# DELNI ETHERNET
# Local Network
# Interconnect

## Technical Manual

EK-DELNI-TM.001

EK-DELNI-TM-001

## Networks • Communicatio

# DELNI
# Ethernet Local
# Network Interconnect

## Technical Manual

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# CONTENTS

# CONTENTS (Cont)

# FIGURES



# TABLES

# PREFACE

This manual describes the physical, electrical, and functional characteristics of the DIGITAL Ethernet Local Network Interconnect (DELNI). This document is intended to provide the Field Service Engineer with a working knowledge of the DELNI unit.

# CHAPTER 1
# INTRODUCTION

## 1.1 DIGITAL ETHERNET LOCAL NETWORK INTERCONNECT (DELNI) OVERVIEW

The DELNI unit (Figure 1-1) is a hardware communications device. The DELNI unit and associated cables can be used to create several types of Local Area Networks (LANs) through which Ethernet Compatible Stations (Stations) may communicate using the DIGITAL Ethernet Carrier Sense Multiple Access/Collision Detect (CSMA/CD) protocol.

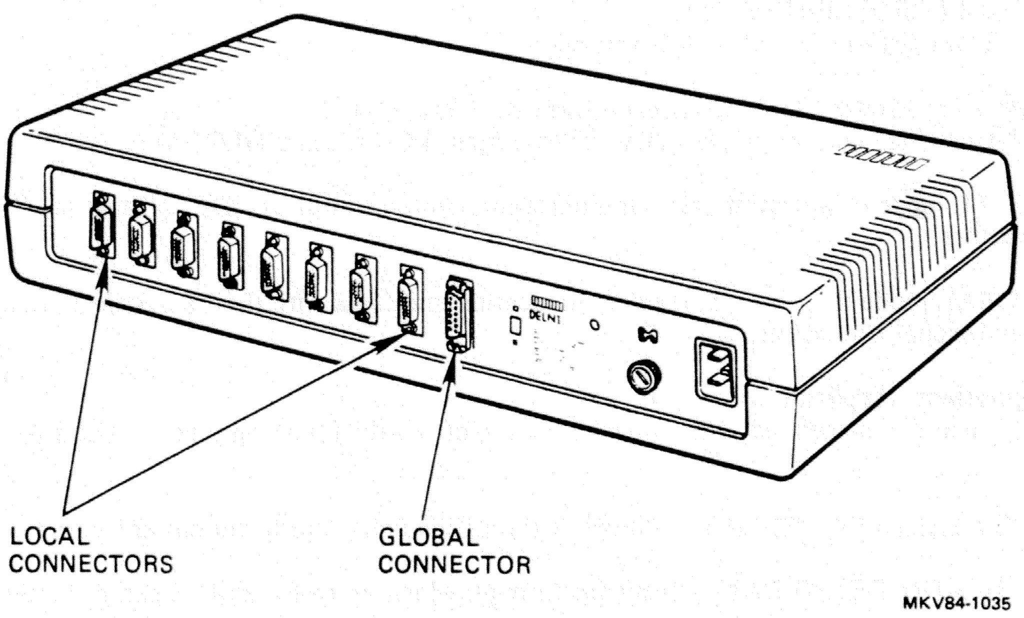



Figure 1-1 Digital Ethernet Local Network Interconnect (DELNI)

### 1.1.1 Communication Interfaces

The DELNI unit provides nine communication interfaces. These are:

- Eight (8) local connectors (labeled 1 through 8 on the front panel), and
- One (1) global connector (labeled □ on the front panel).

Each of the eight local connectors have the following paired signal line interfaces.

- TRANSMIT
- RECEIVE
- COLLISION PRESENCE

The global connector has the following paired signal line interfaces.

- TRANSMIT
- RECEIVE
- COLLISION PRESENCE
- POWER (+12 V and +12 V return)

### 1.1.2 Operating Modes/Operational Communication Interfaces

The DELNI unit has two selectable modes of operation: LOCAL and GLOBAL.

In the LOCAL mode of operation, all communication interfaces with the DELNI unit are by way of the local connectors.

In the GLOBAL mode of operation, the communication interfaces with the DELNI unit are through both the local and global connectors.

### 1.1.3 Operational Applications

The DELNI unit and associated cables may be used to create the following types of Local Area Networks (LANs).

- Standalone DELNI LAN – Network through which up to 8 stations can communicate.
- Two-Tier DELNI LAN – Network through which up to 64 stations can communicate.
- Connected DELNI LAN – Network through which up to 8 stations can communicate on a larger Ethernet network through a single Ethernet transceiver interface.

**NOTE**

**Refer to Ethernet Installation Guide for detailed configuration requirements. General configuration requirements are provided in Chapter 2 of this document.**

## 1.2 DELNI FUNCTIONAL DESCRIPTION

The functional operation of the DELNI unit is dependent on the mode of operation selected: LOCAL or GLOBAL.

### 1.2.1 LOCAL Mode Operation

In the LOCAL mode, the DELNI unit performs the following functions.

- Transmit/Receive – Provides the data paths between the TRANSMIT and RECEIVE pairs of the local connectors.
- Heartbeat Signaling – Provides signaling on the COLLISION PRESENCE pairs of the local connectors after the end of each transmission interval.
- Collision Detection – Detects the condition in which two or more stations are attempting to transmit simultaneously.
- Collision Signaling – Provides signaling on the COLLISION PRESENCE pairs of the local connectors when a collision is detected.

### 1.2.2 GLOBAL Mode Operation

In the GLOBAL mode, the DELNI unit performs the following functions.

- Transmit – Provides a data path from the TRANSMIT pairs of the local connectors to the TRANSMIT pair of the global connector. It is through this data path that stations connected to the local connectors can send data to a global network device for transmission on a larger Ethernet network.
- Local Collision Detection – Detects the condition in which two or more stations connected to the local connectors are attempting to transmit simultaneously.
- Local Collision Condition Data Control and Collision Signaling – During a local collision condition, controls the data sent to the global network device. This ensures that the duty cyle and minimum packet length requirements are not violated. Also, provides signaling on the COLLISION PRESENCE pairs of the local connectors.
- Receive – Provides a data path from the RECEIVE pair of the global connector to the RECEIVE pairs of the local connectors. This data path distributes the data received from a global network device to the stations connected to the local connectors.
- Global Collision and Heartbeat Signal Detection – Detects the presence of signals asserted on the COLLISION PRESENCE pair of the global connector.
- Global Collision and Heartbeat Signaling – Provides signaling on the COLLISION PRESENCE pairs of the local connectors whenever a signal is detected on the COLLISION PRESENCE pair of the global connector.

## 1.3 DELNI PHYSICAL DESCRIPTION

### 1.3.1 Physical Characteristics

The dimensions and weight of the DELNI unit (both with and without the plastic housing) are:

| | With Plastic Housing | Without Plastic Housing |
|---|---|---|
| • Width | 19.25 in (48.9 cm) | 17.50 in (44.5 cm) |
| • Depth | 7.75 in (19.7 cm) | 7.00 in (17.8 cm) |
| • Height | 3.50 in (8.9 cm) | 2.50 in (6.4 cm) |
| • Weight | 10.5 lbs (4.8 kg) | – |

### 1.3.2 Configurations

There are two configurations of the DELNI unit: DELNI-AA configuration for U.S. applications and DELNI-AB configuration for European/GIA applications. The differences between the two configurations are:

- DELNI-AA (U.S.)
  - 3AG, 0.5 A, Slo-Blo fuse and 1/4 inch fuse carrier installed
  - The 120/240 switch is preset to the 120 position
  - Installation/owner's manual
  - AC power cord
- DELNI-AB (European/GIA)
  - 5 × 20 mm, T, 0.5 A fuse and 5 mm fuse carrier installed
  - The 120/240 switch is preset to the 240 position

NOTE

**No ac power cord or installation/owner's manual is shipped with the DELNI-AB configuration. A country kit (containing a power cord and installation/owner's manual) must be ordered separately. Table 1-1 lists the country kits available.**

Table 1-1 DELNI Country Kits

| Order Designation | Primary Country |
|---|---|
| DELNK-AB | Belgium |
| DELNK-AC | Canada - France |
| DELNK-AD | Denmark |
| DELNK-AE | United Kingdom |
| DELNK-AF | Finland |
| DELNK-AG | Germany |
| DELNK-AH | Holland |
| DELNK-AI | Italy |
| DELNK-AK | Switzerland - France |
| DELNK-AL | Switzerland - Germany |
| DELNK-AM | Sweden |
| DELNK-AN | Norway |
| DELNK-AP | France |
| DELNK-AQ | Canada - England |
| DELNK-AS | Spain |
| DELNK-AZ | Australia |

## 1.4 DELNI CONTROLS, INDICATORS, AND FUSING

The location of the controls, indicators, and fuse of the DELNI unit are shown in Figure 1-2.

### 1.4.1 Controls and Indicators

Table 1-2 describes each of the controls and indicators and specifies their function.

### 1.4.2 Fusing

The DELNI unit is fused as follows:

- DELNI-AA    3AG, 0.5 A, Slo-Blo
- DELNI-AB    5 × 20 mm, T, 0.5 A

### 1.4.3 Spare Fuses And Fuse Holders

Spare fuses and fuse holders may be ordered separately.

- 5 × 20 mm, T, 0.5 A fuse (DIGITAL P/N 12-19283-19)
- 5 mm fuse carrier (DIGITAL P/N 12-21126-04)
- 3AG, 0.5 A, Slo-Blo fuse (DIGITAL P/N 90-07209-00)
- 1/4 inch fuse carrier (DIGITAL P/N 12-21126-03)

## 1.5 DELNI RACK MOUNT OPTION

The DELNI unit may be mounted in a standard 19 inch (48.26 cm) rack using the DEXRM rack mount assembly.

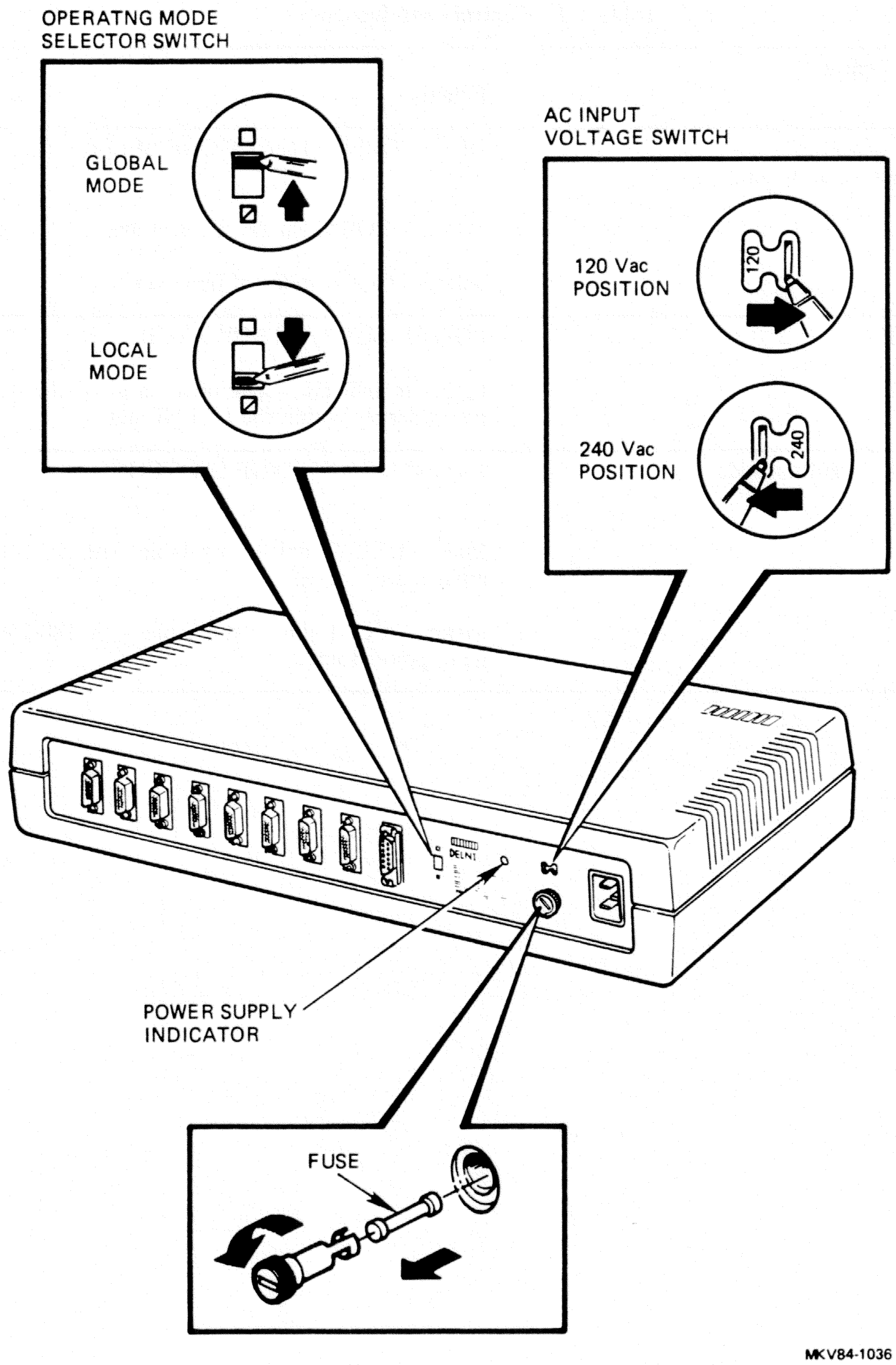



Figure 1-2 DELNI Controls and Indicators

Table 1-2 Controls and Indicators

| Control/Indicator (Type) | Function |
|---|---|
| □/☑ (Two-position slide switch) | DELNI OPERATING MODE SELECTOR |
| □ | Selects GLOBAL mode of operation. |
| ☑ | Selects LOCAL mode of operation. |
| (Green LED) | POWER SUPPLY INDICATOR |
| | Lights to indicate operational status of the +5 Vdc power supply within the DELNI unit. |
| 120/240 (Two-position slide switch) | AC INPUT VOLTAGE SWITCH |
| 120 | Makes DELNI unit compatable with 90-128 Vac input power source. |
| 240 | Makes DELNI unit compatable with 180-256 Vac input power source. |

## 1.6 RELATED DOCUMENTATION

Other documents relative to the DELNI unit and associated Ethernet networks are specified in Table 1-3.

