Honeywell

Understand LCN Communication

L61523
LCN

TotalPlant

Notices and Trademarks

This module supports **TotalPlant** Solution (TPS) system network.

TPS is the evolution of TDC 3000X.

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TABLE OF CONTENTS

FIGURES

TABLES

MODULE INTRODUCTION

In this module you will learn the basic concepts of the TPS Network communication structure.

The following topics are discussed in this module:

- The LCN token-passing scheme
- LCN frame format
- Cable swapping
- Associated hardware
- Cable diagnostic displays

MODULE OBJECTIVE

This module will enable you to understand the LCN token-passing scheme, communication statistics, communication priority structure, and communication timeouts.

LCN GENERAL DESCRIPTION

The LCN is a baseband-type of local area network using digital signaling at a data rate of 5 mbits per second. It consists of interconnections of coaxial and fiber optic cable through which the LCN modules communicate. All LCN communications are carried over a redundant pair of coaxial cables (cable A and cable B). The digital signals are inserted on the coaxial cable as voltage pulses using manchester encoding.

LCN Interface

The interface between modules and the LCN cable consists of

- a single circuit board in the module chassis, and
- paddle boards mounted in the back of the module chassis.

The coaxial cable connects directly to the paddle board with a BNC "T" connector. The “T” connector allows you to disconnect a node from the coaxial cable segment without disrupting communication among the other nodes.

Each paddle board has one or two transceiver circuits. Each module has a separate transceiver for each of the redundant cables. In the 5- and 10-slot modules, one paddle board has both transceivers. In a dual node module, two paddle boards (KLCNA and KLCNB) each have a single transceiver.

The transceiver is an active device that is transformer-coupled to the coaxial cable. The transceivers electrically isolate the node from the LCN through the transformer coupling so that a single-component failure, or many other possible multiple-component failures, will not fail the entire LCN.

LCN TOKEN PASSING

Token-passing Ring

The LCN access mechanism is a token-passing scheme that determines when the LCN is available for communications by the nodes. Only one node can transmit at a time. A special message called a token is passed from node to node around the ring, establishing a logical ring; as a result, LCN nodes have a *physical bus* topology <u>and</u> a *logical ring* topology.

Only one node can transmit information at a time on the LCN. When a node receives the token, it can then transmit a message. The node terminates transmission of its message by passing the token to the next highest addressed node. If a node has no data to transmit, it passes the token immediately. The token represents the right to transmit information. Token passing is a function of the LCN interface.

Token Ring Initialization

If the LCNI encounters silence on the coaxial cables used for reception,

1. The node's processor sends a command to the LCNI to perform token-ring initialization.
2. The LCNI transmits a preamble for a time inversely proportional to its address.
3. The LCNI listens for silence for 5 microseconds to ensure that the LCN is quiet before attempting to send the token to the LCNI with the next highest address.

On simultaneous or near simultaneous ring-initialization commands, the node with the lowest address transmits a longer preamble than any of the other nodes; consequently, it becomes the ring initiator.

Subsequent Communications

The LCNI that is the ring initiator does the following:

- transmits data, then attempts to pass the token, or
- if it has no data to transmit, simply passes the token to the next highest address.

> **NOTE**
>
> Nodes physically located next to each other do not need to have consecutive addresses.

If the next consecutive address is not able to accept the token,

1. The sender tries to send the token to the next highest address, and so on until a node accepts the token.
2. The sending node remembers who finally accepts the token.

On the next pass

1. The sending node tries only one of the addresses that, on the previous pass, did not accept the token.
2. If the sending node still cannot successfully pass the token to that node, it sends the token to the node known to have accepted it on the previous rotation.

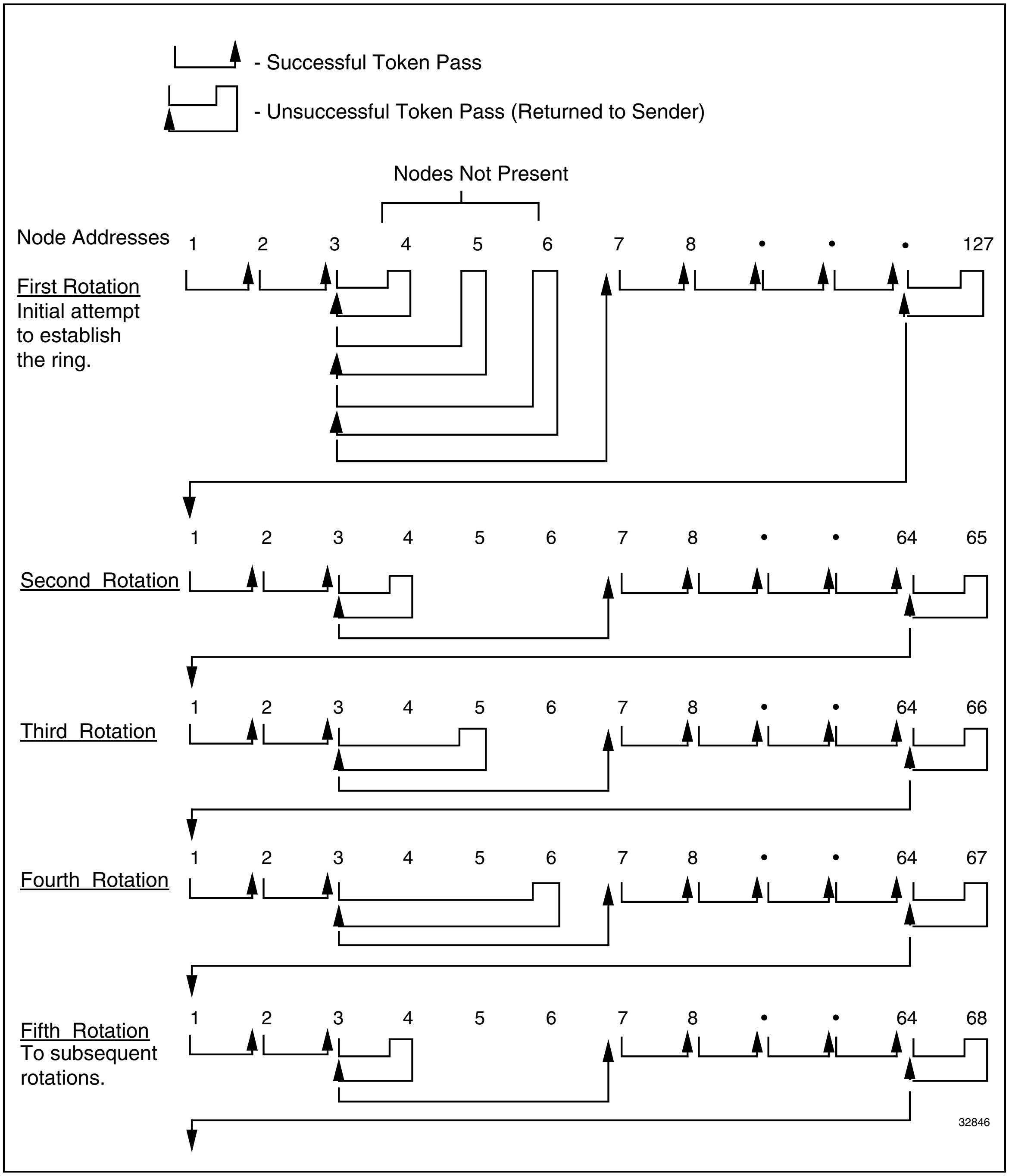


Figure 1 - Token-passing Scheme

LCN Hardware Addressing

The LCN hardware allows up to 127 addresses. Currently, the standard software allows 64 addresses; consequently, there is a gap between addresses 64 and 127. Theoretically, gaps in addressing may cause additional delays in communication; however, as a practical matter, the delays are inconsequential relative to the overall speed of LCN communications.

LCN Data Transmission

All LCN modules send all transmissions on both the A and B coaxial cables; however, a node listens on only one cable. The token frame itself indicates the cable on which the node is to listen.

When a node has the token, it can transmit a frame of information in one of three ways:

- to a particular node through a physical node-to-physical node message,
- to all nodes through a broadcast, or
- to a logical node through a multicast message using logical addressing.

LCN KEY FEATURES AND FUNCTIONS

Protocol

The LCN design is similar to the IEEE 802.4 token-bus standard for local area networks. The protocol has been customized to fit the exact needs of the Honeywell TPS Network architecture.

Redundancy

All LCN communications are carried over a redundant pair of coaxial cables. A separate transceiver circuit is transformer-coupled to both cables to provide electrical isolation between nodes.

Hardware Interface

The interface circuit board interfaces with the module bus and utilizes Direct Memory Access (DMA).

Data Transmission

Received data is converted from serial to parallel for a 16-bit wide transfer on the module bus. The transmitted data is converted from parallel to serial for transmission on the coaxial cables.

Before transmitting any type of frame, a node must not see any energy on either of the cables for a period of 5 microseconds. This is to ensure that the media is quiet and also to keep collisions from occurring. Collisions are extremely rare with this type of token-passing scheme.

Token Passing

The Local Control Network Interface (LCNI) board handles access control to determine when the LCN is available for use. The token-passing scheme is used.

Within the token frame there is a 16-bit cyclic redundancy check added to each frame for error detection in received data.

Physical and Logical Addressing

The LCN interface receives messages with a matching physical address (set in the hardware addressing of the node) or any of up to 8064 logical addresses. The set of logical addresses that can be accepted depends on the program and data loaded in that node.

Clock Signal

The transceivers can also accept the 12.5-kHz clock signal that may be carried on the coaxial cables. This signal is transported to the module bus by the interface board and is used by the processors in each node.

LCN PERFORMANCE SUMMARY

Table 1 lists the attributes of the Local Control Network:

Table 1 - LCN Attributes

Attribute	Description
Data rate	5-megabits per second
Maximum cable length	300 meters
Number of connected devices	40 maximum on a single coaxial cable segment. The hardware allows up to 127 addresses. Currently, Honeywell supports 64 addresses.
Size of information field within a frame	100 - 4088 bytes
Frame Check Sequence (FCS)	Cyclic Redundancy Check (CRC): 16 bits
Undetected error rate	Less than one per 1000 years
Detected error rate	Less than one per 3.3 minutes assuming bit error rate of one in 10E9 bits transmitted.
Token-pass time per node in (microseconds)	Formula for the preamble length: Preamble Length (microseconds) = [7 * (value + 1)] + 3 The default for the preamble parameter is 3 and is not usually changed. The preamble increases the token pass time per module to 44 microseconds.
Maximum token circulation time (64 nodes and largest information frame)	0.42 second (for both ppv=1 or ppv=3)
Minimum token circulation time (64 nodes with no information frame)	Normal minimum circulation time is 2.8 milliseconds with a preamble of three.
Data Format	Manchester Encoding is the format in which LCN data is transmitted. It is a secure form of data transmission. Because a low to high and high to low transition must occur exactly at mid-bit time, it is unlikely for a stray transmission to affect the data being sent. Example: See Figure 2.
Data Transmission	Data is transmitted serially starting with the least significant bit of a byte, and progressing to the most significant bit: • Least significant bit first • Most significant byte first

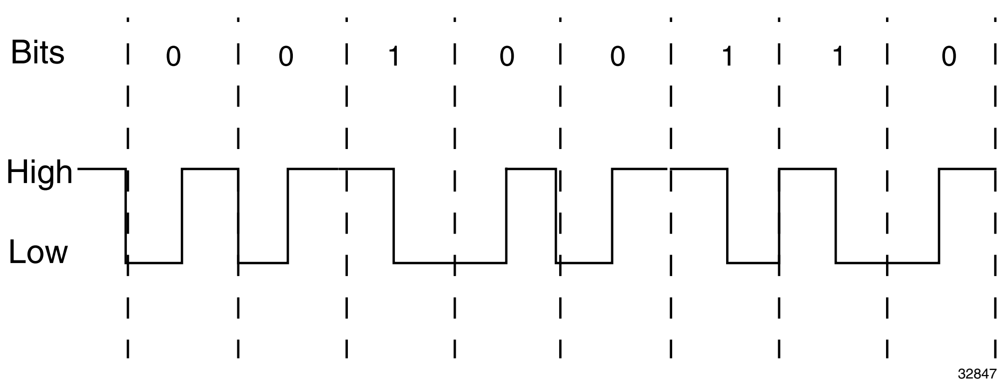
MANCHESTER ENCODING

For communication to take place between two digital devices (such as LCN nodes), a particular length of time is generally associated with the transmission of each bit. This is know as the *bit time* or *bit period*. Both the sending and receiving nodes must be in synchronization and must be able to determine when the beginning and end of each bit time occurs. The receiving device must be able to recognize when data is being transmitted and must be able to identify the portion of the signal that corresponds to each bit.

The LCN uses a type of data encoding called Manchester encoding. With Manchester encoding, a voltage transition occurs at mid-bit time within every bit period. These voltage transitions indicate data (binary ones and zeros). Manchester encoding is a very secure form of data transmission because an errant change in voltage would have to occur exactly at mid-bit time in order to be interpreted as data.

On the LCN, a transition at mid-bit time from high voltage to low voltage indicates a binary one. A transition from low to high voltage at mid-bit time indicates a binary zero. Low voltage is 0 volts, and high voltage is 700 millivolts. (Figure 2)

In addition to indicating data, the mid-bit transition also serves as a clock. The receiving node uses the occurrence of transitions in the signal to help in maintaining synchronization with the bit period.



- When a “0” is transmitted, the first half of the bit time is “low” and the second half of the bit time is “high.”
  There is a low-to-high transition at mid-bit.
- When a “1” is transmitted, the first half of the bit time is high and the second half of the bit time is “low”.
  There is a high to low transition at mid-bit.
- Low = 0 volts on LCN coaxial cable
  High = 700 millivolts on LCN coaxial cable

Figure 2 - Manchester Encoding Example

LCN FRAME FORMATS

Frame Types

The Local Control Network communications uses five frame types:

1. Token Pass Frame
2. Logically Addressed Information Frame
3. Unique (Physical) Addressed Information Frame
4. Diagnostic Frame
5. Processor Watchdog Time-out Frame

Frame Elements

Preamble

Each frame begins with a preamble field which is a voltage pattern used by the receiving station to establish bit synchronization.

Delimiters

A voltage signal held either high or low for the entire bit period indicates something other than data. Signal patterns other than a zero or one are typically used to identify the beginning and end of data blocks being transmitted. These signal patterns are knows as delimiters. Within an LCN frame there is always a Start-of-Frame delimiter and an End-of-Frame delimiter. The receiving node recognizes these sequences.

Address fields

The source address indicates the node that sent the frame. The destination address can be an individual address (as with a physical node to physical node type of frame), a group address (as with a multicast type of frame), or a broadcast address (a frame to be received by all nodes).

Frame Check Sequence

When the sending node assembles a frame, it performs a calculation on the bits in the frame. The sending node stores this value in the frame check sequence field and then transmits the frame. When the receiving node receives the frame, it performs the identical calculation and compares the results with the value in the frame check sequence field. If the two values do not match, the receiving node assumes that an error in transmission occurred, and will discard the frame.

Token Pass Frame

The token pass frame:

- Conveys the right to transmit on the LCN from one node to another.
- Contains no information and is always passed to a physical address.
- Is the normal method of terminating an LCN transaction, after a node sends its information or has no data to send.

The token pass frame consists of the following (see Figure 3):

- preamble,
- start-of-frame delimiter (SFD),
- destination address,
- source address,
- frame check sequence (FCS),
- end of frame delimiter (EFD).

The token pass frame, in addition to providing the right to transmit, indicates the LCN cable to be used for reception (bit 15 of the source address).

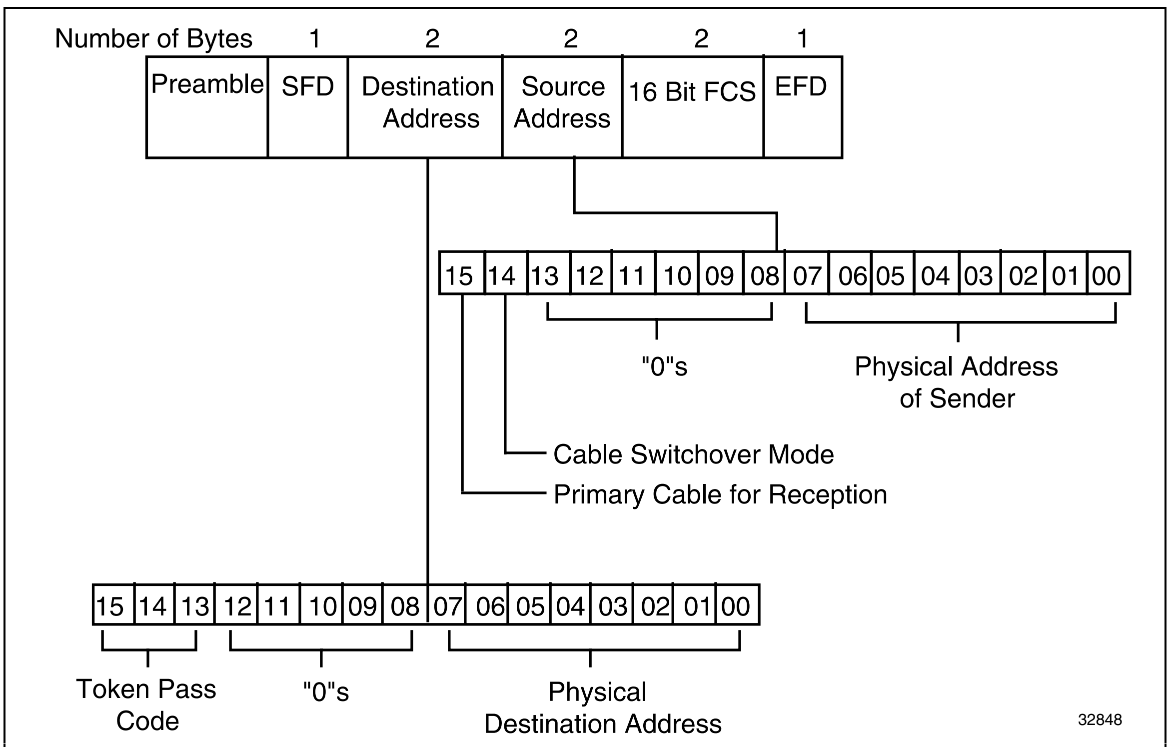


Figure 3 - Token Pass Frame

INFORMATION FRAME

Information frames

- Are used to transmit data.
- Must have an information field of at least 100 bytes long in order for the LCNI to keep up with the incoming data.
- Must not have an information field exceeding 4088 bytes.
- May be sent to either of the following
  - a physical address (1-127) corresponding to the address pinning on the LCNI paddle-board (unique in each node on the LCN), or
  - a logical address existing in software of any or all physical LCN nodes.

Information frames consists of the following (see Figures 4 and 5):

- preamble,
- start-of-frame delimiter (SFD),
- destination address (physical or logical),
- source address,
- information field,
- frame check sequence (FCS),
- end of frame delimiter (EFD).

Only one information frame can be sent for each token receipt.

> **NOTE**
>
> A broadcast message is a type of physical address information frame with a broadcast bit set (see Figure 5).

Logical Address Filter Table

The logical address filter table is

- located at a fixed location in the node's RAM memory,
- 1008 bytes long (contains 8064 bits),
- used as an enabling mask.

Each bit in the Logical Address Filter Table corresponds to a logical address determined by software. A "1" in a given bit location allows the LCNI to receive messages addressed to that logical address.

See Figure 4 for an information frame sent to a logical address. See Figure 5 for an information frame sent to a physical address. The physical address filter table is not implemented.

