ALSTOM

VPI® II

Vital Processor Interlocking Control System

Maintenance and Troubleshooting

Maintenance and Troubleshooting Manual
P2511B, Volume 5

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Alstom Signaling Inc.

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PREFACE

NOTICE OF CONFIDENTIAL INFORMATION

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ABOUT THE MANUAL

This manual is intended provide maintenance and troubleshooting procedures for the Alstom Vital Processor Interlocking Control System, (VPI® II). This manual is part of a 5 volume set of manuals that are summarized in Section 1.

The information in this manual is arranged into sections. The title and a brief description of each section follow:

Section 1 – INTRODUCTION: This section describes the service log, parts, equipment and maintenance schedule for maintenance and troubleshooting of the VPI II system.

Section 2 – TROUBLESHOOTING: This section provides troubleshooting flowcharts for the VPI II system.

Section 3 – SYSTEM DIAGNOSTICS: This section describes the available system diagnostics on the VPI II system.

Section 4 – TRACKER ANALYZER: This section introduces the Tracker analyzer available for the VPI II system.

Section 5 – MAINTENANCE MANAGEMENT SYSTEM (MMS): This section introduces the Maintenance Management System (MMS) available for the VPI II system.

Section 6 – BOARD REPLACEMENT: This section provides board replacement procedures for each of the boards used in the VPI II system.

Section 7 – VPI II VITAL BOARD VERIFICATION: This section provides procedures for verification of VPI II system Vital board functions.

Appendix A – CRG APPLICATION GUIDELINES: This section provides the application guidelines for the CRG (Code Rate Generator) board.

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MANUAL SPECIAL NOTATIONS

In the Alstom manuals, there are three methods used to convey special informational notations to the reader. These notations are warnings, cautions, and notes. Both warnings and cautions are readily noticeable by boldface type two lines beneath the caption.

Warning

A warning is the most important notation to heed. A warning is used to tell the reader that special attention needs to be paid to the message because if the instructions or advice is not followed when working on the equipment then the result could be either serious harm or death. The sudden, unexpected operation of a switch machine, for example, or the technician contacting the third rail could lead to personal injury or death. An example of a typical warning notice follows:

WARNING

DISCONNECT MOTOR ENERGY WHENEVER WORKING ON SWITCH LAYOUT OR SWITCH MACHINE. UNEXPECTED OPERATION OF MACHINE COULD CAUSE INJURY FROM OPEN GEARS, ELECTRICAL SHOCK, OR MOVING SWITCH POINTS.

Caution

A caution statement is used when an operating or maintenance procedure, practice, condition, or statement, which if not strictly adhered to, could result in damage to or destruction of equipment. A typical caution found in a manual is as follows:

CAUTION

Turn power off before attempting to remove or insert circuit boards into a module. Boards can be damaged if power is not turned off.

Note

A note is normally used to provide minor additional information to the reader to explain the reason for a given step in a test procedure or to just provide a background detail. An example of the use of a note follows:

NOTE

A capacitor may be mounted on the circuit board with a RTV adhesive. Use the same color RTV.

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1. SECTION 1 – INTRODUCTION

1.1. GENERAL

This manual contains specific procedures for the maintenance and troubleshooting of the VPI® II system.

WARNING

DISRUPTION OF VITAL CONTROLLER SERVICE POSES A POTENTIAL THREAT TO RAIL SAFETY. BEFORE SHUTTING DOWN AN INTERLOCKING FOR ANY REASON, YOU MUST NOTIFY THE RAILROAD DISPATCHER IN CHARGE OF THE AFFECTED ROUTE(S). TAKE ALL STEPS NECESSARY TO ENSURE THE SAFE PASSAGE OF TRAFFIC IS MAINTAINED.

1.2. MANUAL SET ORGANIZATION

This manual is part of a 5 volume set supporting the VPI II system. The set is organized as follows:

- Volume 1, Installation, Operation, and Theory Manual, includes general overview of the field installation and setup of the VPI II system; including capacity guidelines and allowable VSC/CSEX board combinations, system operation, and theory of operation.
- Volume 2, Chassis Configuration, describes the chassis configuration including cables and power supplies.
- Volume 3, Vital Subsystem, includes the Vital subsystem board drawings, signature headers and proms, and board reference data.
- Volume 4, Non-Vital Subsystem, includes non-vital subsystem board drawings and board reference data.
- Volume 5, Maintenance and Troubleshooting, is this document. It describes system maintenance and troubleshooting, including discussion of diagnostics and references for the applicable software and hardware manuals.

1.3. SERVICE LOG

Keep a service log on the VPI II system to record test results and keep track of any service performed. A log should describe any malfunctions, corrective action taken and all preventive maintenance performed. The log can also be used to maintain a spare parts inventory by recording the quantities and type of printed circuit boards and spare parts used as replacements.

1.4. SPARE PARTS

The VPI II system is designed for long life and trouble-free operation. This equipment, however, as with all electronic equipment may have an occasional component failure. Order spare boards from Alstom based on your projected needs. The recommended spare parts to support one VPI module are:

- A spare of each specific board type used in the module
- A spare set of the signature headers (P/N 59473-871-XX) used in boards above, see P2511B, Volume 3, Appendix A
- A spare set of signature PROMs (P/N 39780-003-XX) used in the boards above, see P2511B, Volume 3, Appendix A
- A spare set of application data EPROMs, both Vital and non-vital
- A spare set of system EPROMs, both Vital and non-vital

Boards with static-sensitive components should be stored, transported or shipped in conductive Velostate bags and have printed circuit Contabs attached. Leave the printed circuit Contabs on all boards except for testing and installation.

1.5. TEST EQUIPMENT

Field maintenance of the VPI II system requires little in the way of external test equipment. Built-in circuitry tests critical system functions and generate the appropriate status messages on an externally connected PC. In addition, all VPI circuit boards have LED indicators that reveal the operating status of the board.

Besides these automated test tools, a standard multi-meter (Fluke Model 87 or similar) is helpful for checking the level of operating voltages, current levels, and for continuity checks.

CAUTION

Verify that all power to the VPI II system is removed before removal or installation of any boards. Failure to do so may result in damage to board components.

1.6. PREVENTATIVE MAINTENANCE

No periodic adjustments are required to sustain continuous VPI II system operation. Check the module periodically for damaged hardware or loose connections, broken or corroded wiring, signs of overheating and build-up of dust or foreign material. Make sure that all boards are seated in the module properly and that the module covers are properly secured.

If the board contact fingers have been touched or show signs of contamination, clean them with a contact cleaner such as Miller-Stephenson's Contact Renu, IBM Contact Lubricant (IBM part no. 451053) or other approved solvent using a clean, lint-free cloth.

Check the VPI Power Supply voltage for a value of +5 ± 0.25 volts DC. Take corrective action if necessary. This voltage check should be made on the test points of boards installed in a system chassis or expansion chassis. As there are different board complements possible with a VPI II system, it is recommended that the test points on processor board assemblies, e.g., CPU II, CSEX3, VSC and NVTWC-FSK be selected for this measurement. Input and output boards, whether Vital or non-vital, are much more tolerant of variations of the system logic voltage than the processors.

Use a PC, laptop, or hand held device running VT-100 terminal emulation software, a CSEX3 board equipped with the Vital Diagnostic Protocol (VDP – see Alstom publication P2346W), or Alstom's Tracker® analyzer (see Alstom publication P2307) to interrogate the system for system diagnostics. For example, a failure may cause a "SYS WARNING" status message to be displayed, which may indicate outputs that fail in a non-fatal fashion such as open lamp filaments.

Check the LED status lamps on the boards for proper signals (refer to “Troubleshooting with LED’s” later in this section).

Before starting any detailed troubleshooting, check for simple problems first such as blown fuses, loose plugs, dirty board contacts or improper voltages.

In addition, if the system has been serviced or turned off and does not restart, check the following prior to beginning detailed troubleshooting:

- Vital Input and Output boards have the proper signature headers and are in their respective slots.
- All on-board switches and jumpers are properly set See the individual board information in P2511B, Volume 3 for Vital boards and P2511B, Volume 4 for non-vital boards.
- Wiring between the Vital Relay Driver (VRD) board and the VRD Relay is intact.
- Input power to the VRD board is between 9.0 and 16.0 volts.
- Energizing the VRD Relay causes voltage between 9.0 to 16.0 volts to be applied to the “VRDFRNT-DI” designated VPI Vital input.
- Application logic version in the CPU II board Flash matches that dictated by the revision signature wire wrapped on the Motherboard (at the CPU II board slot).

2. SECTION 2 – TROUBLESHOOTING

2.1. GENERAL

This section provides troubleshooting flowcharts for the VPI II system. To troubleshoot, refer to Figure 2–1, a three page general diagnostic flowchart.

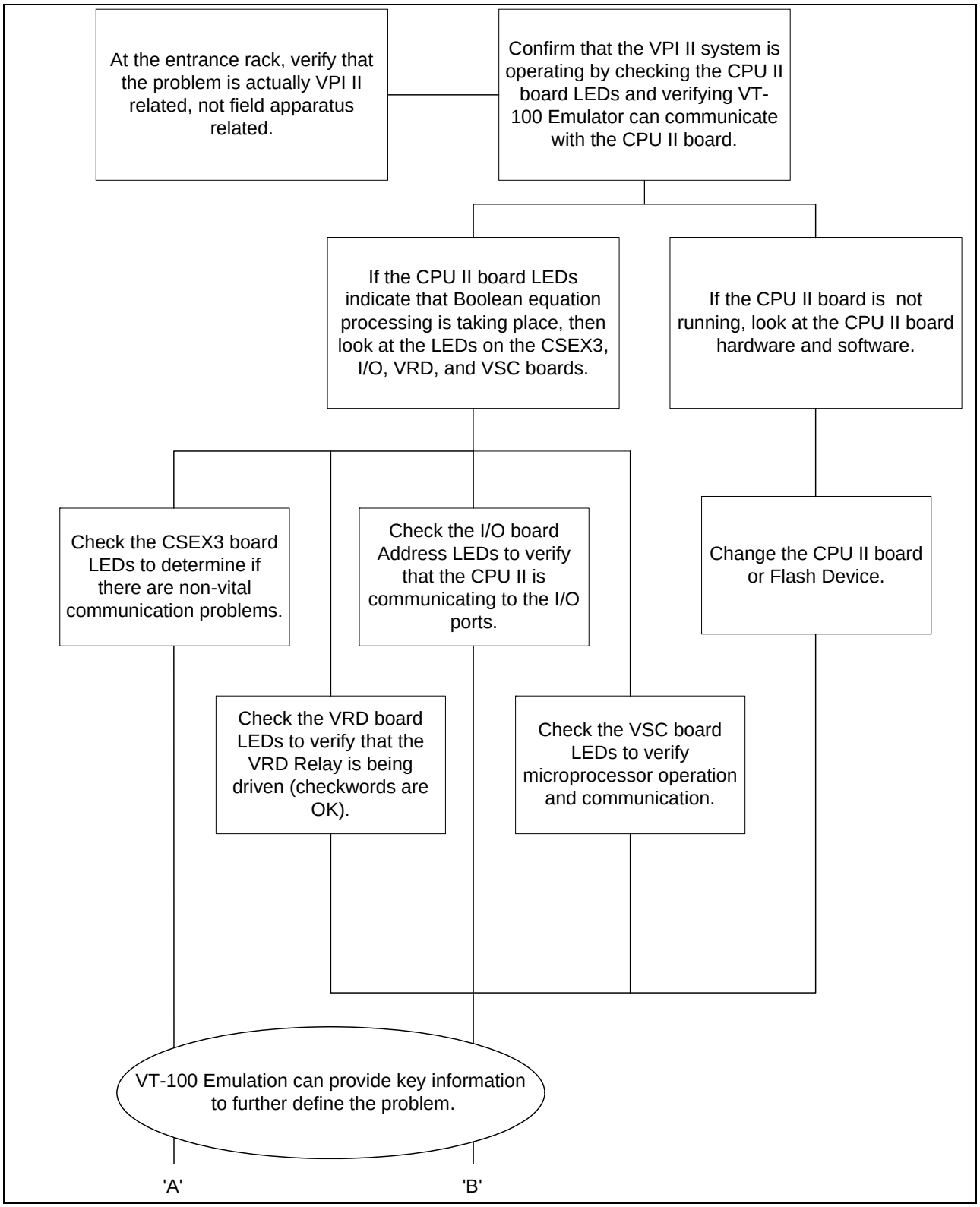

Figure 2–1. General Diagnostic Flowchart (sheet 1 of 3)

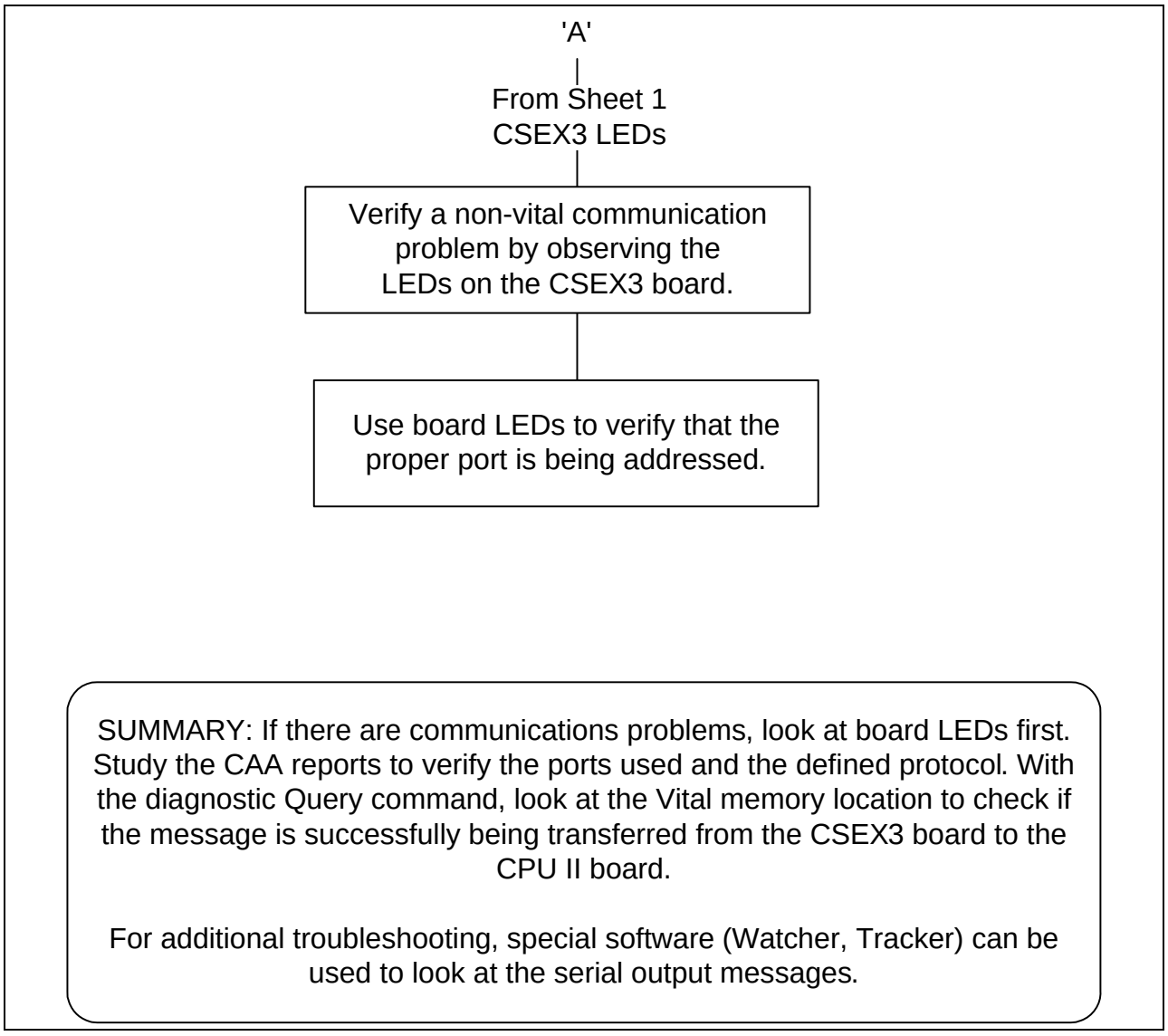

Figure 2–1. General Diagnostic Flowchart (sheet 2 of 3)

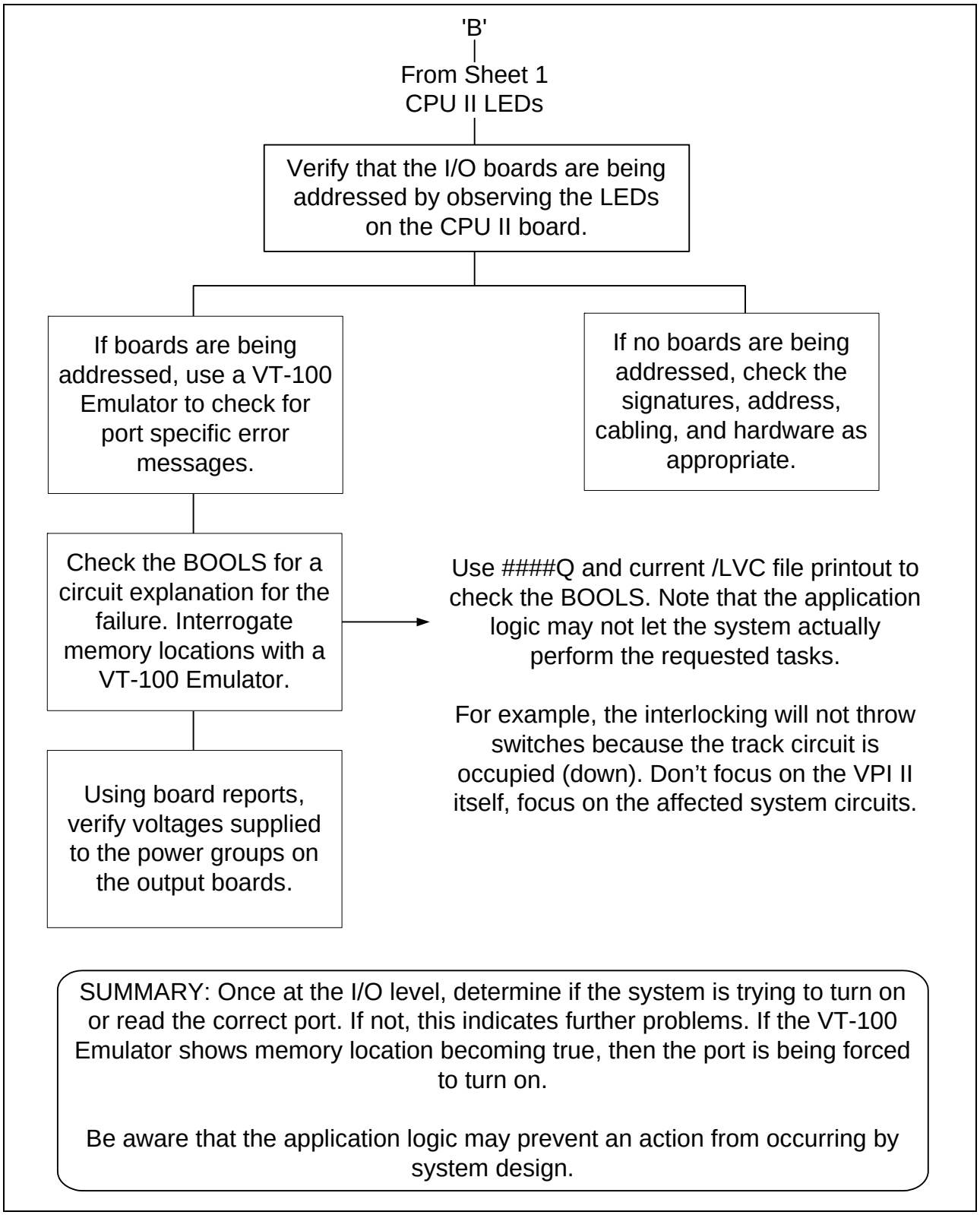

Figure 2–1. General Diagnostic Flowchart (sheet 3 of 3)

3. SECTION 3 – SYSTEM DIAGNOSTICS

3.1. GENERAL

This section discusses the system diagnostics available on the VPI II system, including:

- Troubleshooting with Board LEDs
- Vital subsystem diagnostics with VT-100 Emulation with the
  - CPU II board
  - CSEX3 board for systems configured with VDP Protocol
- Non-vital system diagnostics with the CSEX3 Board

3.2. TROUBLESHOOTING WITH LEDS

Figure 3–1 includes the on-off status, relative position, name and function of diagnostic LEDs in a typical VPI module. The five sheets show the recommended sequence to follow for initial LED troubleshooting in a typical module. CAA file information is given for installations where the CAA package is provided. For additional LED indicator and board edge detail see P2511B, Volume 3 for Vital boards and P2511B, Volume 4 for non-vital boards.

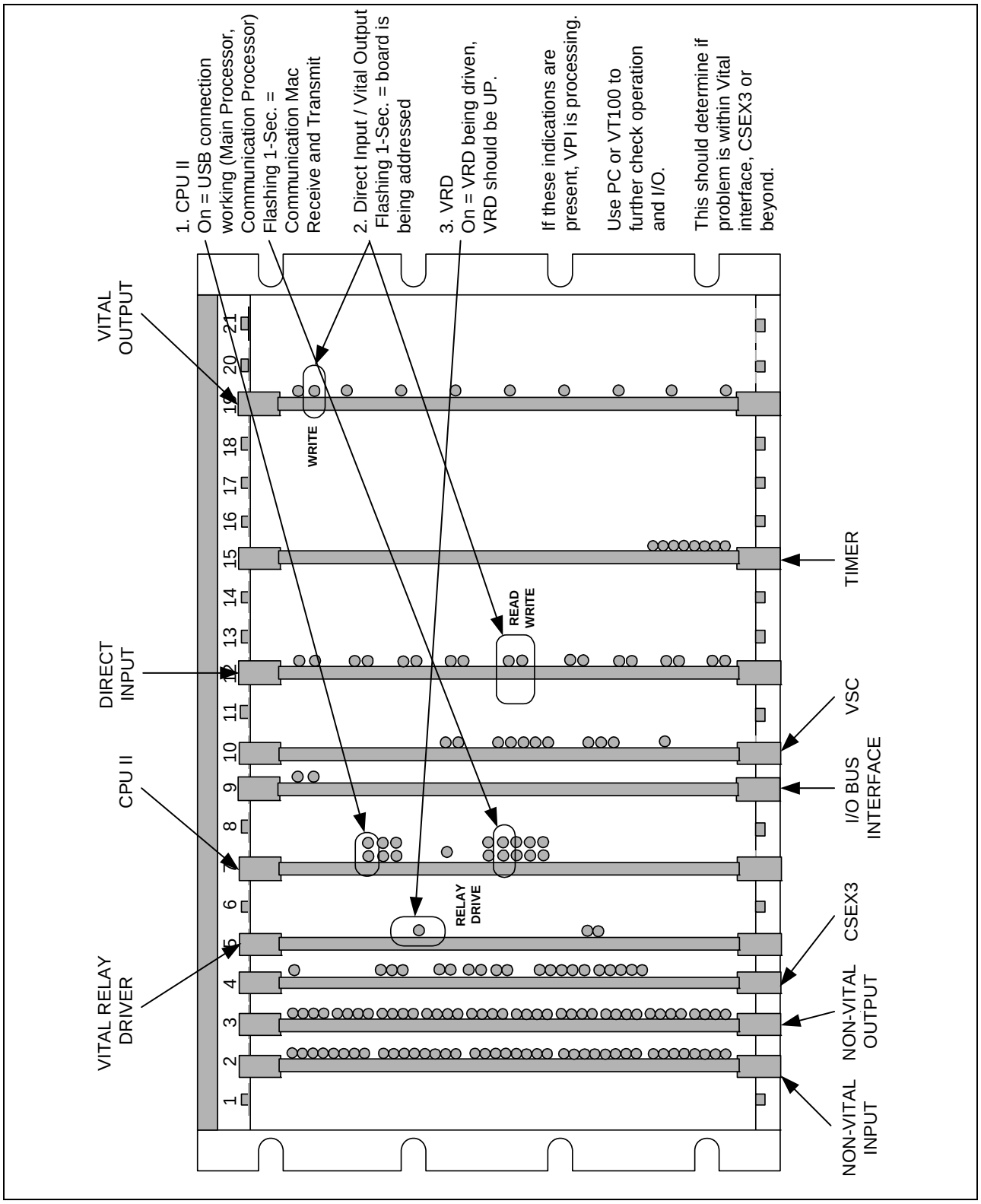

Figure 3–1. LED Troubleshooting Sequence (sheet 1 of 5)

