SIEMENS

APPLICATION GUIDELINES

HD/LINK VITAL I/O MODULES A53201

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Siemens Industry, Inc., Rail Automation
9568 Archibald Ave., Suite 100,
Rancho Cucamonga, California 91730
1-800-793-SAFE

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DOCUMENT HISTORY

Version	Release Date	Sections Changed	Details of Change
A			Initial release
B	June 1999		
B.1	April 2013	I	Page 1-2 Changed Figure 1-1 Page 1-28 Changed Table 1-4
		II	Page 2-4 Changed Figure 2-2 Page 2-5 Changed Figure 2-3 Page 2-6 Changed Figure 2-4 Page 2-7 Changed Figure 2-5 Page 2-8 Changed Figure 2-6 Page 2-15 Changed Figure 2-9
		V	Page 5-4 Para 5.1.2.1 Last paragraph rewritten to describe new connector assembly Para 5.1.2.5 Second paragraph rewritten to describe proper WAGO® tool
		Appendix I	Page I-1 Typical HD/LINK Installation Page I-2 Module Wiring Detai
B.2	May 2014	all	Rebrand for Siemens Rail Automation

NOTES, CAUTIONS, AND WARNINGS

Throughout this manual, notes, cautions, and warnings are frequently used to direct the reader's attention to specific information. Use of the three terms is defined as follows:

⚠ WARNING

WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY. WARNINGS ALWAYS TAKE PRECEDENCE OVER NOTES, CAUTIONS, AND ALL OTHER INFORMATION.

⚠ CAUTION

CAUTION

REFERS TO PROPER PROCEDURES OR PRACTICES WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN A POTENTIALLY HAZARDOUS SITUATION AND/OR POSSIBLE DAMAGE TO EQUIPMENT. CAUTIONS TAKE PRECEDENCE OVER NOTES AND ALL OTHER INFORMATION, EXCEPT WARNINGS.

NOTE

NOTE

Generally used to highlight certain information relating to the topic under discussion.

If there are any questions, contact Siemens Industry Inc., Rail Automation Application Engineering.

ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS

Static electricity can damage electronic circuitry, particularly low voltage components such as the integrated circuits commonly used throughout the electronics industry. Therefore, procedures have been adopted industry-wide which make it possible to avoid the sometimes invisible damage caused by electrostatic discharge (ESD) during the handling, shipping, and storage of electronic modules and components. Siemens Industry, Inc., Rail Automation has instituted these practices at its manufacturing facility and encourages its customers to adopt them as well to lessen the likelihood of equipment damage in the field due to ESD. Some of the basic protective practices include the following:

- Ground yourself before touching card cages, assemblies, modules, or components.
- Remove power from card cages and assemblies before removing or installing modules.
- Remove circuit boards (modules) from card cages by the ejector lever only. If an ejector lever is not provided, grasp the edge of the circuit board but avoid touching circuit traces or components.
- Handle circuit boards by the edges only.
- Never physically touch circuit board or connector contact fingers or allow these fingers to come in contact with an insulator (e.g., plastic, rubber, etc.).
- When not in use, place circuit boards in approved static-shielding bags, contact fingers first. Remove circuit boards from static-shielding bags by grasping the ejector lever or the edge of the board only. Each bag should include a caution label on the outside indicating static-sensitive contents.
- Cover workbench surfaces used for repair of electronic equipment with static dissipative workbench matting.
- Use integrated circuit extractor/inserter tools designed to remove and install electrostatic-sensitive integrated circuit devices such as PROM's (OK Industries, Inc., Model EX-2 Extractor and Model MOS-40 Inserter (or equivalent) are highly recommended).
- Utilize only anti-static cushioning material in equipment shipping and storage containers.

For information concerning ESD material applications, please contact the Technical Support Staff at 1-800-793-7233. ESD Awareness Classes and additional ESD product information are also available through the Technical Support Staff.

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GLOSSARY

AAR: Association of American Railroads - An organization that establishes uniformity and standardization among different railroad systems.

AEI: Automatic Equipment Identification - Equipment installed at sites along the track to read and report train consist information.

ATCS: Advanced Train Control System - A set of specifications compiled by the AAR for controlling aspects of train operation.

BCP: Base Communications Package - Defined by the ATCS specifications as the transmitter/receiver base station and associated processors to handle communications between mobile and central office equipment.

BER: Bit Error Rate - Expresses the quality of a communications in the average number of errors per bits sent.

BPSK: Binary Phase Shift Keying - A method of modulating a carrier signal such that one information bit is contained in each symbol.

Chips: The number of bits in the PN code used to represent each data bit in a Spread Spectrum Radio RF communications.

CRC: Cyclic Redundancy Check – An error check code in which a check key is calculated and appended to the data packet to allow the receiver to verify that no data was lost or corrupted in transmission.

CSAT: Cut Section SAT - A Signaling Application Task allowing a Virtual Circuit to be broken in a manner similar to a relay contact in a pole line system.

CSMA/CA: Carrier-Sense-Multiple-Access/Collision Avoidance - A scheme for allowing multiple transmitters sharing a single medium to cooperatively timeshare with a minimum of overlap and interference.

DAX: Downstream Adjacent Crossing - A prediction indication for a remote crossing predictor located somewhere other than the equipment feed point.

dB: Abbreviation for decibel. The standard unit for expressing transmission gain or loss and relative power levels. Decibels indicate the log ratio of power output to power input.

DCE: Data Communications Equipment - Any device (printer, terminal, etc.) that merely transports (establishes, maintains, and terminates a session) but does not originate or consume data.

GLOSSARY Continued

Device	Specific to the Contents Listing, MCF Approval Listing, and Diagnostic Terminal Utility, a device represents the smallest possible breakdown of an ATCS address which identifies an individual Virtual Circuit SAT, Cut Section SAT, etc.
DT:	Diagnostic Terminal - A PC (Personal Computer) with Siemens Rail Automation Diagnostic Terminal (DT) utility installed for configuring a module and reading status and diagnostic information.
DTE:	Data Terminal Equipment - Any device (computer, terminal, etc.) that originates or consumes data over a transmission facility (can act as data source, data sink, or both).
ECD:	External Configuration Device - The EEPROM embedded in the HD/LINK module interface connector used for storing the module configuration data.
Echelon®:	The company that created the LonTalk™ LAN used by an HD/LINK system to communicate between modules and radios at a location. The term is often used to refer to the twisted pair network.
EIA:	Electronics Industries Association - A standards organization in the U.S. specializing in the electrical and functional characteristics of interface equipment.
ERP:	Effective Radiated Power - The product of the antenna power (transmitter power less transmission-line loss) times either the antenna power gain or the antenna field gain squared.
FIFO buffer:	First In, First Out - A buffer or shift register configured so that the first data queued is also the first data dequeued - i.e., the sequence is preserved.
GCP:	Grade Crossing Predictor - A railroad highway crossing warning system.
Hayes AT Command:	A set of commands defined by the Hayes Corporation for the control and configuration of modems.
HD Pole Line	Wires strung along wayside poles for carrying signal aspect and other train control information. HD stands for Home/Distant, referring to track block signals.
HD/LINK Module:	A vital I/O module installed at a location to interface with the vital inputs (relay contacts) and vital outputs (relay coils) for a specific application. The HD/LINK module communicates over a LAN to the site SSR for communication over the ATCS linear network.

GLOSSARY Continued

HD/LINK System:	A Linear Network of Individual wayside locations, each of which consists of one or more HD/LINK modules (configured for specific applications), SSRs, and SID modules (optional) communicating over a twisted pair LAN.
HDLC:	High-level Data Link Control - A serial protocol for exchanging synchronous information.
In Service Check Number	A number, unique to a particular HD/LINK Module, that is logged in the Event Log when the HD/LINK Module is in service.
LAN:	Local Area Network - A limited network where the data transfer medium is generally wires or cable. In HD/LINK systems, refers to individual twisted pair Echelon® subnets (or segments) at the different sites of a linear networking operation using radio links between the sites.
LAN Segment:	In this manual, refers to the portion of a linear networking operation that is inclusive of Echelon® nodes connected together to form a subnet only, and is separated from the rest of the total network by routers, bus repeaters, or other types of transmission media such as radio link.
MCF:	Module Configuration File - The HD/LINK configuration data.
MEF	Module Executable File - The HD/LINK executable software.
NMS:	Network Management System - A collection of computer programs for managing, monitoring, and troubleshooting an ATCS network.
Null-Modem:	A cable or adapter that connects two DTE devices directly (eliminates the requirement for modems) by emulating the physical connections of a DCE (the Transmit output of each DTE is connected to the Receive input of the other DTE).
Out Of Service Check Number	A number, unique to a particular HD/LINK Module, that is logged in the Event Log when the HD/LINK Module is out of service.
PN code:	Pseudo Noise code - A binary code mathematically optimized in such a way that when used to modulate a transmit carrier signal, the energy is spread evenly over the complete band.
QPSK:	Quadrature Phase Shift Keying - A method of modulating a carrier signal such that two information bits are contained in each symbol.

GLOSSARY Continued

RS232: EIA interface standard between DTE and DCE, employing serial binary data interchange.

RSSI: Received Signal Strength Indication - A numerical value indicating the relative/absolute strength of received carrier.

RTU: Remote Terminal Unit - Also known as Field Code Unit or Code Unit. Used to perform non-vital I/O under control of a central office unit.

SAT: Signaling Application Task - A Virtual Circuit, Cut Sections, or other logical software entity.

SID: Site IDentification module - A memory device installed at a location for storing configuration data for the site SSR and attached to the LAN.

Signal Aspect: The appearance of a fixed signal conveying an indication as viewed from the direction of an approaching train; the appearance of a cab signal conveying an indication as viewed by an observer in the cab.

SIN: Site (Subnode) Identification Number - A twelve-digit ATCS address representing the module as a subnode on the network.

Spread Spectrum: A method of using frequency hopping, direct-sequence modulation, or pulsed FM to spread a radio's RF energy over the complete bandwidth of the radio.

SSR: Spread Spectrum Radio - In this manual, refers to Safetran's S^3/Link radio that uses direct-sequence modulated broadband transmissions for security and noise immunity.

UAX: Upstream Adjacent Crossing - A control indication typically driven from a remote crossing predictor (DAX) location.

UCN: Unique Check Number - A configuration validation number calculated from the contents of an approved MCF and issued to be entered into an HD/LINK Module for the purpose of verifying proper configuration.

VPI: Vital Parallel Input - A vital Input to the HD/LINK Module, designed primarily to read the state of a vital signaling relay.

VRO: Vital Relay Output - A vital Output from the HD/LINK Module, designed primarily to drive a vital signaling relay.

VSAT: Virtual Circuit SAT - A software Virtual Circuit termination device known as a Signaling Application Task for providing logical functionality, and possessing its own unique ATCS address.

GLOSSARY Concluded

WAN: Wide Area Network - A large scale network which incorporates smaller networks (LANs or MANs). In HD/LINK systems, refers to the ATCS network and includes the wireless linear networking operation.

WCP: Wayside Communications Package - Radio and associated processor used by mobile and wayside ATCS compatible equipment to communicate to a central office.

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SECTION I

INTRODUCTION

1.0 GENERAL

An HD/LINK Vital I/O installation consists of one or more vital modules configured to form a specific application, such as the controlling of vital outputs dependent on the state of inputs, stored states, and in accordance with the application data. An HD/LINK installation may be combined with HD/LINK installations at other sites to perform a linear networking function.

An HD/LINK Vital I/O module (hereinafter referred to as HD/LINK module) is a DTE device that interfaces by means of synchronous signals through a non-vital (NV-LAN) Echelon® LonTalk™ interface with other DTE devices, or to DCE devices such as a radio or modem. Each NV-LAN interface has a unique ATCS address, or Subnode Identification Number (SIN), all of which are maintained in an ATCS Address Database to verify and guarantee uniqueness of each SIN. The module also interfaces with vital inputs and outputs such as relay contacts and relay coils. Figure 1-1 illustrates the HD/LINK module with its interface connector installed.

1.1 SCOPE

This manual describes the principles, typical applications, installation, operation, and diagnostics for the HD/LINK module. In addition, this manual includes information on other aspects of the HD/LINK system (such as the Spread Spectrum Radio) as they relate to the HD/LINK module. HD/LINKer, the configuration utility for the HD/LINK module, is described in a separate manual.

1.2 APPLICABLE DOCUMENTS

Installation Handbook, HD/LINK™ Vital I/O Module, 53201 (Siemens Rail Automation Document # SIG-00-97-07)

Troubleshooting Handbook, HD/LINK™ Vital I/O System, Including 53201, 53308, & 53429 (Siemens Rail Automation Document # SIG-00-97-18)

Instruction & Installation, S^3Link™ Spread-Spectrum Radio (Siemens Rail Automation Documents # COM-00-94-04 & COM-00-97-21)

User's Handbook, HD/LINKer (Siemens Rail Automation Document # SIG-00-97-08)

User Guide, Network Management System (NMS) (Siemens Rail Automation Document # SIG-00-96-02)

1.3 SYSTEM DESCRIPTION

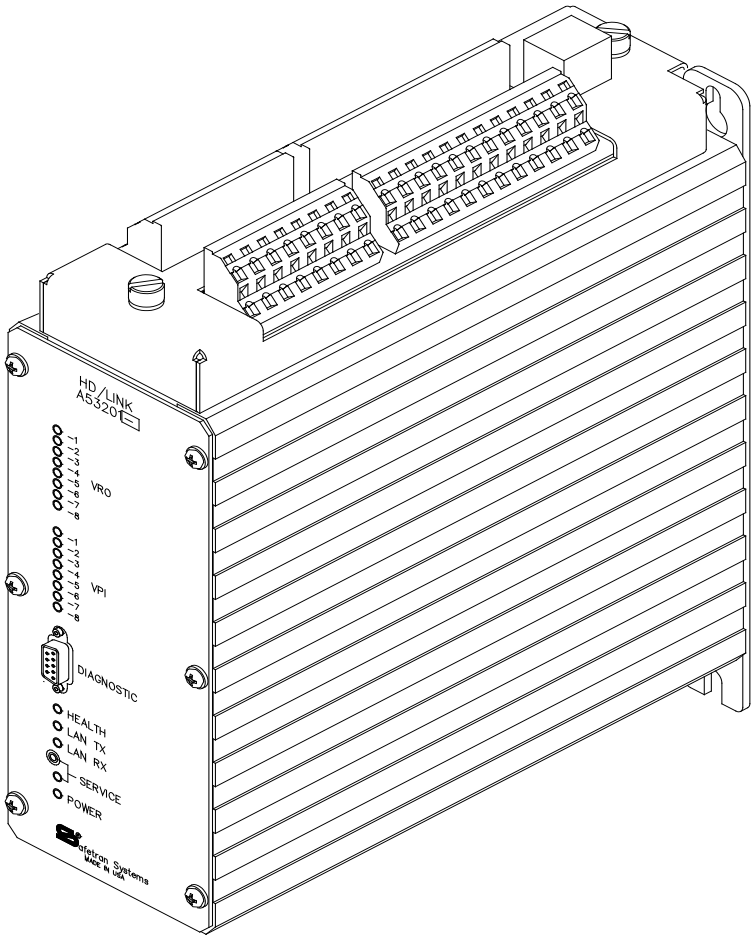
The primary purpose of the HD/LINK module, when combined with a non-vital communications module such as the Safetran Spread Spectrum radio (SSR), is to provide an alternative for pole line and/or cable. The HD/LINK module and SSR provide a drop-in alternative for the pole line, generally with no need to disturb existing relay logic. The relays which interface directly to the

pole line can be connected directly to a robust, detachable, interface connector mounted on the top of the HD/LINK module.

The HD/LINK module, in turn, is connected via LAN to the SSR, which provides the communications link. An additional module that is sometimes required at an HD/LINK system site is the Site Identification Module (SID), Siemens Rail Automation part number 53419 or 53429. The SID is used as an extraneous memory storage device for radio configuration data when the HD/LINK system uses the 53308 SSR, to allow for SSR replacement without requiring reconfiguration.

1.3.1 HD/LINK Module, 53201

The HD/LINK module provides the capability to read the state of a vital input, typically a relay contact, and use this input state to drive a vital output, typically a relay coil. The vital output which is driven may reside on the same module as the vital input, on an adjacent module, or on a remote module. Refer to figure 1-1 for an illustration of the HD/LINK module.



Shown with future External Configuration Device (ECD)
Current release has ECD mounted internally

Figure 1-1. HD/LINK Module With Interface Connector Installed

Each HD/LINK module provides eight vital unipolar inputs (combinable to make four bipolar inputs), and eight vital unipolar outputs (combinable to make four bipolar outputs). These inputs and outputs can also be connected in bidirectional configurations to interface with existing circuits of this nature (refer to Section II, *HD/LINK Module Description*).

A vital ATCS communications protocol is used to safely transfer vital states between HD/LINK modules at different locations using non-vital communications modules, such as Spread Spectrum Radios.

The HD/LINK module is packaged in a rugged metal canister. There should never be a need to open this canister on site, risking damage to printed circuit cards inside. Modules are designed to be quickly and easily replaced without the need for reconfiguration or on-site alignment of any kind. The HD/LINK module incorporates flash memory and serial programmable EEPROMs, thus there is never a need to change EEPROMs. Software and configuration data files are upgradeable via an RS-232 serial link when the need arises.

In order to use an HD/LINK module, it must be configured for the intended application by downloading a Module Configuration File (MCF) into it through the Diagnostic port. The downloaded configuration file is stored in an EEPROM embedded in the interface connector, rather than residing in the module. Placing the configuration EEPROM on the interface connector instead of inside the HD/LINK module allows modules to be replaced without needing to change any configuration data.

The configuration file for the HD/LINK module is created by using the HD/LINKer configuration utility. This is a PC-based configuration tool which allows signaling engineers to allocate HD/LINK modules to the wayside and to design their circuit layout. This configuration information is stored in a central ATCS database. The HD/LINKer configuration utility allows the user to create the Module Configuration Files for each module by using the central ATCS database. The HD/LINKer configuration utility provides a convenient method for managing all aspects of the configuration of the HD/LINK system for the railroad. Refer to the HD/LINKer manual for details on how to use this utility.