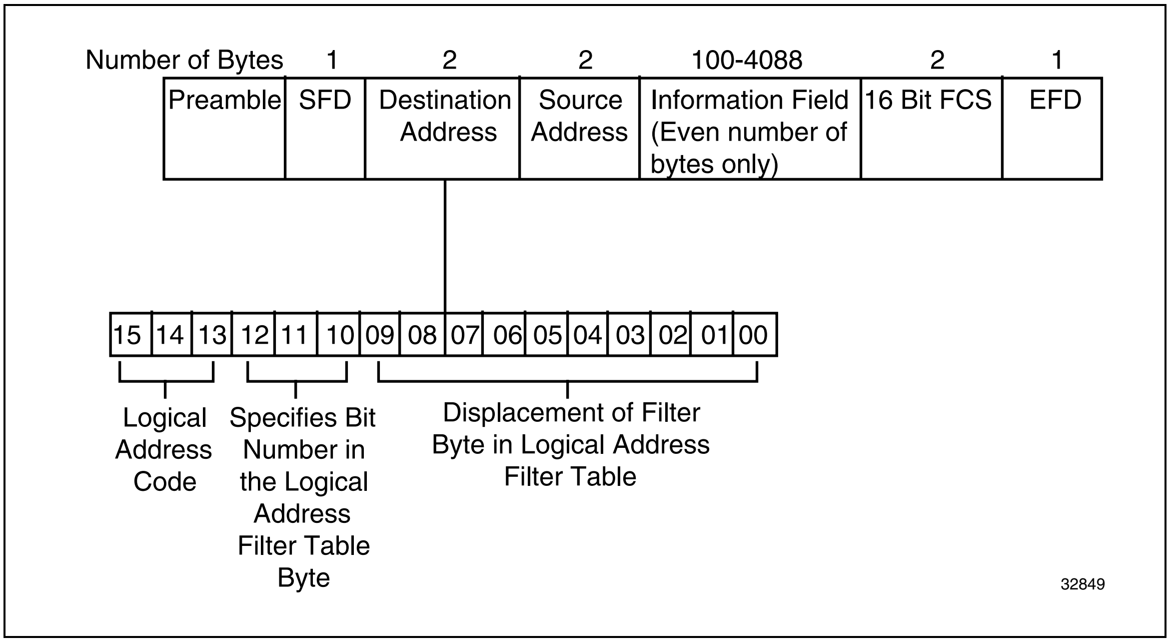


Figure 4 - Information Frame Sent to Logical Address

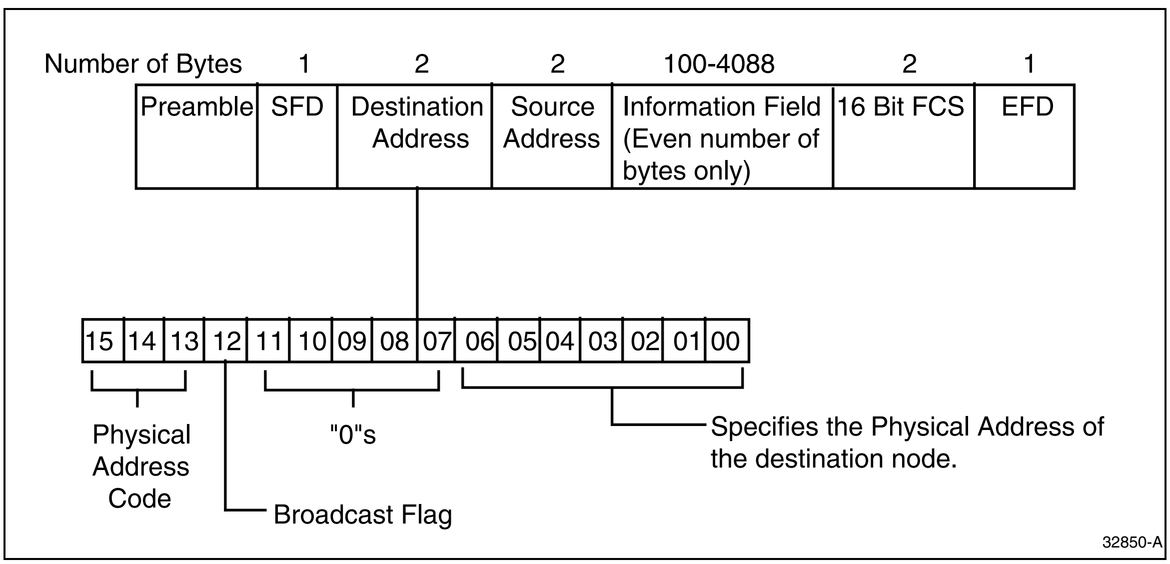


Figure 5 - Information Frame Sent to Physical Address

DIAGNOSTIC FRAMES

The Diagnostic frames are sent by the firmware to

- reset or stun nodes,
- probe failed nodes (SMCC),
- retrieve LCNI configuration status word,
- set a node to the offline state.

Diagnostic frames are always sent in pairs. The first frame is to set the node to the offline state. If a node is already offline or failed, the diagnostic frame is ignored.

WATCHDOG FAILURE FRAMES

The Watchdog Failure frames are used when

- a node, in the online state, becomes “hung up” and cannot “reset” the watchdog timer on the LCNI board, or
- a broadcast message is sent from the CPU firmware to all nodes on the LCN informing them that this node’s CPU has failed.

LCN CABLE SWAPPING

Normal Operation

In normal operation, each node on the LCN transmits on both A and B cables and listens only on the active cable. The active cable is switched once every minute if no errors are detected.

The Universal Station (US) or Global Universal Station (GUS) with the lowest address on the LCN is considered to be the cable master node and controls the automatic, periodic swapping between the A and B cables as well as the declaration of the status of the cables as GOOD or SUSPECT.

Suspect Cable

If the LCN can no longer continue to operate on a given cable, that cable is declared SUSPECT immediately or within three minutes:

- immediately, if the master node sees media dead (no noise) on the selected cable, or
- within three minutes when the master node sees three forced swaps in a row from another LCN node without being able to stay on a selected cable for one minute.

When a cable is declared SUSPECT

1. The periodic swapping stops for 10 minutes.
2. After 10 minutes, the master node attempts to use the SUSPECT cable.
3. If there are no forced returns to the opposite cable, the status of that cable is declared GOOD.

   If errors are still present on the SUSPECT cable, the master node does not attempt a swap for another 10 minutes.

Any single node can control cable switchover, which propagates throughout the network by way of the token; however, only the master node can declare a cable as SUSPECT.

Suspect Cable Example

Assume that the active LCN cable is cable A and a particular node on the LCN discovers that the media is dead (the node sees no energy or there is noise on cable A).

1. The node immediately listens to cable B.
2. The node then sets the “Primary Cable For Reception” bit to cable B in the most significant byte of the token pass frame (see Figure 3).
3. The next node to receive the token will now be listening on cable B.
4. The switchover propagates throughout the network.
5. At the beginning of the next minute, the master node swaps back to cable A.
6. If the master node determines it cannot stay on cable A for the entire minute three times in a row, it declares cable A SUSPECT. This will take up to three minutes.

Such a forced return occurs when a node or multiple nodes receive a single error from the LCNI hardware. If both cables are declared suspect, the network swaps back and forth between the cables.

Lockout on LCN Cable Swap (R510 and later)

This R510 function provides a way to lock out the LCN automatic cable swapping. During NCF configuration, the engineer can specify how long cable swapping is inhibited and the keylevel necessary to inhibit swapping (see Figure 6). You can enter the LCN Cable Swap Inhibit time from 0 to 9999 minutes and specify the lowest keylock level necessary to disable LCN cable swapping. At operating time a new target on the LCN Cable Diagnostics display allows you to call up a display from which you can inhibit LCN cable swapping for the configured timeout period (see Figure 7).

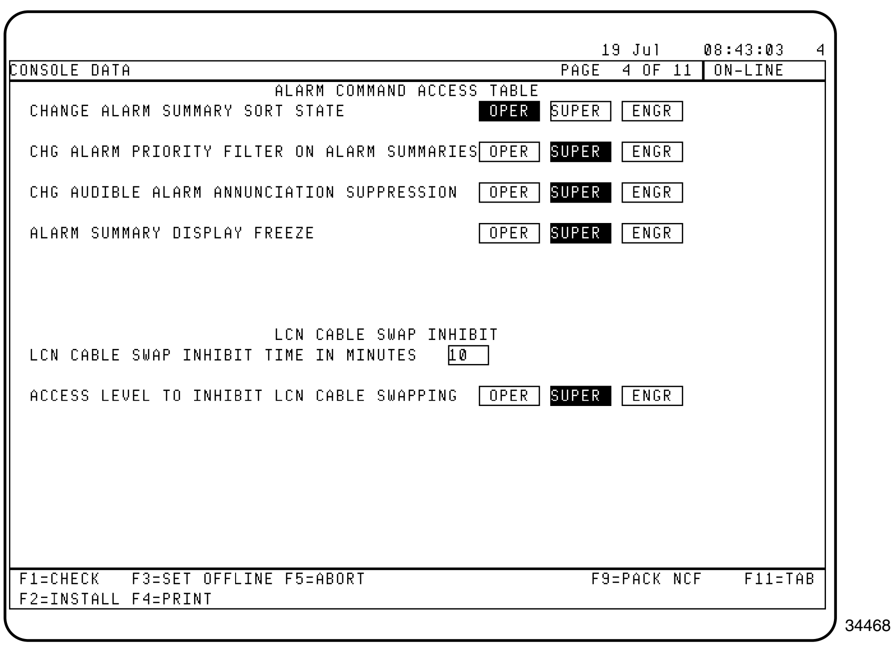


Figure 6 - NCF Cable Swap Lockout Display (R510 and later)

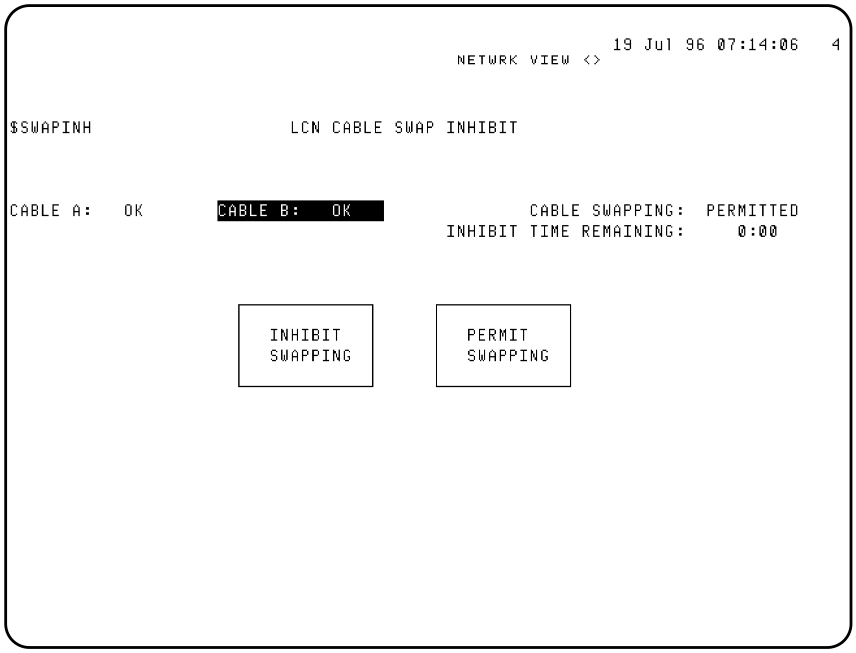


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Figure 7 - $SWAPINH Display (R510 and later)

Cable Swap Lockout PSDP Parameters

The new PSDP parameters for LCN cable swap lockout are:

- $CBLACCL—This R510 parameter returns the ordinal value of the access level required to use the LCN cable swapping function. This value is configured in the NCF.
- $CBLINHT—This R510 parameter returns the time remaining, in minutes, until LCN cable swapping will resume.
- $CBLNCFT—This R510 parameter returns the time value, configured in the NCF, for LCN cable swapping. A value of zero indicates that LCN cable swapping is disabled.

Annunciation of Suspect Cables

When the master node declares a cable as SUSPECT and switches to the other cable, it notifies all US/GUSs on the network and the Journal Manager on the System HM. Declaring a cable as SUSPECT causes the cable to appear as SUSPECT on the System Status display on all USs that received the message.

When a US/GUS receives the message of the SUSPECT cable the following displays and journals are updated:

- LCN Overview display—The status for CABLE A or CABLE B is set to SUSPECT and is displayed in yellow (see Figure 8)
- System Status display—[CABLE A] or [CABLE B] begins blinking and is backlighted in yellow (see Figure 9).
- Real Time Journal— If directed to a printer, the RTJ message prints out

  "CABLE A (B) SUSPECTED"
- System Status Journal—The "CABLE A (B) SUSPECTED" message is stored in the System Status Journal on the HM.

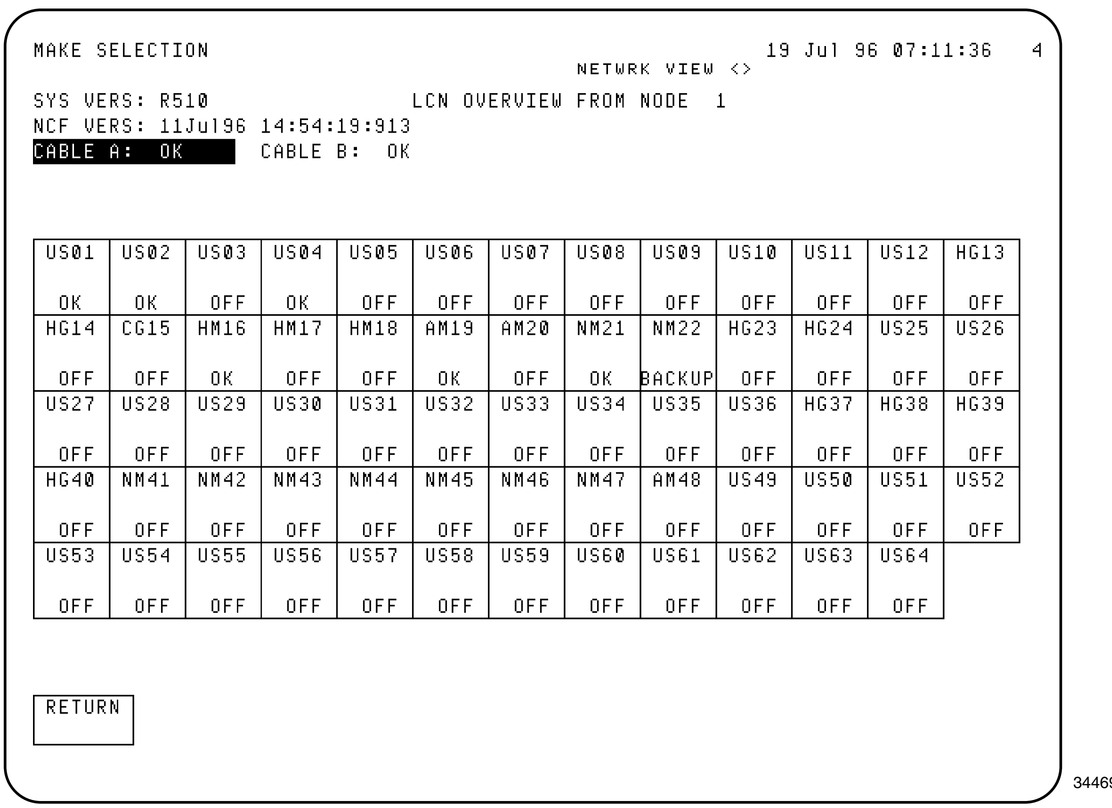


Figure 8 - Cable Status on LCN Overview Display

R500 and Later:

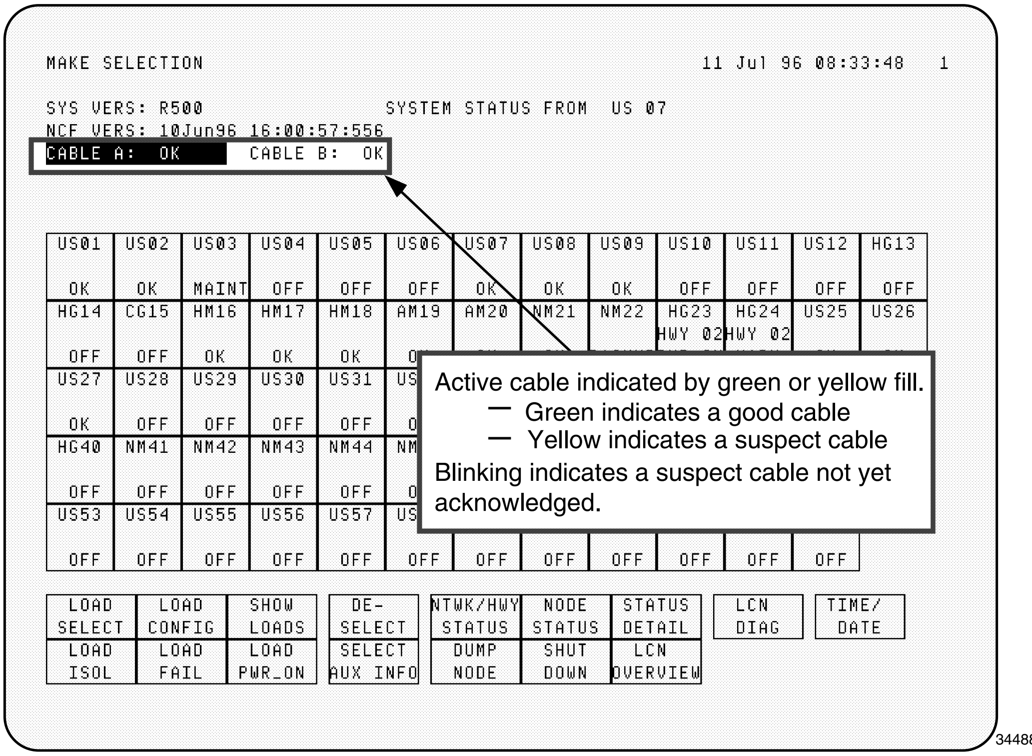


Figure 9 - Cable Status on System Status Display

Procedure to Demand Cable Swap

An operator at a US/GUS (if in the proper keylock access) can demand a swap of the active LCN cable:

1. Touch the inactive cable target on the System Status display (see Figure 9).
2. Press [ENTER].

RESULT: The LCN swaps cables if no problems are detected on selected cable.

Cable Problems That Do Not Cause SUSPECT

There are certain cases where a cable may not show SUSPECT status, although problems are present on the LCN. An LCN cable is *not* declared suspect if the software does not receive any error indication from the hardware or if the master node does not see three forced cable swaps in a row.

The following cable problems may *not* cause the LCN cable to be SUSPECT:

- **Double Cable Fault—**Both cables being disconnected or severed indicates only one or two media dead errors and may not cause communication errors between nodes on the same side of the break. Both portions of the LCN establish their own token ring and successfully pass tokens on both A and B cables.

  Communication across the break is discontinued. Nodes on both sides of the break declare the nodes on the other side as being FAILED (R210M1 and earlier) or ISOLATED. This process can take up to two minutes to complete.

- **Low error rate—**Errors can occur at a rate that does not cause enough forced cable swaps for the master node to declare a cable as SUSPECT, although the rate is higher than the average error rate.

- **Turning off or resetting LCN Extenders on both cables—**This might not cause enough noise on the LCN for the master node to declare either of the cables SUSPECT. Both segments of the LCN establish their own ring and continue to pass tokens successfully. Even if the cable(s) are declared SUSPECT, this condition clears within 10 minutes, because both ends of both cables are still terminated.

  The nodes on both segments of the LCN declare the nodes on the other segment(s) as FAILED (R210M1 or before) or ISOLATED.

- **Removing both T-connectors from a node at the same time—**If the node does not have the token at the time when the T-connectors are removed, the other nodes can still successfully pass the token.

  In this case, the node with the T-connectors removed is declared FAILED (R210M1 or before) or ISOLATED.

  If this node had the token at the time the T-connectors were removed, all other nodes on the LCN would see “media dead” and initialize the ring.

- **Crossed A and B Cables—**No hardware error is detected when cables are crossed because messages are sent out on both A and B cables. The node where the cross occurs is still listening on the cable it is directed to.

- **A single error when A and B cables are crossed—**If the cables are crossed at a single node and one node detects an error, the network is forced back to the cable that the master node has already selected. This can cause the wrong cable to be declared SUSPECT.

LCN FIBER OPTIC LINK

To extend the length of the network, LCN extenders may be used. These consist of two transceivers joined together through fiber optic cables and connected to two different segments of coaxial cables. The LCN extender is a repeater that passes digital signals in both directions between the two segments, amplifying and regenerating the signals as they pass through. Because they do no buffering, LCNEs in no sense isolate one segment from another.

LCN Cable Segments

The LCN can have up to seven coaxial cable segments:

- a main segment, and
- up to six remote segments.

Each segment can be up to 300 meters long. There can be up to 40 devices or electrical loads connected to a single LCN segment, with a maximum of 64 devices per LCN.

Remote LCN Segments

Remote LCN segments connect to the main segment with LCN Extenders (LCNEs). The fiber optic cables (through which the LCNEs connect) provide ground isolation and can run through hazardous areas to interconnect LCN coaxial cable segments. Each fiber optic cable can be up to 2 kilometers long.

NOTE

LCN Extender and Clock Card connections count as electrical loads.
Dual Node modules count as two loads.

Figures 10 and 11 present information about the LCN Fiber Optic Link, including segment length requirements and a sample configuration.