**Table 1-3 Related Documentation**

| Title | Order Number | Description |
|---|---|---|
| DELNI Field Maintenance Print Set | MP-01656-** | Unit assembly drawings, parts listing, and schematic diagrams. |
| *DELNI Installation/ Owner's Manual* | EK-DELNI-IN-*** | Outlines Ethernet networking configurations which can be developed using the DELNI unit. Also provides installation instructions, troubleshooting information, and a description of service options. |
| *Introduction to Local Area Networks* | EB-22714-18 | Describes the terms, concepts, designs, and strategies related to local area networks. |
| *The Ethernet, A Local Area Network, Data Link Layer and Physical Layer Specification* | AA-K759A-TK | Precisely describes the design constraints and functional requirements for components to be used in the Ethernet environment. Also discusses the protocol to be used for communication on the Ethernet. |
| *Ethernet Installation Guide* | EK-ETHER-IN-*** | 2 Volumes:<br>Volume 1; Detailed Site Planning Information.<br>Volume 2; Detailed Installation Instructions. |
| *DELNI Rackmount Option Installation Guide* | EK-DEXRM-IN-*** | Provides the procedural information for installing the DELNI unit in a standard 48.26 cm (19 in) equipment rack using the DEXRM rackmount option. |
| *DELNI Illustrated Parts Breakdown* | EK-DELNI-IP-*** | Identifies components of the DELNI unit using annotated drawings keyed to parts listings. |

**/*** The latest revision is sent if no revision is specified.

# CHAPTER 2
# DELNI NETWORK CONFIGURATION GUIDELINES

## 2.1 CONFIGURATION GUIDELINES

Basic configuration guidelines for three DELNI LAN Ethernet environments (standalone DELNI LAN, Two-Tier DELNI LAN, and Connected DELNI LAN) are outlined in the following sections and Figures 2-1 through 2-3. Restrictions regarding the length of cables that may be used are defined in Section 2.2.

### 2.1.1 Standalone DELNI LAN

In a Standalone DELNI LAN application (Figure 2-1), all stations are interconnected by way of a single DELNI unit. All station interfaces to the DELNI unit are through the local connectors and the DELNI unit is operated in the LOCAL mode.

### 2.1.2 Two-Tier DELNI LAN

In a Two-Tier DELNI LAN application (Figure 2-2), there may be as many as nine DELNI units with one DELNI unit operating in the LOCAL mode and up to eight DELNI units operating in the GLOBAL mode. The interfaces between stations and DELNI units of a typical Two-Tier DELNI LAN are as follows.

- All station interfaces to the DELNI units are through the local connectors.

- The global connector of each DELNI unit operating in the GLOBAL mode is connected to the local connector of the DELNI unit operating in the LOCAL mode.

### 2.1.3 Connected DELNI LAN

In a Connected DELNI LAN application (Figure 2-3), the stations are connected to the local connectors of a single DELNI unit operating in the GLOBAL mode. The global connector of the DELNI unit is connected to an Ethernet transceiver.

## 2.2 CONFIGURATION LIMITATIONS

The primary configuration limitations are due to the maximum length of transceiver cable that can be used to interconnect the stations and DELNI units. The maximum length of transceiver cable that may be used is dependent on the following parameters.

- Type of transceiver cable used.
- Type of Ethernet communications controller installed in the station.
- DELNI LAN configuration.

Figures 2-1 through 2-3 outline the maximum cable lengths for three DELNI LAN configurations. Each figure shows the restrictions associated with several types of Ethernet communications controllers and for two types of transceiver cables.

**Transceiver Cable Types**

Two types of transceiver cables are as follows.

- BNE3X-XX – Transceiver cable
- BNE4X-XX – Office transceiver cable

These cables have different electrical signal attenuation characteristics. The cable length restrictions called out in Figures 2-1 through 2-3 assume that only one type of cable is used in each cabling run (that is, the attenuation characteristics are constant). If the two cable types are connected together to effect any one of the cabling connections, the maximum cable length allowable may be calculated using the following relationship.

The attenuation of a 2 m length of BNE4X-XX cable is equivalent to the attenuation of an 8 m length of BNE3X-XX cable.

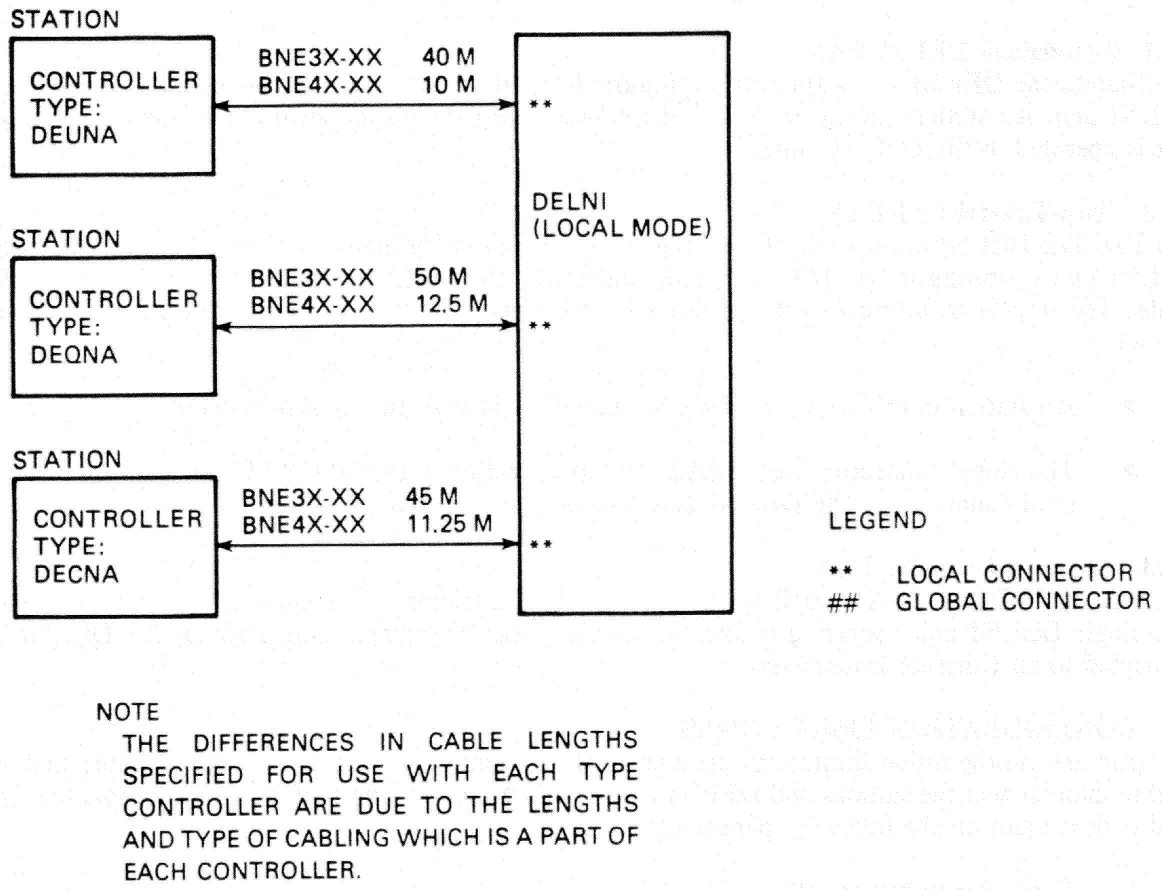
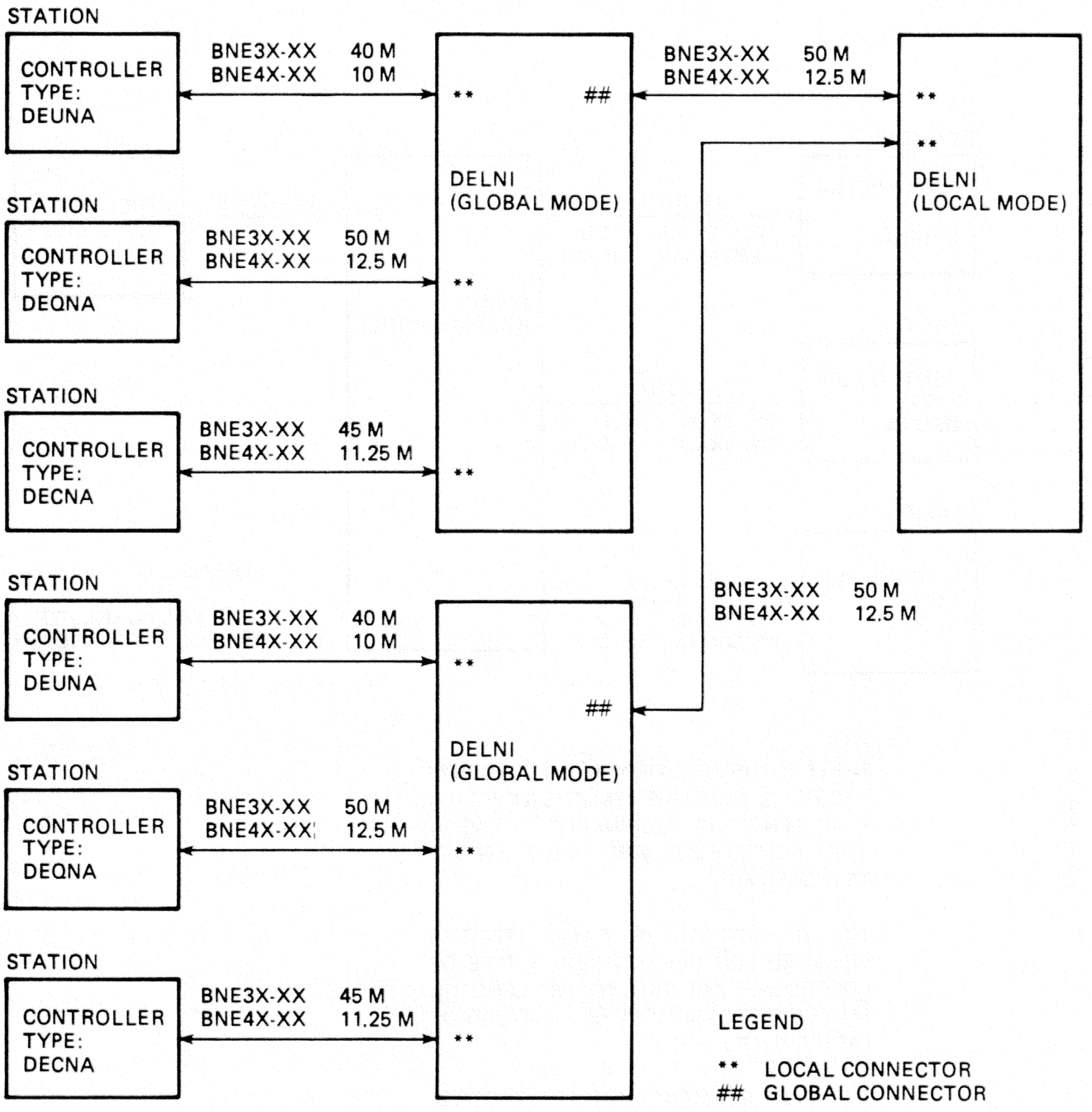



Figure 2-1 Configuration Guidelines and Limitations: Standalone DELNI LAN




NOTES

THE DIFFERENCES IN CABLE LENGTHS SPECIFIED FOR USE WITH EACH TYPE CONTROLLER ARE DUE TO THE LENGTHS AND TYPE OF CABLING WHICH IS A PART OF EACH CONTROLLER.

