TRANSITION NETWORKS' POCKET SWITCH
TECHNICAL SPECIFICATIONS

Standards

IEEE 802.3, IEEE 802.3u

Dimension

4.75" X 5.75" X 1.0"   (120mm x 146mm x 25mm)

Power Supply

NOTE: Replace power supply only with the equivalent input rating (see below) and output rating (regulated 12VDC at 1.5 A).

TN PN	Requirement	Location
3507	240 volts, 50 hertz	United Kingdom
3342	230 volts, 50 hertz	Europe
3340	120 volts, 60 hertz	USA/Canada/Mexico
3346	100 volts, 50-60 hertz	Japan
3511	240 volts, 50 hertz	Australia
3537	(with power cord: 3522)	South Africa

Environment

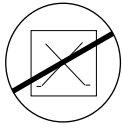|	
Temperature:	0-50°C (32° to 122° F)
Humidity	10-90%, non condensing
Altitude	0-10,000 feet

Warranty

Lifetime

Transition Networks'
Pocket Switch
(E-PSW-TX-02, E-PSW-FX-02)

33015.B

For assistance in installing, using, or maintaining the TRANSITION Networks Pocket Switch, contact TRANSITION Networks Technical Support at:

(800) 260-1312

or contact your local distributor.

CAUTION: RJ connectors are NOT INTENDED FOR CONNECTION TO THE PUBLIC TELEPHONE NETWORK. Failure to observe this caution could result in damage to the public telephone network.

Der Anschluss dieses Gerätes an ein öffentlickes Telekommunikationsnetz in den EG-Mitgliedstaaten verstösst gegen die jeweligen einzelstaatlichen Gesetze zur Anwendung der Richtlinie 91/263/EWG zur Angleichung der Rechtsvorschriften der Mitgliedstaaten über Telekommunikationsendeinrichtungen einschliesslich der gegenseitigen Anerkennung ihrer Konformität.

Compliance Information
UL Listed
C-UL Listed (Canada)
CISPR/EN55022 Class A

FCC Regulations

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at the user's own expense.

Canadian Regulations

This digital apparatus does not exceed the Class A limits for radio noise for digital apparatus set out on the radio interference regulations of the Canadian Department of Communications.

European Regulations
Warning

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Copyright Restrictions

Trademark Notice

100BASE-FX Cable and Connector Specifications

The physical characteristics of the 100BASE-FX cable must meet or exceed IEEE 802.3u 100BASE-FX specifications.

100BASE-FX CABLE SPECIFICATIONS

Fiber Optic Cable Recommended:	62.5 / 125 μm multimode fiber
Optional:	100 / 140 μm multimode fiber
	85 / 125 μm multimode fiber
	50 / 125 μm multimode fiber

Fiber Optic Transmitter Power:

Average power:	-19.0 dBm

Fiber Optic Receiver Sensitivity:

Average sensitivity:	-33.5 dBm
Bit error rate:	$\leq 10^{-10}$

Maximum Cable Distance

Half-Duplex

Collision Domain:	412 meters (1375 feet)
Full-Duplex Link:	2000 meters (6500 feet)

100BASE-FX CONNECTOR CHARACTERISTICS:

One (1) *transmit* and one (1) *receive* ST connector.

ETHERNET CABLE SPECIFICATIONS

10BASE-T/100BASE-TX Cable and Connector Specifications

The physical characteristics of the 10BASE-T /100BASE-TX cable and connectors must meet or exceed IEEE 802.3/802.3u specifications.

10BASE-T CABLE SPECIFICATIONS

Category 3 wire or better is required; category 5 wire (See 100BASE-TX) is recommended. Either shielded twisted pair (STP) or unshielded twisted pair (UTP) can be used. DO NOT USE FLAT OR SILVER SATIN WIRE.

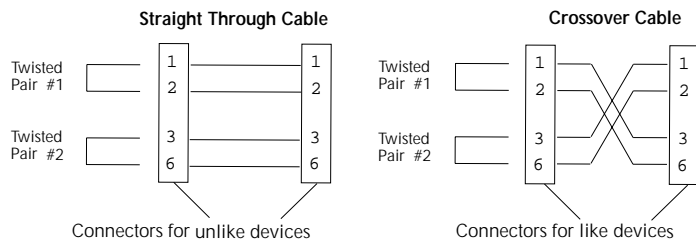| **Category 3:** | Gauge | 24 to 22 AWG |
	Attenuation	28 dB/1000′ @ 10 MHz
	Impedance	100 Ω ±10% @ 10 MHz
Maximum Cable Distance:		100 meters (330 feet)

100BASE-TX CABLE SPECIFICATIONS

Category 5 wire or better is required. Either shielded twisted pair (STP) or unshielded twisted pair (UTP) can be used. DO NOT USE FLAT OR SILVER SATIN WIRE.

Category 5:	Gauge	24 to 22 AWG
	Attenuation	20 dB/1000′ @ 10 MHz
	Impedance	100 Ω ±10% @ 10 MHz
Maximum Cable Distance:		100 meters (330 feet)

10BASE-T/100BASE-TX CONNECTOR CHARACTERISTICS:

The two active pairs in a 10BASE-T/100BASE-TX network are pins 1 & 2 and pins 3 & 6. Use only dedicated wire pairs (such as blue/white & white/blue, orange/white & white/orange) for the active pins. 10BASE-T /100BASE-TX cable for unlike devices (such as hub to terminal device) must be configured as straight through; 10BASE-T/100BASE-TX cable for like devices (such as hub to hub or terminal device to terminal device) must be configured as crossover.

Straight Through Cable — Connectors for unlike devices
Crossover Cable — Connectors for like devices

Table of Contents

1. INTRODUCTION

This guide is intended for the system or network administrator responsible for installing and monitoring a Transition Networks' pocket switch. A working knowledge of local area network (LAN) operations, including familiarity with communications protocols used on interconnected LANs, is assumed.