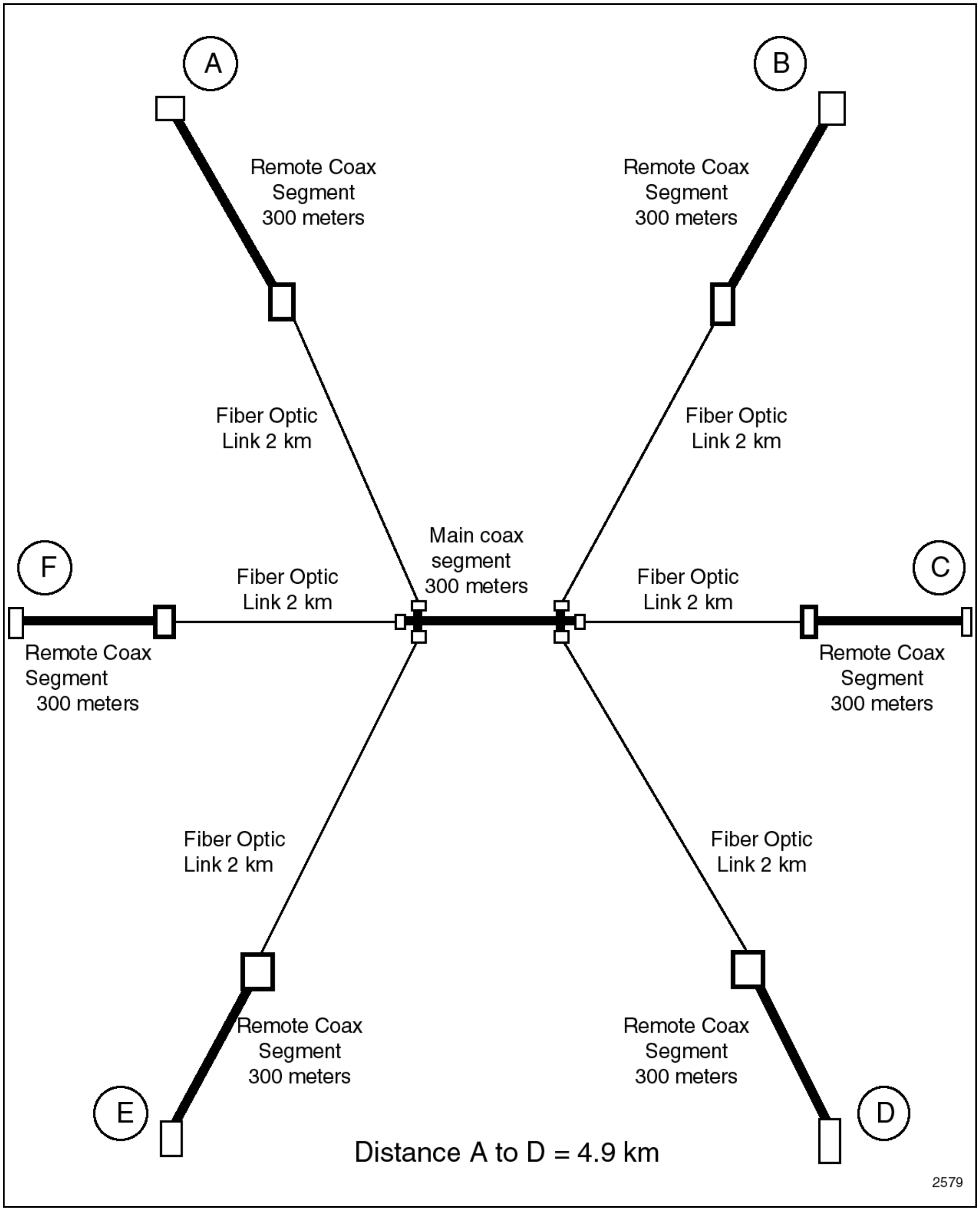


Figure 10 - LCN Extension Set and Segment Lengths

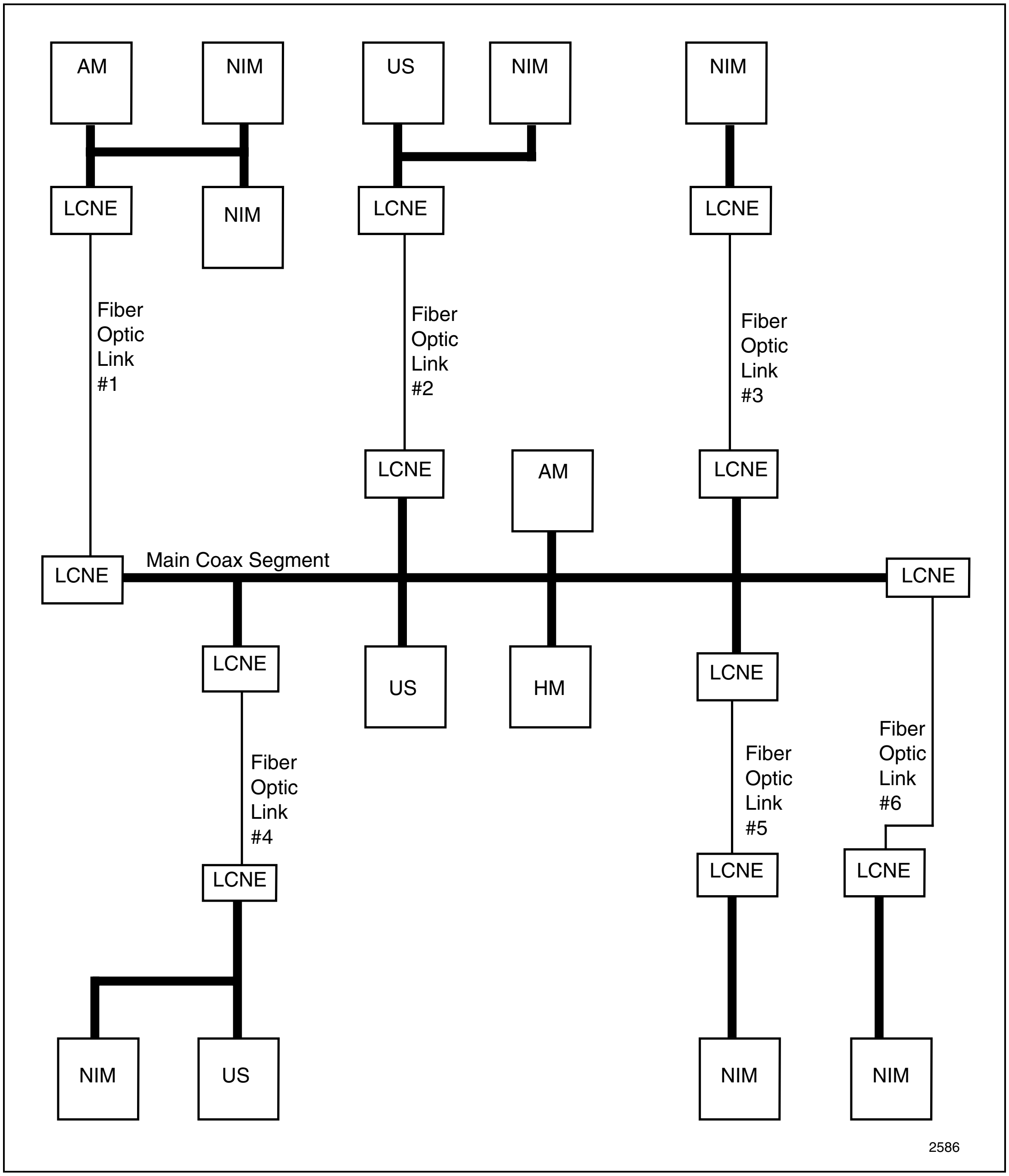


Figure 11 - LCN Extension Sets and Segments, Sample Configuration

COMPONENTS OF AN LCN EXTENSION SET

The LCN Extension Set is a group of circuit boards, each the size of an I/O board, that can be located in the rear of any LCN module where there is an open slot. These boards can be placed in the I/O slots of any module if the slots are not already occupied. The only exception to this rule is the CS/R board. The CS/R board cannot be placed in modules that have MCPUs and they must be located in the bottom I/O slot of the module.

An LCN Extension Set uses a maximum of eight boards (including two LCN I/O boards already in the host module). Both cable A and cable B have two data links and a clock link.

Example

Figure 12 shows an example of a single LCN Extension Set. Notice that 12 boards are used (six boards for cable A and six boards for cable B).

Board Descriptions

The boards used for LCN extension are listed below:

- **LCNE—LCN Extender**

  Provides an interface to one end of a fiber optic link that passes data. One LCNE is required for each end of cable A and cable B. A set of four LCNEs is required to run both cable A and cable B from LCN segment to LCN segment: two for cable A and two for cable B (see Figure 12). See the LCNE Board subsection in this module for more detailed information.

> **WARNING**
>
> Each LCN Extender (LCNE) acts as a load on the LCN segment and reduces the amount of nodes that can reside on a single segment. For example, if a system has three segments, the main segment can contain only 38 nodes and the remote segments can contain 39 nodes.

- **CS/R—Clock Source Repeater**

  Transmits the system clock from the processor board (EMPU, HMPU, HPK2) in a current loop format to an FOCT and from an FOCR board in current loop format to the remote LCN coax segment. CS/R also transmits the clock data to the LCN coax. In Figure 12, there are four CS/R boards: two for cable A and two for cable B. See the Clock Source/Repeater subsection in this module for more information.

- **FOCT—Fiber Optic Clock Transmitter**

  Converts the current loop format from the CS/R and transmits the system clock for a given cable (A or B) over a fiber optic link to a remote segment. In Figure 12, there are two FOCT boards: one for cable A and one for cable B. See the Fiber Optic Clock Transmitter subsection in this module for more information.

- **FOCR—Fiber Optic Clock Receiver**

  Receives the system clock transmitted by an FOCT and converts that fiber optic data format to current loop format to communicate with a remote CS/R. In Figure 12, there are two FOCR boards: one for cable A and one for cable B. See the Fiber Optic Clock Receiver subsection in this module for more information.

- **LCNFL—LCN Fiber Link**

  Connects the node on a one-node remote segment to both A and B fiber optic links. This board replaces the LCNI I/O board in the remote module and has the same node number address requirement as an LCNI I/O board The system clock is not available to this remote node. Notice that there are no LCNFL boards in Figure 12 because the figure depicts an LCN Extension Set function **with** a system clock. See the LCN Fiber Link subsection of this module for more information.

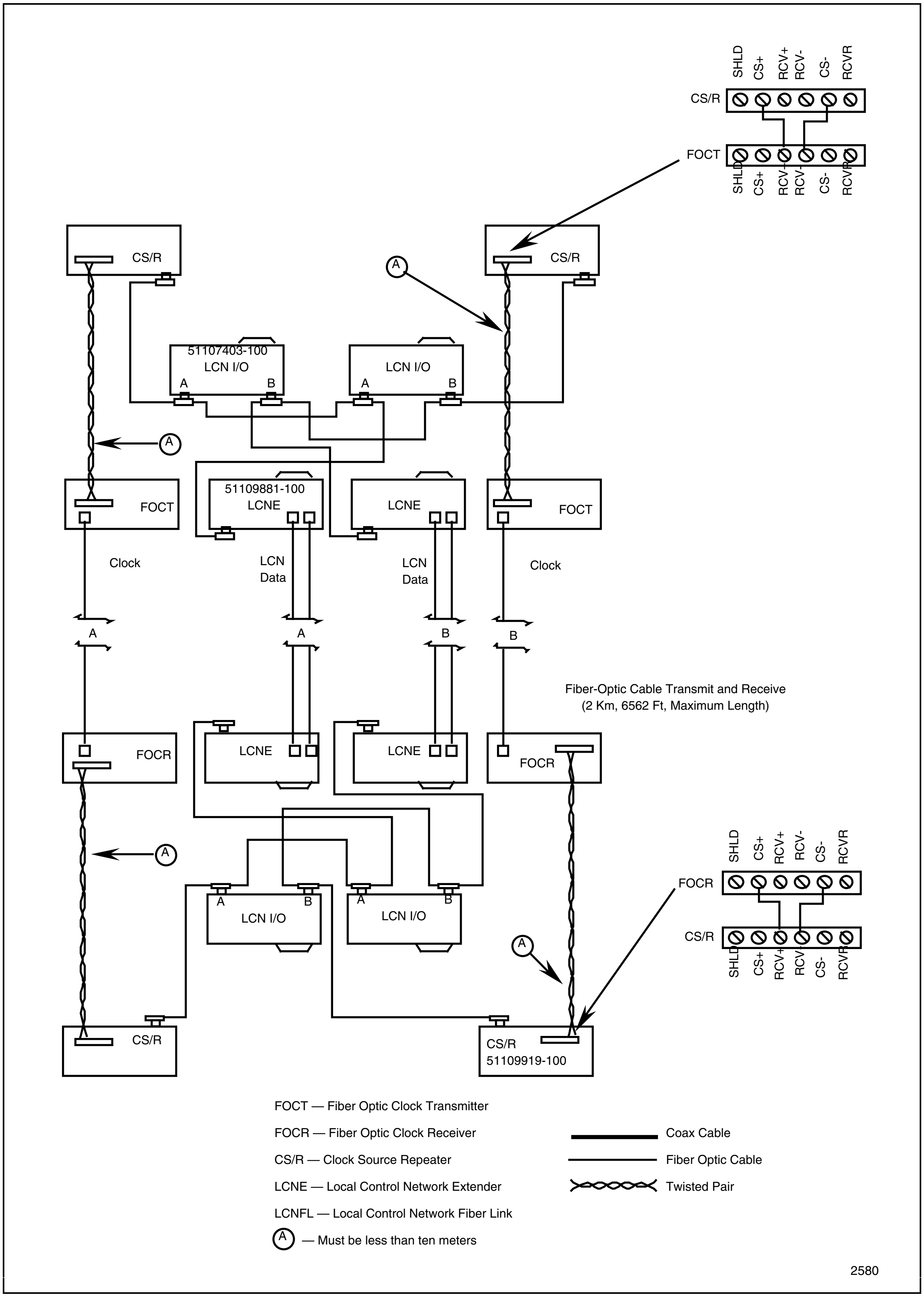


Figure 12 - Sample LCN Extension Set Function

LCNE Board

The LCNE board (see Figure 13) provides both transmit and receive functions to interface a fiber pair. This allows data to be sent in both directions between the main coax segment and a remote segment.

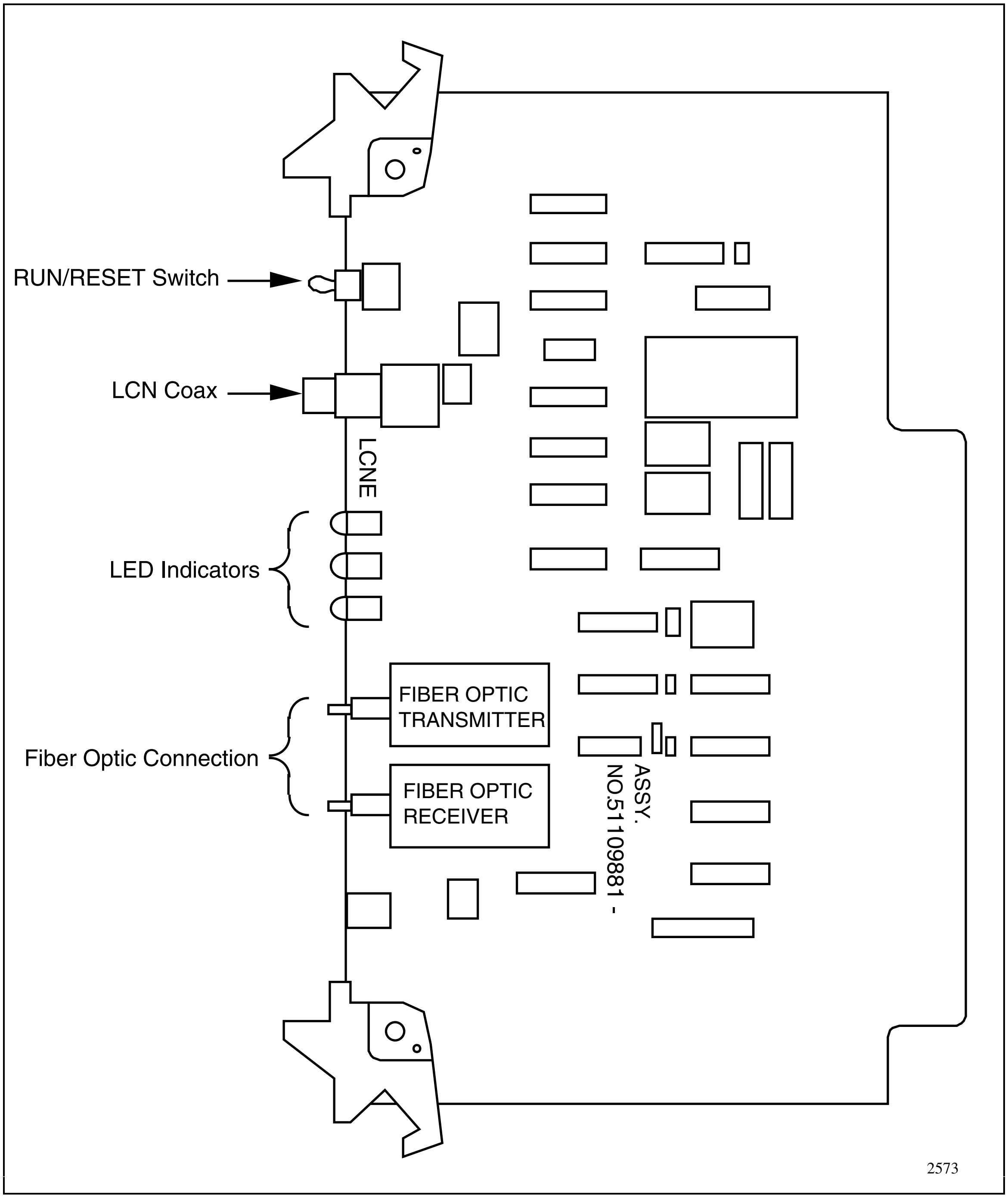


Figure 13 - LCN Extender (LCNE) Board As

Table 2 describes the LED indicators on the LCNE board.

Table 2 - LCNE LEDs

LED	Description
Red LED	**Antijabber Timer Error Flag** This LED is normally **out**. If the LCN transmits too long (data frame too long), this LED lights. If the Antijabber Timer Error Flag is lit, LCNE board should be replaced.
Yellow LED	**Fiber-to-Coax Transmit** This LED either blinks on and off (indicating traffic) or stays on (more traffic).
Green LED	**Receive Light Power Level OK** This LED should always be lit to indicate that the light power received exceeds minimum.

LCNE boards have a single switch located on the edge of the board. Table 3 describes this RUN/RESET switch.

Table 3 - LCNE Run/Reset Switch

Switch Position	Description
RUN	Normal position that allows data transfer.
RESET	Stops data transfer and initializes the Antijabber Error Flag (the Antijabber flag must be manually reset before data can be passed again.

Fiber Optic CLOCK Transmitter (FOCT)

FOCT boards (see Figure 14) provide a current loop receiver that couples to a fiber optic transmitter to drive the clock information to a remote segment on a single fiber that is greater than 300 meters but less than 2 km.

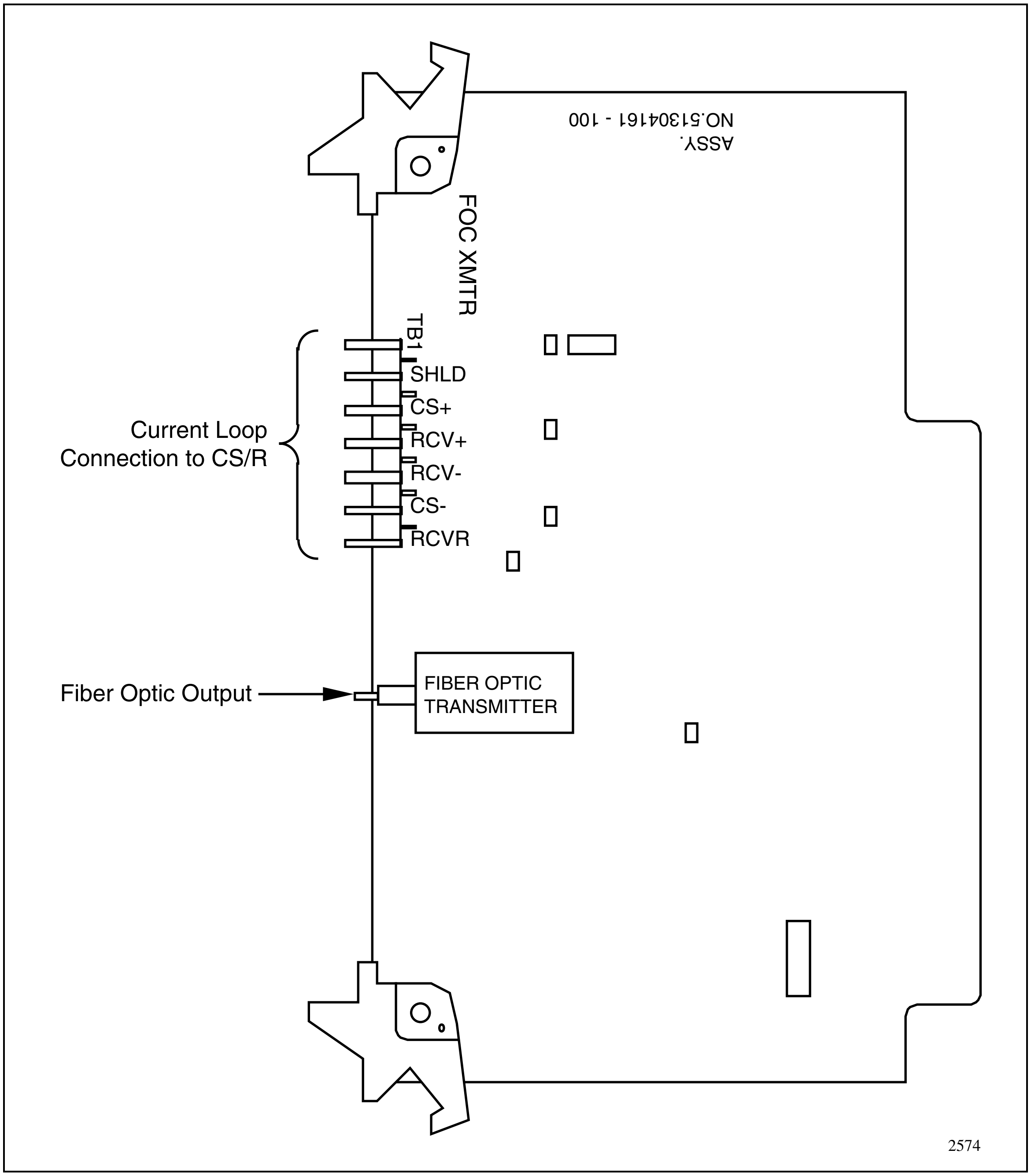


Figure 14 - Fiber Optic CLOCK Transmitter (FOCT) Board Assembly

Fiber Optic CLOCK Receiver (FOCR)

FOCR boards (see Figure 15) provide a fiber optic receiver coupled to a current loop transmitter for communication to a CS/R board. This board is used in applications requiring the transmission of clock data 300 meters to 2 km from a main segment.