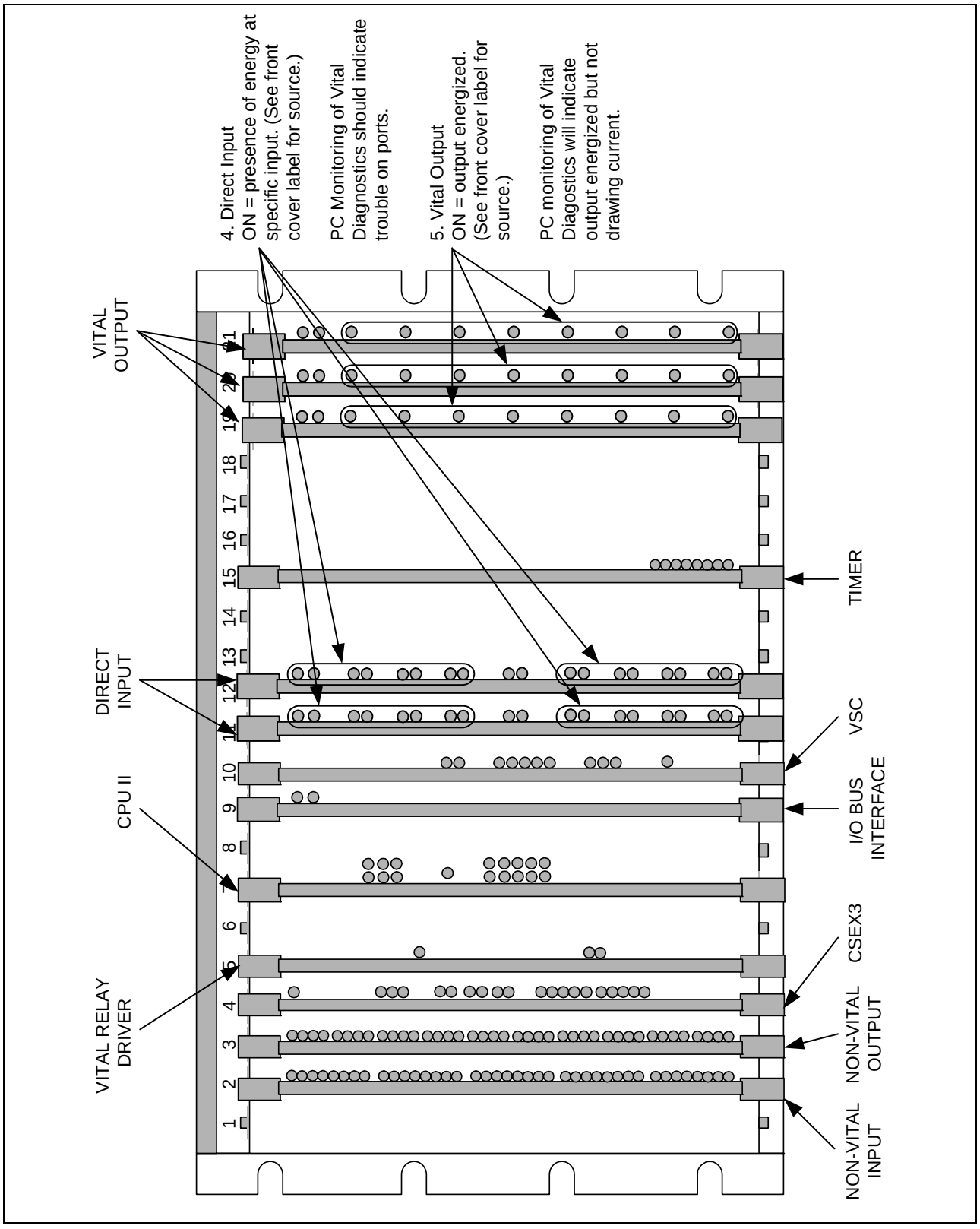

Figure 3–1. LED Troubleshooting Sequence (sheet 2 of 5)

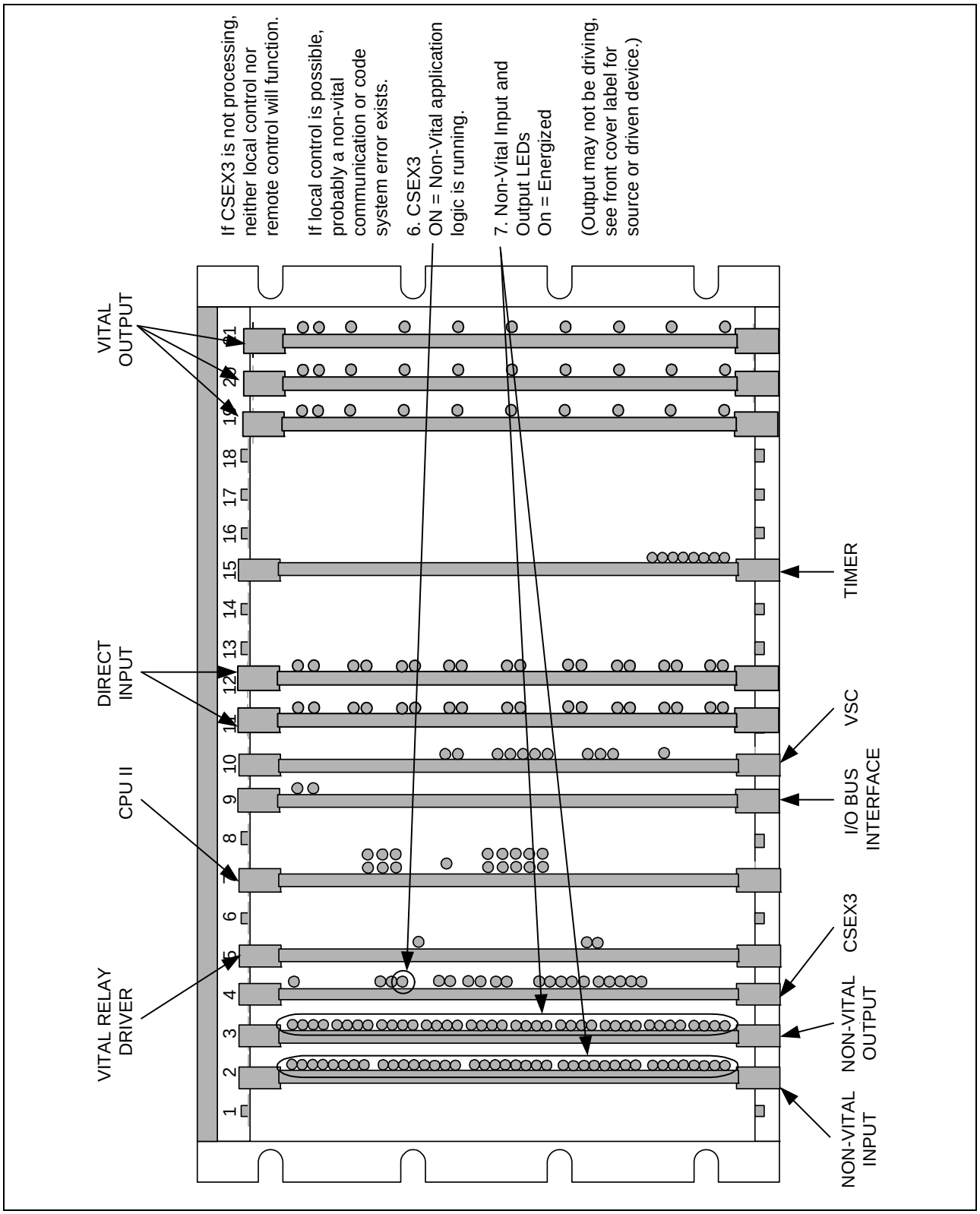

Figure 3–1. LED Troubleshooting Sequence (sheet 3 of 5)

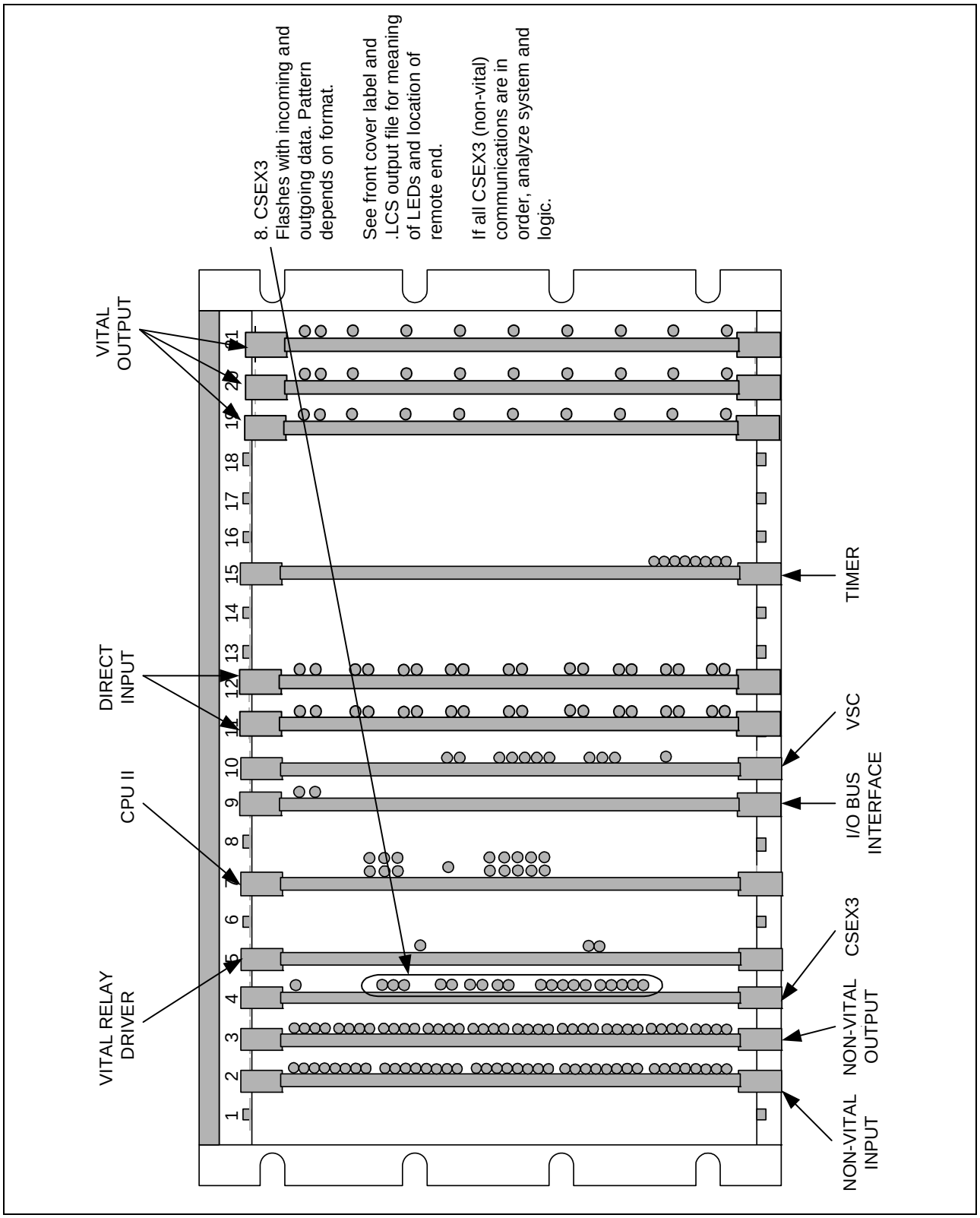

Figure 3–1. LED Troubleshooting Sequence (sheet 4 of 5)

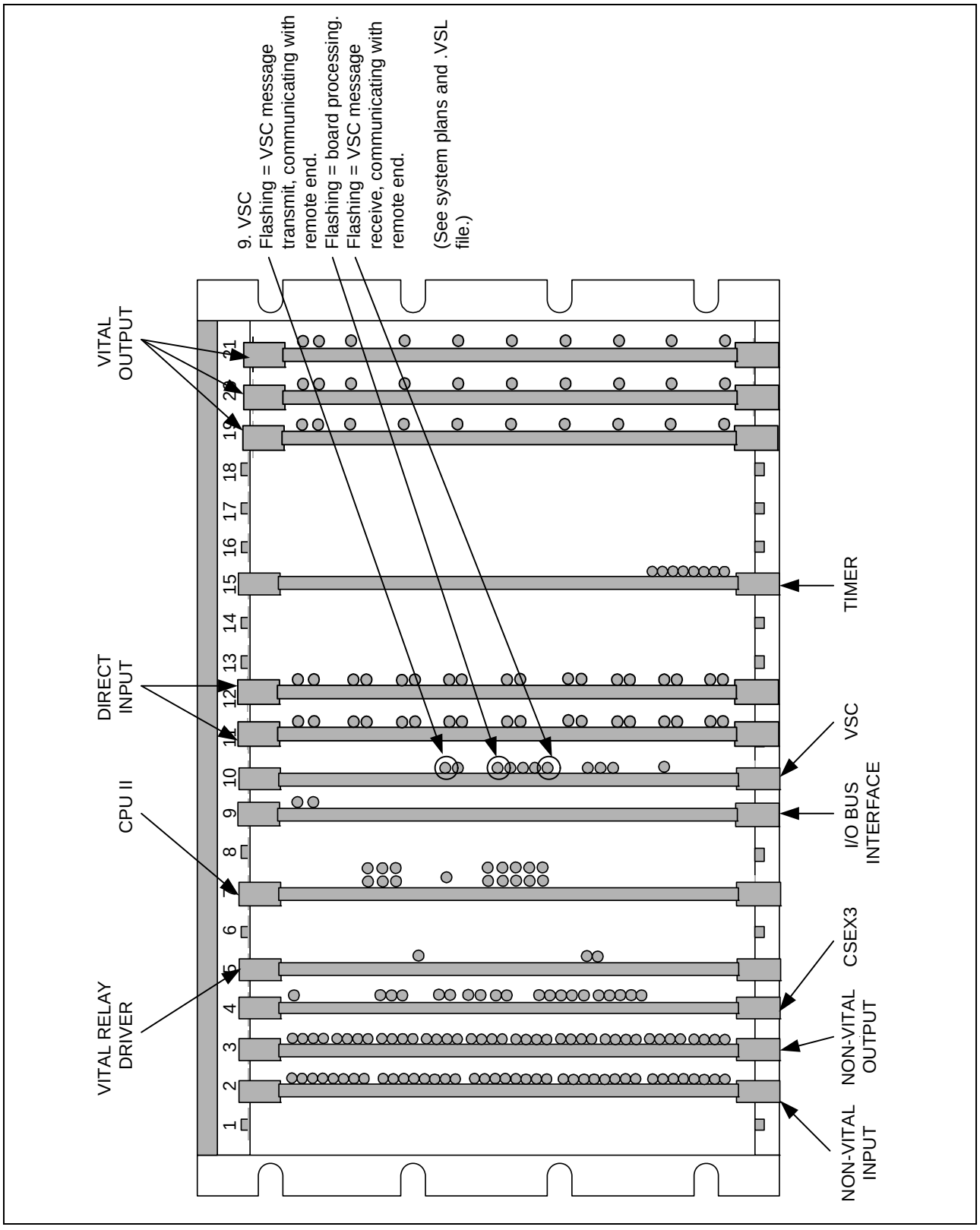

Figure 3–1. LED Troubleshooting Sequence (sheet 5 of 5)

3.3. VT-100 EMULATION

The CPU II board's embedded diagnostic software provides operating status and diagnostic information to the following devices:

- An externally connected PC, laptop, or hand held terminal with VT-100 Emulation software
- An externally connected "dumb terminal"
- An externally connected Personal Computer (PC)
- A CSEX3 board equipped with Alstom's Vital Diagnostic Protocol (VDP)

WARNING

A GROUND ISOLATION PLUG (CONVERTS 3 PRONG TO 2 PRONG) IS REQUIRED ON THE 120-VOLT AC CONNECTION OF THE PC RUNNING VT-100 EMULATION SOFTWARE OR VT-100 EMULATOR TO PREVENT MULTIPLE PATHS TO GROUND.

3.3.1. VT-100 Emulator

A VT-100 Emulator is any PC, laptop or hand held device with VT-100 emulation software used for diagnostics related to CPU II boards.

To perform diagnostics, the device connects to the front of the CPU II Board by a cable no longer than 25 feet:

- TIA/EIA-232 Cable connected to the appropriate 9-pin “D” connector DB-9 (MAC Port) with cabling as described in Table 3–1, or
- Type B USB Cable connected to the appropriate USB connector

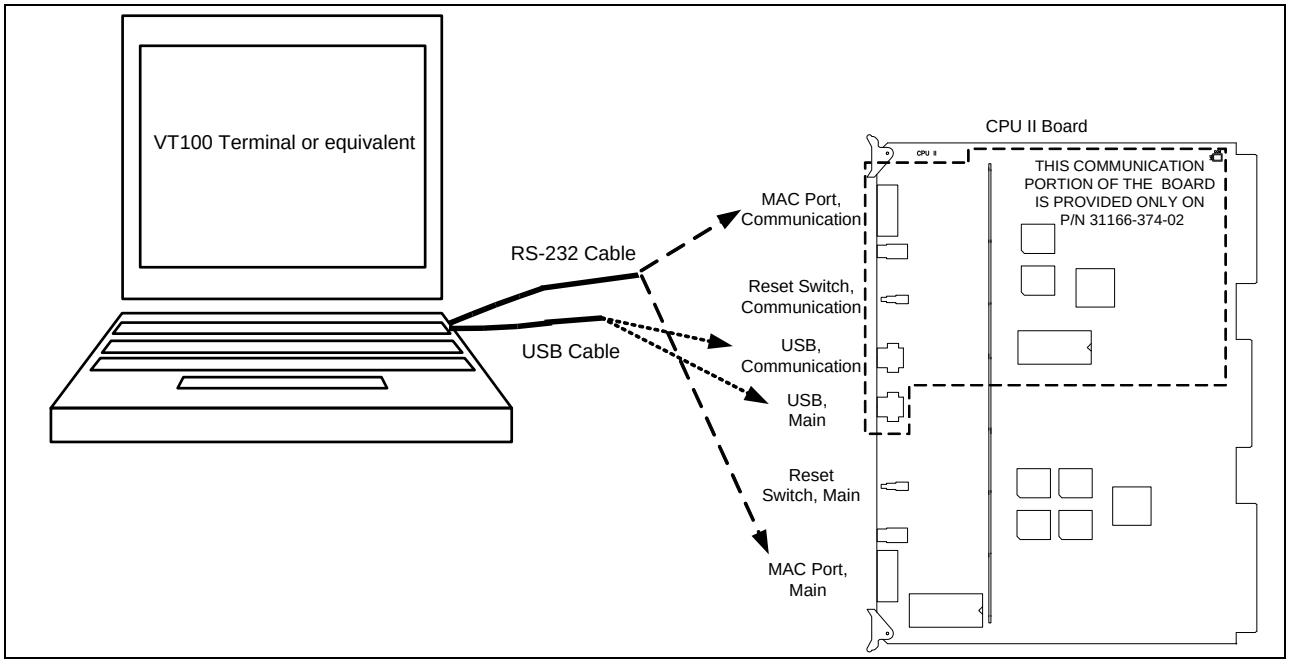

Figure 3–2. Example VT-100 Emulator Connection

Table 3–1. CPU II TIA/EIA-232

CPU II (DB-9)	Terminal or Computer (DB-25)
2 (RX)	2 (TX)
3 (TX)	3 (RX)
5 (GND)	7 (GND)

CPU II (DB-9)	Terminal or Computer (DB-9)
2 (RX)	3 (TX)
3 (TX)	2 (RX)
5 (GND)	5 (GND)

3.3.2. Personal Computer

An externally connected Personal Computer (PC) or Laptop equipped with and running Alstom's AlsDload software or Tracker software can be used for system diagnostics.

3.3.3. CSEX3 Board with VDP Protocol

A CSEX3 board equipped with Alstom's Vital Diagnostic Protocol (VDP) can interrogate the CPU II diagnostics. This protocol extracts diagnostic information from the CPU II board and presents this information in a user-friendly manner at the CSEX3 MAC (Maintenance Access) port. CPU diagnostics are reported to CSEX3 either serially or in parallel through on-board shared memory. Refer to Alstom publication P2346W for a complete description of the VDP and connection to the CPU II board.

3.3.4. Communication

Once per second, the system status ("SYSTEM OK", "SYS WARNING" or "ERROR ALERT") is displayed on the VT-100 Emulator, dumb terminal or CSEX3 VDP diagnostic menu. A VT-100 Emulator, terminal or VDP can also be used in an interactive manner to provide detailed troubleshooting information. In most cases, faults can be localized to a specific board.

This document provides general instructions for using a VT-100 Emulator connected to the CPU II board, and lists the interactive diagnostic commands that are supported. A CSEX3 board running the Vital Diagnostic Protocol (VDP) automatically makes use of the CPU II board's interactive commands to extract and report diagnostic information.

3.3.5. Top Level Vital Status Messages

After starting VT-100 Emulation, one of three top-level system status messages appears once a second:

- "SYSTEM OK" is displayed when all VPI functions are working properly (no errors detected).
- "SYS WARNING" indicates an error that has caused an abnormal or out-of-tolerance condition. Continued VPI operation may still be possible (the VRD Relay stays up). The meaning here is that system safety is unaffected.
- "ERROR ALERT" indicates a "fatal" error. Continued VPI operation is not possible (the VRD Relay is down with all outputs disconnected). The meaning here is that a system safety problem may exist.

If no message is shown:

- Verify the correct port is connected (see Figure 3–2).
- Verify the correct com port is configured on the emulator.
- Verify the correct cable is in use.
- Verify the CPU II board contains a valid set of EPROM software.
- Verify the wiring is configured correctly if using a RS 232 Serial cable (see Table 3–1)
- Try a new cable.
- If the problem persists, replace the CPU II board.

Further interrogation is possible to help determine the exact cause of a top-level error message ("SYS WARNING" or "ERROR ALERT") by using a series of interactive keyboard commands.

NOTE

It may be necessary to enter the "S" command to display system status after connecting the terminal or VT100 emulation.

3.3.6. VT-100 Emulator Keyboard Command Summary

In the following command descriptions, the information given in single quotes (‘x’) represents the exact key or keys to press on the VT-100 Emulator. If any keyboard character is entered during the CPU II board’s power-up cycle, it halts.

The final key to press for any command is ‘CR’ (Carriage Return) on a VT-100 Emulator or Enter on a terminal. This action is required to initiate each command. For example, the Continue command is initiated by pressing the ‘C’ key followed by the ‘CR’ (Carriage Return) key on a VT-100 Emulator or Enter on a terminal.

‘C’ = Continue

This command instructs the VPI module to continue through its start-up sequence after an error is encountered and interrogated during system start-up. However, with some errors, it may not be possible to continue until repairs are made. The ‘C’ command also causes the system to display one of the three top level status messages (“SYSTEM OK”, “SYS WARNING” or “ERROR ALERT”).

‘D’ = Output Diagnostics

This command displays LDO2 output diagnostics in 8 bits.
MSSPP ‘D’ displays LDO2 output diagnostics for LDO2 output PP of the board in slot SS of the module.

‘E’ = Enable

This command negates a previously entered ‘I’ (inhibit) command.

‘G’ = Output Current

This command displays LDO2 output current in amperes.
MSSPP ‘G’ displays LDO2 output current in amperes for LDO2 output PP of the board in slot SS of the module.

‘I’ = Inhibit

This command inhibits the “SYS WARNING” system status message from being displayed due to any warning condition in the system.

‘N’ = Next

This command instructs the system to display the next level of diagnostics, and is used while in the “query”, “report” and “view errors” modes.

‘Q’ = Query Memory

This command is used to display the value of one or more Vital parameters in CPU II RAM, updated once a second. Parameter addresses are typically obtained from the Vital application’s LVC compiled output report file. Use the ‘S’ command to exit from “query” mode.

The ‘Q’ command has several formats:

1. ‘wxyzQ’ – causes the system to once a second display the contents of four consecutive bytes of CPU II RAM, starting at the address entered immediately before the ‘Q’. The starting address entered must be in hexadecimal format. The display shows the lowest (least significant) three characters of the starting address, followed by the contents of four bytes of RAM data in the form of eight hexadecimal characters. Thus, if the command ‘wxyzQ’ is entered, the display shows “xyz/12345678”. The eight characters (12345678) represent, from left to right, the data in the RAM locations wxyz+3, wxyz+2, wxyz+1 and wxyz, respectively. Use the ‘N’ (Next) command to display four new bytes of data, starting at the RAM address wxyz+4. RAM addresses for application parameters are defined in the CAAPE generated application report files.

2. ‘wxyzQnn’ – causes the system to place RAM address wxyz at position nn in the list of 16 Vital parameters to be queried, and once a second output the true (1) or false (0) states of the 16 Vital parameters whose addresses are currently in the list. In this command, the address wxyz may be from one to four hexadecimal characters, but an address of 0 (zero) is invalid. The position nn must be entered as two digits ranging from position 01 to 16. Typically, wxyz is the address of a Vital application parameter obtained from the application’s LVC compiled output report file. After this command is entered, once a second the system displays the current true/false states of the 16 Vital parameters in the format “110000111xx0011x” (for example). The first 1 in the example string is in position 1; the last x in the string is in position 16. The character x appears at positions in the list for which no address has yet been specified by the user. The system retains the list of 16 addresses to query unless it is restarted.

3. ‘wxyzQ00’ – causes the system to remove RAM address wxyz from the list of 16 Vital parameters to be queried, and once a second output the true/false states of the 16 parameters whose addresses are currently in the list. In this command, a pair of zeros follows the letter Q.

4. ‘Q00’ – causes the system to erase the entire list of 16 Vital RAM parameters to be queried, and once a second output a message in the format “xxxxxxxxxxxxxxxx”.

5. ‘0Q00’ – causes the system to once a second output the true (1) or false (0) states of the 16 Vital parameters currently in the list of addresses, without modification to the list. In this command, a single zero precedes and a pair of zeros follows the letter Q.

6. ‘Q’ – causes the system to show the addresses (four at a time) currently in the list of 16 Vital parameters to be queried, in the format “aaaa;aaaa;aaaa;aaaa”. Four dashes (----) are used to indicate an empty position in the list of 16 addresses. Note that initially all positions are empty, until the user enters the ‘wxyzQnn’ command one or more times. Use the ‘N’ (Next) command to view the next four addresses in the list.

'U' = Disable

Use this command to inhibit the “SYS WARNING” message (“OUT NOT ON”) which appears when the VPI diagnostics encounters an output that is turned on but is delivering no output current. This command may be appropriate when a no-current condition is normal.

‘O’ = Enable

This command negates a previously-entered ‘U’ (Disable) command.

‘R’ = Report

This command routes configuration data to the Handheld Terminal. It provides CAA system software and Vital Serial Controller (VSC) application logic configuration information. Step through all configuration messages by using the ‘N’ (Next) command, and exit “report” mode by using the ‘S’ (Stop) command.

‘RPT’ = Report…

This command displays software and application configuration control information for the CPU II board.

