification #802.3.

NCR 7052/sx Cable Connections

Route the Ethernet cables in through the back of the 7052/sx and connect them as shown below.



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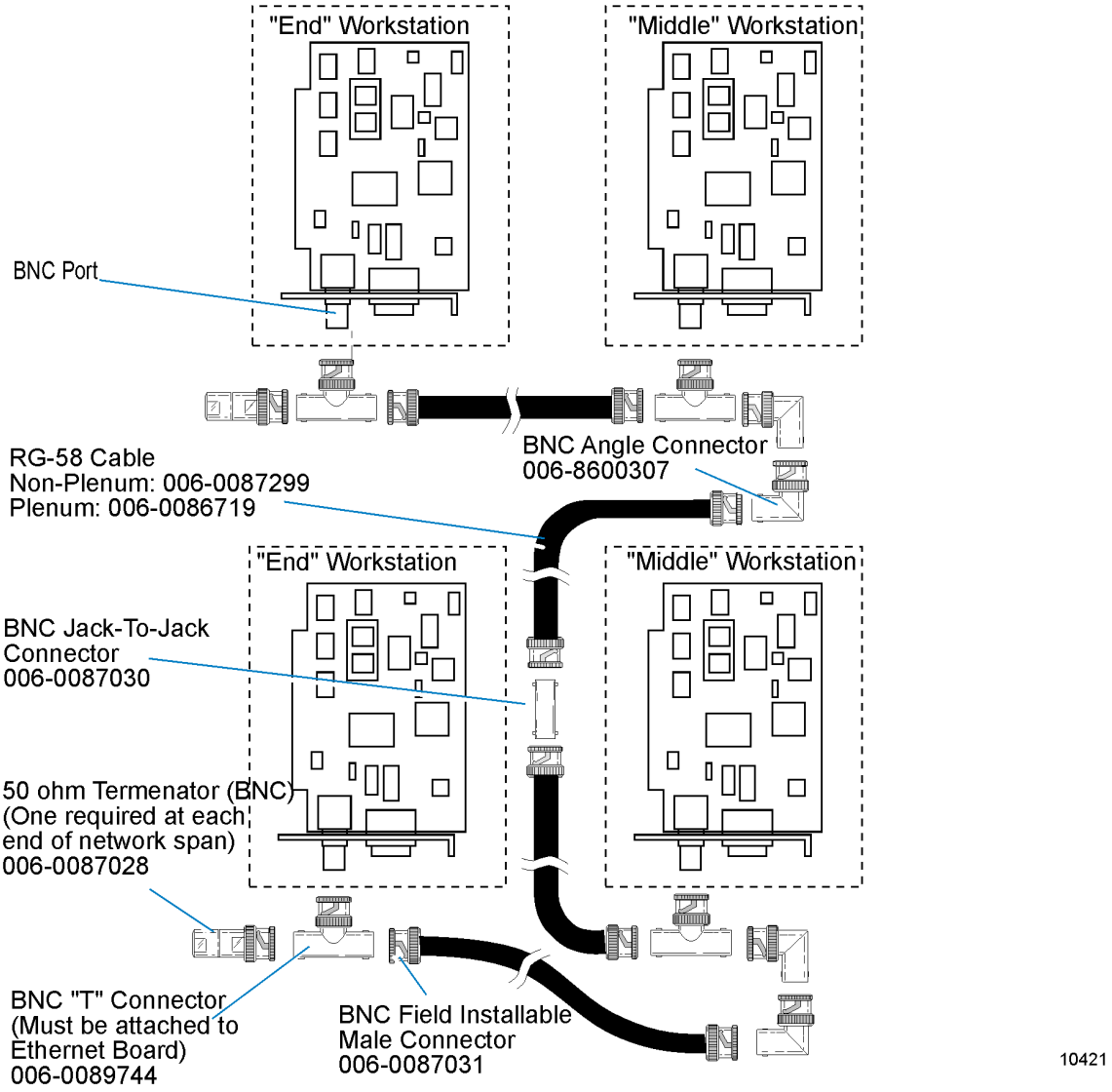
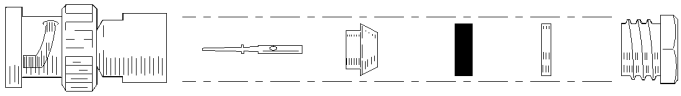
Caution: The Ethernet coaxial cable connectors MUST NOT touch the workstation sheet metal.

The cables connect to BNC "T" type connectors on the Ethernet communications board in the 7052/sx. The first and last workstation (end workstations) in the Ethernet link MUST have a terminator plug installed.

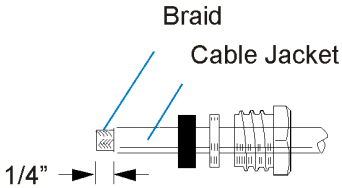
Notice the two BNC angle connectors that are used to route the return cable on all "middle" workstations.



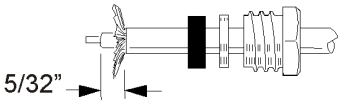
BNC Solder Connector Installation (006-0087031)



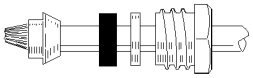
1. Slide nut, washer and gasket over cable and trim cable jacket to dimension shown.



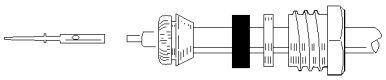
2. Comb out braid and fold outward. Trim cable dielectric to dimension shown. Tin center conductor.



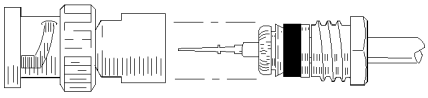
3. Fold braid wires forward and taper them toward center conductor. Slide clamp over braid wires and push clamp abainst cable jacket.



4. Fold back braid wires, trim to proper length (1/8”) and form over clamp as shown. Solder Mail Pin to center conductor using Rosin Core Solder (60% tin, 40% lead).



5. Screw plug body over interior assembly, completing plug assembly.



NOTE: Be sure clamp seats properly in gasket before tightening nut.

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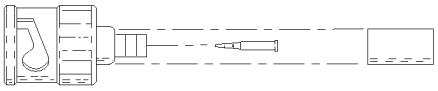
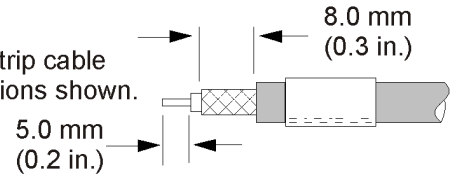
BNC Crimp Connector Installation (998-0717342)

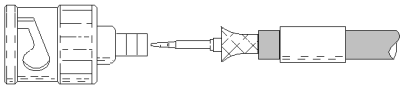


Plug Body Center Contact Ferrule

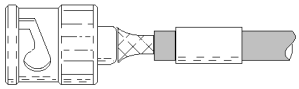
1. Slide ferrule onto unstripped cable. Then strip cable with the appropriate tool, using the dimensions shown. Do not nick or cut the cable braid. Center conductor must be straight and free of burrs.



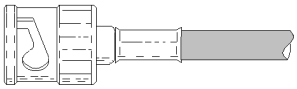
2. Slide center contact over center conductor of cable until shoulder of contact is against the inner dielectric of cable. Crimp the center contact with the appropriate tool. Flare cable braid to permit the support sleeve of the plug body to pass under the cable braid.



3. Insert center contact into plug body until it snaps into place. Make sure the cable braid is positioned over the connector support sleeve as shown. Pull back gently on the cable to ensure that the contact is held in place by the internal locking feature.



4. Slide ferrule over cable braid and support sleeve until it is positioned against the shoulder of the plug body. Crimp the ferrule using the appropriate tool.



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Coaxial Cable Stripper

A special tool for stripping coaxial cable is available from NCR as P/N 603-9012368 or from AMP as P/N 603995-1. Operating instructions are included.

Coax Crimper

A special tool for crimping the 6-227079-7 connector ferrule and center contact is available from NCR as P/N 603-9012369 or from AMP as P/N 220190-1

Crimper Die

A special die to help crimp the center contact of the 6-227079-7 connector is available from NCR as P/N 603-9012370 or from AMP as P/N 220189-1.

Bending The Cable

Ethernet coaxial cables must not be bent at sharp angles. When bending the cable around fixed objects or around corners, a minimum bend radius must be maintained, according to the manufacturer's specification. If this specification is not available, the general rule is to maintain a minimum bend radius that is equal to 20 times the cable external diameter.

Example: Belden thin coaxial cables (#9907 PVC or #89907 FEP) have an external diameter of 4.62 mm (0.18 in.); therefore, the minimum bend radius for these cables is 20 x 4.62 mm, or 9.24 cm (3.7 in.).

Bending the Ethernet cable to a radius smaller than the minimum specified radius may increase the cable impedance and degrade the network performance.

Checking the Coaxial Cable

1. If the system is operating, perform an orderly shutdown and then disconnect ac power from the workstations.
2. Disconnect the coaxial cable from one of the "end" workstations (where a 50 ohm terminator is present).
3. At the disconnected cable end, use an ohmmeter to measure the resistance from the BNC connector center conductor to the connector body (housing). The meter reading should be 50 - 110 ohms, depending on the length of the network cable (longer cables will have a higher resistance reading).
4. If the reading is less than 50 ohms, check the cable, the terminator, and the connectors for shorts.
5. If the resistance is greater than 110 ohms, check for one or more of the following conditions:
   - The terminator is missing from the end of the link; or it is open.
   - The cable shield or center conductor is open.
   - A poor solder joint on a BNC connector center conductor.
   - A damaged "T" connector at one of the workstations.