Transition Networks' Pocket Switches

Transition Networks' pocket switches (E-PSW-TX-02 and E-PSW-FX-02) provide a smooth network migration from legacy Ethernet™ 10BASE-T to Fast Ethernet 100BASE-TX or 100BASE-FX, supporting increasing network demands through incremental upgrades to existing network investments.
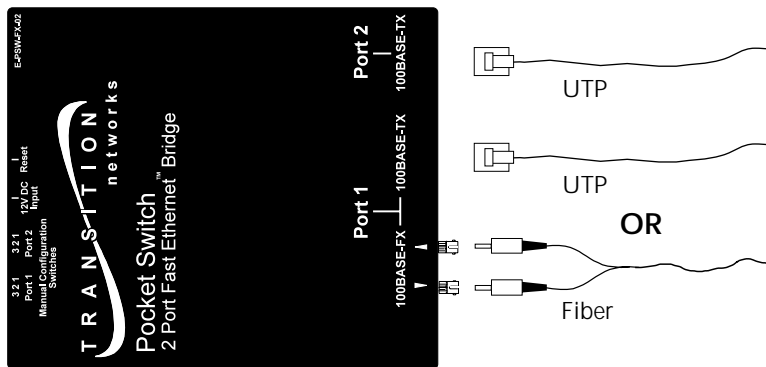
Features

- Supports a full Ethernet segment on each port
- Adheres to current and emerging IEEE802.3 and IEEE802.3u Ethernet standards
- Provides two ports with selectable 10BASE-T or 100BASE-TX
- E-PSW-FX-02 provides one port with selectable 100BASE-FX
- Supports full- or half-duplex operation on both ports
- Provides selectable auto-negotiation for detecting and adapting to line speed/operation mode of attached device on each port
- Provides wire-speed switching for same-speed transfers
- Provides packet buffers for high performance
- Supports self-learning of MAC addresses

The sole purpose of this remedy shall be provided the customer with the replacement or repair of non-conforming goods in the manner described in this Warranty statement. This exclusive remedy shall not be deemed to have failed of its essential purpose so long as TN is willing and able to repair or replace the defective item(s) or refund the purchase price.

TN reserves the right to inspect products claimed to be defective under warranty either at the customer's location or at TN's plant. TN assumes no liability for liability charges incidental to the adjustment, service, repairing, removal or replacement of the product, or other costs, or the expense of repairs made outside of its factory, except when made with TN's prior written consent. Additionally, Transition Networks reserves the right to charge for all testing and shipping incurred, if after testing, a return is classified as "No Problem Found".

TN's total liability in connection with the products and their installation to all persons and from all causes in the aggregate, whether in contract, tort, or strict liability, shall not exceed the amount paid to TN for the product directly related to the alleged damage. However, in no event shall TN have any liability to a customer or any third party for products manufactures according to the customer's specifications.

C. Return Procedure

The customer must follow this procedure for the return of defective items:
1. Locate the serial number(s) of the item(s) to be returned.
2. Determine the date the item(s) was received.
3. Contact Transition Networks Technical Support to determine if the problem can be corrected on site.

If not, and the product is covered by warranty, then:
- Call the distributor directly or contact TN.
- Request a Return Material Authorization (RMA).
- Ship the item, prepaid in original packaging to Transition Networks at the above address.
- Include the RMA number on the outside of the carton and/or on the Packing List.
- Include a copy of the RMA form.
- Include a copy of the original invoice or packing list (if possible) to expedite processing.
- The item(s) may be shipped by the customer or the distributor.
- Transition Networks will repair or replace the unit, at TN's discretion, and cover the cost of the return freight to the distributor or to the customer, whichever requested the RMA number.

If the item(s) was received **more than five years ago**, or if the item(s) is **no longer covered by warranty** for other reasons, then:
- Call the distributor or contact TN.
- Request a Material Repair Authorization number (MRA).
- Ship the item(s), prepaid, in the original packaging to Transition Networks at the above address.
- Include the MRA number on the outside of the carton add/or on the Packing List.
- Include a copy of the MRA form.
- Include a copy of the original invoice or packing list (if possible) to expedite processing.
- Only the customer (end-user) may send the items(s) to TN.
- TN will contact the customer after the item(s) have been received, inspected, and a cost estimate of the repair determined.
- The repair charges may be billed, with customer's approval, though the distributor, or on a prepaid or C.O.D. basis directly to the customer. The charges will include the cost of shipping.

The return authorization numbers are valid only for 90 days from the date issued.

The Evolving Ethernet Network

Installing one Transition Networks' pocket switch alone improves network performance. Installing additional Fast Ethernet equipment (and, optionally, installing additional Transition Networks' pocket switches) can optimize network performance.

A network evolution from legacy Ethernet to legacy Ethernet and Fast Ethernet that is based entirely on the Transition Networks' E-PSW-FX-02 pocket switch might be:
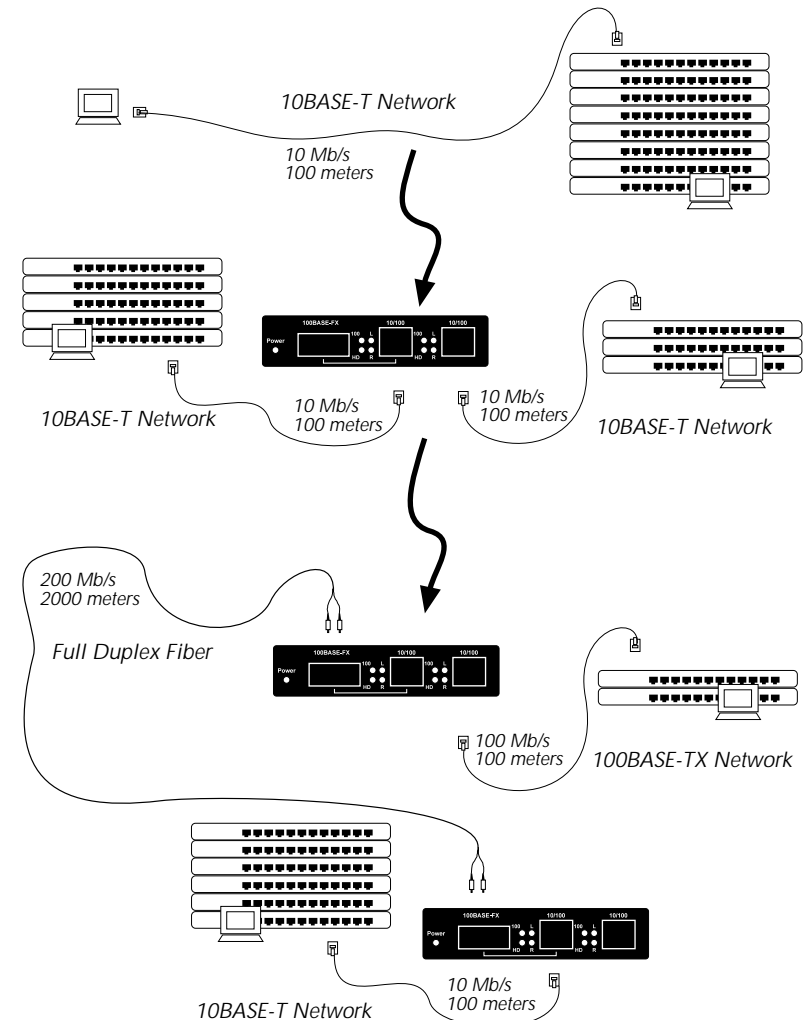
Network Flexibility

The Transition Networks' pocket switch can assist a network administrator in maintaining existing resources as the network evolves from shared legacy 10Mb/s Ethernet to switched 100Mb/s Fast Ethernet because a pocket switch can function as :

- A 2-port bridge in the legacy 10BASE-T environment
- A connection between the legacy 10BASE-T environment and the evolving Fast Ethernet 100BASE-TX /100BASE-FX environment
- A 2-port bridge in the Fast Ethernet 100BASE-TX /100BASE-FX environment.