‘S’ = Status

This command removes the system from the “query”, “report” and “view errors” modes and returns the system to display system status. Exiting from the current mode is necessary when wishing to display other diagnostic messages.

‘T’ = Timing

This command displays cycle timing information in the following format: ABC/00ZZYYXX where

- ABC is a query address
- XX is the point in the 1-second cycle where expression evaluation starts
- YY is the point in the 1-second cycle where expression evaluation ends
- ZZ is the point in the 1-second cycle where the main cycle ends.

‘V’ = Voltage

This command configures the system to display the logic voltage value once per second.

‘W’ = System ID

This command displays the application revision ID and the system site ID.

‘X’ = Erase

This command erases all stored error and warning data. If the problem persists, the error data appears again even after erasure.

‘Z’ = Ignore Command

Any command terminated by a ‘Z’ is ignored by the system.

‘?’ = View Errors/Warnings

Use this command to display warning or error data after a “SYS WARNING” or “ERROR ALERT” message has appeared. Step through all error/warning messages by using the ‘N’ (Next) command and exit “view errors” mode by using the ‘S’ (Status) command.

3.3.7. Vital Diagnostic Charts

Three kinds of system diagnostics or messages are possible:

- Start-up Diagnostics
- SYS WARNING
- ERROR ALERT

Tables 3–2 through 3–4 list errors according to the message displayed on the Handheld Terminal and give the corresponding user responses. Possible causes for the error message and preliminary steps to resolve system failure are also provided. A general system diagnostic flowchart is provided in Figure 2–1.

When troubleshooting, if board replacement is indicated, refer to the board replacement procedures provided in Tables 6–1 through 6–14.

NOTE

Tables 3–2 through 3–4 include the “module number” in failure messages. Module #1 is always the system module in a multiple-module system, module #2 is Extender module #1, module #3 is Extender module #2, and module #4 is Extender module #3.

Table 3–2. Start-up Diagnostics Troubleshooting

Message Displayed	Possible Cause(s)	User Response	Corrective Action
NO MESSAGE DISPLAYED	Faulty test cable or invalid software on CPU II Board. Further testing is not possible.	None	Inspect test cable wiring. Verify CPU II Board *Flash is valid. If problem persists, replace CPU II Board. Verify configuration settings on VT-100 terminal are set correctly for CPU II Board. 19200 baud, 8 databits, 1 stop bit, no parity, no flow control (19, 200, 8, 1, N)
CPU RAM ERR	Failed “Checkerboard” test of system RAM. System may still run if defective RAM area is not required by the application or system.	Press “C” key and then “ENTER” key	Replace CPU II Board. Record failure for CPU II board in module.
POLY DIV ERR	Failure of PD portion of CPU II Board.	Press “N” key and then “ENTER” key <u>Failure Messages</u> ‘PD C3, 1 ERR’ ‘PD C3, 2 ERR’ ‘PD C1, 1 ERR’ ‘PD C1, 2 ERR’ ‘PD C1, 1N ERR’ ‘PD C1, 2N ERR’ ‘PD LOAD ERR’	Record failure for CPU II Board in module. Replace CPU II Board.

*CPU II Board Flash could be either the VPI II System Software or the Application Data Structures.

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Table 3–2. Start-up Diagnostics Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
PROM MEM ERR	CPU II Board *Flash.	Press “N” key and then “ENTER” key Failure Messages ‘ROUTINE PROM’ ‘ADS-NOSHADOW’ ‘ADS-SHADOW’	Record failure for CPU II Board in module. Check Application/System, software compatibility for correct version. Replace CPU II Board *Flash. Replace CPU II Board.
CPU SIG ERR	Failure of CPU II Board *Flash signature to match the hardwired signature on the wirewrap pins on the I/O Bus Motherboard. System does not operate under this condition.	Press “C” key and then “ENTER” key	Verify hardwired signature on wirewrap pins of I/O Bus Motherboard at CPU II slot. Verify that the CPU II Board *Flash version number and motherboard signature match.

OUTPUT ERR	Failed test of one or more AOCDs on a Vital Output Board. Defective CPU II Board *Flash. System not likely to operate under this condition.	Press “?” to find bad output board
		Press “N” key and then “ENTER” key
		Failure Message
		‘OUT # x/yy/z’
		x = Module number
		y = Slot number
		z = Port number
			Check signature PROM on Vital Output Board.
			Check address wiring on Motherboard.
			Check for defective CPU II Board *Flash.
			Check IOB Board.
			Check continuity of VPI II System Bus (ribbon cable).
			Replace Vital Output Board(s) as indicated.

*CPU II Board Flash could be either the VPI II System Software or the Application Data Structures.

Table 3–2. Start-up Diagnostics Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action

CSE INTER ERR	Dual-Port Interface RAM failure on CSEX3 Board. System operates under this condition.	Press “N” key and then “ENTER” key
		<u>Failure Message</u>
		‘CSE BD # x/yy’
		x = Module number
		y = Slot number
			Check CSEX3 address wiring on Motherboard.
			Check continuity of VPI II System Bus (ribbon cable).
			Press Reset Switch on CPU II Board to initialize processor to test CSEX3 Interface RAM.
			If test repeatedly fails, replace CSEX3 Board.
			If test fails with new CSEX3 Board, replace CPU II Board.
			If test continues to fail, check bus connections on module motherboard and check for bent pins on the IOB Board.

VRD INTER ERR	Dual-Port Interface RAM failure on VRD Board. CPU II Board fault. System not likely to operate under this condition.	Press “C” key and then “ENTER” key	Check VRD address wiring on Motherboard. Press Reset Switch on CPU II Board to initialize processor to test VRD Interface RAM. If test repeatedly fails, replace VRD Board. If test fails with new VRD Board, replace CPU II Board. Check continuity of VPI II System Bus (ribbon cable).

Table 3–2. Start-up Diagnostics Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action

VSC INTER ERR	Dual-Port Interface RAM failure on VSC Board. System operates under this condition.	Press “N” key and then “ENTER” key
		Failure Message
		‘VSC BD # x/yy’
		x = Module number
		y = Slot number
			Check VSC address wiring on Motherboard
			Press Reset Switch on CPU II Board to initialize processor to test VSC Interface RAM.
			If test repeatedly fails, replace VSC Board.
			If test fails with new VSC Board, replace CPU II Board.
			Check continuity of VPI II System Bus (ribbon cable).

Table 3–3. SYS WARNING Message Troubleshooting

Message Displayed	Possible Cause(s)	User Response	Corrective Action

BAD IN ERR	One or more of the Vital Input Ports returned “Corrupted” circulation data. Corrupted data is only recognized as faulty after 2 or more consecutive 1-second cycles for a particular port.	Press “N” key and then “ENTER” key
		Failure Message
		‘IN # x/yy/z’
		x = Module number
		y = Slot number
		z = Port number
			Check signature header on Vital Input Board.
			Check signature header on I/O Bus Board.
			Determine if input port changes state twice in 2 seconds during normal operation.
			If no EMI occurs on the input, contact bounce could be at fault.
			If EMI is present, check the source input and the wiring.
			If error appears after clearing all saved error data, replace DI Board.
			Check board address wiring on Motherboard.

CSEX DIAG ERR	Failure of CPU II to obtain data from a CSEX3 Board on a 1-second basis. Indicates CSEX3 program has failed and has stopped or is undergoing reset condition.	Press “N” key and then “ENTER” key
		Failure Message
		‘CSEX BD # x/yy’
		x = Module number
		y = Slot number
			Check CSEX3 address wiring on Motherboard.
			Type ‘x’ to clear and monitor how often it occurs.
			Check mounting of regulator on board.
			Check for incorrect positions of CSEX3 Board jumpers.
			Replace CSEX3 Board if condition continues.
			Check continuity of VPI II System Bus (ribbon cable).

Table 3–3. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action

VSC DIAG ERR	Failure of CPU II to obtain data from a VSC Board on a 1-second basis. Indicates VSC program has failed and has stopped or is undergoing reset condition.	Press “N” key and then “ENTER” key
		Failure Message
		‘VSC BD # x/yy’
		x = Module number
		y = Slot number
			Check VSC address wiring on Motherboard.
			Verify VSC switches are set properly for application.
			Replace VSC Board if condition continues.
			Check continuity of VPI II System Bus (ribbon cable).

OUT NOT ON	Output port has been turned on but returned circulation data shows no current flowing through the output port circuit. Possible burned out lamp or other open condition.	U / ENTER
		Inhibits ‘OUT NOT ON’ message.
		Press “O” key and then “ENTER” key
		Nullifies the U / ENTER command.
		Press “N” key and then “ENTER” key.
		Failure Message
		‘OUT # x/yy/z’
		x = Module number
		y = Slot number
		z = Port number
			NOTE: An open relay contact in series with the energized output circuit will cause this condition.
			NOTE: ACO boards cause this condition even with a proper load intact.
			Check load on this port to determine if it is within proper current range.
			If load on port (field equipment) is operational, replace output board.

Table 3–3. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action

XPR RSLT ERR	Evaluated expression returned a result that was not a codeword in code Channel 1 or code Channel 2.	Press “N” key and then “ENTER” key
		Failure Message
		‘XPR # xxx/CHy’
		x = The expression
		CHy = Channel number or failed expression.
		Press “N” key and then “ENTER” key to continue
		After all expressions have been displayed, ‘END ERR DATA’ appears
			Determine if error data from other failures may have contributed to the expression result failure.
			Examine parameter values of the product term that failed to determine whether a parameter value is an incorrect word.

Table 3–3. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
NO VRD FRONT	VRDFRNT-DI is false and communication between CPU II and VRD Boards remains intact. 12 VDC input low at VRD Board. 5 VDC output low at VPI Module board edges (test points). VPI system wiring bad.	Press “S” key and then “ENTER” key	Verify voltage at DI Board test point TP3; verify DI Board LED lights. Check VRD drive light on VRD Board front edge. If not, troubleshooting external to the VPI module is required. Check 12 VDC input to VRD Board. If DI Board LED lights, replace board. Verify 5VDC at VPI Module board edges (test points). Verify continuity of VPI system wiring (check for disconnected or loose wires). Verify VRD Board switch in position F. Check revision number of Vital application software.

Table 3–4. ERROR ALERT Message Troubleshooting

Message Displayed	Possible Cause(s)	User Response	Corrective Action
POLY DIV ERR	Failure of test performed on CPU II Board once each 1-second main cycle. CPU Board is bad.	Press “N” key and then “ENTER” key Failure Messages ‘PD C3, 1 ERR’ ‘PD C3, 2 ERR’ ‘PD C1, 1 ERR’ ‘PD C1, 2 ERR’ ‘PD C1, 1N ERR’ ‘PD C1, 2N ERR’ ‘PD LOAD ERR’	Record failure for PD portion of CPU II Board in module. Inspect/replace CPU II Board.

MAIN CWD ERR	One or more of the 20 main checkwords was delivered to the VRD Board in error.	Press “N” key and then “ENTER” key
		Failure Message
		‘MAIN CWD # xx’
		x = Main checkword number in the HEX error
		Press “N” key and then “ENTER” key to continue
		After all failed main checkwords have been displayed, ‘END ERR DATA’ appears
			Course of action depends on which checkword is in error.
			If main checkwords I and F appear, verify on CPU II Board that *Flashes are properly installed and signature wiring on Motherboard and P3 for CPU II are correct.
			If other checkwords are bad, replace CPU II Board.

VRD XFR ERR	VRD Relay detected de-energized via the VRDFRNT-DI input and checkword sent to the VRD Board determined to be correct.	Press “C” key and then “ENTER” key	Check VRD address wiring on Motherboard. If VRD Relay continuously down, replace VRD Board. If VRD Relay intermittently down, check VPI II System Bus (ribbon cable).

*CPU II Board Flash could be either the VPI II System Software or the Application Data Structures.

Table 3–4. ERROR ALERT Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action

OUTPUT ERR	Failure of a Recheck checkword delivered to the VRD Board once at the beginning of each 50 ms period. Also may be caused by EMI from external lines, relay, etc. Bad Vital Output Board.	Press “N” key and then “ENTER” key
		<u>Failure Message</u>
		‘OUT # x/yy/z’
		x = Module number
		y = Slot number
		z = Port number
		Press “N” key and then “ENTER” key to continue
		After all failed main checkwords have been displayed, ‘END ERR DATA’ appears
			Check address wiring on Motherboard.
			Check signature PROM on Vital Output Board.
			Inspect/replace Vital Output Board in question.
			Use suppression on external lines and relay to eliminate EMI.
			Verify external connections to field equipment.

	Output Board contains incorrect signature PROM	Verify signature PROM	Replace signature PROM, if required.

TRE VAL ERR
NOTE: This message follows OUTPUT ERR
	Erroneous checkword values returned from output ports. These cause incorrect checkwords to go to the VRD Board.
	Bad Vital Output Board.
		Press “N” key and then “ENTER” key
		<u>Failure Message</u>
		‘TREVAL # xx/yy’
		x = Port group
		y = Slot number
		Press “N” key and then “ENTER” key to continue
		After all failed output ports have been displayed, ‘END ERR DATA’ appears
			See OUTPUT ERR corrective actions above.

Table 3–4. ERROR ALERT Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
RCHK CWD ERR NOTE: This message follows TRE VAL ERR	Failure of a Recheck checkword being delivered to the VRD Board. Bad Vital Output Board. NOTE: recheck checkword numbers 01 and 04 are summations of all other checkwords; so if any checkword is in error, 01 and 04 are also in error.	Press “N” key and then “ENTER” key Failure Message ‘RCHK CWD # xx’ x = Checkword number Press “N” key and then “ENTER” key to continue After all failed output ports have been displayed, ‘END ERR DATA’ appears	See OUTPUT ERR corrective actions on previous page.

3.4. NON-VITAL SYSTEM DIAGNOSTICS ON THE CSEX3 BOARD

Examples of displayed CSEX3 diagnostic menus with features are described in this Section. These examples are graphic representations and may vary slightly from what is actually displayed.

3.4.1. Operational Overview

A terminal or PC connected to the Maintenance Access (MAC) port on the CSEX3 board is needed to display its diagnostic menus, see Figure 3–3. These menus access the CenTraCode II operating system and vary in use; some are used to report system status while others are used for manual control.

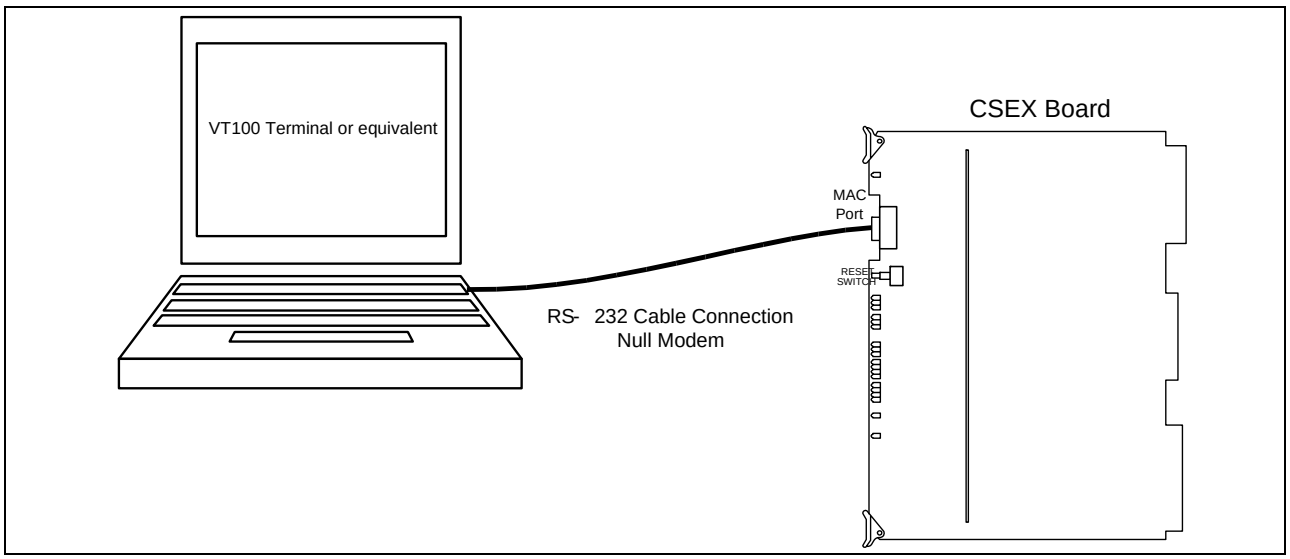

Figure 3–3. Connection to the CSEX3 MAC Port

To access the diagnostics program through the MAC port, any terminal compatible with Digital Equipment Corporation's VT-100 may be used, or a PC with the proper VT-100 emulation software may be used. Alstom recommends a battery-operated laptop PC equipped with VT-100 emulation software that allows capture of the serial data stream. Display modes showing the codeline's traffic can be invoked, and a PC used as a display terminal allows the capture of displayed information to disk files for further analysis at a future date.

WARNING

A GROUND ISOLATION PLUG (CONVERTS 3 PRONG TO 2 PRONG) IS REQUIRED ON THE 120-VOLT AC CONNECTION OF THE PC RUNNING VT-100 EMULATION SOFTWARE OR VT-100 EMULATOR TO PREVENT MULTIPLE PATHS TO GROUND.

CAUTION

When a laptop is connected to the system, the laptop should NOT be grounded.

Be aware that if another peripheral is plugged into the laptop, such as a printer, isolation is breached.

The following equipment is required for correct operation of the MAC port:

- A VT-100 compatible terminal (ANSI standard X3.64-1979) or PC running VT-100 emulation software. The required communication setup is: 24 lines by 80 columns, 9600 baud (typical), 8 data bits, 1 stop bit, no parity, and no flow control.
- Serial interface cable: standard DB-25 to DB-9 TIA/EIA-232 null modem cable no longer than 25 feet connected between the VT-100 terminal or PC running VT-100 emulation software and the MAC port on the CSEX3 Board.
- Proper application documentation for the location of interest.
- Cabling as described in Table 3–5.

Table 3–5. CSEX3 TIA/EIA-232

CSEX3 (DB-9)	Terminal or Computer (DB-25)
2 (RX)	2 (TX)
3 (TX)	3 (RX)
5 (GND)	7 (GND)

CSEX3 (DB-9)	Terminal or Computer (DB-9)
2 (RX)	3 (TX)
3 (TX)	2 (RX)
5 (GND)	5 (GND)

3.4.2. Using Menus

Diagnostics functions are selected from the CSEX3 menus. The term “menu” is used to describe a list of choices that can access other lists of choices or diagnostic test topics by selecting one of the options displayed near the bottom of the screen display. A menu may be a portion of a screen display. If a menu is the predominant feature of a screen, that screen is typically named according to the menu displayed (for example, the “Main Menu”). See Table 3–6 for the menu access keys. After a menu option is selected, additional information may be required and the user is prompted to add specific data.

Table 3–6. CSEX3 Menu Access

Key Sequence	Result
Press the Right or Left Arrow key or the Space Bar	To highlight the menu or option of interest
Press the Enter key	To access a highlighted menu or option of interest
Press the first letter of a menu or option (this letter is usually displayed in uppercase)	To access the menu or option
Press ‘E’ (Exit)	To exit from most menus
Press ‘‘Q’ (Quit)	To exit from certain submenus
Simultaneously press Ctrl and ‘E’	To return directly to the Main Menu from any submenu

CAUTION

Certain diagnostic menu options take the system off-line, causing an adverse effect on system operations. Use only the screens listed.

CAUTION

Diagnostic tasks run at a lower priority than those system tasks supporting the primary purpose of the application. Therefore, some displays may at times appear to be incorrect. This usually occurs because the presentation of the data on the terminal screen occurs after the event being presented.

3.4.3. Menu Structure

Figure 3–4 shows the selection path from the CSEX3 Main Menu to the other menus available. The Main Menu is essentially divided into two functional parts, Emulation and System. This “menu tree” provides an overview of the non-vital VPI II system diagnostic menus and their options.

Here each menu or screen, available options and user selection path is provided. The path lists in order the selection process for the menu or screen being described.

The menus normally used are listed first and then the entire available menu structure is listed.

CAUTION

Certain diagnostic menu options can have an effect on non-vital system operations. Be careful to return to the Main Menu when done accessing the diagnostic information.

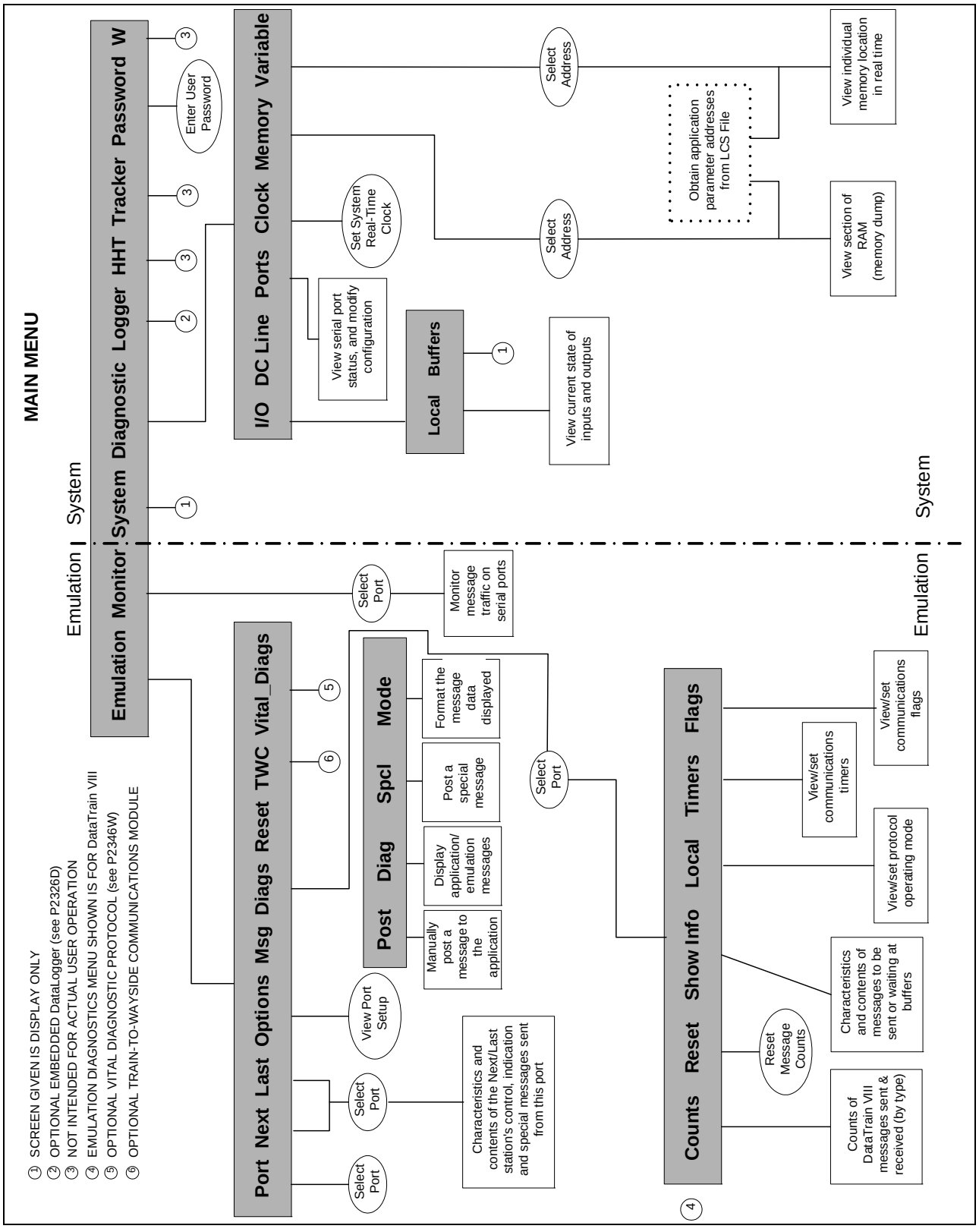

Figure 3–4. Menu Tree

3.4.4. CSEX3 Main Menu

After power is applied and the system is initialized, the CSEX3 Main Menu, shown in Figure 3–5, is displayed on the terminal screen connected to the MAC port. If the Main Menu is not displayed, simultaneously press ‘Ctrl’ and ‘E’ to jump from any submenu back to the Main Menu. If any CSEX3 board resets occurred since the last time the system was turned on, this information appears above the Main Menu. This reset log is cleared once the board is turned off.

Note that if the diagnostic password option has been activated, the password must be entered prior to modifying settings that affect system operation.

When a choice is made in the Main Menu, a submenu may appear. The available submenus are Emulation, Monitor, System, Diagnostic, Logger, HHT_Use, Tracker, Password and W.

NOTE

The Main Menu choices Tracker and W are intended for use by external software utilities, such as Alstom’s Tracker program (refer to Alstom publication P2307), and are not discussed in this manual. Only menu choices used for normal system analysis are discussed in this manual.