Components

Description	Vendor Part No.	NCR Part No
Connector BNC, Jack to Jack	Amphenol 31-219	006-0087030
Connector BNC, Plug RG-58	Amphenol 31-3301	006-0087031
Connector BNC, T	Amphenol 31-008	006-0089744
Terminator, 50 ohm	Amphenol 46650-51	006-0087028
Thin Coaxial Cable, 50 ohm, RG-58C/U, Type PVC	Belden 9907	006-0084381 1144-C000-xxxx
Thin Coaxial Cable, 50 ohm, RG-58C/U, Type FEP	Belden 89907	006-0084380 1146-C000-xxxx

Chapter 3: Ethernet 10Base-T

This chapter shows the assembly, mounting, wiring, and power-up sequence of the hardware and wiring that may be used in an Ethernet 10BASE-T LAN. It is not intended to explain Ethernet and its many possible configurations.

Before installing any Ethernet component, pay particular attention to the individual warnings about accessibility and protection of each piece of hardware.

Ethernet Board Requirements

Ethernet 10BASE-T is available only for the 7052 Rel. 5.4, and the 7054 Rel. 1.2 and 2.1 Workstations. These workstations require an Ethernet adapter. The current adapters approved for use are:

- 7401/7454: Ethernet on the processor board (Intel Controller)
- 7452/7453: Ethernet on the processor board (AMD Controller)
- 7452 (Release 1.0): SMC EtherEZ Card
- SMC EtherCard Plus Elite10T (a PC AT bus board) (7054 only)
- NCR Ethernet Daughter Card
    - NCR 7054 Feature/Kit F152/K152
    - NCR 7052 Feature/Kit F706//K706

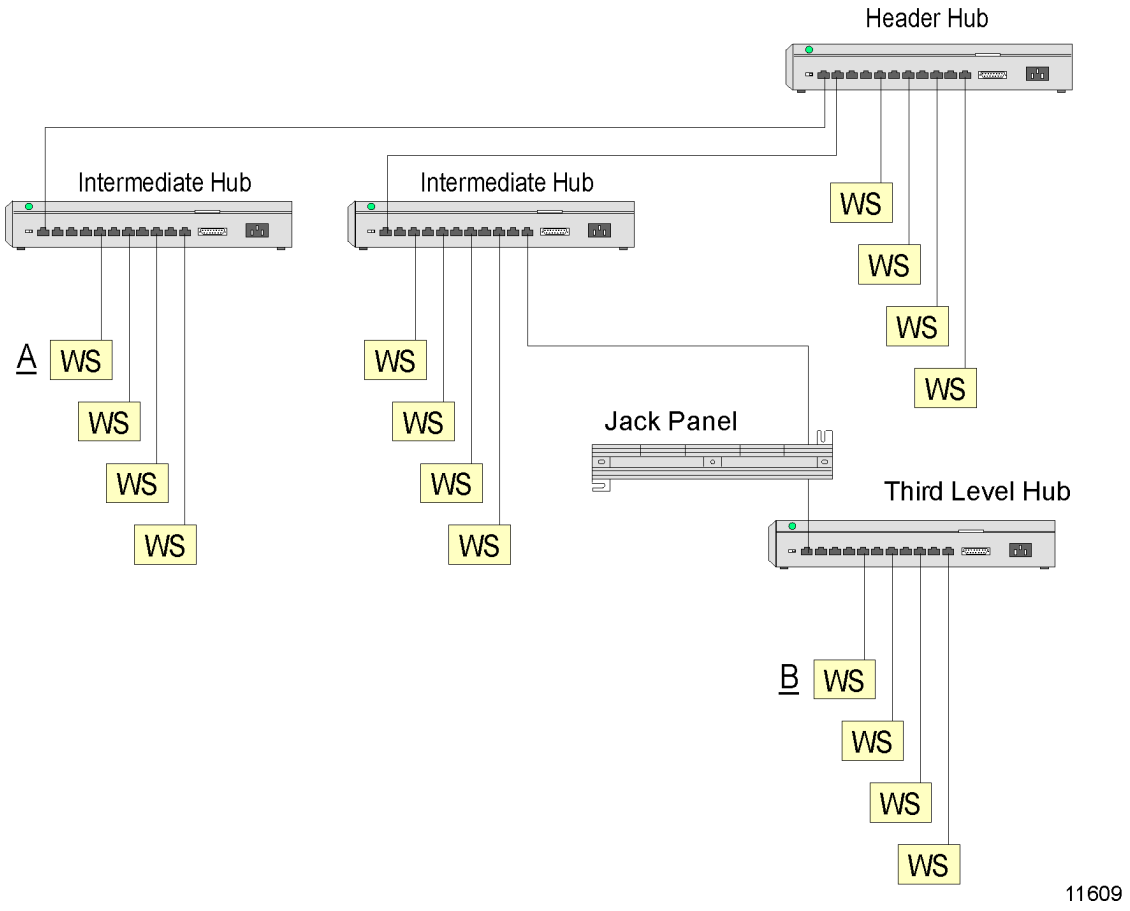
Network Layout Guidelines

An Ethernet 10BASE-T system consists of either a header hub with several workstations connected to it, or a header hub with one or more intermediate hubs connected to it and to the workstations, in a star arrangement. Many variations of networks can be implemented using this system, as long as the 5 - 4 rule is not broken. The 5 - 4 rule simply states that between any two workstations there may be no more than five wire segments and four hubs. Adherence to this rule prevents excessive propagation delays (timing problems).

A wire segment includes all of the circuit elements that provide the physical electrical connection between workstations and hubs. For example, a wire segment can include drop cables, wall boxes, in-store wiring, jack panels, and patch cords.

Nominal Configuration

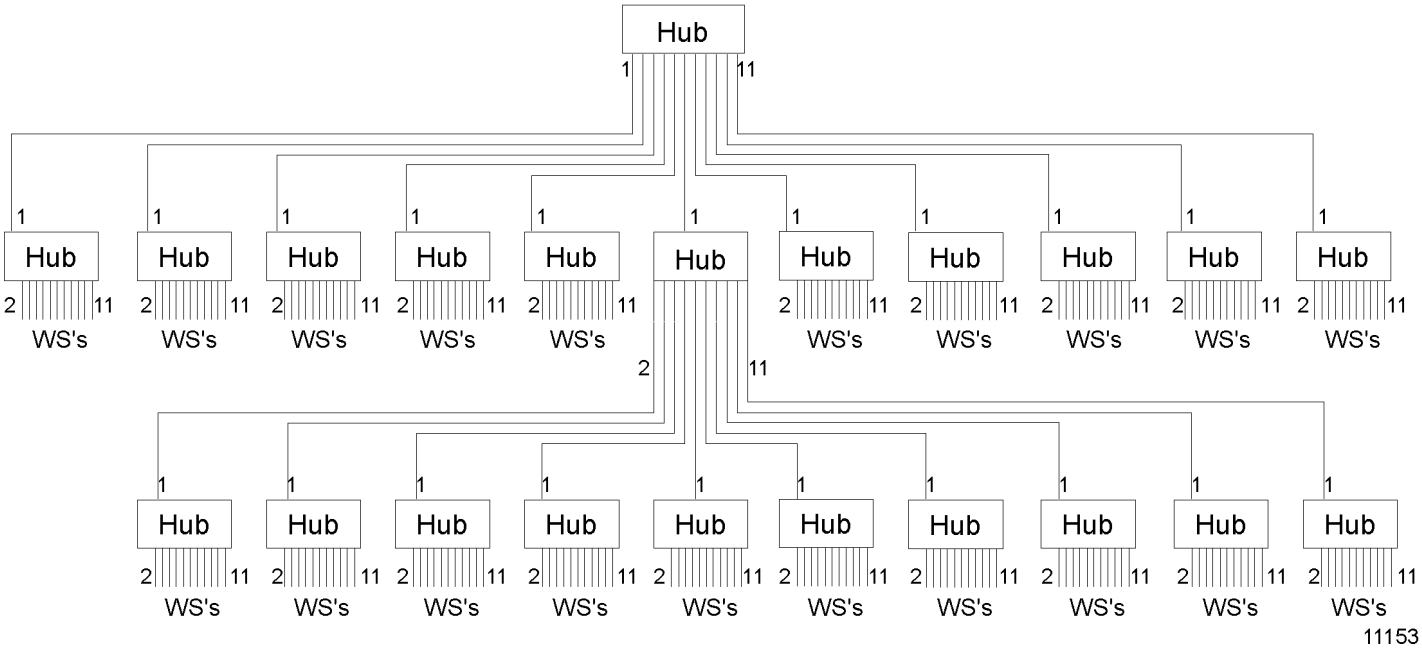
A nominal configuration may consist of a header hub, two intermediate hubs, one more hub off one of the intermediate hubs, and several workstations. Notice that the 5 - 4 rule is satisfied between workstations A and B.



Maximum Configuration

For a maximum configuration, if the header hub connects to eleven other hubs, each of those intermediate hubs can connect to up to ten other devices (since one of the eleven connections must be to a hub above it). One and only one of these secondary hubs may connect to another group of hubs.

These last hubs can only connect to workstations. Up to 200 workstations can be connected using this system. Notice that the 5 - 4 rule is satisfied between any workstation on the bottom row and any workstation on the top row.