Standards-Based

Transition Networks' pocket switches are designed and built according to accepted and evolving Ethernet standards. The *IEEE 802.3 Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*, which applies to 10BASE-T, has been adopted by the International Organization for Standardization (ISO). IEEE 802.3u is the extension of IEEE 802.3 to 100BASE-X.

Protocol Compatible

As devices functioning on the OSI MAC layer, Transition Networks' pocket switches are protocol independent and therefore totally compatible with IEEE 802.3, IEEE 802.3u, TCP/IP, NetWare, DECnet and XNS protocols. No software installation is required. Protocol compatibility allows cost-effective network migration with maximum use of existing equipment, cabling infrastructure, network management systems, and MIS expertise.

Pocket Switch Operation

The Transition Networks' pocket switch is an Ethernet network device integrated into the legacy Ethernet network that adapts selectively to the Fast Ethernet network by examining all incoming data packet frames for the destination address and quickly determining the appropriate output port and mode (half-duplex or full-duplex) for the packet.

5. MAINTENANCE

WARNING: DO NOT, UNDER ANY CIRCUMSTANCES, attempt to repair the Transition Networks' pocket switch. Failure to observe this warning could result in personal injury or death from electrical shock.

NOTE: Failure to observe the above warning will immediately void the warranty.

Fault Isolation

1. Is the power LED on the switch illuminated?
   NO
   - Is the power adapter the proper type of voltage and cycle frequency for the AC outlet?
   - Is the power adapter properly installed in the switch and in the outlet?
   - Contact Technical Support.

   YES
   - Proceed to step 2.

2. Is the Link LED illuminated on a port with twisted-pair installed?
   NO
   - Check UTP cables for proper connection/pin assignment.
   - Contact Technical Support.

   YES
   - Proceed to step 3.

3. Is the Link LED illuminated on a port with fiber installed?
   NO
   - Check fiber cables for proper connection.
   - Verify that TX and RX cables are connected to RX and TX ports, respectively, on 100BASE-FX device.
   - Refer to Tech Tips available at: http://www.transition.com
   - Contact Technical Support.

   YES
   - Contact Technical Support.

Technical Support Contact

(800) 260-1312/(800-LAN-WANS

4. OPERATION

The Transition Networks' pocket switch requires no operator intervention beyond occasionally monitoring LED status indicators.

Power LED Indicator

Port 2 LED Indicators

Port 1 LED Indicators

POWER   Steady green LED indicates connection to external AC power.

NOTE: The port LED indicators provide separate data for each port.

100 (MB/S)   Steady green LED indicates that port transmits and receives at 100 Mb/s.

L(INK)   Steady green LED indicates port link connection is active.

H(ALF) D(UPLEX)   Steady green LED indicates port sends and receives data simultaneously over same cable.

R(ECEIVE)   Blinking green LED indicates port is receiving data.

Connectors, Switches, and Indicators

Port 1 100BASE-FX Connector

Port 1 10BASE-T/100BASE-TX Connector

Port 2 10BASE-T/100BASE-TX Connector

Power LED Indicator

Port 2 LED Indicators

Port 1 LED Indicators
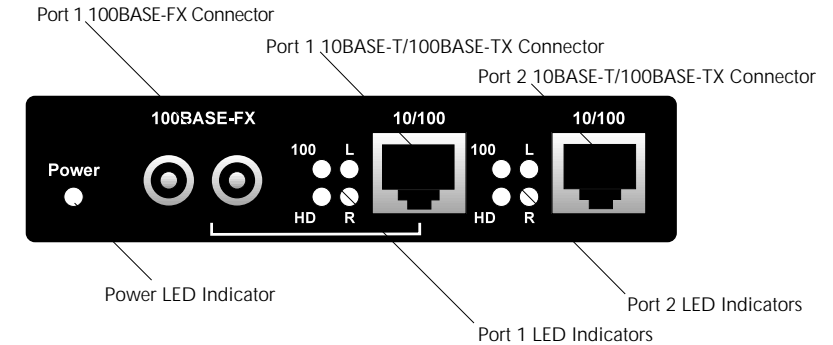
Connectors

ON PORT 1   One (1) 10/100Mb/s RJ-45 twisted-pair connector AND (E-PSW-FX-02 only) one (1) 100Mb/s ST fiber connector pair

ON PORT 2   One (1) 10/100Mb/s RJ-45 twisted-pair connector

LED Indicators

POWER   Steady green LED indicates connection to external AC power.

NOTE: The port LED indicators provide separate data for each port.

100 (MB/S)   Steady green LED indicates that port transmits and receives at 100 Mb/s; dark LED indicates 10 Mb/s.

L(INK)   Steady green LED indicates active port link connection.

H(ALF) D(UPLEX)   Steady green LED indicates half-duplex mode; dark LED indicates full-duplex mode.

R(ECEIVE)   Blinking green LED indicates port is receiving data.

Switches (at surface opposite connectors)

DIP   Allows selection, for each port, of operating speed and mode or selection of Auto-Negotiation.

RESET   Resets hardware to initial operating condition.

Increasing Bandwidth by Segmenting 10BASE-T Collision Domain

The Transition Networks' pocket switch adapts to the fact that each Ethernet network device (station) is connected independently to the shared Ethernet signaling system, called the network medium. Each station transmits serially over the shared medium to **every other attached station**. Access to the medium is determined by a medium access control (MAC) mechanism in the Ethernet interface of the station.

The Ethernet CSMA/CD Protocol

The Ethernet medium access control mechanism is based on the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol. Under the CSMA/CD protocol, each station waits until there is no signal on the channel (Carrier Sense) and then begins transmitting (Multiple Access). Since signals take a finite time to travel from one end of an Ethernet network to the other, the first bits of a transmitted frame do not reach all parts of the network simultaneously. Two stations could sense that the network is idle and start transmitting frames simultaneously. When this happens, the Ethernet system senses the signal "collision", stops the transmission, and resends the frames (Collision Detection). Thus, a collision domain is a single CSMA/CD network in which a collision will occur if two network stations transmit at the same time.