There is one green LED on the FOCR board. This is a **Receive Light Power Level OK** LED that should always be lit to indicate that the light power received exceeds minimum.

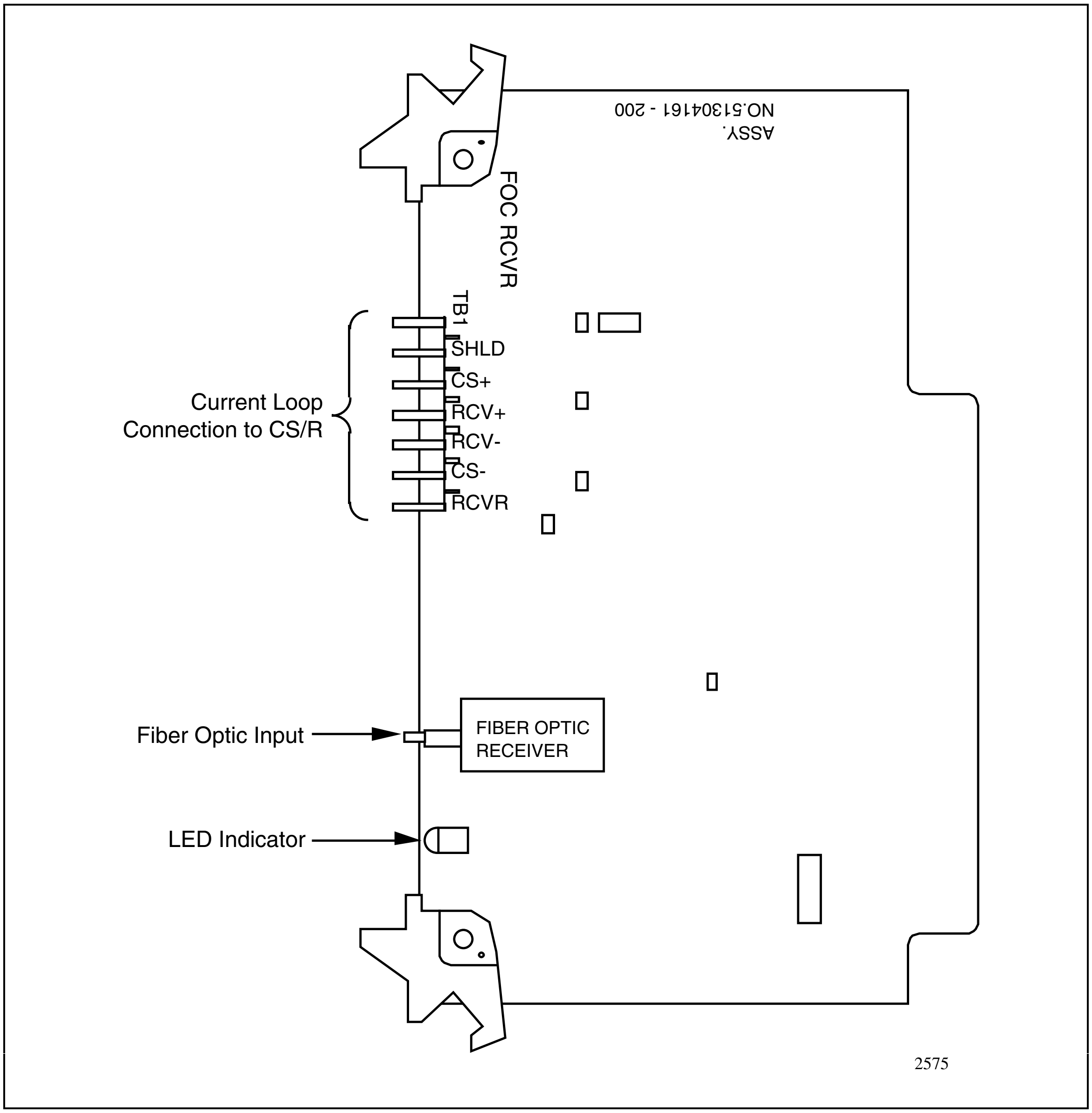


Figure 15 - Fiber Optic CLOCK Receiver (FOCR) Board Assembly

Clock Source/Repeater (CS/R)

CS/R boards (see Figure 16) interface the separately transmitted clock to/from the LCN to the FOCT/FOCR boards. In cases where the length of the fiber optic extension is less than 300 meters, the CS/R board can drive the clock signal without the use of FOCT and FOCR boards.

CS/R boards must be located in the bottom slot of an LCN module that does not have an MCPU.

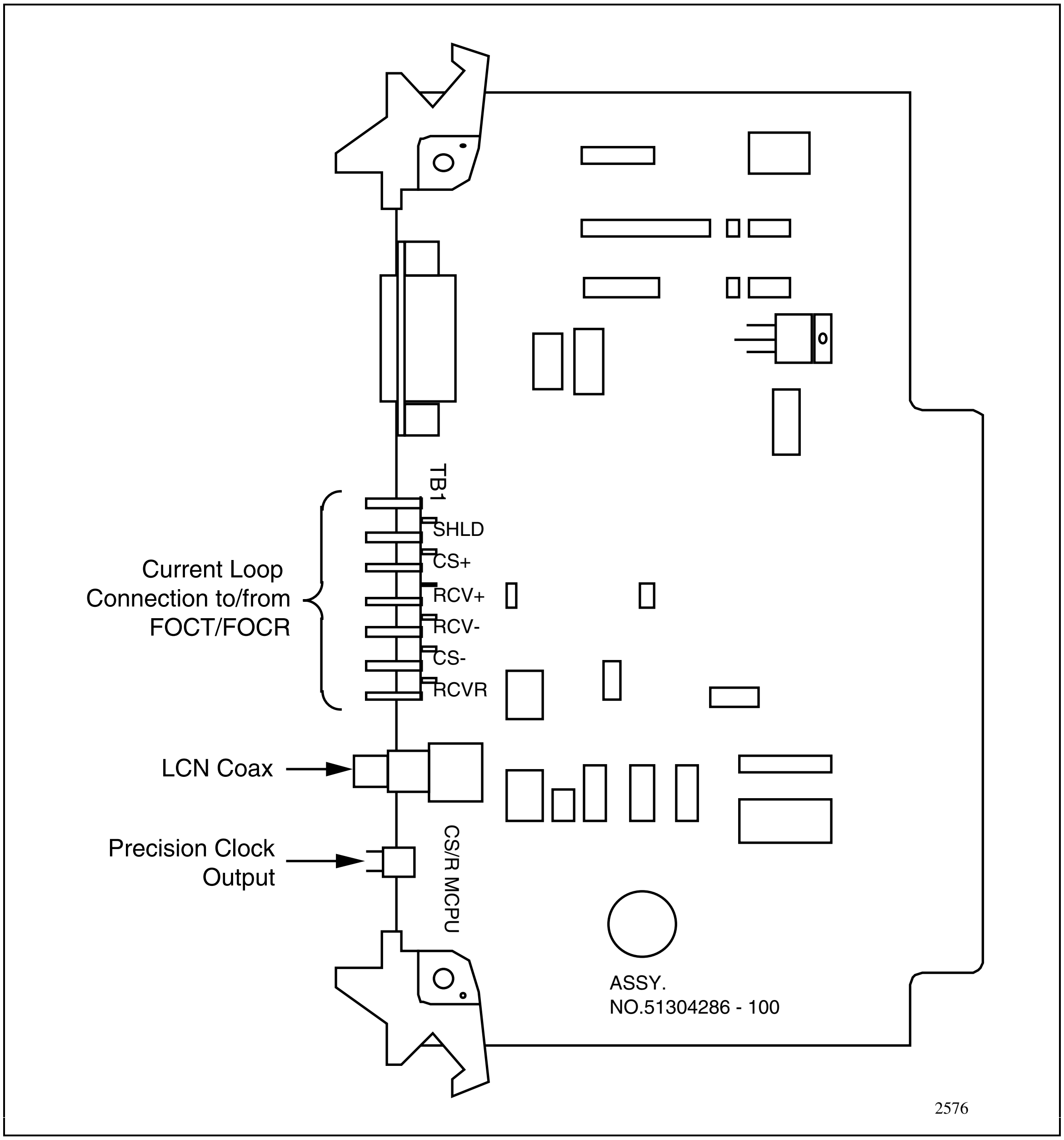


Figure 16 - Clock Source/Repeater (CS/R) Board Assembly

LCN Fiber Link (LCNFL)

A standard LCN extension set has an FOCT and an FOCR for both the A and B cables; however, if a remote node does not employ sequencing, a clock is not needed and a simplified LCN Extension Set can be used. This LCN Extender cannot transmit the clock signal to a remote node. An LCNFL board is used on one end of the fiber optic cable to interface a transmit/receive fiber pair for both cable A and cable B (see Figures 17 and 18).

There are two green LEDs on the LCNFL board. They are **Receive Light Power Level OK** LEDs that should always be lit to indicate that the light power received exceeds minimum.

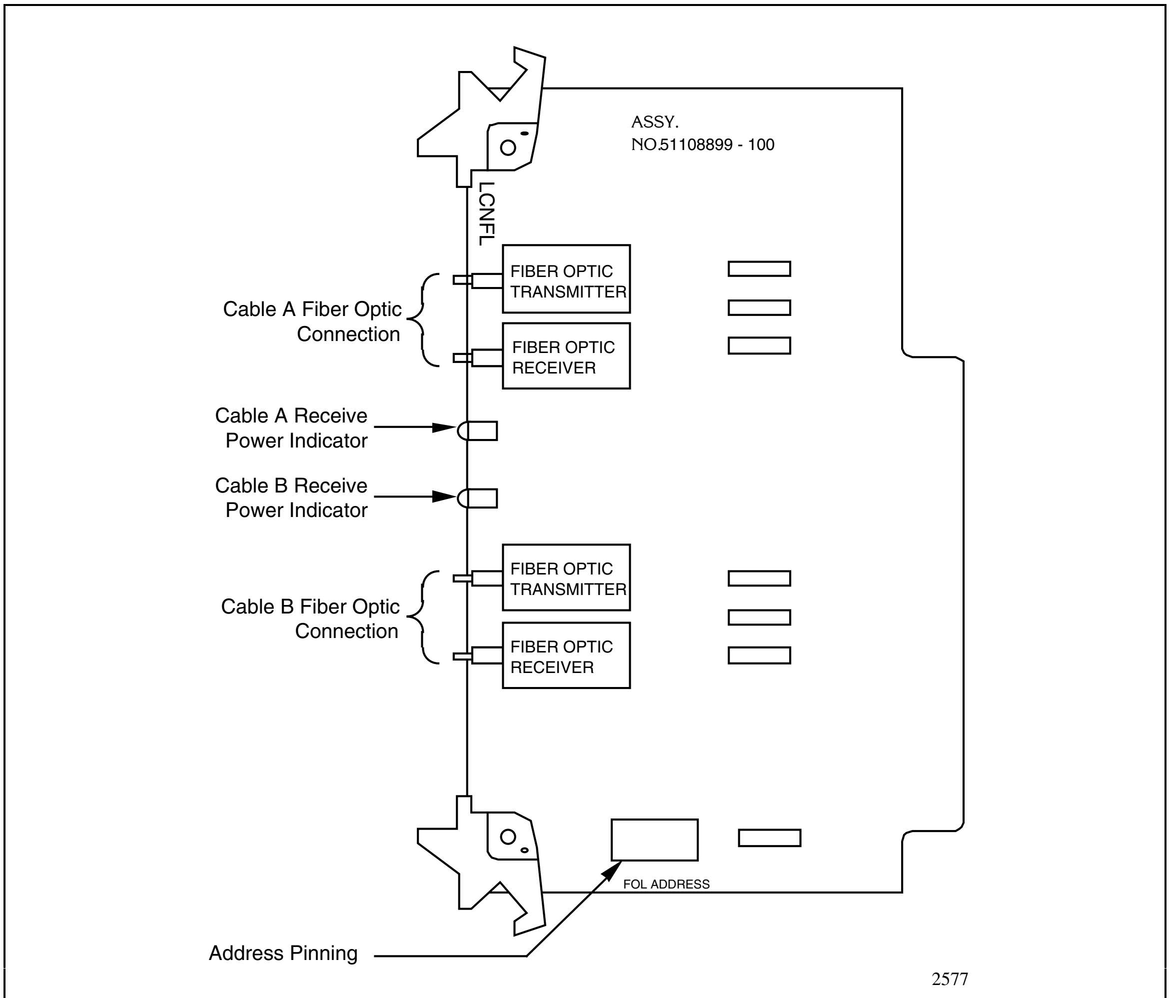


Figure 17 - LCN Fiber Link (LCNFL) Board Assembly

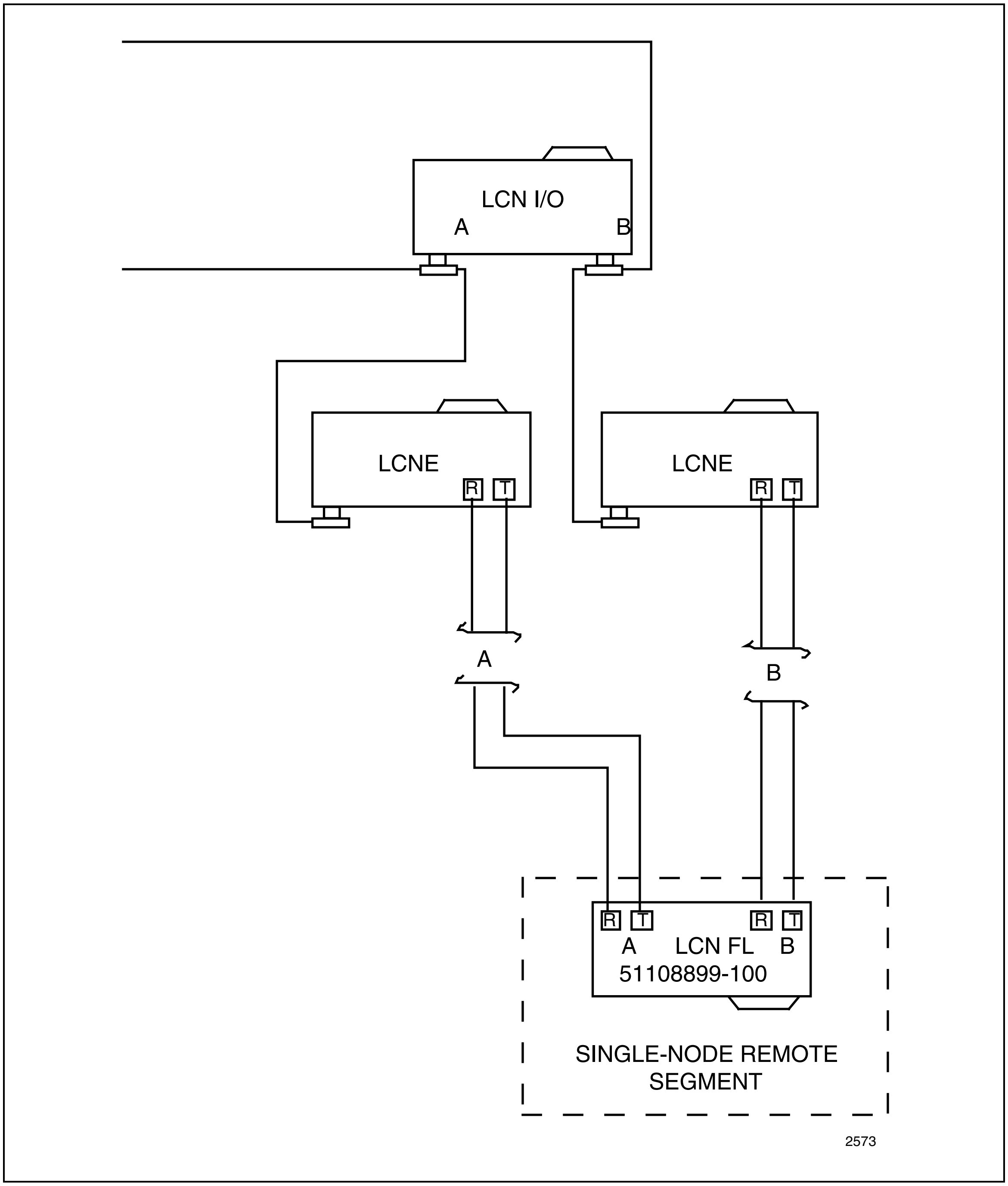


Figure 18 - Sample LCN Extension Set Function (Without Clock)

Because the LCNFL board replaces the LCN I/O board, the node's LCN address is assigned (set) on the LCNFL board the same as described for the LCN I/O board (see Figure 19).