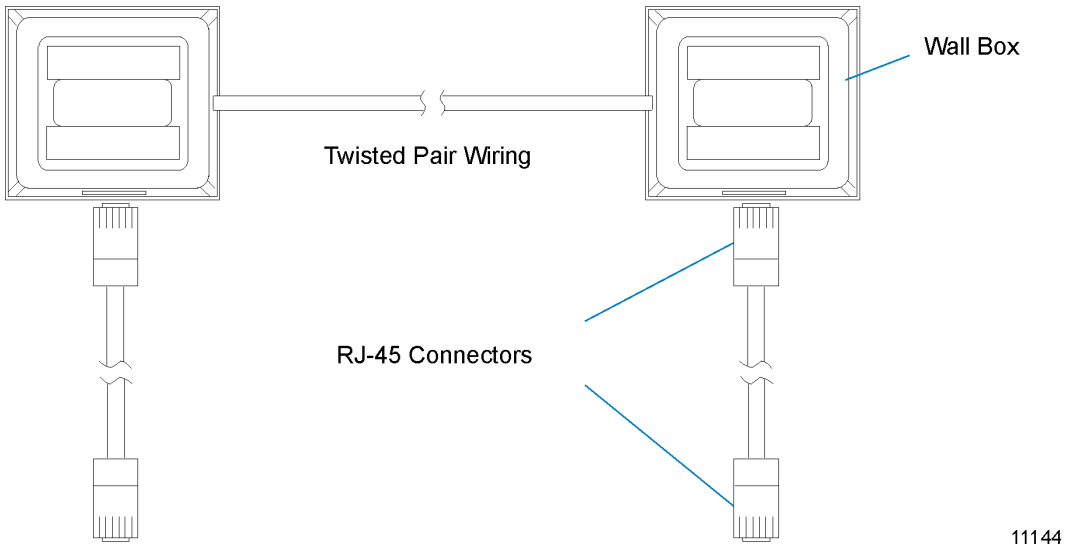
Cabling

The hubs and workstations are connected using twisted-pair cables with RJ-45 connectors. The cable length between any two devices (hubs or workstations) cannot exceed 100 m (328 ft).

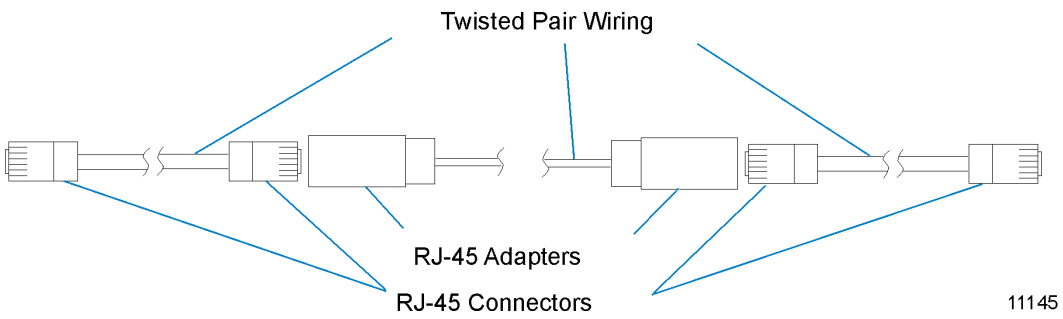
Note: These are connections from hub to hub or from hub to workstation. Workstations cannot be connected to each other except in a two-workstation system. In this situation, the transmit pair must be connected to the receive connections and the receive pair must be connected to the transmit connections at one end of the cable.

Combinations of cabling may be used.

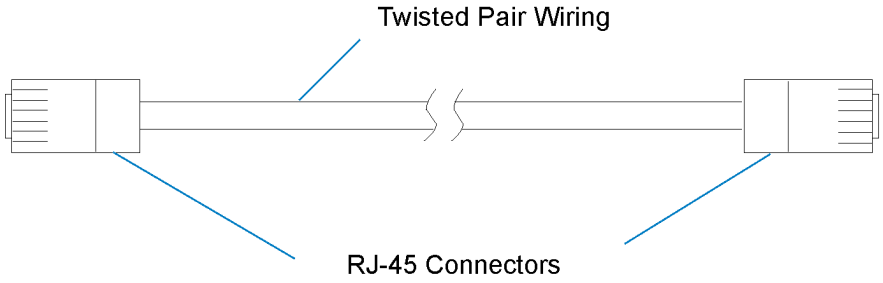
- A drop cable from a hub to a wall box, twisted pair wiring from this wall box to another wall box near the destination, and a drop cable from the second wall box to a workstation or hub. This combination can contain connections through NCR cross connects in wiring closets.



- A drop cable from a hub to an RJ-45 to RJ-45 adapter, an RJ-45 to RJ-45 cable from this adapter to another adapter near the destination, and a drop cable from the second adapter to a workstation or hub.



An RJ-45 cable directly from a hub to a workstation or hub.



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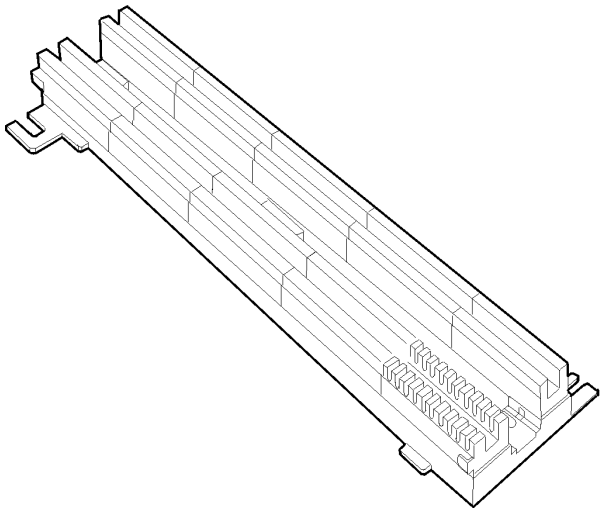
- Twisted pair wiring connections through NCR jack panels in wiring closets.



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Recommended Hardware

Note: The hardware and wiring recommendations listed in this chapter apply to existing 10Base T networks. New installation should use the 100Base T guidelines (see chapter titled Ethernet 100Base T), even if only 10Base T is initially installed. This makes it much easier and less costly to upgrade to 100Base T in the future.

The following hardware is approved for use with Ethernet on NCR Retail workstations. Other hubs that are IEEE 802.3 compliant may also be used.

- AT&T 4261-1001-0000 StarLAN 10 Network Hub Unit
- AT&T 451A Adapter (103-7862400) (connects two modular cords)
- NCR Ethernet device drop cable
  - 497-0008623 (7054, 7452, 7453)
  - 497-0008905 (7052 only)
- Wall box
  - NCR 1008-A077 (250-0030764)
  - AT&T WE 103A (105 164 8180)
- AT&T 1100 Modular Jack Panel
- NCR StarLAN Junction Box 1008-A076 (250-0030765)
- NCR Patch cable (65 cm, 18 in.) (250-0030405)
- Twisted pair wiring

Note: Other hardware can be used, provided it is rated EIA/TIA Category 3 or better.

Recommended Wiring

The cable system for the Ethernet communications network consists of unshielded point-to-point twisted pair network links. Each link consists of a transmit pair and a receive pair.

Note: The integrity of each of the twisted pairs must be preserved. Do not split one of the twisted pairs and use one wire from that pair for transmit traffic and the other for receive traffic, for example.

The following unshielded twisted pair cable is recommended as in-store wiring for Ethernet LANs.

• AT&T SYSTIMAX 1061 up to 100 m (328 ft) If other signals are not run on the other pairs, they should be grounded at both ends, if possible.

• AT&T SYSTIMAX 1010 up to 50 m (164 ft) This cable can be used in a low noise environment, no other signals run on the unused pairs.

• Lucent SYSTIMAX 2061 up to 100 m (328 ft) This cable is the same as the 1061 except it is plenum rated.

• Lucent SYSTIMAX 2010 up to 50 m (164 ft) This cable is the same as 1010 except it is plenum rated.

Unused pairs should be grounded at both ends if the wiring scheme allows it (grounding strip or posts in boxes). If grounding is not available, either twist the wires back and wrap them around the cable, or clip them off.

Other Wiring

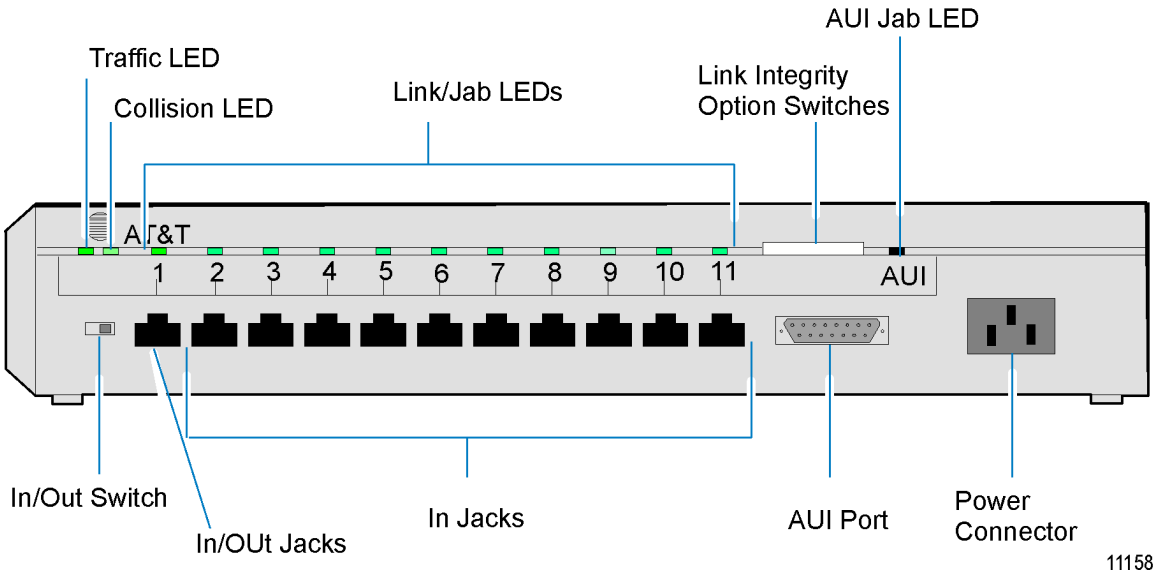
Unshielded cable other than the cable recommended in the preceding section may be used for Ethernet if the cable is rated EIA/TIA Category 3 or better.