Ethernet Switching

The Transition Networks' pocket switch can improve network performance by breaking the large CSMA/CD collision domain into two separate collision domains (called segments). Network segmentation is achieved by regulating the *number* of data signals sent among stations. Since the first two fields in an Ethernet data packet carry 48-bit source and destination addresses, the pocket switch scans the destination address on each packet header received on a port, searches a dynamic internal MAC routing table, and forwards the packet only if the data is intended for a station beyond the local collision domain. If the data is intended for a station on the collision domain from which the packet was received, the pocket switch discards (filters) the packet, since any signal on the local segment already has been received by all stations on that segment. Baseline network performance also is improved because switches do not forward collision signals or error packets from one collision domain to another.

Powering Transition Networks' Pocket Switch

To power ON the Transition Network's pocket switch:

1. Locate the power receptacle on the back of the Transition Network's pocket switch

2. Connect the Transition Network's pocket switch power connector end of the power supply adapter to the power receptacle on the back of the Transition Network's pocket switch.

3. Connect the external power connector end of the power supply adapter to external AC power.

NOTE: After the power supply adapter is connected to the Transition Network's pocket switch and to external power, the green **Power** LED is illuminated.

Installing Network Cable (continued)

Connecting Fiber Cable to TX/RX Connectors

(100BASE-FX)

Effective cable distances are determined by ambient RF noise and by signal loss in the cable. Since fiber has a low signal loss/meter and is invulnerable to RF noise, fiber can be used to extend distances.

OPTICAL POWER LOSS BUDGET

An 11dB loss budget, as measured by a fiber optic power meter, is allowed **per link**. A typical performance rating for standard grade fiber operating at 1350 nm is approximately 1dB-2dB loss per 1000 meters of cable. Approximately 0.5dB-2.0dB loss per connection point is typical, depending on how well the connection has been made.

FAST ETHERNET COLLISION DOMAIN

NOTE: Installing full-duplex fiber cable avoids collision domain considerations and extends distances up to 2000 meters.

A Fast Ethernet collision domain can have ONLY **ONE** CLASS I repeater OR **TWO** CLASS II repeaters.

Refer to the 512-Bit Rule (page18) regarding Fast Ethernet collision domains before installing **half-duplex** 100BASE-FX cable (≤ 415 meters).

INSTALLING CABLE

To install 100BASE-FX cable:

1. Locate or build 100BASE-FX cables with the following characteristics:
   - 803.2u compliant (See page 28)
   - male ST transmit and receive fiber connectors installed at both cable ends.

2. At Transition Networks' pocket switch, connect transmit cable connector at one end of fiber cable to ST connector marked with an "outbound" arrow; connect receive cable connector to ST connector marked with an "inbound" arrow.

3. Connect cable installed at transmit (TX) connector of Transition Networks' pocket switch at receive (RX) connector of device at other end; connect cable installed at receive (RX) connector at transmit (TX) connector of device at other end of fiber cable.

When installed in a legacy 10BASE-T Ethernet network, the Transition Networks' pocket switch segments network traffic on the original 10Mb/s Ethernet collision domain into two distinct 10Mb/s Ethernet collision domains.
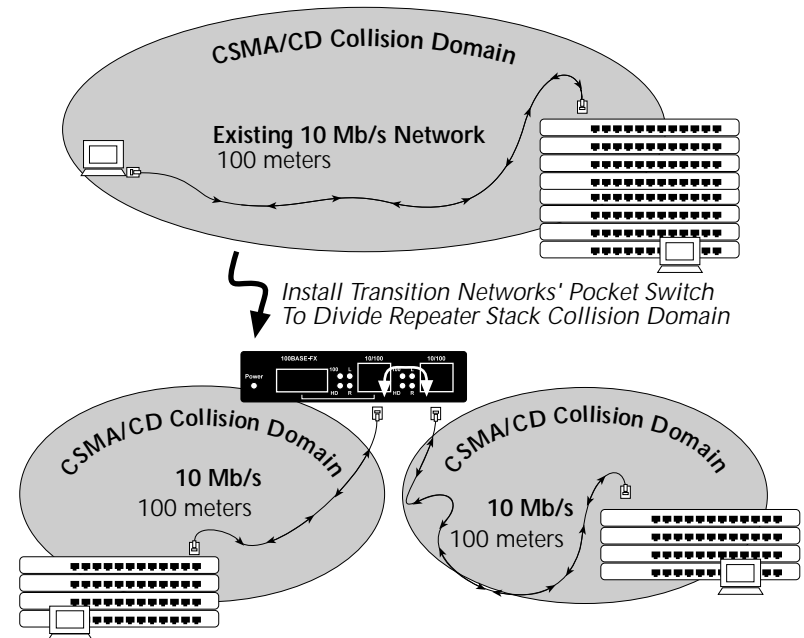
Ideally, the system administrator defines collision domain segments so that most traffic on each segment is local to the segment.

MAC Address Table

The dynamic internal routing table of the Transition Networks' pocket switch provides self learning capabilities for up to 8192 MAC addresses of incoming and outgoing packets. Once a network node address is stored in the MAC address table, data packets addressed to that node are sent directly. Packets whose destination address is on the same CSMA/CD collision domain as the packet source address are discarded by the pocket switch. NOTE: The MAC address table is volatile and disappears when the pocket switch is powered off or reset.

Doubling Bandwidth by Installing Full-Duplex

NOTE: The 10BASE-T specification requires two dedicated twisted copper wire pairs for data transmission and reception. This allows twisted pair copper cable to be used either in half-duplex or full-duplex mode.

Legacy CSMA/CD Ethernet is Half-Duplex

Legacy Ethernet is a half-duplex communications system in which data can be transferred in both directions but in which, at any given time, a station is *either* transmitting or receiving. (On the original Ethernet physical medium (coaxial cable) the same wire was used both for transmission and reception.) With the current 10BASE-T physical media (twisted pair), separate copper wire pairs are used for transmission and for reception. *Each station transmits to all stations and receives from all stations.* Since many devices share the medium, a device at the end of a half-duplex Ethernet link listens for other transmissions or for collisions when sending data, using the CSMA/CD protocol to prevent multiple simultaneous transmissions on the medium.