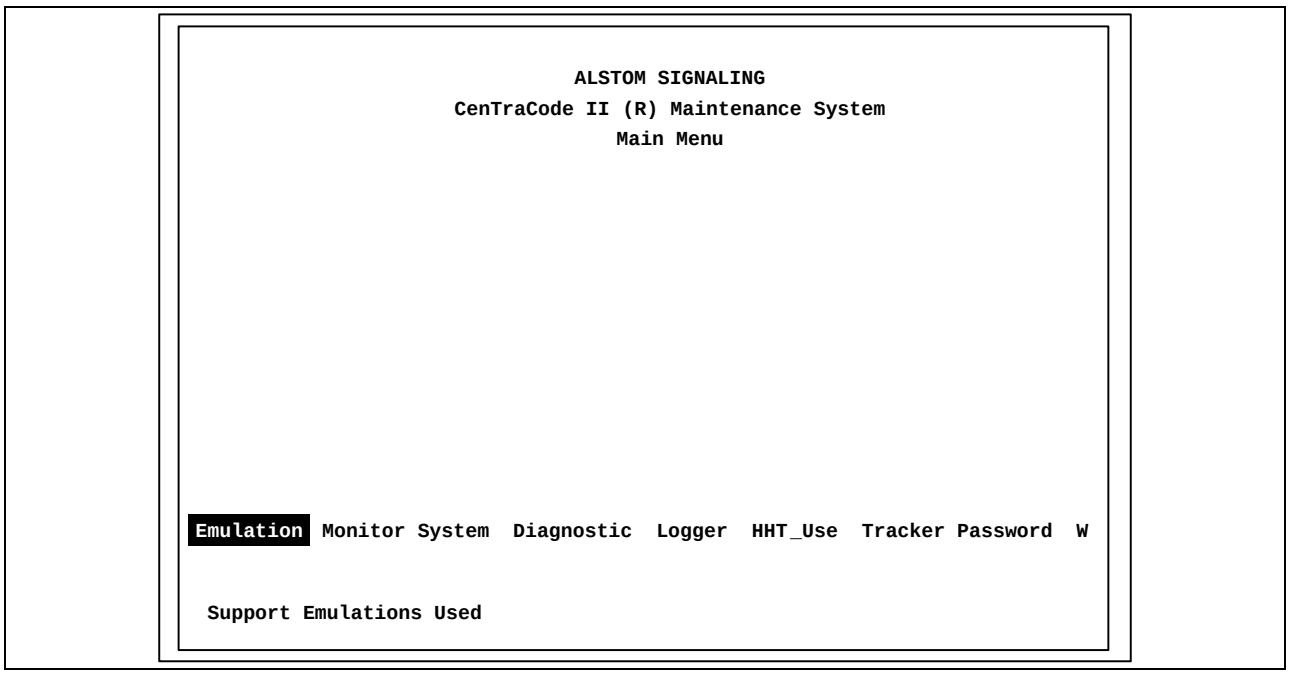

Figure 3–5. CSEX3 Main Menu

Table 3–7 describes the options available in the CSEX3 Main Menu. Further explanation of options is provided later.

Table 3–7. CSEX3 Main Menu Choices

Option	Description
Emulation	Invokes the Emulation Menu used to diagnose problems related to communication protocol emulation operation. Subsequent menus accessible from the Emulation Menu via its *Diags* menu choice are fully documented in the respective Alstom pamphlet for each specific protocol emulation installed (refer to the Alstom publication P2346 series).
Monitor	Starts the operation of the data monitor used to display message traffic on specific serial ports. The Monitor Menu is displayed showing the available data monitor options.
System	Displays the system configuration information consisting of: • The application's CSEX3 ID string • System and CAA drawing numbers • Application compilation time and revision • System compilation time and revision • Optional DataLogger compilation time and revision • Serial ports usage and protocol emulation revision
Diagnostic	Provides access to system diagnostics used to locate hardware problems, and evaluate software operation.
Logger	Provides access to the Alstom Embedded DataLogger diagnostic menus. CSEX3 offers detailed event diagnostic capability when the optional DataLogger module is stored in EPROMs on the CSEX3 board. For details on this advanced data logging feature refer to Alstom Publication P2326D.
HHT_Use	Permits use of a VT-100 Emulator with a minimal subset of diagnostics. Press 'V' (VT-100) to exit from VT-100 Emulation mode. This menu choice is for the exclusive use of Alstom's Tracker diagnostic utility program that runs on a PC, and is not for actual user operation.
Tracker	This menu choice is for the exclusive use of Alstom's Tracker diagnostic utility program that runs on a PC, and is not for actual user operation.

Table 3–7. CSEX3 Main Menu Choices (Cont.)

Option	Description
Password	Permits entry of an application password to allow modification of system settings. If a diagnostic password has been specified in the non-vital application, the password must be entered before modifying any setting that affect system operation. Only authorized persons should know the diagnostic password. Initially, “Password Disabled” appears at the upper left of the Main Menu; however, if no password has been defined in the application, then no message appears and the Password menu choice is disabled. Otherwise, select Password and then enter the correct diagnostic password; “Password Enabled” is now displayed. The operator may now activate features that affect system operation. If there is no MAC port activity for more than 30 minutes, however, the system automatically disables the diagnostic password forcing authorized personnel to reenter it.
W	This menu choice is for the exclusive use of Alstom’s Watcher diagnostic utility program that runs on a PC, and is not for actual user operation.

3.4.5. Emulation Menu

The Emulation Menu , shown in Figure 3–6, is displayed by selecting *Emulation* from the Main Menu. The Emulation Menu provides access to communication protocol emulations loaded in the CenTraCode system. Each protocol emulation, such as Alstom's DataTrain VIII (DT8), is assigned to a specific serial port in the non-vital application.

Selection Path:

- Main Menu
  - Emulation

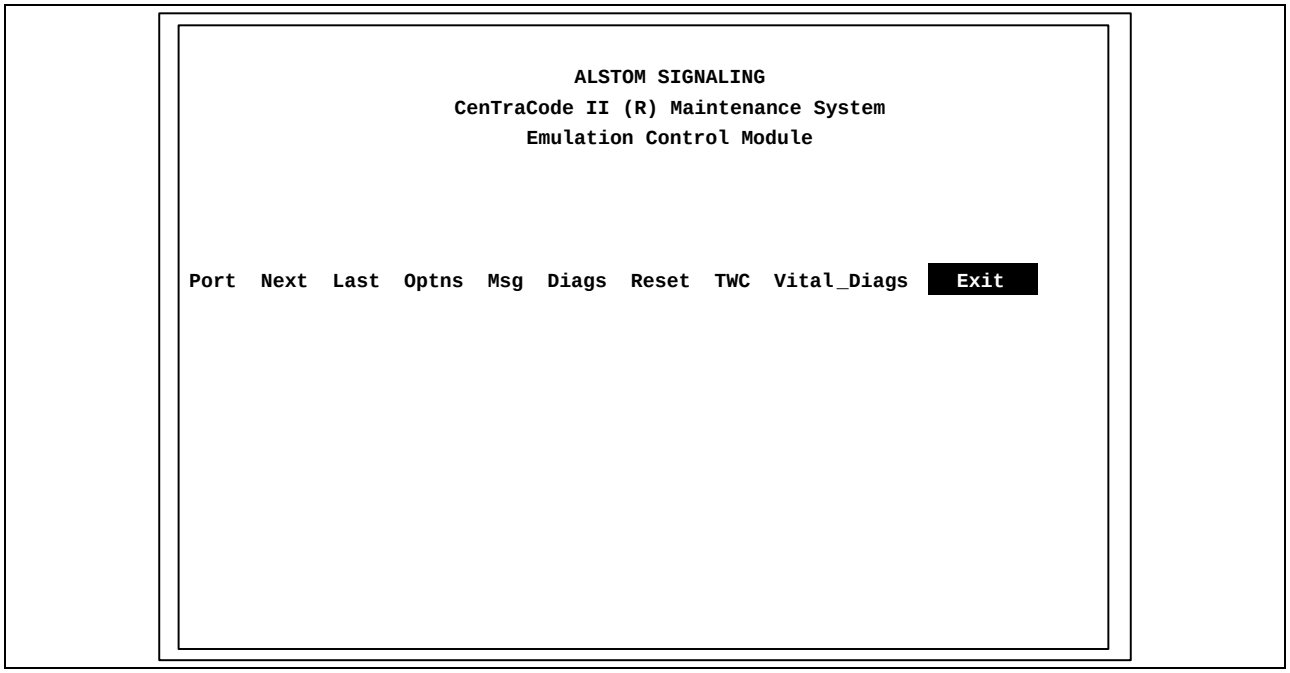

Figure 3–6. Emulation Menu

Refer to the Table 3–8 for a brief description of the available options in the Emulation Menu, after which the menu choices are described in more detail.

Table 3–8. Emulation Menu Choices

Option	Description
Port	Select the serial port of interest (enter the port number from 1 to 5) and view the port's setup. The serial port number must be specified prior to using the *Next*, *Last*, *Optns*, *Msg* or *Diags* menu choices.
Next	Display the addresses and current contents of control, indication and Special Message buffers for the next station on the selected serial port; if only one station is defined for the codeline port, then the *Next* and *Last* options behave identically.
Last	Display the addresses and current contents of control, indication and Special Message buffers for the previous station on the selected serial port.
Optns	View the serial port setup: baud rate and the data format (data bits, stop bits, parity).
Msg	Observe message traffic (controls and indications) between the non-vital application logic and the emulation, and enter and manually post a control or a Special Message to the application logic.
Diags	Execute protocol emulation specific diagnostics.
Reset	Reset the entire system. Use this choice with care since it causes the CSEX3 software to reinitiate its start-up sequence, as if the system were turned off then back on.
TWC	Access the Train-to-Wayside Communications (TWC) diagnostics menu (if applicable).
Vital_Diags	Access the optional Vital Diagnostic Protocol (VDP) diagnostics menu, described in Alstom publication P2346W.
Exit	Return to the Main Menu.

3.4.5.1. Emulation Menu Choice: *Port*

The *Port* menu choice allows the user to specify the CSEX3 serial port (1 to 5) on which the communication protocol is installed. The serial port number must be specified before using the *Next*, *Last*, *Optns*, *Msg* or *Diags* options in the Emulation Menu. Both the port usage and the type of protocol loaded are displayed, an example of which is shown in Figure 3–7.

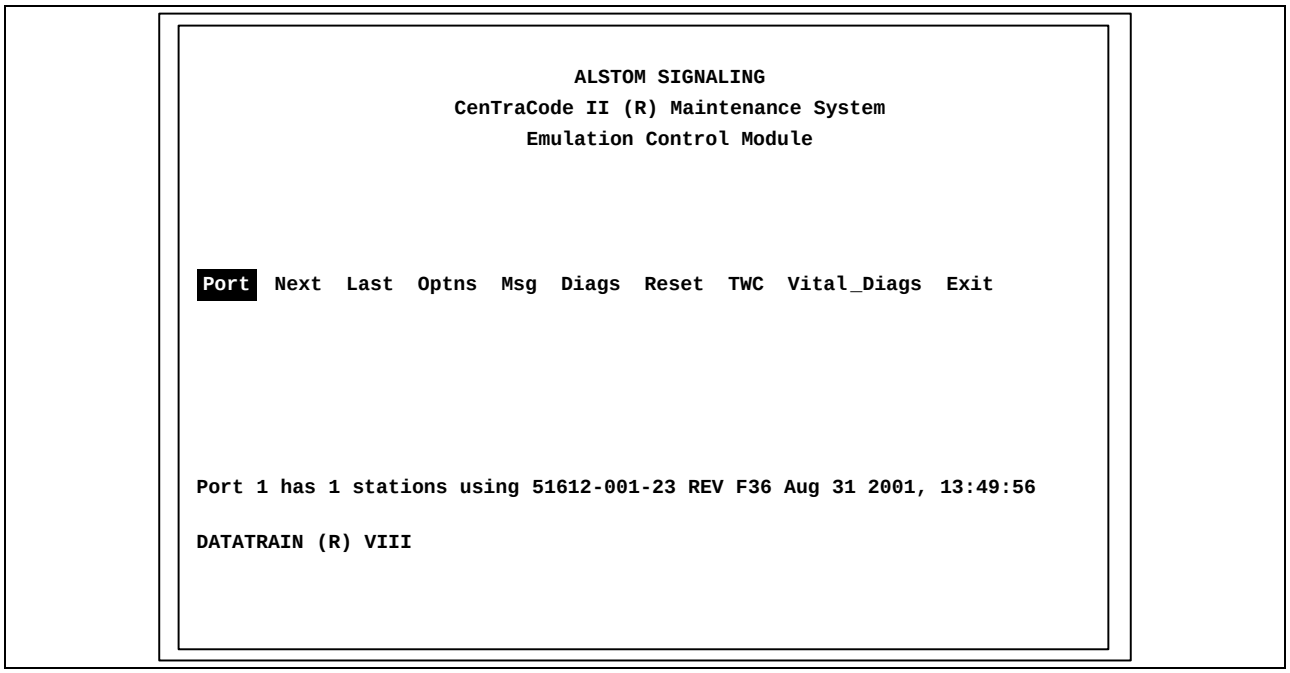

Figure 3–7. Emulation Menu – Select the Serial Port

3.4.5.2. Emulation Menu Choice: *Next* or *Last*

When the *Next* or *Last* menu choice is selected, the current information for a single station is displayed once. This information is not updated in real time. See Figure 3–8 for a sample screen. The *Next* or *Last* menu choices are most useful for a port having multiple stations. For a port with only one station information for station 1 is still displayed when *Next* or *Last* is selected.

The station information consists of:

- Control and indication station addresses and the total number of binary bits in each address
- The length of each message: control, indication and Special
- Each message's starting buffer address in RAM (intended for Alstom technical personnel only)
- The most recently posted control, indication and Special Messages

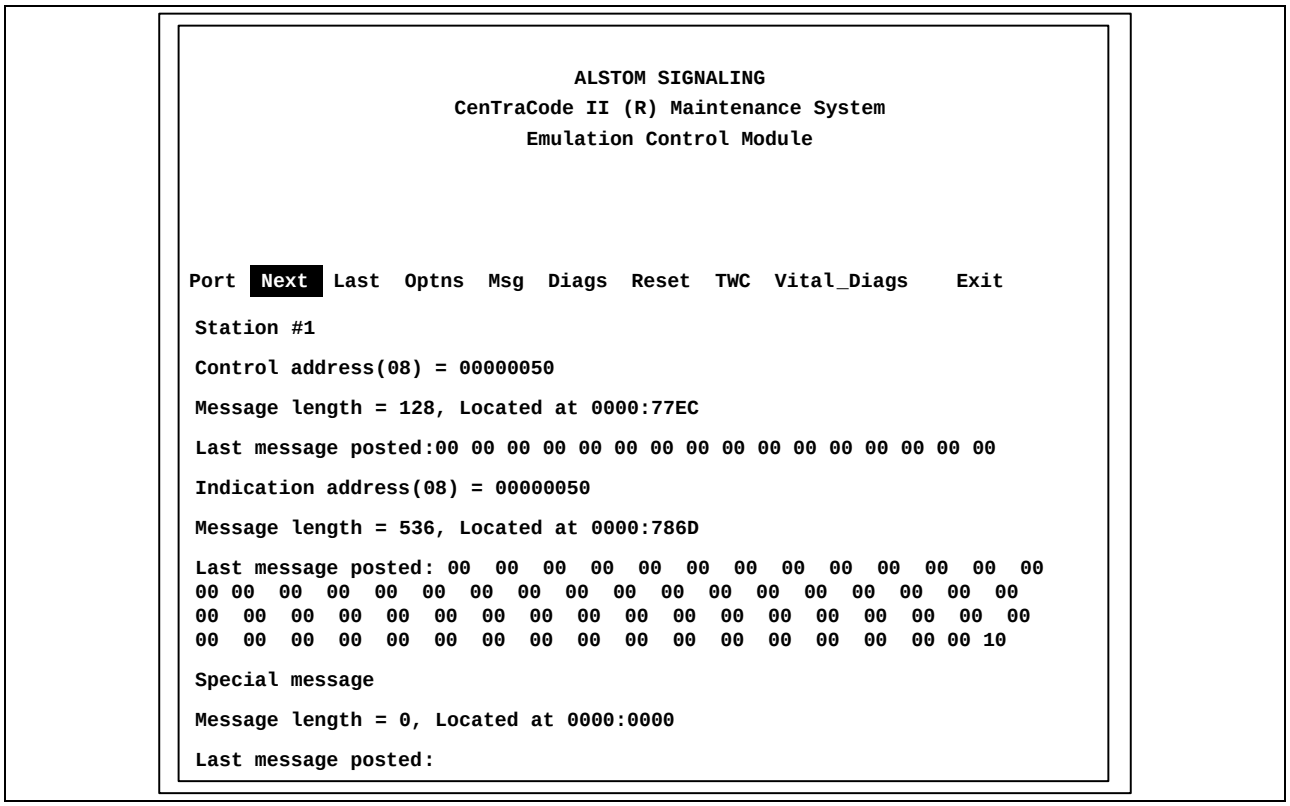

Figure 3–8. Example Emulation Menu – View a Station's Messages

This example shows that the control address for station 1 is 50 with a length of 8 bits. The message itself contains 128 bits (parameters) and is located in memory beginning at address 0000:77EC. The message contents are shown as a series of 16 hexadecimal bytes, eight bits each. In this example, all 128 bits in the last received control message are false (0).

The indication address is also 50 and has a length of eight bits. The message itself is 536 bits in length and is located in memory beginning at address 0000:786D. The last indication sent is 00 00 00 00 … 00 00 00 00 10. Refer to Table 3–9 to convert data from hexadecimal to binary. In this example, no Special Message buffer is defined in the application for station 1.

Table 3–9. Hexadecimal to Binary Conversion

Hex	Binary	Hex	Binary	Hex	Binary	Hex	Binary
0	0000	4	0100	8	1000	C	1100
1	0001	5	0101	9	1001	D	1101
2	0010	6	0110	A	1010	E	1110
3	0011	7	0111	B	1011	F	1111

3.4.5.3. Emulation Menu Choice: *Optns*

The *Optns* menu choice is used to view the selected communication port's setup. Figure 3–9 shows an example screen if *Optns* is selected.

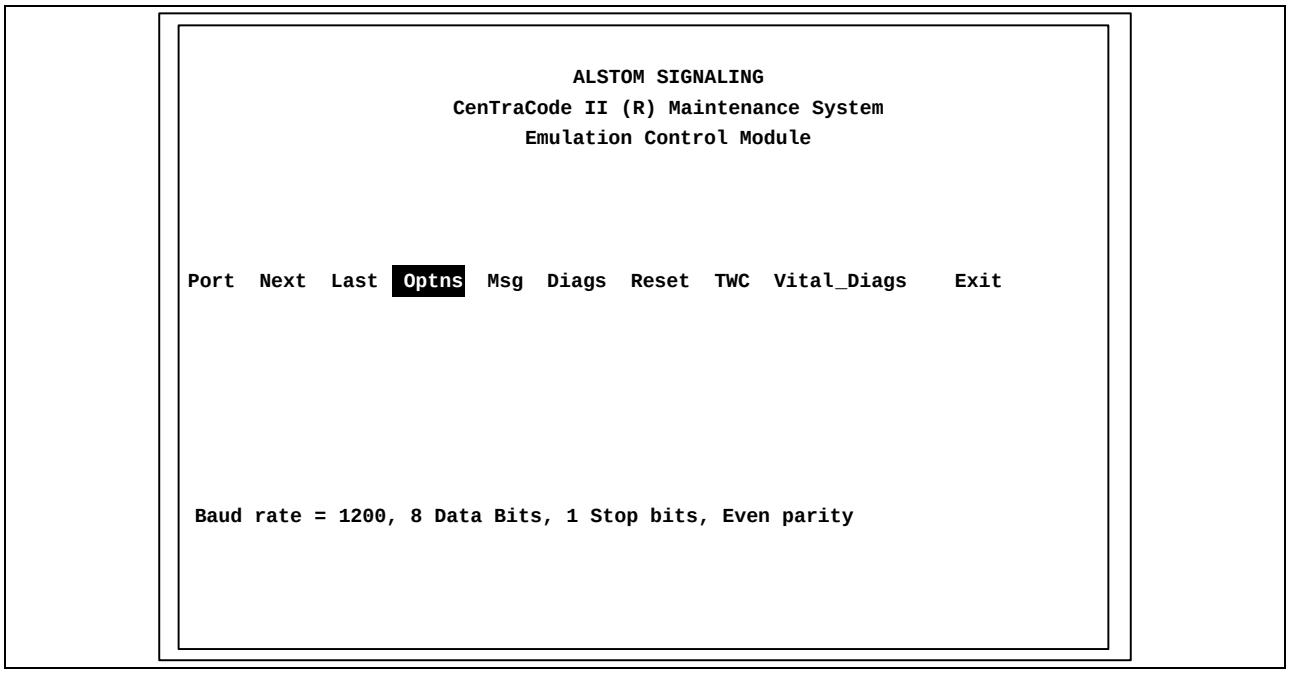

Figure 3–9. Emulation Menu – View Port Setup

3.4.5.4. Emulation Menu Choice: *Msg*

Message flow between the communication protocol installed on a serial port and the non-vital application logic can be monitored using the *Msg* menu choice. A new menu is displayed as shown in Figure 3–10. This menu offers the following selections: *Post*, *Disp* (Display), *Spcl* (Special), and *Mode*. These options are discussed in detail on the next few pages.

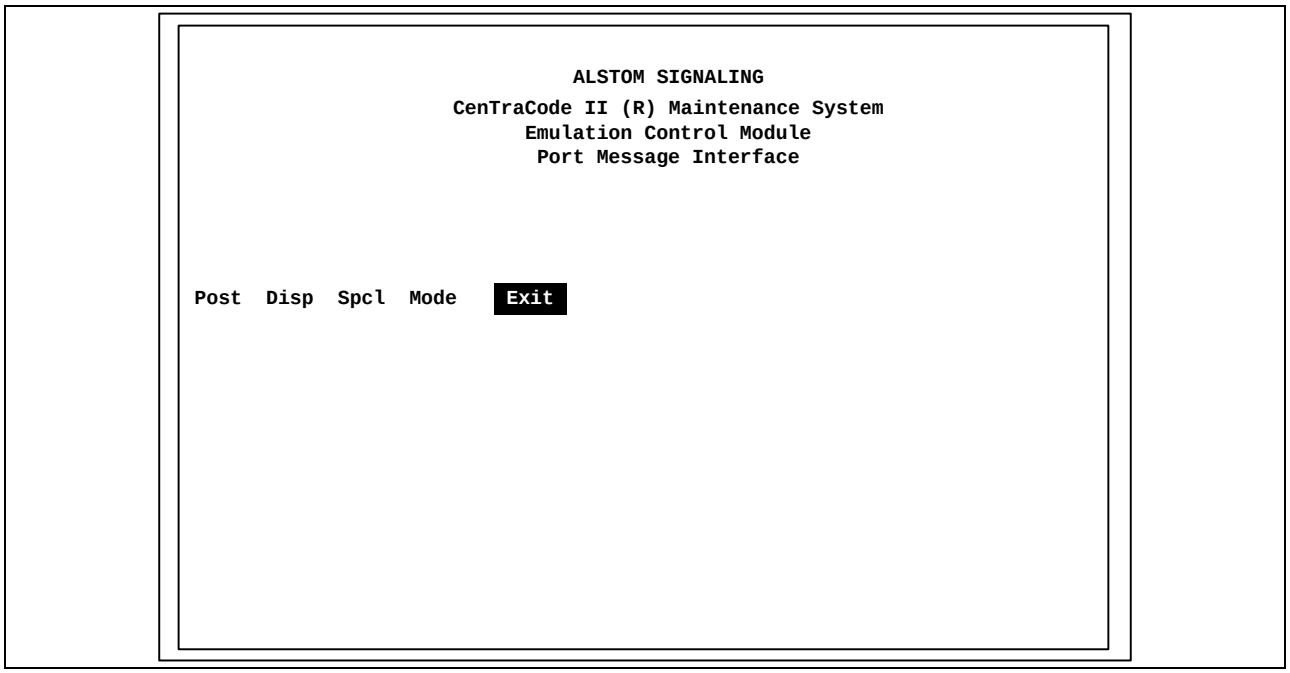

Figure 3–10. Emulation Menu – Message Sub-Menu

3.4.5.5. Emulation/Message Sub-Menu Choice: *Post*

The *Post* menu choice allows user-entered keyboard input to replace the control message normally posted by the protocol emulation. This feature is useful to determine if a problem is in the application or the emulation.

To post a control, select the *Post* option. If more than one station exists, a prompt for the station number appears. In this case, enter the proper station number (the maximum number allowed is displayed). A prompt showing the size of the control message appears, at this point enter the new data as a series of hexadecimal bytes. When the entry is complete, the message is posted to the application logic. At most, 96 bits (12 bytes) may be manually posted. Note that if the protocol loaded on this port receives a valid control message, it is posted by the protocol, thus overwriting the control that was manually posted.

Figure 3–11 shows an example screen if the *Post* option is selected for a control message containing 16 bits (2 bytes).

WARNING

POSTING CONTROL DATA USING THE POST OPTION CAUSES CHANGES TO THE OPERATION OF THE SYSTEM.

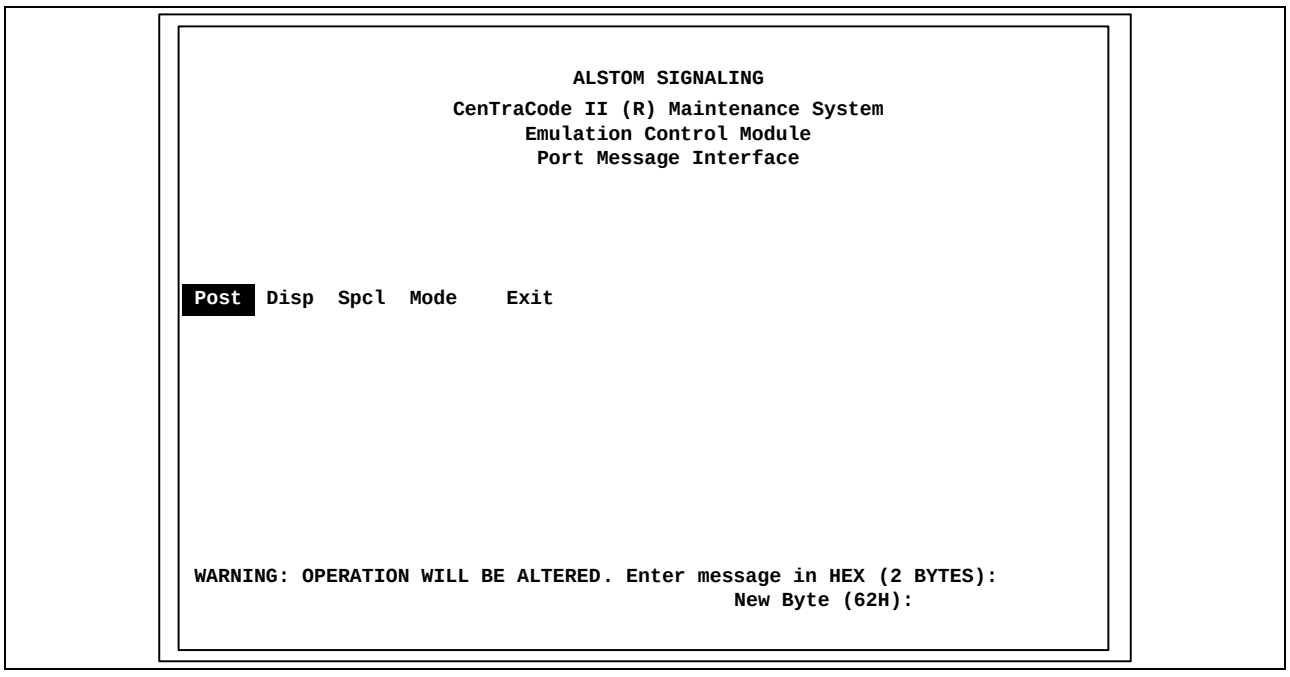

Figure 3–11. Post a Control Message

3.4.5.6. Emulation/Message Sub-Menu Choice: *Disp*

The *Disp* menu choice displays the data portion of messages posted between the protocol emulation and the non-vital application logic, updated in real-time. Figure 3–12 shows a typical screen when the display format is set to “Original”; various data display formats are offered via the *Mode* menu choice discussed later.