Unused pairs should be grounded at both ends if the wiring scheme allows it (grounding strip or posts in boxes). If grounding is not available, you can either bend the wires back and wrap them around the cable, or clip them off.

Installation Procedures

Step 1: Mounting the AT&T StarLAN Hub

Note: Note: Follow the manufacturer's mounting instructions if you are using another type of hub.



At&T StarLAN:Hub

Decide where to mount the hub units.

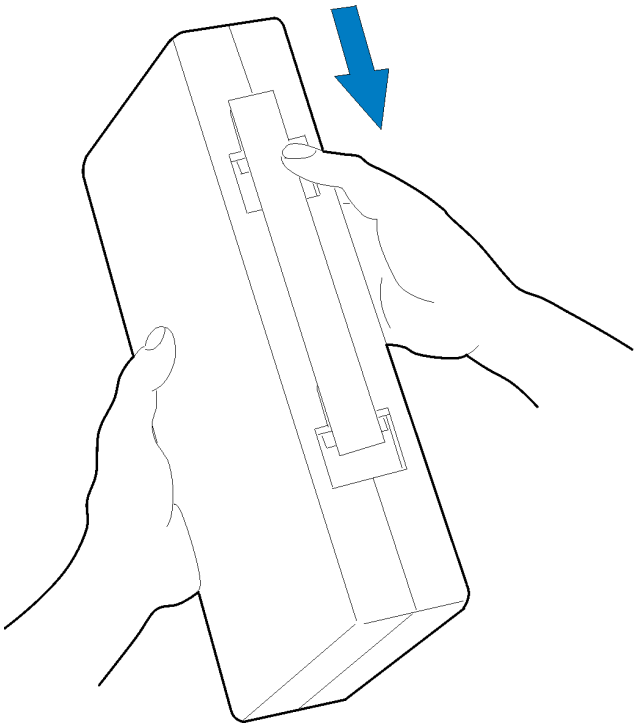
- The hub (Figure 3-3) must be physically protected but accessible for maintenance. This is especially important to remember, since hubs may be positioned in a variety of locations within a store. Wall closets, shelves or under check stands are just a few of the more common locations.
- The distance from the hub to the AC power source cannot be more than:
  - 2.1 m (7 ft) (USA)
  - 3.0 m (10 ft) (international)
- You can place a hub on a level surface or mount it on a wall.
- Provide 12 cm (5 in.) of clearance between the top of the hub and any object positioned above it.

Mounting the Hub Unit on a Wall

The following hardware is included in the hub kit for mounting the hub to a wall:

- A hub mounting bracket
- Wall anchors
- Metal pan head screws suitable for holes drilled with either a 3.175 mm (0.125 in.) bit for mounting into wood or a 4.76 mm (0.1875 in.) bit for mounting into wallboard
- A UL/CSA listed SJT-type power cable for connecting the hub's internal power supply to commercial power

1. Remove the mounting bracket from the hub



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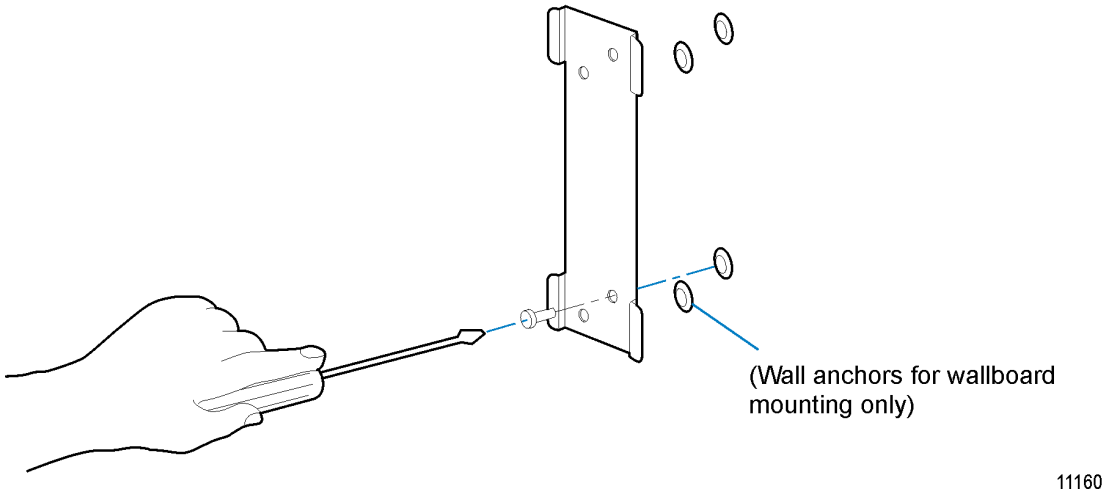
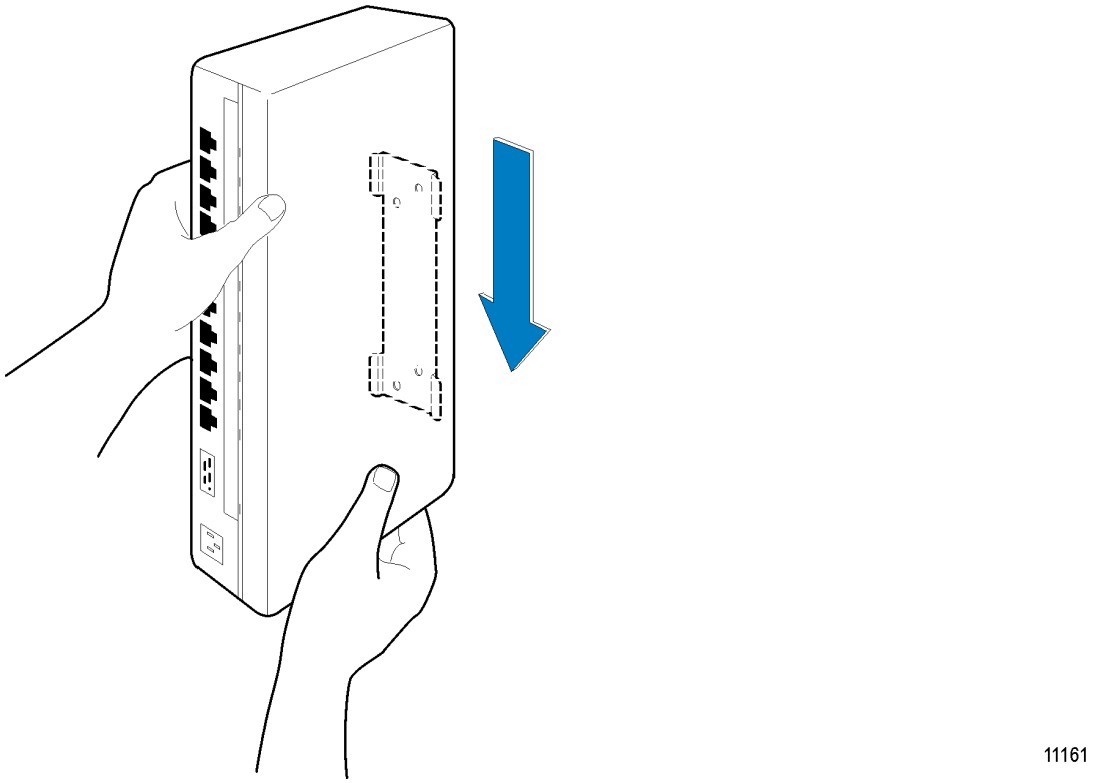
2. Position the bracket on the wall, and carefully mark the location for each screw hole.



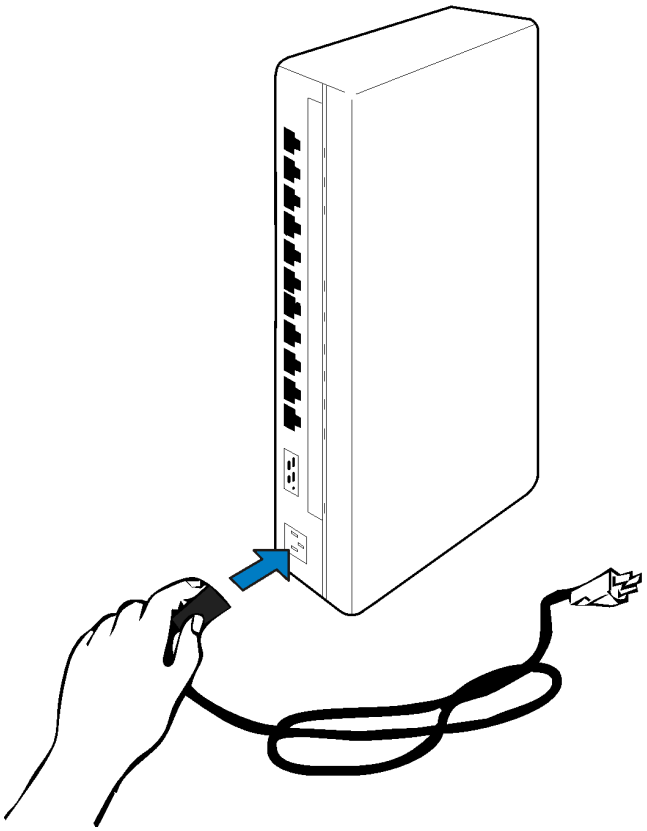
3. Drill the holes with a 3.175 mm (0.125 in.) drill bit for mounting in wood, or a 4.76 mm (0.1875 in.) drill bit for mounting in wall board. If you are mounting the hub on wallboard, use wall anchors.
4. Position the bracket and insert the screws through the appropriate holes in the frame. Then screw the frame onto the wall.
5. Place the hub firmly against the wall so that the mounting bracket fits into the slots on the back of the hub.
6. Slide the hub onto the bracket until it locks into place.