Refer to Section II for a description of the HD/LINK module.

1.3.2 Spread Spectrum Radio (SSR), 53301, 53304, 53308

There are currently three Spread Spectrum Radios in use for HD/LINK systems. The 53301 radio (903-927 MHz) is a manually-configured radio for general purpose use. The 53304 radio (900 MHz/2.4GHz capable) is a manually-configured radio used in conjunction with an up/down converter to provide higher frequency operation for congested areas.

The 53308 radio represents Siemens Rail Automation current development of the SSR. It can be manually configured, but is capable of interfacing over the LAN with a Site Identification Module (SID) which provides a separate repository for configuration data. The latest configuration data in the radio can be uploaded to the SID, and whenever a radio is booted or reset, this data is then automatically downloaded into the radio. This feature streamlines the radio replacement procedure, since no manual configuration is involved. The 53308 radio is available

in several versions, depending on application, including a 2.4GHz capability using an Up/Down Converter.
Refer to figure 1-2 for an illustration of a Spread Spectrum Radio.

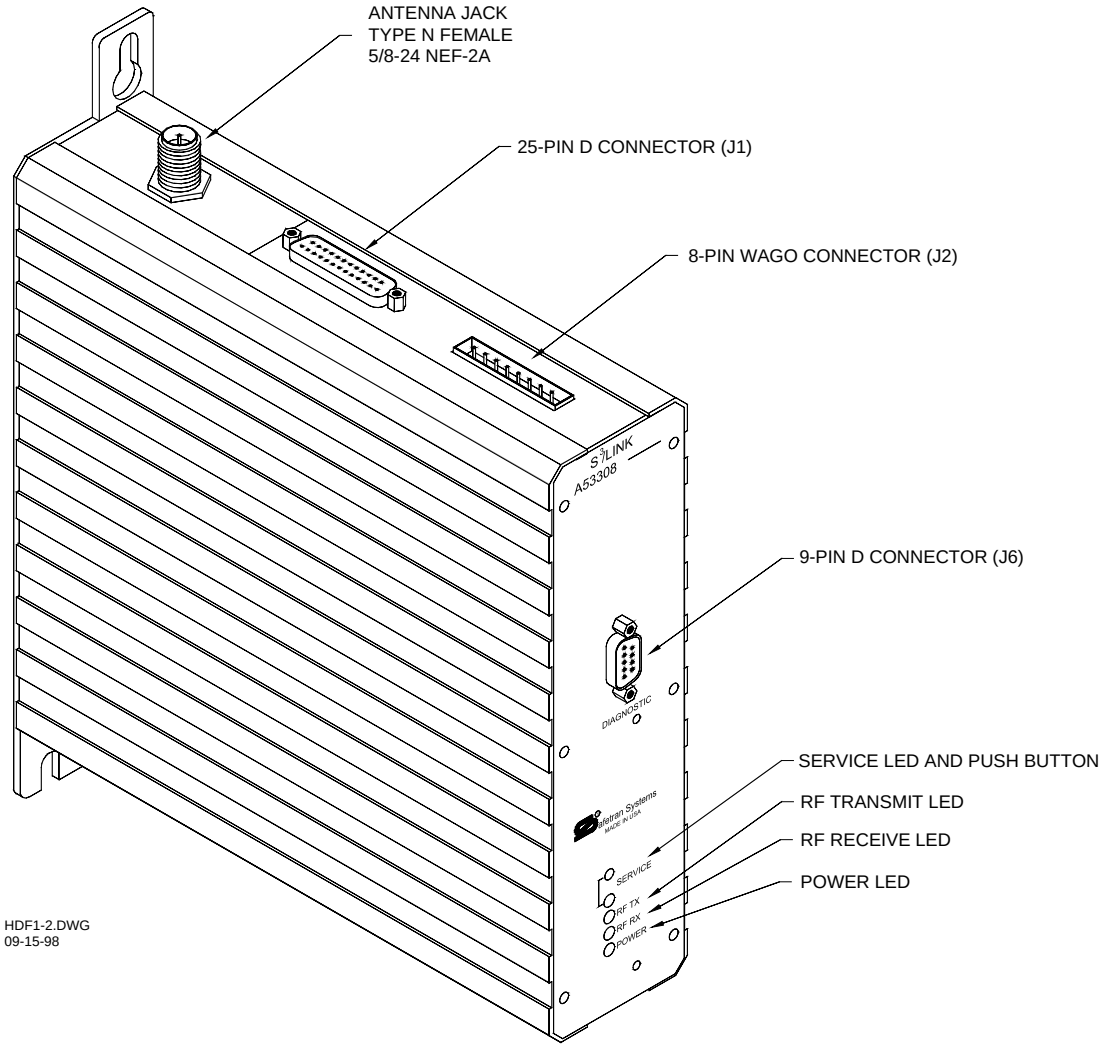


Figure 1-2. Spread Spectrum Radio (53308 shown)

In an HD/LINK system all Spread Spectrum Radios (part numbers 53301, 53304, or 53308) are set up to operate in a linear network. The parameters for this application are established through specific software and hardware configuration (refer to paragraphs 1.3.2.2, 7.6, and 8.2.6 for information on SSR configuration).

NOTE

NOTE

53308 radios are not directly interchangeable with 53301 or 53304 radios in a linear network. To prevent this substitution, the N12 power connection is different on these radios (refer to table 9-4 for pinouts).

1.3.2.1 Linear Networking Operation

The term Linear Networking describes a communications network designed for implementation along railway tracks using Spread Spectrum Radios. In a linear network, each radio is a node in the network configured in such a way that each radio sends and receives messages only with its adjacent neighbor to the immediate left and to the immediate right. The data passed through a linear network originates from HD/LINK units connected to SSRs via an Echelon® LAN.

At selected points, the network may be tied into the ATCS wide-area network to allow seamless communications between wayside and office. Refer to figure 1-3 for the basic Linear Networking application, and figure 1-4 for a typical ATCS network).

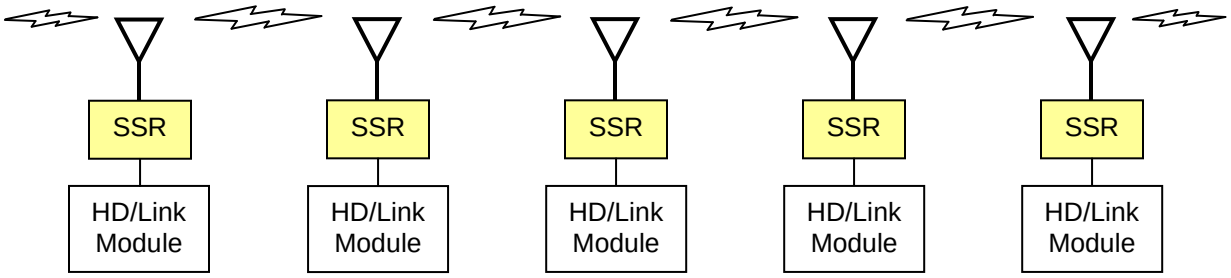


Figure 1-3. Linear Networking Application

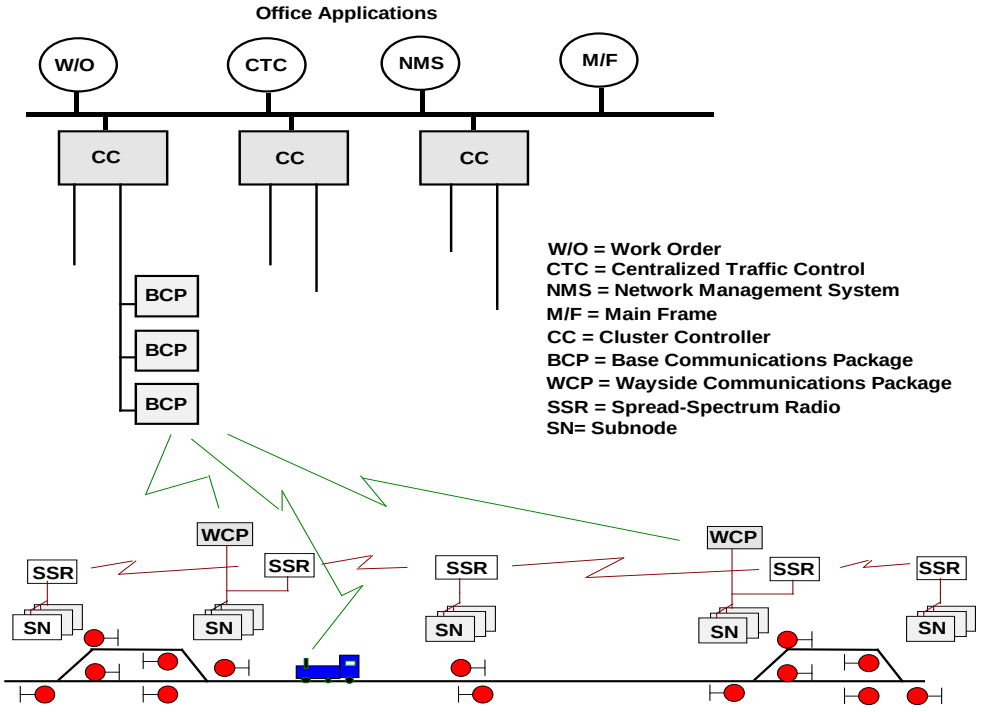


Figure 1-4. Typical ATCS Network

Linear Networking uses time division multiplexing to optimize the use of the RF channel. RF data transmission is in half duplex mode. The leftmost SSR in the network is considered the master and is responsible for keeping all the SSRs to its right in synchronization.

An SSR communicates in both directions, but not at the same time and can only talk to its immediate neighboring SSRs to the right and left. An SSR transmission cannot hop over a neighbor to talk to another SSR. In order for an SSR to send a message to an SSR that is not its immediate left or right neighbor, the message must contain the ATCS address of the destination SSR and the message must pass through each individual SSR in between the originating SSR and the destination SSR.

In Linear Networking, a synchronized four state cycle is used where each SSR is in one of the following states for a fixed period of time:

- Transmit to the left neighbor
- Receive from the right neighbor
- Receive from the left neighbor
- Transmit to the right neighbor

For an SSR that is in the transmit-to-left state, its left neighbor must be in the receive-from-right state. Similarly, for an SSR that is in the receive-from-left state, its left neighbor must be in the transmit-to-right state. Using this scheme, messages may be passed to the left or right until they reach the SSR whose ATCS address matches the destination address in the messages.

Configuration of RF frequencies for left and right neighbor must result in them being unique, and minimum adjacent channel separation must be maintained. To configure the RF frequency parameters, use AT&F*x*, factory configuration command (where *x* is a number from 0 to 7).

Linear networks are ideally suited for linking HD wire replacement systems, hot-box detection equipment, crossing warnings, and other wayside equipment to each other and to the central office without incurring the cost of individual ATCS WCP equipment at each site.

1.3.2.2 Software Identification

An SSR may contain different versions of software, depending on which dash number was specified at the time of product ordering. The dash number specifies SSR options.

The correct dash number for linear networking operation using either the 53301 or 53304 radio is -0611 or -1611, where 6 specifies linear networking configuration. An external label should be attached to the SSR containing the following product identification: 9XXX-53301-X611, or 9XXX-53304-X611.

The correct dash number for linear networking operation using the 53308 radio is -0511 or -1511, where 5 specifies linear networking configuration. An external label should be attached to the SSR containing the following product identification: 9XXX-53308-X511.

This number identifies the radio as configured for linear networking. Another way to determine that the SSR contains the correct software for linear networking is to issue the following command (request for Info) while in command mode:

AT&I

In response to the AT&I command, using the 53301/53304 radio, the following is displayed:

9V129-A01*x* (descriptive text)

In response to the AT&I command, using the 53308 radio, the following is displayed:

9V283-A01*x* (descriptive text)

In the above examples *x* would be replaced by the alphabetic version identification, followed by descriptive text which may indicate the date and time this version was created or SSR revision numbers (e.g., SSR01_10).

Refer to Section IX, *The Linear Networking Spread Spectrum Radio,* for a general description of the linear networking SSR.

1.3.3 Site Identification (SID) Module, 53419 or 53429

The Site Identification Module is a memory device installed at a location and attached to the LonTalk™ LAN for the purpose of storing configuration data for the site SSR (53308 and later versions only). Refer to figure 1-5 for illustrations of the Site Identification Module.

Although a SID is not required at a site for an SSR to operate normally (configuration data is stored in the SSR), use of the SID module makes replacement of SSR modules a plug-and-play feature. The configuration data is automatically downloaded from the SID into any replacement SSRs when they are first booted up.

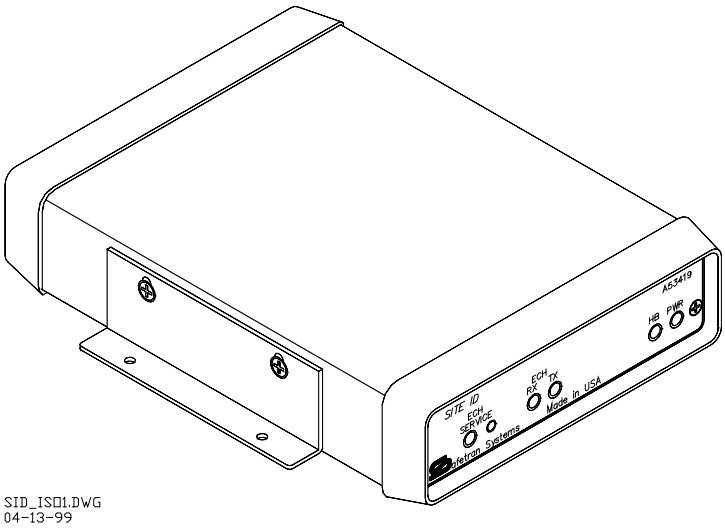
The 32K of non-volatile memory in the SID module is accessed and written to by the SSR over the LAN whenever new configuration data is written into the SSR. This is done by addressing the data on the LAN to node 95, the unique address assigned to the SID. Whenever the SSR is booted or reset, the radio asks the SID to download this data back to the radio.

The SID module does not require forced ventilation and is rated for a temperature range of -40°F to +160°F (-40°C to +71°C).

The SID module is currently available with two case options. The 53419 SID module (see figure 1-5a) is designed for shelf mounting (or wall mounting) and can be rack mounted by using optional 19” or 23” panels or shelves. The 53429 SID module (see figure 1-5b) is designed to be wall mounted using one of two mounting surfaces (can be rack mounted by using an optional

adapter plate, 38969, shown in figure 1-6). The adapter plate makes it possible to mount the 53429 SID module in a rack using relay rails. This arrangement conserves space in a small HD/LINK equipment enclosure.

a. SID Module, 53419



b. SID Module, 53429

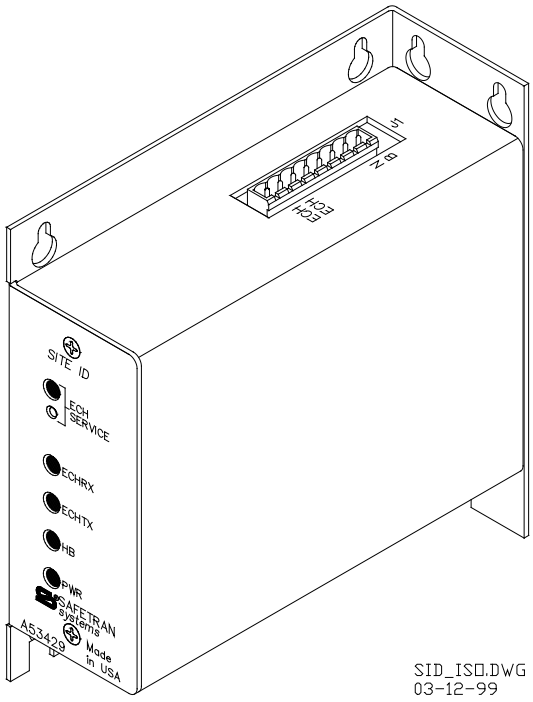


Figure 1-5. Site Identification (SID) Module

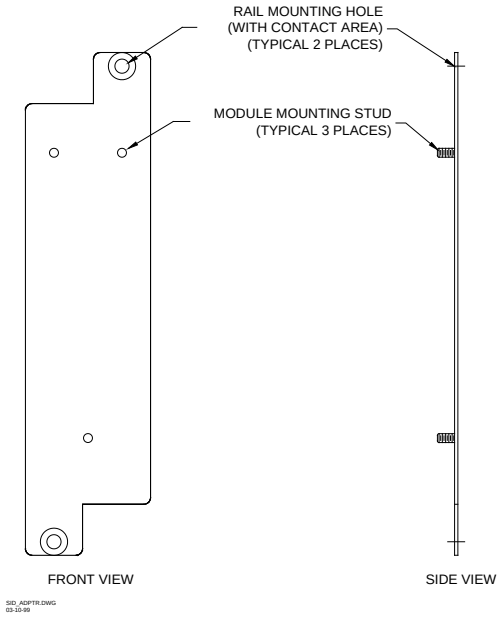


Figure 1-6. SID Mounting Adapter Plate, 38969

1.3.3.1 SID Module Front Panel

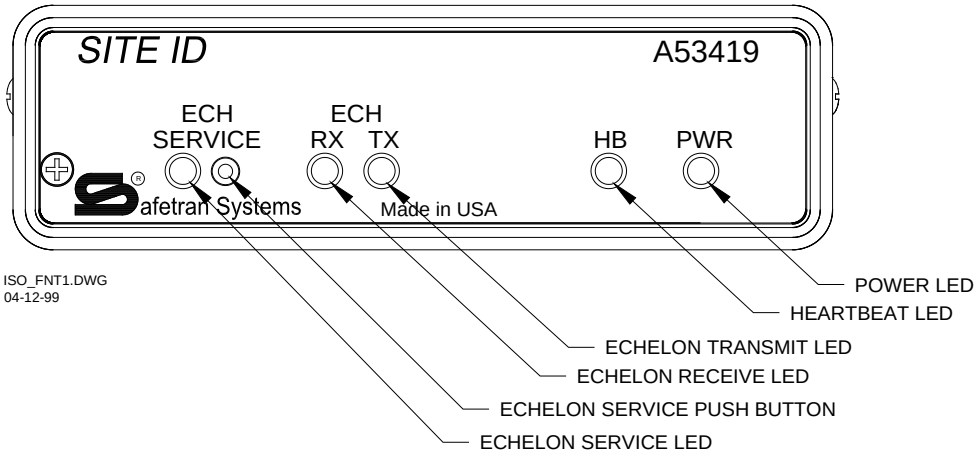
Table 1-1 lists the SID module front panel controls and indicators.