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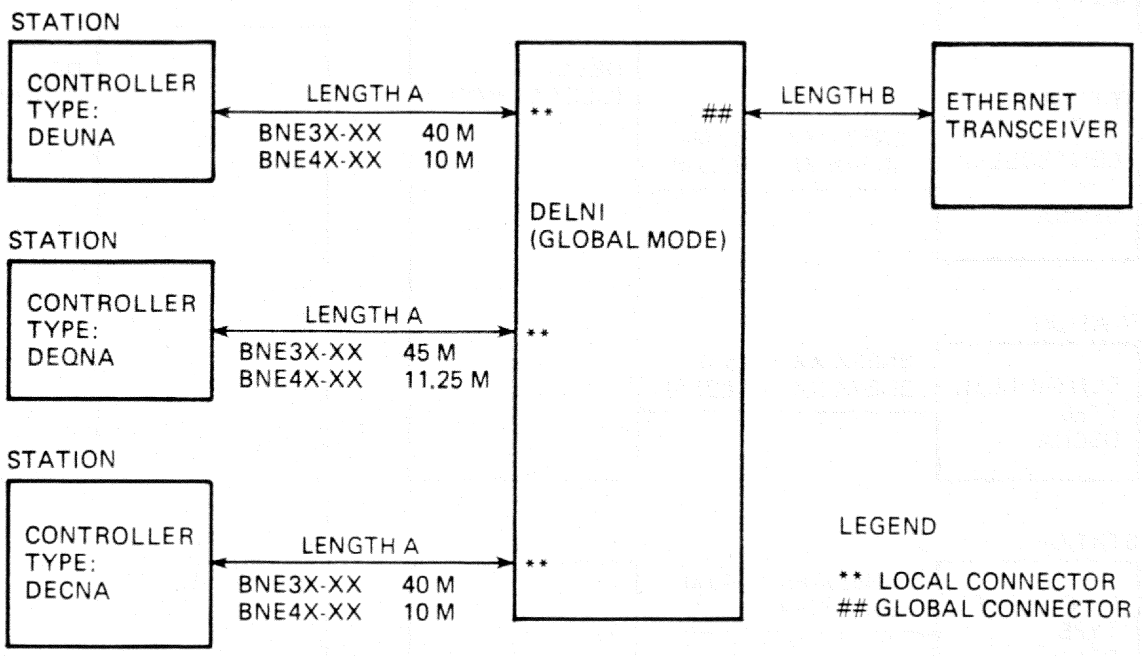
Figure 2-2 Configuration Guidelines and Limitations: Two-Tier DELNI LAN




NOTES

THE LENGTHS SPECIFIED UNDER 'LENGTH A' ARE THE TOTAL CABLE LENGTHS (LENGTH A PLUS LENGTH B) ALLOWABLE BETWEEN THE CONTROLLER AND THE ETHERNET TRANSCEIVER.

THE DIFFERENCES IN CABLE LENGTHS SPECIFIED FOR USE WITH EACH TYPE OF CONTROLLER ARE DUE TO THE LENGTHS AND TYPE OF CABLING WHICH IS A PART OF EACH CONTROLLER.

THE CABLE SEGMENT LABELED 'LENGTH B' MAY BE MADE UP OF TRANSCEIVER CABLES JOINED IN AN ETHERJACK CONNECTION BOX.

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Figure 2-3 Configuration Guidelines and Limitations: Connected DELNI LAN

# CHAPTER 3
# DELNI INTERFACES, INPUT/OUTPUT SIGNAL FLOW, AND SPECIFICATIONS

## 3.1 COMMUNICATION INTERFACES

The DELNI communication interfaces are effected through the following connectors.

- Eight (8) local connectors
- One (1) global connector

### 3.1.1 Local Connector Interfaces

The eight local connectors are physically isolated from the metal chassis. The backshell of each of these connectors is electrically connected to chassis ground through capacitors to maintain electrical isolation. The electrical isolation characteristics are:

- Impedance (connector backshell to chassis) 3 MHz to 30 MHz
  - 10 Ω maximum
  - 0.5 Ω minimum
- Isolation at 60 Hz
  - 280K Ω typical
  - 250K Ω minimum
- Breakdown voltage at 60 Hz
  - 270 V rms

Each of the eight local connectors provide the signal line interfaces listed in Table 3-1.

### 3.1.2 Global Connector Interfaces

The global connector is physically and electrically connected directly to the DELNI chassis (chassis ground) by the metal shell of the connector. The electrical characteristics of this connection are:

| | |
|---|---|
| • Resistive at dc | 0.10 Ω maximum |
| • Inductive at 10 MHz | 50 nH |

The global connector provides the signal line interfaces listed in Table 3-2.

Table 3-1 Local Connector Signal Line Interfaces

| Local Connector Pin | Interface Signal Designation |
|---|---|
| 1 | No Connection |
| 2 | CHn COLLISION PRESENCE (+)* |
| 3 | CHn TRANSMIT (+)† |
| 4 | Reserved |
| 5 | CHn RECEIVE (+)* |
| 6 | POWER (RTN) ‡ |
| 7 | Reserved |
| 8 | Reserved |
| 9 | CHn COLLISION PRESENCE (–)* |
| 10 | CHn TRANSMIT (–)† |
| 11 | Reserved |
| 12 | CHn RECEIVE (–)* |
| 13 | POWER (+)‡ |
| 14 | Reserved |
| 15 | Reserved |

* Denotes output signals
† Denotes input signals
‡ POWER input not used at DELNI unit (no internal connection)

Table 3-2 Global Connector Signal Line Interfaces

| Global Connector Pin | Interface Signal Designation |
|---|---|
| 1 | No Connection |
| 2 | XCVR COLLISION PRESENCE (+)† |
| 3 | XCVR TRANSMIT (+)* |
| 4 | Reserved |
| 5 | XCVR RECEIVE (+)† |
| 6 | XCVR POWER (RTN) * |
| 7 | Reserved |
| 8 | Reserved |
| 9 | XCVR COLLISION PRESENCE (–)* |
| 10 | XCVR TRANSMIT (–)* |
| 11 | Reserved |
| 12 | XCVR RECEIVE (–)† |
| 13 | XCVR POWER (+)* |
| 14 | Reserved |
| 15 | Reserved |

* Denotes output signals
† Denotes input signals

## 3.2 INPUT/OUTPUT SIGNAL FLOW AND TIMING RELATIONSHIPS

### 3.2.1 LOCAL Mode Signal Flow and Timing Relationships (Figures 3-1 and 3-2)

In the LOCAL mode of operation, the signal asserted on a CHn TRANSMIT pair is routed to each of the CHn RECEIVE pairs.

Following termination of the signal asserted on the CHn TRANSMIT pair, a heartbeat signal is asserted on all CHn COLLISION PRESENCE pairs.

The time delay between assertion of the CHn TRANSMIT pair signal and assertion of the CHn RECEIVE pairs signal is due to DELNI squelch circuit characteristics. The time delay between the data content of the CHn TRANSMIT pair signal and the data content of the CHn RECEIVE pairs signal is due to steady-state propagation delay through the DELNI unit.

The CHn COLLISION PRESENCE pairs of the DELNI unit are asserted during two conditions.

1. After the end of each transmission interval (heartbeat signaling)

2. During a transmission interval in which two or more CHn TRANSMIT pairs are being asserted simultaneously (collision condition).

For heartbeat signaling, a short duration 10 MHz signal is asserted on all CHn COLLISION PRESENCE pairs.

For collision condition signaling, a 10 MHz signal is asserted on all CHn COLLISION PRESENCE pairs until the conflicting CHn TRANSMIT pairs are deasserted. Therefore, no time duration is specified in Figure 3-2 for the collision signaling condition. (The link level protocol specifies times of 320 ns minimum and 480 ns maximum.)

### 3.2.2 GLOBAL Mode Signal Flow and Timing Relationships (Figures 3-3 and 3-4)

In the GLOBAL mode of operation, the signal asserted on a CHn TRANSMIT pair is routed to the XCVR TRANSMIT pair.

The time delay between assertion of the CHn TRANSMIT pair signal and the occurrence of the XCVR TRANSMIT pair signal is due to DELNI squelch circuit characteristics. The time delay between the data content of the CHn TRANSMIT pair signal and the data content of the XCVR TRANSMIT pair signal is due to steady-state propagation delay through the DELNI unit.

The signal being asserted on the XCVR TRANSMIT pair is routed back to the XCVR RECEIVE pair by the global network device.

The time delay between the assertion of the XCVR TRANSMIT pair signal and assertion of the XCVR RECEIVE pair signal is due to the squelch circuit characteristics and functioning of the global network device. Therefore, only the maximum allowable delay is specified in Figure 3-4.

The global network device detects all global network transmissions and sends the detected data to the XCVR RECEIVE pair of the DELNI unit.

The DELNI unit detects the signals asserted on the XCVR RECEIVE pair and routes the signals to all CHn RECEIVE pairs.

