



iVPI



Integrated
Vital Processor
Interlocking Control
System

Maintenance and
Troubleshooting

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Maintenance and Troubleshooting Manual
P2521B, Volume 5



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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 Integrated Vital Processor Interlocking Control System, (iVPI). 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 iVPI System.

Section 2 – TROUBLESHOOTING: This section provides troubleshooting flowcharts for the iVPI System.

Section 3 – DESIGN, TEST AND VALIDATION TOOLS: This section describes the available design, test and validation tools for the iVPI System.

Section 4 – SYSTEM DIAGNOSTICS: This section describes the available system diagnostics on the iVPI System.

Section 5 – BOARD REPLACEMENT: This section provides board replacement procedures for each of the boards used in the iVPI System.

Section 6 – VITAL BOARD VERIFICATION: This section provides procedures for verification of iVPI System Vital board functions.

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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 iVPI system.

WARNING

DISRUPTION OF IVPI OPERATION 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 iVPI 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 iVPI system; including capacity guidelines and allowable board combinations, system operation, and theory of operation.
- Volume 2, Subrack Configuration, describes the subrack configuration including cables and power supplies.
- Volume 3, Vital Subsystem, includes the Vital subsystem board drawings 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 iVPI 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 iVPI 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.

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 iVPI 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 the circuit boards include LED indicators visible from the front of the subrack 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 iVPI 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 iVPI 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.

Check the power supply input to the iVPI power isolation unit for 9-16 VDC. Check the output of the power isolation unit for 9-14 VDC. This voltage check should be made on the test points of the power isolation unit on the back of the system subrack.

Use a PC running VT-100 terminal emulation software and a VSP board 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 board LED status indicators for expected signals (refer to "Troubleshooting with LED's" later in this volume).

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 are in their respective slots.
- Input power to the VSP board is between 8.0 and 14.0 volts.
- Energizing the VRD Relay causes voltage between 9.0 to 16.0 volts to be applied to the "VRDFNT-DI" designated Vital input (if configured).

1.7. SYSTEM TERMS

The iVPI System is modular in design, implemented in one or more Subracks with a set of plug-in eurocard style printed circuit boards applied in varying quantities to meet the needs of specific applications.

The terminology used to define the Subrack and its components is as follows:

- A Subrack is a Chassis with Motherboard
- A System is one or more Subracks filled with the appropriate boards for the application
- When a System is configured with more than one Subrack populated with boards, the individual populated Subracks are Subsystems

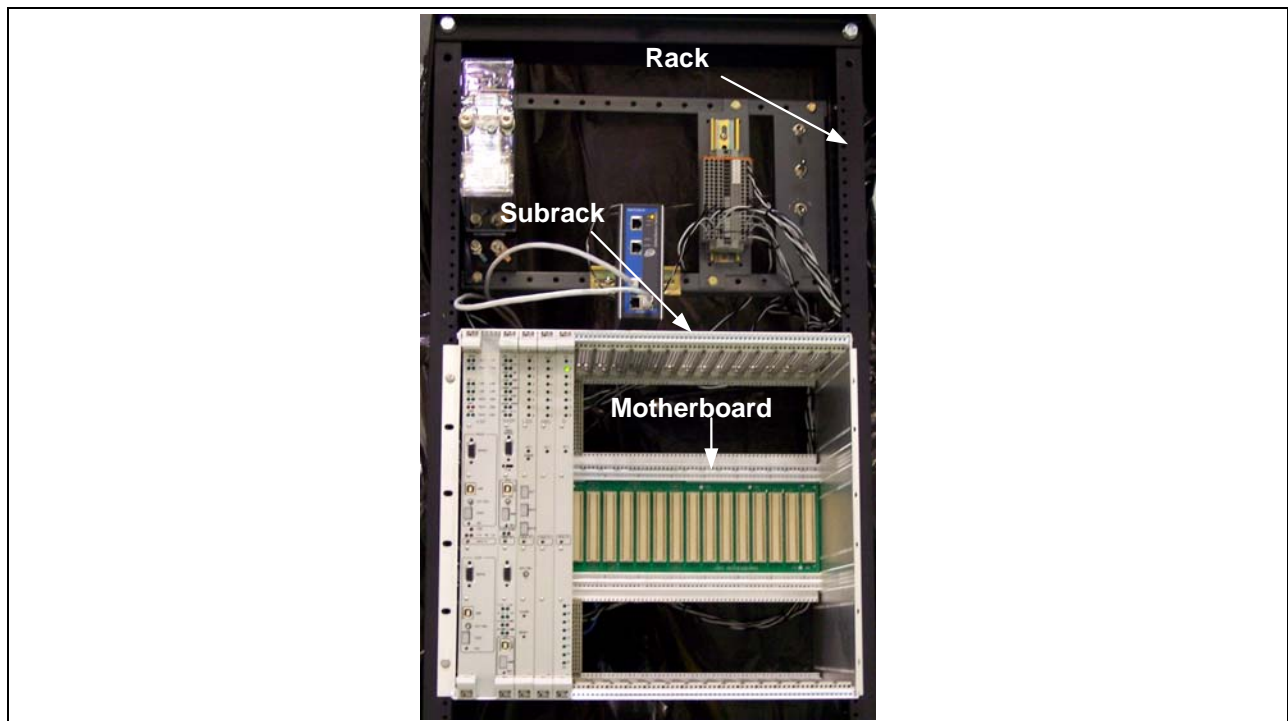


Figure 1–1. iVPI Rack and Subrack

2. SECTION 2 – TROUBLESHOOTING

2.1. GENERAL

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

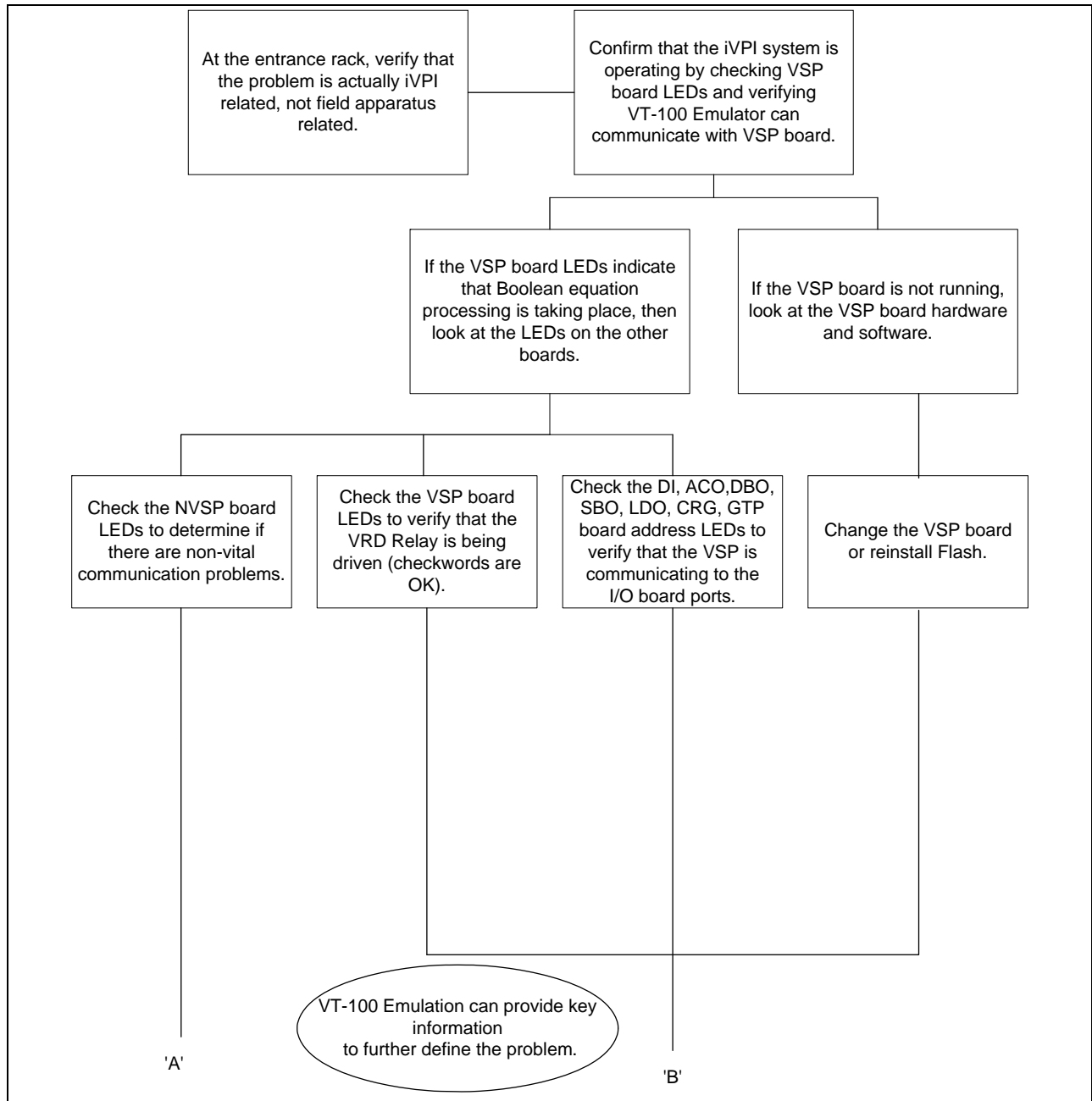


Figure 2–1. General Diagnostic Flowchart (sheet 1 of 3)

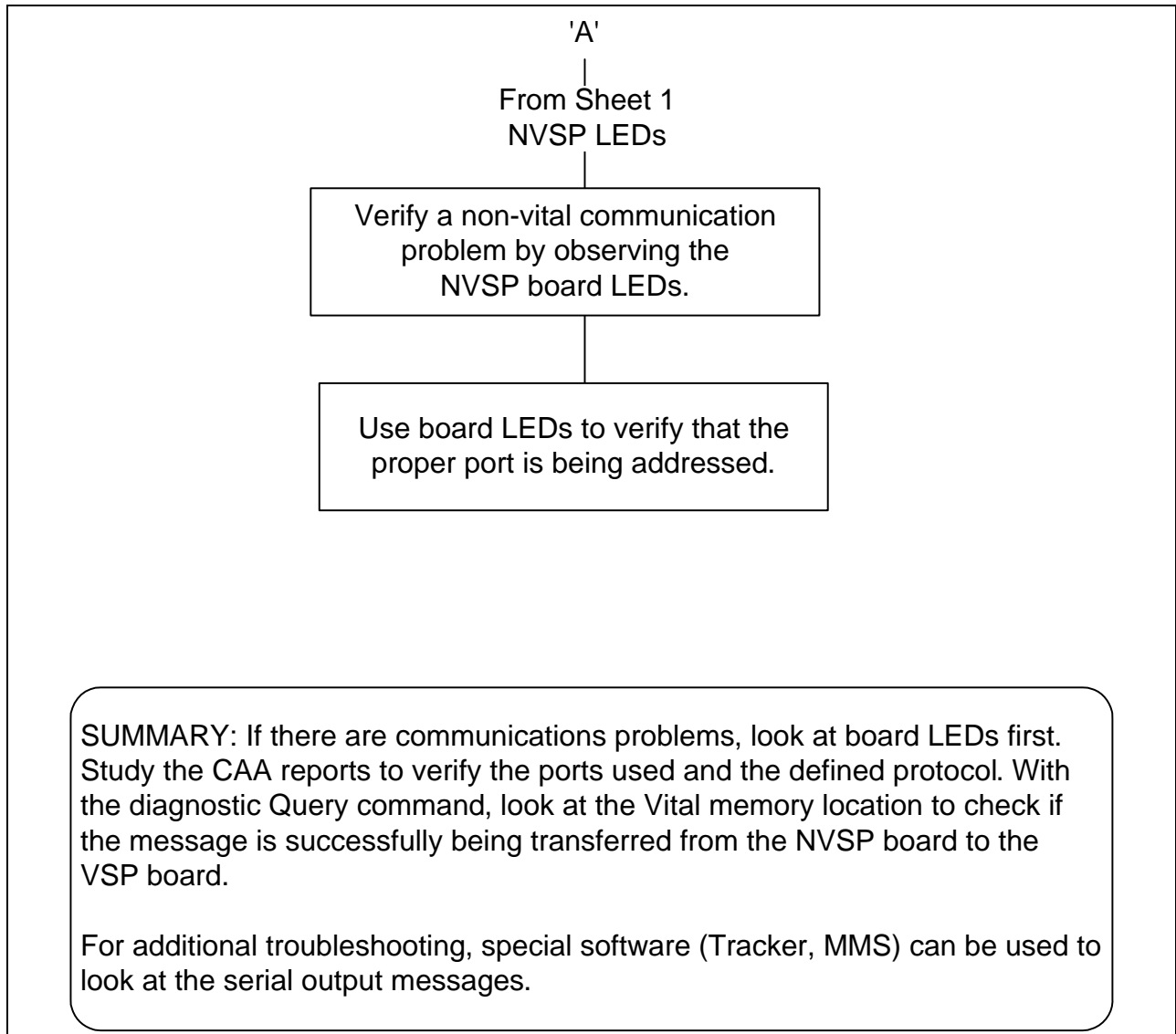


Figure 2–1. General Diagnostic Flowchart (sheet 2 of 3)

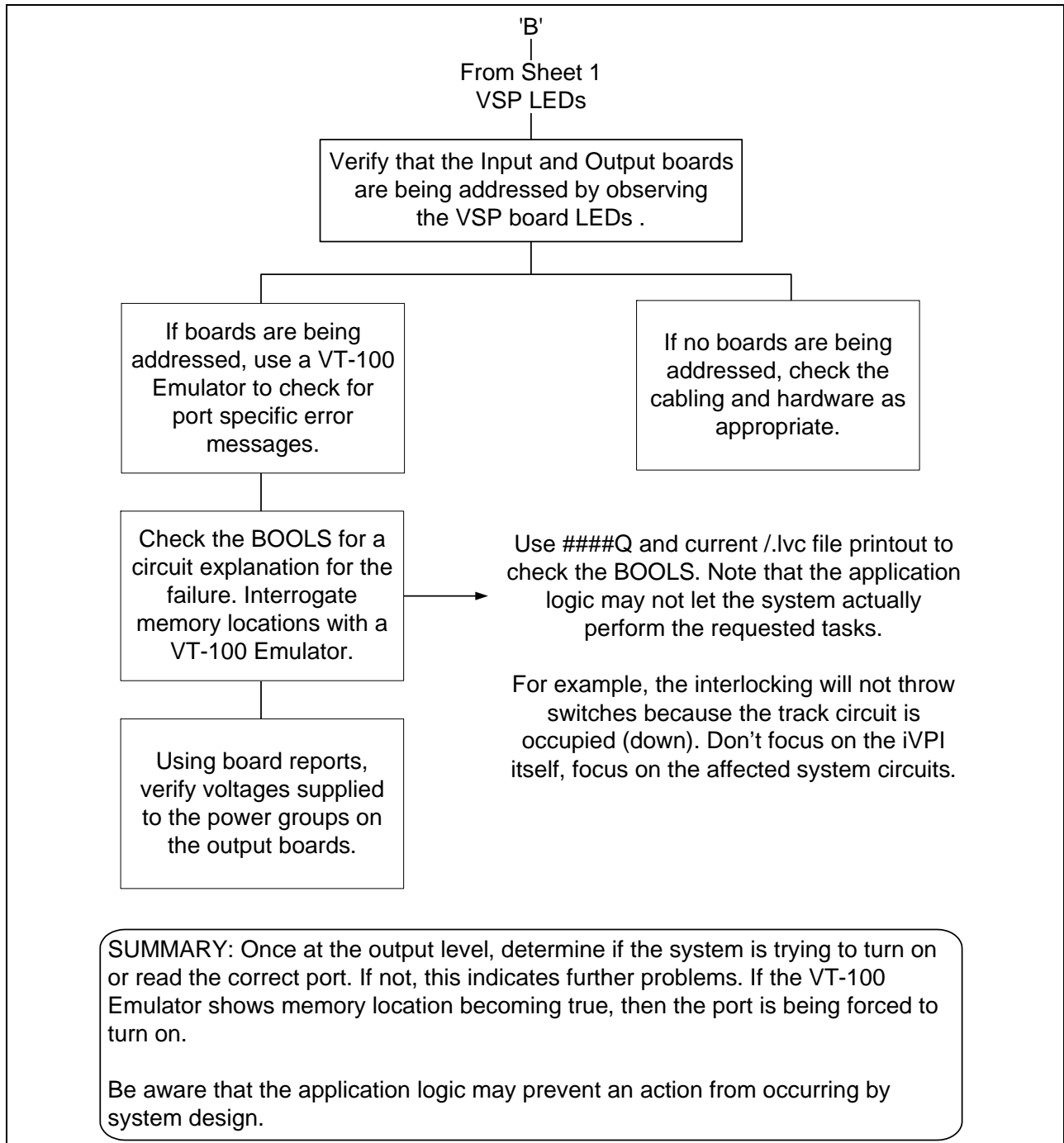


Figure 2–1. General Diagnostic Flowchart (sheet 3 of 3)

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3. SECTION 3 – DESIGN, TEST AND VALIDATION TOOLS

3.1. GENERAL

This section describes the design and validation tools available for the iVPI system.

3.2. INTRODUCTION

The Vital system performs all Vital logic associated with interlocking control (switch control, locking, and signal control). At the user's option, this logic can be written in the form of Boolean equations or drawn as relay circuits in AREMA Drop-Line format, AREMA Straight Line format or as commercial PLC format that emulate traditional relay logic. No special programming language is used in the application thus allowing the source file(s) to be easily understood by a signal engineer.

After the Boolean equations or relay diagrams have been created by the Signal Engineer, the Computer Aided Application (CAA) software package is used to compile the equations into machine readable code for installation and verification on the application FLASH EPROM to be installed on the appropriate System's VSP board.

The non-vital system performs similar functions on all non-vital logic associated with interlocking control (switch position requests, signal clear requests, Local Control interface, communications to the OCC, local data logging).

Through the use of AlsDload, the VSP and NVSP applications can be programmed without removing the FLASH EPROM.

Table 3–1. Design Validation Tool Part Numbers

Description	Part Number
CAAPE CD-ROM	31754-008-GR.
Maintenance Management System (MMS) CD-ROM	51795-063
Relay Equivalent Drawing Package (REDP)	

3.3. APPLICATION DEVELOPMENT TOOL

The Computer-Aided Application Programming Environment (CAAPE) is a comprehensive set of development tools for creating iVPI Vital and non-vital applications. These tools are integrated together within a Windows based development environment for easy access.

The CAAPE package is intended for use by Alstom signal engineers, by railroad and transit signal engineers, and by third party signal engineering consultants. The iVPI CAAPE toolset is built on the same stable foundation that has become an industry-accepted favorite, and is backward compatible to all previous versions.

The top-level CAAPE program provides access to available tools and manages application data through the use of projects. A project is a collection of files describing one or more applications. Some of these files, such as report and prom files are meant to be directly accessible by the user; others are for internal use and are readable only by CAAPE. Typically, a CAAPE project describes all the applications in a particular iVPI System.

All the files for a given project are contained in a single directory. A single main project file acts as a directory to the rest of the files in the project and specifies the CAAPE options selected by the user for the project. When the CAAPE opens a project it reads the main file to determine the full list of files and options in the project. Tools to assist in software configuration control are included within the CAAPE package.

The lower-level tools such as compilers and application data verifiers, which are tied to a particular version of iVPI system software, comprise a CAA package. The CAAPE can provide access to the tools in multiple CAA packages (Windows versions only). The user can select which set of compiler and data verifier tools to use for a particular application by selecting a specific compiler version based on which version of Vital system software is used. This allows support of older versions of the VPI product line as well as newer versions in the same development environment.