Step 2: Connecting Power to the Hub

To connect power to the hub:

1. 1. Connect the power cable into the 3-prong power connector on the front of the hub, as shown below:



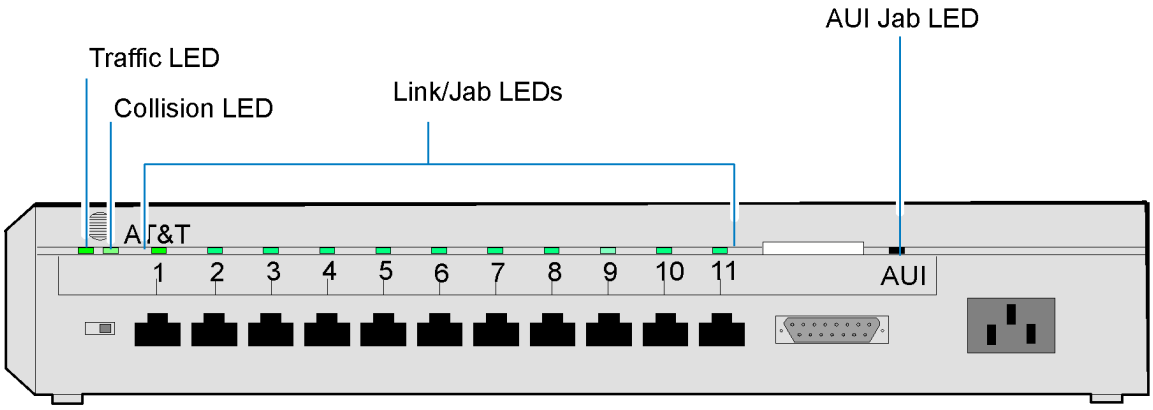
11161a

2. 2. Insert the other end of the power cable into a grounded outlet in the wall, a power strip, or a grounded extension cord.

Warning: DO NOT USE ANY ADAPTER PLUG between the power cord and the outlet because this may result in electrical shock to humans or damage to the hub.

Power-up LED Test

Once the hub is mounted, verify that its light emitting diodes (LEDs) are functioning properly by using the procedure in this section.



11173

To verify that the LEDs are functioning properly, follow these steps:

1. 1. Remove the power cable from the hub (it has no power switch).
2. 2. Reconnect the power cable to the hub, and observe the LED activity, as follows:
   a. a) For approximately two seconds after power is initially applied, the following LED activity should occur.

LED	LED State
Traffic	Off
Collision	On
Link/Jab	On **Red**
AUI/Jab	On

   b. b) After two seconds, the LEDs should return to their normal states.

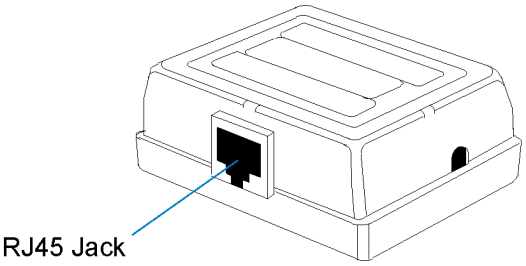
LED	LED State
Traffic	Off
Collision	Off
Link/Jab	Link/Jab Off (On Amber if Link Integrity is disabled)
AUI/Jab	Off

Note: If you are running this test with any of the twisted-pair wire jacks connected, the status of the Link/Jab LED may vary randomly. Therefore, NCR recommends that you disconnect all jacks before performing the power-up LED test.

If all LEDs remained OFF:

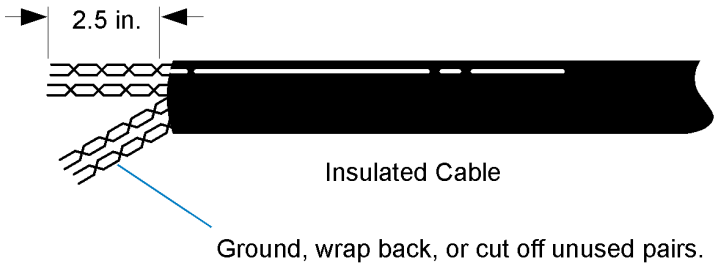
1. Make sure the power source is functioning by plugging another device into the receptacle.
2. Try a new power cord.
3. If there are any other deviations from the power-up sequence in the last series, return the hub to the original place of purchase.

Step 3: Connecting the Wall Boxes to the In-Store Wiring



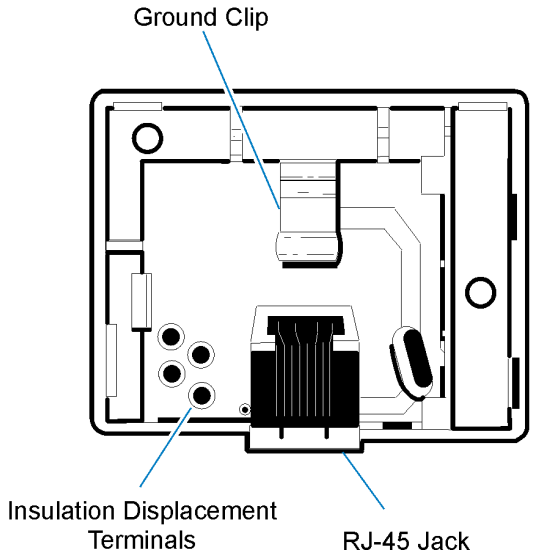
11199

1. Decide where to mount the Wall Box:
   - Provide at least 10 cm (4 in.) of clearance around the mounted wall box for cable connections.
   - Plan to mount the wall box within 3 m (10 ft) of the workstation.
   - The location must be physically protected but still accessible for maintenance.
   - Plan to mount the wall box with the connector opening downward or horizontal so that liquids or other debris cannot enter the box.
2. Assemble the following tools:
   - Insertion tool (NCR P/N 603-9009892 or AMP P/N 552714-3)
   - Cable stripping tool
   - A drill with a 6.35 mm (0.25 in.) to 4.76 mm (0.1875 in.) bit (for screw mounting)
   - A screw driver (for screw mounting)
3. Remove the cover of the wall box by pressing the retaining clips located along the front edge of the wall box cover.
4. Mount the wall box base assembly to the wall, with the connector pointing down or sideways, using the adhesive tape or the mounting screws provided.
5. Prepare the twisted pair wire by stripping the jacket 6.35 cm (2.5 in.).



11147

6. Locate the insulation displacement terminals on the PC board of the wall box.

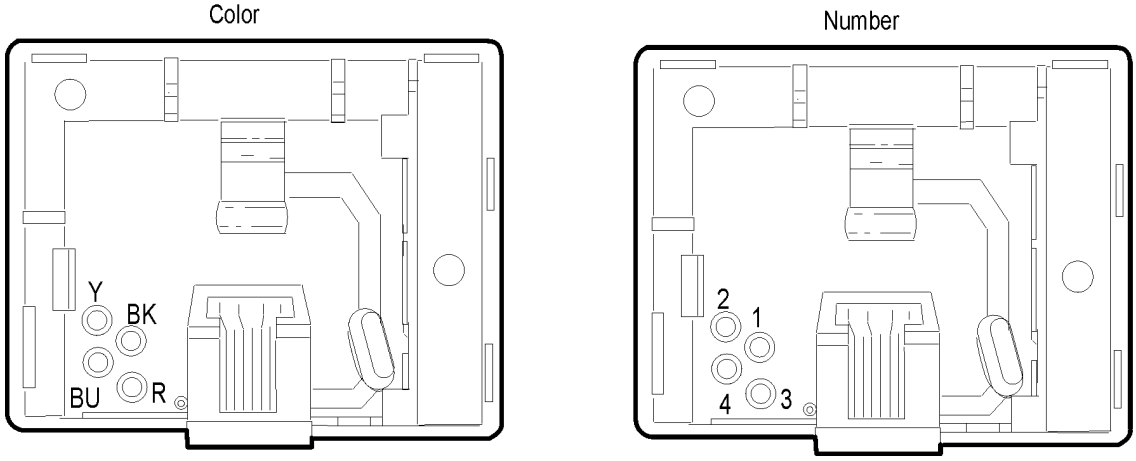


11146

The following procedure details the connection of twisted pair wire to the Wall Box.

Caution: All twisted pair wire has a twisted pair dedicated to transmission, and another pair to reception. DO NOT BREAK THESE PAIRS. Your system will be wired incorrectly if you do.