Table 1-1. SID Module Front Panel Control & Indicator Functions

Indicator/Control	Type	Function
ECH SERVICE	Amber LED	For factory use only
ECH SERVICE	Push-button Switch	For factory use only
ECH RX	Amber LED	Flashes once when a message is received over the LAN. During power up and when SSR configuration is saved, the LED displays a short burst of very rapid flashes (generally too fast to be counted)
ECH TX	Amber LED	Flashes once when a message is sent on LAN. During power up and when SSR configuration is saved, the LED displays a short burst of very rapid flashes (generally too fast to be counted)
HB	Red LED	SID heartbeat- flashes continually during normal operation to indicate module health. If off or steadily lit, an operational problem is indicated.
PWR	Green LED	Illuminates to indicate DC power is applied

Figure 1-7 presents illustrations of the SID module front panel.

a. SID Module, 53419



b. SID Module, 53429

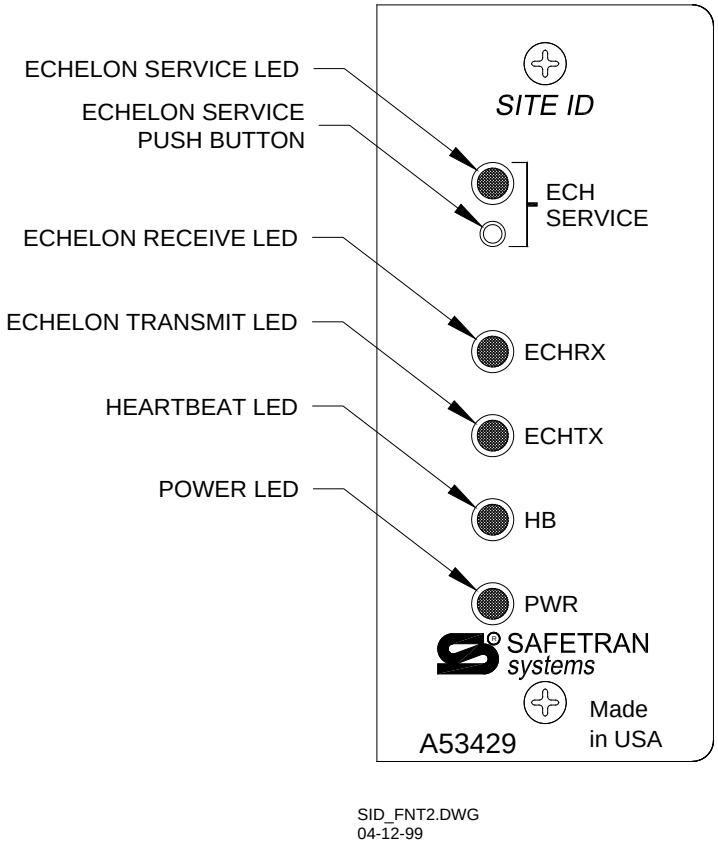


Figure 1-7. SID Module Front Panel

The normal sequence of events when an SSR (53308 and later versions only) is booted is as follows:

1. The SSR performs its initialization procedure. During initialization, the configuration checksum is verified and the Echelon® LAN interface is established.
2. The SSR sends a request over the LAN to the SID to download configuration data.
3. If a SID is not installed, the SSR generates the error message: **SID operational error**, and the SSR does not change configuration data in its EEPROM.
4. If a SID is installed, the SID receives the message requesting configuration data (SID ECH RX LED flashes once) and the following occurs:
   a. If the SID is new and contains no configuration data, the SID cannot send configuration data, therefore the SSR generates an error message: **SID Tag unknown**. The SSR does not change configuration data in its EEPROM.
   b. If the SID contains configuration data, the SID sends its configuration data to the SSR (SID ECH TX LED flashes once).
5. The SSR compares the SID configuration checksum to the SSR configuration checksum.
   a. If the checksum compare fails, the SSR writes the SID configuration data to the SSR (assumes the SID configuration is the correct one), generates an error message: **EEPROM Config updated From SID**, and then reboots the radio (process begins over).
   b. If the checksum compare passes, the SSR is properly configured and begins RF operation.

The normal sequence of events when an SSR (53308 and later versions only) configuration is changed is as follows:

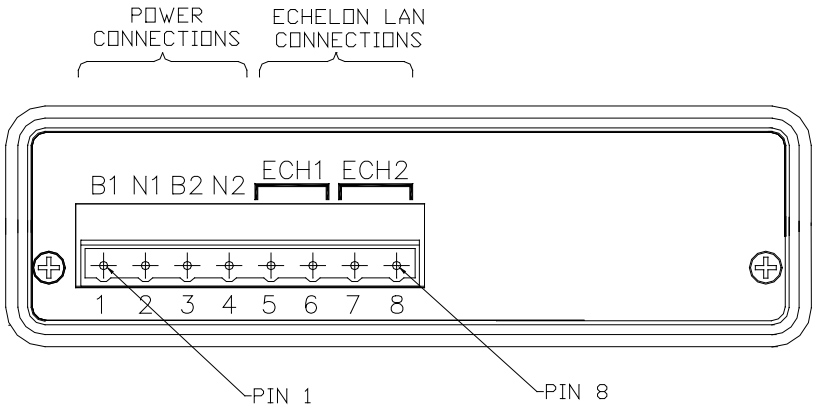
1. New configuration data is written to the SSR EEPROM (in command mode, using the **AT&W** command).
2. The SSR sends configuration data from the EEPROM to the SID module over the LAN.
3. If a SID is installed, configuration data is written to the SID memory (SID ECH RX LED flashes once).
4. If a SID is not installed, the SSR issues an error: **SSR ERR: SID timed out**, and the SSR continues to operate with the new configuration data found in the EEPROM.

A complete list of Runtime error messages involving the SID is presented in Section VII, paragraph 7.2.6.7, *SSR Linear Networking Runtime Errors*.

1.3.3.2 SID Module Interface

The interface connections to the SID module are made through an 8-pin connector and include DC Power and the Echelon® LAN twisted pair interface. The mating connector is supplied with each SID module. The interface connector for the 53419 SID module is not compatible with the connector for the 53429 SID module (size of the connectors and pinouts are different). The 53419 SID module has the interface connector located on the rear of the module, and the 53429 SID module has the interface connector located on the top of the module (refer to figure 1-8).

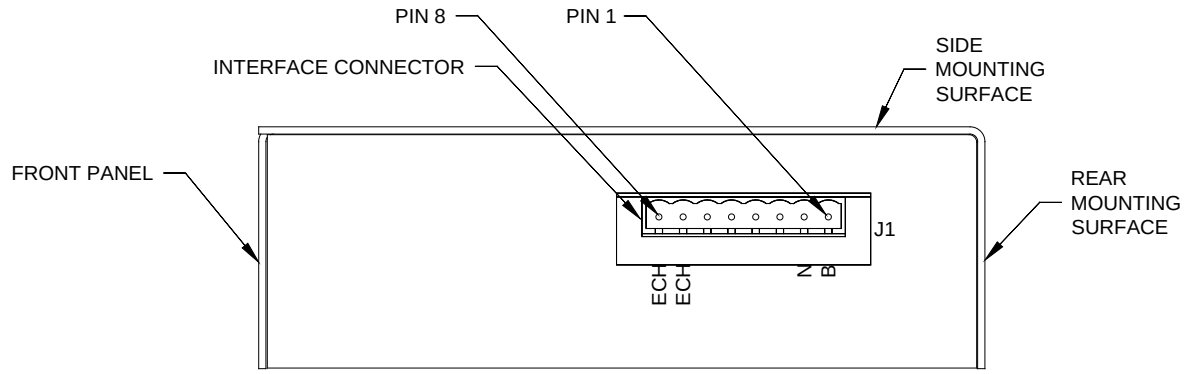
a. SID Module, 53419 (rear view)



NOTE: DO NOT USE THE REDUNDANT POWER AND ECHELON TERMINALS (INTERNALLY JUMPERED) TO DAISY-CHAIN CONNECTIONS, AS DISRUPTION WILL RESULT IF THE SID MODULE (OPTIONAL) IS REMOVED.

SID_REAR1.DWG
04-12-99

b. SID Module, 53429 (top view)



SID_TOP2.DWG
04-13-99

NOTE: PINS 3 THROUGH 6 ARE NOT USED.

Figure 1-8. SID Module Interface

The SID module is designed for a nominal 12VDC power input, such as supplied by a battery, but operates normally over a voltage range of +9.0VDC to +16.5VDC. The power pin-outs for the SID module are labeled B (positive terminal) and N (negative, or return terminal).

The input power and return terminals for the SID are provided with internal secondary surge protection. Siemens Rail Automation strongly recommends installing primary surge protection on the B and N leads.

The LAN interface is labeled ECH and the polarity of the LAN connections is arbitrary. Refer to paragraph 1.8.6, *Echelon® LonTalk™ Interface*, for specifications for the LAN.

Daisy-chaining for the SID module connections can be accomplished by using the dual row screw-downs on the connector supplied (refer to Appendix I for illustrations of typical SID wiring). A single row connector can also be used for the SID module interface.

1.3.4 Surge Panel

For surge protection on the power sources to the HD/LINK system, Siemens Rail Automation supplies surge panels specifically designed for the HD/LINK system, including versions for battery operation only (two DC voltage selections) or for battery and battery charger operation (two DC voltage selections plus 115VAC). Refer to figure 1-9 for an illustration of an AC/DC surge panel, and refer to Section VI for information on surge protection. Table 1-2 presents a list of recommended surge panels for an HD/LINK system.

Table 1-2. HD/LINK System Recommended AC/DC Surge Panels

Part Number	Order Number	Panel Type	Use
43012-13	5000-43012-0013	DC Only (32VDC)	Battery only
43012-21	5000-43012-0021	AC and DC (115VAC & 32VDC)	Battery & charger
43012-22	5000-43012-0022	AC and DC (115VAC & 18VDC)	Battery & charger
43012-23	5000-43012-0023	DC Only (18VDC)	Battery only

NOTE

NOTE

For information on surge protection products, contact Siemens Rail Automation Engineering.

1.3.5 Optional Instrument Case

HD/LINK modules, radio modules, SID modules, and other equipment such as relays, modem, surge panel, battery, and battery charger can be grouped inside a separate enclosure designed for external use. Refer to figure 1-9 for a typical Instrument Case installation.

The suggested enclosure is either Safetran's 051270-260X or 051200-260X (Electro-Mechanical Division part numbers) series instrument cases. These instrument cases are constructed of 0.1 inch thick aluminum sheeting or 14-gauge steel, and are designed for wall, wood pole, or pipe mast mounting (refer to figure 1-10 for mounting brackets, and figure 1-11 for accessories and replacement parts.

The instrument cases are standard 28.375 inches wide by 30.0 inches deep, and are available in heights of 28.0 inches, 39.75 inches, and 51.375 inches. The large and medium sizes are suitable for installations requiring additional equipment (e.g., extra modules, surge panels, relays, battery, battery charger, etc.) besides the minimal HD/LINK system. The small size is ideal for installing piggy-back to an existing instrument house for the purpose of adding a minimal HD/LINK system (e.g., HD/LINK, SSR, and SID, etc.) when no additional room exists inside the existing structure.

Besides the material and height options, the instrument cases are available with two internal options. Both internal options include a RETMA pattern channel installed to provide for 19-inch rack mounting of panels (and modules or relays when used with relay bars or mounting brackets). The channels can be located at the rear of the case to provide for rear panel mounting, or at the front of the case to provide for front panel or shelf mounting.

Each case provides knockouts for conduit (bottom and rear surfaces), aerial cable inlet on each side, and accessories such as an RF PolyPhaser™ TVS surge protector on each side. Conduit bushings are available for conduit ends (see accessories). An aerial cable inlet (see accessories) with cable strain relief eyebolt can be mounted on either side of the case for cable entry or for ventilation.

The door channel is fitted with neoprene gasket to form a weather-tight seal (replacement gasket material can be ordered separately). When open, the door of the case is removable. Door handles (supplied with instrument case) are designed to accept padlocks, or can be locked by means of a built-in locking screw using a standard terminal wrench. Ventilators (top and bottom of door) are provided.

Siemens Rail Automation can also supply instrument cases with equipment installed, wired, and configured, ready for site installation (contact Siemens Industry, Inc., Rail Automation, Louisville Division).

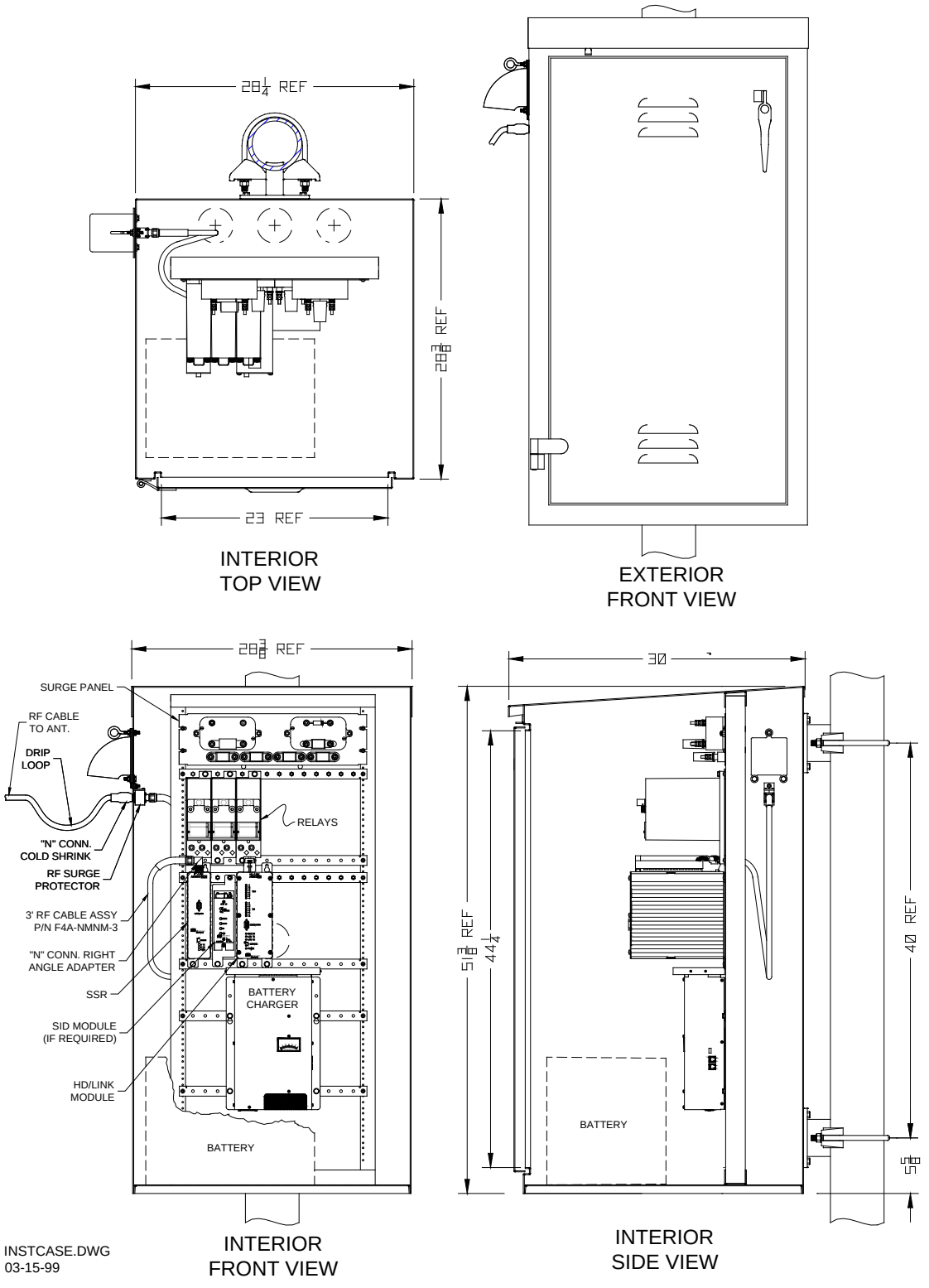
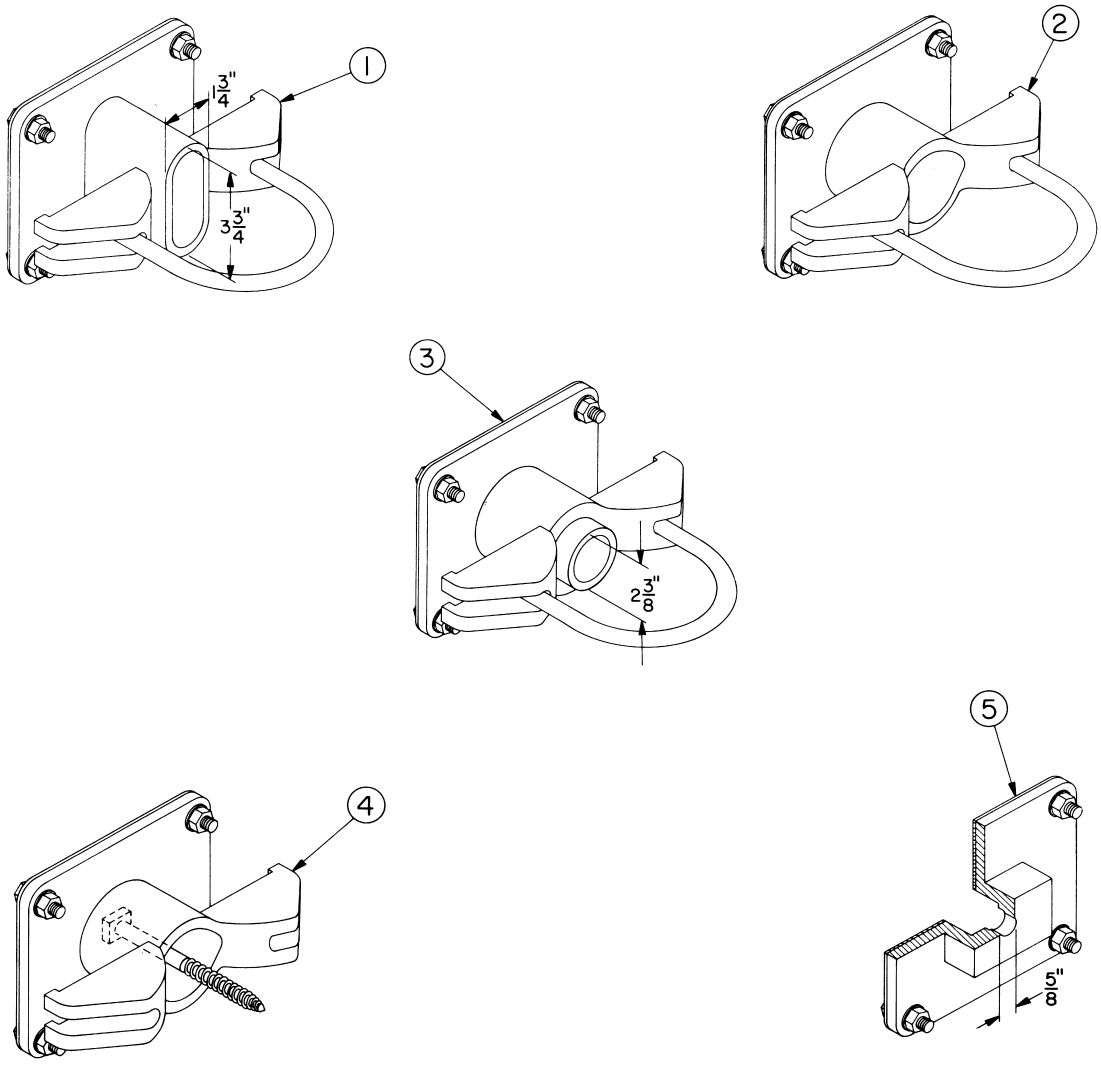