Microsegmented Ethernet Link is Full-Duplex

Installing full-duplex allows the station attached to the Transition Networks' pocket switch to both transmit and receive at the same time. In the microsegmented full-duplex switched Ethernet environment, each station is connected to one dedicated switch port. Only the attached station ever transmits to the switch (using the Transmit pair of the cable), and only the switch ever transmits to the attached station (using the Receive pair of the cable). There is never any contention for the use of the medium, as in a standard half-duplex Ethernet environment. Instead, both the station and the switch transmit at will, using both directions simultaneously.

One advantage of this approach is that the full-duplex link can theoretically provide twice the bandwidth of normal (half-duplex) Ethernet. Since there are only two devices on a full-duplex link, the link is not attempting to create a shared Ethernet channel capable of supporting multiple devices. Therefore, there is no need to adhere to the original Ethernet medium access control system. With no need to use the CSMA/CD medium access control mechanism to share the signal channel with multiple stations, a device at the end of a full-duplex Ethernet link does not have to listen for other transmissions or for collisions when sending data.

Connecting Twisted-Pair Copper Cable to RJ-45 Connector (10BASE-T/100BASE-TX)

Though Category 3 cable is adequate for the 10BASE-T installation, Category 5 cable is strongly recommended because Category 3 cable can NOT be used for a later upgrade to 100BASE-TX. (Refer to the cable specifications on page 27.)

10BASE-T AND THE ETHERNET COLLISION DOMAIN

- Refer to the 5-Segment Rule (page 17) before installing **half-duplex** 10BASE-T cable.

- Installing full-duplex twisted-pair cable avoids collision domain considerations; distances remain ≤ 100 meters.

100BASE-TX AND THE FAST ETHERNET COLLISION DOMAIN

- Refer to the 512-Bit Rule (page 18) before installing **half-duplex** 100BASE-TX cable.

- Installing full-duplex twisted-pair cable avoids collision domain considerations; distances remain ≤ 100 meters.

- A Fast Ethernet collision domain can have ONLY **ONE** CLASS I repeater **OR** ONLY **TWO** CLASS II repeaters.

INSTALLING CABLE

To install 10BASE-T or 100BASE-TX cable:

1. Locate or build 10BASE-T or 100BASE-TX cables with the following characteristics:
   - 803.2 (10BASE-T) or 803.2u (100BASE-TX) compliant (See pages 27, 28)
   - correct *Straight-through or Crossover* cable configuration for site installation (See page 19)
   - male RJ-45 plug connectors installed at both cable ends.

2. Connect male RJ-45 plug connector at one end of 10BASE-T or 100BASE-TX cable to Transition Networks' pocket switch RJ-45 jack connector.

3. Connect male RJ-45 plug connector at other end of 10BASE-T or 100BASE-TX cable to network device RJ-45 jack connector.

Installing Network Cable (continued)

Straight-Through/Crossover (10BASE-T /100BASE-TX)

The most popular wiring used today, unshielded twisted-pair copper cable, is used for 10BASE-T and for 100BASE-TX. As with 10BASE-T, the transmit and receive data signals on each pair of a 100BASE-TX segment are polarized, with one wire of each signal pair carrying the positive (+) signal, and the other carrying the negative (-) signal. The pin numbers used in the eight-pin connector for 100BASE-TX conform to the wiring scheme already in use in the 10BASE-T standard, so a 100BASE-TX board can replace a 10BASE-T board in a Category 5 wiring system without any wiring changes.

The straight-through/crossover rule that applies to 10BASE-T also applies to 100BASE-TX. The 10BASE-T and 100BASE-TX cable and RJ-45 jacks for **Switch to Terminal** connections must be configured as **straight-through**. The 10BASE-T and 100BASE-TX cable and RJ-45 jacks for **Switch to Hub** connections must be configured as **crossover**.

1 2 3 4 5 6 7 8

RJ-45 JACK

RJ-45 PLUG

8

1
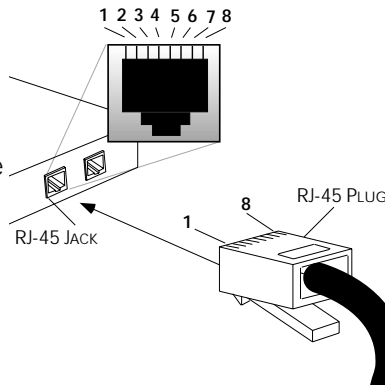
Straight-Through Cable
at RJ-45 Plug

Switch . . . .**PC, transceiver, NIC, printer**

RJ-45 Male . . . . .RJ-45 Male

  1 1
  2 2
  3 3
 6 6

The two active pairs in a 10BASE-T network are pins 1 & 2 and pins 3 & 6. Use only dedicated wire pairs (such as blue/white & white/blue, orange/white & white/orange) for the active pins.

The two wires in each pair of the cable must be twisted together for the entire length of the segment and kept twisted to within approximately 1/2 inch of any connector to ensure the integrity of the signal-carrying characteristics of the unshielded wire pair.

Crossover Cable
at RJ-45 Plug

Switch . . . .**Hub**

RJ-45 Male . . . . .RJ-45 Male

  1 3
  2 6
  3 1
  6 2

Eliminating CSMA/CD collisions on the segment by installing full-duplex cards at the network interfaces in a network with Category 5 cables already installed allows a minimum investment to effectively double the network collision domain diameter.

CSMA/CD Collision Domain

10 Mb/s
100 meters
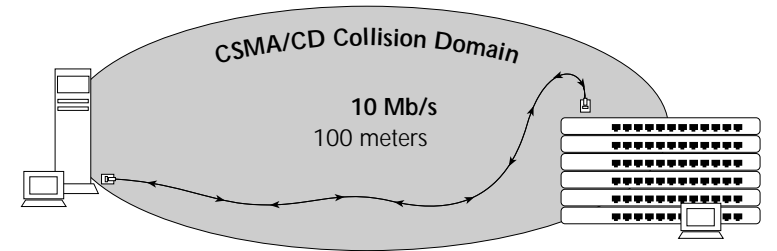
Install Transition Networks' Pocket Switch AND Install Full-Duplex 10BASE-T Card in Server For Collision-Free Full-Duplex Connection to Serve

Full Duplex Ethernet™ Link

20 Mb/s
100 meters

CSMA/CD Collision Domain

10 Mb/s
100 meters
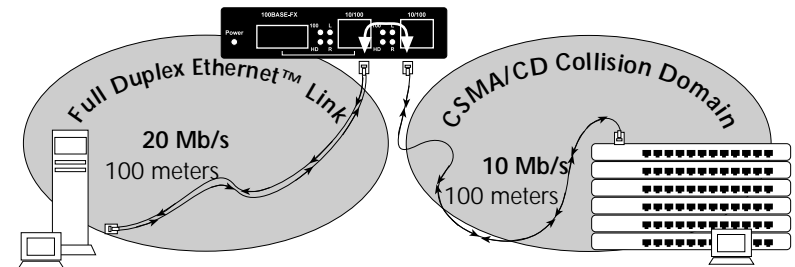
Application behavior determines if a station can take advantage of the increased network capacity of full-duplex. Typical applications do not use bandwidth symmetrically. File transfers, for example, are asymmetrical in nature; bulk data is transferred in one direction, with short acknowledgments returned in the reverse direction. A station which is only doing file transfers will not benefit from the doubling of bandwidth offered by full-duplex switching.