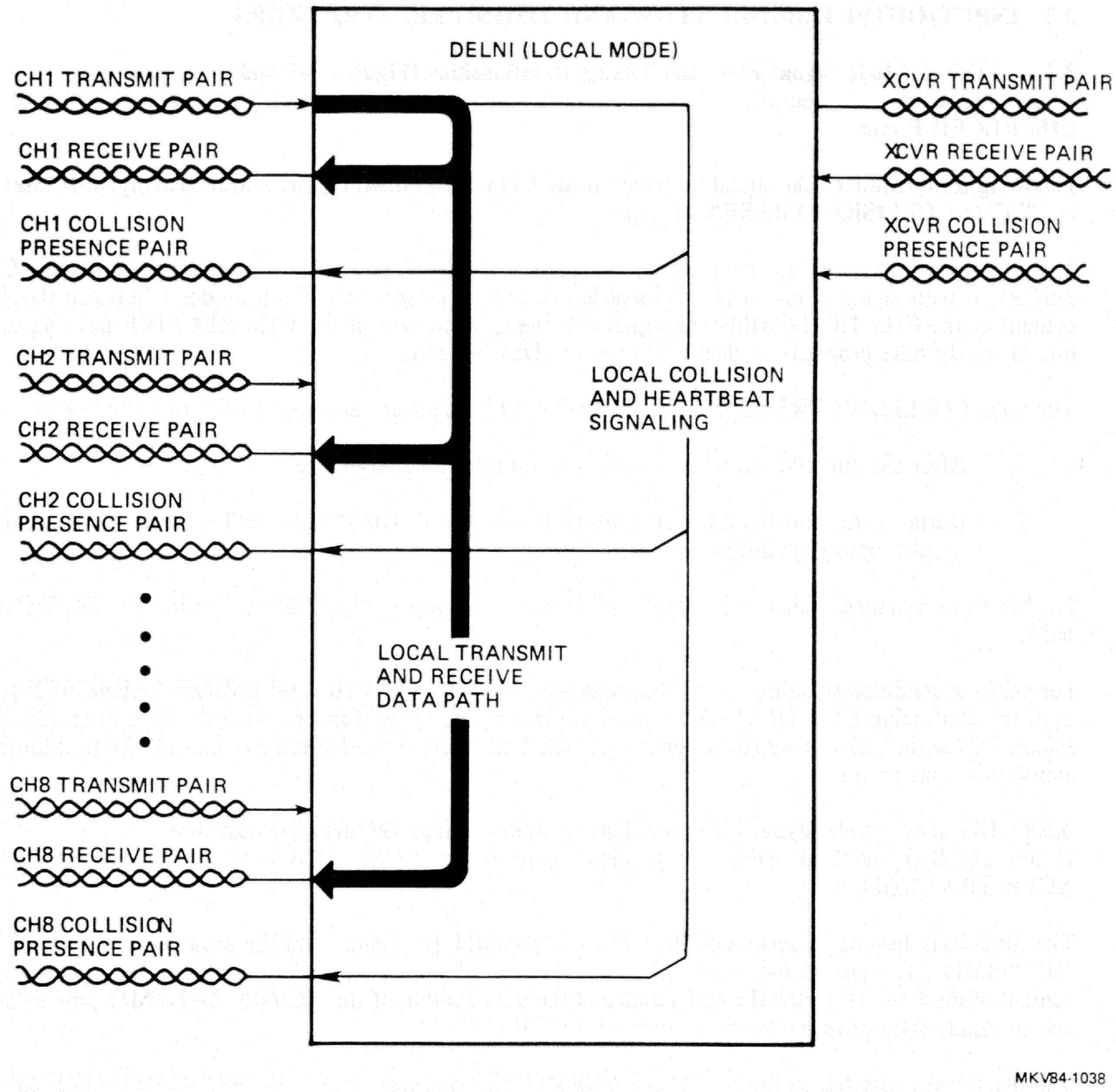



Figure 3-1 LOCAL Mode Signal Flow Diagram

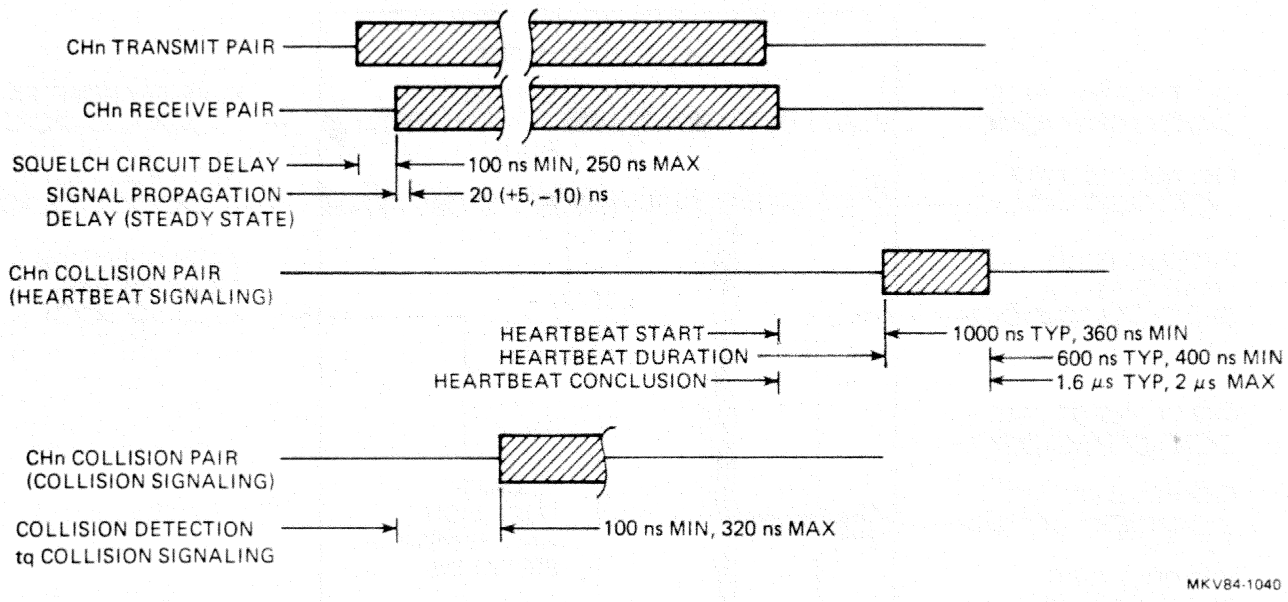



Figure 3-2 LOCAL Mode Signal Timing Diagram

The time delay between assertion of the XCVR RECEIVE pair signal and assertion of the CHn RECEIVE pairs signal is due to the DELNI squelch circuit characteristics. The actual time delay between the data content of the XCVR RECEIVE pair signal and the data content of the CHn RECEIVE pairs signal is due to steady-state propagation delay through the DELNI unit.

For global heartbeat and collision signaling, the global network device asserts the XCVR COLLISION PRESENCE pair.

The DELNI unit responds to a signal asserted on the XCVR COLLISION PRESENCE pair by generating and asserting a 10 MHz signal on all CHn COLLISION PRESENCE pairs.

The time delay between assertion of the XCVR COLLISION PRESENCE pair signal and assertion of the CHn COLLISION PRESENCE pairs signal is due to DELNI squelch circuit characteristics.

The DELNI unit also responds to local collision conditions during the GLOBAL mode of operation.

When a local collision condition is detected, the DELNI unit interrupts the normal data path to the XCVR TRANSMIT pair and asserts a 5 MHz signal on the XCVR TRANSMIT pair. This ensures that a signal that meets Ethernet requirements is asserted on the XCVR TRANSMIT pair. The 5 MHz signal remains asserted until the conflicting CHn TRANSMIT pairs are deasserted.

For local collision condition signaling, the DELNI unit generates and asserts a 10 MHz signal on all CHn COLLISION PRESENCE pairs. Local collision signaling starts when the signal transmitted on the XCVR TRANSMIT pair has been looped back to the XCVR RECEIVE pair by the global network device, and the received signal has been detected by the DELNI unit. The 10 MHz signal sent on the CHn COLLISION PRESENCE pairs remain asserted until the conflicting CHn TRANSMIT pairs are deasserted. Therefore, only the maximum time interval between local collision detection and the start of local collision condition signaling is specified in Figure 3-4.

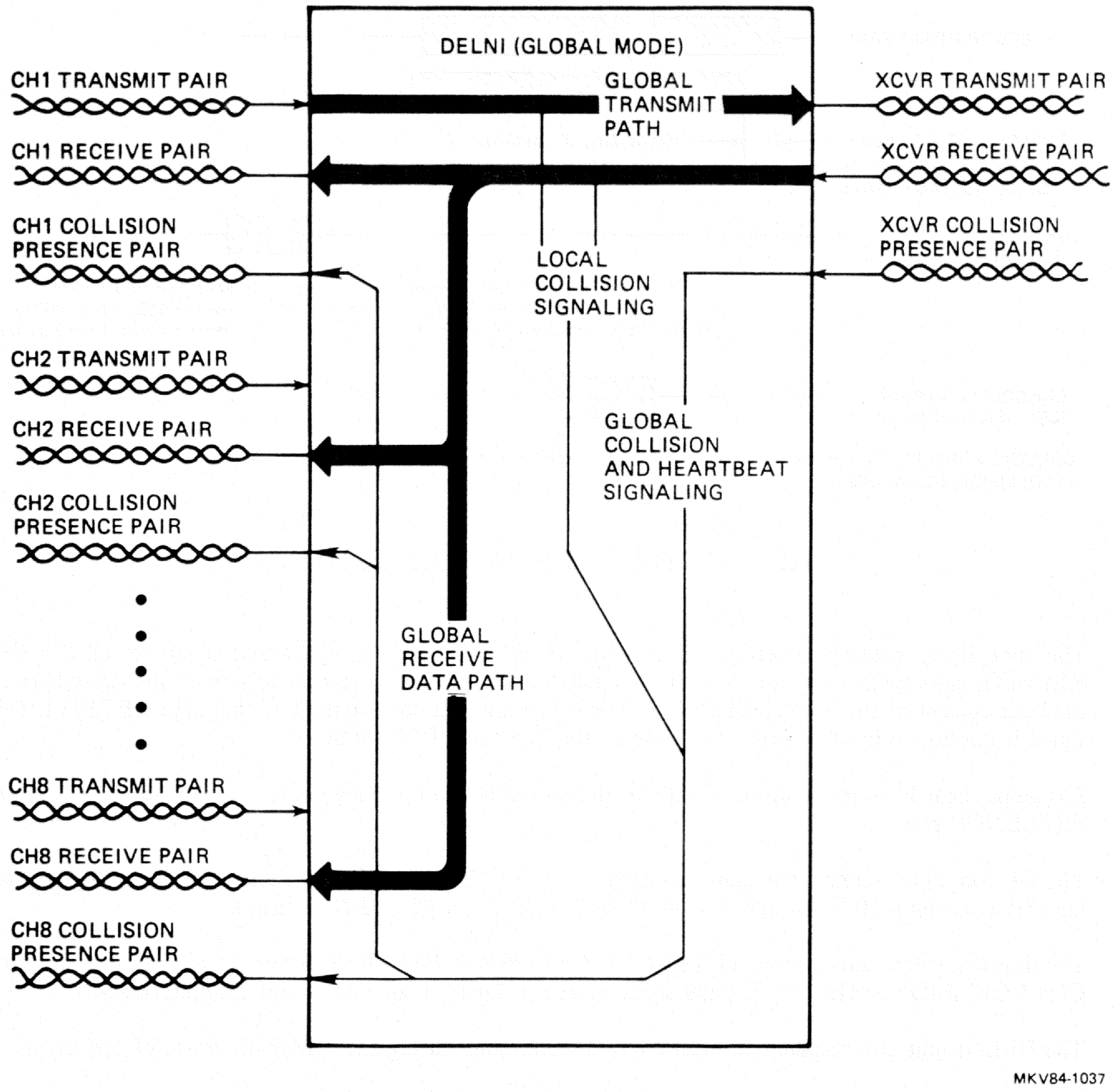
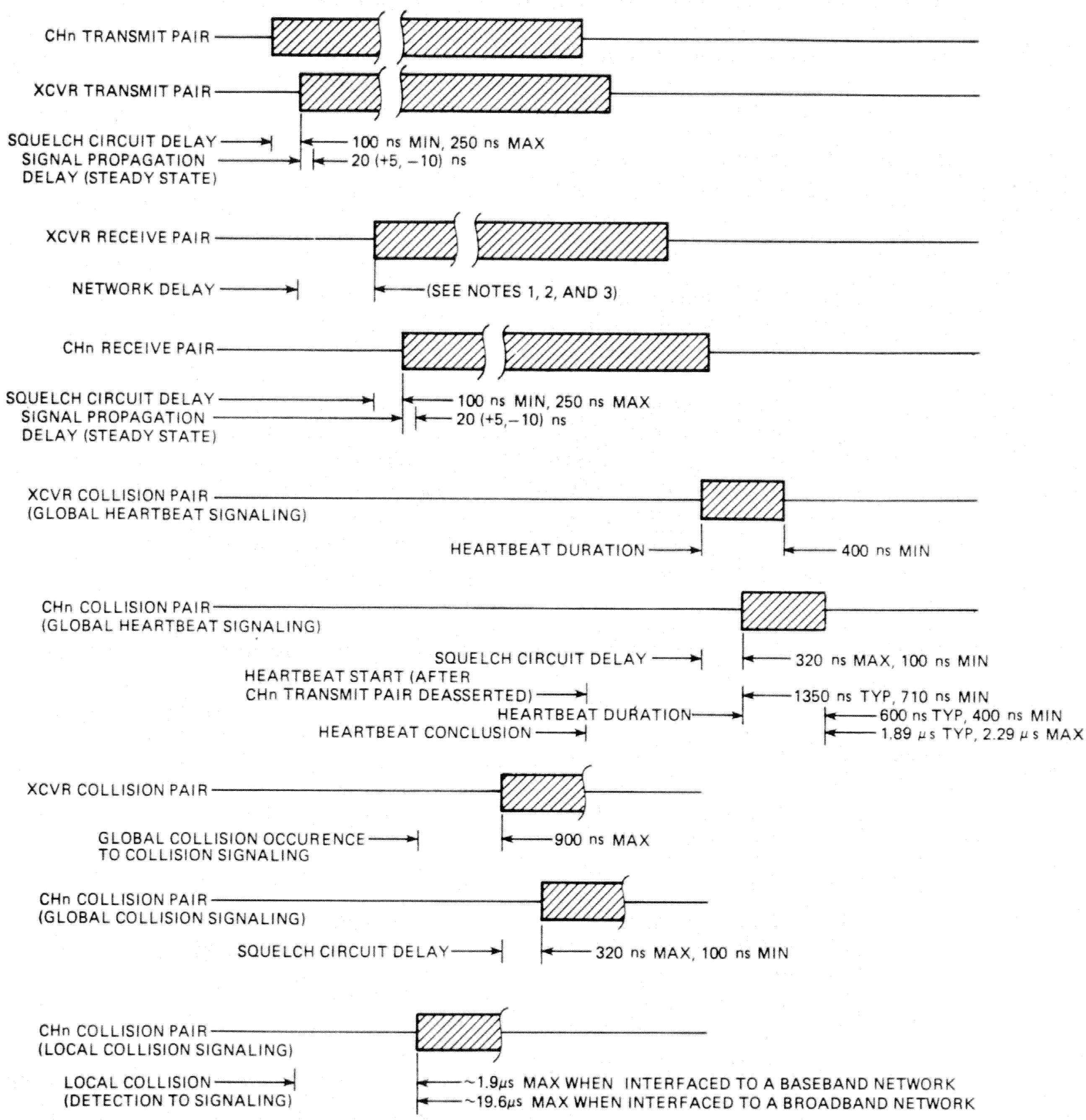



Figure 3-3 GLOBAL Mode Signal Flow Diagram




NOTES:

1. IN THE TWO-TIER DELNI ENVIRONMENT, THE DELAY WILL BE 788 ns MAX, WHICH INCLUDES DELAYS AS FOLLOWS:
   50 M TRANSCEIVER CABLE (5.13 ns/m), ROUND TRIP DELAY 513 ns
   SQUELCH TURN-ON DELAY OF DELNI UNIT, 250 ns MAX
   STEADY-STATE DELAY THROUGH DELNI UNIT, 25 ns MAX
2. IN A CONNECTED DELNI LAN ENVIRONMENT, THE DELAY IS 900 ns MAX.
3. IN A CONNECTED DELNI LAN ENVIRONMENT, WHICH INTERFACES TO A BROADBAND NETWORK, THE DELAY IS ~19.6 μs MAX.