Figure 1-9. Typical Instrument Case Installation (051270-260X Shown With Pipe Mount And Aerial Cable Inlet)



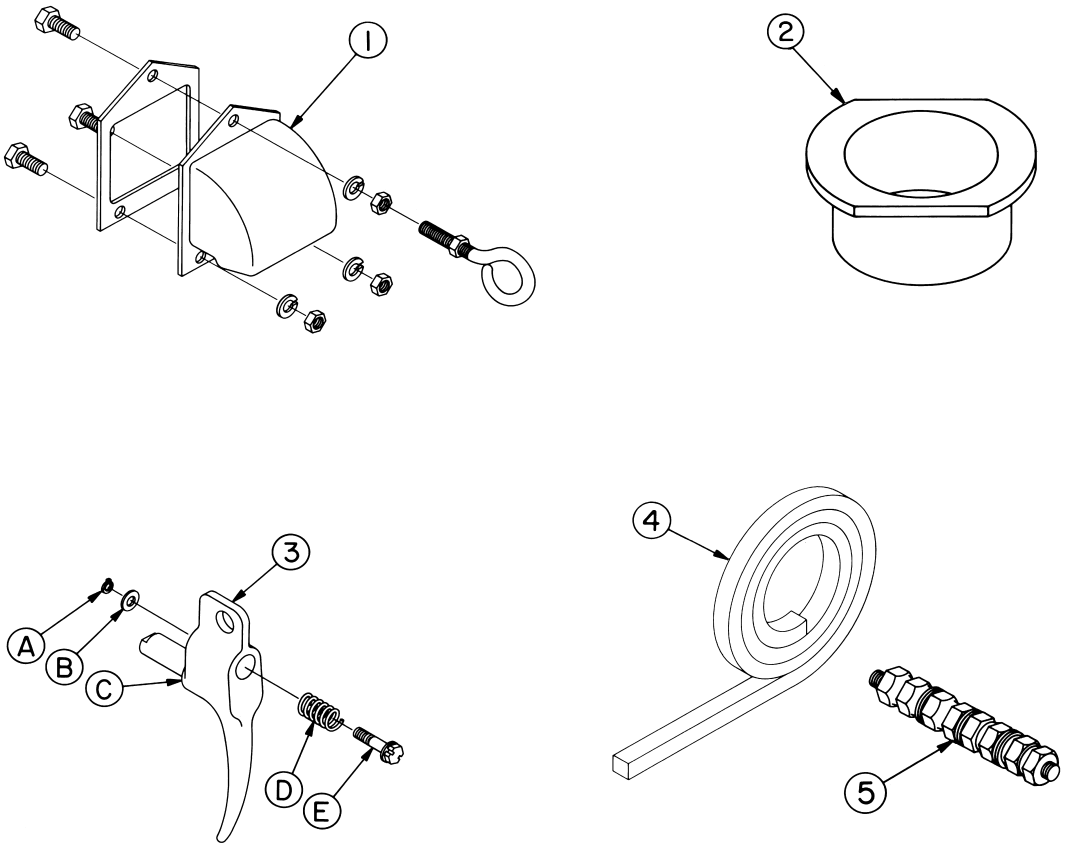
To Order: Specify Application and Part Number

Item Number	Application	Required Hole Size In Pipe Mast In Inches	Part Number[1]
1	4 Inch Pipe[2]	2 x 4	035021-X
2	4 Inch Pipe[2]	None	035023-X
3	4 Inch Pipe[2]	2-1/2 Diameter	035023-1X
4	Wood Pole	None	035023-2X
5	Wall or Concrete Post	None	035030-X

[1]Siemens Rail Automation, Electro-Mechanical Division part numbers.

[2] Adapters for mounting to 5 and 8 inch pipe masts will be furnished upon request.

Figure 1-10. Instrument Case Mounting Brackets



To Order: Specify Description and Part Number

Item Number	Description	Part Number[1]
1	Inlet, Aerial Cable	035035-X
2	Bushing, Bottom	035041
3	Door Handle Assembly	051128-1AX
	Includes: A, Ring, Snap	7564
	B, Washer	051128-2
	C, Handle, Door	051128-5
	D, Spring	051150
	E, Bolt, Locking	051128-1X
4	Gasket, Door, .562" x .75" (Specify Length)	10-08-002
5	Terminal, Ground	035049-X

[1] Siemens Rail Automation, Electro-Mechanical Division part numbers.

Figure 1-11. Instrument Case Accessories & Replacement Parts

1.3.5.1 Instrument Case Ordering Information

Refer to table 1-3 for ordering information for instrument cases.

Table 1-3. Instrument Case Ordering Information

Part Number[1]	Case Material	Case Height	Interior Rack Location
051270-260X	0.1 inch thick Aluminum	51.375 inches	Rear
051270-260X1	0.1 inch thick Aluminum	51.375 inches	Front
051270-260X2	0.1 inch thick Aluminum	39.75 inches	Rear
051270-260X3	0.1 inch thick Aluminum	39.75 inches	Front
051270-260X4	0.1 inch thick Aluminum	28.0 inches	Rear
051270-260X5	0.1 inch thick Aluminum	28.0 inches	Front
051200-260X	14 Ga. (.075) Steel	51.375 inches	Rear
051200-260X1	14 Ga. (.075) Steel	51.375 inches	Front
051200-260X2	14 Ga. (.075) Steel	39.75 inches	Rear
051200-260X3	14 Ga. (.075) Steel	39.75 inches	Front
051200-260X4	14 Ga. (.075) Steel	28.0 inches	Rear
051200-260X5	14 Ga. (.075) Steel	28.0 inches	Front

[1]Siemens Rail Automation, Electro-Mechanical Division part numbers.

1.4 COMPARISON WITH TRADITIONAL POLE LINE SYSTEMS

Although the HD/LINK system is designed to replace pole line systems, its behavior will not be identical to pole line systems. The main differences can be summarized as: communication delays, discrete messages, greater bandwidth, and a need for unique ATCS addressing.

1.4.1 Communication Delays

When a relay changes state at one end of a circuit, the HD/LINK module takes a finite amount of time to transmit this information to the other end of the circuit. This is usually between 0.7 seconds and 1.5 seconds. The delays in the HD/LINK module are due to inherent device propagation delays and built-in or programmed delays.

1.4.2 Discrete Messages

With a pole line system, data is carried continuously down the wire. For an HD/LINK system, data is carried by discrete repeated messages. It is therefore necessary, for an HD/LINK module, to set vital timeout parameters on the receiving end to handle a failure of the communication medium or transmitting end.

1.4.3 Greater Bandwidth

The pole line system only allows as much information to be carried as there are wires to carry it. Due to the excessive cost of line wire, the number of wire circuits is typically minimized. The HD/LINK module does not have this limitation, hence there is no further need to replicate 2-wire HD schemes in new installations (unless one is already present, in which case the existing relays need not be altered). The radio messages can also be used to transmit non-vital diagnostic data so that the equipment operation can be monitored.

1.4.4 Need For Unique ATCS Addressing

With the pole line system, the vital data goes wherever the pole line goes; there is no chance of data being misrouted, other than by a mis-wired relay. With an HD/LINK system, the vital data messages are transmitted via radio. The routing of these messages depends upon the ATCS address encoded in the message. It is therefore theoretically possible for a message from one location to end up at any location on the network. Therefore, to prevent misrouting, it is critically important to ensure that two HD/LINK modules do not have the same ATCS address. This can be achieved by proper use of HD/LINKer configuration utility as described in the HD/LINKer manual.

1.5 TYPICAL APPLICATIONS

The HD/LINK module can be used in any application where input signals need to be translated to output signals. The input signals may be translated from one type of input to a different type of output (LAN-to-relay, relay-to-LAN, etc.), and may include programmed time delays. Two typical applications for the HD/LINK module are as a pole line or cable replacement, and as a stand-alone vital timer.

1.5.1 Pole line Replacement

By utilizing the HD/LINK module in conjunction with the spread-spectrum radio, railroads can extend the reach of their ATCS networks to cover hot-box, crossing warning, AEI, and other wayside equipment where conventional ATCS equipment may be too expensive, too hard to maintain, or does not provide the necessary coverage. The combination of the HD/LINK module and the spread spectrum radio, operating across the LAN, allows for individual sites to be integrated into a large scale linear network, as well as allowing for the transfer of information on the status of equipment. The spread spectrum radios also provide the ability to withstand interference and to operate with a signal-to-noise ratio of less than one (processing gain).

Figures 1-12 and 1-13 show typical applications of the HD/LINK module and Spread Spectrum Radio for replacing 4-wire HD pole lines, and figures 1-14 and 1-15 show typical applications of the HD/LINK module and Spread Spectrum Radio for replacing 2-wire HD pole lines.

The home and distant relay contacts at each signal location are connected to two vital inputs on the HD/LINK module. The state of these contacts is sent, via the radio, to the signal location to its rear (respective to train movement), where two HD/LINK module Vital Relay Outputs (VRO) are used to drive relay coils.

NOTE

NOTE

The dashed arrows in figures 1-12 through 1-15 represent the data transfer over the LonTalk™ LAN interface between the HD/LINK modules and the Spread Spectrum radios.

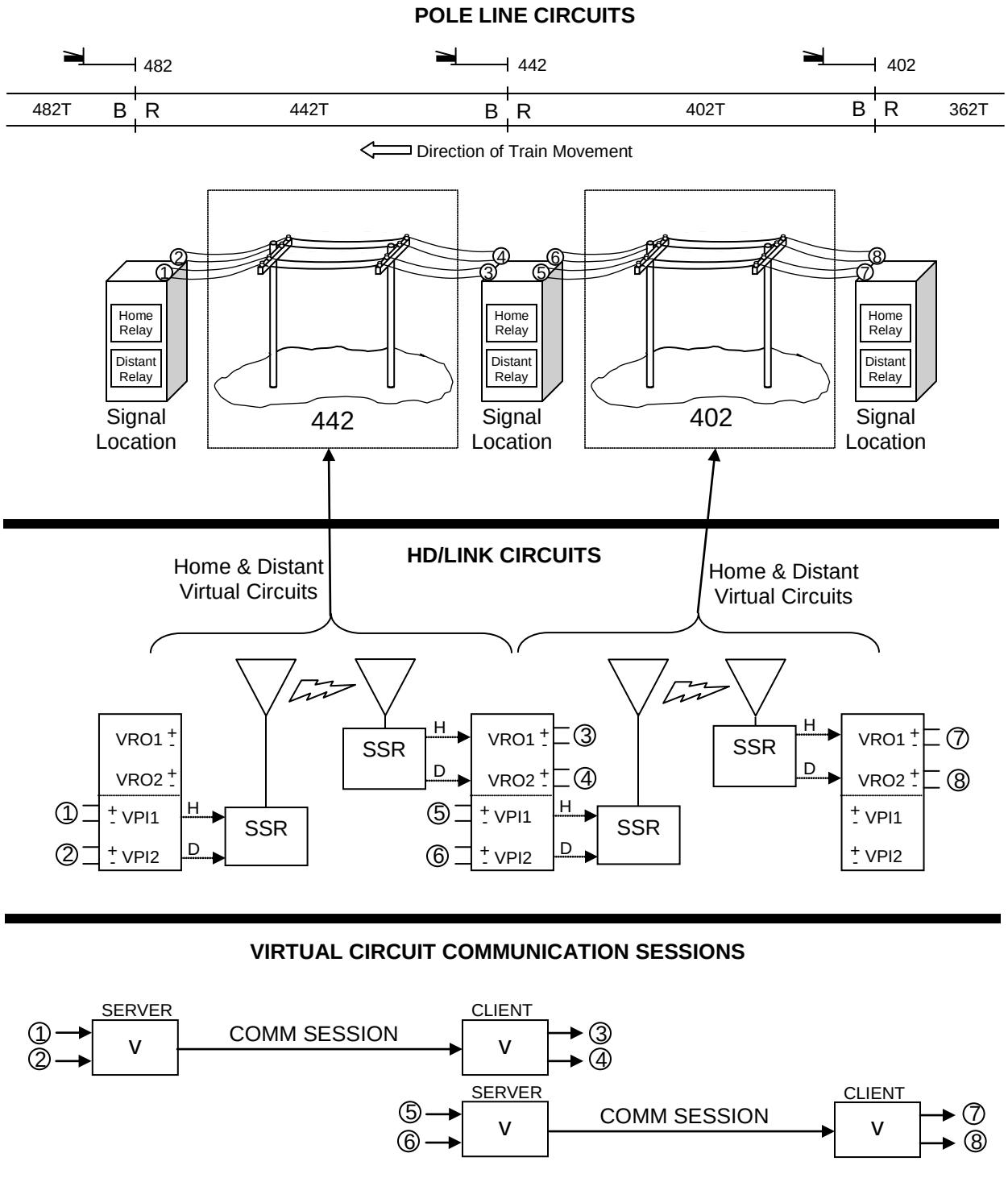


Figure 1-12. Typical 4-Wire HD Pole Line Replacement Application (Unidirectional & Unipolar)

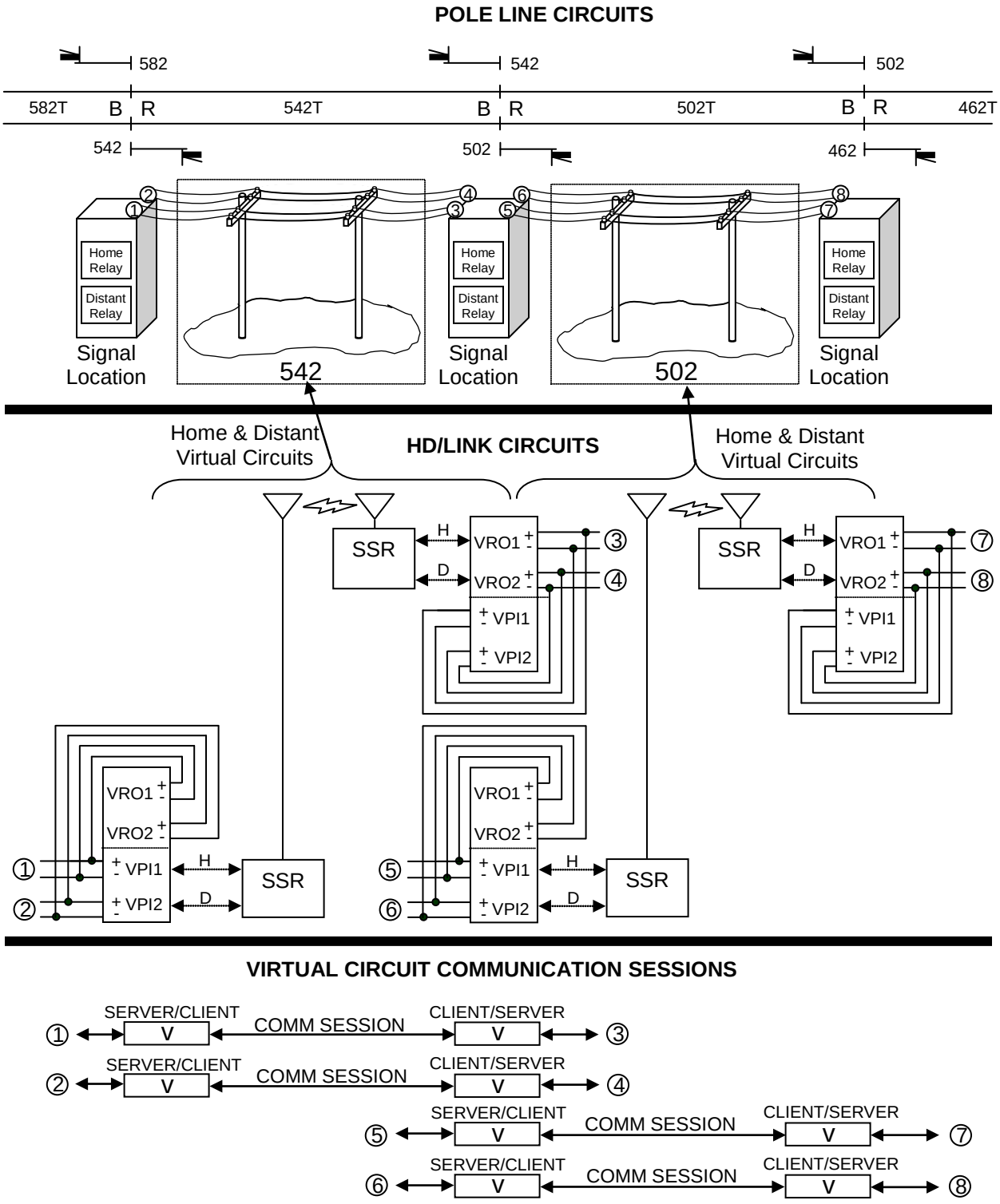


Figure 1-13. Typical 4-Wire HD Pole Line Replacement Application (Bidirectional & Unipolar)