When multiple applications are using the network simultaneously on a single device, the benefits of full-duplex are apparent. Typically servers handle simultaneous network traffic to and from multiple workstations. While any given workstation is using the network asymmetrically, the server can take advantage of full-duplex operation to simultaneously handle transfers in from one station and out to another.

Increasing Bandwidth Ten-fold by Installing 100BASE-TX (Fast Ethernet)

Fast Ethernet, 100BASE-TX or 100BASE-FX on the Transition Networks' pocket switch, moves signals at 100 Mb/s, ten times faster than legacy Ethernet.

Legacy Ethernet and Fast Ethernet

Since 100BASE-TX Fast Ethernet is an extension of the existing Ethernet IEEE 802.3 standard that uses the existing 802.3 media access control (MAC) layer, there is no change in the link layer frame format and no need to recompute checksums or rebuild frames before forwarding. Thus, the Transition Networks pocket switch moves frames easily between Ethernet ports running at 10 Mb/s (10BASE-T, legacy Ethernet) and 100 Mb/s (100BASE-TX, Fast Ethernet).

Since the pin numbers used in the eight-pin connector for 100BASE-TX conform to the wiring already in use in the 10BASE-T standard, a 100BASE-TX card can replace a 10BASE-T card in an Ethernet station that has Category 5 wiring installed without making any wiring changes.

However, though both 10BASE-T and 100BASE-TX both are limited to a distance of 100 meters, the maximum segment length for the 10 Mb/s link is limited to 100 meters mostly by signal strength, while the maximum segment length for the 100BASE-TX is limited to 100 meters to ensure that round trip timing specifications are met. Also, though both 10BASE-T and 100BASE-TX collision domains can be measured using the 512-Bit Rule, the 5-Segment Rule is more commonly used for legacy 10BASE-T Ethernet (See page 17). Fast Ethernet is measured using the 100BASE-TX/100BASE-FX 512-Bit Rule (See page 18).

Connecting Legacy Ethernet to Fast Ethernet

Installing the Transition Networks' pocket switch between existing Ethernet workgroups or networks and a new Fast Ethernet workgroup or network, using the cabling appropriate to each, connects technologies.

Migrating from Legacy Ethernet to Fast Ethernet

Migration from 10 Mb/s to 100 Mb/s operation can be on a station-by-station basis, as needed, using incremental upgrades of station network interface cards and of cable.

The 512-Bit Rule (100BASE-TX/100BASE-FX)

A bit-time (BT) is the amount of time required to send one data bit across an Ethernet LAN. The total number of bit-times between any two DTEs in the same Fast Ethernet 100BASE-TX or 100BASE-FX collision domain cannot exceed 512 bit-times in the round trip.

CALCULATING RTD (ROUND TRIP DELAY)

To calculate the round trip delay in bit-times between a station (DTE) and the Transition Networks' pocket switch, refer to the Fast Ethernet worst case round-trip delays expressed in bit times. Then:

Class I Repeater	140 BT
Class II Repeater	92 BT
Class I TX/FX Media Converter	130 BT
Class II TX/FX Media Converter	92 BT
DTE	50 BT
1 meter of CAT.5 TP cable	1.11 BT
1 meter of fiber cable	1 BT
Fast Ethernet Switch	50 BT

- Find the longest and most complicated collision domain path between the station and the Transition Networks' pocket switch.
- Calculate the round trip delay for each cable segment by multiplying the length of the cable (in meters) by the delay per meter (in bit times (BT)) for each cable type as listed in the table
- Calculate the total round trip delay by taking the sum of all the individual cable delay values in the path, as listed in the table, plus station (DTE) delays and hub (repeater) delays.
- Add the segment delay values together. If the result is less than or equal to 512 bit times, the path passes the test.
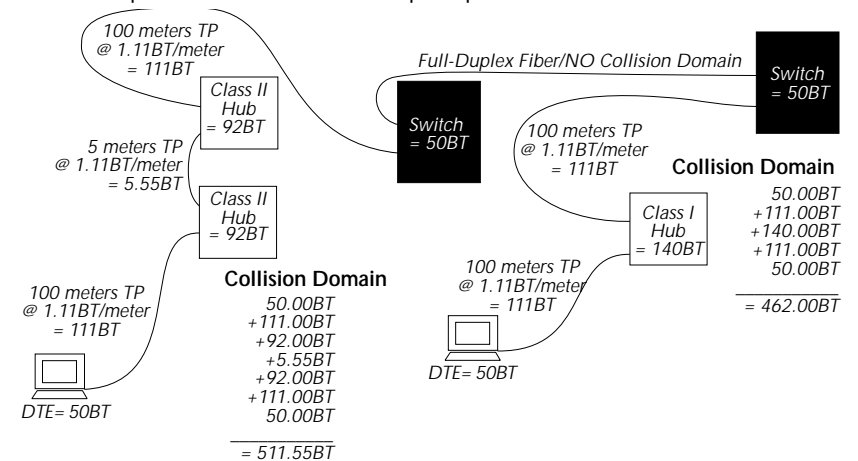

NOTE: Actual manufacturers' bit-time values or measured bit-time values may be greater or less than bit-time values listed in the chart.