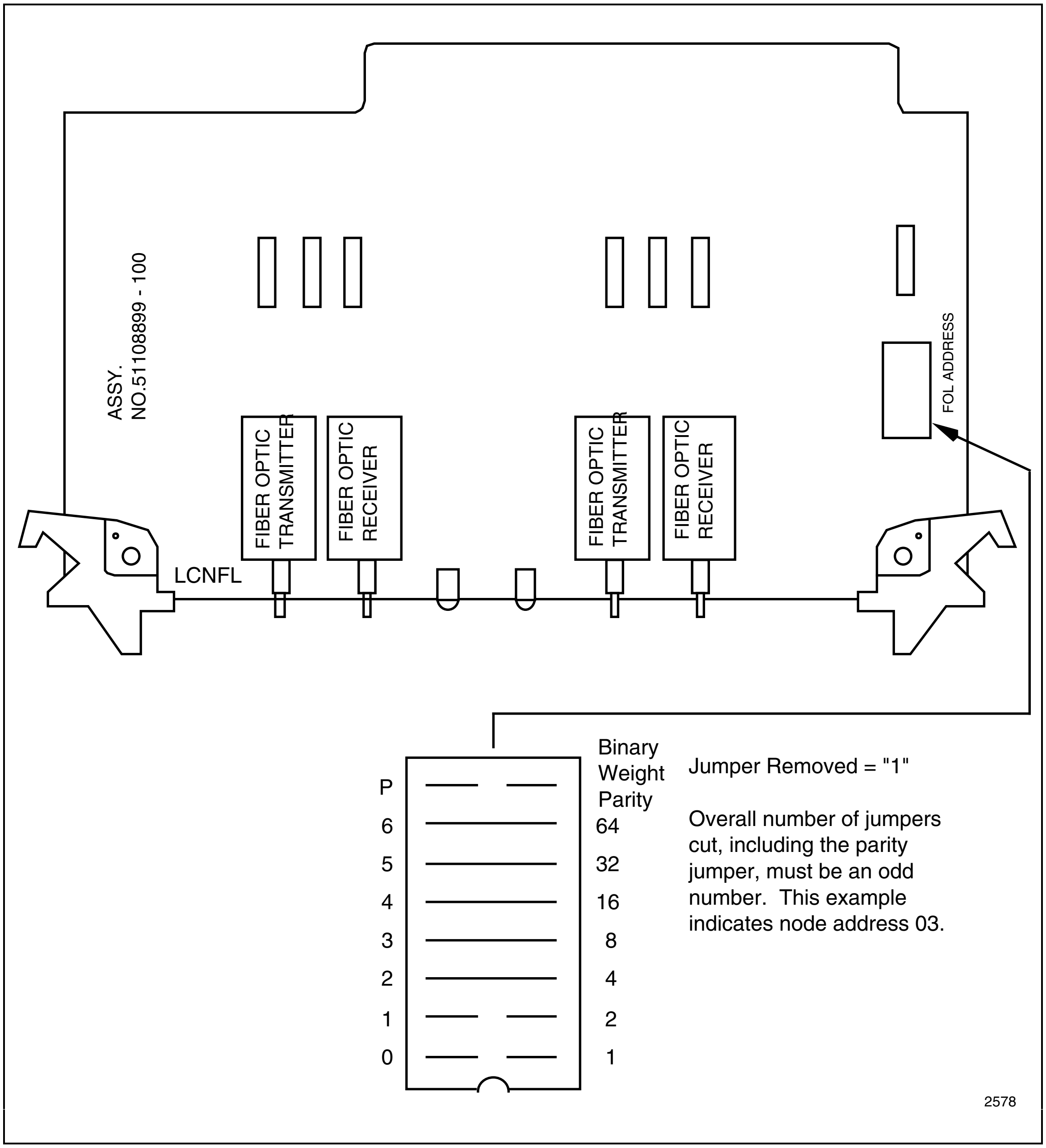
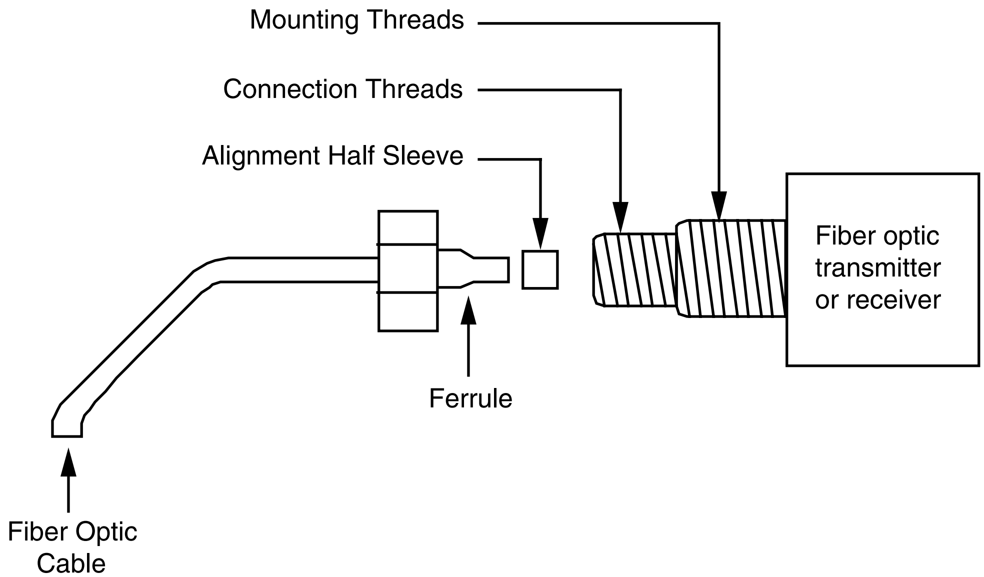


Figure 19 - Node Addressing on the LCNFL Board

Fiber optic Cable Connections

Fiber optic cable connections to transmitting/receiving devices are shown in Figure 20.



1. Insert tip of terminator into hole in end of connector and start ferrule onto connection threads.
2. Turn ferrule clockwise until snug. Finger tightening is sufficient. DO NOT use a wrench to tighten the ferrule because damage to the connector will result.

32852

Figure 20 - Fiber Optic Cable and Connector

> **REFERENCE**
>
> *LCN Guidelines Manual*
> Sections 3, Implementation of Fiber Optic Extenders
> Binder: LCN Installation
> TPS 2025 (R4xx)
> TPS 3025 (R5xx)

POWER LOSS IN FIBER OPTIC CABLE

To determine the maximum length of LCN fiber optic extension possible, a power budget calculation must be made. The maximum distance that Honeywell specifies for the LCN fiber optic extension using LCNEs is two km. That distance is determined as follows.

The output power of the fiber optic transmitter Honeywell uses is 100 microwatts minimum into 100 micron fiber with a numerical aperture of 0.28. The fiber optic can properly decode data with as little as 0.8 microwatt received power. Thus, the total power budget available, in dB, is 21.

To calculate the distance the fiber optic link can be extended, certain losses must be applied to this total link budget:

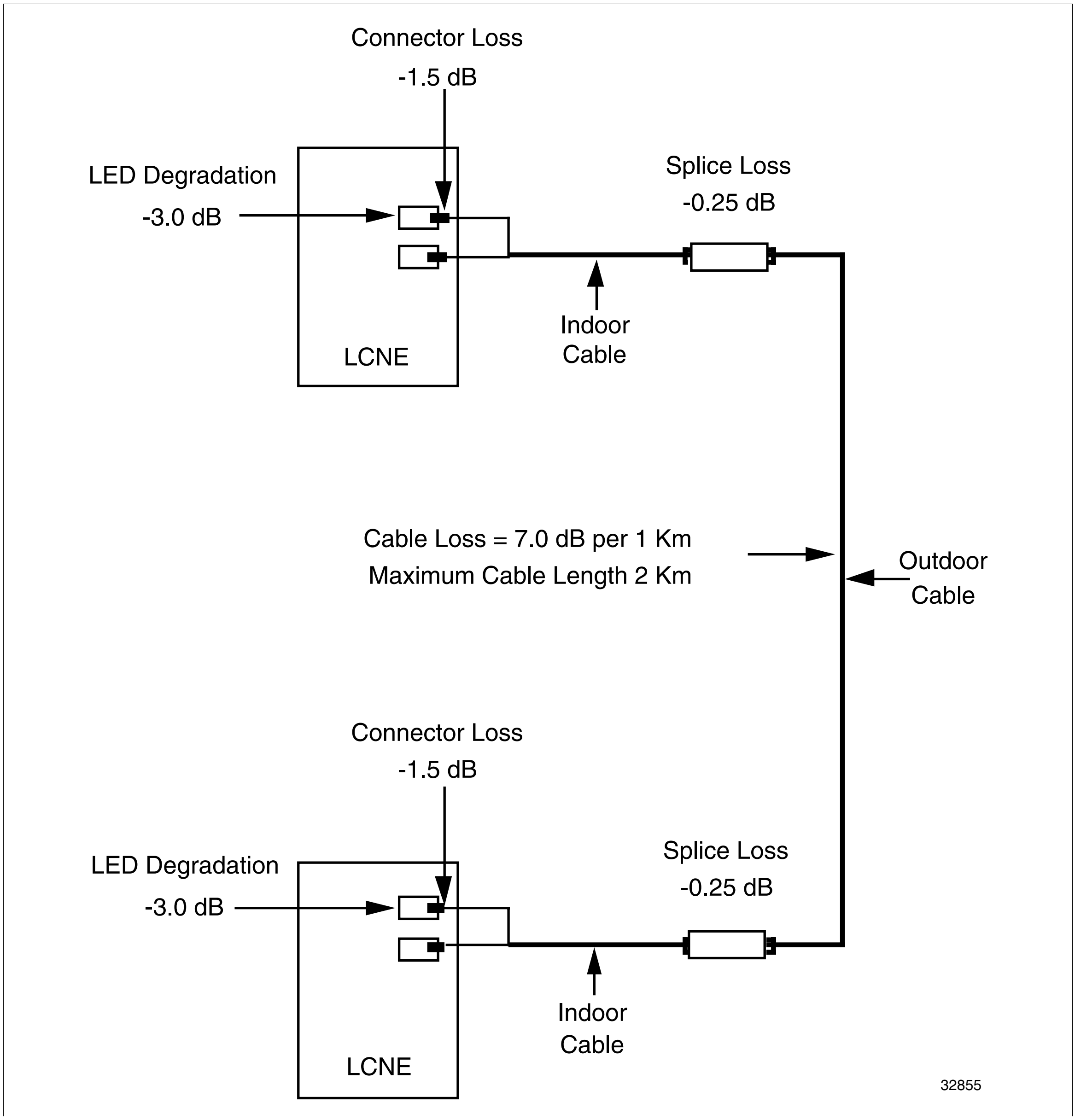
> To allow for degradation of LED output over time, 3 dB is typically allotted (1-1/2 dB is allotted per fiber optic connector).
>
> Splices are necessary to couple the outdoor grade cable to the indoor cable that is routed to the cabinets, and 1/4 dB is allotted per slice.

Total power budget	21.0 dB
Degradation	-3.0 dB
Connector loss (2*1.5 dB)	-3.0 dB
Splice loss (2*.25 dB)	-0.5 dB
Budget remaining for cable loss	14.5 dB

The maximum attenuation of the cable specified by Honeywell is 7 dB per kilometer; thus, 2 kilometers of cable can be used with 0.5 dB of excess budget remaining.

FIBER OPTIC BUDGET LOSS

Total Power Budget	21.0 dB
Degradation	-3.0 dB
Connector Loss (2*1.5 dB)	-3.0 dB
Splice Loss (2*0.25 dB)	-0.5 dB
Budget Remaining for Cable Loss	14.5 dB



LCN TOPOLOGY MAPS

Figures 21 and 22 are examples of typical LCN topology maps. You can use the topology map and the LCN Cable Diagnostic displays to visualize where an LCN problem exists.

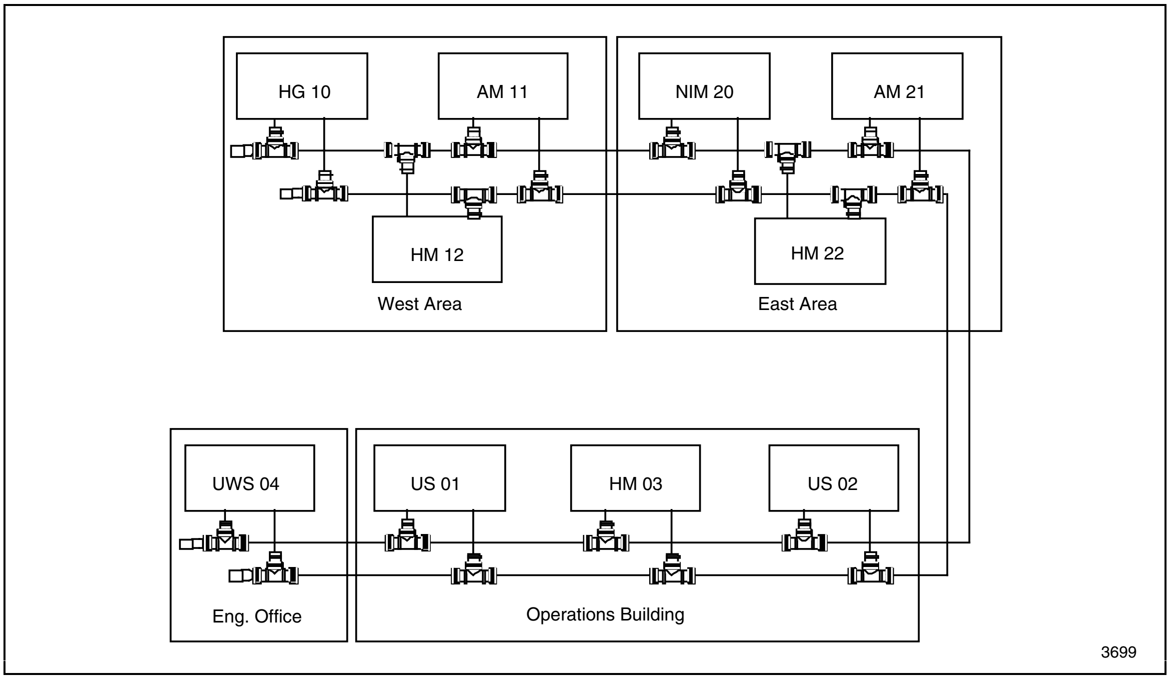


Figure 21 - Typical Topology Map #1

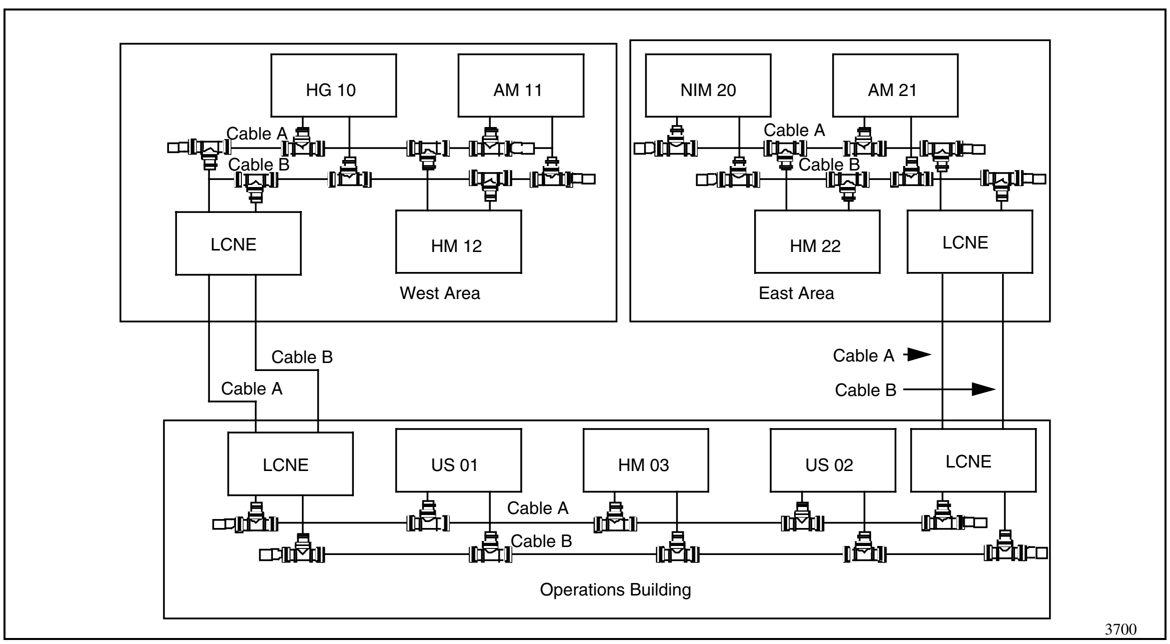


Figure 22 - Typical Topology Map #2

LCN COMMUNICATION ERRORS

Causes of LCN communication errors include:

- Attenuation—The strength of a signal decreases with distance over the LCN cables. With sufficient attenuation, the receiving node may have difficulty recovering the data from the received signal.
- Noise—This is any unwanted signal that combines with, and thus distorts, the signal intended for reception.
- Collisions—In a bus topology, if two nodes transmit at the same time, their signals overlap and neither message can be successfully received. This is an extremely rare occurrence on the LCN.

LCN CABLE DIAGNOSTIC DISPLAYS

In the displays on the following pages, you will be able to view the PSDP COMM parameters for all the nodes on the LCN. To analyze the values displayed, consult the topology map of the LCN. These parameters are useful in determining if communication errors are present on the LCN.

Main Menu

From the System Status display (on R500 and later), select the LCN DIAG target to access the LCN Cable Diagnostics Main Menu.

Figure 23 is the LCN Cable Diagnostics Main Menu. The menu contains targets to access the diagnostic displays. The CROSSED CABLES target is available on R420 and later.

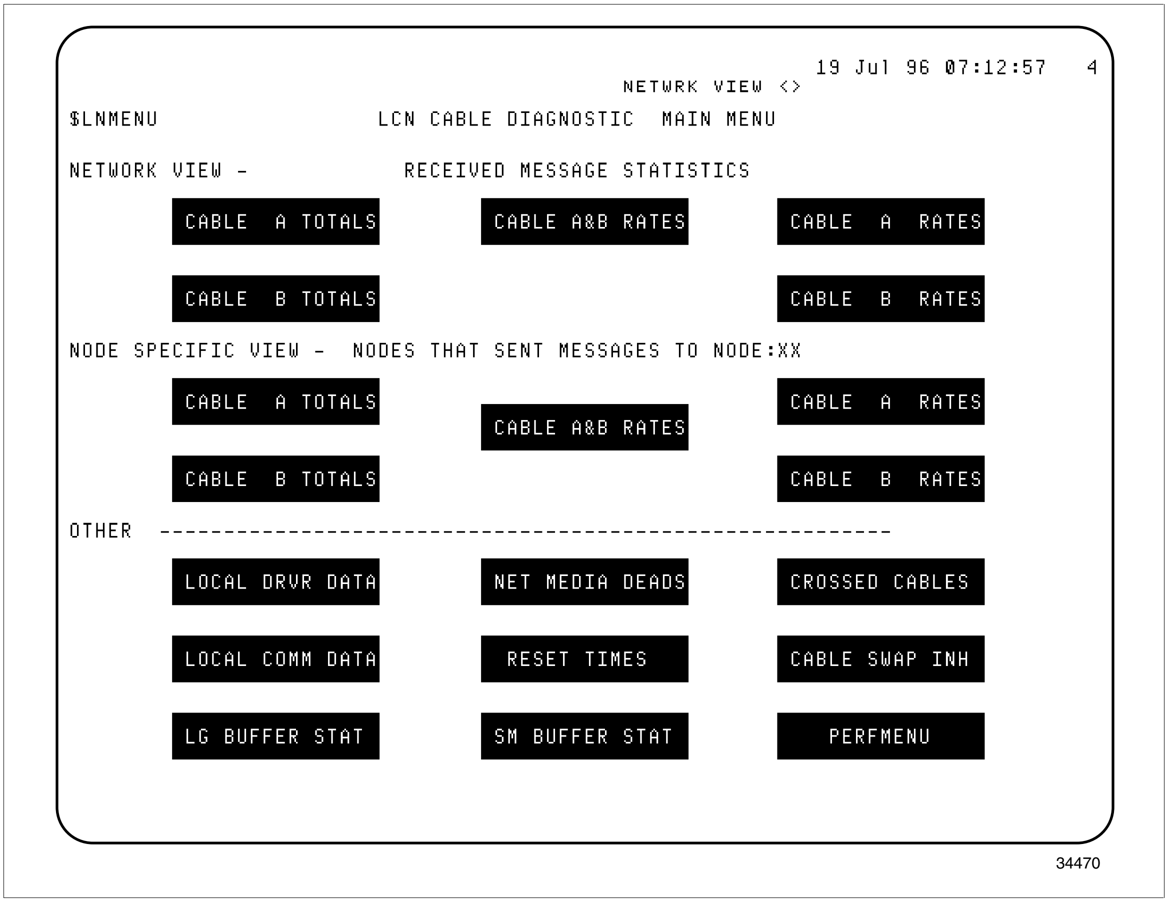


Figure 23 - LCN Cable Diagnostics Main Menu

Reset Times Display

The statistical information on the LCN Cable Diagnostics displays is meaningful only if the person analyzing them knows when accumulation of data started. The data starts accumulating as soon as the node is started or when the counters are reset.

To determine the time that accumulation started for each node, call up the Reset Times display (see Figure 24) by selecting the RESET TIMES target on the $LNMENU display.

The Reset Times display shows the time and date the counters were reset for each LCN node. The counters can be reset from this display, either for an individual node or for all nodes at one time. Other cable diagnostic displays also show the accumulation start time and provide a target to reset the counters.

Resetting the Statistics

Do the following to reset a single node's PSDP COMM counters from the Reset Times display:

1. Put the station in engineering keylock access.
2. Select the node, then press [ENTER]

Do the following to reset the counters for *all nodes:*

- On R500 and later—Select the RESET ALL COUNTERS target from the Reset Times display.
- On R4xx—Re-enter the system date from the Console Status display.

WARNING Before R500—Be aware that if LCN time is changed (for example, from a VAX system that resynchs LCN time), the PSDP counters will be reset.