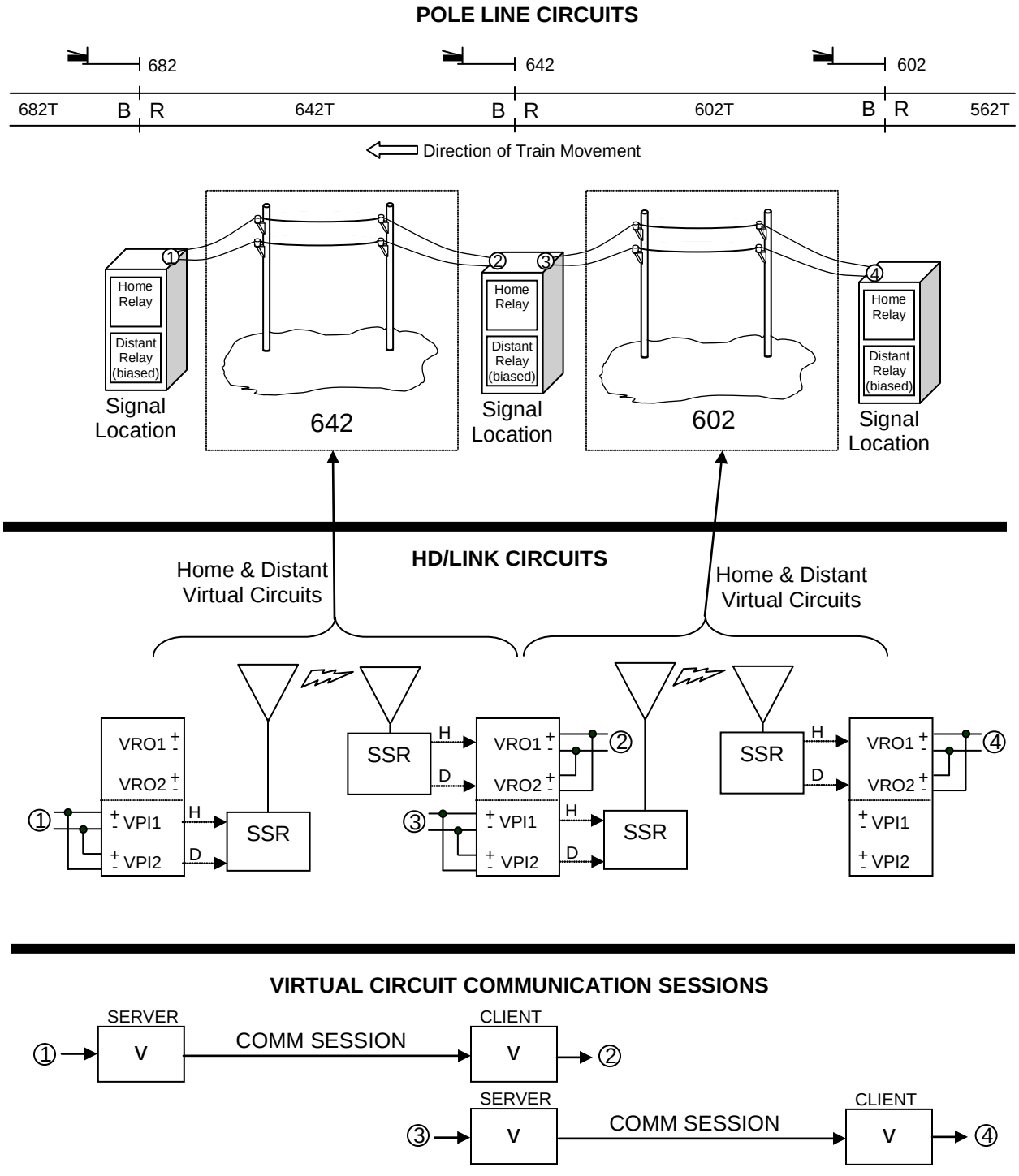


Figure 1-14. Typical 2-Wire HD Pole Line Replacement Application (Unidirectional & Bipolar)

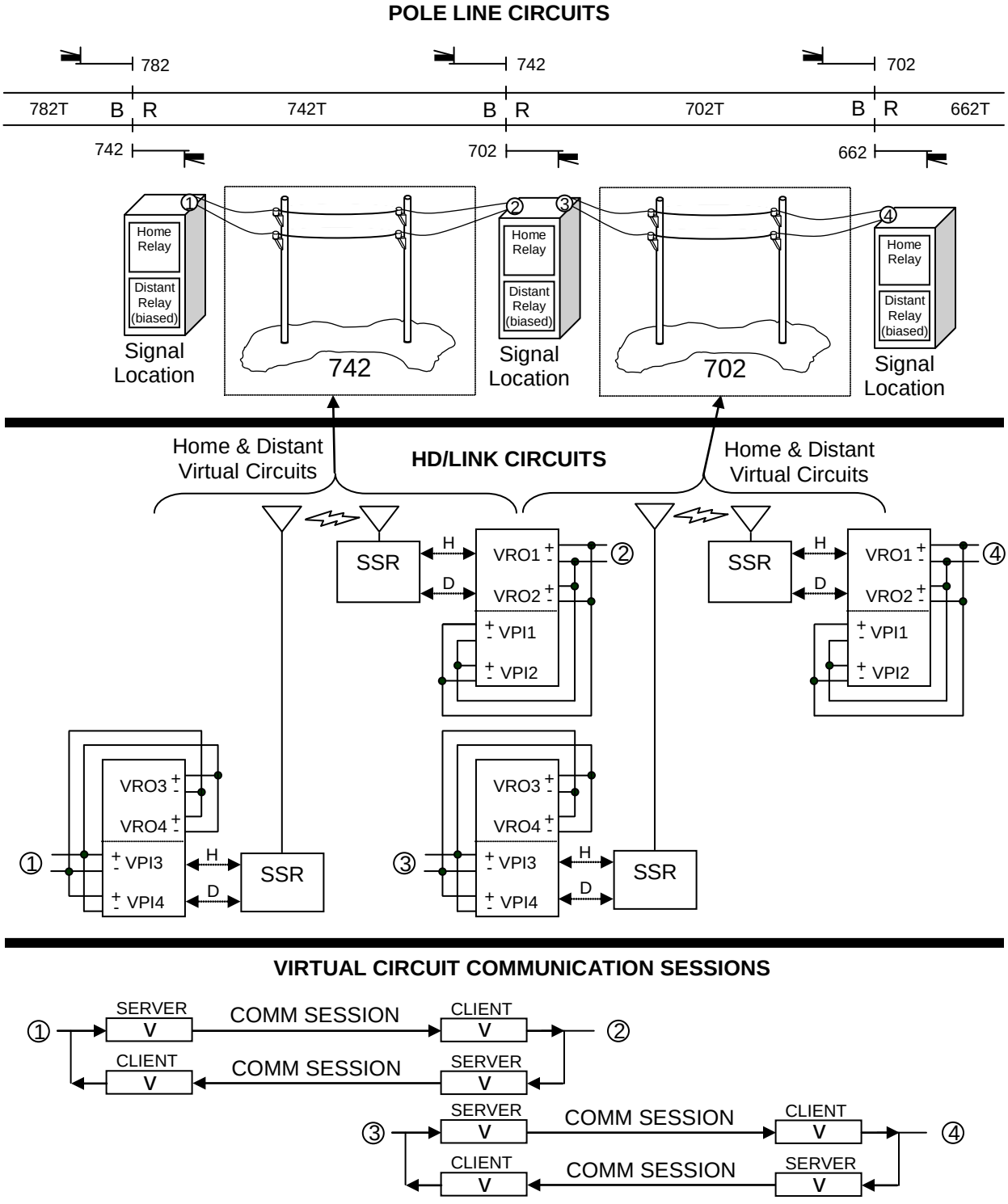


Figure 1-15. Typical 2-Wire HD Pole Line Replacement Application (Bidirectional & Bipolar)

1.5.2 Stand-Alone Vital Timer

The HD/LINK module may be used as a stand-alone vital timer with the ability to replicate up to eight independent vital timing relays. Using the HD/LINKer configuration utility, the inputs can be mapped directly to the outputs within the same module.

NOTE

NOTE

Refer to the manual for Stand-Alone Vital Timer for more detailed information on the HD/LINK module when used in this capacity.

Following are characteristics of the HD/LINK module when configured as a stand-alone vital timer:

- The VRO Pickup Delay time and Drop Delay time can be set to the required values (up to a maximum time of 9999 seconds = 2.7 hours).
- The VRO output drops 200ms before the specified time in order to allow for processing time.
- If the Module is being used as a stand-alone vital timer with a single communication session between input and outputs, the Pickup Delay timer will be accurate to within approximately 100ms of the configured Pick Time.
- The Pickup Delay timer will be accurate to within approximately 100ms of the configured Drop Delay time minus 200ms. Thus, if a timing relay is to be imitated with a 2s Pickup Delay and a 2s Drop Delay time (+/-10%), the VRO Pickup Delay time should be set to 2s and the VRO Drop Delay time set to 2.2s. The HD/LINK module accuracy would then be: Pickup Delay timer – 2s (+5%) and Drop Delay timer 2s + 5%.
- The Pickup Delay timer is guaranteed to always time longer than the configured time, even under failure conditions. For instance, if the module reboots, the timer is restarted.
- The Drop Delay timer is guaranteed to always time shorter than the configured time (200ms taken off the configured time to allow for processing time), even under failure conditions. For instance, if the module reboots, the output drops.

1.6 CONFIGURATION SYSTEM OVERVIEW

Refer to figure 1-16 for a brief overview of the configuration system components. The configuration system for the HD/LINK modules is fully described in the HD/LINKer manual.

A field copy of the database can be created after the configuration data has been established. This allows the configuration data for a particular group of modules to be taken to the site during installation, permitting unforeseen changes to be made in the field when cutting over from pole line to the HD/LINK system.

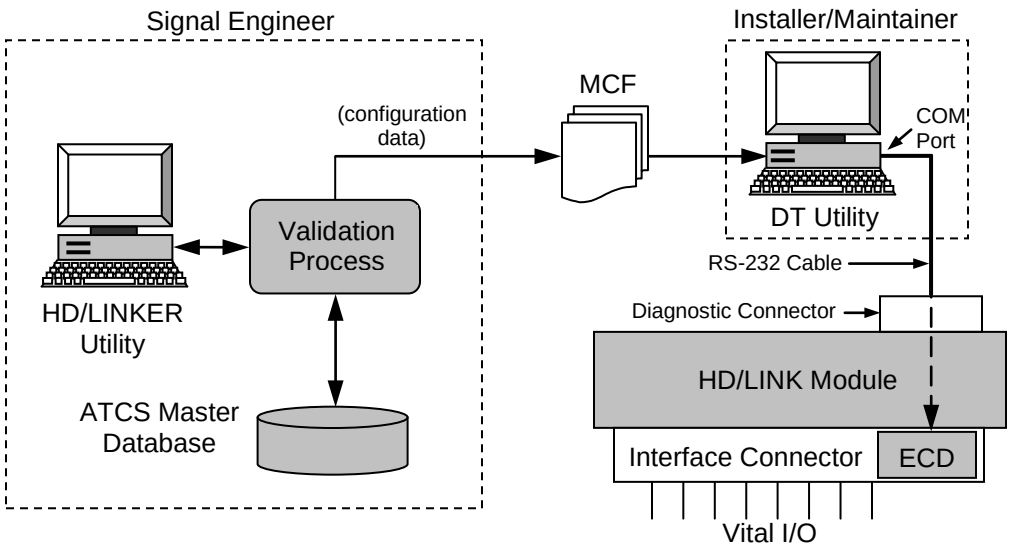


Figure 1-16. Configuration System Overview

Central to the HD/LINK module configuration is an ATCS database. The database provides a central repository of equipment and configuration data for the railroad. Office network management systems, for example, the Safetran Network Management System (NMS), can manage, provide remote diagnostics, monitoring and troubleshooting of the ATCS network. The Railroad may choose, for instance, to have one central ATCS database or allocate one database per line.

The HD/LINKer configuration utility is a Windows PC-based utility which allows the user to configure an HD/LINK module. The configuration data is down-loaded into an External Configuration Device (ECD- an EEPROM embedded in the module interface connector) from a Module Configuration File (MCF). The information used to generate the MCF is stored in the central ATCS database. The HD/LINKer configuration utility allows users to produce and manage the HD/LINK module Configuration Files.

ATCS addressing provides a hierarchical addressing scheme which can be used to allocate a unique address to each HD/LINK module. A central ATCS database automatically prevents duplicate addresses.

⚠ WARNING

WARNING

IF MULTIPLE DATABASES ARE USED BY A RAILROAD, CARE MUST BE TAKEN TO PREVENT DUPLICATE ATCS ADDRESSES.

The Module Configuration Files are downloaded into HD/LINK modules using the Installers Diagnostic Terminal (DT) Utility, a DOS-based PC program. This configuration data is actually stored in an external EEPROM embedded in the 40-pin interface connector. This enables modules to be swapped without altering the configuration.

1.7 COMMUNICATION EQUIPMENT

The HD/LINK module has been designed for use with the Safetran Spread Spectrum Radio (SSR).

HD/LINK modules can be connected to other devices such as the SSR via twisted pair wire (refer to figure 2-7). The Echelon® LonTalk™ Interface Specifications (refer to paragraph 1.8.6) must be strictly adhered to when connecting devices together on the LAN.

1.8 HD/LINK MODULE SPECIFICATIONS

The HD/LINK module carries the following specifications.

⚠ WARNING

WARNING

THE HD/LINK MODULE SHOULD ONLY BE USED WITHIN THE DEFINED SPECIFICATIONS.

NOTE

NOTE

Refer to Appendix A for detailed input and output specifications for the HD/INK module.

1.8.1 Vital Relay Outputs (VRO)

Quantity	8 per module (unipolar configuration)
Relay drive	100Ω – 1000Ω load per output (designed to drive Safetran ST1 and ST2 relays, or equivalent)

1.8.2 Vital Parallel Inputs (VPI)

Quantity	8 per module (unipolar configuration)
Energized voltage range	7.5VDC to 20VDC
Input impedance	800Ω to 1.2kΩ (1kΩ nominal)
AC Frequency Rejection	25-220Hz, 65 VAC maximum

⚠ WARNING

WARNING

IF USING THE HD/LINK MODULE IN ELECTRIFIED TERRITORY, ENSURE THAT IT IS NOT USED OUTSIDE OF ITS AC FREQUENCY REJECTION SPECIFICATION.

1.8.3 Power Requirements

Input Voltage	9.0VDC to 16.5VDC (12V nominal)
Maximum Ripple Voltage	0.5V peak-to-peak
Initial Startup Current	2-3A for 3-4 seconds
Input Current (all relays energized)	2A Maximum, 1.4A Typical (8 x 100Ω)
Input Current (all relays deenergized)	730mA Maximum, 500mA Typical
Maximum Power Consumption	33W (all relays energized) 12W (all relays deenergized)

1.8.4 Diagnostic Terminal Interface

Connector	9-pin D type (DB-9)
Data Interface Type	Serial
Interface Standard	RS-232

1.8.5 I/O Interface

Connector Type	40-pin with dual cage clamps

Table 1-4 lists the I/O interface connector pinout assignments.

⚠ WARNING

WARNING

THE MATING CONNECTOR FOR THE HD/LINK MODULE MUST BE WIRED AS SPECIFIED IN SECTION V.

NOTE

NOTE

Refer to figure 5-1 for an illustration of the mating connectors.

Table 1-4. Interface Connector Pinout Assignments

Pin	Signal		Pin	Signal
1	VPI 1 -		21	VPI 1+
2	VPI 2+		22	VPI 2-
3	VPI 3-		23	VPI 3+
4	VPI 4+		24	VPI 4-
5	VPI 5-		25	VPI 5+
6	VPI 6 +		26	VPI 6-
7	VPI 7-		27	VPI 7+
8	VPI 8+		28	VPI 8-
9	VRO 1-		29	VRO 1+
10	VRO 2+		30	VRO 2-
11	VRO 3-		31	VRO 3+
12	VRO 4+		32	VRO 4 -
13	VRO 5-		33	VRO 5+
14	VRO 6+		34	VRO 6-
15	VRO 7-		35	VRO 7+
16	VRO 8+		36	VRO 8-
17	VCL *		37	SCL *
18	OV *		38	SDA *
19	ECH TWP 1		39	ECH TWP 2
20	B12		40	N12

* Optional External ECD Connections

NOTE

NOTE

Siemens Rail Automation recommends twisted pairs for inputs, outputs, and the DC Power and Return wires B12 and N12.

NOTE

NOTE

The polarity of ECH TWP 1 and ECH TWP 2 does not matter; they may be connected in any order.

Abbreviations

VPI 1 -	Negative connection for input 1
VPI 1 +	Positive connection for input 1
VRO 1 -	Negative connection for output 1
VRO 1 +	Positive connection for output 1
ECH TWP 1	Echelon® LonTalk™ LAN twisted Pair Wire 1
ECH TWP 2	Echelon® LonTalk™ LAN twisted Pair Wire 2

B12	Positive Signal Battery (Nominal 12V)
N12	Negative Signal Battery (Nominal 12V)

⚠ CAUTION

CAUTION

DO NOT APPLY BATTERY VOLTAGE TO THE ECHELON® CONNECTIONS AS THIS MAY DAMAGE THE TRANSCEIVER MODULES.