Installing Network Cable (continued)

The 5-Segment Rule (10BASE-T)

The Ethernet 10BASE-T 5-segment rule defines a segment as the cable connection between station interfaces. The transmission path between any two terminal devices *in the same collision domain* can consist of no more than five segments. Installing the Transition Networks' pocket switch in the network separates collision domains, so the 10BASE-T 5-segment rule applies *separately to each collision domain*.
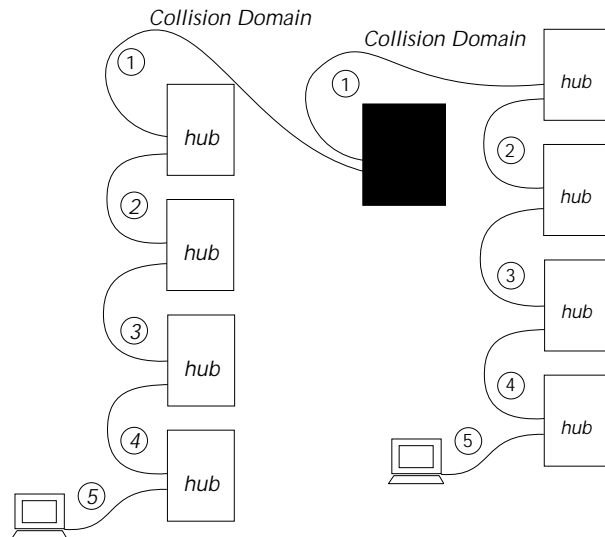

ASSIGNING SEGMENT NUMBERS

To assign segment numbers to cable connections:

1. Determine the network device separated from the Transition Networks' pocket switch by the greatest number of segments.

2. Define a segment path between that network device and the Transition Networks' pocket switch by labeling the cable connection to the Transition Networks' pocket switch "segment 1" and numbering each segment in the path to the terminal up to "segment n" (n = total number of segments ≤ 5).

3. Verify that no segment path in the collision domain contains more than n $\leq$ 5 segments.

4. Repeat steps 1-3 for next collision domain.

The Transition Networks pocket switch can be installed to provide one 10BASE-T switched port and one 100BASE-TX switched port.
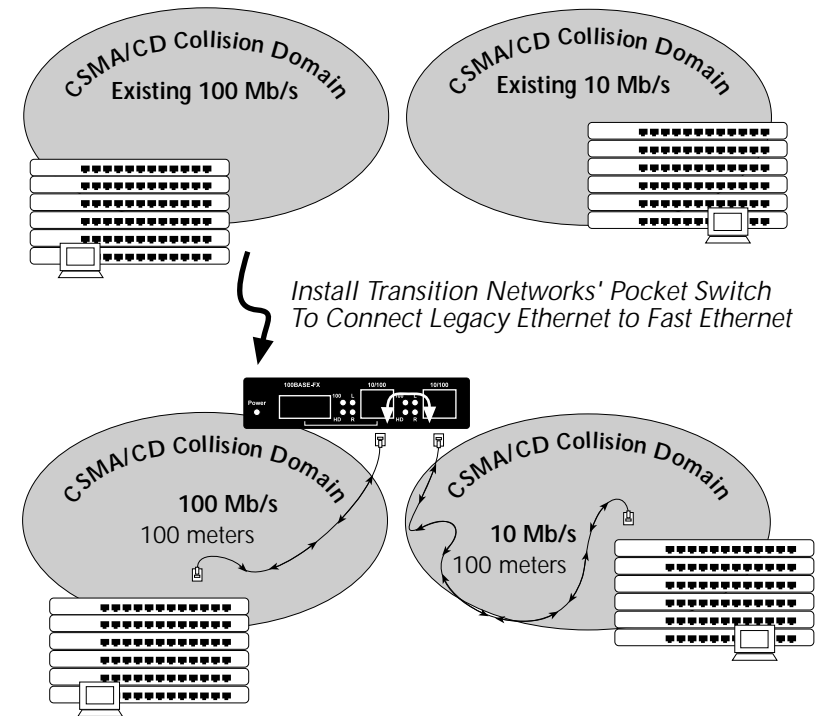
Auto-Negotiation

The 100BASE-TX standard includes automatic speed and duplex mode sensing as part of the Auto-Negotiation function. When two Auto-Negotiation devices with multiple capabilities are connected together, they find their highest performance mode of operation based on a priority table. The Auto-Negotiation protocol contains a set of priorities which result in the devices selecting their highest common set of abilities. (The process happens out of band, with no loss of network throughput.) Each 100BASE-TX station sends a burst of link integrity test pulses, called a fast link pulse (FLP), generated automatically. If the receiving switch is capable of 10BASE-T communication only, the FLPs are ignored and the cable segment operates as 10BASE-T. If the switch *can* support 100BASE-TX operation, the switch detects the FLPs, uses the Auto-Negotiation algorithm and FLP data to determine the highest possible cable segment speed and mode, and automatically places both the station and the switch into 100BASE-TX mode.

Increasing Network Distance by Installing 100BASE-FX

Fiber Fast Ethernet, 100BASE-FX, can be used for links to the Transition Networks' pocket switch, particularly between buildings or where the 100 meter distance limitation of copper Fast Ethernet, 100BASE-TX, must be exceeded. Signals move over fiber 10% faster than over copper.

The 100BASE-FX fiber optic media system uses pulses of light instead of electrical currents to send signals over the Ethernet medium. Light pulses propagate faster that electrical signals, with less signal loss, and provide superior electrical isolation for network devices at each end of the link. While network devices used in copper segments have protective circuits designed for protection from typical indoor electrical hazards, fiber optic media is totally non-conductive. This complete electrical isolation provides immunity from much larger electrical hazards, including the effect of lightning strikes and the different levels of electrical ground currents found in separate buildings. Complete electrical isolation is essential when Ethernet segments must link separate buildings.

NOTE: The 100BASE-FX specification requires two strands of multimode fiber optic cable per link, one to transmit data, and one to receive data, with the signal crossover (TX to RX) performed in the link. This allows fiber cable to be used either in half-duplex or full-duplex mode.

Half-duplex Fiber

The 100BASE-FX media system is designed to allow half-duplex Fast Ethernet segments of *up to 412 meters for the entire collision domain*. In practice, however, half-duplex fiber is limited to 111 meter distances. and typically is used to connect a server to a workstation with no intervening hub.

Full-duplex Fiber

The 100BASE-FX media system is designed to allow full-duplex Fast Ethernet segments of up to 2000 meters in length. The 2000 meter limit is possible because round trip timing (collision domain) specifications are not a factor in full-duplex. In full-duplex, the limiting factor for fiber is optical power loss. (See page 21.)

Installing Network Cable

Use care when installing network cable to ensure that the restrictions that apply separately to each cable type (10BASE-T, 100BASE-TX, and 100BASE-FX) are satisfied.