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Figure 3-4 GLOBAL Mode Signal Timing Diagram

## 3.3 INPUT/OUTPUT CIRCUIT AND SIGNAL CHARACTERISTICS

### 3.3.1 CHn TRANSMIT Pair Signal Requirements

- DELNI local connector pins
  - CHn TRANSMIT (+) Pin 3
  - CHn TRANSMIT (–) Pin 10
- Signal level (measured differentially)
  - 800 mV peak-to-peak minimum
  - 2400 mV peak-to-peak maximum

**NOTE**

**During the idle state, the output of the circuit driving the CHn TRANSMIT pair must be high. However, during the idle state, the output voltage decays to zero due to transformer coupling at the DELNI input. The first transition of the signal asserted on the CHn TRANSMIT pair must be negative going; the last transition must be positive going.**

### 3.3.2 CHn TRANSMIT Pair Circuit Response

The CHn TRANSMIT pair is transformer-coupled to a squelch circuit, line receiver, and data gate.

The characteristics of the input circuitry associated with the CHn TRANSMIT pair are as follows.

- Input impedance

| | |
|---|---|
| – Differential mode @10 MHz | 78 ±3.9 Ω |
| – Common mode (3 MHz to 20 MHz) | 18.5 Ω minimum |

- Isolation transformer

| | |
|---|---|
| – Magnetizing inductance | 30 μH ±10% |
| – Isolation withstanding voltage | 270 V rms minimum |
| – Common mode voltage | ±30 V |

- Squelch parameters
  - The squelch circuit turns OFF only in response to valid Ethernet signals, remains OFF during the transmission interval, and turns ON again after the end of the transmission interval. While the squelch is OFF, it allows the data asserted on the CHn TRANSMIT pair to pass through the data gate.
  - The squelch circuit has three parameters: turn-off, stay-off, and turn-on. The following information specifies squelch action relative to input signal parameters. Note that in the following list of parameters, –400 is less than –500.

| | |
|---|---|
| Turn-off voltage | –350 mV typical, –400 mV minimum |
| Turn-off time | 100 ns minimum, 250 ns maximum |
| Stay-off voltage | –200 mV minimum |
| Turn-on voltage | –150 mV typical, –100 mV maximum |
| Turn-on time | 120 ns minimum, 270 ns maximum |

### 3.3.3 CHn RECEIVE Pair Circuit Characteristics

The characteristics of the circuitry associated with the CHn RECEIVE pairs are as follows.

- Source impedance of driver
  - 430 Ω typical
  - 408 Ω minimum
- Isolation transformer
  - Magnetizing inductance 30 μH ±10%
  - Isolation withstanding voltage 270 V rms minimum

### 3.3.4 CHn RECEIVE Pair Signal Characteristics

- DELNI local connector pins
  - CHn RECEIVE (+) Pin 5
  - CHn RECEIVE (−) Pin 12
- Signal level into 78 ±5 Ω (measured differentially)
  - 1100 mV peak-to-peak minimum
  - 1500 mV peak-to-peak maximum
- Timing asymmetry (duty cycle timing variance for a minimum voltage 10 MHz signal having a 50% duty cycle)
  - 1 ns typical
  - 2 ns maximum
- Signal rise/fall time (20% to 80%)
  - 3.5 ns typical
  - 1.5 ns minimum
  - 5.0 ns maximum

**NOTE**

**During the idle state, the output of the circuits driving the CHn RECEIVE pairs is high. However, during the idle state, the output voltage decays to zero due to transformer coupling. The first transition of the signal asserted on the CHn RECEIVE pairs is negative going; the last transition is positive going.**

### 3.3.5 CHn COLLISION PRESENCE Pair Circuit Characteristics

The characteristics of the circuitry associated with the CHn COLLISION PRESENCE pairs are as follows.

- Source impedance of driver
  - 430 Ω typical
  - 408 Ω minimum
- Isolation transformer
  - Magnetizing inductance 30 μH ±10%
  - Isolation withstanding voltage 270 V rms minimum

### 3.3.6 CHn COLLISION PRESENCE Pair Signal Characteristics

- DELNI local connector pins
  - CHn COLLISION PRESENCE (+) Pin 2
  - CHn COLLISION PRESENCE (−) Pin 9
- Signal level into 78 ±5 Ω (measured differentially)
  - 1100 mV peak-to-peak minimum
  - 1500 mV peak-to-peak maximum
- Signal frequency
  - 10 ±1 MHz
- Timing asymmetry (duty cycle timing variance for a minimum voltage 10 MHz signal having a 50% duty cycle)
  - 1 ns typical
  - 2 ns maximum
- Signal rise/fall time (20% to 80%)
  - 3.5 ns typical
  - 1.5 ns minimum
  - 5.0 ns maximum

**NOTE**

**During the idle state, the output of the circuits driving the CHn COLLISION PRESENCE pairs is high. However, during the idle state, the output voltage decays to zero due to transformer coupling. The first transition of the signal asserted on the CHn COLLISION PRESENCE pairs is negative going.**

### 3.3.7 XCVR TRANSMIT Pair Circuit Characteristics

The characteristics of the circuitry associated with the XCVR TRANSMIT pair are as follows.

- Source impedance of driver
  - 430 Ω typical
  - 408 Ω minimum

### 3.3.8 XCVR TRANSMIT Pair Signal Characteristics

- DELNI global connector pins
  - XCVR TRANSMIT (+) Pin 3
  - XCVR TRANSMIT (−) Pin 10
- Signal level into 78 ±5 Ω (measured differentially)
  - 1100 mV peak-to-peak minimum
  - 1500 mV peak-to-peak maximum
- Timing asymmetry (duty cycle timing variance for a minimum voltage 10 MHz signal having a 50% duty cycle)
  - 1 ns typical
  - 2 ns maximum
- Signal rise/fall time (20% to 80%)
  - 3.5 ns typical
  - 1.5 ns minimum
  - 5.0 ns maximum

**NOTE**

**During the idle state, the output of the circuit driving the XCVR TRANSMIT pair is high. However, during the idle state, the output voltage decays to zero due to transformer coupling in the network device to which the signal is asserted. The first transition of the signal asserted on the XCVR TRANSMIT pair is negative going; the last transition is positive going.**

### 3.3.9 XCVR RECEIVE Pair Signal Requirements

- DELNI global connector pins
  - XCVR RECEIVE (+) Pin 5
  - XCVR RECEIVE (−) Pin 12
- Signal level (measured differentially)
  - 800 mV peak-to-peak minimum
  - 2400 mV peak-to-peak maximum

**NOTE**

**During the idle state, the output of the circuit driving the XCVR RECEIVE pair is high. However, during the idle state, the output voltage decays to zero due to transformer coupling. The first transition of the signal asserted on the XCVR RECEIVE pair must be negative going; the last transition must be positive going.**

### 3.3.10 XCVR RECEIVE Pair Circuit Response

The XCVR RECEIVE pair is asserted to a squelch circuit and data gate.

The characteristics of the input circuitry associated with the XCVR RECEIVE pair are as follows.

- Input impedance
  - Differential mode @10 MHz — 78 ±3.9 Ω
  - Common mode (3 MHz to 20 MHz) — 18.5 Ω minimum
- Common mode voltage (relative to 12 V return line)
  - +2.1 V minimum
  - +5.4 V maximum
- Squelch parameters
  - Same as specified for the CHn TRANSMIT pair (refer to Section 3.3.2).

### 3.3.11 XCVR COLLISION PRESENCE Pair Signal Requirements

- DELNI global connector pins
  - XCVR COLLISION PRESENCE (+) Pin 2
  - XCVR COLLISION PRESENCE (–) Pin 9
- Signal level (measured differentially)
  - 800 mV peak-to-peak minimum
  - 2400 mV peak-to-peak maximum

**NOTE**

**During the idle state, the output of the circuit driving the XCVR COLLISION PRESENCE pair must be high. However, during the idle state, the output voltage decays to zero due to transformer coupling. The first transition of the signal asserted on the XCVR COLLISION PRESENCE pair must be negative going; the last transition must be positive going.**

### 3.3.12 XCVR COLLISION PRESENCE Pair Circuit Response

The XCVR COLLISION PRESENCE pair is asserted to a squelch circuit.

The characteristics of the input circuitry associated with the XCVR COLLISION PRESENCE pair are as follows.

- Input impedance

| | |
|---|---|
| – Differential mode @10 MHz | 78 ±3.9 Ω |
| – Common mode (3 MHz to 20 MHz) | 18.5 Ω minimum |

- Common mode voltage (relative to 12 V return line)
  - +2.1 V minimum
  - +5.4 V maximum
- Squelch parameters
  - The squelch circuit turns OFF only in response to valid Ethernet signals, remains OFF while the signal remains asserted, and turns ON again after the signal input has ended. While the collision presence squelch is turned OFF, it enables the DELNI unit to generate and assert a 10 MHz signal on the CHn COLLISION PRESENCE pairs.
  - The squelch circuit has three parameters: turn-off, stay-off, and turn-on. The following information specifies squelch action relative to input signal parameters. Note that in the following list of parameters −400 is less than −500.

| | |
|---|---|
| Turn-off voltage | −350 mV typical, −400 mV minimum |
| Turn-off time | 100 ns minimum, 250 ns maximum |
| Stay-off voltage | −200 mV minimum |
| Turn-on voltage | −150 mV typical, −100 mV maximum |
| Turn-on time | 120 ns minimum, 270 ns maximum |

### 3.3.13 XCVR POWER Pair Characteristics

The XCVR POWER pair of the DELNI unit provides a +12 V power source for an Ethernet transceiver.

The +12 V power source is short-circuit protected by a current-limiting circuit within the DELNI unit. The power source can withstand an externally applied voltage [to XCVR POWER (+) pin with respect to XCVR POWER (RTN) pin] of +15 V maximum without damage to the power source.

The XCVR POWER pair meets the requirements for Class 2 wiring devices.

The general output characteristics are as follows.

- DELNI global connector pins
  - XCVR POWER (+) Pin 13
  - XCVR POWER (RTN) Pin 6
- Output voltage (Vout)
  - No load (Iout<Imin)

    19 V peak
  - Imin<Iout<Imax

    12.5 V typical
    14.0 V maximum
    11.4 V minimum

NOTE

**The output voltage is regulated within the given range over the intended operational current range of Iout min to Iout max. Output current above Iout max may cause the supply to come out of regulation and reduce the output voltage.**

- Output current (Iout)
  - 0.5 A rms maximum (continuous)
  - 0.025 A rms minimum
- Output current at current limit (output current into 0 V for the current limit mode)
  - 2.5 A rms typical
  - 4.0 A rms maximum
  - 2.0 A rms minimum
- Ripple voltage
  - 0.5 V peak-to-peak (includes both ripple frequency components)

- Ripple frequency
  - 40 kHz typical
  - 44 kHz maximum
  - 36 kHz minimum

NOTE

**The output ripple has two frequency components: one at double the line frequency and one at the power supply switching frequency.**

### 3.3.14 XCVR POWER Pair External Load Requirements

Specific external load requirements are as follows.

- Maximum reactive load

| | |
|---|---|
| – Capacitance | 2000 $\mu$F |
| – Inductance | 1 mH |

- Maximum continuous load current fluctuations

| | |
|---|---|
| – 0 to 20 kHz | 200 mA peak-to-peak |
| – 20 kHz to 1 MHz | 500 mA peak-to-peak |

## 3.4 INPUT POWER REQUIREMENTS

The input power requirements for the DELNI unit are as follows.

- Voltage/frequency/phase
  - 90-128 Vac/47-63 Hz/single phase
  - 180-256 Vac/47-63 Hz/single phase
- Current (steady state)
  - 0.35 A at 120 Vac
  - 0.18 A at 240 Vac
- Inrush current
  - 10 A at 120 Vac
  - 5 A at 240 Vac
- Surge current
  - 2 A for 5 cycles at 120 Vac
  - 1 A for 5 cycles at 240 Vac

- Apparent power
  - 36 W at 120 Vac
  - 36 W at 240 Vac
- Maximum power consumption
  - 26 W at 120 Vac
  - 26 W at 240 Vac
- Input power protection
  - Fuse

    3AG, 0.5 A, Slo-Blo (U.S. version)
    5 × 20 mm, T, 0.5 A (European/GIA version)

## 3.5 ENVIRONMENTAL REQUIREMENTS

The DELNI unit is designed for use in a Digital Equipment Corporation Class C Environment (a non-air conditioned or exposed area in an industrial site).