1.8.6 Echelon® Lontalk™ Interface

Data Transfer Rate	1.25 Mbps
Transmission Medium	Level 4 (NEMA) cable- stranded, twisted pair (shielded or unshielded), conductor size 22AWG (recommended by Echelon) to 18AWG. A suitable 18AWG cable is Belden Cable #8461 Echelon recommends the following cable characteristics: DC Resistance: 18.0 ohms /1000 feet @ 20° C per conductor maximum DC Resistance Unbalance: 5% maximum Impedance: 100 ohms ±15% (1.0 - 20.0 Mhz) Attenuation: 5.5 dB/1000 feet @ 20° C maximum (1.0 Mhz) Pair mutual capacitance: 17 pF/foot maximum Pair-to-ground capacitance unbalance: 1 pF/foot maximum
Topology	Bus (direct daisychain) Maximum stub of 12 inches reserved for internal circuits
Number of Nodes	16 maximum per network segment (including terminations) No more than 8 (including terminations) in any 16 meter (53 feet) length of transmission cable
Termination	For small installations with few modules and very short LAN cable runs (e.g., single rack installations), termination is not generally required. However, extended Echelon® cable runs and/or connection to several modules may require special termination at both LAN endpoints (refer to Section II, paragraph 2.1.3.2, *LAN Termination*, or contact Siemens Rail Automation Applications Engineering, for details).
Network Length	430 feet (130m) maximum per network segment; 53 feet (16m) maximum recommended without termination

⚠ WARNING

WARNING

BECAUSE THE ECHELON® LONTALK™ INTERFACE CANNOT BE SURGE PROTECTED (REFER TO PARAGRAPH 6.2), THE NETWORK CONNECTIONS MUST BE RESTRICTED TO EQUIPMENT CONTAINED INSIDE THE PROTECTED BUILDING.

1.8.7 Mechanical Specifications

Packaging	Black powder-coat metal canister
Weight	4 pounds (1.8 kg)
Depth	9.6 inches (24.4 cm)
Height	11.3 inches (28.7 cm) including connector and mounting tab
Width	3.6 inches (9.1 cm) Equal to a 1 1/2 width ST2 relay
Mounting	Safetran ST relay rack, wall or shelf mount

1.8.8 Environmental Specifications

Temperature	-40°F to +160°F (-40°C to +71°C)
Humidity	95% non-condensing

1.9 HD/LINK MODULE ORDERING INFORMATION

Hardware Title	Part Number
HD/LINK Module	53201-ccXX

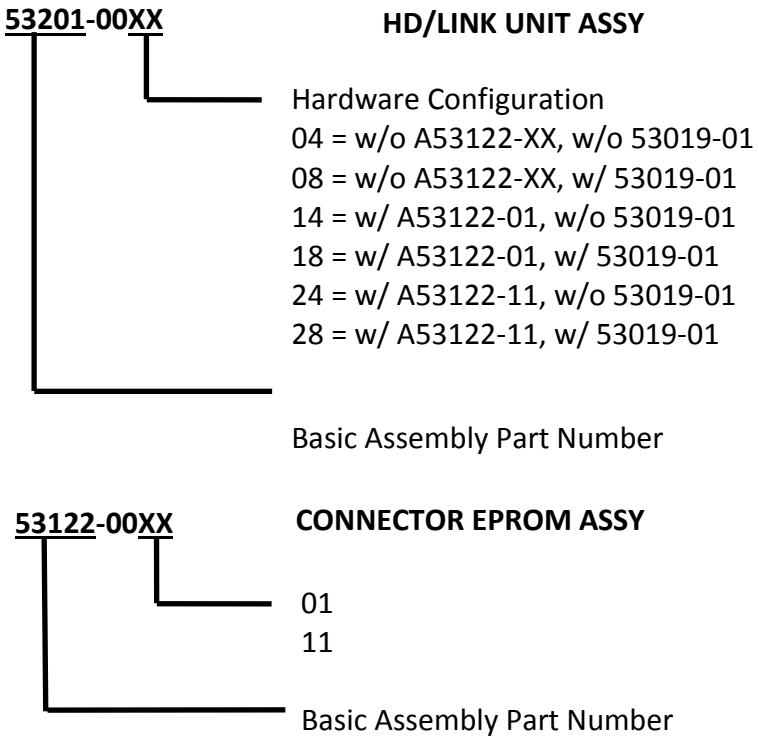
Where cc = the Compatibility Index and XX = the Hardware Configuration.

Compatibility Index: A number which is used to identify different compatibilities for the hardware. The software executive (MEF) checks that it is running on hardware which supports this version of the executable software. Siemens Rail Automation increments the compatibility index only when future hardware changes are required which renders the older software version incompatible with the hardware. When loading the software executive, the HD/LINKer configuration program prevents the user from selecting a version of software which is incompatible with the specified hardware part number. If incompatible software should be loaded into the hardware, the initial configuration checks fail with a message similar to the following:

```
ER0 97/01/01 00:00:37.1 Startup Check Error:  53, HW SW Compatibility
```

When ordering hardware, please specify 00 for Compatibility Index (Siemens Rail Automation will supply the latest version). Refer to the part number breakdown below.

Hardware Configuration: A number which is used to identify the particular hardware configuration desired. Refer to the part number breakdown below for hardware configuration selection.



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SECTION II

HD/LINK MODULE DESCRIPTION

2.0 GENERAL

The Safetran 53201 HD/LINK module is designed as a general purpose vital I/O module. It is primarily intended for use in pole line or cable replacement (home/distant line wire, submarine cable, crossing detector, hazard detector, repeater, etc.), but its configurability also makes it suitable for other applications such as for vital timers.

The module supports non-vital diagnostic requests either via the Diagnostic port (Diagnostic Terminal or modem) or via the LonTalk™ LAN (using radio, modem, remote module, etc.). Section VII, *HD/LINK Diagnostics*, provides the full details of the diagnostic capabilities. The following information is available:

- Module Status, executive and MCF software version information, SIN, verbosity level, battery voltage
- Module Time, current time and date for the module
- Event Log
- Communication Statistics
- MCF

2.1 HD/LINK MODULE FUNCTIONAL DESCRIPTION

The vital I/O connections and the LonTalk™ LAN connections for the HD/LINK module are made through a connector located on the top of the HD/LINK module. Personnel performing installation or maintenance interface with the HD/LINK module through the front panel of the HD/LINK module by the use of LED indicators and a connection to a Diagnostic Terminal. Refer to figure 2-7 for an illustration of the HD/LINK module. Figure 2-1 illustrates the indicators and diagnostic connector located on the front panel of the HD/LINK module.

NOTE

NOTE

There are no controls, indicators, or connectors located on the rear panel of the HD/LINK module. The rear panel is for mounting only.

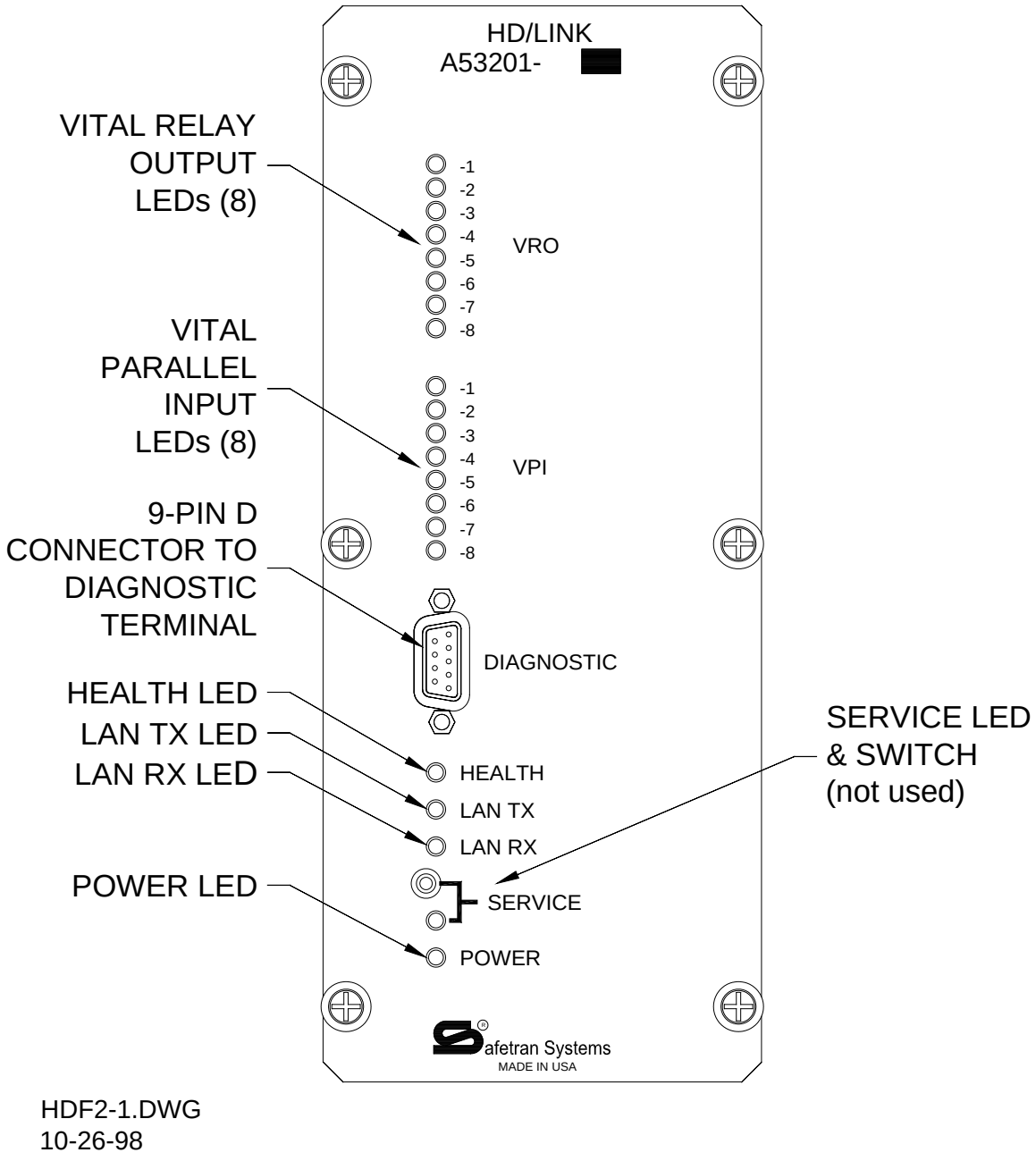

Figure 2-1. HD/LINK Module Front Panel

2.1.1 Vital Inputs

The HD/LINK module has eight Vital Parallel Inputs (VPIs) designed to be connected to relay contacts. Each input consists of a positive and a negative terminal (see figure 2-2) and each input terminal is optically isolated from all the other inputs. Not all VPIs need to be used in a configured HD/LINK system.

The vital inputs energize if a voltage between 7.5VDC and 20VDC and of the correct polarity is applied. The vital inputs are guaranteed to be deenergized if a voltage between -20 VDC and +2.5VDC is applied. Under normal conditions an input voltage of less than +7.5VDC causes the VPI to deenergize. The vital inputs are guaranteed to be deenergized if a voltage between -20VDC and +20VDC is applied through a source impedance of greater than 10kΩ.

The vital inputs are software filtered so that an alternating current with frequency between 25Hz and 220Hz does not cause the input to energize.

In order to eliminate the effects of relay contact bounce or transient voltages, the inputs only change state if the input voltage persists. Any voltage change that lasts less than 250ms is rejected. The voltage change is guaranteed to be detected if it persists longer than 500ms. In practice, a voltage lasting 330ms is detected.

The inputs to the HD/LINK module were designed to detect steady voltage states. The HD/LINK module should not be used to replace a coded system.

Eight red VPI LEDs are mounted on the front panel of the HD/LINK module. These indicate the state of the eight inputs as determined by the software. Thus if the module is unconfigured, i.e. in a state where it is unable to perform vital processing, the VPI LEDs are off even though an applied voltage may be present on the inputs.

The default configuration provides individual unipolar input and output circuits (see figure 2-2). Observe the proper polarity when using these inputs and outputs.

For bipolar input applications, two inputs must be used and connected together in a reverse polarity parallel configuration (see figure 2-3).

To create a 3-wire bipolar bidirectional configuration using a bipolar input channel and a bipolar output channel, the circuits of figure 2-3 must be configured (using the HD/LINKer utility) as separate bipolar input and output channels, and wired with a common signal return (see figure 2-4 for the resulting 3-wire circuit).

For bidirectional applications, a vital input and a vital output must be used and connected directly together: positive to positive, negative to negative (see figure 2-5).

For 2-wire bipolar bidirectional applications, two inputs and two outputs must be used and connected together in both the bipolar and bidirectional configurations (see figure 2-6).

NOTE

NOTE

A 500 ohm resistor must be added in series with each input feed (battery to relay contact) to provide current limiting for when a VRO in a 2-wire bipolar bidirectional circuit may be energized while the VPI in the circuit is receiving an input voltage of a polarity that causes the voltages to add.