10BASE-T

Cable type:	Category 3 or Category 5	(See page 27)
Connector:	RJ-45	(See page 27)
Maximum distances:	100 m *(half-duplex)*	(See page 27)
	100 m *(full-duplex)*	(See page 27)
Restrictions:	5-segment rule	(See page 17)
	Straight-through or Crossover cable	(See page 19)

100BASE-TX

Cable type:	Category 5	(See page 27)
Connector:	RJ-45	(See page 27)
Maximum distances:	100 m *(half-duplex)*	(See page 27)
	100 m *(full-duplex)*	(See page 27)
Restrictions:	512-bit rule	(See page 18)
	Straight-through or Crossover cable	(See page 19)

100BASE-FX

Cable type:	62.5/125 multimode fiber	(See page 28)
Connector:	ST	(See page 28)
Maximum distances:	412 m *(half-duplex)*	(See page 28)
	2000 m *(full-duplex)*	(See page 28)
Restrictions:	Optical loss budget	(See page 21)

NOTE: If the Transition Networks' pocket switch is installed in a network that is evolving by increments from legacy 10BASE-T Ethernet to 100BASE-TX Fast Ethernet and/or to 100BASE-FX Fast Ethernet, refer again to these cable type restrictions at each upgrade.

Setting DIP Switch

NOTE: The Auto-Negotiation system is designed so that a twisted-pair link will not become operational until matching capabilities exist at each end. T*he Auto-Negotiation protocol is NOT able to test the cable*. The installer must ensure that the correct cable type is installed to support the highest speed and mode of operation to be selected.

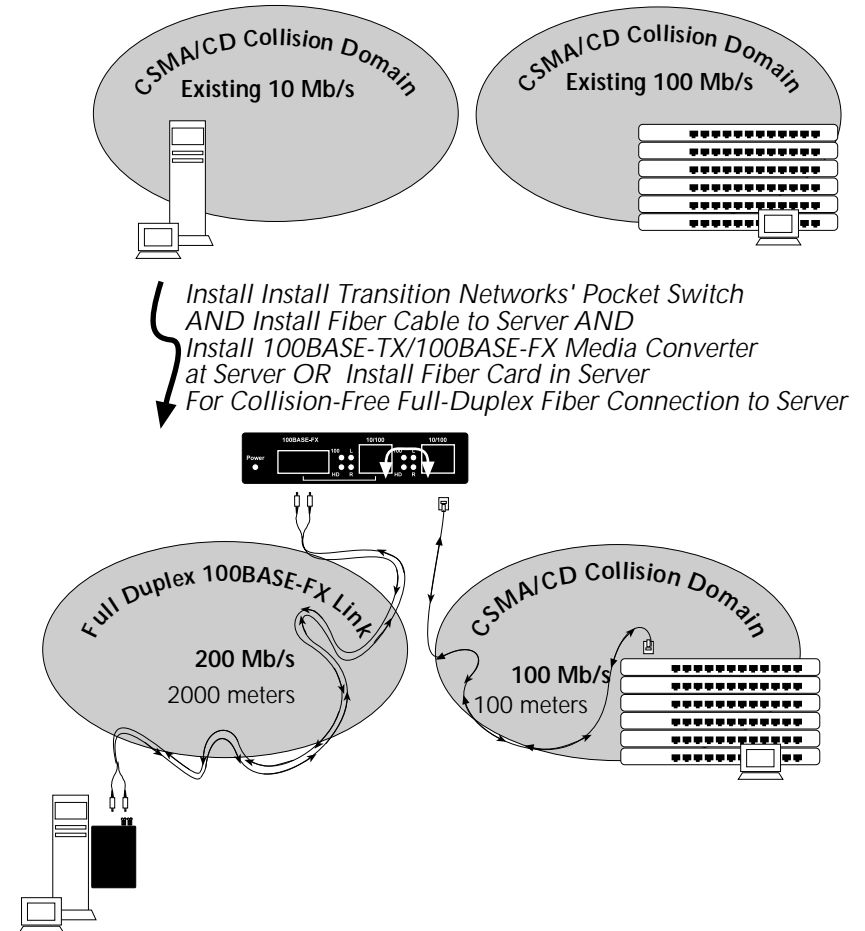To set network speed(s) and operation mode(s) using DIP switch:

1. Locate the DIP switch at the back of the Transition Network's Pocket Switch.

2. Using a VERY small flatblade screwdriver or similar device and the table below, set Port 1 DIP switch to select **one** of the following modes:

    - Auto-Negotiation   (*twisted-pair only*)
    - 100 Mb/sec – full-duplex   (*twisted-pair OR fiber*)
    - 100 Mb/sec – half-duplex   (*twisted-pair OR fiber*)
    - 10 Mb/sec – full-duplex   (*twisted-pair only*)
    - 10 Mb/sec – half-duplex   (*twisted-pair only*)

3. Repeat for Port 2 (*twisted-pair only*).

KEY: ▯ =Switch Up
       ▮ =Switch Down

NOTE: Switch 4 is unused.

Network distances can be extended to up to 2000 meters by installing a full-duplex fiber network interface card in the network device and then connecting fiber cable between the network device and the Transition Networks' pocket switch.

Install Install Transition Networks' Pocket Switch AND Install Fiber Cable to Server AND Install 100BASE-TX/100BASE-FX Media Converter at Server OR Install Fiber Card in Server For Collision-Free Full-Duplex Fiber Connection to Server

Class I and Class II Fast Ethernet Repeaters

Both 100BASE-TX and 100BASE-FX use the same signalling techniques, so either Class I or Class II repeaters can be installed in the Transition Networks' Fast Ethernet pocket switch network.

2. SITE CONSIDERATIONS

The site for the Transition Networks' pocket switch must provide:

- AC power outlet for each Transition Networks' pocket switch
- Adequate ventilation
- Standard environmental conditions
- Isolation from electrical noise, including radio transmitters and broadband amplifiers, motors, high power electrical lines, or fluorescent light fixtures.

Additionally:

- The twisted pair cables should not run in the same conduit with power line cables.
- Phone lines should be separated from data cables.
- Flat or "silver satin" wires should not be used.

And:

- The entire installation should comply with the IEEE Ethernet 802.3 and the 802.3u specifications.

3. INSTALLATION

To install the Transition Networks' pocket switch:

- Unpack Transition Networks' pocket switch
- Install Transition Networks' pocket switch on stable, flat surface
- Set DIP switch
- Install network cable
- Power Transition Networks' pocket switch.

Direction is provided in the pages that follow.

Unpacking the Transition Networks' Pocket Switch

The Transition Networks' pocket switch packing contents should include the following:

Item	Part Number
Transition Networks' Pocket Switch	E-PSW-TX-02 OR E-PSW-FX-02
Power Supply Adapter	3340, 3507, 3342, 3340, 3346, 3511, OR 3537/power cord: 3522 . (depending upon power configuration in country where installed)
User's Guide	33015

Installing on Flat, Stable Surface

The Transition Networks' pocket switch was designed and built to be installed on a table or shelf.

Ensure that the installation location is:

- stable
- well- ventilated
- near a standard AC electrical outlet.