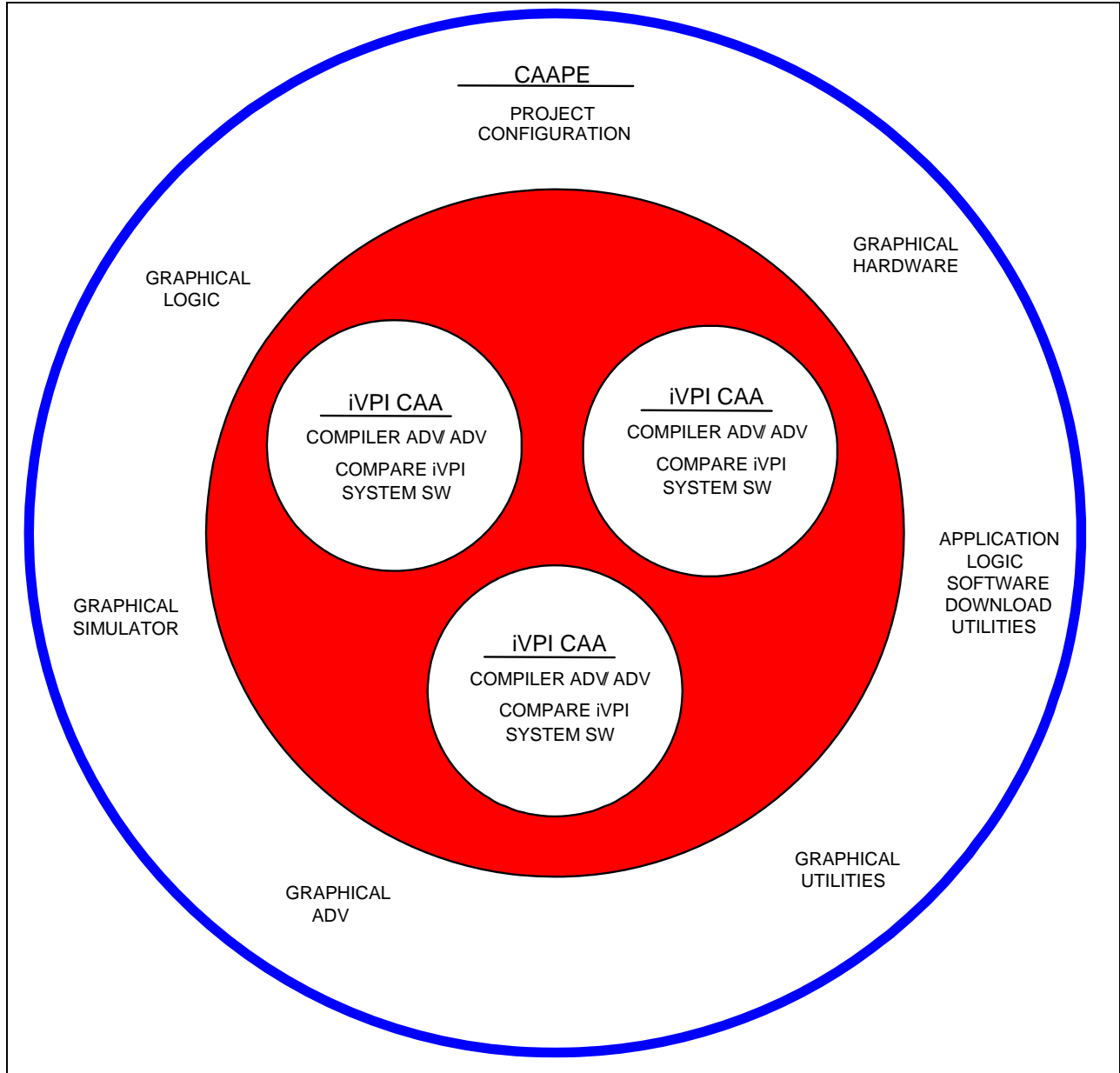


Figure 3-1. iVPI / VPI CAAPE/CAA Typical Arrangement

3.3.1. AlsDload

AlsDload is a tool for programming application and system software on VPI, WIU, iVPI, and PGK boards.

AlsDload provides the following capabilities:

- Download of application and/or system software from files on the PC to the programmable memory on the board
- Upload of application and/or system software from the programmable memory on the board to files on the PC
- Verification that board configuration data is identical to that in selected files
- Access to board diagnostics
- Basic VT100 terminal emulation

3.4. MAINTENANCE MANAGEMENT SYSTEM (MMS)

The Maintenance Management System (MMS) is an Alstom diagnostic tool that can remotely monitor each iVPI 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 composed of Commercial Off The Shelf (COTS) components, which the end-user has access to in order to modify and customize the system to his needs.

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

3.4.1. 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.

3.4.2. 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.

3.4.3. 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.

3.4.4. MMS Graphical System Diagnostics

MMS provides a graphical view of the entire iVPI 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.

3.4.5. MMS Application Explorer

The MMS Application Explorer function provides troubleshooting of the iVPI 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.

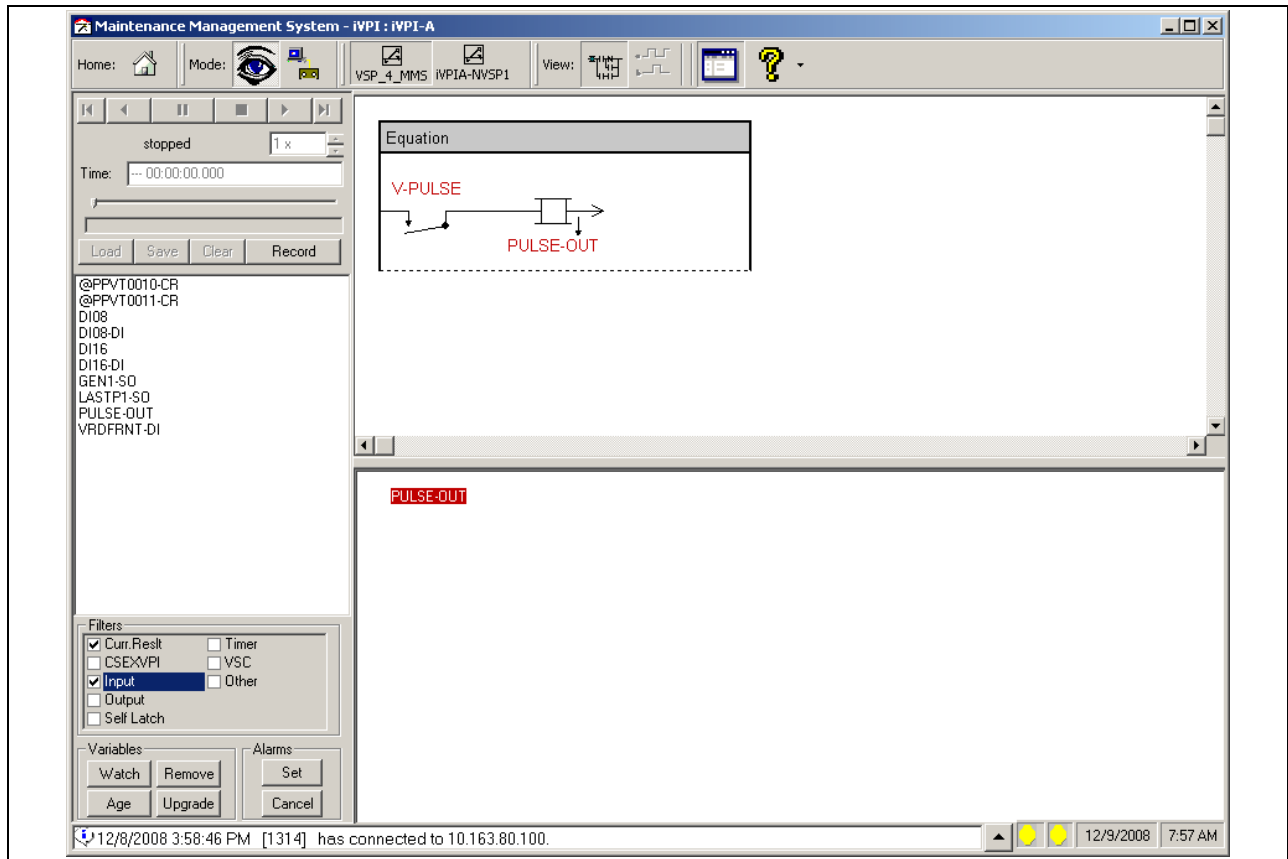


Figure 3–2. MMS Application Explorer (Depicting PLC Ladder Logic Symbols)

3.4.6. MMS Configuration Manager

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

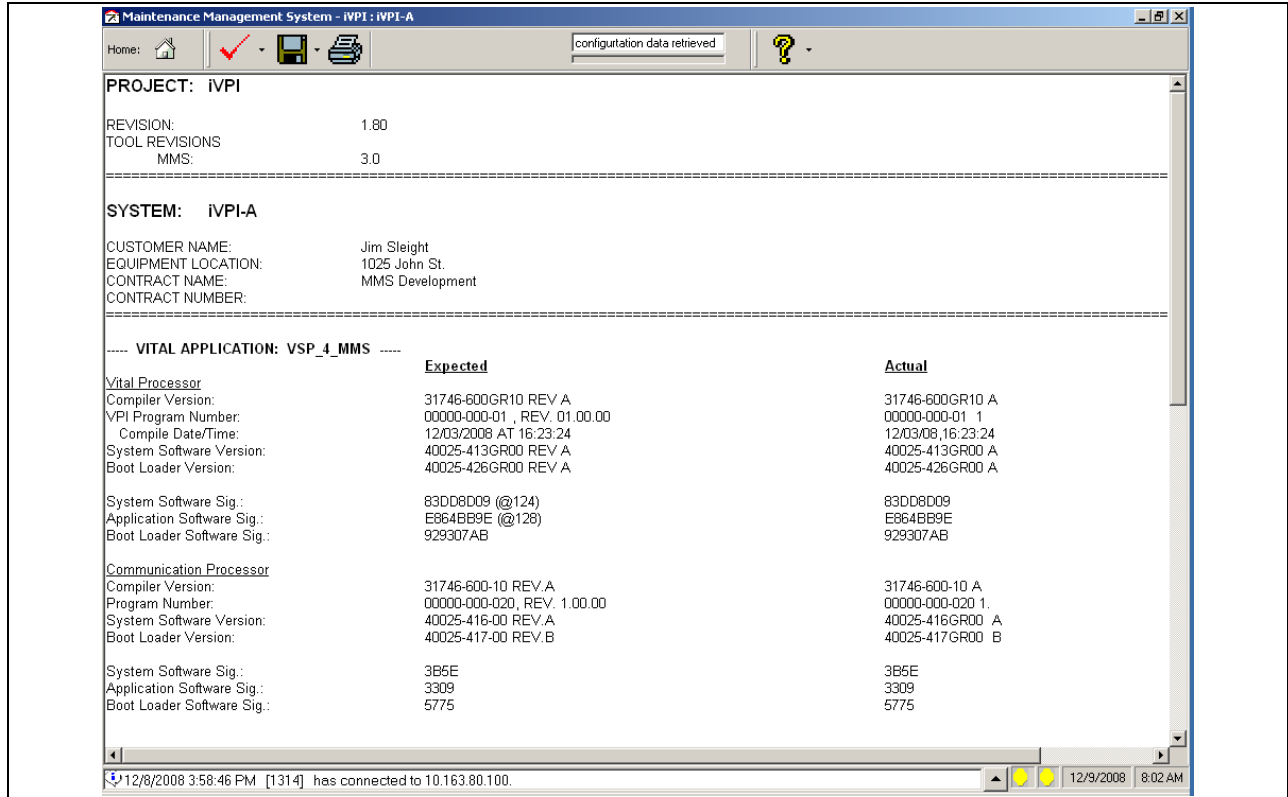


Figure 3–3. MMS Configuration Manager

3.4.7. Communication Explorer – VT 100 Screen

The Communication Explorer - VT100 screen provides a VT100 terminal emulation with macro and capture capabilities.

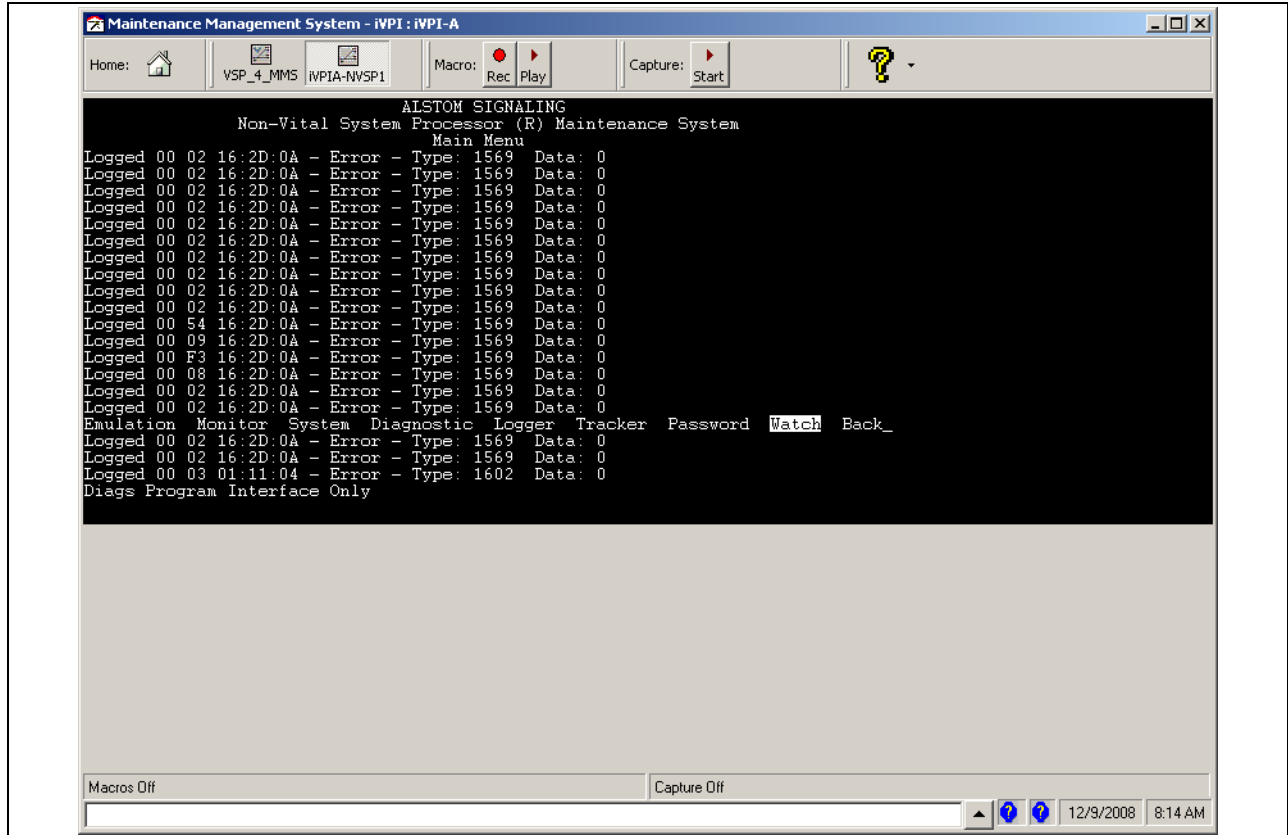


Figure 3–4. MMS Runtime, Communication Explorer – VT100 Screen

3.5. EMBEDDED DATALOGGER

A feature provided by the non-vital Subsystem, the embedded data logger permits viewing of time stamped events in log form or in near real-time chart recorder form. Multiple views are provided.

Key features are:

- View Events Historical, Real-Time
- Filters Unwanted Info
- Saves Data In Nonvolatile Memory
- Timeline and Timestamp Views
- Record time-stamped events to on-board battery-backed memory
- Event capacity is typically several days
- Automatically detect a change to a large number of user-specified application parameters, and record when changes occur in real-time
- On-line help is available to assist the operator

4. SECTION 4 – SYSTEM DIAGNOSTICS

4.1. GENERAL

This section discusses the system diagnostics available on the iVPI system, including:

- Troubleshooting with Board LEDs
- Vital subsystem diagnostics with VT-100 Emulation with the VSP board
- Non-vital system diagnostics with the NVSP Board

4.2. TROUBLESHOOTING WITH LEDS AND DIAGNOSTIC DISPLAYS

All iVPI boards contain a HEALTH LED that displays in three possible colors to indicate board health

- Green = Board OK
- Yellow = Board Warning
- Red = Board Error

For all iVPI boards:

- If the HEALTH LED is yellow or red, use System Diagnostics to determine the specific error or warning.
- If no LEDs are lit, verify both the system and the board have power.
- If the LED status never changes, verify communication ports.

Board illustrations along with descriptions of how to use the information on board edges for troubleshooting are provided in Figures 4–1 through 4–8 for Vital boards and Figures 4–9 through 4–11 for non-vital boards.