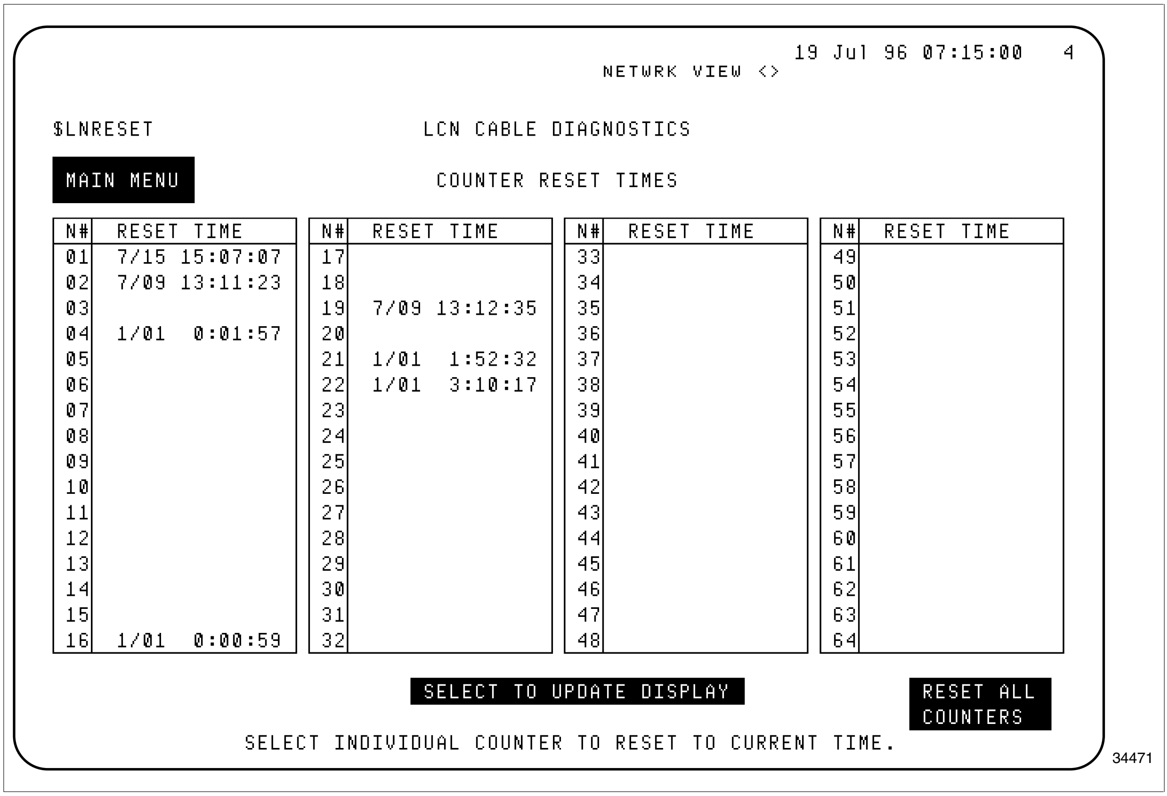


Figure 24 - Reset Times Display

Message Statistics—Network View [CABLE A TOTALS] [CABLE A RATES]

Figure 25, which is available for each node on the LCN, shows:

- the number of messages received by the node, and
- the number of messages that contained errors.

Figure 26 shows error rates per 10,000 messages.

Select the [CABLE B] target to see the same values for the other cable (cable B in this case).

From the Totals display, select the [RATES] target to see the error rates.

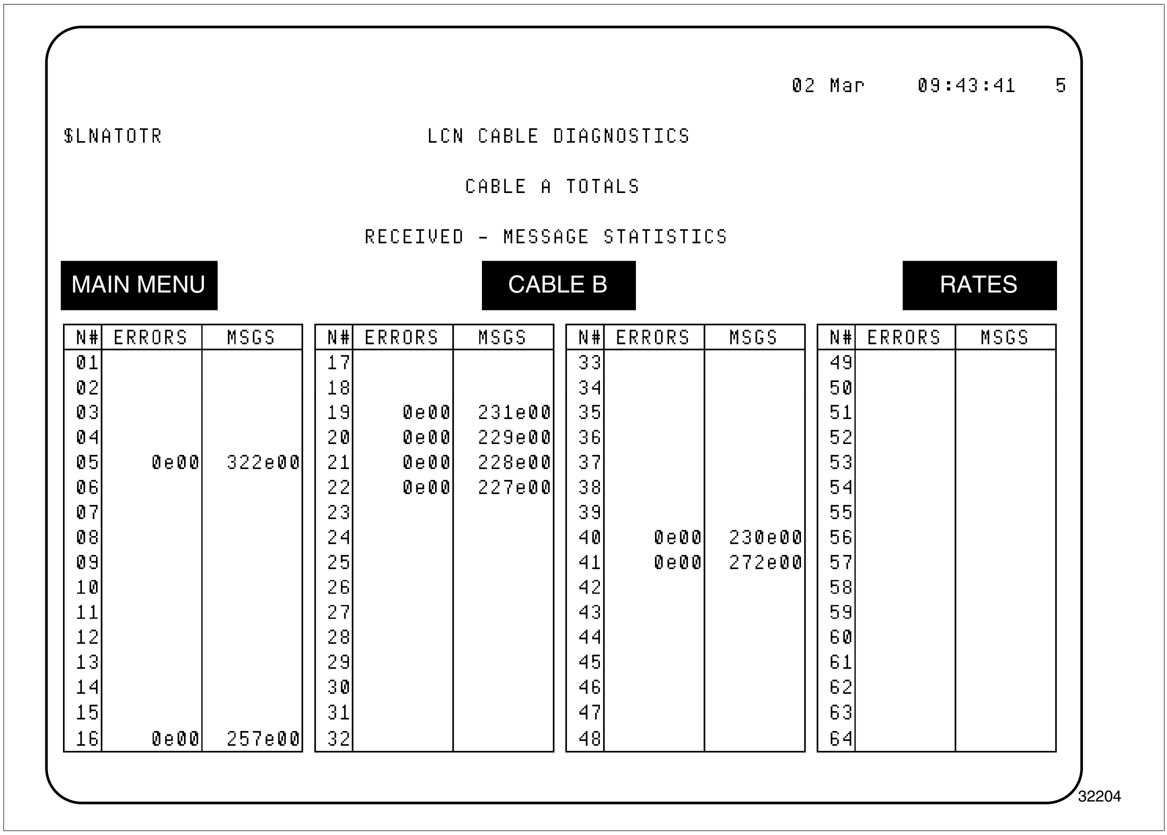
From the Rates display, select the [TOTALS] target to see the message totals.

To show, in the space available, the large values that can accumulate, the displays indicate a decimal mantissa and exponent.

Examples:

3931e01 = 3931 x 10e1 = 39,310

16939e2 = 16939 x 10e2 = 1,693,900



N#	ERRORS	MSGS	N#	ERRORS	MSGS	N#	ERRORS	MSGS	N#	ERRORS	MSGS
01			17			33			49		
02			18			34			50		
03			19	0e00	231e00	35			51		
04			20	0e00	229e00	36			52		
05	0e00	322e00	21	0e00	228e00	37			53		
06			22	0e00	227e00	38			54		
07			23			39			55		
08			24			40	0e00	230e00	56		
09			25			41	0e00	272e00	57		
10			26			42			58		
11			27			43			59		
12			28			44			60		
13			29			45			61		
14			30			46			62		
15			31			47			63		
16	0e00	257e00	32			48			64		

Figure 25 - Received-Message Statistics—Totals

02 Mar 09:51:40 5

$LNARATR LCN CABLE DIAGNOSTICS

CABLE A RATES

RECEIVED - MESSAGE STATISTICS

MAIN MENU CABLE B TOTALS

N#	ERRORS	ER/10K	N#	ERRORS	ER/10K	N#	ERRORS	ER/10K	N#	ERRORS	ER/10K
01			17			33			49		
02			18			34			50		
03			19	0e00	0	35			51		
04			20	0e00	0	36			52		
05	0e00	0	21	0e00	0	37			53		
06			22	0e00	0	38			54		
07			23			39			55		
08			24			40	0e00	0	56		
09			25			41	0e00	0	57		
10			26			42			58		
11			27			43			59		
12			28			44			60		
13			29			45			61		
14			30			46			62		
15			31			47			63		
16	0e00	0	32			48			64		

32205

Figure 26 - Received-Message Statistics – Rates

Errors Per 10 K Messages Received—Network View [CABLE A&B RATES]

Figure 27 shows the error rate for both A and B cables per 10,000 messages received by each LCN node.

Because all errors are recovered by retransmitting the message, the error rate is the only relevant factor. If a log is maintained for error rates, a trend can be seen, telling of damage or deterioration.

02 Mar 09:52:28 5

$LNABRTR LCN CABLE DIAGNOSTICS

RECEIVED - MESSAGE STATISTICS

MAIN MENU

ERRORS PER 10,000 MESSAGES

N#	CBL-A	CBL-B	N#	CBL-A	CBL-B	N#	CBL-A	CBL-B	N#	CBL-A	CBL-B
01			17			33			49		
02			18			34			50		
03			19	0	0	35			51		
04			20	0	0	36			52		
05	0	0	21	0	0	37			53		
06			22	0	0	38			54		
07			23			39			55		
08			24			40	0	0	56		
09			25			41	0	0	57		
10			26			42			58		
11			27			43			59		
12			28			44			60		
13			29			45			61		
14			30			46			62		
15			31			47			63		
16	0	0	32			48			64		

32206

Figure 27 - Received-Message Statistics–Rates on Both Cables

Message/Error Rates/Totals—by Node CABLE A TOTALS CABLE A RATES

For the selected node number (indicated in the heading), Figure 28 shows

- the number of messages received from each of the other nodes on the LCN, and
- the number of messages that contained errors.

Figure 29 shows the number of errors and the error rate per 10,000 messages received from each node on the LCN.

Select the CABLE B target to see the same values for the other cable (cable B in this case).

To show, in the space available, the large values that can accumulate, the displays indicate a decimal mantissa and exponent.

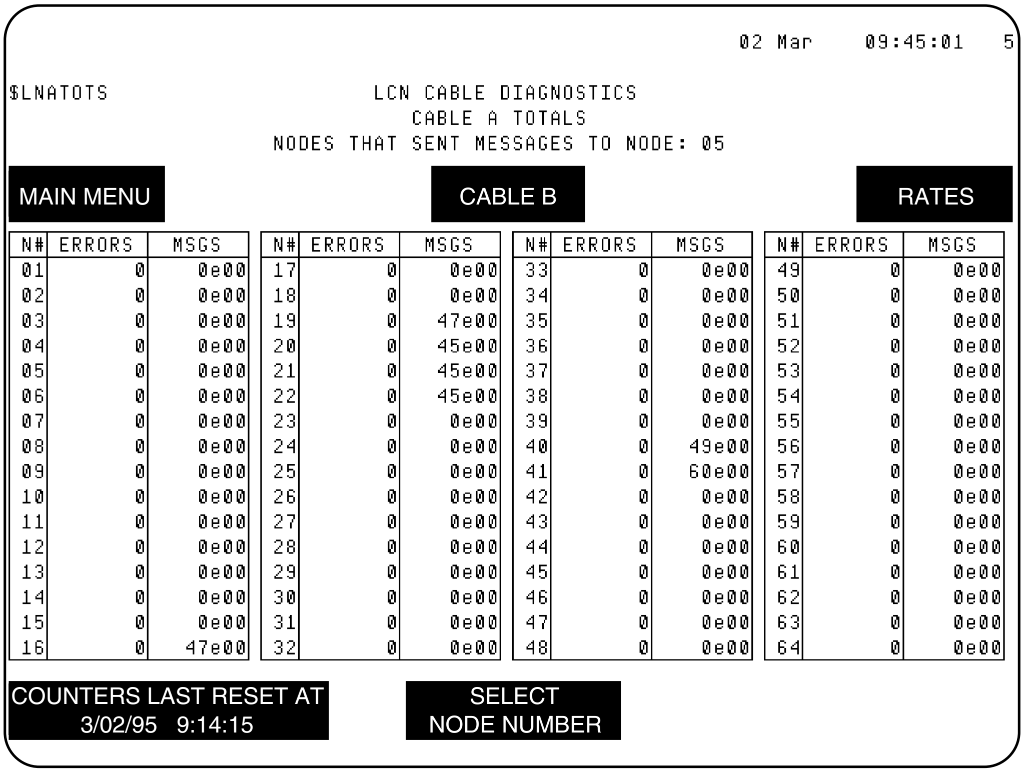
From the Totals display, select the RATES target to see the error rates and totals.

From the Rates display, select the TOTALS target to see the error and message totals.

Resetting the Statistics

You can reset a node's PSDP COMM parameters from the displays shown in Figures 28-32:

1. Put the station in engineering keylock access.
2. Select COUNTERS LAST RESET AT MM/DD/YY HH/MM/SS
3. Press [ENTER]



02 Mar 09:45:01 5

$LNATOTS

LCN CABLE DIAGNOSTICS
CABLE A TOTALS
NODES THAT SENT MESSAGES TO NODE: 05

MAIN MENU | CABLE B | RATES

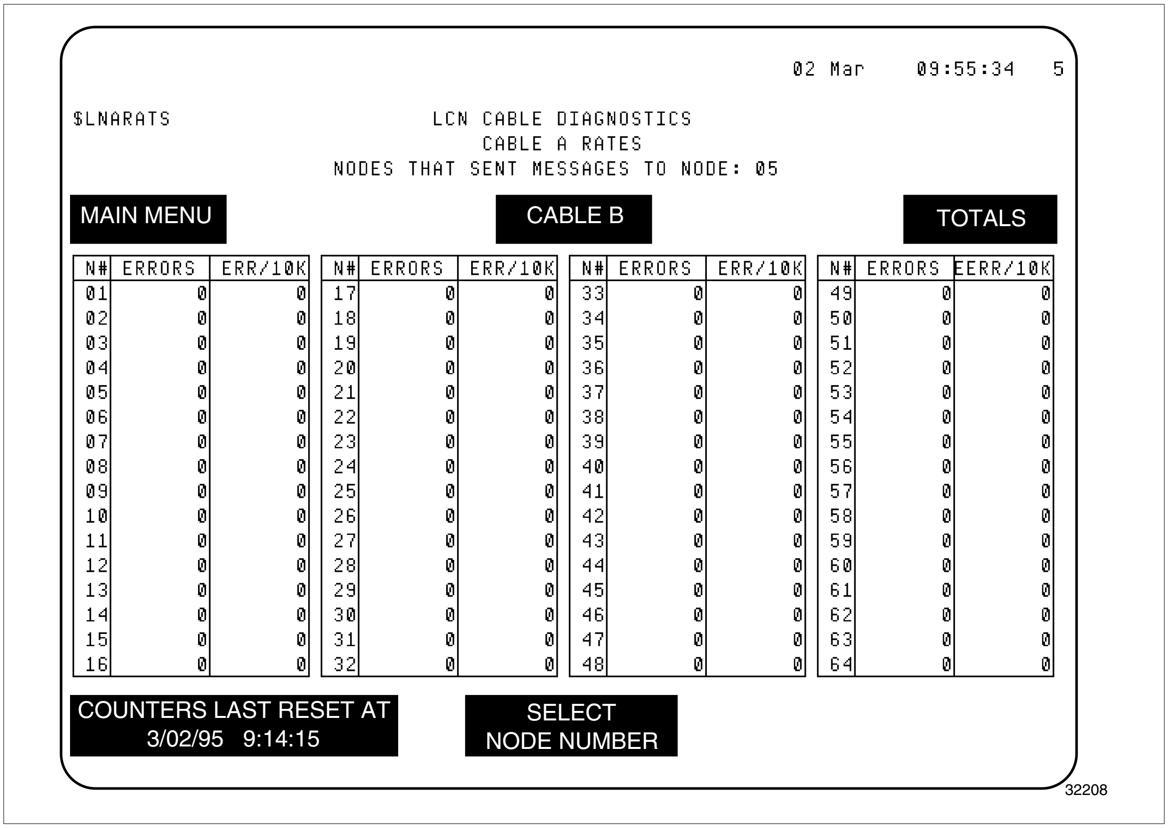
N#	ERRORS	MSGS	N#	ERRORS	MSGS	N#	ERRORS	MSGS	N#	ERRORS	MSGS
01	0	0e00	17	0	0e00	33	0	0e00	49	0	0e00
02	0	0e00	18	0	0e00	34	0	0e00	50	0	0e00
03	0	0e00	19	0	47e00	35	0	0e00	51	0	0e00
04	0	0e00	20	0	45e00	36	0	0e00	52	0	0e00
05	0	0e00	21	0	45e00	37	0	0e00	53	0	0e00
06	0	0e00	22	0	45e00	38	0	0e00	54	0	0e00
07	0	0e00	23	0	0e00	39	0	0e00	55	0	0e00
08	0	0e00	24	0	0e00	40	0	49e00	56	0	0e00
09	0	0e00	25	0	0e00	41	0	60e00	57	0	0e00
10	0	0e00	26	0	0e00	42	0	0e00	58	0	0e00
11	0	0e00	27	0	0e00	43	0	0e00	59	0	0e00
12	0	0e00	28	0	0e00	44	0	0e00	60	0	0e00
13	0	0e00	29	0	0e00	45	0	0e00	61	0	0e00
14	0	0e00	30	0	0e00	46	0	0e00	62	0	0e00
15	0	0e00	31	0	0e00	47	0	0e00	63	0	0e00
16	0	47e00	32	0	0e00	48	0	0e00	64	0	0e00

COUNTERS LAST RESET AT
3/02/95 9:14:15

SELECT
NODE NUMBER

32207

Figure 28 - Message/Error Totals—by Node



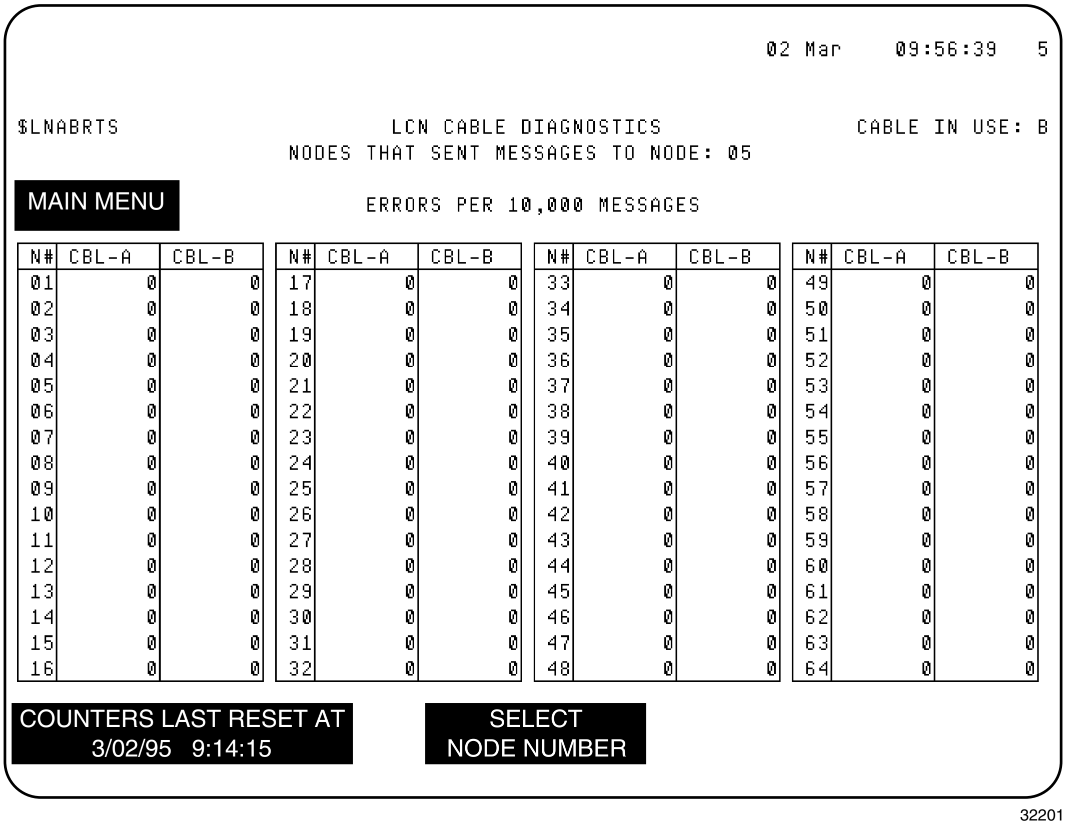
N#	ERRORS	ERR/10K	N#	ERRORS	ERR/10K	N#	ERRORS	ERR/10K	N#	ERRORS	ERR/10K
01	0	0	17	0	0	33	0	0	49	0	0
02	0	0	18	0	0	34	0	0	50	0	0
03	0	0	19	0	0	35	0	0	51	0	0
04	0	0	20	0	0	36	0	0	52	0	0
05	0	0	21	0	0	37	0	0	53	0	0
06	0	0	22	0	0	38	0	0	54	0	0
07	0	0	23	0	0	39	0	0	55	0	0
08	0	0	24	0	0	40	0	0	56	0	0
09	0	0	25	0	0	41	0	0	57	0	0
10	0	0	26	0	0	42	0	0	58	0	0
11	0	0	27	0	0	43	0	0	59	0	0
12	0	0	28	0	0	44	0	0	60	0	0
13	0	0	29	0	0	45	0	0	61	0	0
14	0	0	30	0	0	46	0	0	62	0	0
15	0	0	31	0	0	47	0	0	63	0	0
16	0	0	32	0	0	48	0	0	64	0	0

Figure 29 - Error Rates/Totals—by Node

Errors Per 10 K Messages—by Node CABLE A&B RATES

For the selected node number (indicated in the heading), Figure 30 shows the detected error rate per 10,000 messages received from each of the other nodes on the LCN. The error rates for both A and B cables are shown.

Because all errors are recovered by retransmitting the message, the error rate is the only relevant factor. If the user maintains a log for error rates, a trend can be seen, telling of damage or deterioration.