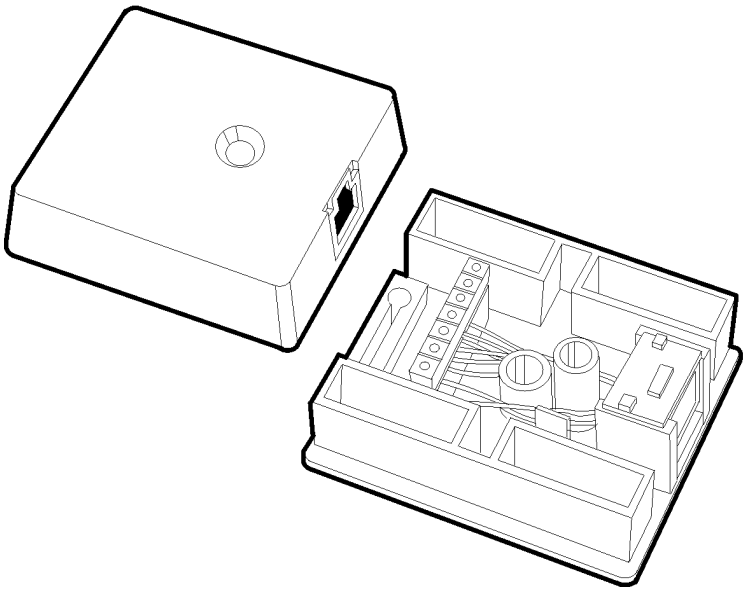
Note: Some non-NCR wall boxes may use screw terminals instead of insulation displacement terminals. In this case, use the following pin connections in order to interface to an RJ-45 modular plug.



11106

NCR Wall Box and Cable

Signal	Color	Terminal	RJ-45 Connector Pin
Transmit (+)	Black	1	1
Transmit (-)	Yellow	2	2
Receive (+)	Red	3	3
Receive (-)	Blue	4	6



11608

AT&T WE 103A Wall Box

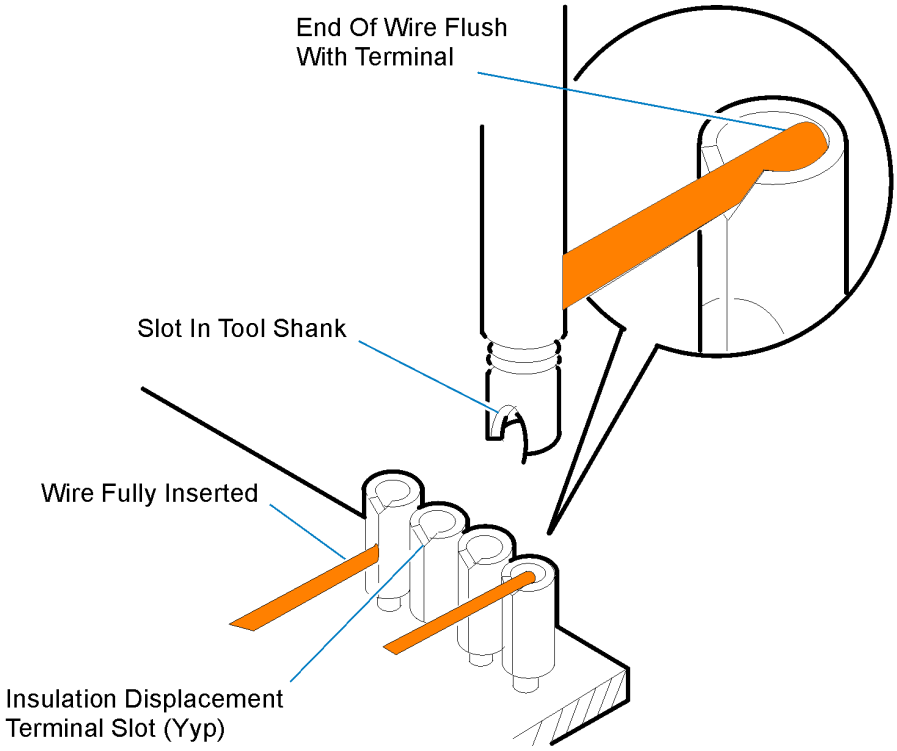
NCR Wall Box and Cable

Signal	Terminal/Color	RJ-45 Pin/Color
	1 White/Blue	5 White/Blue
	2 Blue	4 Blue/White
Transmit (+)	3 White	1 White/Orange
Transmit (-)	4 Yellow	2 Orange/White
Receive (+)	5 Red	3 White/Green
Receive (-)	6 Black	6 Green/White
	7 White/Brown	7 White/Brown
	8 Brown	8 Brown/White

7. Insert wires into the insulation displacement terminals:
   a. Place the wire over the terminal slot with the end of the wire touching the back inside wall of the terminal.
   b. Position the tool on the terminal so that the wire enters the slot in the tool shank.
   c. Press straight down on the tool handle until the tool stop bottoms on the terminal. Remove the tool from the terminal. DO NOT tilt or twist the tool as this may break off the insulation displacement terminal.

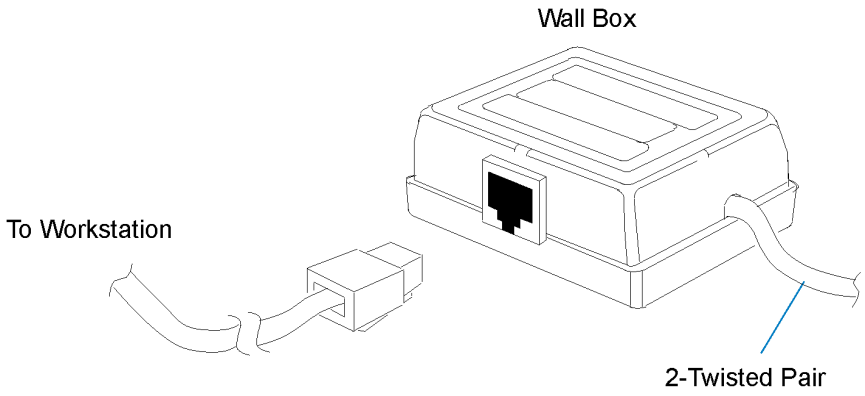
Note: If you are using shielded cable, the cable shield must not be exposed to the outside of the wall box.

8. Position the cable carefully inside the base and snap the plastic cover in place. The cover provides both strain relief for the cable and protection for the PC board.



Step 4: Connecting the Workstations to the Wall Boxes

1. Connect the NCR workstations according to the plan prepared by the system analyst.
2. Plug one end of the workstations drop cable into the wall box and the other end into the workstation.



Step 5: Powering Up

1. Power on the in-store processor and the workstations.
2. Confirm that all hub link integrity LEDs in use are lighted, indicating connection.
3. Confirm that the workstations are functioning.

Testing Ethernet In-store Wiring

This section contains information that is to be used to test the Ethernet in-store wiring for proper installation.

There are three types of Ethernet wire tests that are intended to ensure that the transmit and receive pairs are correctly installed and do not exceed the maximum permissible cable length:

CASE A: Transmit Pair Continuity Tests

CASE B: Receive Pair Continuity Tests

CASE C: Phasing Between Transmit Pair and Receive Pair

There are two types of Ethernet wire tests that check the phasing of the transmit pair and the receive pair.

CASE D: Transmit Pair Phasing

CASE E: Receive Pair Phasing

Included in this section are assembly instructions for special wall boxes and instructions for their use in combination with ohmmeters to test Ethernet wire.

To construct these boxes, you need to use two standard Ethernet wall boxes (Wall Box Feature Kit 1008-A077).

To modify these boxes, you need the following equipment:

Quantity	Item	Part Number
1	Wire Insertion Tool	NCR P/N 603-9009892 or AMP 552714-3
6" (14.5cm)	#22 AWG wire	
2	76 cm (2.5 ft) patch cord	D8W
3	Wall boxes	NCR 1008-A077 (250-0034057)
3	1N4001 diodes	NCR 007-9812817 or Radio Shack 276-1101
Misc	. Store Ethernet wiring chart	

Note: Proper wire phasing can also be determined by noting the wire color coding as connected to the Y and BK and the BU and R connectors in the junction and wall boxes.

Note: An analog meter is easier to work with when looking for diode polarity. Digital meters may give conflicting results when in the ohms range. Some digital meters have a special diode range that measures open line in the reverse direction and forward voltage in the other. This type of digital meter range is preferred.

Building a Wall Box for Tests A - C

To build a wall box to test for transmit/receive pair continuity and transmit/receive phasing, for test cases A through C, you need the following items:

- Insertion tool
- two pieces of #22 AWG wire 8 cm (3 in.) long
- Two wall boxes
- One 1N4001 diode
- Two 47 cm (18 in.) patch cords

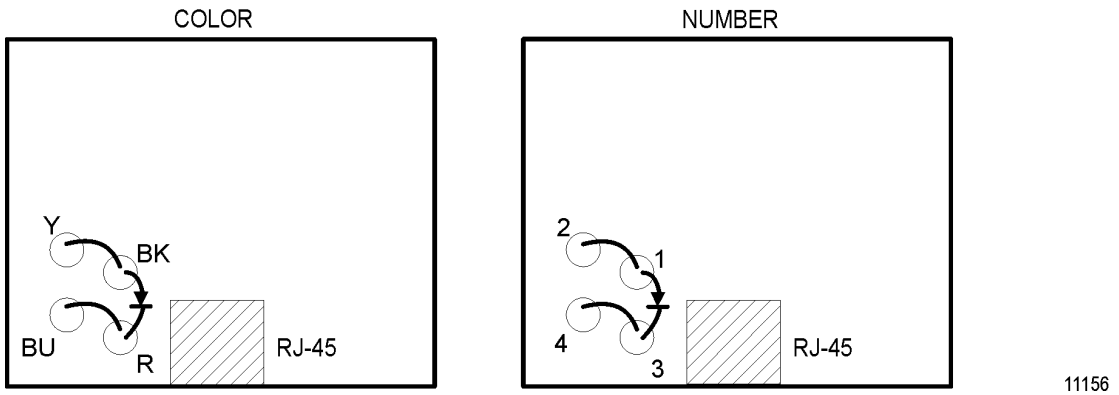
Modify the box as follows:

1. Remove the cover of the wall box.

   The wall labeling of the insulation displacement terminals on the PC board in the wall box may be either by number or color.