The terms “control” and “indication” refer to inbound (received) and outbound (sent) messages, respectively. A Special Message is a bi-directional buffer containing protocol-specific flags used to report or control message flow. Depending upon the application, no Special Message buffer may be defined. The use of flags in the Special Message buffer varies among the communication protocols supported in VPI. For specifics, refer to each protocol’s manual (Alstom publication series P2346).

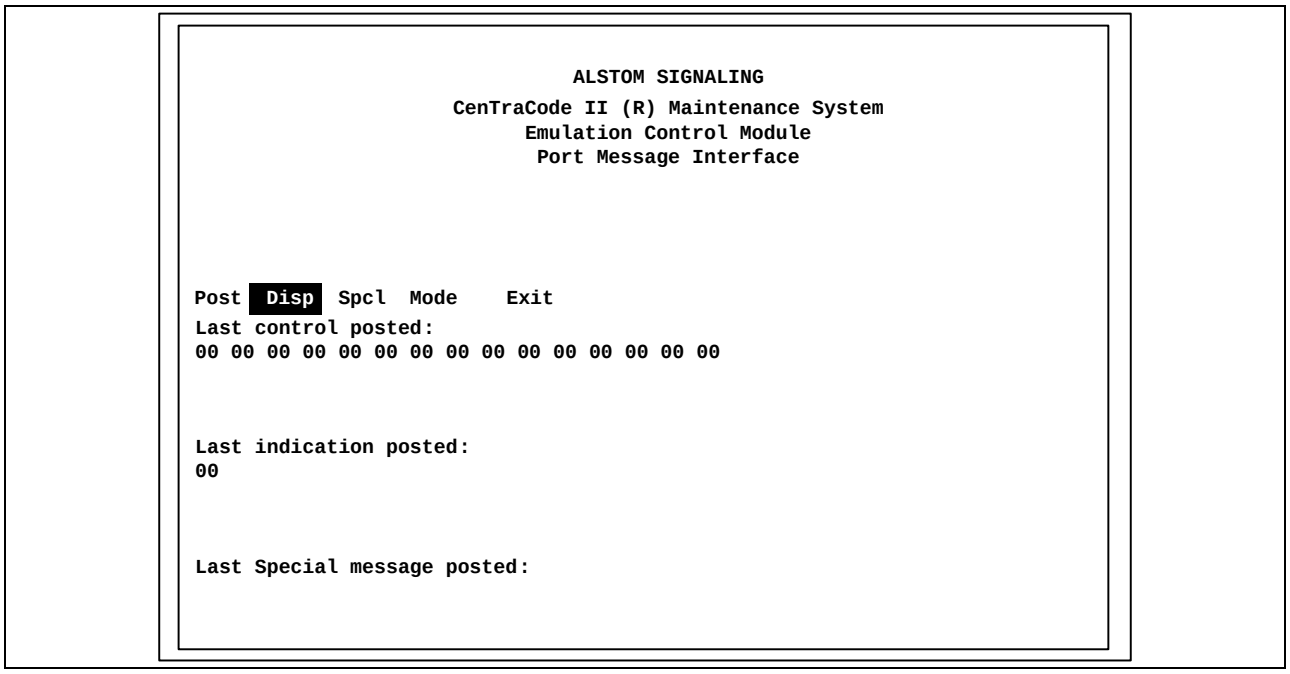

Figure 3–12. Display Messages in Real-Time

3.4.5.7. Emulation/Message Sub-Menu Choice: *Spcl*

The *Spcl* menu choice allows user-entered keyboard input to be posted to the protocol's Special Message buffer. To post a Special Message, select the *Spcl* option. If more than one station exists, a prompt for the station number appears. In this case, enter the proper station number (the maximum number allowed is displayed). A prompt showing the size of the Special Message appears, at this point enter the new data as a series of hexadecimal bytes. When the entry is complete, the message is posted to the application logic. At most, 96 bits (12 bytes) may be manually posted. Note that if the protocol loaded on this port receives messages, this may cause the protocol to write to the Special Message buffer, potentially overwriting the information that was manually posted.

Figure 3–13 shows an example screen if the *Spcl* option is selected for a Special Message containing 24 bits (3 bytes).

WARNING

POSTING SPECIAL MESSAGE DATA USING THE SPCL OPTION CAUSES CHANGES TO THE OPERATION OF THE SYSTEM.

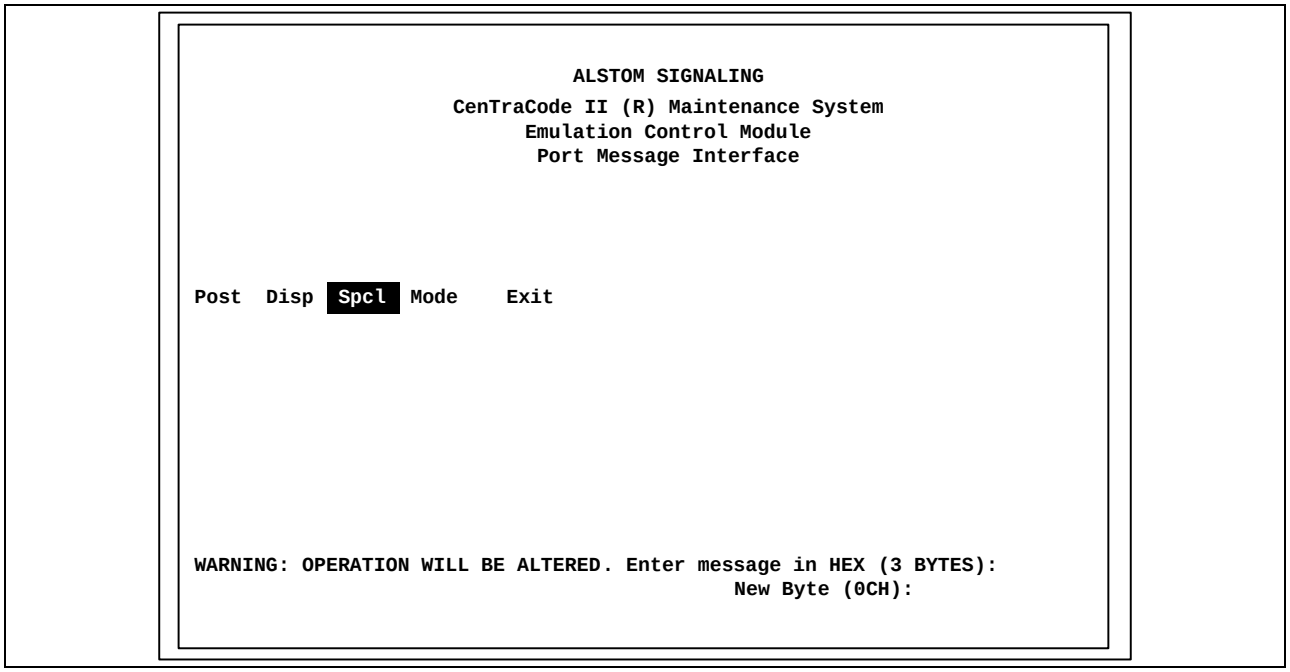

Figure 3–13. Post a Special Message

3.4.5.8. Emulation/Message Sub-Menu Choice: *Mode*

The *Mode* menu choice results in the display of several additional menu options that affect the format of message data displayed using the Disp option in the Message Submenu as shown in Figure 3–14. After the display format has been set to either *Original*, New *Hex*, *Binary* or *Inverse*, message contents are automatically displayed and updated in real-time as if the Disp menu choice had been selected.

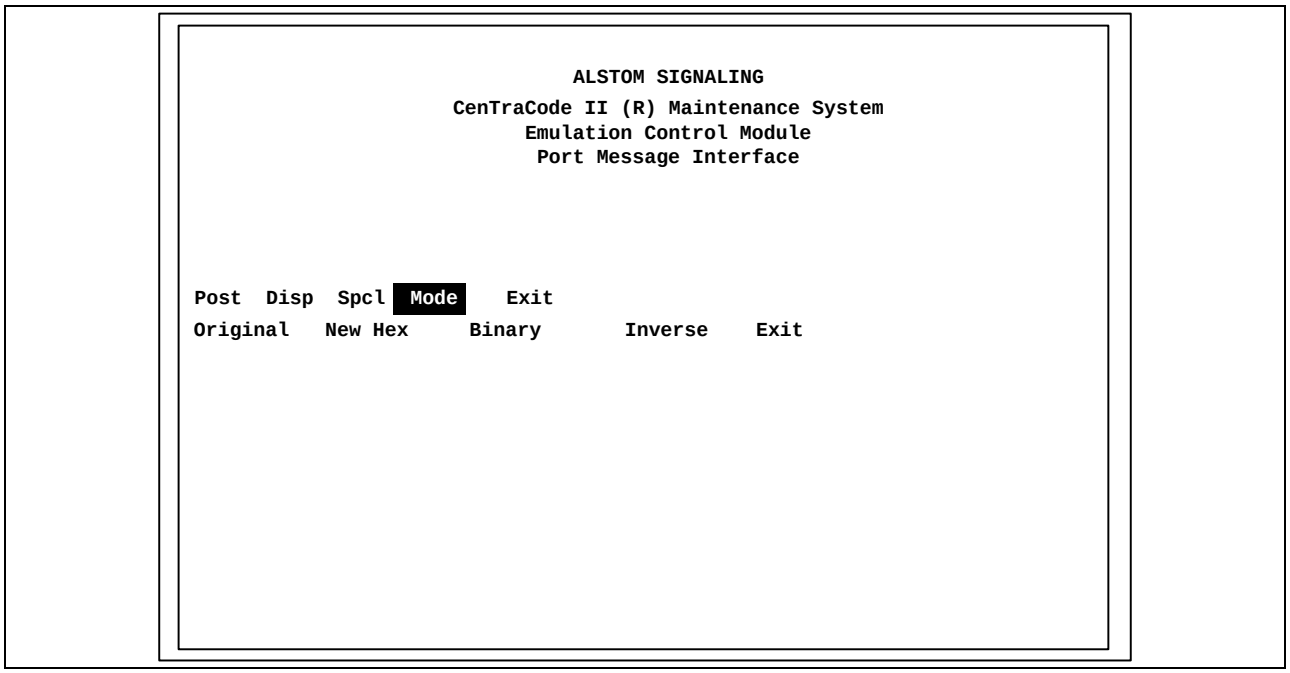

Figure 3–14. Select the Message Display Mode

Table 3–10 describes the message display mode options in this menu.

Table 3–10. Message Display Modes

Option	Description
Original	Restores the display format to the default setting. In this format, data for a single station is shown as a series of hexadecimal bytes, wrapping between lines on the display based on the message lengths for controls, indications and Special Messages.
New Hex	In this format, message data is shown 24 hexadecimal bytes at a time from left to right on a single line per station for up to four stations, with the station number shown at the start of each line of data, see Figure 3–15. Multiple stations' data (up to four) is shown on subsequent lines as needed. If a message (control, indication or Special) exceeds 192 bits (24 bytes), use the 'V' (increment byte numbers) and 'B' (decrement byte numbers) keys to bring additional data bytes (one at a time) into view. At most, 24 bytes of a message's data may be viewed at a time in this format. If more than four stations are defined on the port, use the 'G' and Space Bar keys to view data for additional stations. Press the 'H' key to bring the display back to the first station, first byte setting.
Binary	This display format is similar to New Hex except that message data is shown eight bytes at a time in binary (eight bits per byte). The least significant bit of each byte is shown at the left of each byte of data. For example, the hexadecimal byte 0x01 is shown as 10000000 in Binary format. Use this format to view message data exactly as posted to the non-vital application logic. Figure 3–16 contains the same data shown in Figure 3–15 (New Hex format), but in Binary format instead.
Inverse	This display format is similar to Binary except that the least significant bit of each byte is shown at the right of each byte of data. For example, the hexadecimal byte 0x01 is shown as 00000001 in Inverse format.

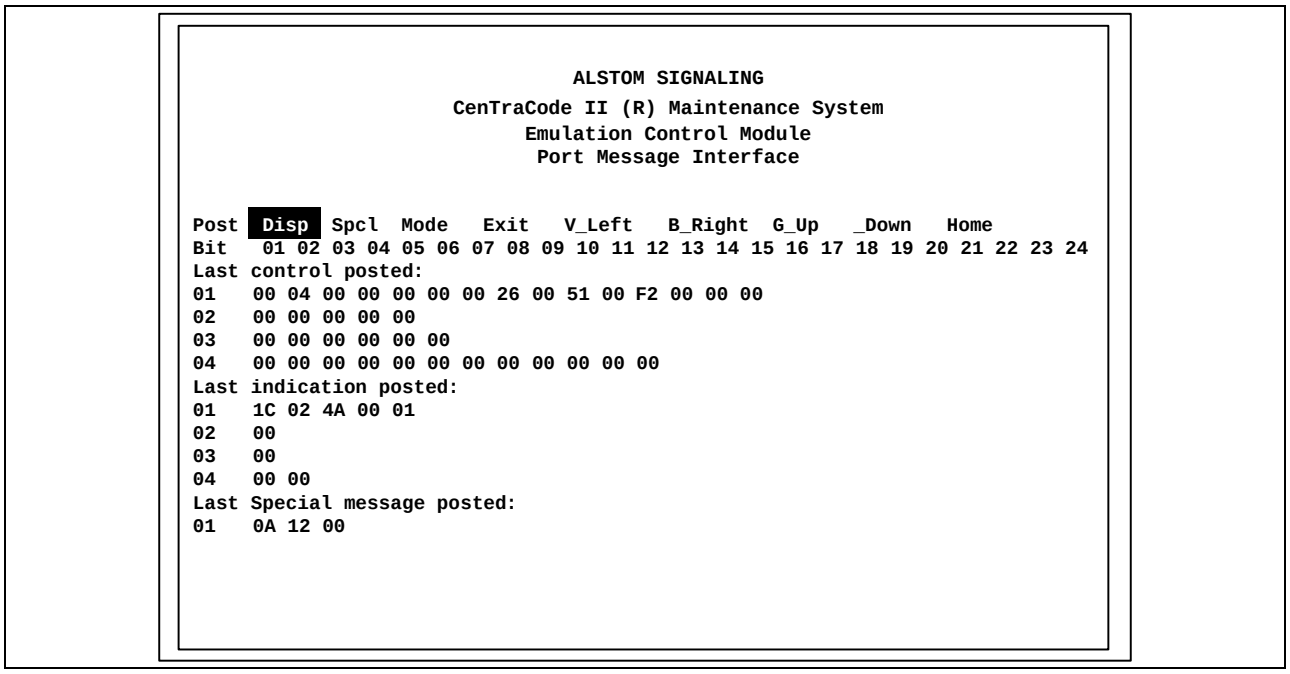

Figure 3–15. Display Messages – New Hex Display Option

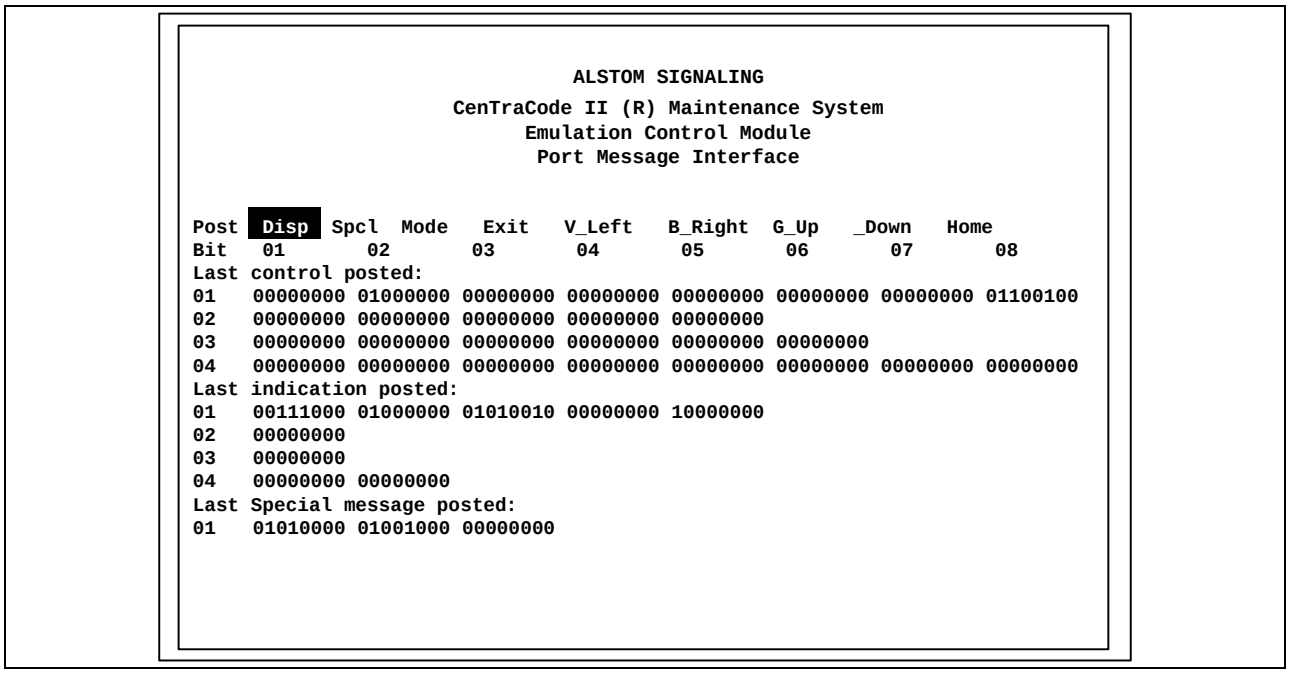

Figure 3–16. Display Messages – Binary Display Option

3.4.6. Emulation Diagnostics Menu

Select *Diags* from the Emulation Menu for protocol-specific diagnostic functions. Refer to Alstom publication P2346E for detailed information on Alstom's DataTrain VIII protocol. Figure 3–17 shows a typical protocol diagnostics menu, specifically the DataTrain VIII Diagnostics Menu. Several DataTrain VIII diagnostic screens are available, only the Counts function is discussed in this manual.

Selection Path:

- Main Menu
  - Emulation
  - *Port* (serial port selection from 1 to 5)
  - Diags

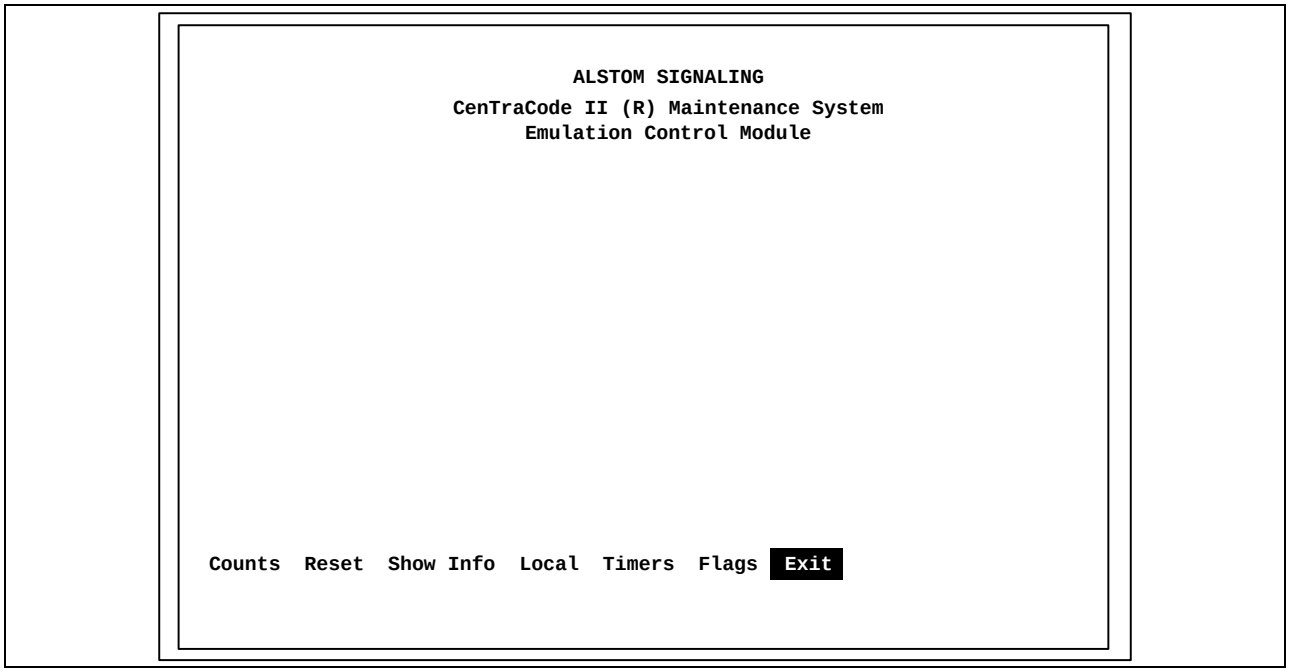

Figure 3–17. DataTrain VIII Diagnostics Menu

3.4.6.1. DataTrain VIII Counts Screen (Emulation Diagnostics)

Select the DataTrain VIII *Counts* menu choice to check the status of communications on the selected port. This dynamically updated screen may be out of step with the actual I/O because of a particular combination of application choices. Figure 3–18 shows a typical DataTrain VIII messages counts screen.

Selection Path:

- Main Menu
  - Emulation
  - *Port* (serial port selection from 1 to 5)
  - Diags
  - Counts

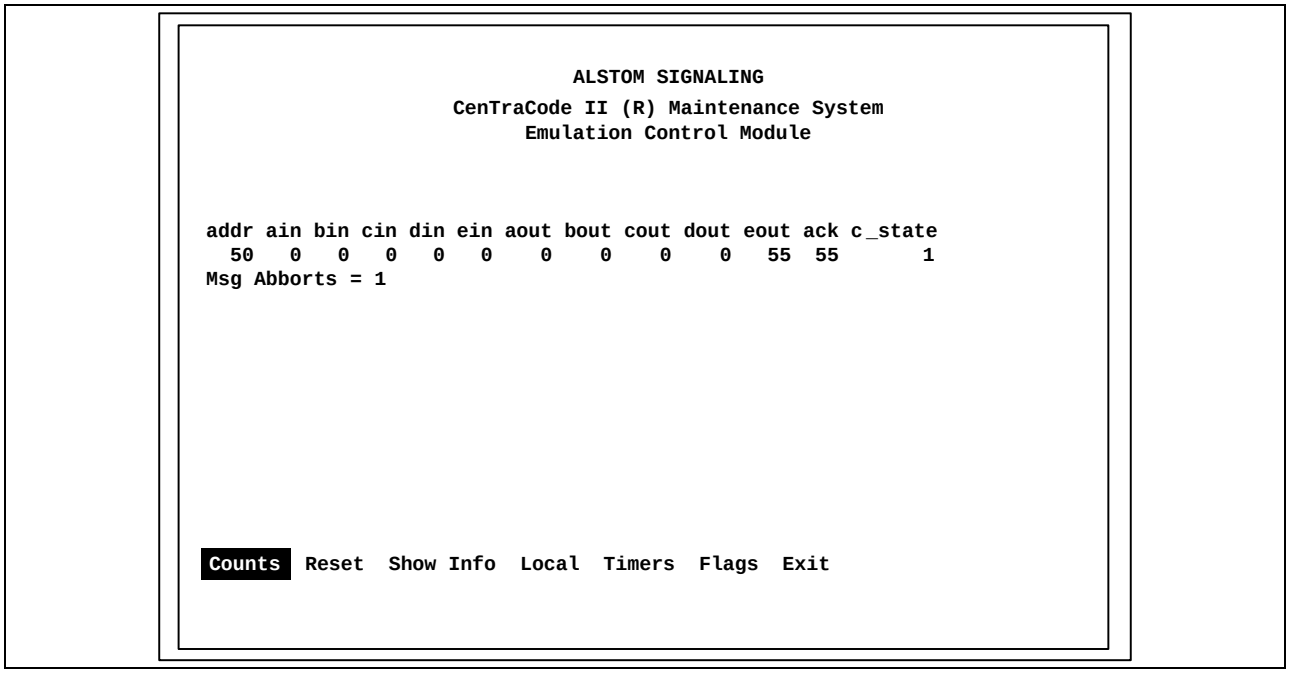

Figure 3–18. DataTrain VIII Counts Screen

While viewing the messages counts, use the Reset option to set the number of messages both sent and received to zero (doing so has no affect on system operation). In this screen “ain” is the total number of DataTrain VIII Acknowledge messages (type AA) received, whereas “aout” is the total number of Acknowledge messages sent, and “bin” is the number of Poll messages (type AB) received.