4.2.1. Vital Board LEDs

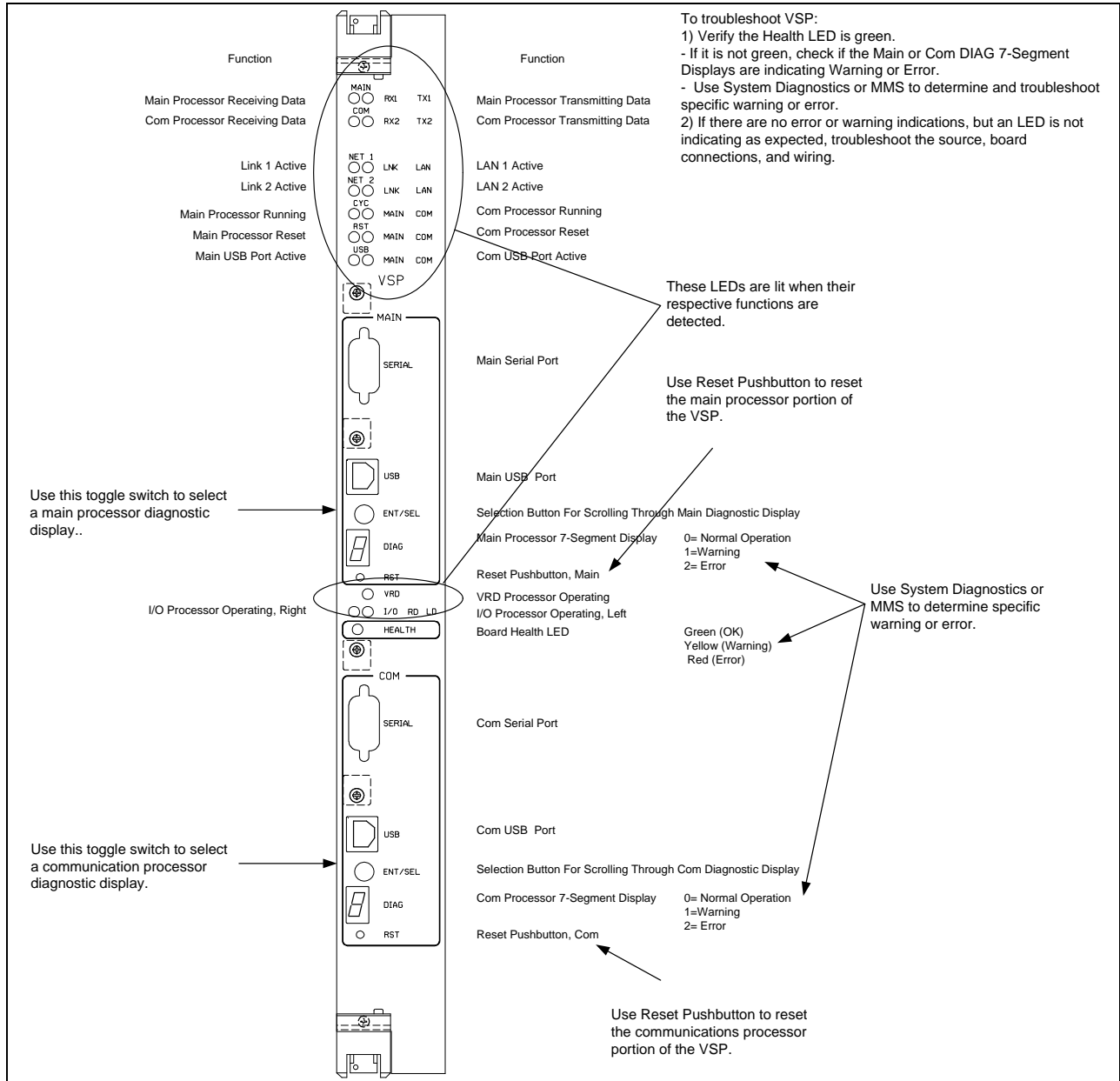


Figure 4–1. VSP Board Troubleshooting Using Board Indications

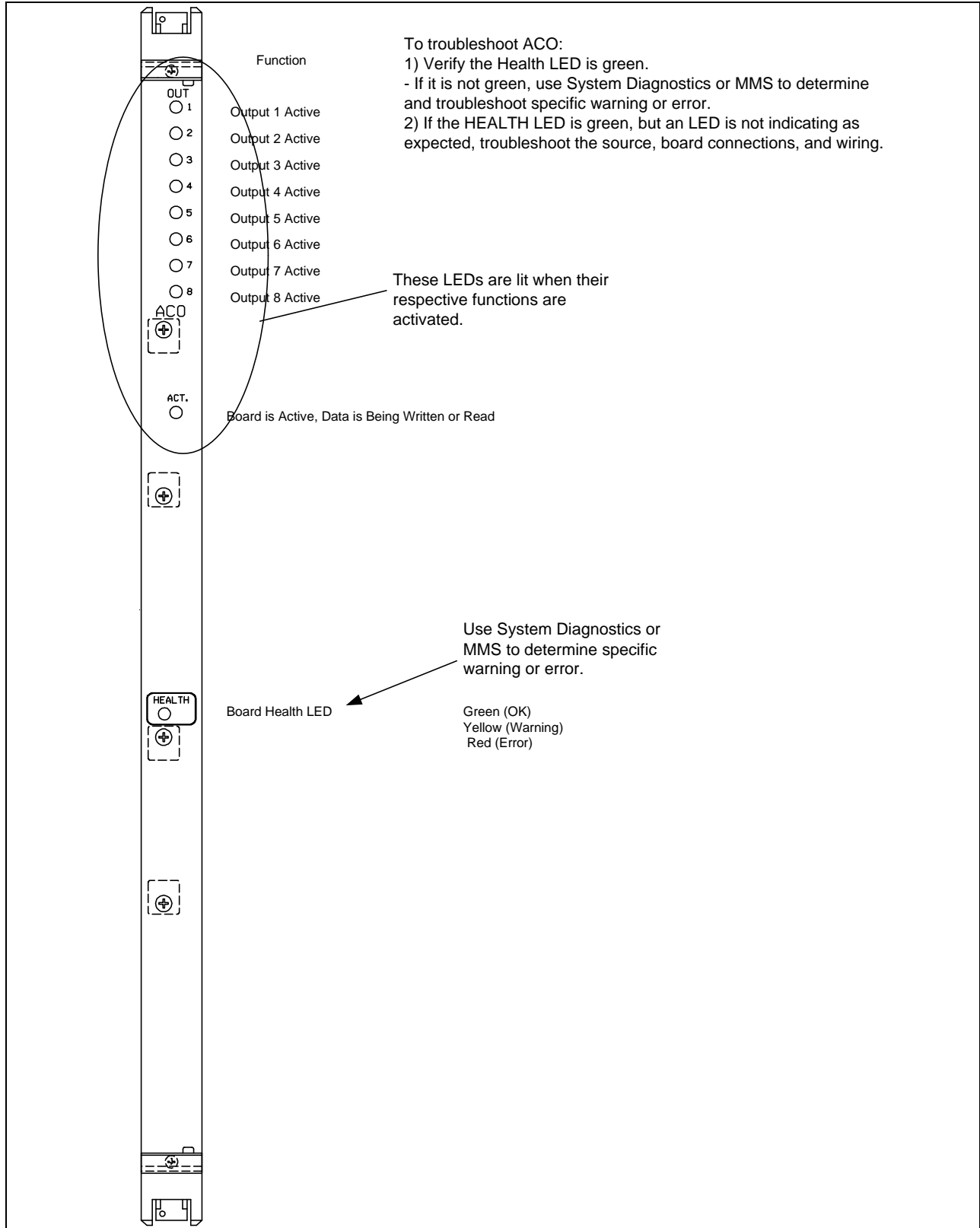


Figure 4–2. ACO Board Troubleshooting Using Board Indications

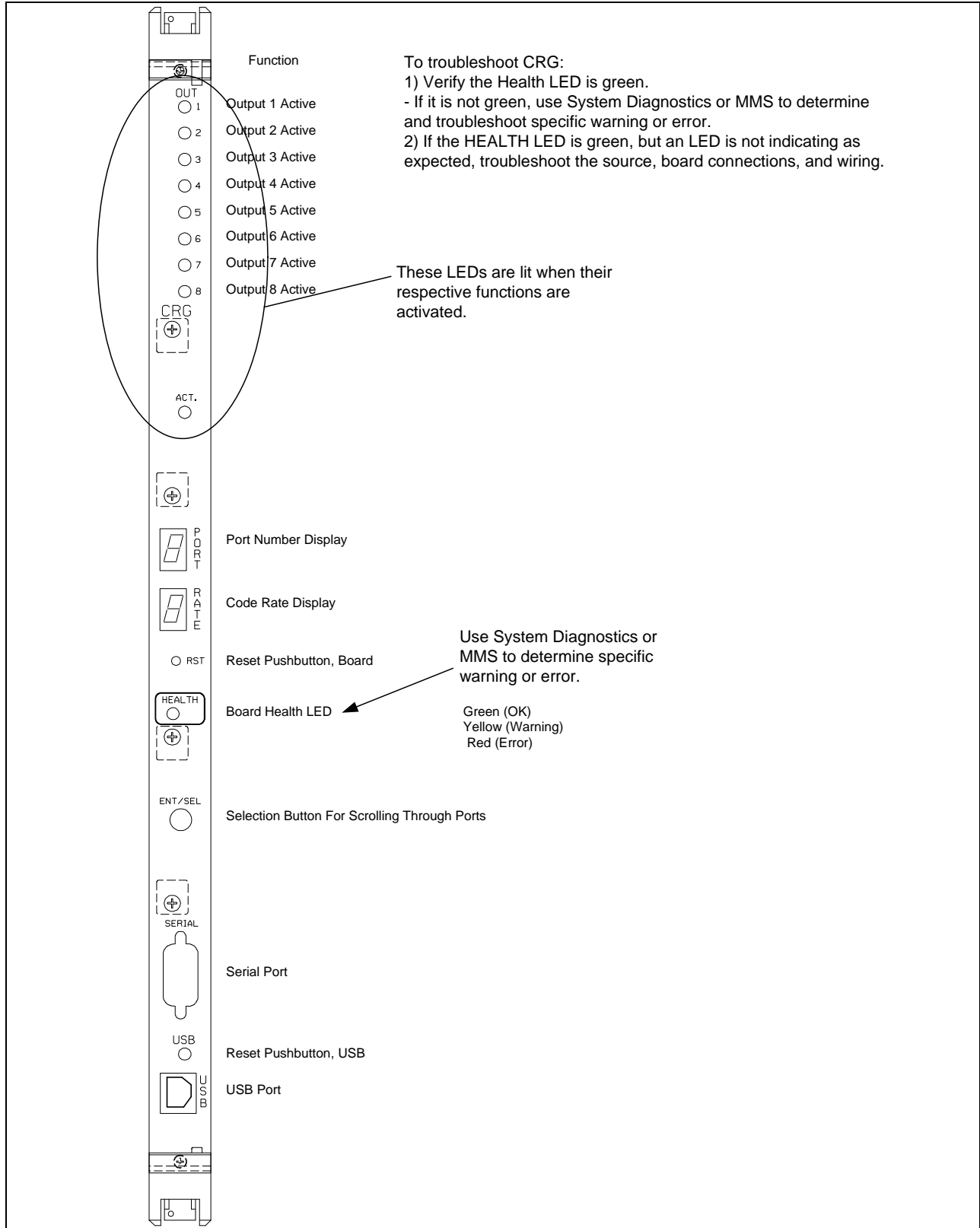


Figure 4-3. CRG Board Troubleshooting Using Board Indications

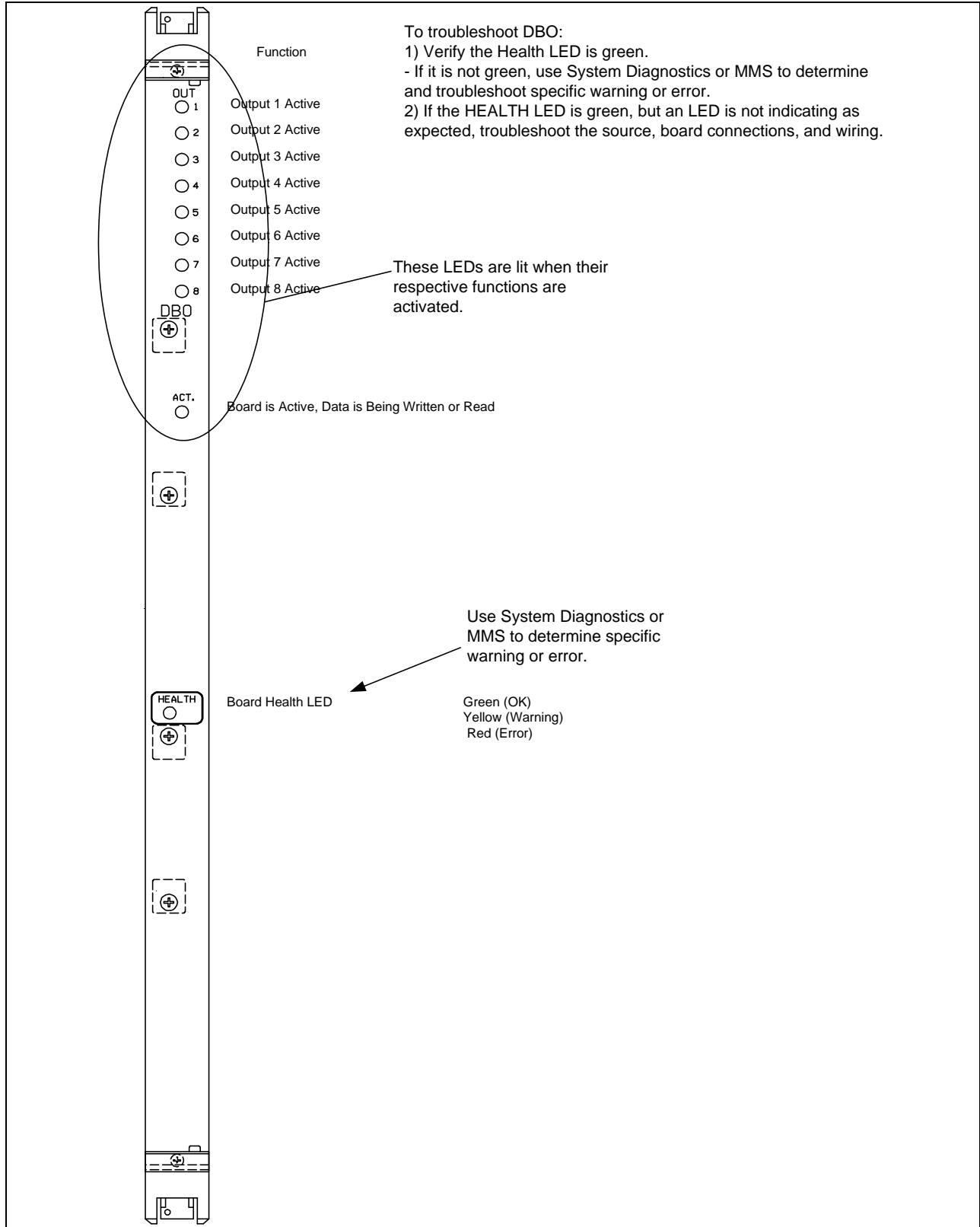


Figure 4-4. DBO Board Troubleshooting Using Board Indications

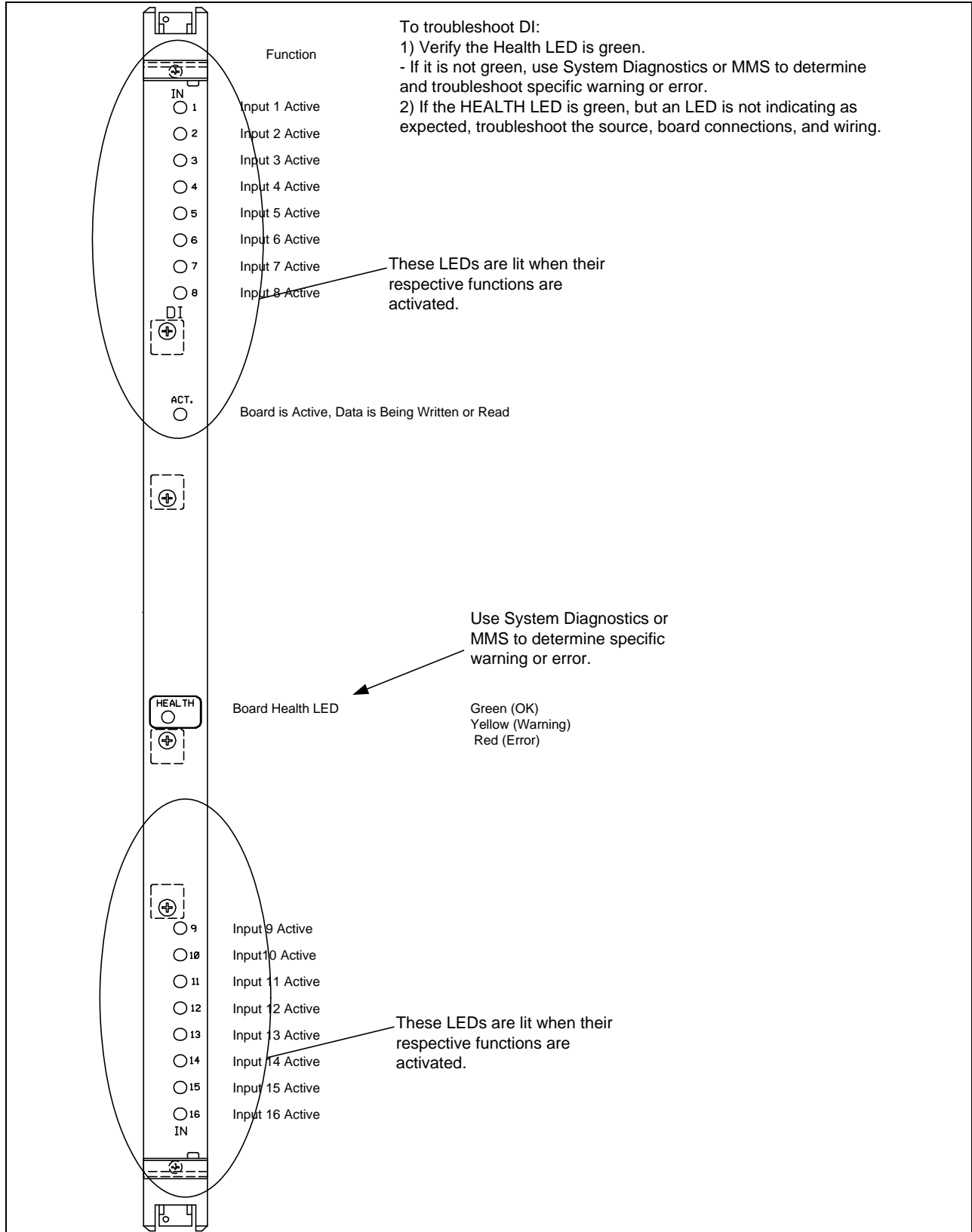


Figure 4–5. DI Board Troubleshooting Using Board Indications

System Diagnostics

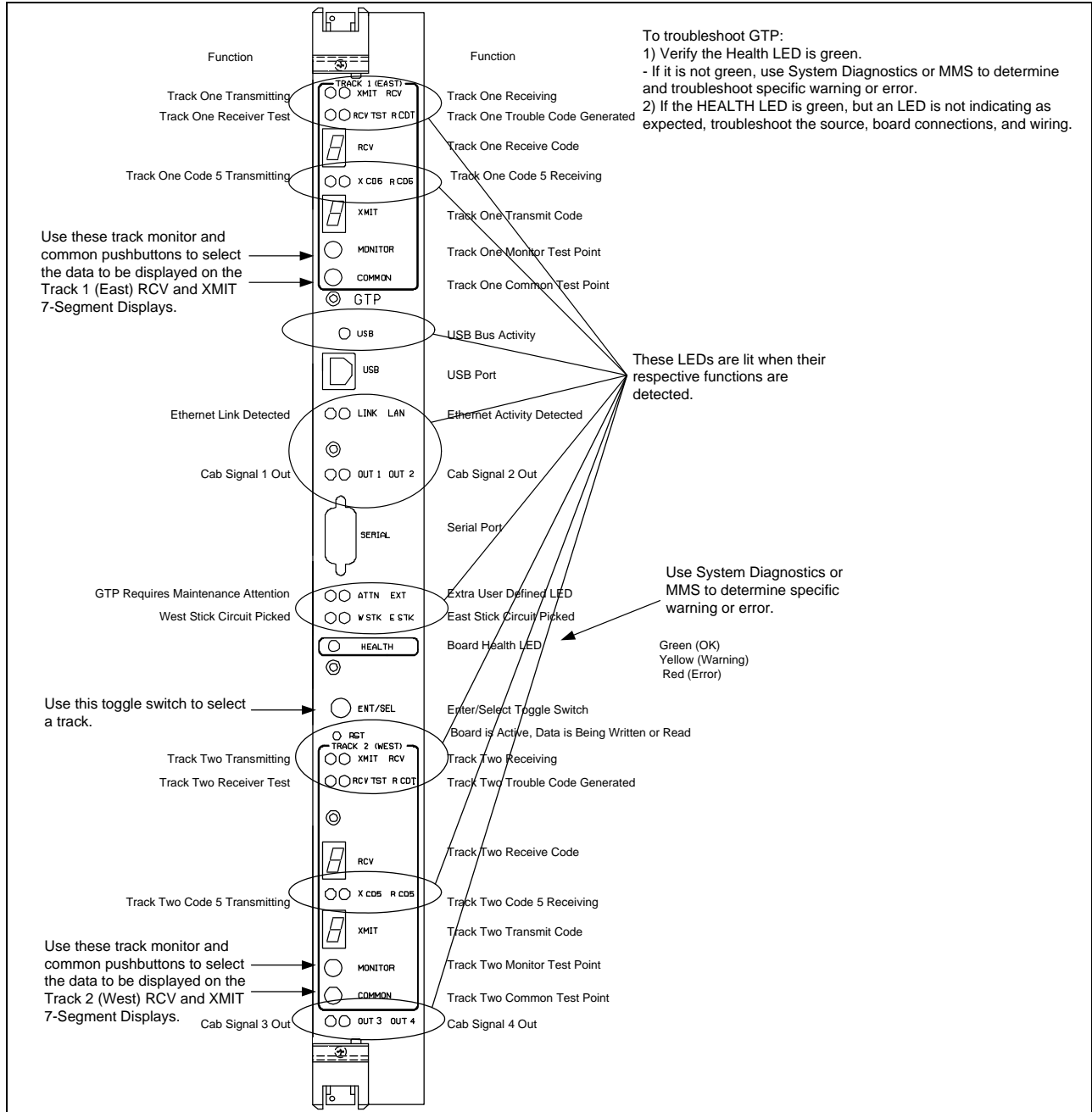


Figure 4-6. GTP Board Troubleshooting Using Board Indications

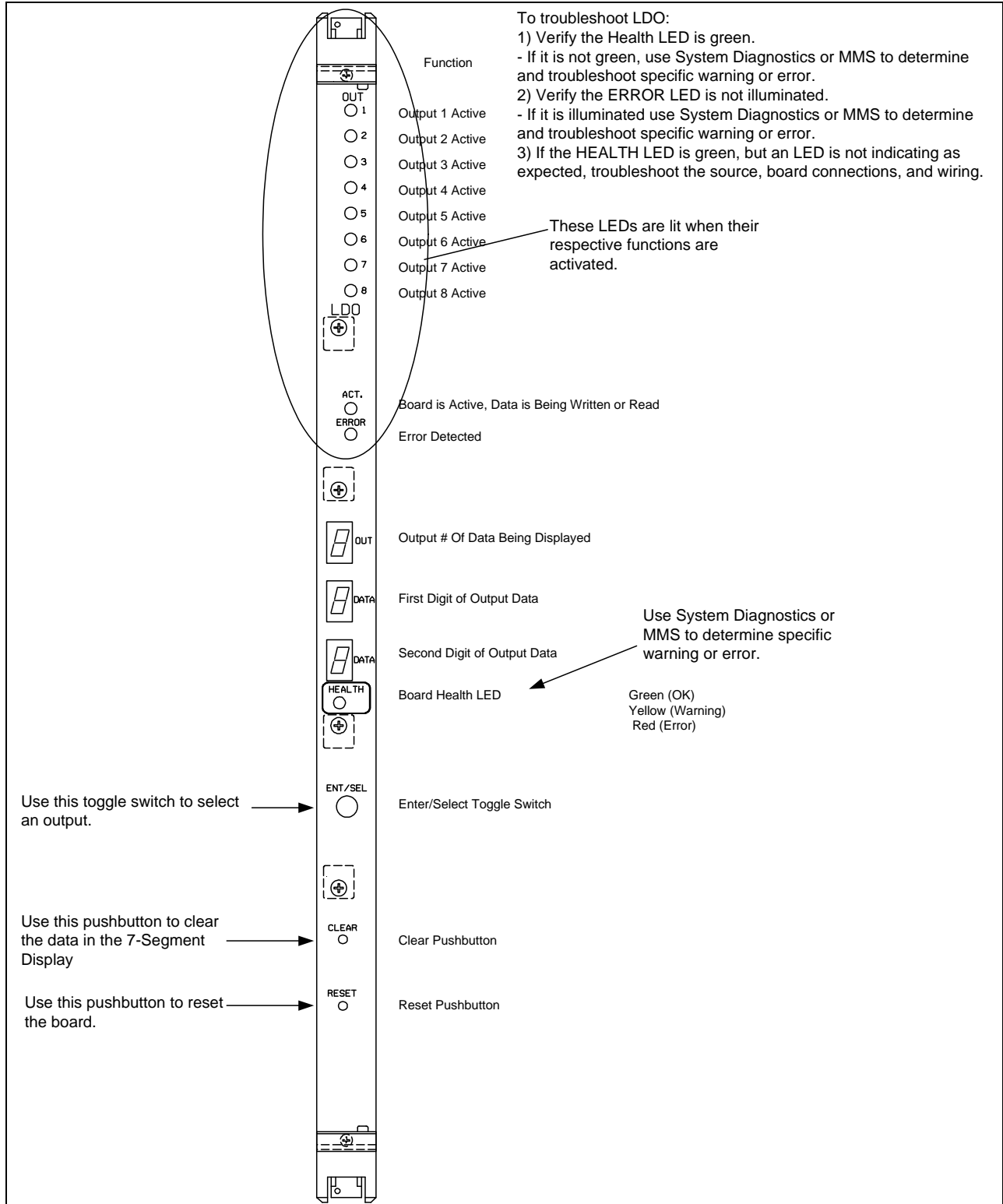


Figure 4-7. LDO Board Troubleshooting Using Board Indications

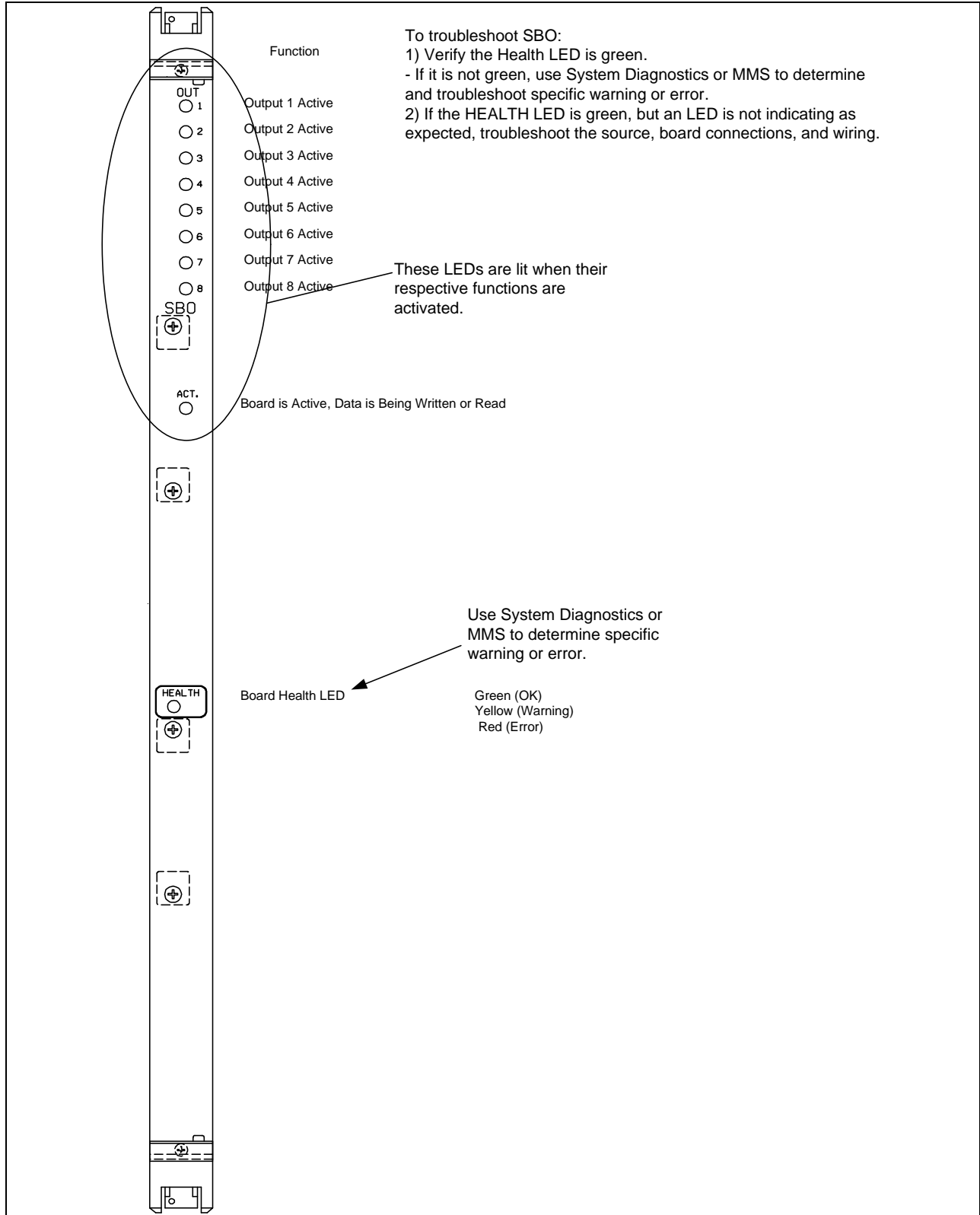


Figure 4–8. SBO Board Troubleshooting Using Board Indications