The specific operational environmental conditions are as follows.

- Temperature
  - 5°C (41°F) to 50°C (122°F)

**NOTE**

**Temperature based on operation at sea level; 760 mm Hg (29.92 in Hg). Maximum allowable temperature is reduced by a factor of 1.8°C/1000 m (1°F/1000 ft) for operation at high altitude sites.**

- Relative humidity
  - 10% or less to 95% with maximum wet bulb 32°C (90°F) and minimum dew point 2°C (36°F).

# CHAPTER 4
# FUNCTIONAL
# THEORY OF OPERATION

## 4.1 DELNI CIRCUIT CHARACTERISTICS

Figure 4-1 shows a functional block diagram of the DELNI unit. As shown, the DELNI unit is made up of the following functional circuits.

- Power supply
- Operating mode control
- Eight local connector interfaces with each interface containing:
  - Isolation transformers,
  - Transmit pair squelch, line receiver, and data gate,
  - Receive pair line driver, and
  - Collision presence pair line driver.

**NOTE**

**For simplicity, only one of the eight local connector interfaces are shown in Figure 4-1. The RCV DATA, CHA COLL EN, and 10 MHz signals shown in Figure 4-1 are common to all eight local connector interfaces. The XMIT DATA n and XMIT n signal outputs are individual outputs of each local connector interface.**

- Data concentrator
- Data router
- Data presence and local collision detector
- Data enable/local collision control
- Local heartbeat timers
- Local/global heartbeat and collision signaling control
- 10 MHz oscillator
- Global XMIT data substitute
- Global Connector Interface which contains:
  - Transmit pair line driver,
  - Receive pair squelch, line receiver, and data gate, and
  - Collision presence signal detector.

### 4.1.1 Power Supply

The power supply uses a switching regulator to convert the 120/240 Vac input power to a regulated +4.9 Vdc output and a +12 Vdc output. The +4.9 Vdc output is used to power the DELNI unit. The +12 Vdc output is used to provide power to an Ethernet transceiver. The +12 Vdc output is not directly regulated, however, since both the +4.9 Vdc and +12 Vdc outputs are derived from the same output transformer, regulation of the +12 Vdc output is achieved by regulating the +4.9 Vdc output.

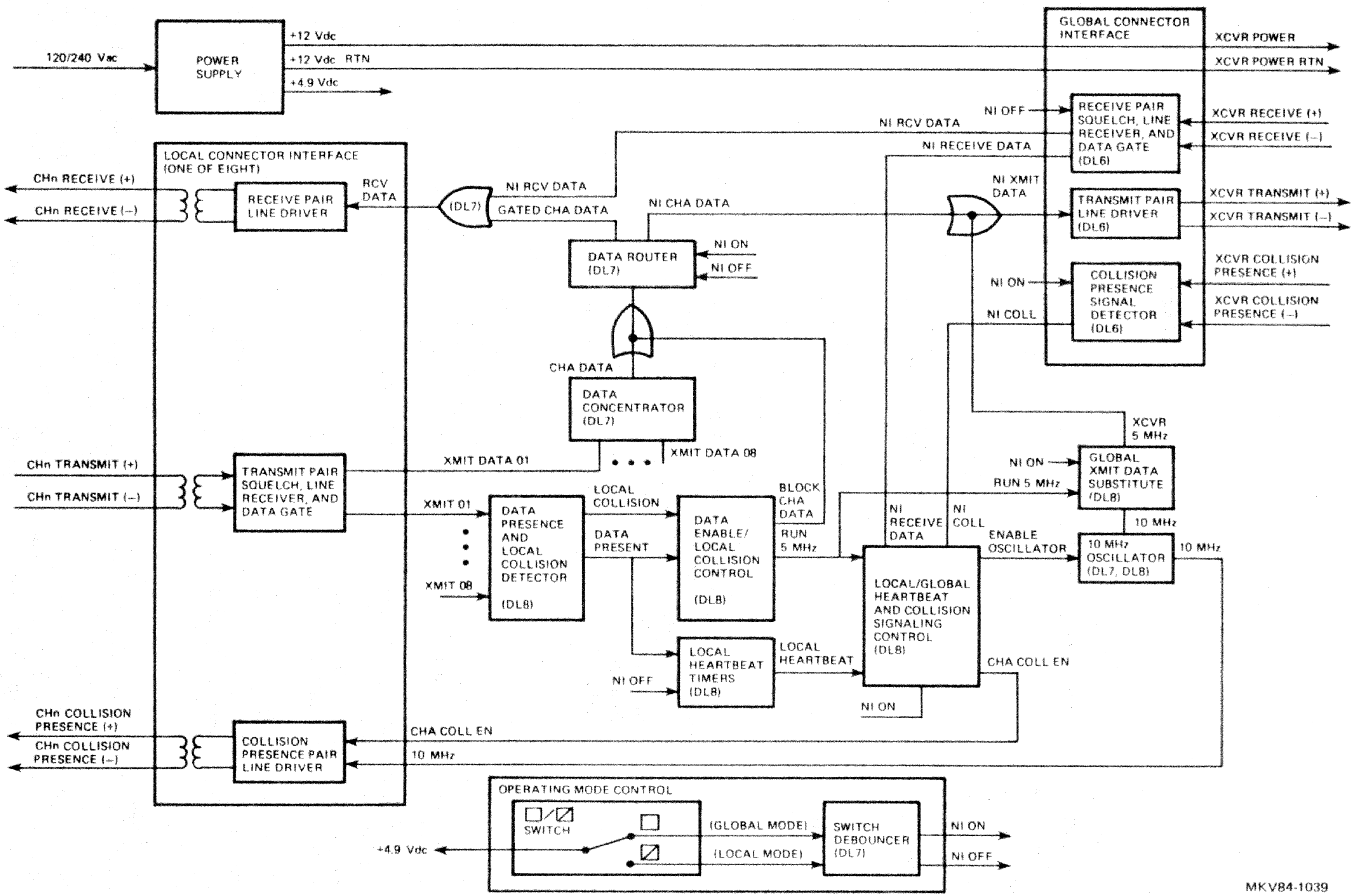


Figure 4-1 DELNI Functional Block Diagram

The two-position slide switch on the front panel makes the DELNI power supply compatible with either 120 Vac input or 240 Vac input. The +4.9 Vdc output of the power supply drives the power indicator light (green LED) on the front panel of the DELNI unit.

### 4.1.2 Operating Mode Control

The operating mode control consists of the □/☑ (GLOBAL/LOCAL) switch (located on the front panel of the DELNI unit) and a switch debouncer. The position of the □/☑ switch is used by the switch debouncer to assert the appropriate NI ON (GLOBAL mode) and NI OFF (LOCAL mode) outputs. The NI ON and NI OFF outputs are used to enable or inhibit functions of the DELNI unit as applicable to the selected operational mode.

### 4.1.3 Local Connector Interfaces

As shown in Figure 4-1, each of the eight local connector interfaces is made up of the following.

- Isolation transformers
- Transmit pair squelch, line receiver, and data gate
- Receive pair line driver
- Collision presence pair line driver

The isolation transformers are used to provide electrical isolation between the DELNI unit and the devices connected to the local connectors.

The transmit pair squelch, line receiver, and data gate perform the following functions.

- The transmit pair squelch provides noise immunity by ensuring that only valid Ethernet signals are passed through the data gate.

- The line receiver amplifies the signals received from the secondary of the isolation transformer.

- The data gate allows data from the line receiver to be passed to the XMIT DATA n output only after the transmit pair squelch parameters have been met.

The receive pair line driver amplifies the RCV DATA signal input and drives the CHn RECEIVE pair of the DELNI unit.

The collision presence pair line driver is enabled by the CHA COLL EN input. This line driver amplifies the 10 MHz signal and drives the CHn COLLISION PRESENCE pair of the DELNI unit.

### 4.1.4 Data Concentrator

The data concentrator combines the XMIT DATA n outputs of the eight local connector interfaces to a single data signal line (CHA DATA).

### 4.1.5 Data Router

The data router sends the CHA DATA input to either the GATED CHA DATA output (LOCAL mode) or to the NI CHA DATA output (GLOBAL mode) depending on the mode of operation selected.

### 4.1.6 Data Presence and Local Collision Detector

The data presence and local collision detector monitors the operation of the local connector interface transmitter squelch circuits to detect the following conditions.

- Data presence
  - Valid Ethernet signals are being asserted on any CHn TRANSMIT pair (that is, an XMIT n signal is asserted).
- Local collision
  - Two or more devices are attempting to transmit simultaneously (that is, more than one XMIT n signal is asserted).

### 4.1.7 Data Enable/Local Collision Control

The data enable/local collision control is used only during local collision conditions. When a local collision condition is detected (LOCAL COLLISION is asserted), the data enable/local collision control:

- Asserts BLOCK CHA DATA to inhibit the normal transmit data path.
- Asserts RUN 5 MHz to initiate local collision signaling and, if in GLOBAL mode of operation, initiates gating of substitute data to the global network device.

Once the data enable/local collision control has been set due to a local collision condition, it remains set for as long as any device remains transmitting.

### 4.1.8 Local Heartbeat Timers

The local heartbeat timers are used only during the LOCAL mode of operation to control the interval and the duration of the LOCAL HEARTBEAT signal.

The local heartbeat timers are charged during the interval that DATA PRESENT is asserted. When the DATA PRESENT signal is deasserted, the local heartbeat timers start a timeout sequence. The timeout sequence controls the interval and duration of the LOCAL HEARTBEAT signal.

### 4.1.9 Local/Global Heartbeat and Collision Signaling Control

The local/global heartbeat and collision signaling control is used to turn on the 10 MHz oscillator and enable the collision presence pair line drivers of the local connector interface.

*LOCAL mode operation*

During the LOCAL mode of operation, the local/global heartbeat and collision signaling control is used to control local collision condition signaling and local heartbeat signaling.

- Local heartbeat signaling – Asserts the ENABLE OSCILLATOR and the CHA COLL EN outputs for as long as the LOCAL HEARTBEAT signal is asserted.
- Local collision signaling – Asserts the ENABLE OSCILLATOR and the CHA COLL EN outputs for as long as the RUN 5 MHz signal is asserted.

*GLOBAL mode operation*

During the GLOBAL mode of operation, the local/global heartbeat and collision signaling control is used to signal local collision conditions, global collision conditions, and global heartbeat.

- Local collision signaling
  - Asserts the ENABLE OSCILLATOR output in response to the RUN 5 MHz input.
  - Asserts the CHA COLL EN output in response to the NI RECEIVE DATA input.
- Global collision and global heartbeat signaling
  - Asserts the ENABLE OSCILLATOR and the CHA COLL EN outputs in response to the NI COLL input.

**4.1.10 10 MHz Oscillator**

The 10 MHz oscillator generates and asserts a 10 MHz square wave on the 10 MHz signal line in response to an ENABLE OSCILLATOR input.

**4.1.11 Global XMIT Data Substitute**

The global XMIT data substitute is used only during the GLOBAL mode of operation to maintain an average 50/50 duty cycle on the NI XMIT DATA signal line during local collision conditions.

The global XMIT data substitute is enabled by the RUN 5 MHz signal input when the DELNI unit is in the GLOBAL mode of operation (NI ON is asserted).

The global XMIT data substitute generates the XCVR 5 MHz signal from the 10 MHz input.

**4.1.12 Global Connector Interface**

As shown in Figure 4-1, the global connector interface is made up of the following.

- Transmit pair line driver
- Receive pair squelch, line receiver, and data gate
- Collision presence signal detector

The transmit pair line driver amplifies the NI XMIT DATA signal input and drives XCVR TRANSMIT pair of the DELNI unit.

The receive pair squelch, line receiver, and data gate is enabled only when the DELNI unit is in the GLOBAL mode of operation (NI OFF asserted). These circuits perform the following functions.

- The receive pair squelch provides noise immunity by ensuring that only valid Ethernet signals on the XCVR RECEIVE pair are passed through the data gate. The receive pair squelch also asserts the NI RECEIVE DATA signal output when the receive pair squelch parameters have been met.

- The line receiver amplifies the signals received on the XCVR RECEIVE pair.

- The data gate allows data from the line receiver to be passed to the NI RCV DATA signal line only after the receive pair squelch parameters have been met.

The collision presence signal detector is enabled only when the DELNI unit is in the GLOBAL mode of operation (NI ON asserted). The collision presence signal detector is a squelch circuit that asserts the NI COLL output signal when a valid signal is asserted on the XCVR COLLISION PRESENCE pair.