3.4.7. Monitor Menu

The data monitor screen is viewed by selecting Monitor from the Main Menu, see Figure 3–5. Use the data monitor to observe message traffic on one or more code system ports, as shown in Figure 3–19.

Selection Path:

- Main Menu
  - Monitor
  - *Port* (port selection from 1 to 5)

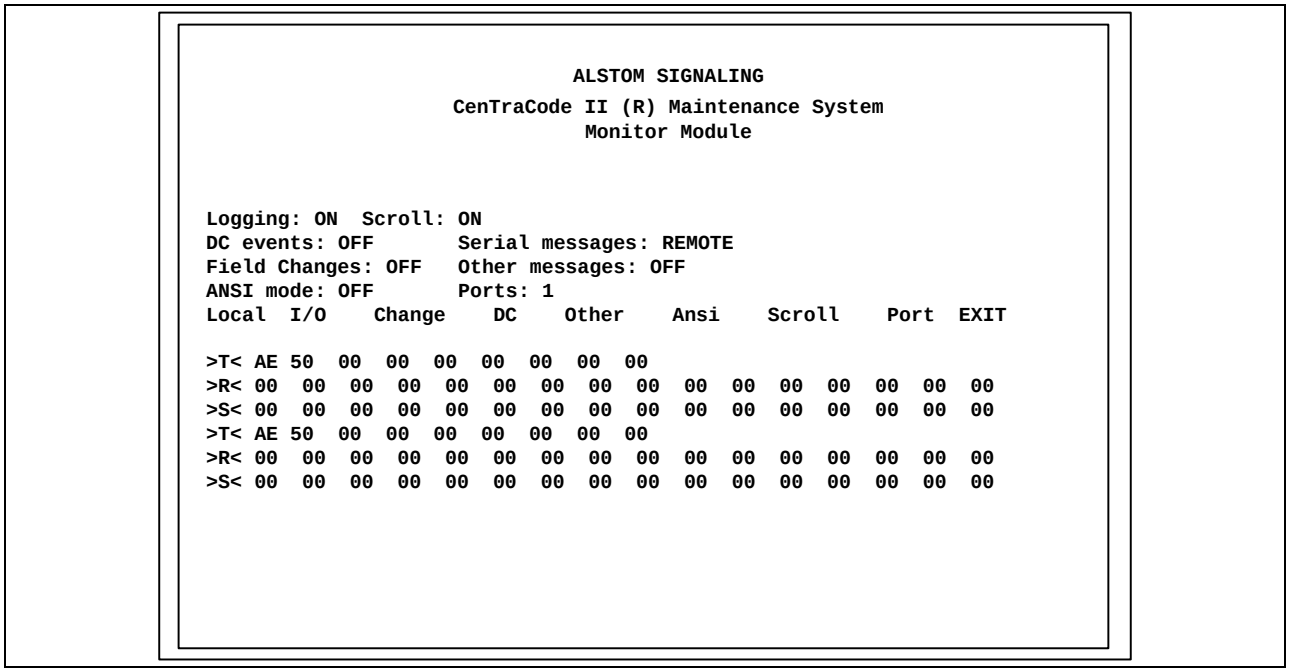

Figure 3–19. Data Monitor Screen

Data monitor operation is a background task. The displayed information may be pre-empted by other processor operations of a higher priority. As a result, it may not be possible to report all code system port message traffic in monitor mode. Split bytes and CRC checksums are not shown on this display.

Table 3–11 provides a description of the choices available in the Monitor Menu.

Table 3–11. Monitor Menu Choices

Option	Description
Local	Toggle the Local/Remote serial message flag. When in Local mode, only local messages are displayed.
I/O	Toggle the input/output status display.
Change	Toggle the field changes display. When this option is on, field I/O are displayed in order of their occurrence.
DC	Display DC type events (not used in electronic code applications).
Other	Display communication error messages and other miscellaneous message types.
Ansi	Select ANSI mode in which the unit sends control codes to format the screen so that data appears in organized order. These codes cannot be used if a printer or other device is connected to the port.
Scroll	Start or stop updating the screen so that message traffic can be monitored and displayed in real time.
Port	Select the number of the port (or ports), from 1 to 5, to monitor and display. Activity on multiple ports may be observed at the same time.
EXIT	Exit the data monitor. Note that Ctrl + ‘E’ should not be used to exit from the data monitor screen.

The status of the data monitor fields is displayed at the top of the screen, as shown in Table 3–12.

Table 3–12. Data Monitor Status Indicators

Field	Description
Logging	On/off status of the data monitor, this is normally turned on.
Scroll	On/off status of the display, turn “Scroll” on for real-time display of message traffic.
DC Events	On/off status of the DC display, this is normally turned off.
Serial Messages	Serial message type (remote or local); this is normally set to remote.
Field Changes	Field changes display is turned on or off; this is normally turned off.
Other Messages	Other messages display is turned on or off; this must be on for error messages to be displayed.
ANSI Mode	ANSI display mode is turned on or off; this is normally turned off.
Ports	Reports message traffic for only the code line ports displayed.

When “Scroll” is on, message traffic on the selected port(s) is displayed. A descriptor indicating the type of message received or transmitted precedes each message. Message descriptions are summarized in Table 3–13.

Table 3–13. Message Descriptors

Message Type	Description
>T<	Transmitted message (for example, an indication).
>R<	Received message (for example, a control).
>P<	Received poll message.
>S<	Supervisory or status message.
>-CFG-<	Received system configuration message.
ERROR	The received message contained an error.

Communication problems can be monitored in this screen and are displayed in error messages. Specific messages vary between the communication protocols supported by Alstom. Note that “Other Messages” must be turned on in order for error messages to be displayed by the data monitor.

3.4.8. System Configuration Information

System configuration information is displayed by selecting System from the Main Menu, see Figure 3–5. This screen shows system configuration information, including the system and CAA drawing numbers, application compilation time, system compilation time, and active serial ports and their usage. No options are available from this screen; press any key to return to the Main Menu. Figure 3–20 shows a typical system configuration screen.

Selection Path:

- Main Menu
  - System

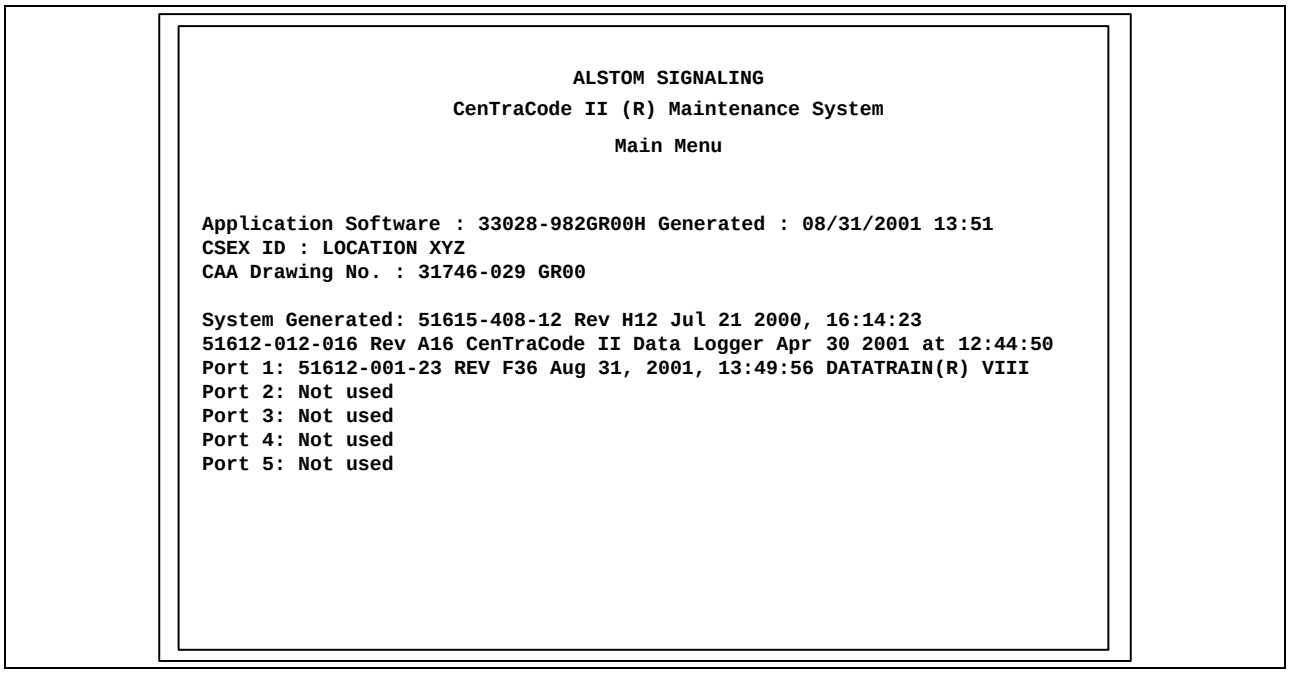

Figure 3–20. CenTraCode II System Configuration Screen

3.4.9. System Diagnostics Menu

The System Diagnostics Menu is displayed by selecting Diagnostic from the Main Menu see Figure 3–5. The System Diagnostics Menu provides access to the hardware so that low level testing can be done. The menu also provides access to many board functions such as the non-vital I/O, serial ports, DC interface, memory, and much more. Some options when executed may result in disruption of online operation. These tests are only intended to be run when the system is offline. Figure 3–21 shows the System Diagnostics Menu. Table 3–14 summarizes the system diagnostic menu choices.

Selection Path:

- Main Menu
  - Diagnostic

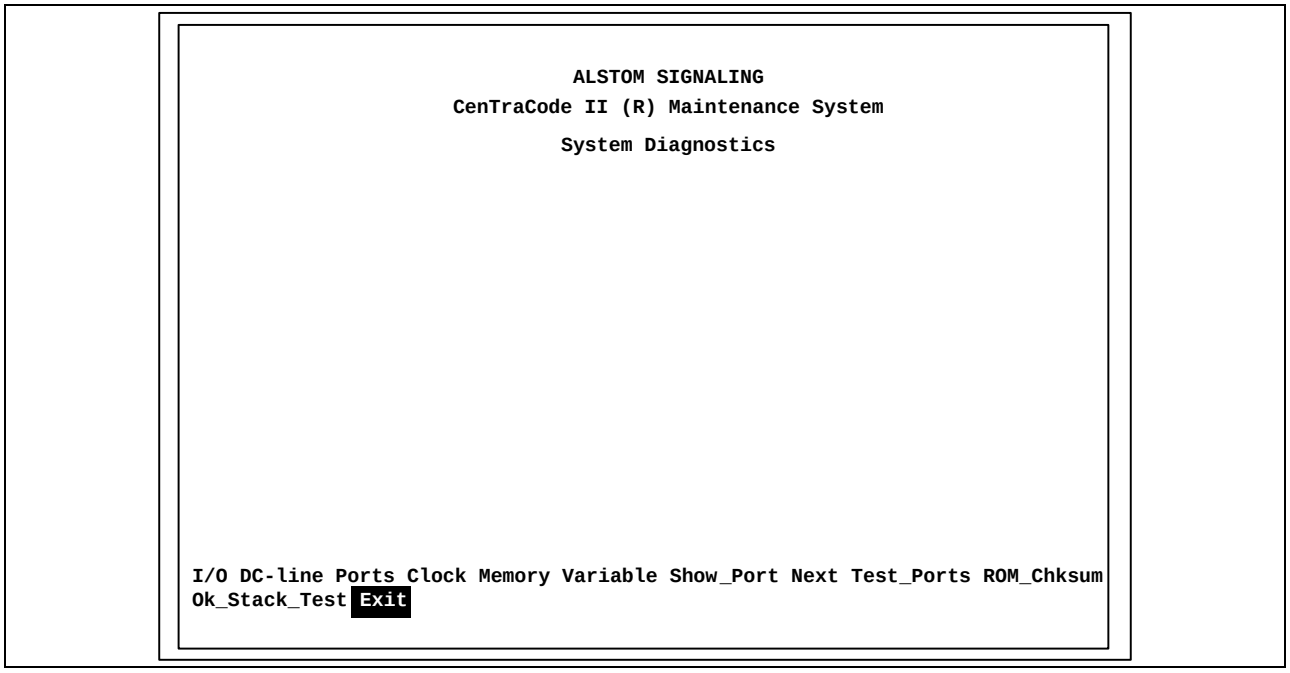

Figure 3–21. CenTraCode II System Diagnostics Menu

System diagnostic options can be selected from the System Diagnostics Menu and from a Secondary Diagnostics Menu (described later) that is accessed via the Next menu choice in the System Diagnostics Menu. Each menu choice leads to a submenu or requires user input. The choices available in the System Diagnostics Menu are listed next. Most menu choices are intended for use by Alstom technical personnel for system troubleshooting, and are not designed for field maintainer use. Some options that affect system operation can be password-protected.

Table 3–14. System Diagnostic Menu Choices

Option	Description
I/O	This option leads to a submenu. Use the *Local* menu choice in this submenu to view the current state of all non-vital inputs and outputs in the VPI II system. I/O states are updated in real-time only after the *Disp* menu choice has been selected. The state of an input port is either on (1) or off (0), and each is debounced at the rate shown (e.g. 50ms). The state of each output port depends upon its definition in the application, and is shown as a single hexadecimal digit Each bit (four total) of this hexadecimal digit represents the various types of non-vital outputs (NVO) available in a VPI II system: Code NVO State 0001 (1) Steady on 0010 (2) Source 0100 (4) Pulse, width 1 0101 (5) Pulse, width 2 1000 (8) Normal flash, phase A 1001 (9) Fast flash, phase A 1100 (C) Normal flash, phase B 1101 (D) Fast flash, phase B From the I/O submenu, individual outputs may be turned on and off manually using the *Off*, *Pulse* and *Flash* menu choices. To do so, first halt the non-vital application logic using the *Caa* menu choice. Note that this action affects normal system operation. Use the *Rate* and *Mode* menu choices to vary the type of each pulsed or flashed output port, and use the *All* menu choice to apply the latest output type selected to all displayed output ports. The *Src/Snk* (sink and source) menu choice is applicable to CenTraCode II-s only, and not to CSEX3.
DC-line	Monitor the DC codeline, or toggle a DC relay. This menu choice is primarily intended for use by Alstom technical personnel.
Ports	View a code line port's setup and current status, and manually modify its configuration (using the *CFG* submenu choice). Also allows hardware control lines to be manually toggled. This menu choice is primarily intended for use by Alstom technical personnel.

Table 3–14. System Diagnostic Menu Choices (Cont.)

Option	Description
Clock	Set the system's battery-backed real-time clock (RTC) date/time registers. The RTC is used primary to time-stamp events stored by Alstom's optional DataLogger module (refer to Alstom publication P2326D). The CSEX3 clock must be initialized when the VPI II system is first put into service, power to the module is left off for more than 48 hours, when the CSEX3 board's battery is replaced, or when the CSEX3 board's EPROMs are replaced. To set the RTC, use the *Clock* menu choice followed by the *Time* (T), *Date* (D) and then the *Initialize* (I) submenu choices. Take care to enter the date and time in the exact format shown. Select *Exit* (E) when done.
Memory	Display an area of CSEX3 system memory, 256 bytes at a time, and optionally modify a byte of memory. The RAM starting address must first be entered in Intel-hex segment:offset notation (ssss:oooo). This menu choice is primarily intended for use by Alstom technical personnel.
Variable	Examine the contents of a non-vital memory location. The address to be monitored must be entered in Intel-hex segment:offset notation (ssss:oooo). Typically, this is the address of a non-vital application parameter obtained from the Symbol Table Report in the application's LCS file. Either a 1- or 2-byte (integer) location may be monitored. Press any key to stop monitoring the variable.
Show_Port	Examine the contents of a CPU II I/O port. This menu choice is to be used by Alstom technical personnel only.
Next	Advance to the next level of CenTraCode II diagnostics and display the Secondary Diagnostics Menu described in Table 3–15.
Test_Ports	Enable the system's "serial port test". Doing so severely encumbers system operation and is to be used by Alstom technical personnel only.
ROM_Chksum	Display the checksum stored in the combined system/application program memory (PROM).
Ok_Stack_Test	Test stack space used by the currently running system task. This menu choice is to be used by Alstom technical personnel only.
Exit	Return to the Main Menu.

The Secondary Diagnostics Menu is accessed using the *Next* menu choice in the System Diagnostics Menu. It offers additional diagnostic features, most of which are intended for use by Alstom technical personnel for system troubleshooting, and is not

designed for field maintainer use. The choices in the Secondary Diagnostics Menu are summarized in Table 3–15.

Table 3–15. Secondary Diagnostics Menu Choices

Option	Description
Mode	Change the operating mode of one of the system's tasks. This menu choice affects system operation and is to be used by Alstom technical personnel only.
Time	Computes and displays average timing of the non-vital application logic and the tasks running in the system. This is a non-destructive test. Typically, the calculation is based on 1000 tasking loops and a timing base of 1 and a resolution of 1. This menu choice is primarily intended for use by Alstom technical personnel.
Remove	Remove a task from the system's round-robin task loop. This menu choice affects system operation and is to be used by Alstom technical personnel only.
Insert	Insert a task into the system's round-robin task loop. This menu choice affects system operation and is to be used by Alstom technical personnel only.
CAA	Suspend/resume operation of the non-vital application logic. This menu choice affects system operation and is to be used by Alstom technical personnel only.
Oprtr	Change the operating mode of one of the system's tasks (similar to the Mode menu choice). This menu choice affects system operation and is to be used by Alstom technical personnel only.
Disp	Display information on all currently installed system tasks, such as stack space and usage. This menu choice is primarily intended for use by Alstom technical personnel.
Reset	Show the total number of system resets since power up, and optionally perform a manual system reset. Use this choice with care since it causes the CSEX3 software to reinitiate its start-up sequence, as if the system were turned off and back on.
Sys_Err	List all system errors logged since power up. Refer to Table 3–16 for all system errors that may be logged by the self-checking mechanism built into the CSEX3 System Software. All accumulated errors (up to 20) are automatically shown above the Main Menu, or may be viewed by selecting the Sys_Err menu choice in the Secondary Diagnostics Menu. In the latter case, errors may be erased from memory by selecting 'R' (Reset).
Exit	Return to the System Diagnostics Menu.

Table 3–16 lists all CenTraCode system errors that may be displayed at the MAC port diagnostic menu by the self-checking mechanism built into the CenTraCode System Software. Note that all logged errors are lost by the system in the event of power loss. The error codes shown in this table apply to the 2-digit diagnostic display on CSEX3 and CenTraCode II-s boards only. In most cases, contact Alstom to resolve the cause of displayed errors.

All accumulated errors (up to 20) are automatically shown above the Main Menu, or may be viewed by selecting the Sys_Err menu choice in the Secondary Diagnostics Menu. Displayed error messages are of the form:

“Logged mm dd hh:mm:ss – Error – message”

Table 3–16 details each message and its associated 2-digit error code (applicable to CSEX3 and CenTraCode II-s only). In this table, TCB stands for the “Task Control Block” number, whose value is meaningful only to Alstom technical personnel.

Table 3–16. System Errors

Code	Displayed Error Message	Possible Cause(s)
00	*None*	No errors detected (normal operation).
11	Memory Shortage on port *n*	Insufficient system RAM for application requirements.
12	No protocol on port *n*	No valid communication protocol installed on this serial port.
13	Protocol init on port *n*	Protocol emulation initialization failure.
14	Tasking on port *n*	Failure in loading a port’s task.
15	Ring on port *n*	Failure in RAM allocation for a port’s serial ring buffers.
16	Port on port *n*	Failure in RAM allocation for a port’s internal data structures.
17	CAA Indication Flag on port *n*	Invalid value for a RAM indication buffer flag.
18	CAA Control Flag on port *n*	Invalid value for a RAM control buffer flag.
19	CAA Spcl Msg Flag on port *n*	Invalid value for a RAM special buffer flag.

Table 3–16. System Errors (Cont.)

Code	Displayed Error Message	Possible Cause(s)
1a	Protocol Error *n*	Error code for protocol emulation initialization (error 13) or other failure.
1b	Unknown reset TCB *nn* Active	Reset due to unknown cause: • Momentary power loss • Reset button manually pressed • Miscellaneous hardware or software failure
1c	Watchdog caused reset TCB *nn* Active	The main task loop has stalled – the system performs an automatic reset.
1d	Software reset called	Operator-induced software reset caused by: • Diagnostic input switch (CenTraCode II-s or CSEX3 only) • MAC port diagnostics – *Reset* option • PROM or RAM failure (automatic system reset)
1e	Prom error at *n*	Test of RAM or PROM failed – the system performs automatic reset with the diagnostic display showing Error 1d. n Meaning 1 System's startup RAM test failed 2 System's startup PROM checksum verification failed 3 Not assigned (future) 4 System's periodic PROM checksum test failed
1f	Reset due to stack crash, task number *nn*	A task's stack or its local memory area has been corrupted, or the diagnostic test of a serial port's local memory area failed – the system performs an automatic reset.

Table 3–16. System Errors (Cont.)

Code	Displayed Error Message	Possible Cause(s)
20	CRC error in port *n* local memory	Diagnostic test of a serial port's local memory area failed – the system performs an automatic reset.
22	Application is not running	The application logic is no longer running – the system performs an automatic reset.
23	Flag error – Pointer *nnnn*	Application buffer flag locked "in use" and the application logic is no longer running – the system performs an automatic reset with the diagnostic display showing Error 22.
24	CS:IP error–last TCB active *nn*	Executing code from RAM (invalid) – the system performs an automatic reset.

3.5. EMBEDDED DATALOGGER (DL)

3.5.1. General Information

An Alstom Signaling CSEX3 board based system is composed of several software modules. Each module is dedicated to performing a specific function in the system. Although all modules do not share data with each other, all have links to the operating system software. Alstom's optional Embedded DataLogger module provides the user with real-time on-line event logging with time-stamping and reporting capabilities. Complete detail on DataLogger can be found in Alstom publication P2346D.

When used in an application, the DataLogger (DL) module provides interfaces suitable for accepting data to be logged from other installed modules. It also provides three Non-Vital Application (NVA) monitoring modules. These modules perform specific functions and pass data to the DL for storage. The first of the three modules is dedicated to monitoring changes in user-composed messages called User Non-Vital Messages (UNVM) or simply User Messages. The second module is dedicated to monitoring changes occurring at Non-Vital Inputs (NVI) and the third is dedicated to monitoring changes occurring at Non-Vital Outputs (NVO).

3.5.2. Real-Time Clock

All logged data bears a time stamp resolved to one second relative to the system clock. CSEX3 boards are equipped with a battery-supported, hardware-based Real-Time Clock (RTC).

3.5.3. Memory Usage

The CSEX3 board reserves 256K bytes of battery-backed memory (BBRAM) for data logging. The DL partitions its assigned memory space into three major components: the Scratch Pad, the Directory, and the Data Log Area, see Table 3–17.

Table 3–17. DataLogger Memory Usage

Memory Location	Content
Scratch Pad (234 bytes)	Operating parameters and intermediate variables are stored in this area.
Directory (3840 bytes)	This area contains room for 192 Directory Frames (20 bytes each).
Data Log Area (CSEX3: 258,070 bytes)	Log Frames are stored in this area.

Scratch Pad: The DL program reserves 234 bytes of its memory to support housekeeping activities. This secured area, referred to as the Scratch Pad, holds DataLogger's operating parameters and intermediate data.

Directory: Another 3,840 bytes of the DataLogger's memory hold Directory Frames. This area is a circular buffer large enough to hold 192 Directory Frames. A record is entered in this area to mark the creation of a new directory, typically each hour. Each record has a fixed length of 20 bytes and is referred to as a Directory Frame.

Data Log Area: The remaining portion of DataLogger's memory is used for recording logged events, called Log Frames. The first 17 bytes of each Log Frame contain overhead information that distinguishes the different types of event data. Log Frames are variable in length due to the various types of data that may be logged.

The Data Log Area is a circular buffer. Events are logged in consecutive memory locations until the end of the area has been reached, at which time the DL restarts at the beginning of the Data Log Area to store subsequent event data. This "wrap around" causes the data stored at the beginning of memory to be overwritten. This overwrite can be inhibited by utilizing the Timed Data Protection mechanism provided by the DL.

3.5.4. Directory Frames

A Directory Frame is stored when any of these events occur:

- System Reset: when the CSEX3 based system is reset or powered up
- Start of Each Hour: when the system clock advances to a new hour
- Clock Setting: when the operator modifies the system date or time through the DataLogger's password protected clock-setting utility
- End of Memory: when the DL reaches the end of the Data Log Area (end of actual memory), and Timed Data Protection has expired for the oldest directory data
- Erasure of Current Directory: when an erase command is issued for the currently open directory

In all five instances, the creation of a new Directory Frame can be inhibited by the enforcement of Timed Data Protection wherein logs are protected from being overwritten until the data is older than the user-specified duration. A new Directory Frame is not created until after timed protection expires.

A Directory Frame contains the following information:

- Date and time of creation
- Primary and secondary status indicators
- A log count (number of events)
- A pointer (address) to the first logged event associated with this directory
- A moving pointer to the last event associated with this directory

3.5.5. Log Frames

A Log Frame is composed of event and descriptive data. An event's data is generated by different software modules and passed to the DL for storage. The descriptive portion of a Log Frame has a fixed length used to identify the type and source of the event data.

3.5.6. Logging Capacity

The logging capacity of DataLogger can be roughly expressed in terms of the maximum number of events that can be stored.

In this example, it is assumed that DataLogger is configured to log only changes to User Message parameters, and that a single parameter changes state in each event. In this case, each stored event (Log Frame) requires 19 bytes of memory: 17 bytes of overhead plus 2 bytes of data for the parameter that changed state. CSEX3 boards have 258070 bytes of RAM for data logging. Therefore, in this example, 13582 events (258070/19) are logged before memory becomes full. Be aware that this is approximate, since periodically (typically every hour) DataLogger also automatically stores a snapshot of all parameters.