4.2.2. Non-Vital Board LEDs

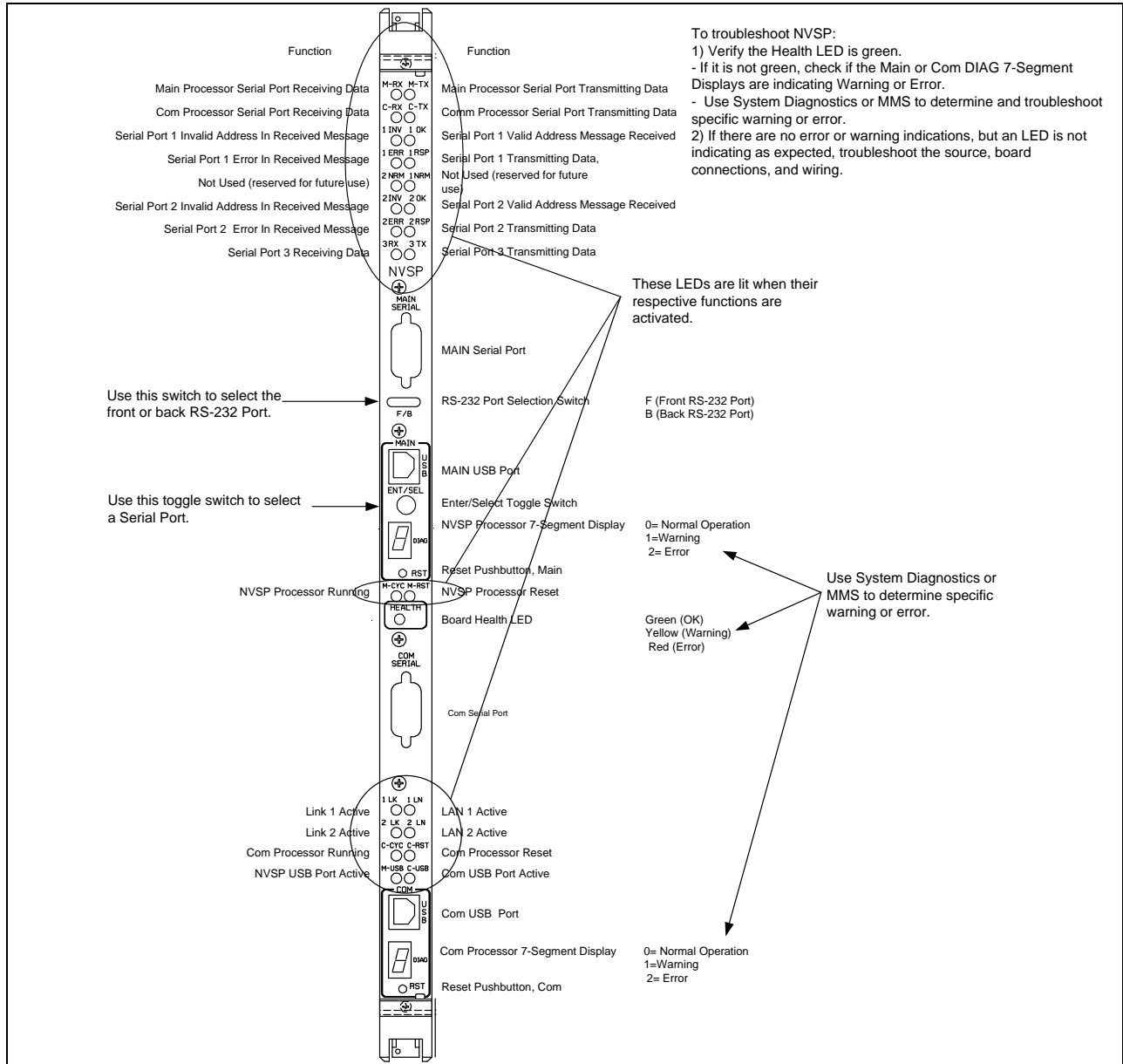


Figure 4–9. NVSP Board Troubleshooting Using Board Indications

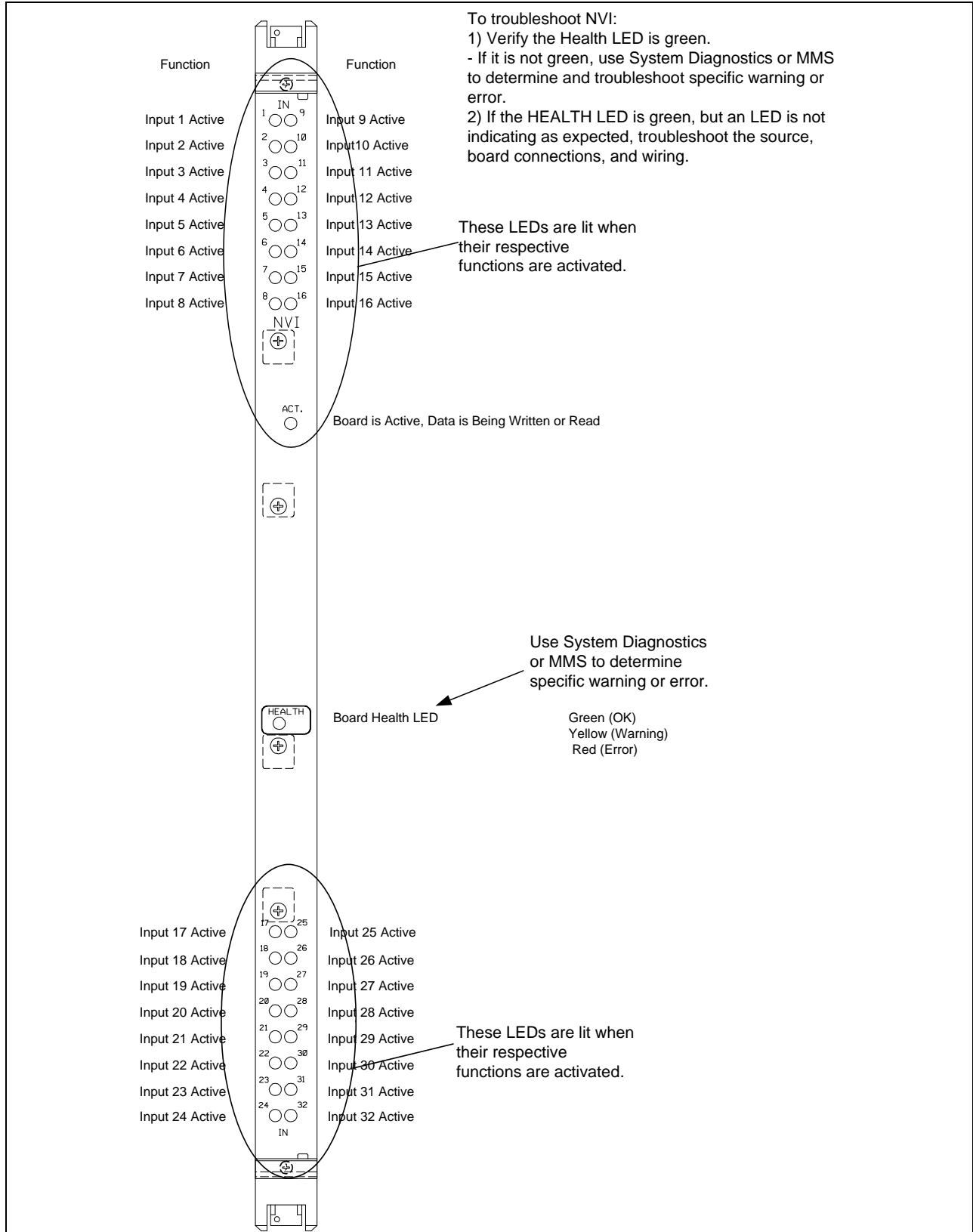


Figure 4–10. NVI Board Troubleshooting Using Board Indications

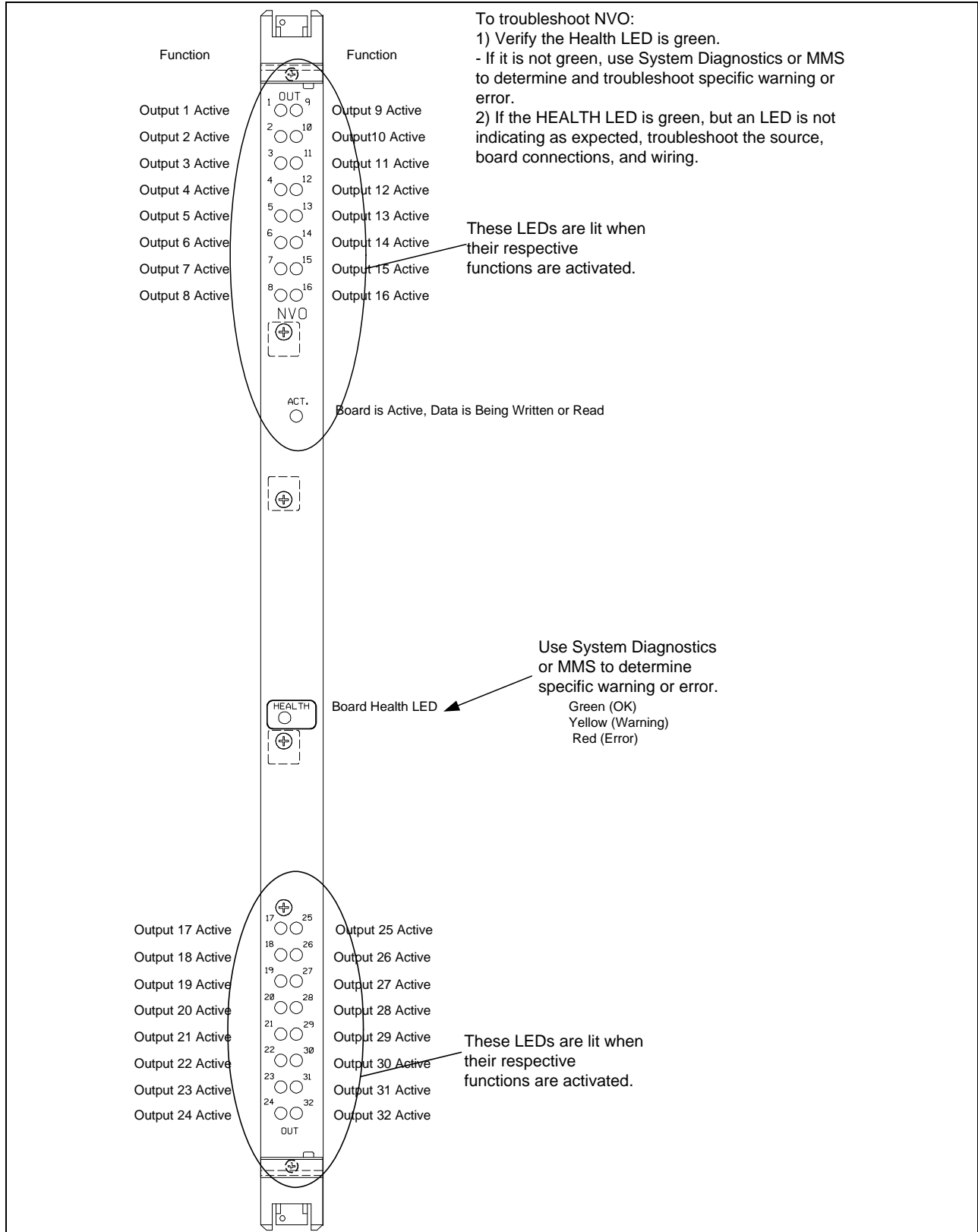


Figure 4–11. NVO Board Troubleshooting Using Board Indications

4.3. VT-100 EMULATION

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

- An externally connected PC or laptop with VT-100 Emulation software
- An externally connected VT100
- An externally connected Personal Computer (PC) with MMS or AlsDload software
- An NVSP board connected to a PC with VT-100 emulation or AlsDload software

4.3.1. VT-100 Emulator

A VT-100 Emulator is any PC or laptop with VT-100 emulation software. It is used for diagnostics related to the VSP and Vital I/O boards.