## 4.2 DELNI FUNCTIONAL OPERATION

To provide a cohesive functional theory of operation, the operation of the DELNI unit is discussed relative to the functions performed in each operational mode.

### 4.2.1 LOCAL Mode Functional Theory

**4.2.1.1 Transmit/Receive** – The DELNI unit provides the data paths between the CHn TRANSMIT and RECEIVE pairs of the local connectors. The data path between the CHn TRANSMIT pairs and CHn RECEIVE pairs is made up of the following functional circuits (refer to Figure 4-1).

- Local connector interface transmit pair squelch, line receiver, and data gate
- Data concentrator
- Data router
- Local connector interface receive pair line driver

The signals asserted on any one of the eight CHn TRANSMIT pairs are coupled through an isolation transformer and asserted to the associated transmit pair squelch and line receiver. The line receiver amplifies the signals asserted on the CHn TRANSMIT pair and asserts the amplified signals to the data gate.

The transmitter squelch turns OFF only after the differential signal input has met the specific threshold and timing requirements outlined in Chapter 2.

When the transmitter squelch turns OFF, it enables the data gate to pass the output of the line receiver to the XMIT DATA n signal line. Also, when the squelch turns OFF, it asserts an XMIT n signal to the data presence and local collision detector.

The eight XMIT DATA n signal lines are ORed together. This is allowed, since according to Ethernet protocol, for a valid transmission to occur, only one device may be transmitting at any one time. The data concentrator performs the OR function to concentrate the XMIT DATA n signal lines to the CHA DATA signal line.

The CHA DATA output of the data concentrator is wire ORed with the BLOCK CHA DATA signal from the data enable/local collision control. The BLOCK CHA DATA signal is asserted only during local collision conditions to block the conflicting data signals from being asserted to the data router.

In the LOCAL mode of operation, the data router asserts the CHA DATA input on the GATED CHA DATA output.

The GATED CHA DATA output is coupled through an OR gate to the RCV DATA input of all local connector interface receive pair line drivers. These line drivers amplify the RCV DATA signal input and drive CHn RECEIVE pairs.

**4.2.1.2 Local Heartbeat Signaling** – Local heartbeat signaling is performed by the following functional circuits (refer to Figure 4-1).

- Data presence and local collision detector
- Local heartbeat timers
- Local/global heartbeat and collision signaling control
- 10 MHz oscillator
- Local connector interface collision presence pair line drivers

During each transmission interval, an XMIT n signal is asserted to the data presence and local collision detector by the local connector interface squelch circuit. At the end of the transmission interval, the squelch circuit deasserts the XMIT n signal. While the XMIT n signal is asserted, the data presence and local collision detector asserts DATA PRESENT.

The local heartbeat timers use the DATA PRESENT signal to generate the LOCAL HEARTBEAT signal. The local heartbeat timers contain two RC networks. While DATA PRESENT is asserted, it conditions the RC networks. When DATA PRESENT is deasserted, the RC networks, which are coupled to differential amplifiers, control assertion of the LOCAL HEARTBEAT signal. This output is asserted approximately 0.8 $\mu$s after the DATA PRESENT signal is deasserted and remains asserted for approximately 1.4 $\mu$s. This provides a 0.6 $\mu$s window following each transmission interval in which heartbeat signaling is performed.

The LOCAL HEARTBEAT signal enables the ENABLE OSCILLATOR and CHA COLL EN outputs of the local/global heartbeat and collision signaling control.

The ENABLE OSCILLATOR signal turns on the 10 MHz oscillator, which sends a 10 MHz signal to each of the local connector interface collision presence pair line drivers.

The CHA COLL EN signal enables the local connector interface collision presence pair line drivers to pass the 10 MHz signal to the CHn COLLISION PRESENCE pairs.

**4.2.1.3 Local Collision Detection** – Local collision detection is performed by the data presence and local collision detector shown in Figure 4-1.

When valid Ethernet signals are asserted on a CHn TRANSMIT pair, the associated local connector interface squelch circuit turns OFF. While the associated squelch circuit is OFF, it asserts an XMIT n signal to the data enable and local collision detector.

The data enable and local collision detector incorporates an exclusive OR circuit that asserts the LOCAL COLLISION output if more than one XMIT n signal is asserted.

**4.2.1.4 Local Collision Signaling** – Local collision signaling is performed by the following functional circuits (refer to Figure. 4-1).

- Data enable/local collision control
- Local/global heartbeat and collision signaling control
- 10 MHz oscillator
- Local connector interface collision presence pair line drivers

When a local collision condition is detected, a LOCAL COLLISION signal is asserted to the data enable/local collision control. This circuit responds to the LOCAL COLLISION signal by asserting the BLOCK CHA DATA and RUN 5 MHz outputs.

The BLOCK CHA DATA and RUN 5 MHz signals remain asserted until all CHn TRANSMIT pairs become inactive. When this happens, the DATA PRESENT output of the data presence and local collision detector is deasserted. When DATA PRESENT is deasserted, the BLOCK CHA DATA and RUN 5 MHz outputs of the data enable/local collision control are deasserted.

The BLOCK CHA DATA output is wire ORed with the CHA DATA output of the data concentrator. When the BLOCK CHA DATA signal is asserted, it blocks the conflicting data outputs from being asserted to the data router.

The RUN 5 MHz output is asserted to the local/global heartbeat and collision signaling control, where it enables the the ENABLE OSCILLATOR and CHA COLL EN outputs.

The ENABLE OSCILLATOR signal turns ON the 10 MHz oscillator, which sends a 10 MHz signal to each of the local connector interface collision presence pair line drivers.

The CHA COLL EN signal enables the local connector interface collision presence pair line drivers to pass the 10 MHz signal to the CHn COLLISION PRESENCE pairs.

### 4.2.2 GLOBAL Mode Functional Theory

**4.2.2.1 Transmit** – The DELNI provides the data paths between the CHn TRANSMIT pairs of the local connectors and XCVR TRANSMIT pair of the global connector interface. The data path between any of the CHn TRANSMIT signal line pair inputs and the XCVR TRANSMIT signal line pair outputs is made up of the following functional circuits (refer to Figure 4-1).

- Local connector interface transmit pair squelch, line receiver, and data gate
- Data concentrator
- Data router
- Global connector interface transmit pair line driver

The signals asserted on any one of the eight CHn TRANSMIT pairs are coupled through an isolation transformer and asserted to the associated transmit pair squelch and line receiver. The line receiver amplifies the signals and asserts them to the data gate.

The transmitter squelch turns OFF only after the differential signal input has met the specific threshold and timing requirements outlined in Chapter 2.

When the transmitter squelch turns OFF, it enables the data gate to pass the output of the line receiver to the XMIT DATA n signal line. Also, when the squelch turns OFF, it asserts an XMIT n signal to the data presence and local collision detector.

The eight XMIT DATA n signal lines are wire ORed together. This is allowed, since according to Ethernet protocol, for a valid transmission to occur, only one device may be transmitting at any one time. The data concentrator performs the OR function to concentrate the XMIT DATA n signal lines to the CHA DATA signal line.

The CHA DATA output of the data concentrator is wire ORed with the BLOCK CHA DATA signal from the data enable/local collision control. The BLOCK CHA DATA signal is asserted only during local collision conditions to block conflicting data signals from being asserted to the data router.

In the GLOBAL mode of operation, the data router asserts the CHA DATA input on the NI CHA DATA output.

The NI CHA DATA output is wire ORed with the XCVR 5 MHz output of the global XMIT data substitute to produce the NI XMIT DATA signal. The XCVR 5 MHz signal is asserted only during local collision conditions.

The NI XMIT DATA signal goes to the transmit pair line driver, which sends the data on the XCVR TRANSMIT pair.

**4.2.2.2 Local Collision Detection** – Local collision detection is performed by the data presence and local collision detector shown in Figure 4-1.

When valid Ethernet signals are asserted on a CHn TRANSMIT pair, the associated local connector interface squelch circuit turns OFF. While the associated squelch circuit is OFF, it asserts an XMIT n signal to the data enable and local collision detector.

The data enable and local collision detector incorporates an exclusive OR circuit that asserts the LOCAL COLLISION output if more than one XMIT n signal is asserted.

**4.2.2.3 Local Collision Condition Data Control and Collision Signaling –** When a local collision condition is detected during the GLOBAL mode of operation, the DELNI unit performs the following.

- Blocks the CHA DATA signal from being asserted on the NI CHA DATA signal line. (This signal is blocked since it results from the signal inputs from more than one transceiver and thus may not conform to Ethernet requirements.)

- Asserts a 5 MHz square wave signal on the NI XMIT DATA signal line to ensure that the signals asserted on the XCVR TRANSMIT pair of the DELNI unit maintain a 50/50 duty cycle. The DELNI unit ensures that the transmission attémpt is recognized by the global network device.

- Signals the transmitting devices that a collision condition exists.

The local collision condition data control and collision signaling function of the DELNI unit is implemented by the following functional circuits (refer to Figure 4-1).

- Data enable/local collision control
- Local/global heartbeat and collision signaling control
- 10 MHz oscillator
- Global XMIT data substitute
- Local connector interface collision presence pair line drivers

When a local collision condition is detected, the data presence and local collision detector asserts the LOCAL COLLISION signal. This signal sets the data enable/local collision control causing it to assert the BLOCK CHA DATA and RUN 5 MHz signals.

The BLOCK CHA DATA output is wire ORed with the CHA DATA output of the data concentrator. When the BLOCK CHA DATA signal is asserted, it blocks the conflicting data outputs from being asserted to the data router.

The RUN 5 MHz output is asserted to the local/global heartbeat and collision signaling control and to the global XMIT data substitute. At the local/global heartbeat and collision signaling control, the RUN 5 MHz input causes the ENABLE OSCILLATOR signal to be asserted. The ENABLE OSCILLATOR signal turns on the 10 MHz oscillator.

At the global XMIT data substitute, the RUN 5 MHz signal enables the XCVR 5 MHz signal to be generated from the 10 MHz input. The XCVR 5 MHz signal is asserted on the NI XMIT DATA input to the global connector interface transmit pair line driver.

The BLOCK CHA DATA and RUN 5 MHz signals remain asserted until all CHn TRANSMIT pairs become inactive. When this happens, the DATA PRESENT output of the data presence and local collision detector is deasserted. When DATA PRESENT is deasserted, the BLOCK CHA DATA and RUN 5 MHz outputs of the data enable/local collision control are deasserted.

The local collision condition is not signaled on the CHn COLLISION PRESENCE pairs of the DELNI until:

- The XCVR 5 MHz signal asserted on the XCVR TRANSMIT pair has been returned to the XCVR RECEIVE pair.
- The signal returned on the XCVR RECEIVE pair has been detected by the DELNI unit.

After valid Ethernet signals are asserted on the XCVR RECEIVE pair, the global connector interface receive pair squelch asserts an NI RECEIVE DATA signal. This signal indicates that data is being received by the DELNI unit.

The NI RECEIVE DATA signal is asserted to the local/global heartbeat and collision signaling control. Since the RUN 5 MHz is already asserted, the NI RECEIVE DATA input causes the CHA COLL EN output to be asserted. The CHA COLL EN signal enables the local connector interface collision presence line driver to pass the 10 MHz signal to the CHn COLLISION PRESENCE pairs.

**4.2.2.4 Receive** – The DELNI unit provides the data path between the XCVR RECEIVE pair of the global connector interface and the CHn RECEIVE pairs of the local connector interface. The data path between the XCVR RECEIVE pair and the CHn RECEIVE pairs is made up of the following functional circuits (refer to Figure 4-1).

- Global connector interface squelch, line receiver, and data gate
- Local connector interface receive pair line driver

The signals asserted on the XCVR RECEIVE pair are asserted to the global connector squelch, line receiver, and data gate. This functional circuit is enabled only during the GLOBAL mode of operation by the NI OFF signal input.

The line receiver amplifies the signals asserted on the XCVR RECEIVE pair and asserts the amplified signals to the data gate.

The squelch turns OFF only after the differential signal input has met the specific threshold and timing requirements outlined in Chapter 2.

When the squelch turns OFF, it enables the data gate to pass the output of the line receiver to the NI RCV DATA signal line. Also, when the squelch is turned OFF, it asserts an NI RECEIVE DATA signal used by the local/global heartbeat and collision signaling control.

The NI RCV DATA is coupled to the input of all of the local connector interface receive pair line drivers as the RCV DATA input.

Each of the local connector interface receive pair line drivers amplifies the RCV DATA input and drives the CHn RECEIVE pairs of the DELNI unit.