To estimate capacity in total logging time, estimate how many events typically occur each hour. Using the previous example and assuming an average of 4 events per minute (240 per hour), DataLogger memory becomes full in about 56.6 hours (13582/240) – approximately 2.3 days. Adjust this calculation based upon the expected frequency of events.

In a given application, it may be determined that typically multiple parameters change at once, and are therefore logged as a single event. In this case, a typical event log contains more than just a single parameter change and is larger than the 19 bytes shown in the example above. Calculate the size (in total number of bytes) of a typical Log Frame as follows:

- 17 bytes of overhead; plus
- 2 bytes multiplied by the average number of parameters that change state in each event

For example, if a typical event contains three parameter state changes, the size of a typical Log Frame is 23 bytes (17+2*3) resulting in a storage capacity of 11220 events (258070/23).

3.5.7. Data Protection

The DL stores Log Frames in contiguous memory locations. When the DL runs out of room in the Data Log Area, it seeks to overwrite the logs that belong to the oldest directory. An optional Timed Data Protection mechanism exists to allow users to prevent logs from being overwritten. The user specifies the minimum length a Directory Frame is to be saved after is it created. The specification is made once and applies uniformly to all directories.

3.5.8. Log Area Reclamation

The DL reclaims an entire directory's Data Log Area at a time. Given the same log sources and types, the size of a directory's memory area varies with the number of logs taken. Areas occupied by periods of heavy traffic are larger than those with little or no traffic. When the DL reclaims a Data Log Area, the status indicator in the Directory Frame that describes the area indicates expired. Data in an expired area cannot be meaningfully interpreted.

Provisions, accessible through the DataLogger's diagnostics, exist to allow a user to erase and recover memory blocks. When an area is erased, the status in its Directory Frame indicates erased. The erasure of an area is simply a change in status and is not destructive to the previously logged data in that area. However, an erased area loses its timed protection. When the DL runs out of room and encounters an erased area, it sets the area to expired and proceeds to overwrite it with new logs.

The status of unexpired and unerased directories is normally set to valid. An erased area can be recovered only as long as the DL has not run out of memory and has set the directory's status to expired.

3.5.9. System Overloading

A CSEX3 based system primarily serves as a code system emulator. Its flexibility has allowed it to fill a much wider range of applications. However, it is possible to overload a system by setting up the DL to record a wide range of frequently-changing parameters in a system configured with fast communication protocols for code system emulation. Application designers should limit loading to essential requirements and set up the DL to record only needed parameters.

Another example of how a system can be overloaded is to configure the DL to log code line messages (serial controls and indications) in Direct mode. Direct mode introduces an overhead that handicaps code line systems that operate with short inter-scan delays (the time interval between messages received by the system).

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4. SECTION 4 – TRACKER ANALYZER

4.1. GENERAL

This section introduces the Tracker analyzer available for the VPI II system.

4.2. INTRODUCTION

The Tracker™ Remote Diagnostic Analyzer, an Alstom software innovation, is a cost-effective and time-saving solution for monitoring and troubleshooting faults in the VPI II Vital and non-vital control systems and in other field control systems (hereafter referred to as devices). Complete Tracker documentation is available in Alstom Publication P2307.

Although not essential for using the Tracker analyzer, the user should have some knowledge of the terminology used in microprocessor-based control equipment to fully understand and interpret error codes and diagnostic messages.

4.3. SYSTEM OVERVIEW

Figure 4–1 shows a typical Tracker analyzer installation. The equipment supplied may vary from that pictured depending on specific system requirements. For information on additional or specialized equipment, contact an Alstom Sales Representative.

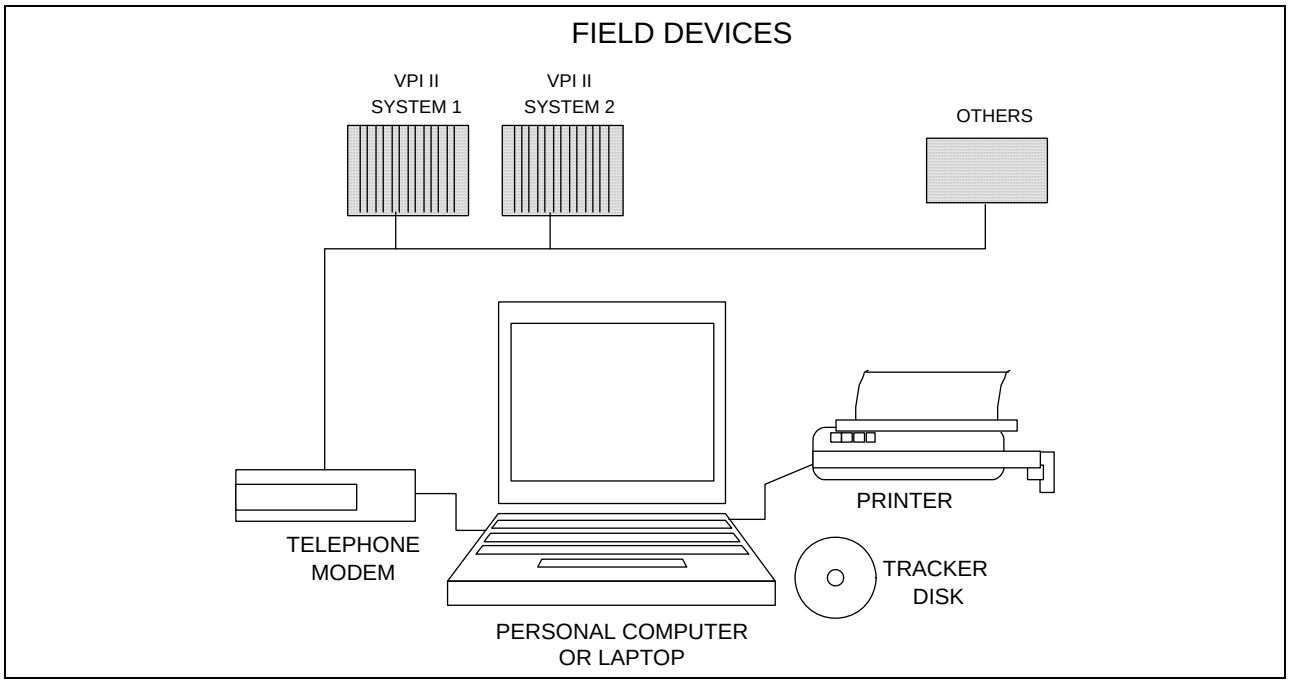

Figure 4–1. Typical System Using Tracker Software

In the convenience of an office setting, the Tracker Remote Diagnostic Analyzer software provides full-time simultaneous monitoring of multiple field locations. Using customized “Instruction Files” Tracker can be configured to sound an alarm when a malfunction occurs. When a fault is detected, Tracker can automatically diagnose the problem to indicate the fault or field condition, and display the information to the operator. This helps ensure that proper spares are taken to the site the first time, minimizing system down time.

Tracker permits historical logging of data so that the events leading up to a failure can be later analyzed for possible trends. By knowing the conditions leading to a device failure, preventative action may be possible to protect against future problems.

5. SECTION 5 – MAINTENANCE MANAGEMENT SYSTEM (MMS)

5.1. GENERAL

This section introduces the Maintenance Management System (MMS) available for the VPI II system.

5.2. INTRODUCTION

The Maintenance Management System (MMS) is an Alstom diagnostic tool that can remotely monitor each VPI II Vital and non-vital networked system.

The Maintenance Management System (MMS) runs on a PC under Windows NT 4 (SP 6), NT/2000, XP, Vista, or later operating systems. An MMS Editor is supplied to allow easy modification to any MMS Project. MMS is built of many Commercial Off The Shelf (COTS) components, which the end-user has access to in order to modify and customize the system to his needs.

Complete MMS documentation is available in Alstom Publication P2509.

MMS functionality includes:

- Fault Detection
- Logging
- Graphical User Interface
- Graphical System Diagnostics at the Board Level
- Verify the Installed Hardware and Software Components
- Quickly Select and Diagnose any System
- Troubleshooting using Application Explorer
- Watch Application Parameters and Logic while the Systems are Running
- Configuration Management
- Task Scheduler

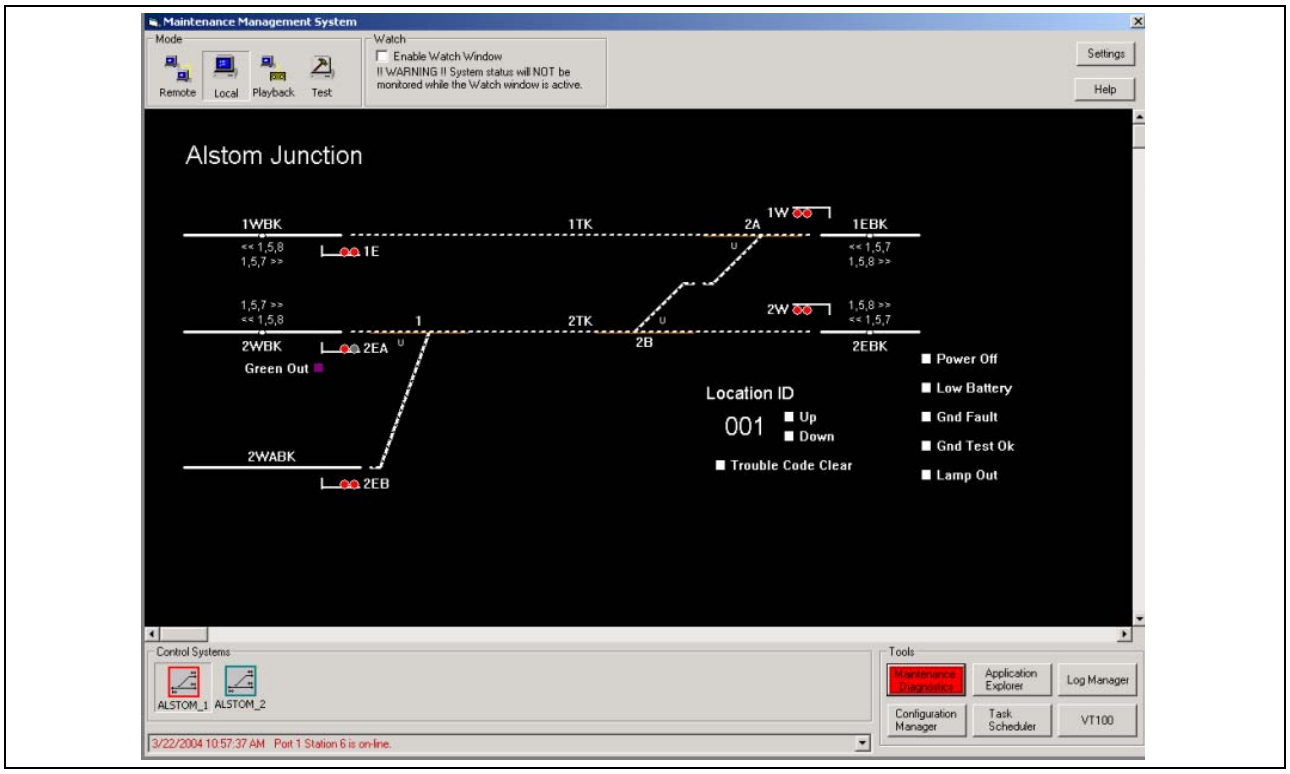

Figure 5–1. Maintenance Management System (MMS)

5.2.1. MMS Fault Detection

In the “REMOTE” setting, the MMS can provide either full-time or part-time monitoring of multiple field device sites simultaneously and can be configured to sound an alarm when a malfunction occurs. When a fault is detected, the MMS automatically diagnoses the problem to indicate the fault or field condition and displays this information to the operator. This helps ensure that proper spares are taken to the site for replacement, minimizing system downtime.

5.2.2. MMS Logging

MMS provides a historical log of errors detected, so that the events leading up to a particular failure can be analyzed later. System Diagnostics allow the user to add comments to the log through keyboard entry. Based on analysis of the log, preventive action can prevent future problems, minimizing system downtime.

5.2.3. MMS Graphical User Interface

MMS uses a graphical user interface, with user input coming from both the mouse and the keyboard. The user interface is designed to minimize confusion and to reduce the learning curve for the user.

5.2.4. MMS Graphical System Diagnostics

MMS provides a graphical view of the entire VPI II system, showing boards with alarms and time-stamped textual diagnostics showing current or historical events. User configurable processing of system commands using Tracker™ style instruction files are easily modified using a COTS editor (such as Notepad). Additional comments can be added to the log through keyboard entry.

MMS offers online troubleshooting help with corrective action. The help is written as standard HTML text that can be easily modified using any COTS HTML editor. Changes can be made using a variety of COTS tools including graphics (any standard COTS format such as JPEG, BMP, and TIFF), trouble shooting charts (such as HTML format), text and links to other HTML text.

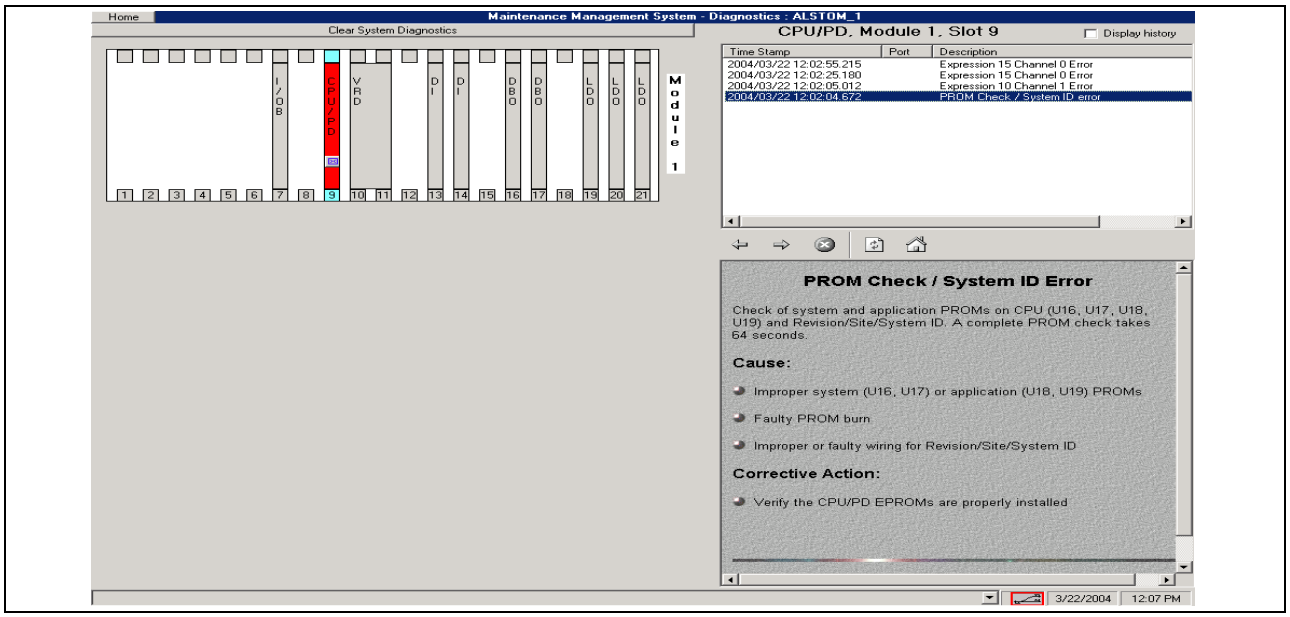

Figure 5–2. MMS Graphical System Diagnostics

5.2.5. MMS Application Explorer

The MMS Application Explorer function provides troubleshooting of the VPI II systems by accessing variable data obtained through the diagnostic ports. The user may view application parameters and multiple logic, message or I/O variables in real time.

Variables are displayed using their assigned names and their current Boolean or integer values. Application logic statements can be displayed including the current state of the variables that comprise them. Variable states can be logged and saved in human-readable text files, and assigned alarms based on variable state changes.

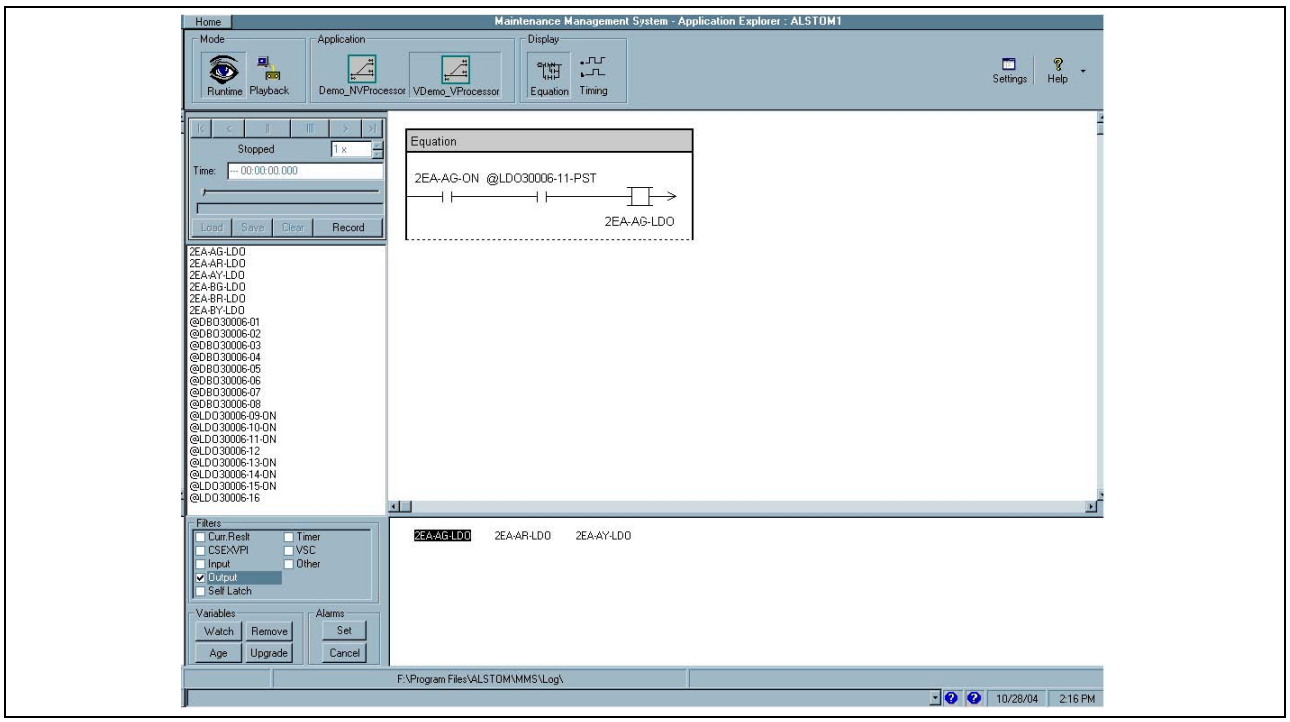

Figure 5–3. MMS Application Explorer (Depicting PLC Ladder Logic Symbols)

5.2.6. MMS Configuration Manager

MMS verifies the software that is installed on the client's VPI II systems, allowing the user confirmation of what is running prior to making changes.

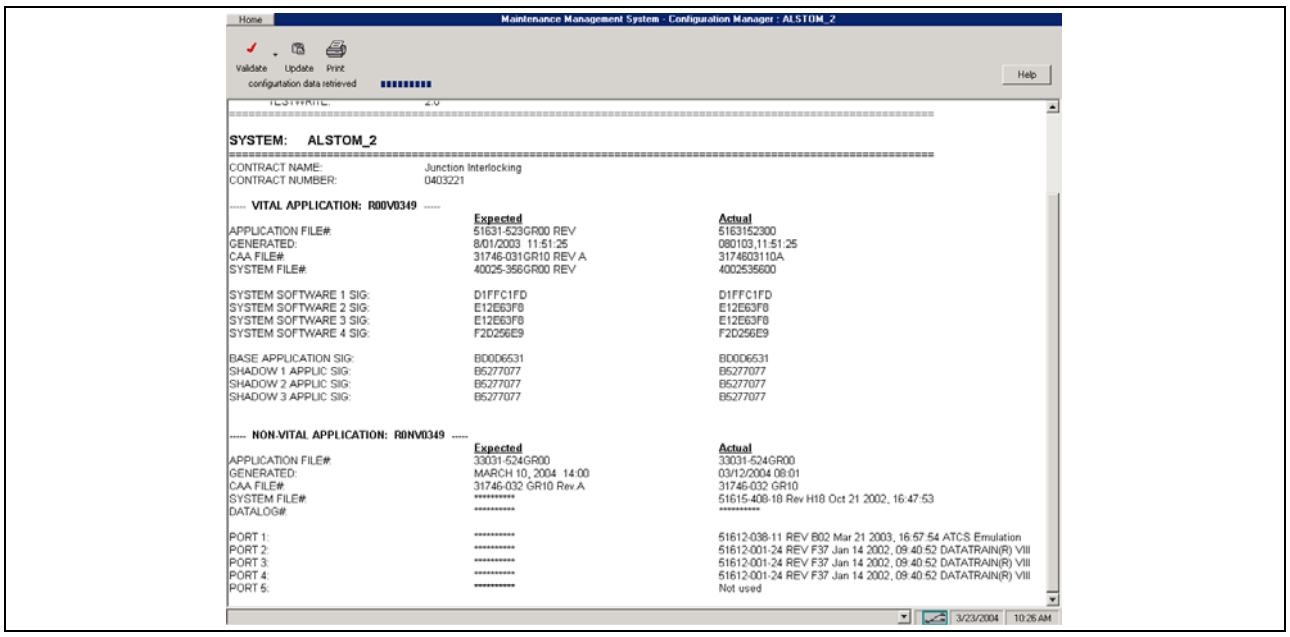

Figure 5–4. MMS Configuration Manager

5.2.7. MMS Task Scheduler

The MMS Task Scheduler function provides a calendar to use to build a “To Do” list of activities allowing a user to control maintenance tasks. By recording maintenance visits by location, future preventative maintenance actions based on time are triggered, reducing maintenance time and expense.

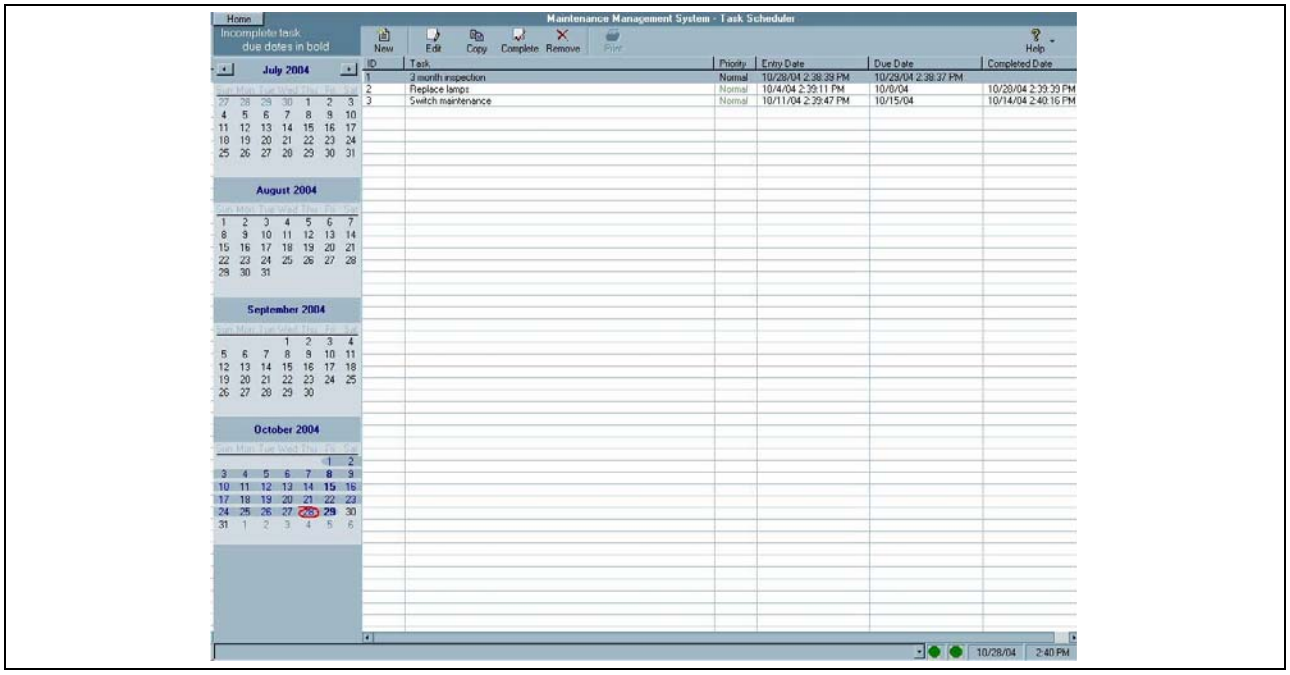

Figure 5–5. MMS Task Scheduler

6. SECTION 6 – BOARD REPLACEMENT

6.1. GENERAL

This section provides board replacement procedures for each of the boards used in the VPI II system.

6.2. SYSTEM BOARDS

Some board types have configuration data that must remain intact if the board is replaced with a spare. In all cases check the front cover label for proper board number and signature. If the board being replaced contains jumpers or switches, make sure they are configured the exact same way on the spare board.

The CPU II, VSC, and CSEX3 boards contain system software and application logic that must be reinstalled on replacement boards and verified by procedures outlined later in this Section. Doing this is essential to restoring proper operation to the VPI II system.

Besides software, other items that require removal from failed circuit boards and reinstallation on replacement boards are: Output Board Signature PROMs (P/N 39780-003-XX), Input Board and I/O Bus Interface (IOB) Board Signature headers (P/N 59473-871-XX), and time selection jumpers for the Vital Timer Board.

CAUTION

Replacement of all system and application EPROMs, Signature PROMs, Signature headers and other ICs should be performed at a static-safe work station, using proper IC removal/insertion tools to eliminate the introduction of static discharge into the device, or bending of device leads.