To perform diagnostics, the VT-100 Emulator is connected to the 9-pin "D" connector (DB-9) on the USB connector at the front of the VSP board.

4.3.2. Personal Computer

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

4.3.3. NVSP MAC Port

When an NVSP board is connected to a PC with VT-100 emulation software through the MAC port VSP diagnostics are reported to the NVSP through on-board shared memory.

4.3.4. Communication

Once per second, the system status ("SYSTEM OK", "SYS WARNING" or "ERROR ALERT") is displayed on the VT-100 Emulator, dumb terminal or NVSP diagnostic menu. A VT-100 Emulator 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 VSP board Main Processor (MP) MAC port, and lists the interactive diagnostic commands that are supported. It may be necessary to type the 'C' command (described below) to continue operation during system start-up if an error is detected and interrogated. This command allows display of any of the diagnostic messages described herein. An NVSP board automatically makes use of the VSP board's interactive commands to extract and report diagnostic information.

4.3.5. Top Level Vital Status Messages

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

- "SYSTEM OK" is displayed when all iVPI functions are working properly (no errors detected).
- "SYS WARNING" indicates an error that has caused an abnormal or out-of-tolerance condition. Continued iVPI operation may still be possible (the VRD Relay remains up). The meaning here is that system safety is unaffected.
- "ERROR ALERT" indicates a "fatal" error. Continued iVPI 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.
- Verify the correct com port is configured on the emulator.
- Verify the correct cable is in use.
- Verify the VSP board contains valid software.
- Verify the wiring is configured correctly if using a RS 232 Serial cable.
- Try a new cable.
- If the problem persists, replace the VSP 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.

4.3.6. VSP Main Processor MAC Port

4.3.6.1. 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. 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, although for brevity, it is explicitly shown for only the first command's description below. Note that if any keyboard character is entered during the VSP board's power-up cycle, it halts.

NOTE

These commands may be entered using upper-case or lower case letters.

'C' = Continue

This command instructs the iVPI module to continue through its start-up sequence after an error is encountered 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") without erasing stored error data. The Continue command is initiated by pressing the 'C' key followed by the 'CR' (Carriage Return) key.

'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.

'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.

'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 described below.

'?' = View Errors/Warnings

Use this command to display warning or error data after a "SYS WARNING" or "ERROR ALERT" message has appeared. This command is ignored while the status is "SYSTEM OK". Step through all error/warning messages by using the 'N' (Next) command (see below), and exit "view errors" mode by using the 'S' (Status) command.

'X' = Erase

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

'Q' = Query Memory

This command is used to display the value of one or more Vital parameters in VSP 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 VSP 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 .LVC report file.

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." 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 (such as "OUT NOT ON") which appears when the iVPI 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 Terminal. It provides system software and application 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 VSP board.

'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.

'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.

'Z' = Ignore Command

Any command terminated by a 'Z' is ignored by the system.

'FST' = Field Settable Timer Display

This command will display the Field-Settable Software Vital Timer(s). The iVPI module will display timer information in four columns. In the first column it will display the expression number. In the second column it will display the application timer name. In the third column it will display the current timer setting. In the fourth column it will display the default timer value in parenthesis. The terminal is expected to be able to display a maximum of 24 lines of text and the iVPI module is capable of having up to 32 Field-Settable Software Vital Timers.

If more timers are defined than can be displayed on the screen at once then a message saying 'MORE' will appear indicating that there is more information to display. If the user presses the space bar then it will display the next group of timer information. The command will continue as previously described until the end of the list is reached.

4.3.6.2. Vital Diagnostic Messages

Three kinds of system diagnostics or messages are possible when accessing VSP board system diagnostics:

- Start-up Diagnostics
- SYS WARNING
- ERROR ALERT

Tables 4–1 through 4–3 list errors according to the message displayed by System Diagnostics 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 troubleshooting flowchart is provided in Figure 2–1.

When troubleshooting, if board replacement is indicated, refer to the board replacement procedures provided in Tables 5–1 through 5–8.

NOTE

Tables 4–1 through 4–3 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 4–1. Start-up Diagnostics Troubleshooting

Message Displayed	Possible Cause(s)	User Response	Corrective Action
" " (no message displayed)	Faulty test cable or invalid software on VSP Board. Further testing is not possible.	None	Inspect test cable wiring. Verify VSP Board software is valid. If problem persists, replace VSP Board. Verify configuration settings on VT-100 terminal are set correctly for VSP Board. 19200 Baud, 8 databits, 1 stop bit, no parity, no flow control (19200, 8, 1, N).
CPU DPRAM ERR	Failed checkerboard test of VSP DPRAM. System may run if not using defective RAM areas.	None	Replace VSP board.
CPU RAM ERR	Failed "Checkerboard" test of system RAM. System may still run if not using defective RAM areas.	Press "C" key and then "ENTER" key	Replace VSP Board.

Table 4–1. Start-up Diagnostics Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
CPU SIG ERR	Failure of System ID, Revision ID, or Site ID as defined in the VSP application to match the hardwired signature on the back of the system module. System does not operate under this condition.	Press "C" key and then "ENTER" key	Verify that the hardwired signature on the back of the system module matches the System ID, Revision ID, and Site ID as defined in the VSP application.
VSP LOGIC VOLTG LOW	Faulty regulator or voltage level detection circuit on the VSP board. Low input voltage to the power isolation unit. Faulty isolation unit.	None	Verify input to power isolation unit to be 8-16 VDC. Verify Output of power isolation unit to be 8-14 VDC. Verify power wiring. Replace VSP board. Replace power isolation unit.
VSP LOGIC VOLTG HIGH	Faulty regulator or voltage level detection circuit on the VSP board. High input voltage to the power isolation unit. Faulty isolation unit.	None	Verify input to power isolation unit to be 8-16 VDC. Verify Output of power isolation unit to be 8-14 VDC. Verify power wiring. Replace VSP board. Replace power isolation unit.

Table 4–1. Start-up Diagnostics Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
POLY DIV ERR	Failure of PD portion of VSP 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 VSP Board in module. Inspect/replace VSP Board.
PROM MEM ERR	VSP system as application FLASH.	Press "N" key and then "ENTER" key <u>Failure Messages</u> 'ROUTINE PROM' 'ADS-NOSHADOW' 'ADS-SHADOW'	Record failure for VSP Board in module. Check Application/System software compatibility per the application. Replace VSP Board system or application Flash. Replace VSP Board.
OUTPUT ERR	Failed test of one or more outputs on a Vital Output Board Defective VSP Board. System not likely to operate under this condition.	Press "?" to find bad 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	Check for defective VSP Board. Verify continuity of iVPI Motherboard. Check expansion cables. Replace Vital Output Board(s) as indicated.

Table 4–1. Start-up Diagnostics Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
NVSP INTR ERR	Dual-Port Interface RAM failure on NVSP Board. System operates under this condition.	Press "N" key and then "ENTER" key <u>Failure Message</u> 'NVSP BD x/yy' x = Module number y = Slot number	Check continuity of iVPI System Bus (Motherboard). Press Reset Switch on VSP Board to initialize processor to test NVSP Interface RAM. If test repeatedly fails, replace NVSP Board. If test fails with new NVSP Board, replace VSP Board. If test continues to fail, check bus connections on module motherboard and expansion cables.
VRD INTER ERR	VRD Interface RAM failure on VSP Board. VSP Board fault. System not likely to operate under this condition.	Press "C" key and then "ENTER" key	Press Reset Switch on VSP Board to initialize processor to test VRD Interface RAM. If test repeatedly fails, replace VSP Board. If test continues to fail, check bus connections on module motherboard.
VS INTR ERR	Dual-Port Interface RAM failure on Vital System (VS) Board (GTP or CRG). System operates under this condition.	Press "N" key and then "ENTER" key <u>Failure Message</u> 'VS BD x/yy' x = Module number y = Slot number	Press Reset Switch on VSP Board to initialize processor to test Interface RAM. If test repeatedly fails, replace GTP or CRG Board. If test continues to fail, check bus connections on module motherboard and expansion cables. Replace VSP Board.

Table 4–2. SYS WARNING Message Troubleshooting

Message Displayed	Possible Cause(s)	User Response	Corrective Action
BAD IN DATA	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 <u>Failure Message</u> 'IN # x/yy/z' x = Module number y = Slot number z = Port number	Determine if input port changes state twice in 2 seconds during normal operation. If it does not change state twice in 2 seconds, then contact bounce could be at fault. If error appears after clearing all saved error data, replace DI Board.
NVSP DIA ERR	Failure of VSP to obtain data from a NVSP Board on a 1-second basis. Indicates NVSP program has failed and has stopped or is undergoing reset condition.	Press "N" key and then "ENTER" key <u>Failure Message</u> 'NVSP BD x/yy' x = Module number y = Slot number	Check bus connections on Motherboard. Type 'x' to clear and monitor how often it occurs. Replace NVSP Board if condition continues. Check mounting of regulator on board.
OVERCURRENT (ON)	Degrading signal load. Faulty output wiring.	Press "N" key and the "ENTER" key <u>Failure Message</u> Out# x/yy/z x = module number yy = slot number z = port number	Replace signal bulb/LED unit. Inspect output wiring and cables. Inspect/replace LDO Board.

Table 4–2. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
OVERCURRENT (OFF)	Faulty LDO Board.	Press "N" key and the "ENTER" key <u>Failure Message</u> Out# x/yy/z x = module number yy = slot number z = port number	Inspect/replace LDO Board.
UNDERCURRENT (ON)	Degrading signal load.	Press "N" key and the "ENTER" key <u>Failure Message</u> Out# x/yy/z x = module number yy = slot number z = port number	Replace signal bulb/LED unit. Inspect/replace LDO Board.
EXTERNAL VOLTAGE	Voltage applied externally from the output. Cable short.	Press "N" key and the "ENTER" key <u>Failure Message</u> Out# x/yy/z x = module number yy = slot number z = port number	Inspect output wiring and cables.

Table 4–2. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
VS DIAG ERR	Failure of VSP to obtain data from a Vital System (VS) Board (CRG or GTP) on a 1-second basis. Indicates VS program has failed and has stopped or is undergoing reset condition.	Press "N" key and the "ENTER" key <u>Failure Message</u> VS BD x/yy x = module number yy = slot number	Check bus connections on Motherboard. Replace CRG or GTP if condition continues.
V TIMER ERR	Vital Timer expression (PPVT) returned a result that was not a codeword for Ch. 1 or Ch. 2. PPVT = Permanently Programmed Vital Timer (time is coded into PROM)	Press "N" key and the "ENTER" key <u>Failure Message</u> ' 'PPVT XPR#bbb' bbb = hexadecimal number of PPVT expression'	If error is related to PPVT timeout, use the query RAM to examine parameters of final timer expression.

Table 4–2. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
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.	<p>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. <u>Failure Message</u> 'OUT # x/yy/z' x = Module number yy = Port number z = Port number</p>	<p>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. This may be a valid condition if, for example, there is a relay contact in series with the output wiring.</p>
XPR RSLT ERR	Evaluated expression returned a result that was not a codeword in code Channel 1 or code Channel 2.	<p>Press "N" key and then "ENTER" key <u>Failure Message</u> 'XPR # xxx/CHy' xxx = 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</p>	<p>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.</p>

Table 4–2. SYS WARNING Message Troubleshooting (Cont.)

Message Displayed	Possible Cause(s)	User Response	Corrective Action
NO VRD FRONT	VPI system wiring bad. 12V not applied to VRD section of VSP Board. Output errors. 5V logic low.	Press "N" key and then "ENTER" key	Verify 12V applied to VSP Board VRD section. Interrogate VSP for more diagnostics.

Table 4–3. ERROR ALERT Message Troubleshooting

Message Displayed	Possible Cause(s)	User Response	Corrective Action
POLY DIV ERR	Failure of test performed on VSP Board once each 1-second main cycle. VSP Board is bad.	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 PD portion of VSP Board in module. Inspect/replace VSP Board.
MAIN CWD ERR	One or more of the 20 main checkwords was delivered to the VRD in error.	Press "N" key and then "ENTER" key <u>Failure Message</u> '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. Only 'CHKMEM' points to a specific failure. If CHKMEM appears, verify on VSP Board that correct software is installed as configured in the application. Verify System ID is configured per the application. Verify that correct application is installed on VSP Board. If other checkwords are bad, replace VSP Board.
VRD XFR ERR	VRD Relay detected de-energized and checkword sent to the VRD Board determined to be correct.	Press "C" key and then "ENTER" key	If VRD Relay continuously down, replace VRD Board. If VRD Relay intermittently down, check iVPI System Bus (Motherboard). Verify 12V applied to VRD section of VSP Board.

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

Message Displayed	Possible Cause(s)	User Response	Corrective Action
<p>OUTPUT ERR</p>	<p>Failure of a Recheck checkword delivered to the VRD Board once at the beginning of each 50 ms period. Also may be caused by electromagnetic interference from external lines, relay, etc. Bad Vital Output Board.</p>	<p>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</p>	<p>Inspect/replace Vital Output Board in question. Use suppression on external lines and relay to eliminate noise. Verify external connections and field equipment.</p>
<p>TRE VAL ERR NOTE: This message follows OUTPUT ERR</p>	<p>Erroneous TRE values returned from output ports. These causes incorrect Recheck the checkwords to go to the VRD. Bad Vital Output Board.</p>	<p>Press "N" key and then "ENTER" key <u>Failure Message</u> 'TRE VAL # xx/yy' xx = Port group yy = Slot number Press "N" key and then "ENTER" key to continue After all failed output ports have been displayed, 'END ERR DATA' appears</p>	<p>Verify external connections on field equipment. Inspect/replace Vital Output Board in question.</p>

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

Message Displayed	Possible Cause(s)	User Response	Corrective Action
<p>RCHK CWD ERR NOTE: This message follows TRE VAL ERR</p>	<p>Failure of a Recheck checkword being delivered to the VRD. Bad Vital Output Board.</p> <p>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.</p>	<p>Press "N" key and then "ENTER" key</p> <p><u>Failure Message</u> 'RCHK CWD # xx' xx = Checkword number</p> <p>Press "N" key and then "ENTER" key to continue</p> <p>After all failed output ports have been displayed, 'END ERR DATA' appears</p>	<p>Verify external connections and field equipment.</p> <p>Inspect/replace Vital Output Board in question.</p>

4.3.7. VSP Communication Processor MAC Port

4.3.7.1. 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. 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, although for brevity, it is explicitly shown for only the first command's description below. Note that if any keyboard character is entered during the VSP board's power-up cycle, it halts.

NOTE

These commands must be entered using upper-case letters. The Vital processors treat lower-case characters as invalid.

'?' = View All Errors/Warnings

Use this command to display all warnings or error codes from both the Main processor and the Communication Processor. See Tables 4-4 and 4-5.

'C' = View Communication Processor Errors/Warnings

Use this command to display all warning or error codes from the Communication Processor. See Tables 4-4 and 4-5.

'V' = View Main Processor Errors/Warnings

Use this command to display all warning or error codes from the Main Processor. See Table 4-4.

'G m/ss/pp' = Display Signal Output Current

Use this command to display the signal output current from an LDO board specified by module (m), slot (ss) and part (pp).

'H' = Display Command Summary

Use this command to display all available commands.

'I' = Inhibit All Warnings

Use this command to inhibit the warning states indication.

'O' = Enable

This command negates a previously entered 'U' (Disable) command.

'RIP' = Display IP Report

This command displays the configured IP addresses for each network controller.

'RPT' = Display Configuration Report

This command displays the Main Processor and Communication Processor configuration reports.

'RNET' = Display Network Status

This command displays network statistics (such as messages transmitted and messages received) for each network controller.

'S' = Display System Status

This command displays the Main Processor and Communication Processor status.

'T' = Display Main Processor Timing Cycle

This command displays the Main Processor timing cycle.

'TSK' = Display Communication Processor Task Usage

This command displays the Communication Processor task usage in percent.

'U' = Disable

Use this command to inhibit the "OUT NOT ON" warning indication.

'V' = Display Logic Voltage

Use this command to display the logic voltage.

'W' = Display System ID

Use this command to display the system Site/Rev. ID.

'X' = Clear All Diagnostics

Use this command to clear all Main Processor and Communication Processor diagnostics.

'XC' = Clear Communication Processor Diagnostics

Use this command to clear the Communication Processor diagnostics.

'XNET' = Clear Network Statistics

Use this command to reset all network statistics to zero.

'XV' = Clear Main processor Diagnostics

Use this command to clear all main Processor Diagnostics.

4.3.7.2. Diagnostic Messages

Tables 4–4 through 4–5 list errors according to the error number. The error number is the second field of the display error code. All Main Processor error numbers are cross-references to the corresponding diagnostic table (Tables 4–1 through 4–3).

Table 4–4. Main Processor Error Numbers

Error Number (hex)	Message Displayed	Failure Messages
0001	CPU RAM ERR	
0002	LOGIC VOLTG LOW	
0003	LOGIC VOLTG HIGH	
0004	CPU DPRAM ERR	
000B	POLY DIV ERR	PD C3,1 ERR
000C		PD C3,2 ERR
000D		PD C1,1 ERR
000E		PD C1,2 ERR
000F		PD C1,1N ERR
0010		PD C1,2N ERR
0011		PD LOAD ERR
0015	PROM MEM ERR	ROUTINE
0016		ADS NOSHADOW
0017		ADS SHADOW
0018		Bootloader
001E	CPU SIG ERR	
0032	VRD INTR ERR	
0033	NO VRD FRONT	
0034	VRD XFER ERR	
003D	CSE INTER ERR	
003E	CSE DIAG ERR	
0047	VSC INTER ERR	
0048	VSC DIAG ERR	
00C9	OUTPUT ERR	
00CA	OUT NOT ON	
00CB	LDO2 DIAGNOSTICS	OVERCURRENT ON
00CC		OVERCURRENT OFF
00CD		UNDERCURRENT ON
00CE		EXTERNAL VOLTAGE
00CF		NO I/O DIAGS

Table 4–4. Main Processor Error Numbers (Cont.)

Error Number (hex)	Message Displayed	Failure Messages
012D	BAD IN DATA	
015F	V TIMER ERR	FSVT SW ERR
0160		
0161		
0162		
0163		FSVT TIMEOUT
0164		
0165		
0166		
02BD		PPVT TIMEOUT
0259	XPR RSLT ERR	
02BE	FSVT XPR ERR	
02BF	CRG CWD ERR	
02C0	MAIN CWD ERR	
02C1	RCHK CWD ERR	
02C2	TRE VAL ERR	

Table 4–5. Communication Processor Error Numbers

Error Number	Description	Possible Causes	Corrective Action
4E21	Stack initialization error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E22	IP Address error	Invalid IP address	Verify configured IP addresses
4E23	Bring up device error	Bad network controller	Replace board
4E24	Create socket error	Network stack error	Reset CP; replace board
4E25	Blocking error	Heavy network traffic	Reduce network traffic
4E26	Socket Bind error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E27	Listen socket error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E85	Pass data up stack error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E86	Select error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E87	Accept error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E88	Receive error	Network stack error	Reset CP; if diagnostic is frequent replace board
4E89	Send error	Network stack error	Reset CP; if diagnostic is frequent replace board
7531	Flash CRC mismatch	Bad Flash	Use AlsDload to re-download Flash data; if frequent replace board
7532	Memory test error	Bad RAM	Replace board
7534	DPRAM locked by MP	Main Processor busy	Reduce MP load; clear diagnostic; if frequent call customer service
7535	Invalid MAC command	Bad MAC_TCP message	Clear diagnostic; if frequent call customer service
7536	Unsupported protocol	Bad network message	Clear diagnostic; if frequent call customer service

Table 4–5. Communication Processor Error Numbers (Cont.)