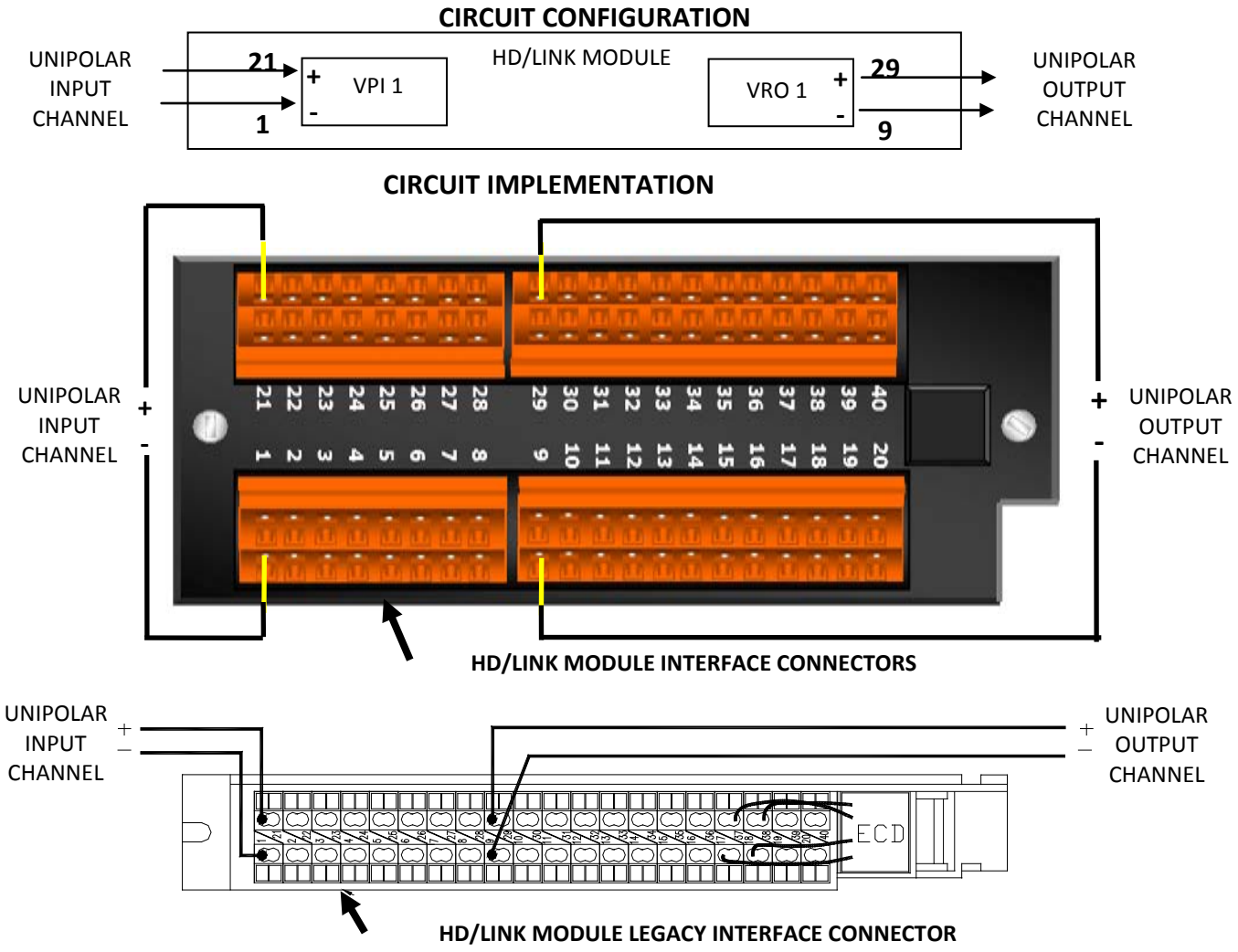

Figure 2-2. Typical Unipolar Input & Output Applications

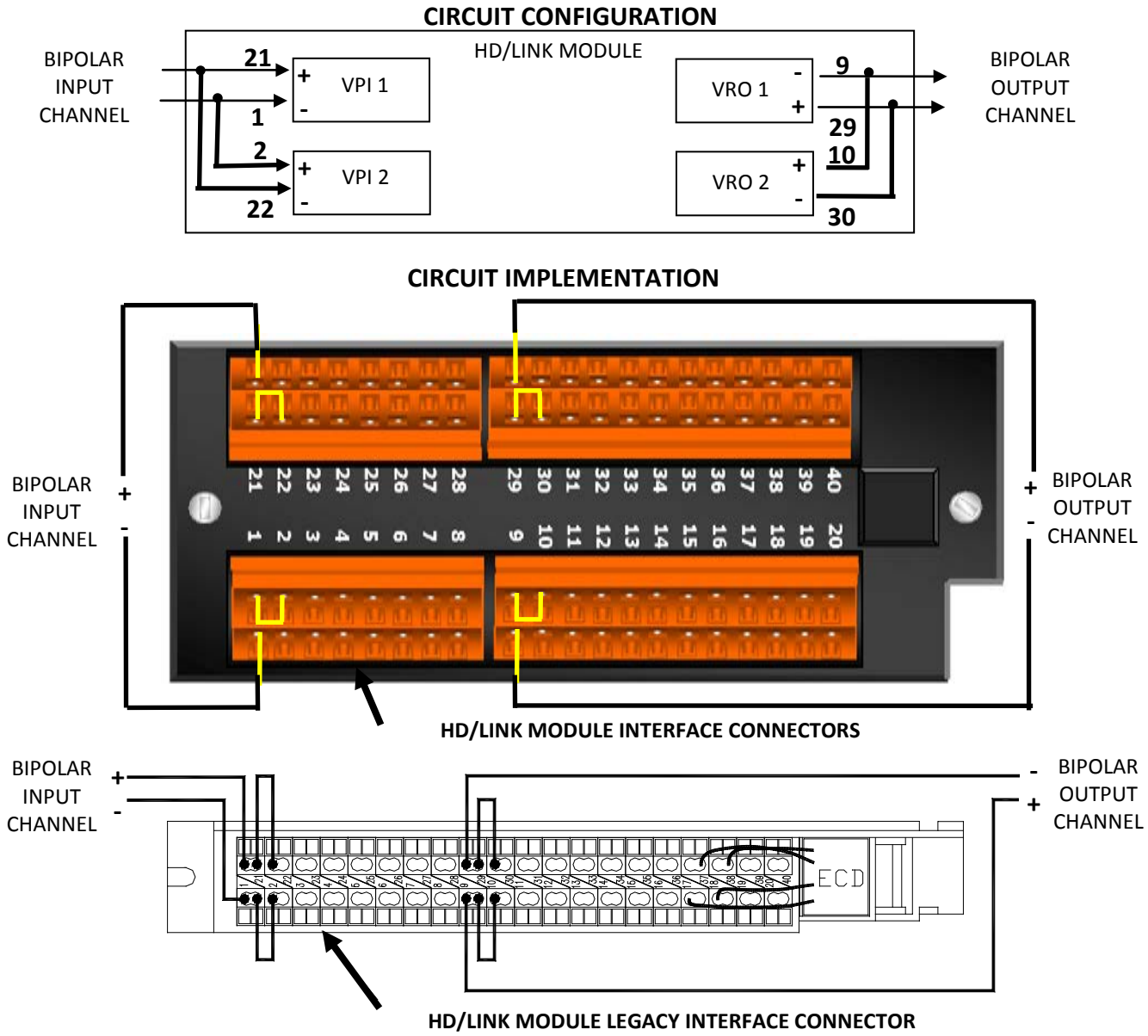

Figure 2-3. Typical Bipolar Input & Output Applications

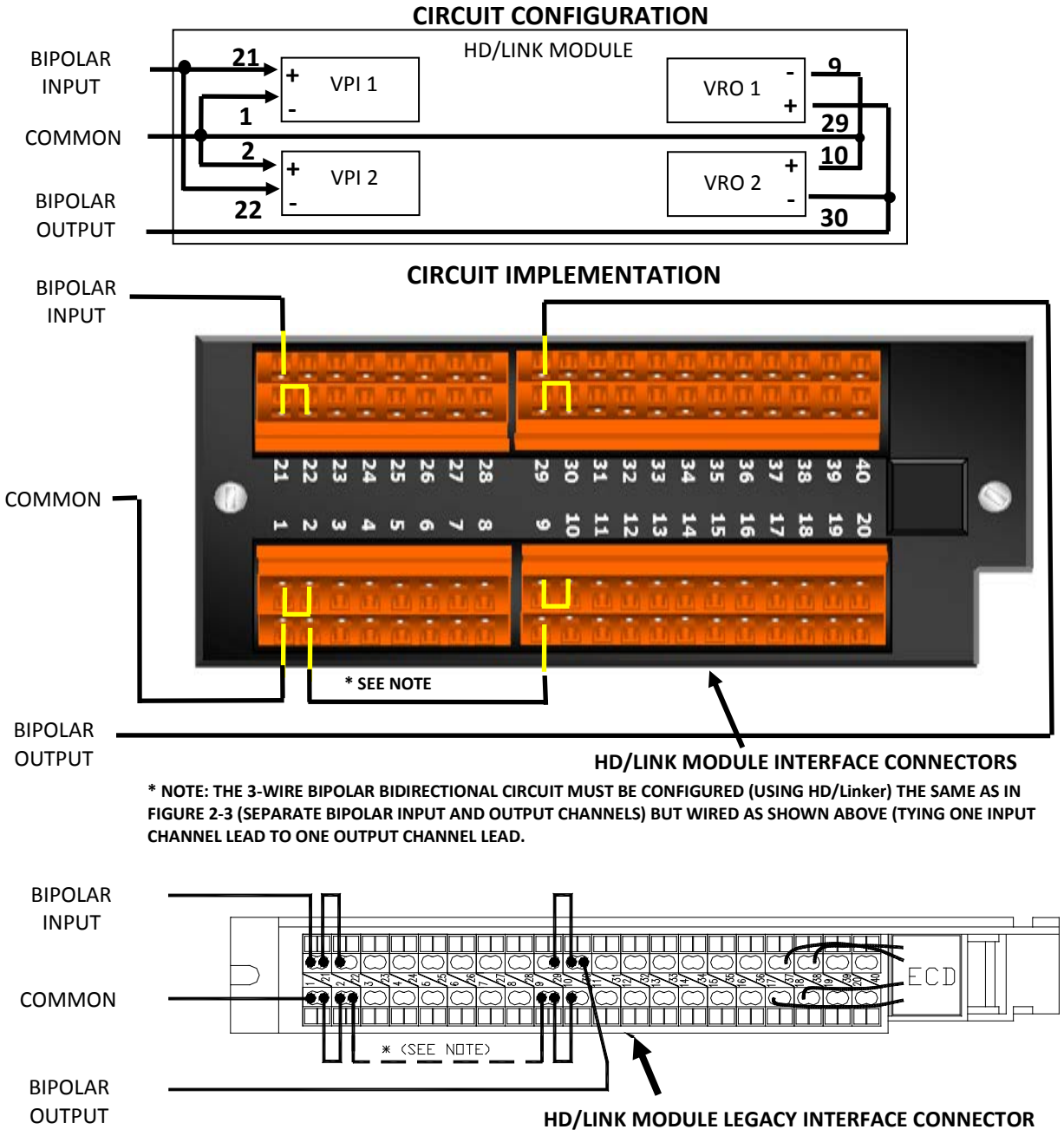

Figure 2-4. Typical 3-Wire Bipolar Bidirectional Application

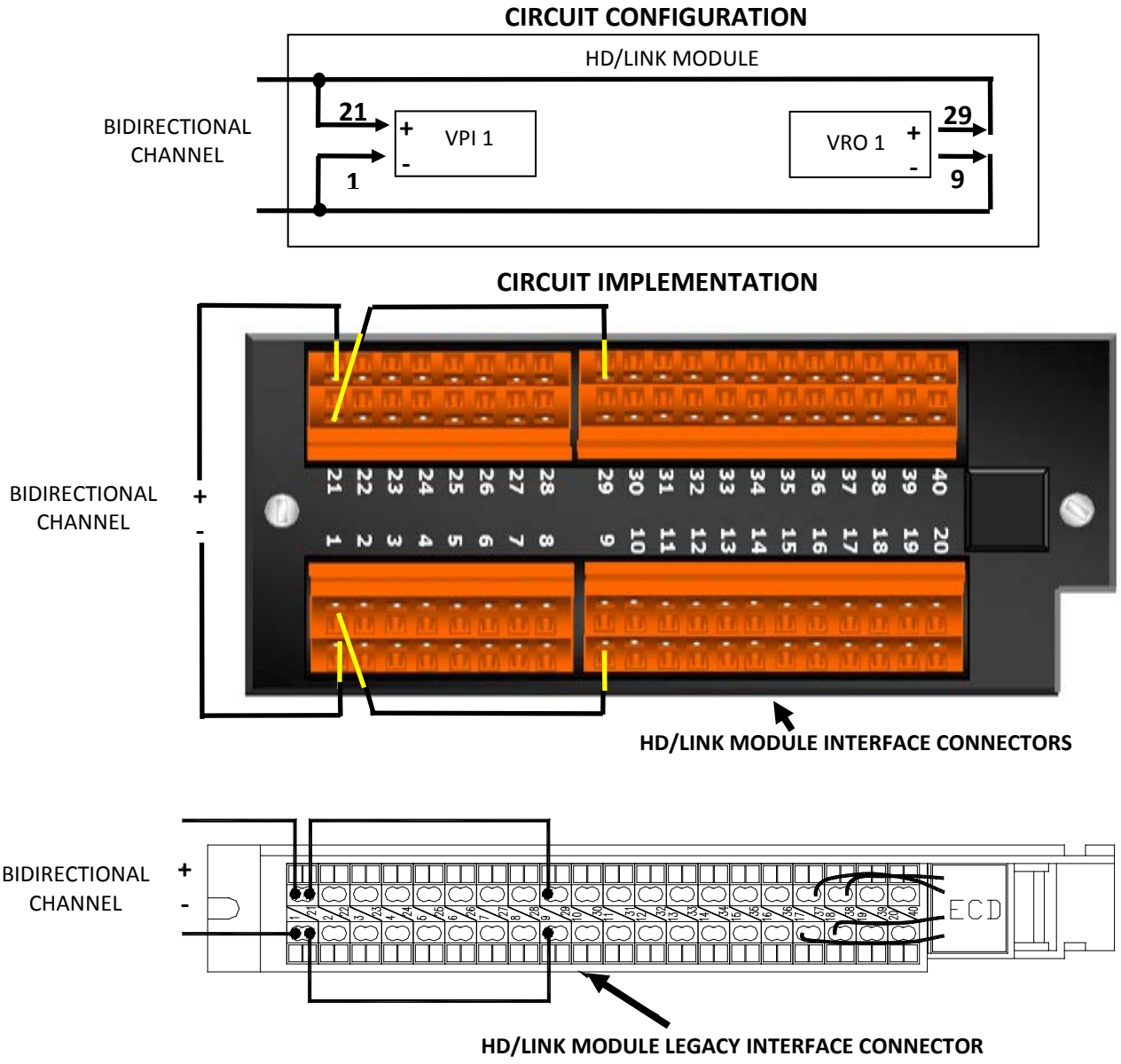

Figure 2-5. Typical Bidirectional Application

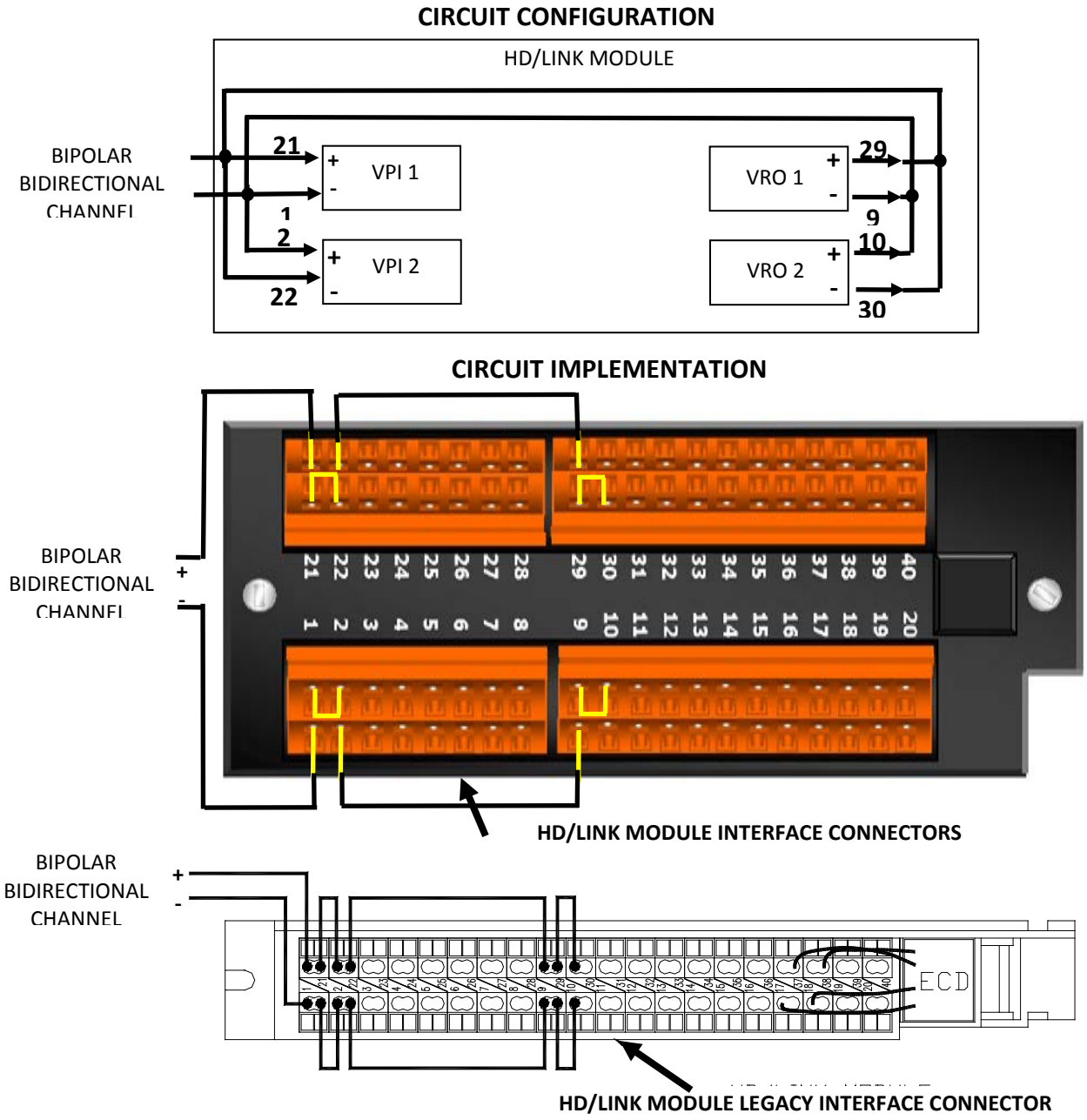

Figure 2-6. Typical 2-Wire Bipolar Bidirectional Application

Inputs which are not currently configured as being used in the MCF can be connected to relay contacts in preparation for future use. If the module detects an unused input as being energized, it logs an Event in the Event Log, and no action is taken on the unused input.

⚠ WARNING

WARNING

PRIMARY SURGE PROTECTION MUST BE FITTED TO VITAL INPUTS AS SPECIFIED IN SECTION VI.

2.1.2 Vital Outputs

The HD/LINK module has eight Vital Relay Outputs (VROs) designed to drive vital signaling relays (100 ohm to 1000 ohm coils) – Safetran ST1, ST2 or equivalent. Each output consists of a positive and a negative terminal (see figure 2-2). Not all VROs need to be used in a configured system.

Eight red VRO LEDs are mounted on the front panel of the HD/LINK module. These indicate the state of the eight outputs as determined by the software. Thus if the module is unconfigured, i.e. in a state where it is unable to perform vital processing, the VRO LEDs are always off.

For bipolar output applications, two outputs must be used and connected together in a reverse polarity parallel configuration (refer to figure 2-3).

For bidirectional applications, a vital input and a vital output must be used and connected directly together: positive to positive, negative to negative (refer to figure 2-5).

For 2-wire bipolar bidirectional applications, two inputs and two outputs must be used and connected together in both the bipolar and bidirectional configurations (see figure 2-6). A 500 ohm resister must be added in series with each input feed (battery to relay contact) to provide current limiting for the situation encountered when a VRO in a 2-wire bipolar bidirectional circuit is energized while the VPI in the circuit is receiving an input voltage of a polarity that causes the voltages to add.

The outputs can be configured to be slow-to-pick or slow-to-drop. The configurable pick/drop time can be up to 2.7 hours. This feature allows HD/LINK channels to replicate Slow Release, Quick Drop-away, Slow Pick-up, or Quick Pick-up relays. Neutral or Biased relays can be replicated through the Virtual Circuit configuration. Refer to Section IV, paragraph 4.1.1, *VRO Timers*, for details. It may be necessary to add a deenergization delay to bipolar outputs to prevent a flashing signal aspect due to slow changeover of the bipolar relay.

The HD/LINK system maintains all VROs in a deenergized state while rebooting.

⚠ WARNING

WARNING

PRIMARY SURGE PROTECTION MUST BE FITTED TO VITAL OUTPUTS AS SPECIFIED IN SECTION VI.

2.1.3 LonTalk™ LAN

The HD/LINK module interfaces with other modules at the same location or with HD/LINK modules at other locations (by using the Safetran Spread Spectrum Radio) via an Echelon® LonTalk™ LAN. Data on the LAN is transferred by using ATCS messages. The interface uses a twisted wire pair from the interface connector of the HD/LINK module.

The LAN is capable of connecting up to 16 different modules, for the temperature range of -40°C to +71°C. The total length of the LAN connections should be no more than 430 feet of wire. Distribution of the nodes on the LAN must meet the 8-in-16 rule (refer to paragraph 2.1.3.1). The data transfer rate is 1.25Mbps. The twisted pair cable characteristics and LAN topology requirements must be strictly adhered to (refer to Section I, paragraph 1.8.6 for the specifications for the LonTalk™ LAN interface).

NOTE

NOTE

The Echelon® LonTalk™ LAN must only be installed and utilized within the specifications in Section I, paragraph 1.8.6, Echelon® LonTalk™ Interface.

NOTE

NOTE

Although the LAN may be capable of supporting 16 modules, there may be insufficient bandwidth available. The Spread Spectrum Radio may also limit the number of modules connected in a single LAN. Refer to Section III, paragraph 3.1 for a discussion of bandwidth considerations.

The HD/LINK module connects to the Spread Spectrum Radio or other modules in an HD/LINK system as shown in figure 2-7.