**4.2.2.5 Global Collision and Heartbeat Signal Detection** – The global connector interface collision presence signal detector (see Figure 4-1) provides monitoring of the XCVR COLLISION PRESENCE pair to detect global collision and heartbeat signaling.

The global connector interface collision presence signal detector is a squelch ciruit that is enabled only during the GLOBAL mode of operation by the NI ON signal input.

The squelch circuit is turned OFF only by valid Ethernet signal inputs. The squelch turns OFF only after the differential signal input has met the specific threshold and timing requirements outlined in Chapter 2.

When the squelch turns OFF, it asserts an NI COLL signal to the local/global heartbeat and collision signaling control. The presence of this signal indicates that a global collision or global heartbeat signal is being asserted by the global network device.

**4.2.2.6 Global Collision and Heartbeat Signaling** – The global collision and heartbeat signaling function of the DELNI is implemented by the following functional circuits (refer to Figure 4-1).

- Local/global heartbeat and collision signaling control
- 10 MHz oscillator
- Local connector interface collision presence pair line drivers

When a global collision or global heartbeat signal is detected, the global connector interface collision presence signal detector asserts an NI COLL signal. The NI COLL signal remains asserted for as long as the global collision or global heartbeat signal is present on the XCVR COLLISION PRESENCE pair.

Assertion of the NI COLL signal causes the local/global heartbeat and collision signaling control to assert the ENABLE OSCILLATOR and CHA COLL EN outputs.

The ENABLE OSCILLATOR output turns ON the 10 MHz oscillator, which sends a 10 MHz signal to the local connector interface collision presence pair line drivers.

The CHA COLL EN output enables the local connector interface collision presence pair line drivers to pass the 10 MHz signal to the CHn COLLISION PRESENCE pairs.

# CHAPTER 5
# MODULE REMOVAL AND REPLACEMENT INSTRUCTIONS

## 5.1 LOGIC MODULE REMOVAL PROCEDURE

To remove the logic module (P/N 54-15475/JQ) from the DELNI unit, perform the following procedure.

1. Disconnect ac power cord from facility power outlet.

NOTE

**The screws that secure the plastic case about the DELNI unit are captive screws. In Step 2 below, do not remove the screws from the plastic case.**

2. Loosen the four screws (Items 1 through 4, Figure 5-1) that hold the top and bottom sections of the plastic case together.
3. Remove the plastic case.
4. Remove the six screws (Items 1 through 6, Figure 5-2) that secure the metal casing cover in place.
5. Remove the metal casing cover.
6. Disconnect plug (Item 13) from connector (Item 9).
7. Remove the three screws (Items 7, 8, and 10) that secure the logic module to the metal casing.
8. Grasp the logic module at the areas designated (Points A and B in Figure 5-2) and gently pull the logic module in the direction indicated by the arrows until the logic module connectors disengage from the connector board bayonet connectors.

## 5.2 CONNECTOR BOARD REMOVAL PROCEDURE

To remove the connector board (P/N 54-15628/JQ), perform the logic module removal procedure (Section 5.1), and then perform the following procedure.

1. Remove the two screws (Shown in Detail A of Figure 5-1) that secure the slide latch to the global connector.
2. Remove the slide latch from the global connector.
3. Remove the seven screws (Items 11, 12, and 14 through 18, Figure 5-2) that secure the connector board to the metal housing.

NOTE

**In Step 4, use care in removing the connector board: the decal on the metal housing sticks to the LOCAL/GLOBAL switch on the connector board.**

4. Grasp the connector board at the top outside edges and pull gently away from the metal housing.

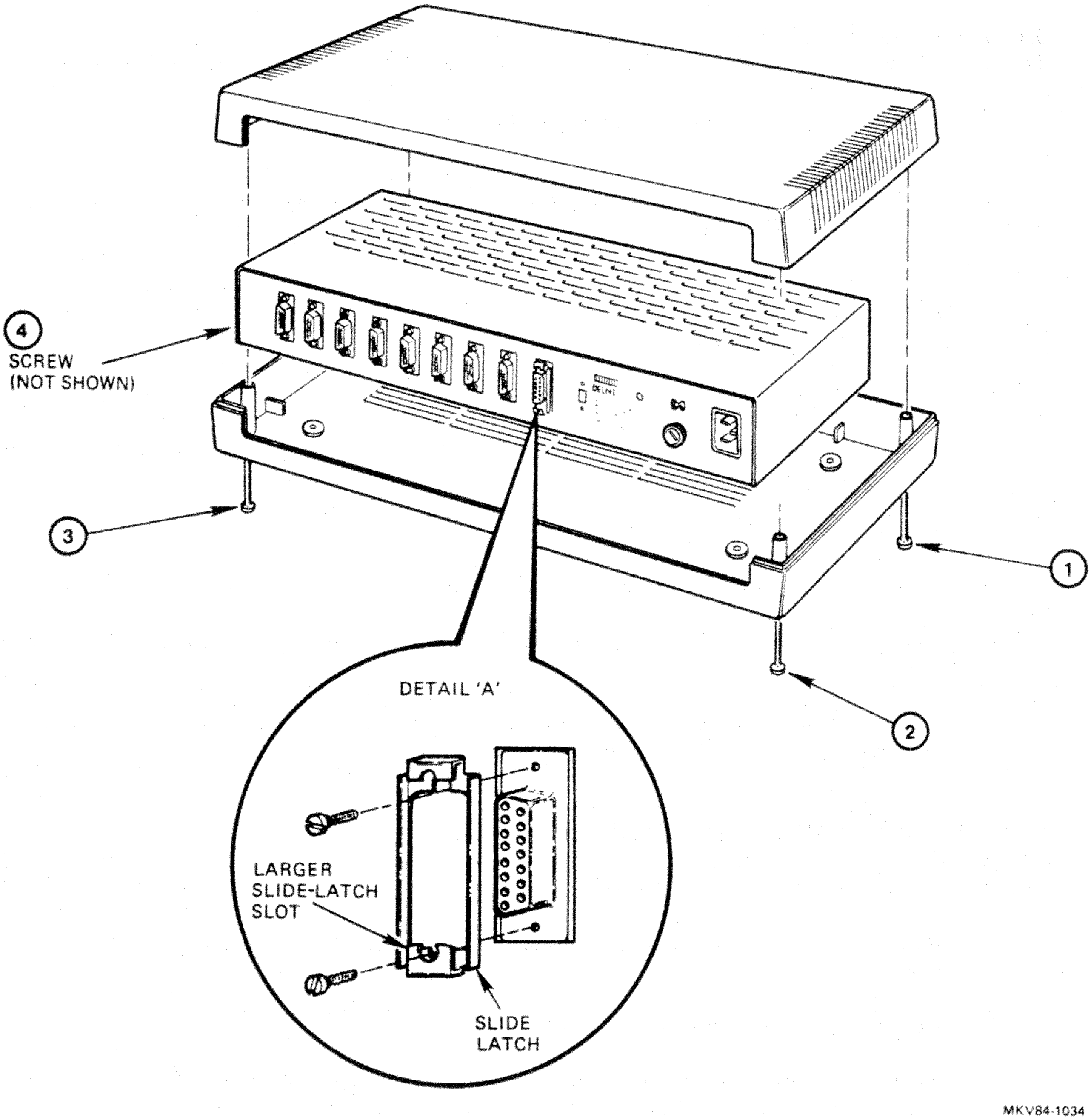


Figure 5-1 DELNI Plastic Case Removal

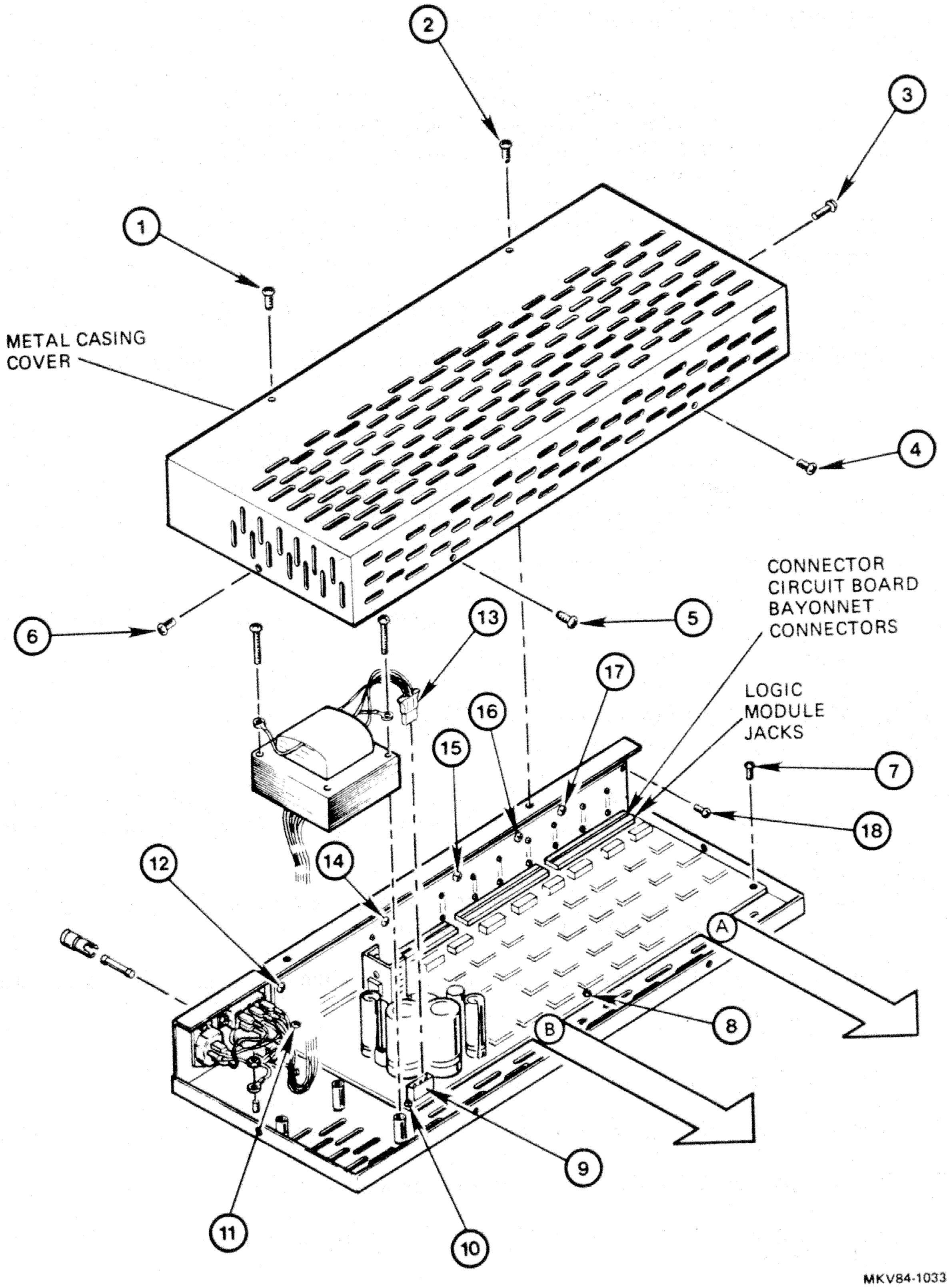


Figure 5-2 DELNI Exploded View

## 5.3 CONNECTOR BOARD INSTALLATION PROCEDURE

**NOTE**
**The metal housing of the DELNI unit contains raised metal strips directly behind the area where the lower portion of the connector board is to be positioned.**

1. Place the lower edge of the connector board between the raised metal strips of the metal housing and the front panel.

2. Place the connector board in position against the front panel.

3. Install the seven screws (Items 11, 12, and 14 through 18, Figure 5-2) that secure the connector board to the metal housing.

**NOTE**
**In Step 4, make certain that the large slide-latch slot (shown in Detail A of Figure 5-1) is positioned with the larger slide-latch slot on the bottom.**

4. Place the slide latch on the global connector.

5. Install the two screws (Shown in Detail A of Figure 5-1) that secure the slide latch to the global connector.

## 5.4 LOGIC MODULE INSTALLATION PROCEDURE

The following procedure assumes that the connector board is installed.

1. Grasp the logic module at the areas designated (Points A and B in Figure 5-2) and position the logic module such that the logic module jacks are aligned with the connector board bayonet connectors.

2. Mate the logic module jacks and connector board bayonet connectors by exerting an even pressure at the areas designated (Points A and B).

3. Install the three screws (Items 7, 8, and 10) that secure the logic module to the metal casing.

4. Connect plug (Item 13) to connector (Item 9).

5. Place the metal casing cover in the proper position.

6. Install the six screws (Items 1 through 6) that secure the metal casing cover in place.

7. Properly position the metal housing within the plastic case (see Figure 5-1).

8. Tighten the four screws (Items 1 through 4) that hold the top and bottom sections of the plastic case together.