Terminal	Marking Signal
1 or BK	Transmit (+)
2 or Y	Transmit (-)
3 or R	Receive (+)
4 or BU	Receive (-)

2. Using the wire insertion tool, connect one of these 8 cm (3 in.) wires from Bk (#1, Tx+) to Y (#2, Tx-).
3. Connect the other wire from R(#3, Rx+) to BU(#4, Rx-).
4. With the insertion tool, connect the anode of a diode to BK (#1, Tx+) and the Cathode to R (#3, Rx+).

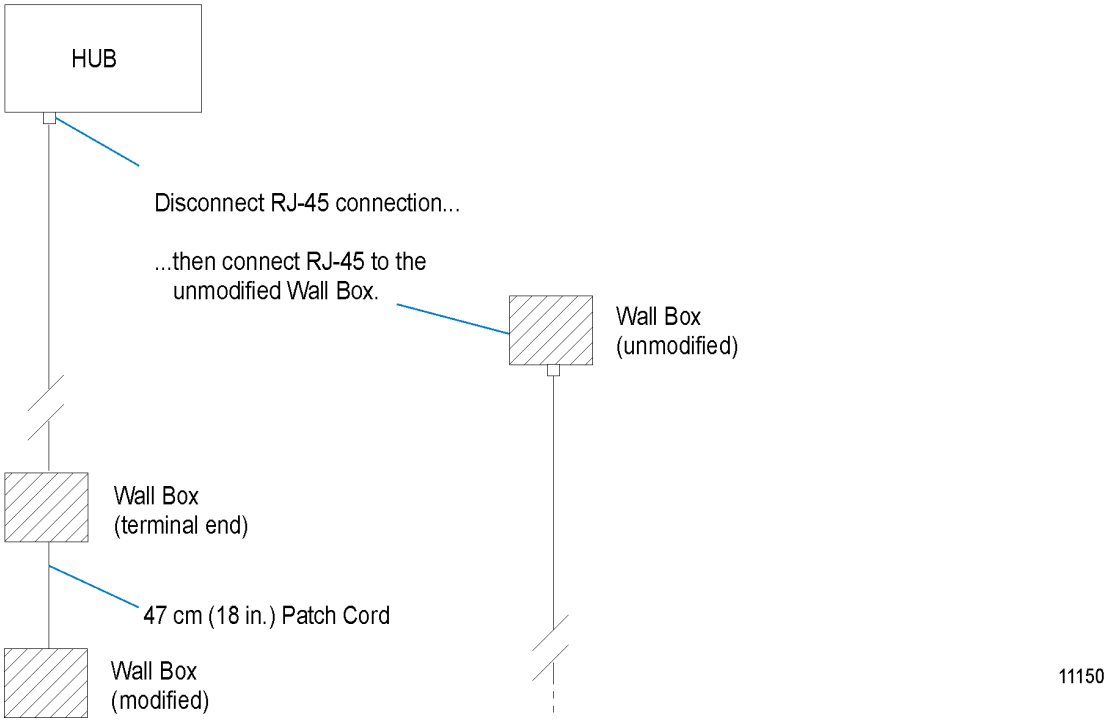


Tests A - C for Transmit/Receive Pair Continuity and Phasing

This section details the test procedure for Transmit/Receive Pair Continuity and Transmit/Receive Phasing testing, test cases A through C.

Follow the instructions below to perform the tests:

1. Using one of the 47 cm (18 in.) patch cords, connect this modified wall box to the previously installed terminal end wall box of the line you wish to test.
2. Connect a second wall box (with the cover removed and no wires connected to the insulation displacement terminals) directly to the RJ-45 terminated cable which plugs into the hub at the other end of the line you wish to test. The complete connection should look like that in Figure 3-16.



3. Determine whether the installation is a 100 percent NCR-recommended Ethernet system or one that uses non-NCR wire and/or equipment. It is necessary to identify the type of Ethernet system since different system configurations have different allowable cable lengths.

With your ohmmeter in the ohm range, perform the appropriate test below:

Case A: Tests to measure the continuity in the transmit pair

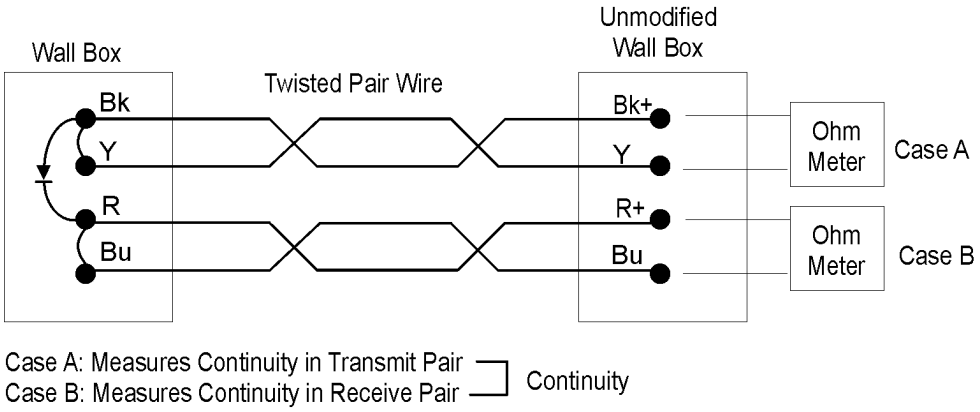
Measure the resistance between the BK (#1) and Y (#2) terminals at the wall box at the end of the line you are testing.

The resistance levels should be in the range of the table shown in Figure 3-19. Refer to Figure 3-17 for arrangement of wall boxes and ohm meter probes.

Case B: Tests to measure the continuity in the receive pair

Measure the resistance between the R (#3) and BU (#4) at the wall box t the end of the line you are testing.

The resistance values should be in the range of the table shown in Figure 3-19. Refer to Figure 3-17 for the arrangement of wall boxes and ohmmeter probes.

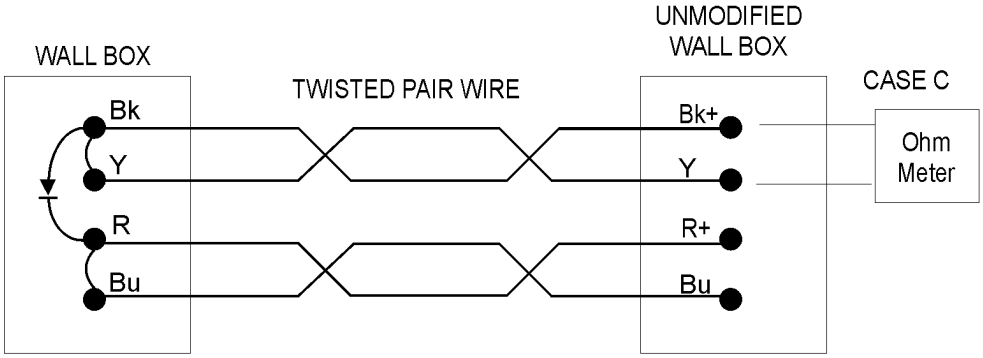


Note: Intermediate Connections between wall boxes not shown.

11151

Case C: Test the phasing between transmit pair and receive pair

At the wall box from which you are testing, measure the resistance between BK (#1) and R (#3) with the positive meter probe on the BK terminal. Use the meter to look for the low forward resistance of the diode with this polarity. If a high resistance is observed, the lines are reversed or there is an open line. Resistance level guidelines are not valid when measuring a diode.



CASE C: Test phasing between transmit Pair and Receive Pair

NOTE: Intermediate Connections between wall boxes not shown.

11152

Wire Type	Maximum Cable Length	Max Resistance Per Conductor of 304.8 m (1000 ft) of Cable	Max Resistance (for Maximum Cable Length)
AT&T 1061	100 m (328.1 ft)	28.6 ohms	18.76 ohms
AT&T 1010	50 m (164.0 ft)	28.6 ohms	9.38 ohms
Other 50 m	(164.0 ft)	28.6 ohms	9.38 ohms

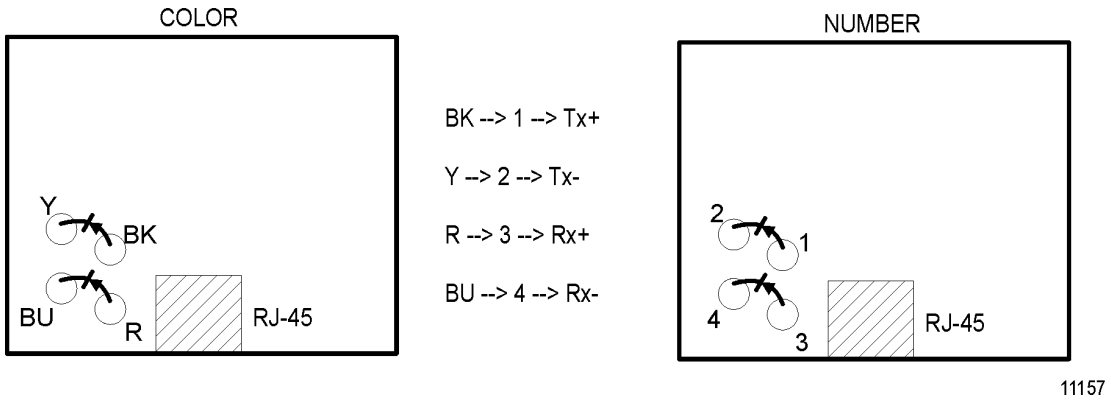
Building a Wall Box for Test D - E

To build a wall box to test for transmit/receive pair phasing, you need the following items:

- Insertion tool
- Two wall boxes
- Two 1N4001 diodes (NCR P/N 007-9812817)
- Two 47 cm (18 in.) patch cords

Assemble the box in the following manner:

1. Remove the cover of the wall box.
2. The PC board coding of the insulation displacement terminals is either by number or by color, as shown earlier in Figure 3-11.
3. Using the wire insertion tool, connect the anode of a diode to Bk (#1, Tx+) and the cathode to Y (#2, Tx-).
4. Connect the anode of the other diode to R (#3, Rx+) and the cathode to BU (#4, Rx-). Figure 3-20 shows the modified wall box.