N#	CBL-A	CBL-B	N#	CBL-A	CBL-B	N#	CBL-A	CBL-B	N#	CBL-A	CBL-B
01	0	0	17	0	0	33	0	0	49	0	0
02	0	0	18	0	0	34	0	0	50	0	0
03	0	0	19	0	0	35	0	0	51	0	0
04	0	0	20	0	0	36	0	0	52	0	0
05	0	0	21	0	0	37	0	0	53	0	0
06	0	0	22	0	0	38	0	0	54	0	0
07	0	0	23	0	0	39	0	0	55	0	0
08	0	0	24	0	0	40	0	0	56	0	0
09	0	0	25	0	0	41	0	0	57	0	0
10	0	0	26	0	0	42	0	0	58	0	0
11	0	0	27	0	0	43	0	0	59	0	0
12	0	0	28	0	0	44	0	0	60	0	0
13	0	0	29	0	0	45	0	0	61	0	0
14	0	0	30	0	0	46	0	0	62	0	0
15	0	0	31	0	0	47	0	0	63	0	0
16	0	0	32	0	0	48	0	0	64	0	0

Figure 30 - Errors per 10,000 Messages—by Node

Local Driver Data LOCAL DRVR DATA

Figure 31 shows the Local Driver Data for the selected node (indicated in the display heading). Table 1 describes the display items and their values.

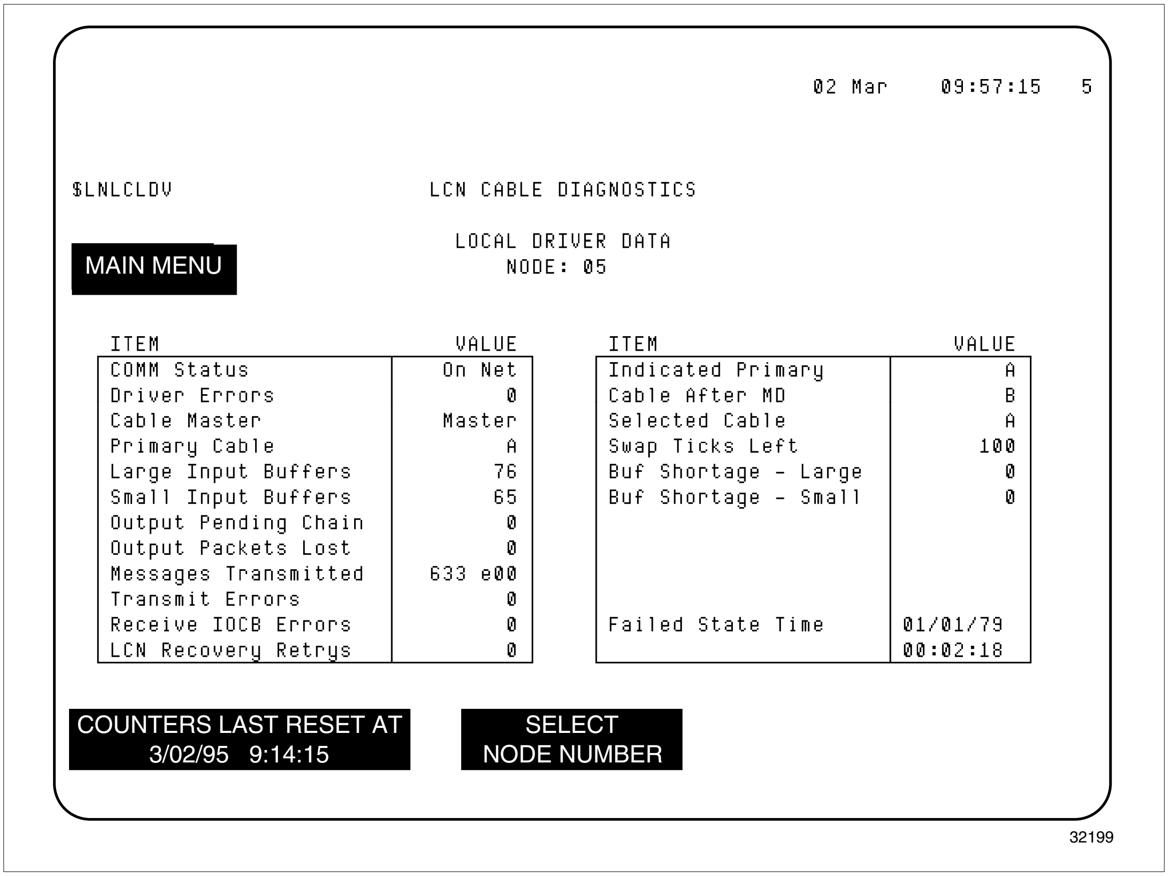


Figure 31 - Local Driver Dat

Table 4 - Local Driver Data

Item	Description/Values
COMM Status	LCN Driver Status for this node. Values are: Initializing, Recovering, Uninitialized, On Network, Entering Ring, Failed, and Waiting
Driver Errors	Secondary error code for this node is in a range from 001-031. These codes are defined in Table 5.
Cable Master	Indicates if this node is the cable master node or a slave node.
Primary Cable	This indicates the cable that this node sees as the primary cable for receiving messages.
Large Input Buffers	The current number of large message input buffers available in this node.
Small Input Buffers	The current number of small message input buffers available in this node.
Output Pending Chain	The current number of output messages pending from this node.
Output Packets Lost	The number of packets thrown away by this node because of off-network status.
Message Transmitted	The number of messages transmitted by this node.
Transmit Errors	The number of transmit errors detected by the hardware.
Receive IOCB Errors	The number of messages received by this node with errors in their I/O control block. The I/O control block contains the information necessary for the LCN transmit or receive operation and provides a location for reporting back to the processor the results or status of the operation.
LCN Recovery Retries	The number of times this node attempted to recover from an abnormal LCN error (corrupted messages and “media dead” are considered normal and do not result in attempts to recover). Indicates retries caused by hardware problems when attempting to communicate on the LCN. Range is 0-5.
Indicated Primary	The cable the LCNI in this node last reported as selected.
Cable After MD	The cable the LCNI in this node reported after a “media dead” interrupt.
Selected Cable	Cable most recently selected by the software in this node.
Swap Ticks Left	The number of 50-ms time ticks remaining until the master node selects the other LCN cable.
Buffer Shortage—Large	The number of times a message was lost because the large message buffers were not available.
Buffer Shortage—Small	The number of times a message was lost because the small message buffers were not available.
Failed State Time	The date and time when the LCN driver in this node last entered a failed state. Defaults to 01/01/79 00:01:11.

Table 5 - LCN Driver Errors

Secondary (SECD) Error Code	Error Definition
001	**Definition**: Error encountered during a module bus data transfer **Probable cause**: LCNI hardware error or software error
002-003	Not Used
004	**Definition**: Integrity failure **Probable cause**: LCNI hardware error
005	**Definition**: Illegal command received by LCNI. **Probable cause**: Software error
006	**Definition**: CCB format not valid **Probable cause**: Software error
007	**Definition**: IOCB format not valid **Probable cause**: Software error
008	**Definition**: Illogical software condition **Probable cause**: Software error
009	**Definition**: Self-test or board error, red LED on LCNI is on. **Probable cause**: LCNI hardware error
010	Not Used
011	**Definition**: Invalid IOCB code **Probable cause**: DRAM corruption by software error or hardware malfunction
012- 015	Not Used
016	**Definition**: Token received but when ready to transmit, LCN not silent **Probable cause**: Noise on cable or misoperation of some other LCNI. Possible duplicate LCNI addresses
017	**Definition**: In background testing a parity error was detected in the LCN-address connections on the transceiver board, or there is no match between the value in local RAM and what was read.
018	**Definition**: LCNI command time out **Probable cause**: LCNI hardware error
019	**Definition**: Frame-check sequence error detected while receiving data **Probable cause**: LCNI hardware error or cable problems

Table 5 LCN Driver Errors, *continued*

Secondary (SECD) Error Code	Error Definition
020	**Definition**: Framing error—received frame did not have an even number of bytes. **Probable cause**: LCNI hardware error or cable problems
021	**Definition**: LCNI receiver overrun—LCNI received data faster than it could be transferred to memory. **Probable cause**: LCNI not installed in slot 2 or LCNI hardware error
022	**Definition**: Underrun during LCNI transmission—LCNI cannot get data from memory fast enough to keep up with transmission rate. **Probable cause**: LCNI not installed in slot 2 or LCNI hardware error
023	**Definition**: Received an oversized frame. **Probable cause**: Software error. Might also be caused by hardware error in detecting end-of-frame delimiter before maximum frame time.
024	**Definition**: Manchester decoder error—LCNI could not decode incoming data. **Probable cause**: LCNI hardware error or poor signal quality on cable.
025	**Definition**: Alone in the ring—LCNI received token or tried to initialize token-passing ring and was unable to pass the token to another LCNI. **Probable cause**: LCNI hardware error, all other nodes disconnected or without power, or cable failure.
026	**Definition**: Cables dead—LCNI has not received a token pass addressed to itself or any other address for approximately 18 ms, so the token-passing ring has collapsed. This error is also reported if the LCNI has received 4352 token pass frames addressed to other nodes since it last received a token pass frame addressed to itself—the LCN cannot receive data passed by its predecessor in the token-passing ring. **Probable cause**: Power was removed from the node that held the token, noise on the cable, or cable fault.
027	**Definition**: LCNI in nonautomatic cable switchover mode. **Probable cause**: LCNI hardware error.
28-29	Not Used
030	**Definition**: Swapped to cable B because of errors on cable A. Reported only by master node (normally, node with lowest address). **Probable cause**: Occurrence of errors 019 through 024, above.
031	**Definition**: Swapped to cable A because of errors on cable B. Reported only by master node (normally, node with lowest address). **Probable cause**: Occurrence of errors 019 through 024, above

Local Communication Data LOCAL COMM DATA

Figure 32 shows the Local Communication Data. Table 6 describes the display items and their values.

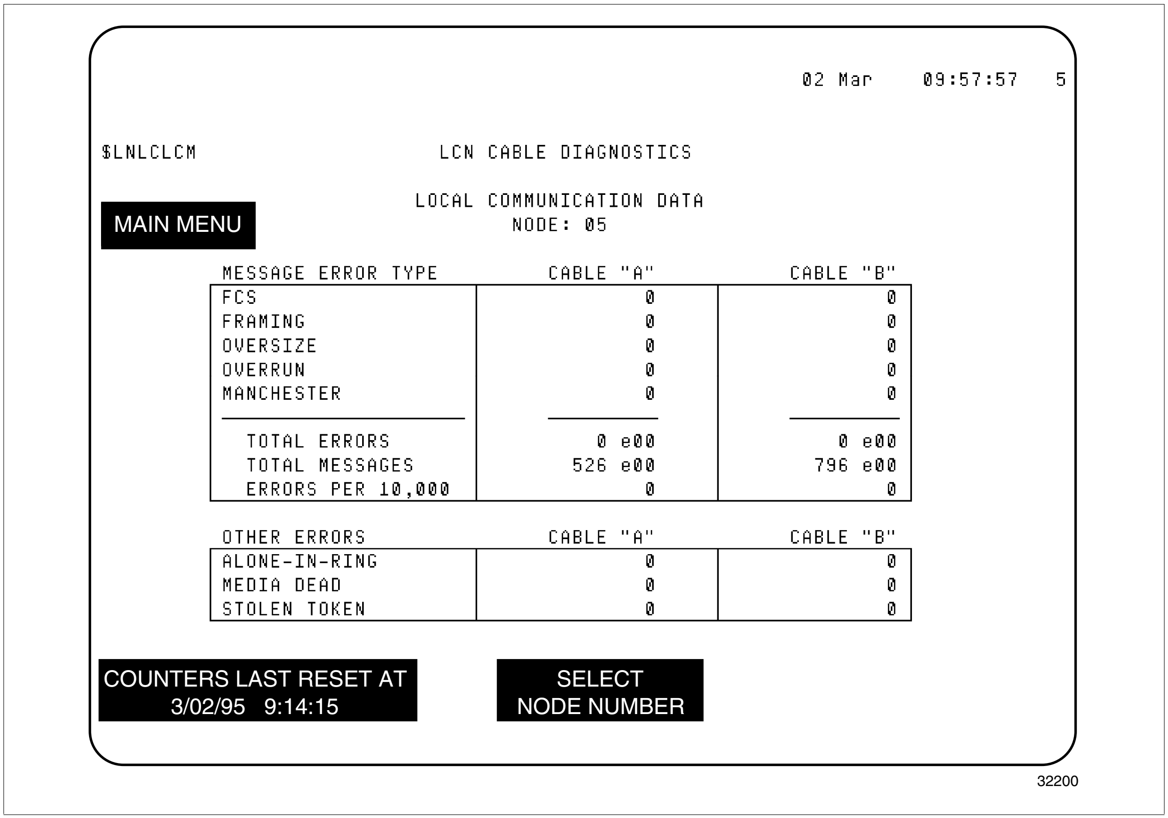


Figure 32 - Local Communication Data

Table 6 - Local Communication Data

Item	Description/Values
FCS	Frame Check Sequence Error count for this node.
Framing	The number of framing errors detected by this node.
Oversize	The number of messages received by this node that were larger than the allocated buffer size.
Overrun	The number of times this node’s LCNI could not gain direct-memory access to the CPU in time to process data.
Manchester	The number of Manchester errors detected by this node.
Alone- In-Ring	The number of alone-in-ring events detected by this node’s LCNI.
Media Dead	The number of media dead events detected by this node’s LCNI.
Stolen Token	The number of times the LCNI was ready to transmit and detected a signal on one or both cables (possibly noise or a valid transmission by another node).

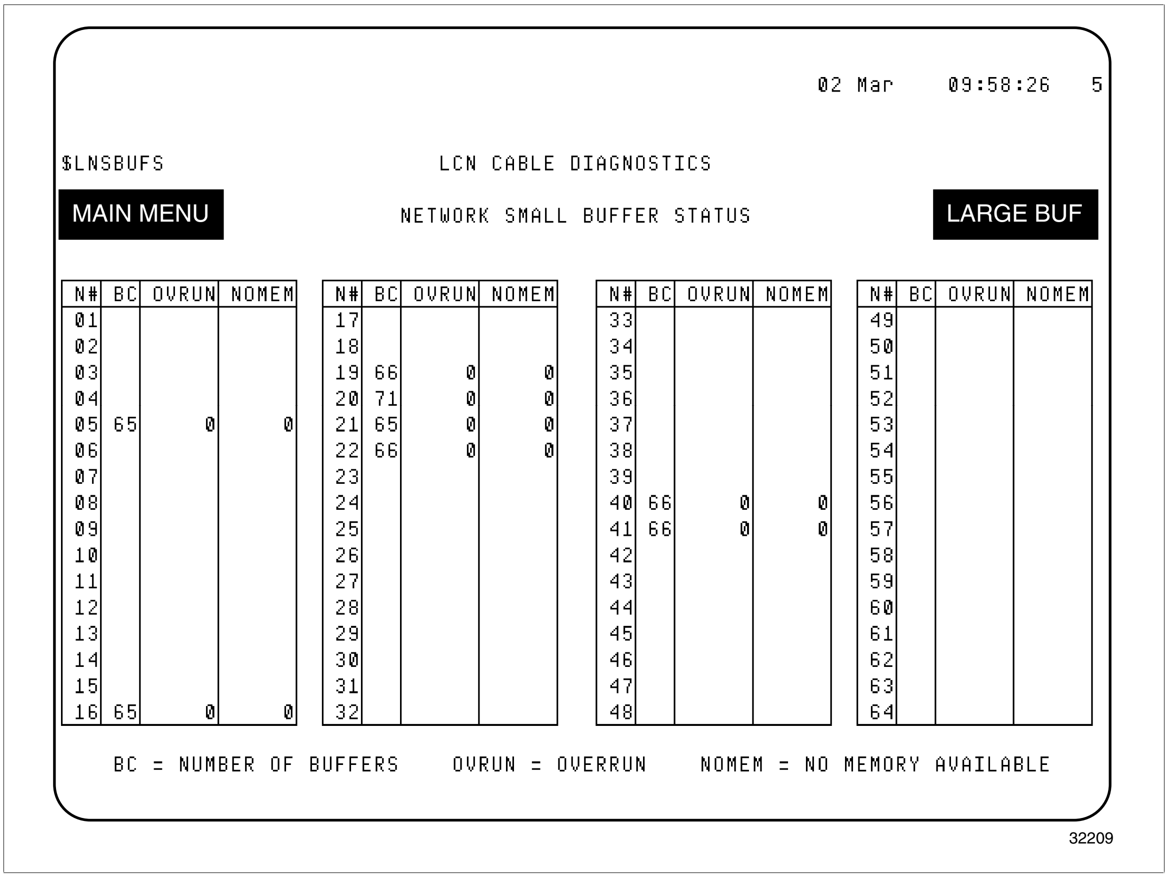
Buffer Status [SM BUFFER STAT] [LG BUFFER STAT]

Figure 33 shows:

- the number of small or large buffers available,
- the number of overruns, and
- if no buffer memory is available for each node on the LCN.

From the Small Buffer display, you can select the [LARGE BUF] target.

From the Large Buffer display, you can select the [SMALL BUF] target.



02 Mar 09:58:26 5

$LNSBUFS LCN CABLE DIAGNOSTICS

MAIN MENU NETWORK SMALL BUFFER STATUS LARGE BUF

N#	BC	OVRUN	NOMEM	N#	BC	OVRUN	NOMEM	N#	BC	OVRUN	NOMEM	N#	BC	OVRUN	NOMEM
01				17				33				49			
02				18				34				50			
03				19	66	0	0	35				51			
04				20	71	0	0	36				52			
05	65	0	0	21	65	0	0	37				53			
06				22	66	0	0	38				54			
07				23				39				55			
08				24				40	66	0	0	56			
09				25				41	66	0	0	57			
10				26				42				58			
11				27				43				59			
12				28				44				60			
13				29				45				61			
14				30				46				62			
15				31				47				63			
16	65	0	0	32				48				64			

BC = NUMBER OF BUFFERS OVRUN = OVERRUN NOMEM = NO MEMORY AVAILABLE

32209

Figure 33 - Network Small Buffer Status

Media Dead Status NET MEDIA DEADS

Figure 34 Shows the number of “media dead” events detected by each of the nodes on the LCN.