Error Number	Description	Possible Causes	Corrective Action
7595	Memory allocation error	Out of memory	Call customer service
7596	Illegal RtOs return	Operating system error	Call customer service
7597	Failed to create semaphore	Operating system error	Call customer service
7598	Failed to create mutex	Operating system error	Call customer service
7599	Failed to create task	Operating system error	Call customer service
759A	Invalid semaphore status	Operating system error	Call customer service
759B	Heap Initialization error	Bad RAM	Replace board
75F9	Duplicate IP address detected	IP address used by another node	Verify configured IP addresses
75FA	Duplicate MAC address detected	MAC address used by another node	Replace board
75FB	Unsupported network protocol	Bad network message	Clear diagnostic; if frequent call customer service
75FC	Maximum open sockets exceeded	Too many open connections	Reduce network connections
75FD	Network link is lost	Remote node shutdown, disconnected cable	Check network connections. Verify remote node communication
75FE	Network device is down	Remote node shutdown, disconnected cable	Check network connections. Verify remote node communication
75FF	Network device Rx queue overrun	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic
7600	Network device Tx queue overrun	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic
765D	Vital Serial Tx transfer overrun	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic

Table 4–5. Communication Processor Error Numbers (Cont.)

Error Number	Description	Possible Causes	Corrective Action
765E	Vital Serial Tx transfer invalid	Operating system error	Call customer service
765F	Vital Serial Rx transfer overrun	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic
7660	Vital Serial Rx transfer invalid	Operating system error	Call customer service
7661	Vital Serial Tx timeout	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic
7662	TCP timeout	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic
7663	TCP lost connection	Remote node shutdown, disconnected cable	Check network connections; verify remote node communication

4.4. NON-VITAL SYSTEM DIAGNOSTICS ON THE NVSP BOARD

Examples of displayed NVSP diagnostic menu with features are described in this Heading. These examples are graphic representations and may vary slightly from what is actually displayed.

4.4.1. Operational Overview

A terminal or PC connected to the Maintenance Access (MAC) port on the NVSP board is needed to display its diagnostic menus, see Figure 4–12. These menus access the operating system and vary in use; some are used to report system status while others are used for manual control.

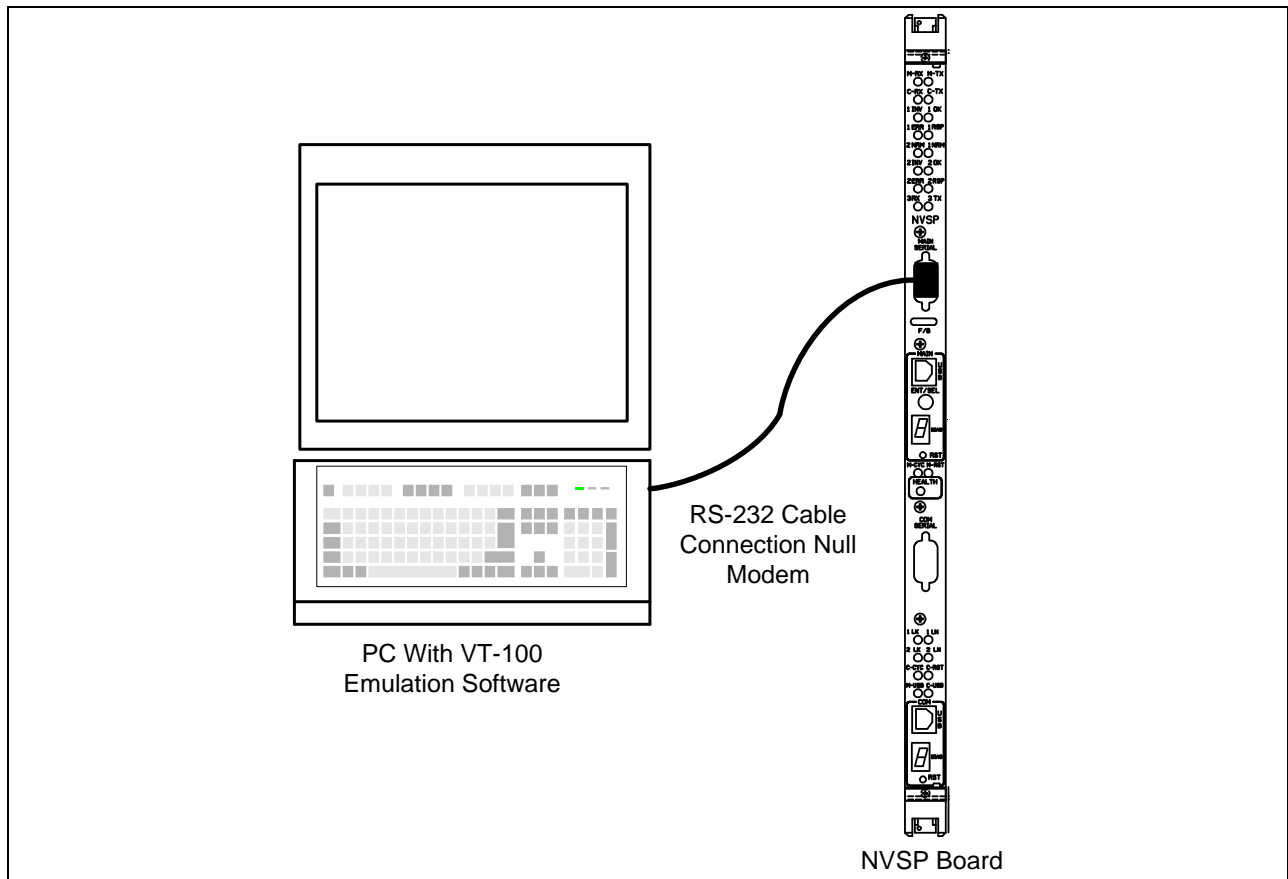


Figure 4–12. Connection to the NVSP MAC Port

To access the diagnostics program through the MAC port, any terminal compatible with Digital Equipment Corporation's VT-100 may be used, or an IBM compatible 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) running VT-100 emulation software. The required communication setup is: 24 lines by 80 columns, 19200 baud (typical), 8 data bits, 1 stop bit, no parity, and no flow control.
- Serial interface cable: standard 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 NVSP Board. Cabling as described in Table 4–6.
- Proper application documentation for the location of interest.

Table 4–6. NVSP EIA-232

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

4.4.2. Non-Vital Diagnostic Messages

The non-vital system diagnostics specific messages displayed when accessing NVSP board system diagnostics are summarized in Table 4–7. Communication Processor errors can also be displayed for the NVSP; see Table 4–5 for a summary of these errors.

When troubleshooting, if board replacement is indicated, refer to the board replacement procedures provided in Tables 5–1 through 5–8.

Table 4–7. NVSP Main Processor Error Numbers

Error Number	Description	Possible Causes	Corrective Action
0500	Checksum error		
0501	CAA Not Found	No Application present	Use AlsDload to download an Application
0502	C Not Found		
0503	CAA Run error		
0504	Missing Card		
0510	C Firmware error		
0511	Memory Allocation error	Out of memory	Reduce communications, Application size
0512	Missing Protocol		
0513	Protocol Initialization error		
0514	Task Allocation error		
0515	Ring Allocation error		
0516	Port Allocation error		
0517	CAA I Buffer Flag		
0518	CAA C Buffer Flag		
0519	CAA S Buffer Flag		
051A	Protocol error number		
051B	Unknown Reset		
051C	Watchdog Reset		
051D	Software Reset		
051E	PROM error		

Table 4–7. NVSP Main Processor Error Numbers (Cont.)

Error Number	Description	Possible Causes	Corrective Action
051F	Stack error		
0520	Port CRC error		
0521	Port CRC error reset		
0522	CAA Stall		
0523	Bad Flag		
0524	Bad Csip		
0525	Bad Fast Scan		
0530	CAA Divby0		
0600	Invalid Query Type		
0620	CP Message Header error		
0621	Rx Ring Full	Heavy network traffic	Clear diagnostic; if frequent, reduce network traffic
0640	Invalid Interrupt From CP		
0641	MP Lock Fail CP Using	Communication Processor busy	Reduce CP load; clear diagnostic; if frequent call customer service
0642	CP Lock Request Timeout	Main Processor busy	Reduce MP load; clear diagnostic; if frequent call customer service
0660	MP Lock Fail MP Using	Main Processor busy	Reduce MP load; clear diagnostic; if frequent call customer service
0661	Invalid Flag Value		
0680	DPRAM Test Fail		
06A0	Rev/Site Mismatch		
06A1	Bad Rev Id Switch Setting		

4.4.3. Using Menus

Diagnostics functions are selected from the NVSP 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 (such as Main Menu). See Table 4–8 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 4–8. NVSP 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.

4.4.4. Menu Structure

Figure 4–13 shows the selection path from the 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 iVPI system diagnostic menus and their options.

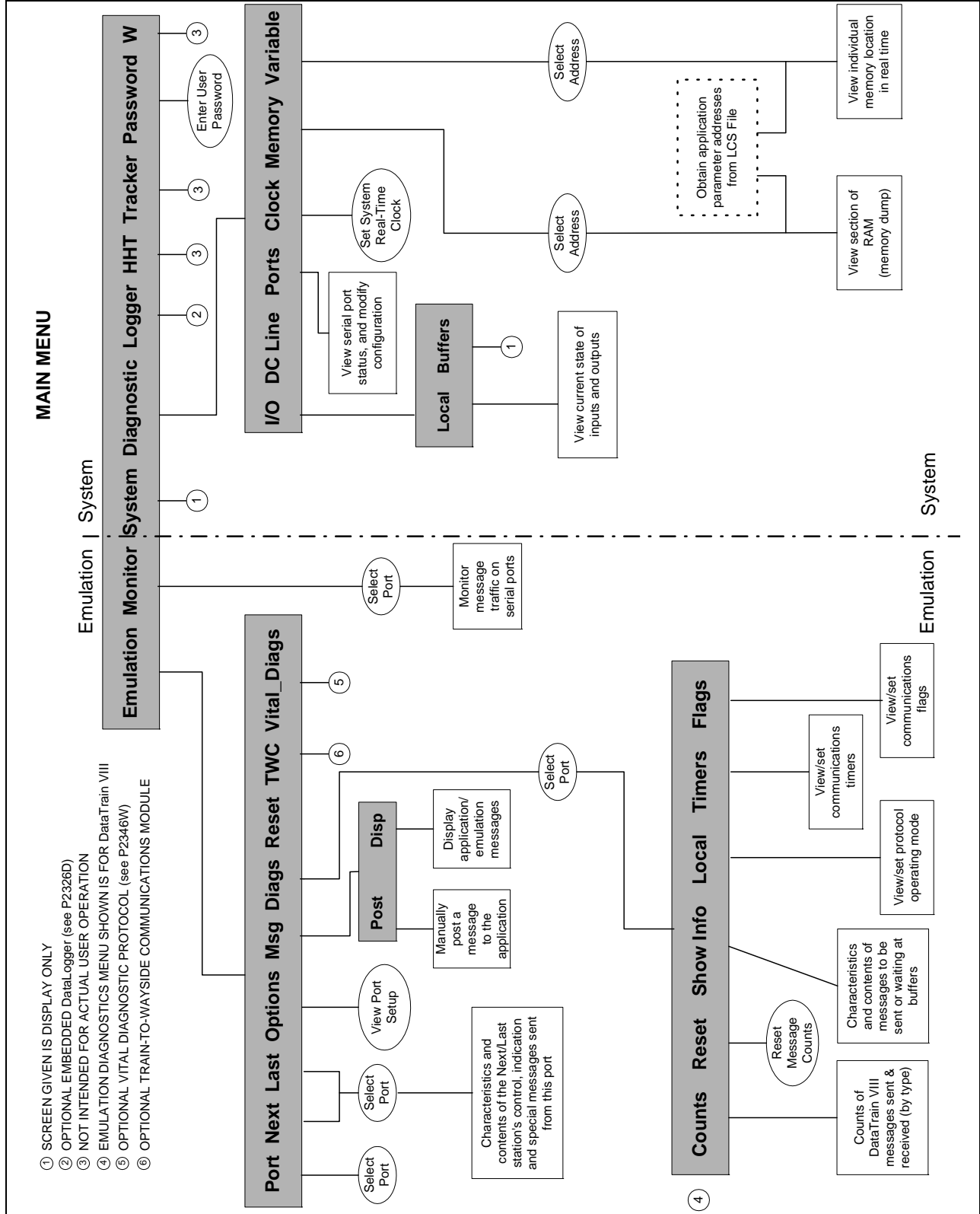
Each menu or screen is provided with available options and user selection path. The path lists in order the selection process for the menu or screen being described.

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.

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 is presented.



- ① SCREEN GIVEN IS DISPLAY ONLY
- ② OPTIONAL EMBEDDED DataLogger (see P2326D)
- ③ NOT INTENDED FOR ACTUAL USER OPERATION
- ④ EMULATION DIAGNOSTICS MENU SHOWN IS FOR DataTrain VIII
- ⑤ OPTIONAL VITAL DIAGNOSTIC PROTOCOL (see P2346W)
- ⑥ OPTIONAL TRAIN-TO-WAYSIDE COMMUNICATIONS MODULE

Figure 4-13. Menu Tree

4.4.5. NVSP Main Menu

After power is applied and the system is initialized, the NVSP Main Menu, shown in Figure 4–14, 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 NVSP 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 menus and selections are explained below. The available sub-menus 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.

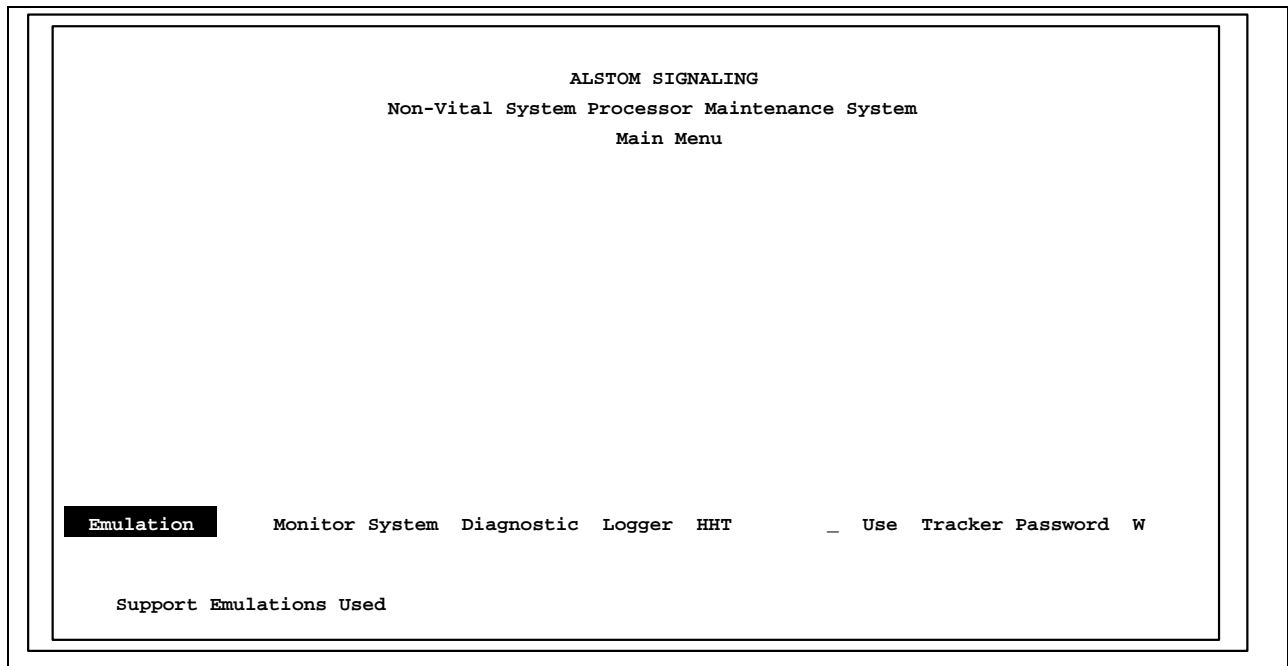


Figure 4–14. NVSP Main Menu

Table 4–9 describes the options available in the NVSP Main Menu. Further explanation of options is provided later.

Table 4–9. 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 the 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: <ul style="list-style-type: none"> • The application's NVSP 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. NVSP offers detailed event diagnostic capability. For details on this advanced data logging feature refer to Alstom Publication P2512E.

Table 4–9. Main Menu Choices (Cont.)

Option	Description
Password	<p>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.</p> <p>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 enter it again.</p>
W	<p>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.</p>

4.4.6. Emulation Menu

The Emulation Menu , shown in Figure 4–15, is displayed by selecting *Emulation* from the Main Menu. The Emulation Menu provides access to communication protocol emulations loaded in the NVSP 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

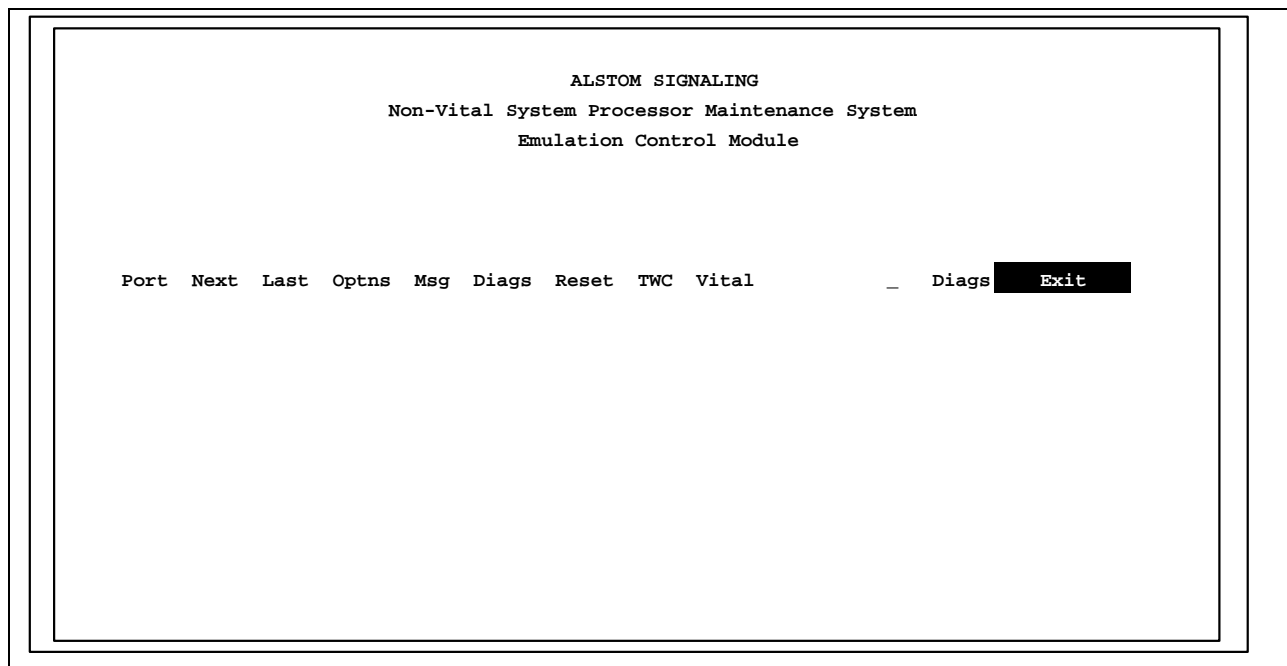


Figure 4–15. Emulation Menu

Refer to the Table 4–10 for a brief description of the available options in the Emulation Menu, after which the menu choices are described in more detail.