To use this box to test a particular line:

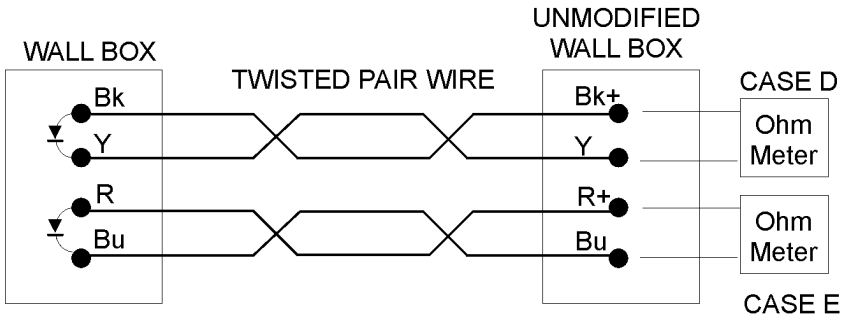
1. Using a patch cord, connect the modified wall box to the workstation end wall box.
2. At the other end (See Figure 3-21) connect the second wall box directly to the RJ-45 terminated cable which plugs into the hub.

Case D: Tests for transmit pair phasing

At the wall box at the hub end, with the positive meter probe on BK and the negative probe on the Y, the resistance should be low.

Case E: Tests for receive pair phasing

At the wall box at the hub end, with the positive meter probe on R and the negative probe on BU, the resistance should be low. Swap the wires BK to Y and Y to BK, and so forth, if a high resistance or open line is observed.



CASE D: Transmit Pair Phasing
CASE E: Receive Pair Phasing

NOTE: Intermediate Connections between wall boxes not shown.

11154

Chapter 4: Ethernet 100Base-T

Ethernet 100Base-T (also referred to as 100Base-TX or Fast Ethernet) is an extension of the 10Base-T standard for increased data rate that multimedia intensive applications require.

Physically, 100Base-T is similar to 10Base-T. However, there are restrictions on material and equipment selection that must be adhered to in order for 100Base-T to operate properly. Also, there are limitations on the network size

Note: Even if you do not plan to install 100Base-T Ethernet initially, it is strongly recommended that all new 10Base-T network installations be designed for 100Base-T compatibility. This permits future upgrade without the expense of rewiring.

This section shows the assembly, mounting, wiring, and power-up sequence of the hardware and wiring that may be used in an Ethernet 100BASE-T LAN. It is not intended to explain Ethernet and its many possible configurations.

Before installing any Ethernet component, pay particular attention to the individual warnings about accessibility and protection of each piece of hardware.

Hardware Requirements

Ethernet 100BASE-T is only available on the following NCR retail platforms:

- NCR 7452/7453: Ethernet on the processor board (AMD Controller)
- NCR 7401/7454: Ethernet on the processor board (Intel Controller)

  The 7401/7454 terminals can be connected to either 100Base T or 10Base T networks. The speed is selected automatically through an auto-negotiation process. If the hub or other device connected to the terminal does not support auto-negotiation, then the terminal may not select the correct operating speed. In this case, you must manually select the correct speed using the appropriate driver utilities for the terminal operating system.

Note: The 7401/7454 terminals have link integrity LEDs and 10/100 Mb/s speed LEDs that are used to determine proper link connection.

If you want to use other types of terminals than those listed above, then you must use Ethernet adapters that comply to the IEEE 802.3u standard. All adapter boards must have a PCI interface.

Category 5 Wiring

In order to use 100Base T Ethernet, all cabling must be rated EIA/TIA 568, Category 5. This cable has improved attenuation and crosstalk characteristics compared with traditional 10Base T cabling, which is usually Category 3. Category 5 cable is labeled on its outer jacket.

Note: In addition to the cable, all jacks, patch panels, and tap boxes must also be Category 5 rated.

Category 3 wiring, sometimes called voice grade, exists in many existing 10Base T installations, but does not support 100Base T.

Network Layout Guidelines

Length of Network Links - Each network link (from hub to terminal) can be a maximum of 100 m (325 ft.) in length.

Number of Hubs - There can be only two wire segments and one hub between any two terminals (2/1 rule). A wire segment includes all of the circuit elements that provide the physical electrical connection between workstations and hubs. For example, a wire segment can include drop cables, wall boxes, in-store wiring, jack panels, and patch cords. Therefore, the diameter of the entire network is limited to 200 m (650 ft.). Hubs cannot be nested to gain ports as can be done in 10Base T networks, i.e. links from hub to hub. To accommodate for this restriction, many 100Bast-T Ethernet hubs have large numbers of ports.

Stackable Hubs – Stackable hubs permit starting with 8 or 12 100Base T ports and then expanding to as many as 80 or more ports. This method does not violate the one-hub rule.

Large Networks – 100Base-T network configurations of more than 40 terminals is not certified by NCR. Before configuring a large network you should test the application to validate that there is sufficient bandwidth available in the network and servers. Remember to consider future needs. It may be necessary to locate multimedia-intensive terminals (i.e. video promotions) on a separate network from networks that demand fast response times (i.e. POS terminals).

Mixing 10 Mb/100 Mb Terminals - It is not possible to mix terminals that are running 10Base T (10 Mb/s) and those running 100Base T (100 Mb/x) on the same hub. Certain Ethernet switches permit a mix of speeds (see below), however these switches are very expensive. Evaluate the cost of upgrading any existing 10 Mb/s terminals to 100 Mb/s before deciding to purchase a dual speed switch.

Dual Speed Switches – Switches operate differently than do hubs. Hubs repeat all network traffic to all terminals on the network. Switches direct the traffic to specific terminals. All terminals on the network can receive/transmit simultaneously, without collisions. Thus the full 100Mb/s bandwidth is available to all ports.

The full benefit of switches is realized only if the network servers can handle the load. Switches with a 1 Gb/s server port, or support for both 10 Mb/s and 100 Mb/s terminals, are expensive but do offer superior performance to hubs in many applications. Hubs can be installed initially and then upgraded to switches.

Mixing 100Base T Network Variations – Terminals must be connected to a IEEE 802.3u 100Base TX hub or switch. Other network variations, such as 100Base VG and 100Base T4, do not operate with 100Base TX.

Connecting Twisted Pairs - When connecting twisted pairs to wall boxes or patch panels, each pair may be untwisted a maximum of one inch.

Appendix A: **IEEE Standards**

The following Standards can be ordered from IEEE Committee Members at this address:

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

345 EAST 47TH STREET

NEW YORK, NEW YORK 10017

IEEE 802.3i - 1990 “Twisted-Pair medium attachment Unit (MAU) and baseband medium, Type 10BASE-T”.

ISO/IEC 8802-3 (ANSI/IEEE 802.3) "Carrier Sense Multiple Access With Collision Detection (CSMA/CD) Access Method And Physical Layer Specification", Third Edition 1992-03-20.

IEEE 802.3u – 100Base T Standard

Appendix B: Hardware & Cable Part Numbers

10BASE-2 Hardware

The following chart shows the approved hardware for Ethernet 10BASE-2 installations.

Hardware	Part No.
Connector BNC, Jack to Jack	006-0087030 AMP 31-219
Connector BNC, Plug RG-58, (Solderable)	006-0087031 AMP 31-3301
Connector BNC, Plug RG-58, (Dual Crimp)	998-0717342 AMP 6-727079-1
Connector BNC, L	006-8600307 AMP 329517
Connector BNC, T	006-0089744 AMP 31-008
Terminator, 50 ohm	006-0087028 AMP 46650-51
Thin Coaxial Cable, 50 ohm, RG-58C/U, Type PVC	006-0084381 1144-C000-xxxx Belden 9907
Thin Coaxial Cable, 50 ohm, RG-58C/U, Type FEP	006-0084380 1146-C000-xxxx * Belden 89907
Coaxial Cable Stripper	603-9012368 AMP 603995-1
Coax Crimper (for crimp connector)	603-p9012369 AMP 220190-1
Crimper Die (for crimper)	603-9012370 AMP 220189-1

* Bulk cable may be ordered by specifying the length (xxxx) in meters and tenths (0025 = 2.5 meters).

10BASE-T Hardware

The following chart shows the approved hardware for Ethernet 10BASE-T installations.

Hardware	Part Number
AT&T StarLAN 10 Network Hub Unit	Model No. 4261-1001-0000
AT&T 451A Adapter (connects two modular cords)	103-7862400
NCR Ethernet Device Drop Cable	497-0008623 (7054 only) 497-0008905 (7052 only)
Wall Box: NCR 1008-A077 AT&T WE 103A	 250-0030764 105 164 8180
AT&T SYSTIMAX twisted pair cable	Type 1061
AT&T SYSTIMAX twisted pair cable	Type 1010
Insertion Tool (for NCR wall box) NCR AMP	 603-9009892 552714-3

Appendix C: System Map Template

Hub _____ of _____

Hub Port	Device/Terminal#	Location	Ethernet ID
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			