6.3. SIGNATURE PROM

Each Vital Output board has a 16-pin plug-in PROM. At the time of application design the signature PROM is selected to key the board to a particular module slot. Therefore, whenever a faulty or suspect board is replaced, the same PROM must be installed on the spare board. Both the signature PROM and the signature number for each slot housing a Vital output board are indicated on the module front cover label. This number is shown in the form of "SIG=#", where # is a number 1 to 40. The # and the Signature number are identical. See P2511B, Volume 3, Vital Subsystem, Appendix A for a complete list of Signature PROMs and the associated Alstom part numbers.

6.4. SIGNATURE HEADERS

The IOB Board (P/N 59473-827-XX) and the Vital Input Boards (P/N 59473-867-XX) contain a 36-pin IC Signature Header. There are 16 varieties of this header (Signatures A through P). Each IOB and Vital Input board requires a different header to be established before field installation. The headers are a Vital part of the VPI II system and are used to associate either board type with a specific module slot. These headers are keyed to a module slot, like boards may not be substituted without first installing the correct header. See P2511B, Volume 3, Vital Subsystem, Appendix A for a complete list of Signature Headers and the associated Alstom part numbers.

6.5. FIELD-SETTABLE VITAL TIMER

A part of every Field-Settable Vital Timer board is a sealed time matrix where one to eight time settings can be programmed. When board replacement is necessary, ensure that the time settings on the spare board are identical to those of the board being replaced. The matrix must be then sealed and the label on the front of edge of the timer board must be updated with information regarding the timing functions used in that system. Only after these steps have been taken should the spare timer board be installed in the module.

Verification of the programmed timing functions is performed much the same as with electromechanical (relay) timers and is described later.

6.6. BOARD REPLACEMENT PROCEDURES

Once a faulty board is identified using the procedures described earlier, follow these steps to replace it and to verify proper operation of the new board. While these tests apply to many types of VPI II repairs, they must not be considered as exhaustive procedures applicable to all possible situations. Use them as guidelines to develop tests that are suited to the requirements of your specific installation.

6.7. VITAL BOARD REPLACEMENT

CAUTION

Prior to replacing any board, verify the part number and group number of the replacement board.

CAUTION

When replacing boards in a Vital, electronic system, the user should be guided by the instructions and requirements of the operating agency with regard to any testing that must be performed before placing the altered equipment back in service.

CAUTION

Voltage potentials in the Module could damage printed circuit boards if removed with power applied. Disconnect power from the Module prior to removing boards. Failure to do so could result in damage to the boards.

Boards in the Module contain Electrostatic Discharge (ESD) sensitive components that could be damaged by improper handling. Always ensure boards are transported and stored in static-safe packaging. Before handling any bare board or connecting diagnostic equipment to any board, touch something verified to be grounded and work wearing at least a grounded static-control wrist strap whenever possible. Handle boards only by their edges and do not touch signal traces, leads or output pins on the boards.

6.7.1. CPU II Board (P/N 31166-374-XX)

Table 6–1. CPU II Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	If the replacement board already contains the appropriate system and application Flash, skip to Step 4. Otherwise, install the system and application Flash on the replacement board. Ensure that all switch and jumper settings on the replacement board match the settings of the failed board.
4	Verify that jumper settings on the replacement board are the same as the board being replaced.
5	Install the board, apply system power, and observe the processor messages for errors.
6	If no errors occur, verification of board functionality is complete.
7	Record the system configuration data on the Logic Configuration Log Sheet used during installation especially when using spare software sets. The log sheet is provided in and provided in P2511B, Volume 1, Section 2 (Figure 2–3. Logic Configuration Log Sheet for CPU II Board Assembly).
8	Use a terminal connected to CPU II board and record system configuration data as described in P2511B, Volume 1.
9	Verify that the configuration data matches exactly that recorded when the system was last commissioned for service. **CAUTION** If the data does not match, do not place system in service until the reason for the discrepancy is found and accepted. This may require running the Application Data Verifier (ADV) program and comparing current system documentation to that archived when the system was commissioned for service.
10	Once system and application EPROMs have been verified, return the VPI II system to service. Observe system operation for at least 5 minutes to ensure that all errors have been corrected.
11	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.2. Vital Relay Driver Board (P/N 59473-740-XX)

Table 6–2. VRD Relay Driver Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Ensure rotary switch SW1 on the replacement board is set to position “F.”
4	Install replacement board and apply system power.
5	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.3. Vital Serial Controller Board (P/N 59473-939-XX)

Table 6–3. Vital Serial Controller Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	If the replacement board already contains the appropriate system and application EPROMs, skip to Step 4. Otherwise, remove system and application EPROMs and install on the replacement board. Ensure that all switch and jumper settings on the replacement board match the settings of the failed board.
4	Install replacement board, apply system power and observe VT-100 emulation on CPU II for further errors.
5	If no errors occur, verify board functionality. Observe system operation at both ends of the affected serial link by viewing in CPU II system memory, specific Vital serial link functions using the ‘Q’ (Query) diagnostic command. Exercise the system logic such that you can observe several serial link functions, first getting a permissive and then subsequent restrictive state.
6	Using a VT-100 Emulator connected to CPU II board, record the system configuration data on the Logic Configuration Log Sheet used during installation especially when using spare EPROM sets. The log sheet is provided in P2511B, Volume 1, Section 2 (Figure 2–3. Logic Configuration Log Sheet for CPU II Board Assembly).
7	Verify that the configuration data matches exactly that recorded when the system was last commissioned for service. **CAUTION** If the data does not match, do not place system in service until the reason for the discrepancy is found and accepted. This may require running the application data verifier (ADV) and comparing current system documentation to that archived when the system was commissioned for service.
8	Date and initial configuration data log.
9	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.4. Code Rate Generator Board (P/N 31166-261-XX)

Table 6–4. Code Rate Generator Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Install replacement board, apply system power and observe VT-100 emulation for further errors.
4	If no errors occur, verify board functionality. Exercise the system logic such that each output is energized and then de-energized. Repeat this for all outputs on the board. Observe the system for proper operation by ensuring that the wayside equipment connected to each output is operating properly and matches the associated output indicator.
5	Using a VT-100 Emulator connected to CPU II board, record the system configuration data on the Logic Configuration Log Sheet used during installation. The log sheet is provided in P2511B, Volume 1, Section 2 (Figure 2–3. Logic Configuration Log Sheet for CPU II Board Assembly).
6	Verify that the configuration data matches exactly that recorded when the system was last commissioned for service. **CAUTION** If the data does not match, do not place system in service until the reason for the discrepancy is found and accepted. This may require running the application data verifier (ADV) and comparing current system documentation to that archived when the system was commissioned for service.
7	Date and initial configuration data log.
8	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.5. IOB Board (P/N 59473-827-XX)

Table 6–5. IOB Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Remove Signature header (P/N 59473-871-XX) and install it on the replacement board.
4	Install replacement board, apply system power and observe VT-100 emulation or CPU II for further errors.
5	If no errors occur, verify board functionality. Energize and subsequently de-energize each input and verify the system operates as intended.
6	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.6. Vital Input Boards (P/N 59473-867-XX)

Table 6–6. Vital Input Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Remove Signature header (P/N 59473-871-XX) and install it on the replacement circuit board.
4	Install replacement board, apply system power and observe VT-100 emulation for further errors.
5	If no errors occur, verify board functionality. Energize and subsequently de-energize each input and verify the system operates as intended.
6	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.7. Vital Output Boards (P/N 59473-739-XX, -747-XX, -749-XX, -937-XX, -977-XX)

Table 6–7. Vital Output Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Remove Signature PROM (P/N 39780-003-XX) and install it on the replacement board.
4	Install replacement board, apply system power and observe VT-100 emulation for further errors.
5	If no errors occur, verify board functionality. Exercise the system logic such that each output is energized and then de-energized. Repeat this for all outputs on the board. Observe the system for proper operation by ensuring that the wayside equipment connected to each output is operating properly and matches the associated output indicator.
6	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.8. Vital LDO2 Output Board (P/N 31166-340-XX)

Table 6–8. Vital LDO2 Output Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Configure the switches to select the appropriate AOCD PROM Group and to select the Low Current Threshold on the replacement board.
4	Install replacement board, apply system power and observe VT-100 emulation for further errors.
5	If no errors occur, verify board functionality. Exercise the system logic such that each output is energized and then de-energized. Repeat this for all outputs on the board. Observe the system for proper operation by ensuring that the wayside equipment connected to each output is operating properly and matches the associated output indicator.
6	Return VPI II system to service and record maintenance performed in the Service Log.

6.7.9. Field-Settable Vital Timer Board (P/N 59473-894-XX)

Table 6–9. Field-Settable Vital Timer Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Configure time settings on replacement timer board as required. See the timer setting examples in P2511B, Volume 3, Vital Subsystem, Figure 10–1. FSVT Board Timer Setting Examples.
3	Remove failed board and verify time settings match those of the spare board.
4	Install replacement board.
5	Using separate time reference (stop watch, etc.), verify that each time function executes the time selected. Date and initial label on the timer board.
6	Return VPI II system to service and record maintenance performed in the Service Log.

6.8. NON-VITAL BOARD REPLACEMENT

CAUTION

Prior to replacing any board, verify the part number and group number of the replacement board.

CAUTION

When replacing boards in a Vital, electronic system, the user should be guided by the instructions and requirements of the operating agency with regard to any testing that must be performed before placing the altered equipment back in service.

CAUTION

Voltage potentials in the Module could damage printed circuit boards if removed with power applied. Disconnect power from the Module prior to removing boards. Failure to do so could result in damage to the boards.

Boards in the Module contain Electrostatic Discharge (ESD) sensitive components that could be damaged by improper handling. Always ensure boards are transported and stored in static-safe packaging. Before handling any bare board or connecting diagnostic equipment to any board, touch something verified to be grounded and work wearing at least a grounded static-control wrist strap whenever possible. Handle boards only by their edges and do not touch signal traces, leads or output pins on the boards.

6.8.1. Code System Emulator Extended 3 – CSEX3 (P/N 31166-175-XX)

Table 6–9. CSEX3 Board Replacement Procedure

Step	Procedure
1	Remove system power and communications power.
2	Remove failed board.
3	If the replacement board already contains the appropriate system and application EPROMs, skip to Step 4. Otherwise, remove system and application EPROMs and install on the replacement board.
4	Make sure jumper settings on replacement board are correct.
5	Install replacement board.
6	Verify board functionality by exercising local and remote control operations, non-vital logic operation and/or non-vital field indications and communication (all where applicable).
7	Return VPI II system to service and record maintenance performed in the Service Log.

6.8.2. Non-Vital Input Boards (P/N 59473-757-XX)

Table 6–10. Non-Vital Input Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove failed board.
3	Install replacement board.
4	Return VPI II system to service and record maintenance performed in the Service Log.

6.8.3. Non-Vital Input Differential Switch Board (P/N 31166-276-XX)

Table 6–11. Non-Vital Input Differential Switch Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove failed board.
3	Install replacement board.
4	Set input switch as required.
5	Return VPI II system to service and record maintenance performed in the Service Log.

6.8.4. Non-Vital Output Boards (P/N 59473-785-XX, -936-XX and P/N 31166-123-XX)

Table 6–12. Non-Vital Output Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove failed board.
3	Install replacement board.
4	Return VPI II system to service and record maintenance performed in the Service Log.

6.8.5. Non-Vital Output Relay Board (P/N 31166-238-XX)

Table 6–13. Non-Vital Output Relay Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove failed board.
3	Install replacement board.
4	Return VPI II system to service and record maintenance performed in the Service Log.

6.8.6. Non-Vital TWC Frequency Shift Keying Board (P/N 31166-119-XX)

Table 6–14. Non-Vital TWC Frequency Shift Keying Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove failed board.
3	Install replacement board.
4	Return VPI II system to service and record maintenance performed in the Service Log.

7. SECTION 7 – VPI II VITAL BOARD VERIFICATION

7.1. GENERAL

This Section covers verification testing of Vital input and output boards.

7.2. INTRODUCTION

The procedures provided in the Section indicate that the ports should be verified by testing the function controlled by the input or output. The technician must be familiar with the operation of the related portion of the system. The technician identifies a specific input or output device, then “exercises” the board to verify that it is properly interfaced with the VPI II system by noting that the expected response occurs. Specific examples of each possible verification scenario are not provided, as the number of possible combinations is too large to be useful.

7.3. IOB BOARD

Follow Table 7–1 to test that the IOB Board communicates to I/O boards.

Table 7–1. IOB Board Functionality Test Procedure

Step	Procedure
1	Using the functionality test procedure for a Vital Input Board, verify one port of each Input Board controlled by the IOB Board.
2	Using the functionality test procedure for a Vital Output Board, verify one port of each Output Board controlled by the IOB Board.

7.4. VITAL INPUT BOARDS

Follow Table 7–2 to test each input port.

Table 7–2. Vital Input Board Functionality Test Procedure

Step	Procedure
1	Using VPI Module Label or VPI Output Report LVC, note the functions assigned to each input. For example: VRDFRNT-DI; input from VRD relay, NWP-DI; input from switch machine.
2	Using Book of Plans, note the required input condition for each of the listed functions.
3	Enable then disable each input, noting the functional response to the input status change.

7.5. VITAL OUTPUT BOARDS

Follow Table 7–3 to test each output port.

Table 7–3. Vital Output Board Functionality Test Procedure

Step	Procedure
1	Using VPI Module Label or VPI Output Report LVC, note the functions assigned to each output. For example: NW-DBO; output to switch machine, GO-SBO; output to AF module Go circuit.
2	Using Book of Plans, note the apparatus connected to each of the listed functions.
3	By initiating the appropriate request, enable then disable each output, noting the response of the apparatus to the output status change.

7.6. FIELD-SETTABLE VITAL TIMER BOARD

Follow Table 7–4 to test each timer.

Table 7–4. Field-Settable Vital Timer Board Functionality Test Procedure

Step	Procedure
1	Using VPI Module Label or VPI Output Report LVC, note the route approach locking function that is assigned to each timer.
2	Select the route.
3	Cancel selected route.
4	Start stopwatch when LED for timer begins to blink; stop timing when light ceases to blink.
5	Verify time matches jumper setting.
6	Write time setting on timer board.
7	Perform steps 2 through 6 for each timer.

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A. APPENDIX A – CRG APPLICATION GUIDELINES

A.1. GENERAL

This section explains the CRG application guidelines.

A.2. INTRODUCTION

The VPI Code Rate Generator (CRG) Board, 31166-261-XX, is a Vital output board developed for use in a VPI system. CRG outputs (ports) are requested by the CPU II board via direct Vital serial communications rather than through the motherboard and I/O Bus. CRG responds back to the CPU II board with port status indications and port recheck data. The CPU II board can communicate with a maximum of three CRG boards to produce cab code rates from within the VPI system. Each CRG board contains eight Vital outputs. Each output on the Group 3 CRG boards is used to interface to a solid state relay load. The Group 4 CRG board is used to interface to a Vital Code Following Relay. The CAAPE is used to configure the CRG boards within the system and to define the application parameters.

The port status indications from CRG are non-vital and indicate whether the CRG outputs have been commanded to generate the code rates as requested by the CPU II board application logic. The port status indication is true if the CRG is able to properly decode the code rate request from the CPU II board and the application logic has requested only one valid rate that is supported by the CRG.

Power to the CRG outputs is controlled by the VPI resident VRD. CRG generates port recheck data via AOCD and transmits the result to the CPU II board every 250 milliseconds. The CPU II board uses this information in the formation of recheck checkwords for VRD. If the CRG fails to generate the proper data, VRD de-energizes thus turning off all Vital outputs.

A.3. APPLICATION PARAMETERS

The CAAPE is used to configure the control and indication parameters for CRG application. The parameters for turning on the CRG outputs are defined in Table A–1. Each of the eight outputs is assigned ten parameters according to these definitions (ppm denotes pulses per minute).

Table A–1. CPU II to CRG Parameters

Parameter Number	CRG GR. 3	CRG GR. 4
1	0	0
2	50 ppm	50 ppm
3	75 ppm	75 ppm
4	120 ppm	120 ppm
5	180 ppm	180 ppm
6	spare	270 ppm
7	spare	420 ppm
8	spare	ON
9	spare	spare
10	spare	spare

The port status parameters from CRG are defined in Table A–2. For each CRG board, there are eight parameters assigned according to these definitions.

Table A–2. CRG to CPU II Parameters

Parameter Number	Definition
1	Port 1 status
2	Port 2 status
3	Port 3 status
4	Port 4 status
5	Port 5 status
6	Port 6 status
7	Port 7 status
8	Port 8 status

A.4. INSTALLATION AND OPERATION

The CRG board may be placed in any slot of any module, of the VPI system, that is not on the P1 system bus. The CRG P1 connector provides the multidrop 4-wire communications with the CPU II board and provides the board identification (board ID) wire jumpers. The board ID jumpers are assigned by the VPI CAA and are listed in the compiler-generated LVC report under the board report (shown as address wiring) and wire table sections.

Application Engineering assigned cable numbers 55816-065-01 or 55816-065-02 as the cable between the CRG board and the CPU II board. This cable provides for the communications and the wire jumpers; however, it can restrict the placement of the CRG board within the system. The CRG P2 connector provides +5V and 5VCOM to the board. The CRG P3 connector provides the eight 2-wire outputs and the Vital power input. Application Engineering assigned cable number 55816-064-81. The required Vital power is +8V to +16V through a front contact of the VPI VRD relay, or a repeater. This allows VPI to shut off the CRG outputs due to failure. VPI requires correct validation of CRG outputs, as well as all other VPI Vital outputs, in order to energize VRD.

A.5. DISPLAYS AND DIAGNOSTICS

Figure A–1 shows the front edge of the CRG board. Included are two 7-segment displays. During normal operation, the top display indicates the port number, 1 through 8, (selected from the on-board rocker switch) and the bottom display indicates the requested code rate. The code rate consists of a dash (-) and three code rate digits, scrolling at a 1-second rate. The dash indicates the start of the code rate display. Additional displays are provided in Table A–3.

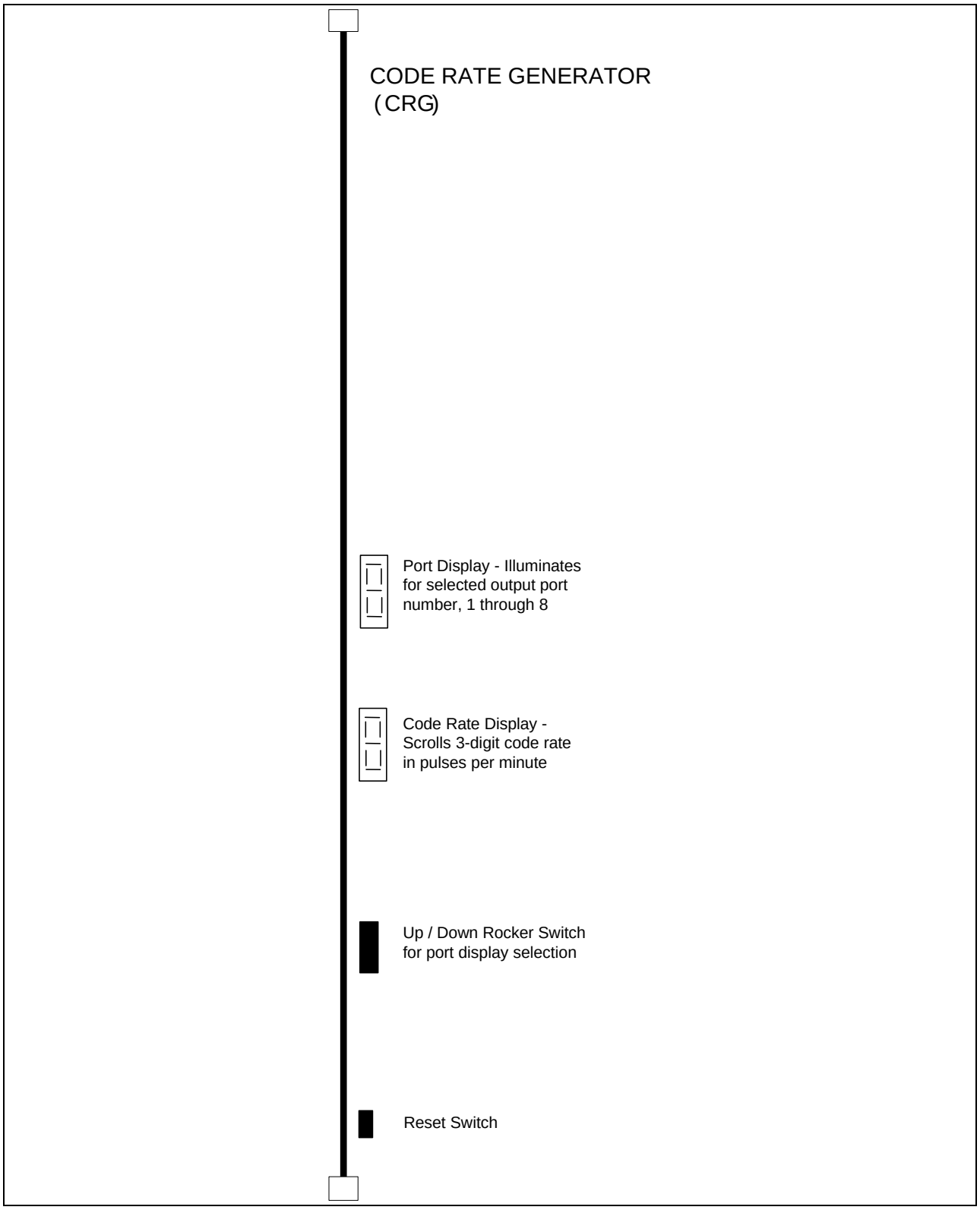


Figure A–1. CRG Board LED Indications

Table A–3. CRG Board Displays

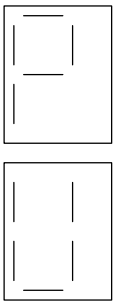
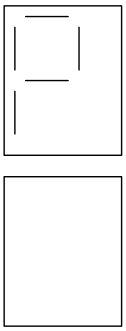
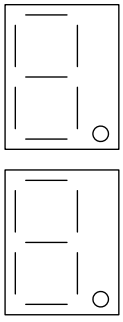
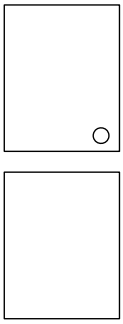
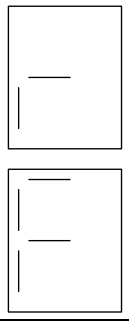
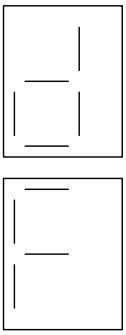
Display	Indication
	The display of 'P'/'U' (power-up) indicates CRG is awaiting program verification from the CPU II board. This occurs during start-up for initialization. Each CRG output defaults to 0-ppm code rate. This display also indicates code rate command messages are received from CPU II, serial communications are active.
	The display of 'P'/blank indicates the program verification is not valid. This may result from any of these conditions: • The software resident on the CPU II board (U16, U17, U18, U19) and CRG (U23) are not compatible. One, or both, may be the improper version. The VRD may energize. • The software resident on the CRG (U23, U13, U19) are not compatible. Any may be the improper version. The VRD does not energize. • The CRG board ID is not configured properly. • This display also indicates code rate command messages are received from the CPU II board, serial communications are active. However, the code rate data is invalid. Each CRG output defaults to 0-ppm code rate.
	The display of 8./8. indicates the CRG board has undergone a reset. The display continuously flashes under any of these conditions: • The watchdog jumper TB10 is not connected • The User Interface FPGA U25 is not programmed • The system software device U23 is not programmed.

Table A–3. CRG Board Displays (Cont.)

Display	Indication
	The display of '.'/blank indicates the CRG board is running, but there is no recheck communication between the CPU II board and CRG. Each CRG output defaults to 0-ppm code rate. This may result from any of these conditions: • The CPU II board is reset. • Improper serial communication cable connection between the CPU II and CRG boards. • If information is not shown, verify the Tx and Rx LED operation of the CPU II board. • If the CPU II board is running, verify the CRG data in the CPU II Report is correct. Verify the system software version on the CPU II board (U42, U43) is the same as that expected by the VPI compiler and application (U40, U41). The CPU II board diagnostic may show a 'MAIN CWD #0F' error message if the software versions are not compatible. VRD is de-energized.
	The display of r/F indicates a failure during the CRG RAM test at power-up. Diagnostic messages are posted to the terminal to indicate the failure mode.
	The display of d/F indicates a failure during the CRG Polynomial Divider test at power-up. Diagnostic messages are posted to the terminal to indicate the failure mode.

A VT100 configured at 9600 baud, 8 data bits, 1 stop bit, no parity may be connected to the CRG MAC port. The CRG indicates board configuration during start-up. There are also diagnostic commands that can be entered for software report, board ID and jumper assignments. The available commands are shown in Table A–4.

Table A–4. CRG MAC Port Commands

Command	Definition
DCR	Display Code Rates - Displays the code rate transmitted by each port. This information is updated once per second if valid code rate command messages are received from the CPU II board. The displayed rates for a port is zero under any of these conditions: • Zero rate is requested from the CPU II board • More than one rate (for a port) is requested from the CPU II board • A non-supported rate (spare) is requested from the CPU II board • CRG is unable to decode a valid rate. This may be due to incompatible software versions between CRG and the CPU II boards. The 7-segment displays should show 'P'/blank.
DID	Display ID - Displays the board ID and jumper configuration read by the CRG board
MEM	Memory Monitor - Allows the query of internal RAM buffers
RPT	Configuration Report - Displays board resident software revision
?	Command Summary - Displays a list of the available diagnostic commands

The CPU II board report includes records for the software revision of each CRG board configured in the system. This information is the same information displayed using the CRG configuration report command and is transmitted to the CPU II board during start-up.

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