Table 4–10. Emulation Menu Choices

Option	Description
Port	Select the serial port of interest (for example, 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 <i>Next</i> , <i>Last</i> , <i>Optns</i> , <i>Msg</i> or <i>Diags</i> menu choices.
Next	Display the 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 <i>Next</i> and <i>Last</i> options behave identically.
Last	Display the 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 NVSP 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).
Exit	Return to the Main Menu.

4.4.6.1. Emulation Menu Choice: *Port*

The *Port* menu choice allows the user to specify the NVSP serial port 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 4–16.

```
ALSTOM SIGNALING
Non-Vital System Processor Maintenance System
Emulation Control Module

Port      Next  Last  Optns  Msg  Diags  Reset  TWC  Vital      _  Diags  Exit

Port 1 has 1 stations using 51612 - 001 - 23 REV F 36 Aug 31 2001 , 13:49:56

DATATRAN (R) VIII
```

Figure 4–16. Emulation Menu – Select the Serial Port

4.4.6.2. 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 4–17 for a sample screen. The *Next* or *Last* menu choices are most useful for a port having multiple stations, otherwise information for station 1 is always 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

```

                                ALSTOM SIGNALING
                                Non-Vital System Processor Maintenance System
                                Emulation Control Module

Port  Next      Last Optns Msg Diags Reset TWC Vital      _ Diags  Exit
Station #1
Control address  ( 08 ) = 00000050
Message length  = 128 , Located at 0000 : 77 EC
Last message posted : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Indication address  ( 08 ) = 00000050
Message length  = 536 , Located at 0000 : 786 D
Last message posted : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 10
Special message
Message length  = 0 , Located at 0000 : 0000
Last message posted :
    
```

Figure 4–17. 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 4–11 to convert data from hexadecimal to binary. In this example, no Special Message buffer is defined in the application for station 1.

Table 4–11. 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

4.4.6.3. Emulation Menu Choice: *Optns*

The *Optns* menu choice is used to view the selected communication port's setup. Figure 4–18 shows an example screen if *Optns* is selected.

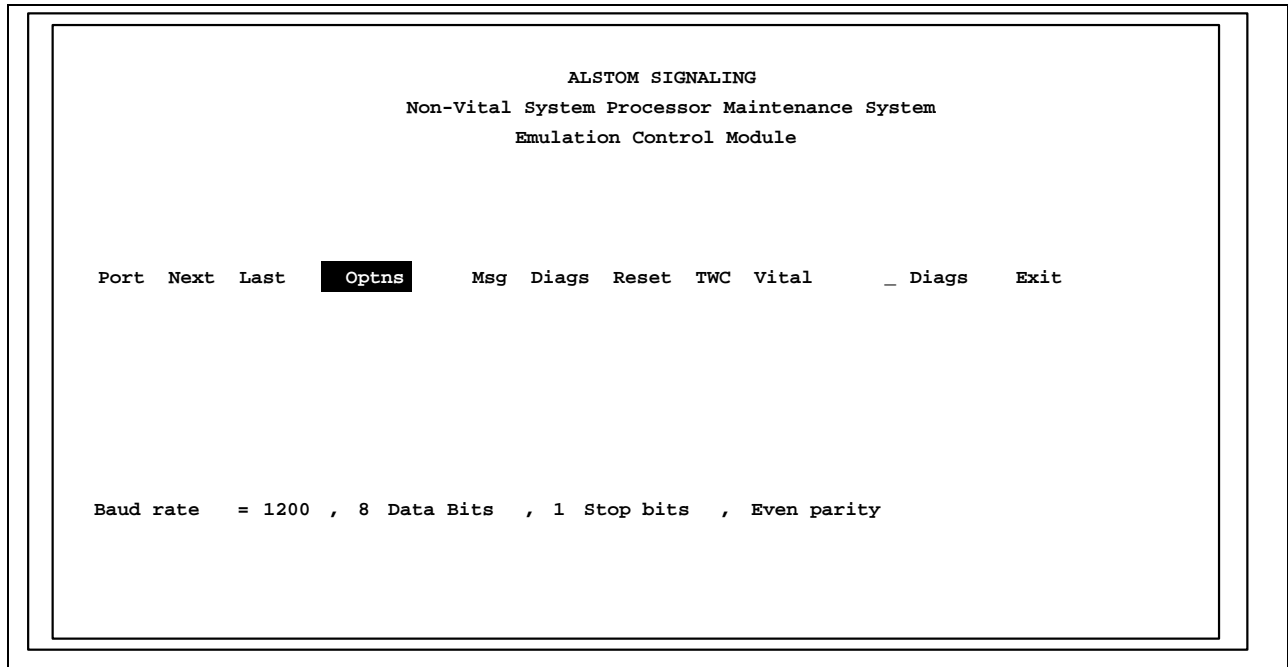


Figure 4–18. Emulation Menu – View Port Setup

4.4.6.4. 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 4–19. This menu offers the following selections: *Post*, *Disp* (Display), *Spcl* (Special), and *Mode*. These options are discussed in detail on the next few pages.

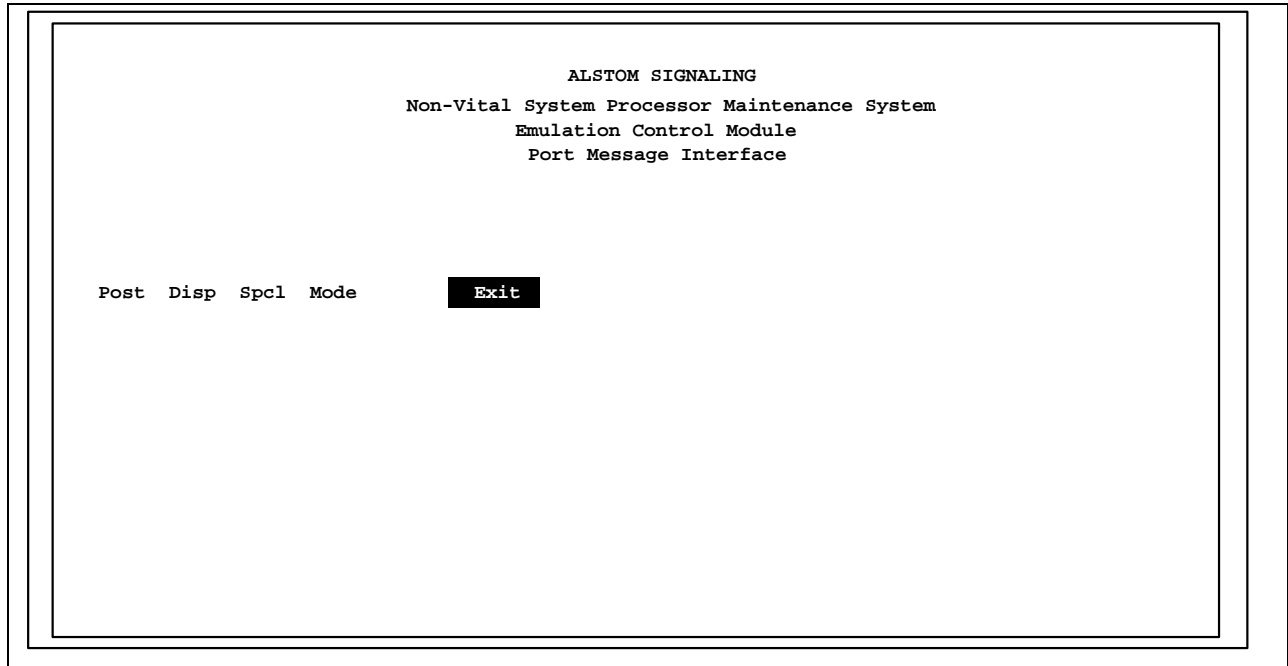


Figure 4–19. Emulation Menu – Message Sub-Menu

4.4.6.5. 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 4–20 shows an example screen if the *Post* option is selected for a control message containing 16 bits (2 bytes).

WARNING

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

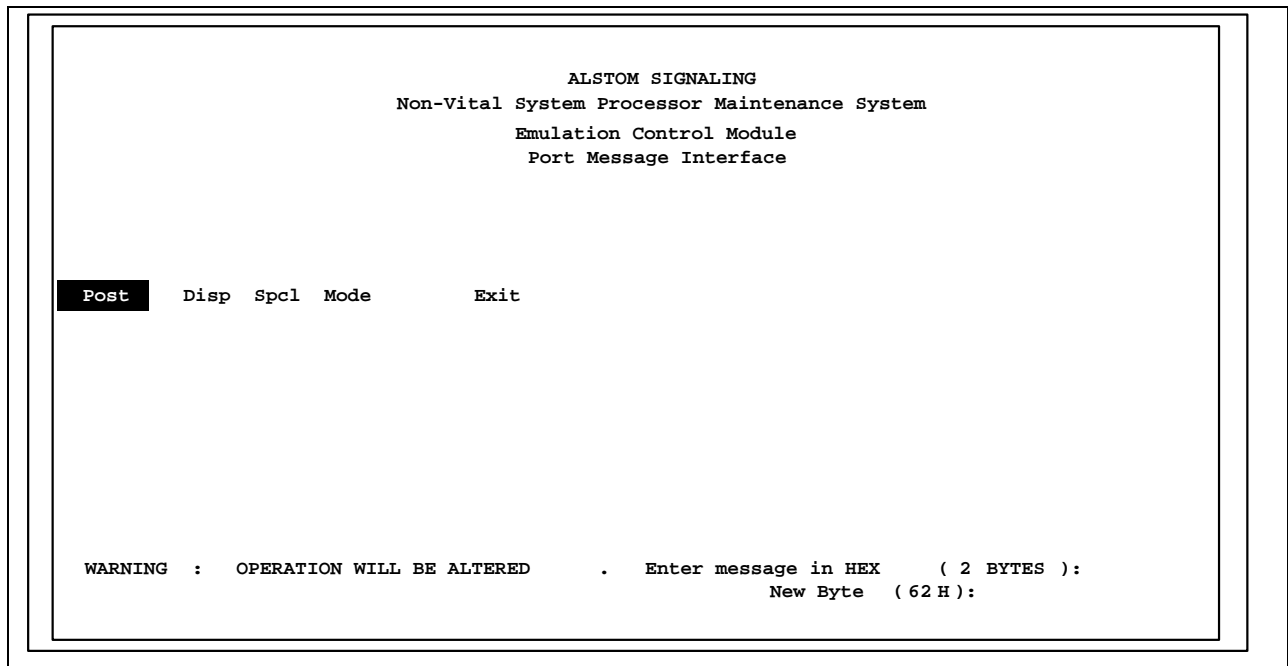


Figure 4–20. Post a Control Message

4.4.6.6. 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 4–21 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 iVPI. For specifics, refer to each protocol's manual (Alstom publication series P2346).

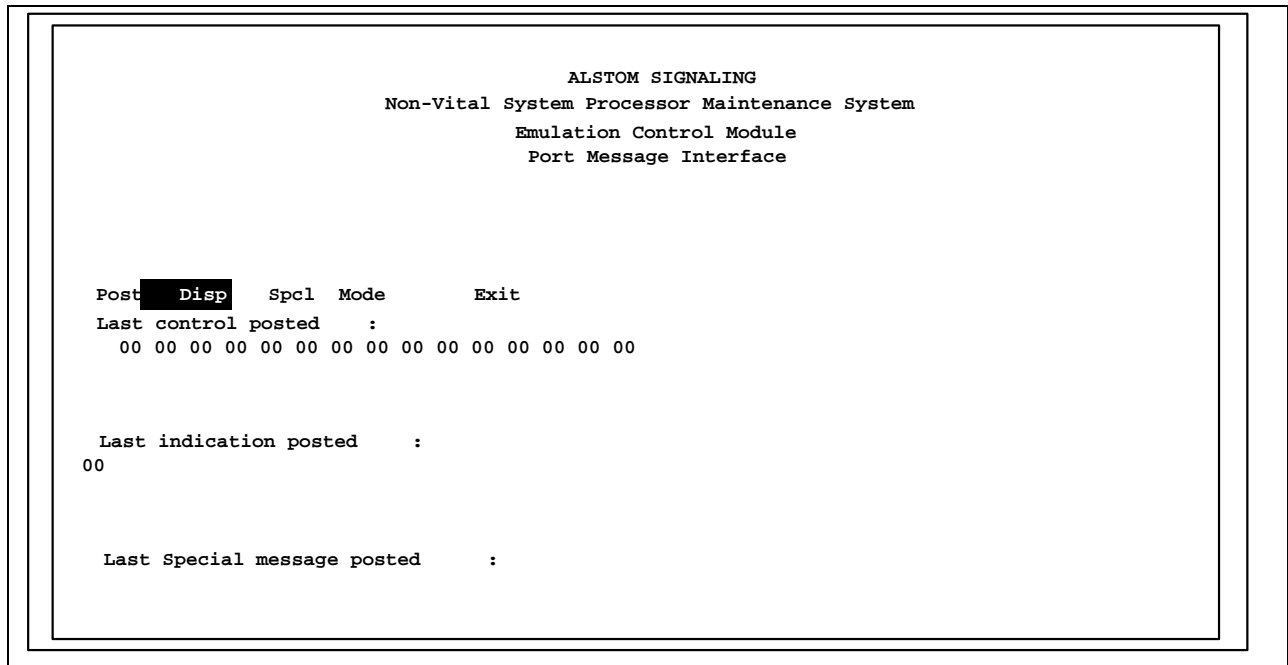


Figure 4–21. Display Messages in Real-Time

4.4.6.7. 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 4–22 shows an example screen if the *Spcl* option is selected for a Special Message containing 24 bits (3 bytes).

WARNING

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

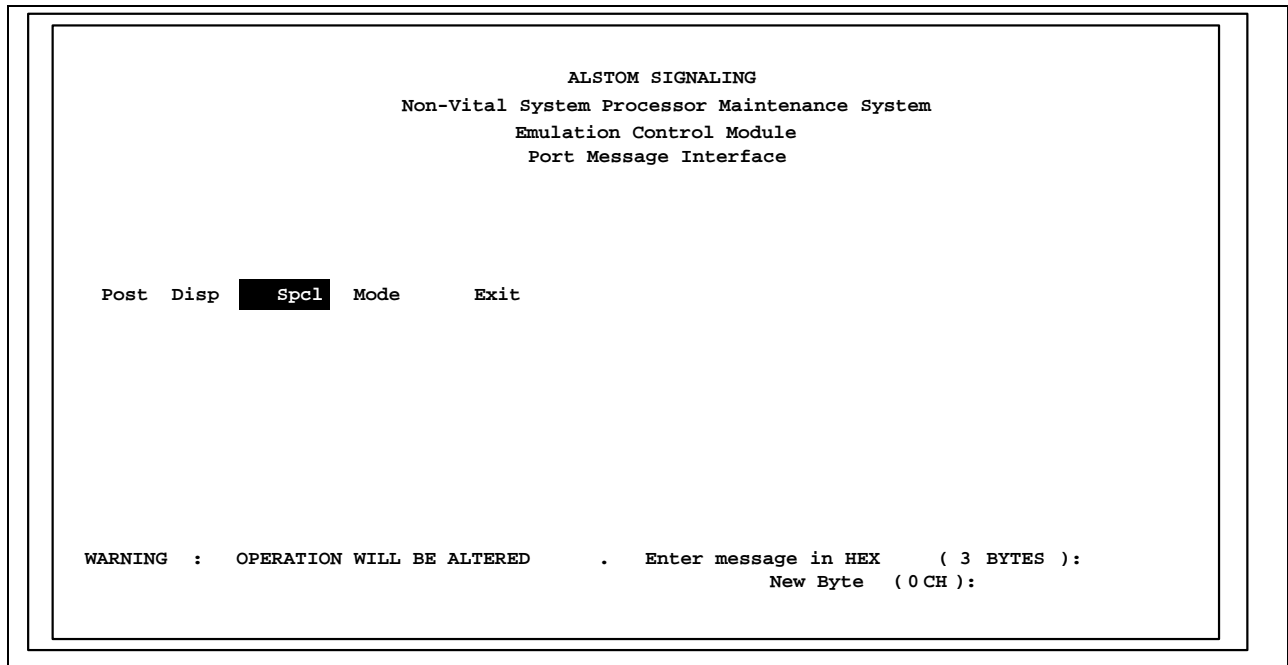


Figure 4–22. Post a Special Message

4.4.6.8. 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 4–23. 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.

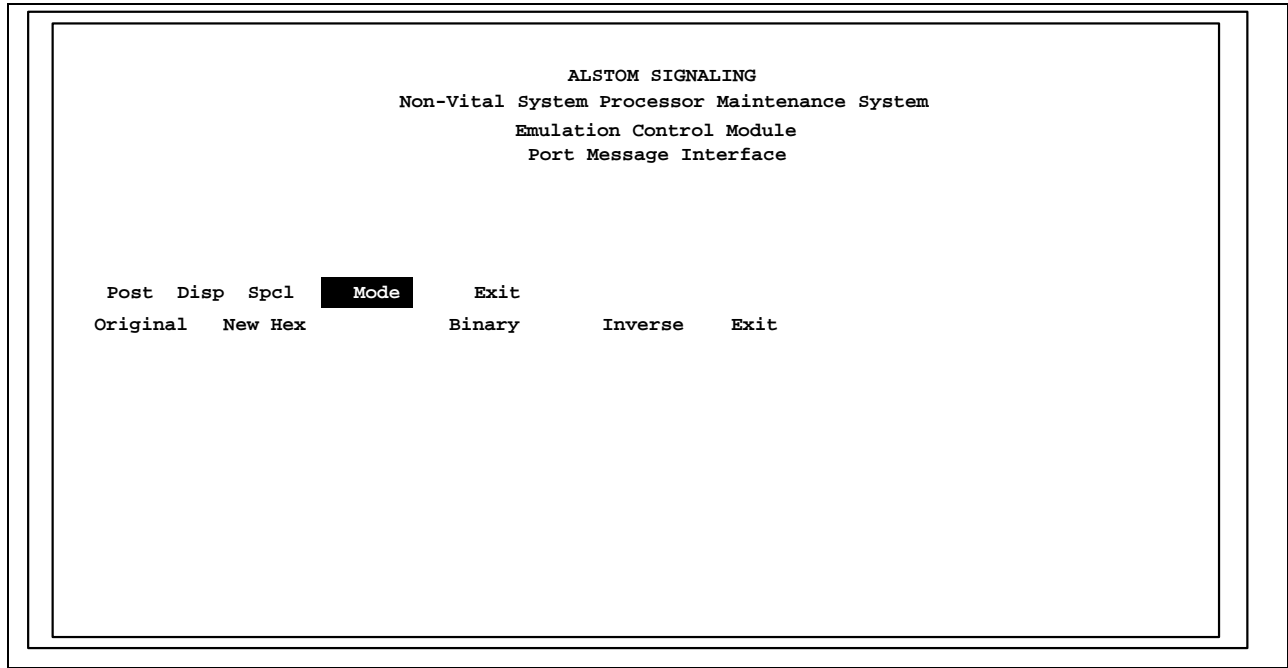


Figure 4–23. Select the Message Display Mode

Table 4–12 describes the message display mode options in this menu.