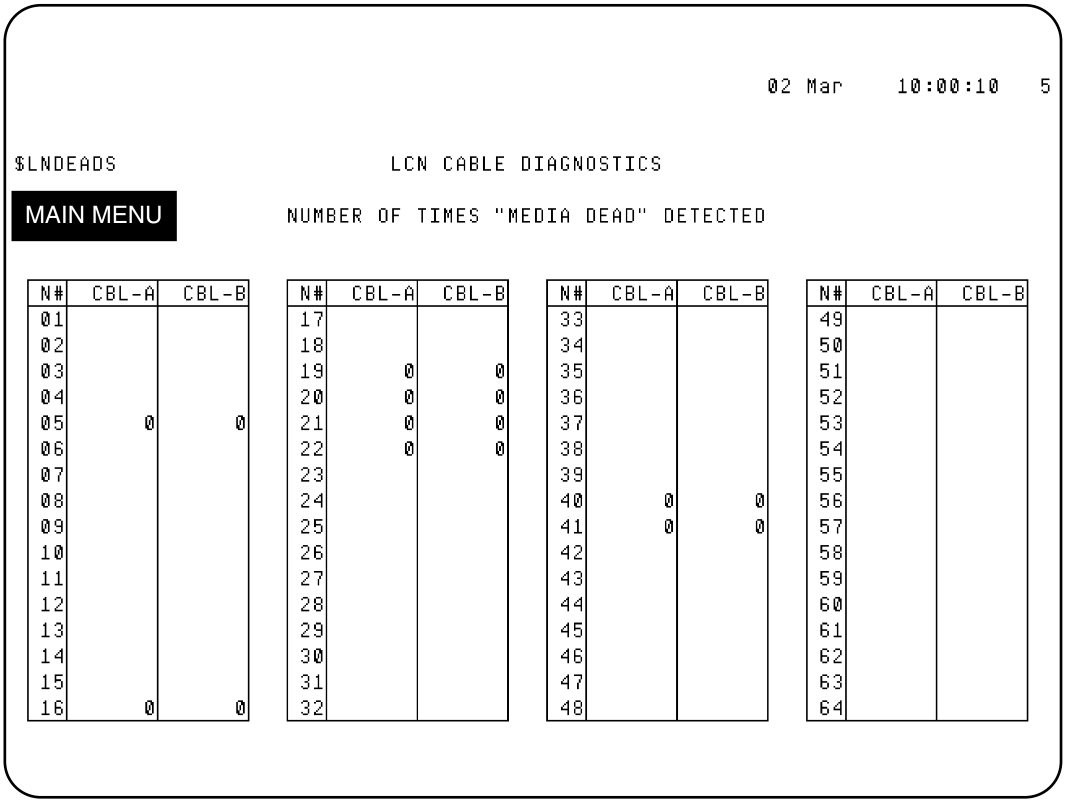


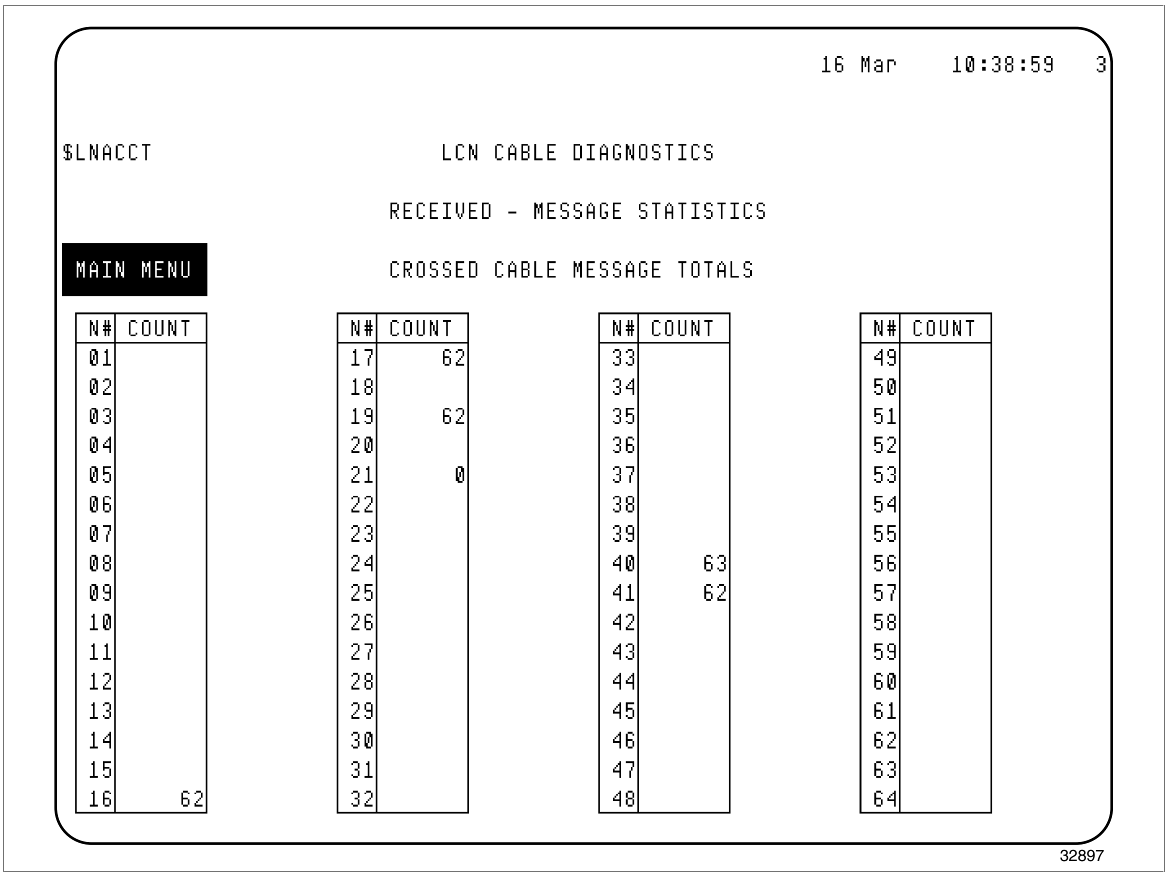
Figure 34 - Number of Times “Media Dead” Detected

Crossed Cable Display CROSSED CABLES

The $LNACCT display (used on R322 and R430 and later) provides a count for each node that can be used to determine the location of crossed LCN cables. If the LCN cable master has a K2LCN board with Rev. P or higher hardware and firmware or a K4LCN, it sends a count message on only the *active* cable. This is the one instance in which a message is transmitted only on one cable. Any node with crossed cables will not see the message, so its count should be less than the others. Occasionally, a node with crossed cables will hear the count; this can occur if the master US/GUS has sent out the count before the crossed node has swapped cables. To obtain completely accurate information from this display, you should monitor it over a 5-minute period.

The cable master always indicates one count higher than other nodes.

In the example below, the lowest numbered US/GUS node (the cable master) is node 40.


16 Mar 10:38:59 3

$LNACCT LCN CABLE DIAGNOSTICS

RECEIVED - MESSAGE STATISTICS

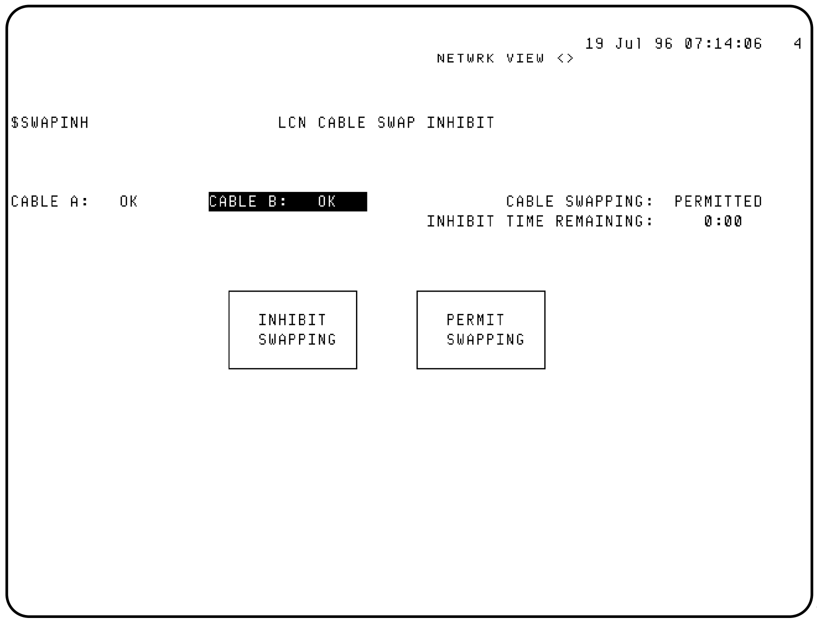
MAIN MENU CROSSED CABLE MESSAGE TOTALS

N#	COUNT	N#	COUNT	N#	COUNT	N#	COUNT
01		17	62	33		49	
02		18		34		50	
03		19	62	35		51	
04		20		36		52	
05		21	0	37		53	
06		22		38		54	
07		23		39		55	
08		24		40	63	56	
09		25		41	62	57	
10		26		42		58	
11		27		43		59	
12		28		44		60	
13		29		45		61	
14		30		46		62	
15		31		47		63	
16	62	32		48		64	

Figure 35 - Crossed Cable Display ($LNACCT)

Cable Swap Inhibit CABLE SWAP INH

On the LCN Cable Swap Inhibit display, a target INHIBIT SWAPPING appears. If the keylevel access is at least equal to the level configured in the NCF, selecting this target inhibits LCN cable swapping for the configured time period. The inhibit time remaining appears on screen and another target (PERMIT SWAPPING) allows immediate return to normal.



34467

Figure 36 - Cable Swap Inhibit

BUILDING YOUR OWN LCN STATUS CUSTOM DISPLAYS

You might find it easier to build a custom display unique to your plant's layout. A topology map display can aid in the troubleshooting should LCN cable problems occur. Table 7 lists the Processor Status Data Point (PSDP) parameters that can be used in this type of display.

The way to add these values into your custom display is as follows:

`$PRSTSnn.COMM(###)`

where `nn` = LCN node address
`###` = COMM parameter array index number

Table 7 - PSDP "Comm" Parameter—Data Array Elements

Index	Description
1	Env_PSDP_Flag 1 – Counter Reset Flag
2	Env_PSDP_Flag 2 – Set Mode Flag
3	Env_PSDP_Flag 3 – Reserved for Future Use
4	Env_Software_Version
5	Env_Communication_Management_Status
6	Env_Driver_Error_Number
7	Env_Cable_Status.Master_Status
8	Env_Cable_Status.Cable_Primary_Selection
9	Env_Number_of_Input_Buffers_Arr[Channel_One]
10	Env_Number_of_Input_Buffers_Arr[Channel_Two]
11	Env_Output_Pending_Chain_Count
12	Env_Output_Packet_Lost_Count
13	Man(Env_Packet_Transmission_Counter)
14	Exp(Env_Packet_Transmission_Counter)
15	Env_Transmit_Error_Count
16	Env_Receive_IOCB_Packet_Error_Count
17	Env_LCN_Recovery_Retry_Count
18	Env_Indicated_Primary_Cable
19	Env_Cable_After_MD_Interrupt
20	Env_Last_Cable_Actually_Selected
21	Env_Swap_Ticks_Remaining
22	YYMM(Env_Failed_State_Entry_Time)
23	DDHH(Env_Failed_State_Entry_Time)
24	MMSS(Env_Failed_State_Entry_Time)
25	YYMM(Env_Time_Counters_Were_Last_Reset)
26	DDHH(Env_Time_Counters_Were_Last_Reset)
27	MMSS(Env_Time_Counters_Were_Last_Reset)
28	All.FCS.A
29	All.FCS.B
30	All.FCS_Rate.A

(Continued)

Table 7 - PSDP “Comm” Parameter—Data Array Elements (Continued)

Index	Description
31	All.FCS_Rate.B
32	All.Framing.A
33	All.Framing.B
34	All.Framing_Rate.A
35	All.Framing_Rate.B
36	All.Oversize.A
37	All.Oversize.B
38	All.Oversize_Rate.A
39	All.Oversize_Rate.B
40	All.Overrun.A
41	All.Overrun.B
42	All.Overrun_Rate.A
43	All.Overrun_Rate.B
44	All.Manchester.A
45	All.Manchester.B
46	All.Manchester_Rate.A
47	All.Manchester_Rate.B
48	Man(All.Total_Frames.A)
49	Exp(All.Total_Frames.A)
50	Man(All.Total_Frames.B)
51	Exp(All.Total_Frames.B)
52	Man(All.Total_Errors.A)
53	Exp(All.Total_Errors.A)
54	Man(All.Total_Errors.B)
55	Exp(All.Total_Errors.B)
56	All.Total_Errors_Rate.A
57	All.Total_Errors_Rate.B
58	Alone_In_Ring.A
59	Alone_In_Ring.B
60	Media_Dead_Count.A
61	Media_Dead_Count.B
62	Stolen_Token_Count.A
63	Stolen_Token_Count.B
64	Input_Packet_Chain_Overrun_Count[Channel_One]
65	Input_Packet_Chain_Overrun_Count[Channel_Two]
66	Input_Packet_Buffer_Not_Available[Channel_One]
67	Input_Packet_Buffer_Not_Available[Channel_Two]
68	Buffer_Shortage_Count[Channel_One]
69	Buffer_Shortage_Count[Channel_Two]
70	Multipacket_Buffer_Memory_Unavailable

(Continued)

Table 7 - PSDP “Comm” Parameter—Data Array Elements (Continued)

	Total Errors		Total Frames				Errors/10,000	
Node	A	B	A-Man	A-Exp	B-Man	B-Exp	A	B
00	71	72	73	74	75	76	77	78
01	79	80	81	82	83	84	85	86
02	87	88	89	90	91	92	93	94
03	95	96	97	98	99	100	101	102
04	103	104	105	106	107	108	109	110
05	111	112	113	114	115	116	117	118
06	119	120	121	122	123	124	125	126
07	127	128	129	130	131	132	133	134
08	135	136	137	138	139	140	141	142
09	143	144	145	146	147	148	149	150
10	151	152	153	154	155	156	157	158
11	159	160	161	162	163	164	165	166
12	167	168	169	170	171	172	173	174
13	175	176	177	178	179	180	181	182
14	183	184	185	186	187	188	189	190
15	191	192	193	194	195	196	197	198
16	199	200	201	202	203	204	205	206
17	207	208	209	210	211	212	213	214
18	215	216	217	218	219	220	221	222
19	223	224	225	226	227	228	229	230
20	231	232	233	234	235	236	237	238
21	239	240	241	242	243	244	245	246
22	247	248	249	250	251	252	253	254
23	255	256	257	258	259	260	261	262
24	263	264	265	266	267	268	269	270
25	271	272	273	274	275	276	277	278
26	279	280	281	282	283	284	285	286
27	287	288	289	290	291	292	293	294
28	295	296	297	298	299	300	301	302
29	303	304	305	306	307	308	309	310
30	311	312	313	314	315	316	317	318
31	319	320	321	322	323	324	325	326
32	327	328	329	330	331	332	333	334
33	335	336	337	338	339	340	341	342
34	343	344	345	346	347	348	349	350
35	351	352	353	354	355	356	357	358
36	359	360	361	362	363	364	365	366
37	367	368	369	370	371	372	373	374
38	375	376	377	378	379	380	381	382
39	383	384	385	386	387	388	389	390
40	391	392	393	394	395	396	397	398
41	399	400	401	402	403	404	405	406
42	407	408	409	410	411	412	413	414
43	415	416	417	418	419	420	421	422
44	423	424	425	426	427	428	429	430
45	431	432	433	434	435	436	437	438
46	439	440	441	442	443	444	445	446
47	447	448	449	450	451	452	453	454
48	455	456	457	458	459	460	461	462
49	463	464	465	466	467	468	469	470

(Continued)

Table 7 - PSDP "Comm" Parameter—Data Array Elements (Continued)

Node	Total Errors		Total Frames				Errors/10,000	
	A	B	A-Man	A-Exp	B-Man	B-Exp	A	B
50	471	472	473	474	475	476	477	478
51	479	480	481	482	483	484	485	486
52	487	488	489	490	491	492	493	494
53	495	496	497	498	499	500	501	502
54	503	504	505	506	507	508	509	510
55	511	512	513	514	515	516	517	518
56	519	520	521	522	523	524	525	526
57	527	528	529	530	531	532	533	534
58	535	536	537	538	539	540	541	542
59	543	544	545	546	547	548	549	550
60	551	552	553	554	555	556	557	558
61	559	560	561	562	563	564	565	566
62	567	568	569	570	571	572	573	574
63	575	576	577	578	579	580	581	582
64	583	584	585	586	587	588	589	590
65	591	592	593	594	595	596	597	598
66	599	600	601	602	603	604	605	606
67	607	608	609	610	611	612	613	614
68	615	616	617	618	619	620	621	622
69	623	624	625	626	627	628	629	630
70	631	632	633	634	635	636	637	638
71	639	640	641	642	643	644	645	646
72	647	648	649	650	651	652	653	654
73	655	656	657	658	659	660	661	662
74	663	664	665	666	667	668	669	670
75	671	672	673	674	675	676	677	678
76	679	680	681	682	683	684	685	686
77	687	688	689	690	691	692	693	694
78	695	696	697	698	699	700	701	702
79	703	704	705	706	707	708	709	710
80	711	712	713	714	715	716	717	718
81	719	720	721	722	723	724	725	726
82	727	728	729	730	731	732	733	734
83	735	736	737	738	739	740	741	742
84	743	744	745	746	747	748	749	750
85	751	752	753	754	755	756	757	758
86	759	760	761	762	763	764	765	766
87	767	768	769	770	771	772	773	774
88	775	776	777	778	779	780	781	782
89	783	784	785	786	787	788	789	790
90	791	792	793	794	795	796	797	798
91	799	800	801	802	803	804	805	806
92	807	808	809	810	811	812	813	814
93	815	816	817	818	819	820	821	822
94	823	824	825	826	827	828	829	830
95	831	832	833	834	835	836	837	838
96	839	840	841	842	843	844	845	846

LAB TIME	<45 Minutes
Use your US.	
Take with you: • This course module	

LAB EXERCISE 1

The following lab exercise will familiarize you with the $LNMENU display (LCN Cable Diagnostics Main Menu), its targets, and the diagnostics information that is accessed by selecting the targets.

Your course manager will take an active part in this lab exercise, and may provide you with additional guidelines as you perform the exercise.

1. Call up the $LNMENU display (LCN Cable Diagnostics Main Menu).

2. Note the targets available. Select each of the targets, and use the information in this course module to become familiar with the data displayed. If you have any questions, check with your course manager.

3. Use the targets on the $LNMENU display to determine which of the LCN nodes is the “master” node for cable swapping.

   Record the display used and the node number.

   Display/node number: ____

End of Lab Exercise 1

LAB EXERCISE 2

Build the following QUIKTRND display to monitor several of the COMM parameters:

- COMM(8) = primary cable
- COMM(21) = number of 50 msec. swap ticks remaining before a cable swap occurs
- COMM(60) = number of media dead interrupts on cable A
- COMM(61) = number of media dead interrupts on cable B

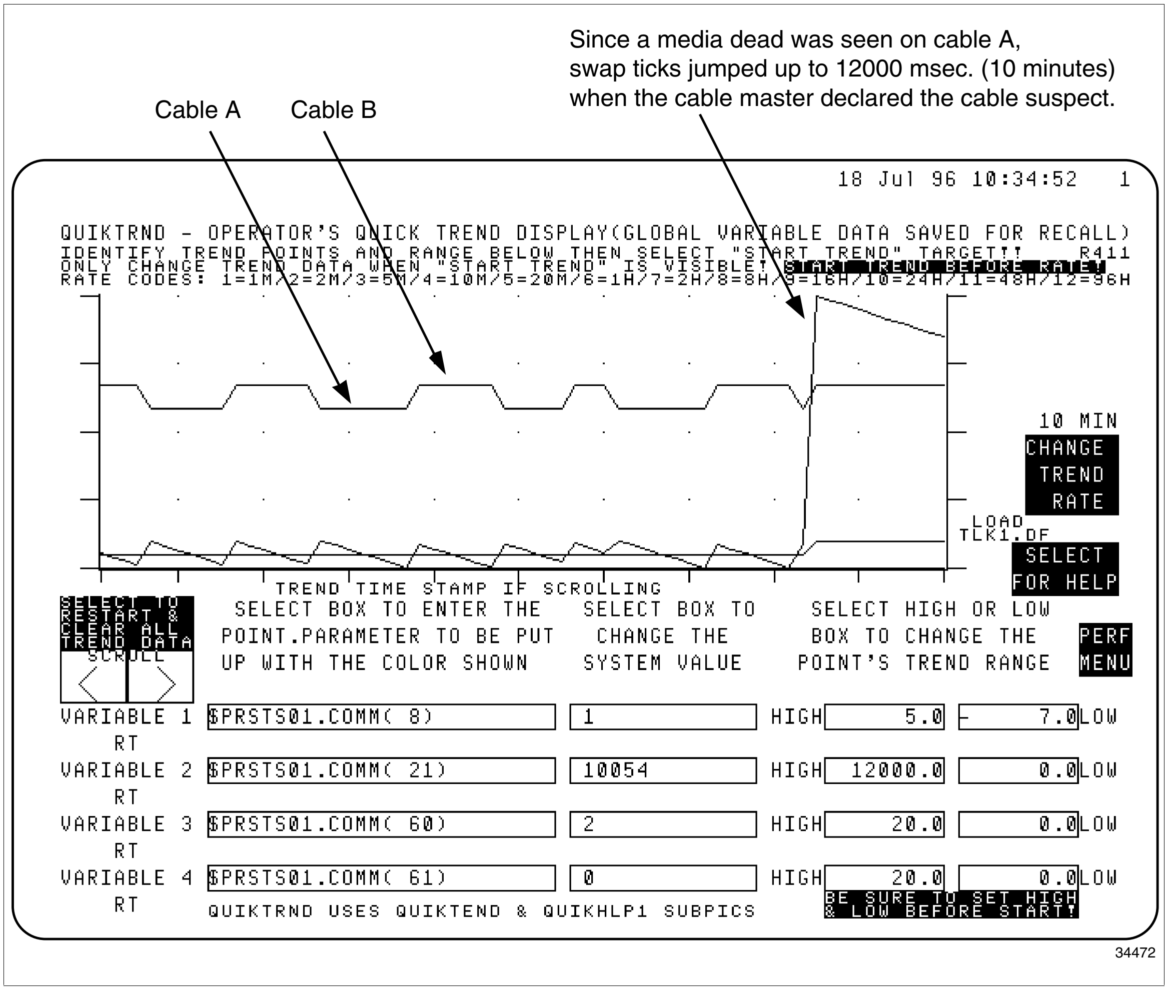


Figure 37 - QUIKTRND—Lab Exercise

End of Lab Exercise 2

LAB EXERCISE 3

1. Call up the System Status display and check the cable status to ensure that neither of the cables is suspect (cable targets are green).

2. Ask your course manager to remove the inactive cable from a node other than the master node.

   Time how long it takes the master node to declare the cable suspect.

   Time: ____

3. Ask your course manager to replace the cable, and time how long it takes for the cable status to return to a nonsuspect (cable targets green) state.
   Time: ____

4. Ask your course manager to install a special device on the cable to introduce cable errors.

   Reset the error counters for all nodes from the [RESET TIMES] target on the $LNMENU display.

5. Once the error counters are reset, access the various cable diagnostics displays and record the number of errors detected.

   Errors: ____

6. From the $LNMENU, select the [LOCAL DRVR DATA] and [LOCAL COMM DATA] targets to determine the types of errors being detected.

   Record the types of errors being detected.

   Errors: ____
   ____

7. Ask your course manager to remove the terminator from one of the LCN cables. This action should cause signal reflections to occur on that cable.

   Determine which of the nodes is indicating communication errors.

End of Lab Exercise 3

LAST PAGE