Table 4–12. 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	<p>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 4–24.</p> <p>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.</p> <p>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.</p>
Binary	<p>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.</p> <p>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 4–25 contains the same data shown in Figure 4–24 (New Hex format), but in Binary format instead.</p>
Inverse	<p>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.</p> <p>For example, the hexadecimal byte 0x01 is shown as 00000001 in Inverse format.</p>

```

                                ALSTOM SIGNALING
                                Non-Vital System Processor Maintenance System
                                Emulation Control Module
                                Port Message Interface

Post  Disp  Spcl Mode  Exit  V  _ Left  B _ Right  G _ Up  _ Down  Home
Bit   01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Last control posted   :
01      00 04 00 00 00 00 00 26 00 51 00      F 2 00 00 00
02      00 00 00 00 00
03      00 00 00 00 00 00
04      00 00 00 00 00 00 00 00 00 00 00 00
Last indication posted :
01      1 C 02 4 A 00 01
02      00
03      00
04      00 00
Last Special message posted   :
01      0 A 12 00
    
```

Figure 4–24. Display Messages – New Hex Display Option

```

                                ALSTOM SIGNALING
                                Non-Vital System Processor Maintenance System
                                Emulation Control Module
                                Port Message Interface

Post  Disp  Spcl Mode  Exit  V  _ Left  B _ Right  G _ Up  _ Down  Home
Bit   01 02 03 04 05 06 07 08
Last control posted   :
01      00000000 01000000 00000000 00000000 00000000 00000000 00000000 01100100
02      00000000 00000000 00000000 00000000 00000000
03      00000000 00000000 00000000 00000000 00000000 00000000 00000000
04      00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
Last indication posted :
01      00111000 01000000 01010010 00000000 10000000
02      00000000
03      00000000
04      00000000 00000000
Last Special message posted   :
01      01010000 01001000 00000000
    
```

Figure 4–25. Display Messages – Binary Display Option

4.4.7. 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 4–26 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

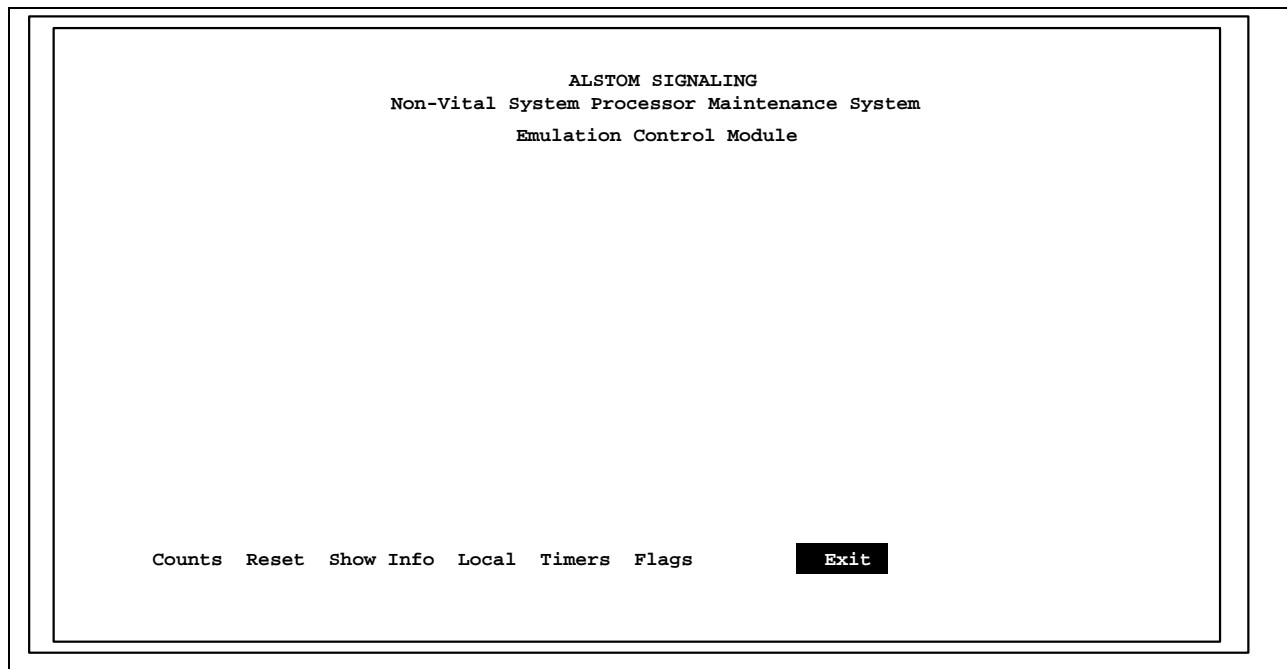


Figure 4–26. DataTrain VIII Diagnostics Menu

4.4.7.1. 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 4–27 shows a typical DataTrain VIII messages counts screen.

Selection Path:

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

```

                                ALSTOM SIGNALING
                          Non-Vital System Processor Maintenance System
                                Emulation Control Module

addr ain bin cin din ein aout bout cout dout eout ack c      _ state
   50  0  0  0  0  0  0  0  0  0  0  0  55  55      1
Msg Aborts   = 1

Counts  Reset Show Info Local Timers Flags Exit

```

Figure 4–27. 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.

4.4.8. Monitor Menu

The data monitor screen is viewed by selecting Monitor from the Main Menu. Use the data monitor to observe message traffic on one or more code system ports, as shown in Figure 4–28.

Selection Path:

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

```

                                ALSTOM SIGNALING
                                Non-Vital System Processor Maintenance System
                                Monitor Module

Logging : ON   Scroll : ON
DC events : OFF   Serial messages : REMOTE
Field Changes : OFF   Other messages : OFF
ANSI mode : OFF   Ports : 1
Local I / O   Change   DC   Other   Ansi   Scroll   Port   EXIT

>T < AE  50 00 00 00 00 00 00 00
>R <    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
>S <    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
>T < AE  50 00 00 00 00 00 00 00
>R <    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
>S <    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

```

Figure 4–28. 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 4–13 provides a description of the choices available in the Monitor Menu.

Table 4–13. 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 4–14.

Table 4–14. 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 4–15.

Table 4–15. Message Descriptors

Message Type	Description
>T<	Transmitted message (e.g. an indication).
>R<	Received message (e.g. 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.

4.4.9. System Configuration Information

System configuration information is displayed by selecting System from the Main Menu. 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 4–29 shows a typical system configuration screen.

Selection Path:

- Main Menu
 - System

```
ALSTOM SIGNALING
Non-Vital System Processor Maintenance System
Main Menu

Application Software      : 33028 - 982 GR 00 H Generated      : 08 / 31 / 2001 13 : 51
CSEX ID      : LOCATION XYZ
CAA Drawing No      . : 31746 - 029 GR 00

System Generated      : 51615 - 408 - 12 Rev H 12 Jul 21 2000 , 16 : 14 : 23
51612 - 012 - 016 Rev A 16 CentraCode II Data Logger Apr      30 2001 at 12 : 44 : 50
Port 1 : 51612 - 001 - 23 REV F 36 Aug 31 , 2001 , 13 : 49 : 56 DATATRAN ( R ) VIII
Port 2 : Not used
Port 3 : Not used
Port 4 : Not used
Port 5 : Not used
```

Figure 4–29. NVSP System Configuration Screen

4.4.10. System Diagnostics Menu

The System Diagnostics Menu is displayed by selecting Diagnostic from the Main Menu. 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 4–30 shows the System Diagnostics Menu. Table 4–16 summarizes the system diagnostic menu choices.

Selection Path:

- Main Menu
 - Diagnostic

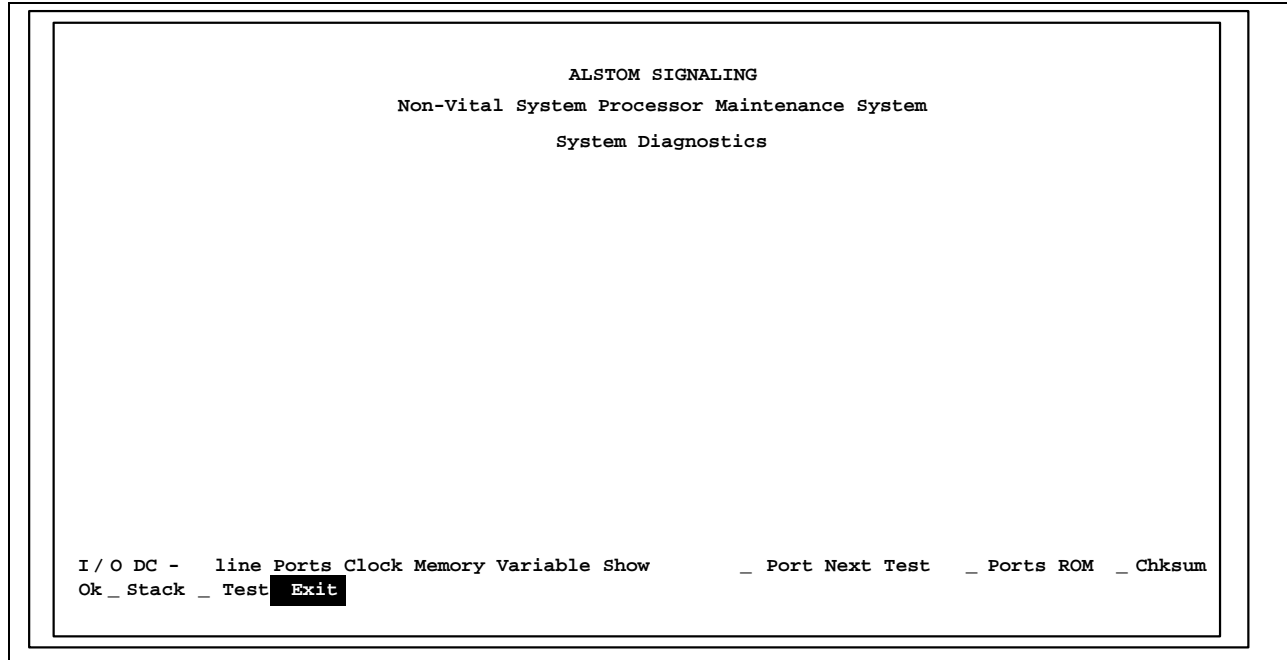


Figure 4–30. NVSP System Diagnostics Menu

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 intended for field maintainer use. Some options that affect system operation can be password-protected.

Table 4–16. System Diagnostic Menu Choices

Option	Description																		
I/O	<p>This option leads to a submenu. Use the <i>Local</i> menu choice in this submenu to view the current state of all non-vital inputs and outputs in the iVPI system. I/O states are updated in real-time only after the <i>Disp</i> 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).</p> <p>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 iVPI system, as shown below:</p> <table border="0"> <tr> <td>Code</td> <td>NVO State</td> </tr> <tr> <td>0001 (1)</td> <td>Steady on</td> </tr> <tr> <td>0010 (2)</td> <td>Source</td> </tr> <tr> <td>0100 (4)</td> <td>Pulse, width 1</td> </tr> <tr> <td>0101 (5)</td> <td>Pulse, width 2</td> </tr> <tr> <td>1000 (8)</td> <td>Normal flash, phase A</td> </tr> <tr> <td>1001 (9)</td> <td>Fast flash, phase A</td> </tr> <tr> <td>1100 (C)</td> <td>Normal flash, phase B</td> </tr> <tr> <td>1101 (D)</td> <td>Fast flash, phase B</td> </tr> </table> <p>From the I/O submenu, individual outputs may be turned on and off manually using the <i>Off</i>, <i>Pulse</i> and <i>Flash</i> menu choices. To do so, first halt the non-vital application logic using the <i>CAA</i> menu choice. Note that this action affects normal system operation.</p> <p>Use the <i>Rate</i> and <i>Mode</i> menu choices to vary the type of each pulsed or flashed output port, and use the <i>All</i> menu choice to apply the latest output type selected to all displayed output ports. The <i>Src/Snk</i> (sink and source) menu choice is applicable to CenTraCode II-s only, and not to NVSP.</p>	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
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																		
DC-line	<p>Monitor the DC codeline, or toggle a DC relay. This menu choice is primarily intended for use by Alstom technical personnel.</p>																		
Ports	<p>View a code line port's setup and current status, and manually modify its configuration (using the <i>CFG</i> submenu choice). Also allows hardware control lines to be manually toggled. This menu choice is primarily intended for use by Alstom technical personnel.</p>																		

Table 4–16. 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 NVSP clock must be initialized when the iVPI system is first put into service or power to the module is left off for more than 48 hours. To set the RTC, use the <i>Clock</i> menu choice followed by the <i>Time</i> (T), <i>Date</i> (D) and then the <i>Initialize</i> (I) submenu choices. Take care to enter the date and time in the exact format shown. Select <i>Exit</i> (E) when done.
Memory	Display an area of NVSP 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:0000). 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:0000). 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 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 4–17.
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 intended for field maintainer use. The choices in the Secondary Diagnostics Menu are summarized in Table 4–17.

Table 4–17. 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 NVSP 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 4–18 for all system errors that may be logged by the self-checking mechanism built into the NVSP 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 4–18 lists all 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 NVSP. 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 4–18 details each message and its associated 2-digit error code (applicable to NVSP). In this table, TCB stands for the "Task Control Block" number, whose value is meaningful only to Alstom technical personnel.

Table 4–18. System Errors

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

Table 4–18. System Errors (Cont.)

Code	Displayed Error Message	Possible Cause(s)
1a	Protocol Error <i>n</i>	Error code for protocol emulation initialization (error 13) or other failure.
1b	Unknown reset TCB <i>nn</i> Active	Reset due to unknown cause: <ul style="list-style-type: none"> • Momentary power loss • Reset button manually pressed • Miscellaneous hardware or software failure
1c	Watchdog caused reset TBC <i>nn</i> Active	The main task loop has stalled – the system performs an automatic reset.
1d	Software reset called	Operator-induced software reset caused by: <ul style="list-style-type: none"> • Diagnostic input switch (NVSP) • MAC port diagnostics – <i>Reset</i> option • RAM failure (automatic system reset)
1e	Prom error at <i>n</i>	Test of RAM failed – the system performs automatic reset with the diagnostic display showing Error 1d. <u>n</u> <u>Meaning</u> 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 <i>nn</i>	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 4–18. System Errors (Cont.)

Code	Displayed Error Message	Possible Cause(s)
20	CRC error in port <i>n</i> 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 <i>nnnn</i>	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 <i>nn</i>	Executing code from RAM (invalid) – the system performs an automatic reset.

4.5. EMBEDDED DATALOGGER (DL)

4.5.1. General Information

An Alstom Signaling NVSP 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).

4.5.2. Real-Time Clock

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

4.5.3. Memory Usage

Each NVSP system reserves 256Kbytes 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 4–19.

Table 4–19. 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 (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 the 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.

4.5.4. Directory Frames

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

- System Reset: when the NVSP 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

4.5.5. Log Frames

A Log Frame is composed of event and descriptive data. An event's data is generated by different CTC 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.

4.5.6. 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. NVSP 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 ($258070/23$).

4.5.7. 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.

4.5.8. 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 not set the directory's status to 'expired.'

4.5.9. System Overloading

An NVSP 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 an NVSP 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 (such as 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 NVSP system).

5. SECTION 5 – BOARD REPLACEMENT

5.1. GENERAL

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

5.2. SYSTEM BOARDS

Some board types have configuration data that must remain intact if the board is replaced with a spare.

The VSP and NVSP 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 iVPI system.

5.3. 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 iVPI 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.

5.4. VITAL BOARD REPLACEMENT

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.

5.4.1. VSP Board (P/N 31166-427-XX)

Table 5–1. VSP Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Install software and application on the spare board.
4	Install replacement board, apply system power, and observe the processor messages for errors.
5	If no errors occur, verification of board functionality is complete.
6	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 P2521B, Volume 1, Section 2.
7	Use a terminal connected to VSP board and record system configuration data as described in P2521B, Volume 1.
8	<p>Verify that the configuration data matches exactly that recorded when the system was last commissioned for service.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>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.</p>
9	Return the iVPI system to service. Observe system operation for at least 5 minutes to ensure that all errors have been corrected.
10	Record maintenance performed in the Service Log.

5.4.2. CRG Board (P/N 31166-459-XX)

Table 5–2. CRG 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	Return iVPI system to service and record maintenance performed in the Service Log.

5.4.3. DI Board (P/N 31166-429-XX)

Table 5–3. DI 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. Energize and subsequently de-energize each input and verify the system operates as intended.
5	Return iVPI system to service and record maintenance performed in the Service Log.

5.4.4. GTP Board (P/N 31166-434-XX)

Table 5–4. GTP Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Install software on the spare 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 track output is energized and then de-energized. Observe the system for proper operation.
6	Return iVPI system to service and record maintenance performed in the Service Log.

5.4.5. SBO, LDO, ACO, DBO Boards (P/N 31166-430-XX, -431-XX, -432-XX, -433-XX)

Table 5–5. SBO, LDO, ACO, DBO 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	Return iVPI system to service and record maintenance performed in the Service Log.

5.4.6. System ID Board (P/N 31166-472-XX) and Vital Interface Boards (P/N 31166-473-XX and 31166-485-XX)

Table 5–6. System ID Board and Vital Interface Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the mounting screws securing the board to the appropriate P connector on the VSP or BEX Board
3	Remove the failed board.
4	Install replacement board, reinstalling the mounting screws. <p style="text-align: center;"><u>NOTE</u></p> <p style="text-align: center;">If replacing the System ID board, verify the address configured on the new board matches that of the failed board.</p>
5	Apply system power.
6	Return iVPI system to service and record maintenance performed in the Service Log.

5.5. NON-VITAL BOARD REPLACEMENT

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.

5.5.1. NVSP Board (P/N 31166-428-XX)

Table 5–7. NVSP Board Replacement Procedure

Step	Procedure
1	Remove system power and communications power.
2	Remove failed board.
3	Install software on replacement board.
4	Place board jumpers appropriately, compare jumper locations to those on failed board.
5	Place configuration switches appropriately by comparing the switches to those on the failed board.
6	Install replacement board.
7	Apply system power.
8	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).
9	Return iVPI system to service and record maintenance performed in the Service Log.

5.5.2. NVI Boards (P/N 31166-457-XX)

Table 5–8. NVI Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove failed board.
3	Install replacement board.
c	Apply system power.
5	Return iVPI system to service and record maintenance performed in the Service Log.

5.5.3. NVO Boards (P/N 31166-458-XX)

Table 5–9. NVO Board Replacement Procedure

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

5.5.4. NVSP interface Boards (P/N 31166-474-XX, 31166-475-XX)

Table 5–10. NVSP Interface Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the mounting screws securing the board to the appropriate P connector on the NVSP Board
3	Remove the failed board.
4	Install replacement board, reinstalling the mounting screws
5	Apply system power.
6	Return iVPI system to service and record maintenance performed in the Service Log.

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6. SECTION 6 – VITAL BOARD VERIFICATION

6.1. GENERAL

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

6.2. 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 iVPI 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.

6.3. VITAL INPUT BOARDS

Follow Table 6–1 to test each input port.

Table 6–1. Vital Input Board Functionality Test Procedure

Step	Procedure
1	Using iVPI Module Label or iVPI 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.

6.4. VITAL OUTPUT BOARDS

Follow Table 6–2 to test each output port.

Table 6–2. Vital Output Board Functionality Test Procedure

Step	Procedure
1	Using iVPI Module Label or iVPI Output Report LVC, note the functions assigned to each output. For example: NW-DBO; output to switch machine; 2W-LDO; output to signal.
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.

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