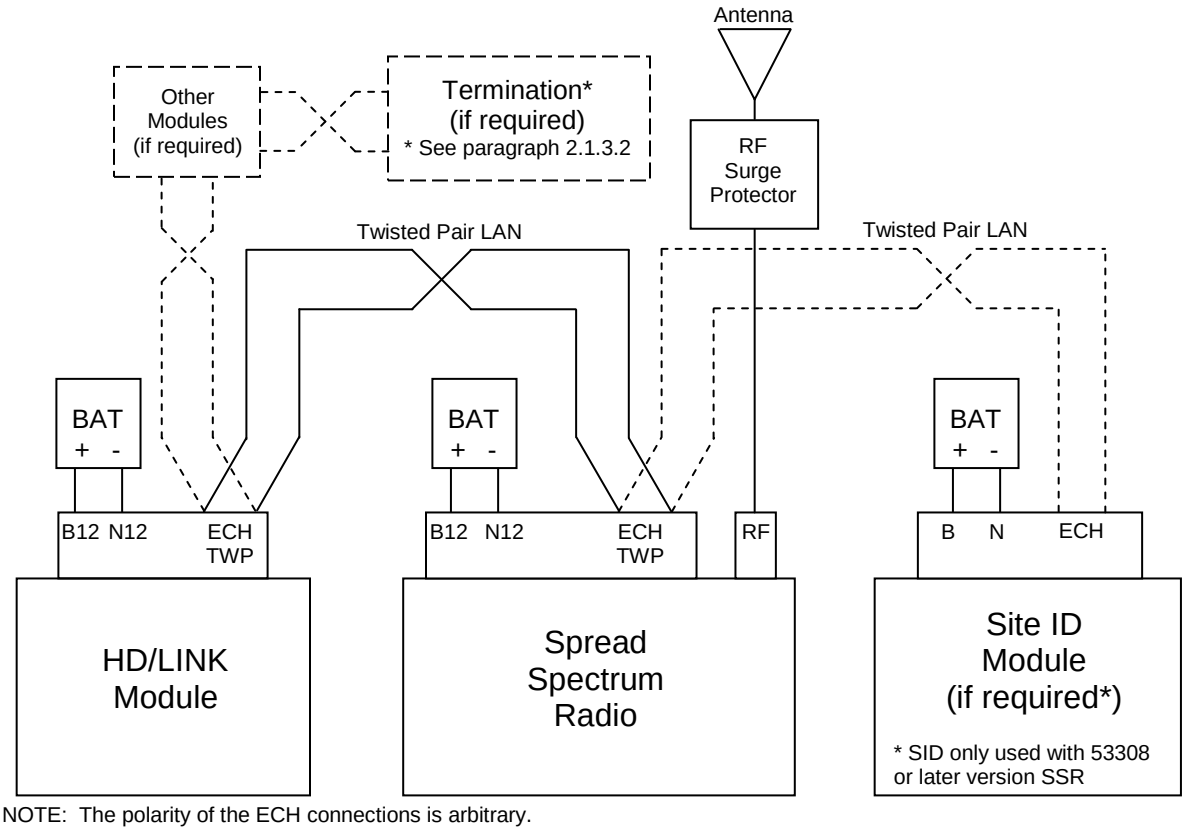

Figure 2-7. HD/LINK Module LAN Connections

2.1.3.1 Node Distribution

To prevent communication failures on the LAN caused by transmission reflections, certain restrictions such as stub length and concentrated node loading must be controlled. Modules should be connected in a bus configuration (direct daisychain) without using any drops to nodes, because the maximum stub length allowable is twelve inches and most of this allowance is used up internally to the modules in the form of cabling and printed circuit traces. Any other form of connections or additional wires must be avoided.

To minimize reflections, it is preferable to distribute nodes on the LAN rather than to concentrate them. To this end, the "8-in-16" topology rule is in effect in HD/LINK systems (using the TPT/XF-1250 transceivers). In effect, this rule requires that no more than 8 nodes (where a node is represented by a single transceiver, control module, or endpoint termination) can be located within any 16 meter (53 feet) length of LAN cable.

In cases where the modules and terminations at one location would exceed this limitation, the solution is to add additional cable to the bus between nodes (ensure that the maximum network cable length is not exceeded by doing so). In cases where more than the allowable number of modules is required for a system (i.e., 14), the solution is to divide the network segment into other segments by inserting a router or bus repeater. Each of the resulting network segments can then be made to meet the "8-in-16" rule (the router or bus repeater is treated as two separate nodes, one in each of two adjacent segments).

2.1.3.2 LAN Termination

Single rack installations with very short LAN cable runs (less than 16m) do not generally require LAN endpoint termination. However, extended cable runs may require termination at both endpoints of the LAN (refer to figure 2-8 for the termination configuration). Terminations are to be treated the same as nodes, and should meet all the same requirements (node distribution, etc.). The additional cable length connecting to network terminations must not cause the total network length to exceed 430 feet (130m).

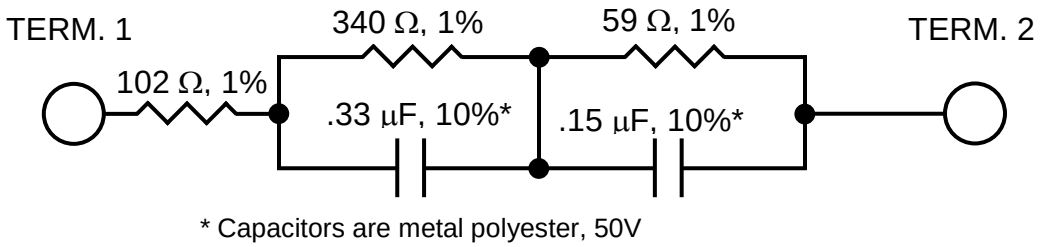

Figure 2-8. Bus Termination For Twisted Pair Networks

2.1.4 Diagnostic Port

The HD/LINK module has an RS-232 serial port for use with a Diagnostic Terminal (usually a laptop PC), modem or other DTE or DCE equipment. The interface is via a 9-pin D type (DB-9) connector mounted on the front panel of the module.

⚠ WARNING

WARNING

EQUIPMENT (DIAGNOSTIC TERMINALS, MODEMS, ETC.) WHICH COULD CAUSE GROUNDING OF THE HD/LINK MODULE THROUGH ITS RS232 PORT MUST NOT BE USED.

If a modem is required, the recommended unit is the Safetran Mighty Modem, part number 53413, a DC- powered modem suitable for remote sites. Refer to Siemens Rail Automation Document No. COM-00-97-09 for instructions and installation information on the Mighty Modem.

The recommended Diagnostic Terminal is a laptop PC with Safetran Systems Corporation's Diagnostic Terminal Utility installed. The use of the Installers and Maintainers Diagnostic Terminal is described in Section VII, *HD/LINK Diagnostics*.

2.1.5 Event Log

The HD/LINK module includes an internal Event Log. The Event Log can store up to 2340 I/O Events at verbosity level 1 (see Section VII, paragraph 7.2, *Event Messages*). This includes a message logging the change of state of the IO and a message logging the change of state of the message sent to the neighbor.

The Event memory is non-volatile. If power is removed from the module, the Events are retained in the Event Log for at least 14 days. Full details of Events stored are provided in Section VII, *HD/LINK Diagnostics*. Because of the limited storage capabilities for the Event Log, the HD/LINK module supports different levels of Event recording, known as verbosity levels. Verbosity level 1 is the most general and level 3 the most detailed. The verbosity level is selected by using the DT Utility.

The three verbosity levels are listed below. The default verbosity is level 1.

Verbosity 1: I/O state changes, I/O Message changes, serious errors, Communication Errors

Verbosity 2: Communication Warnings

Verbosity 3: Receipt of individual messages

See Section VII, *HD/LINK Diagnostics* for details of verbosity levels.

2.1.6 External Configuration Device

The External Configuration Device (ECD) is a serial EEPROM that is embedded in the interface mating connector. The ECD is used to store the configuration information for the HD/LINK module: Module Configuration File (MCF), Unique Check Number (UCN) and Site Identification Number (SIN). There is a label placed on the interface mating connector for the Site Identification Number (SIN). This helps identify the configuration information stored at that location.

Having the configuration stored on the connector provides the following benefits:

- A module can be replaced without also requiring that the connector or configuration be changed.

- The configuration is associated with the site wiring rather than the module, making spares management easier.

- Because there are far fewer components on the connector, its reliability is much greater than that of the module. Hence the configuration is likely to need changing far less often.

- The module software can prove, by using the Unique Check Number (UCN), that the configuration has not changed, hence the installation does not have to be retested when a module is replaced.

Figure 2-9 illustrates the HD/LINK module with the I/O connector and ECD.

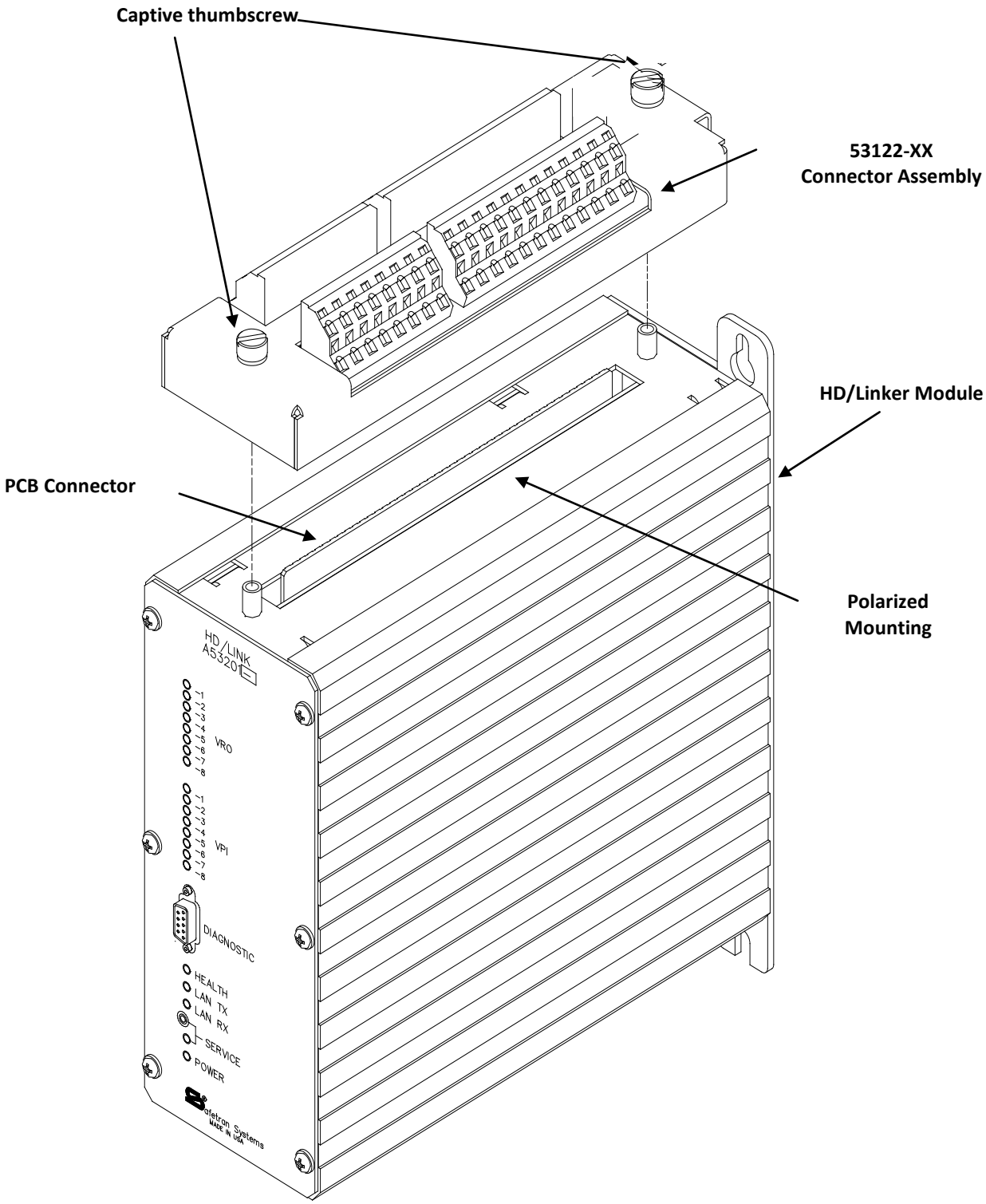

Figure 2-9. I/O Connector, ECD, and HD/LINK Module

2.1.7 Real Time Clock

The HD/LINK module contains a real time clock. The time and date of the module can be set using the Diagnostic Terminal or over the LAN. The time and date is used to timestamp Events in the Event Log.

In the event of a power loss, the real time clock continues running for at least 2 days without losing module time and date.

2.1.8 Visual Indicators

The HD/LINK module is equipped with Light-Emitting Diodes (LEDs) on the front panel to provide a visual indication of module operation. Table 2-1 lists the indicators and their functions.

Table 2-1. HD/LINK Module Front Panel Indicators

LED	Quantity	Color	Purpose
VRO	8	Red	Illuminates to indicate that the software is setting the output to the energized state
VPI	8	Red	Illuminates to indicate that the software has detected that the input is energized
HEALTH	1	Green	Flashes at a slow rate (once every two seconds) to indicate that the module is fully operational Flashes at a fast rate (approximately 3 times per second) to indicate that the module is unconfigured LED is off when the module is on but not operational (could be rebooting, performing startup checks, or left in setup mode)
LAN TX	1	Red	Flashes when the module transmits an ATCS message (containing an ATCS address) over the LAN
LAN RX	1	Green	Flashes when an ATCS message (addressed to the HD/LINK module) is received over the LAN (does not flash when non-ATCS messages are received)
SERVICE	1	Amber	Unused in a linear networking application
POWER	1	Green	Illuminates to indicate power is applied to the module. Does not indicate whether the applied voltage is within the correct operating range

2.1.9 Power Source

The HD/LINK module is designed for a nominal power input voltage of 12VDC with a maximum ripple voltage of 0.5V peak-to-peak. The HD/LINK module operates normally over an input voltage range of 9.0VDC to 16.5VDC. Refer to Section VIII, paragraph 8.1.2, *HD/LINK Module Power Supply Problems*, for the reaction of the HD/LINK module when different voltages are applied.

The HD/LINK module normally draws two to three amps of DC current for three or four seconds on initial startup, and then settles to a typical current drain of 500mA to 1.4 amps (depending on number of energized output relays). The power source must have sufficient current rating to handle the initial start-up current of multiple HD/LINK modules at one location.

⚠ WARNING

WARNING

PRIMARY SURGE PROTECTION MUST BE FITTED TO B12 AND N12 CONNECTIONS AS SPECIFIED IN SECTION VI.

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SECTION III

SAT COMMUNICATION OVERVIEW

3.0 GENERAL

The HD/LINK module is highly configurable. Inputs on one module may be used to set outputs on its own module or on many different modules (refer to figure 3-1).

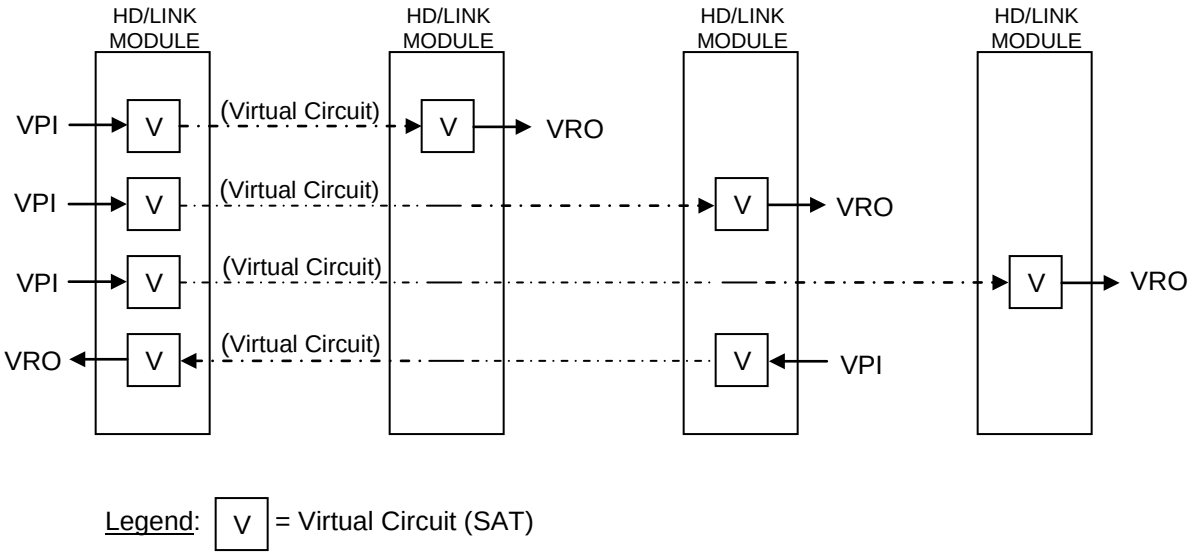


Figure 3-1. Inputs Driving Outputs On Many Remote Modules

In order to make this possible, Virtual Circuits are created. A Virtual Circuit is analogous to a group of pole line or cable circuits between two points. Each end of a Virtual Circuit is called a Virtual Circuit SAT (SAT - Signaling Application Task) also known as a 'Termination Device' in the HD/LINKer configuration utility. A SAT reads inputs which are either Internal Channels, VPI Channels, or VRO Channels (a SAT internally reads the VRO channel, and can only do so if the VRO Channel has been set by a SAT in the module). The Module Configuration File (MCF) defines which inputs the SAT is connected to.

A SAT sets outputs which are either Internal Channels or VRO Channels. The MCF defines which outputs the SAT is connected to.

Communication between SATs is via vital ATCS messages. Each of these Virtual Circuit SATs (VSATs) has its own unique ATCS address based upon the Subnode Identification Number (SIN) of the HD/LINK module in which it resides. Information is included in the messages to allow SATs to detect corrupted, mis-addressed, or stale messages.

Thus a Virtual Circuit SAT has on one side connections to physical I/O (VPIs, VROs) or internal I/O (discussed in paragraph 3.5) and on the other side a serial ATCS connection to its neighbor SAT which is either another Virtual Circuit SAT or a Cut Section SAT (discussed in paragraph 3.3). Figure 3-2 shows HD/LINK modules containing 3 Virtual Circuit SATs, the neighbors of each of these reside in another module at the same location (the Group number is the same and the Subnode Identification Number differs).

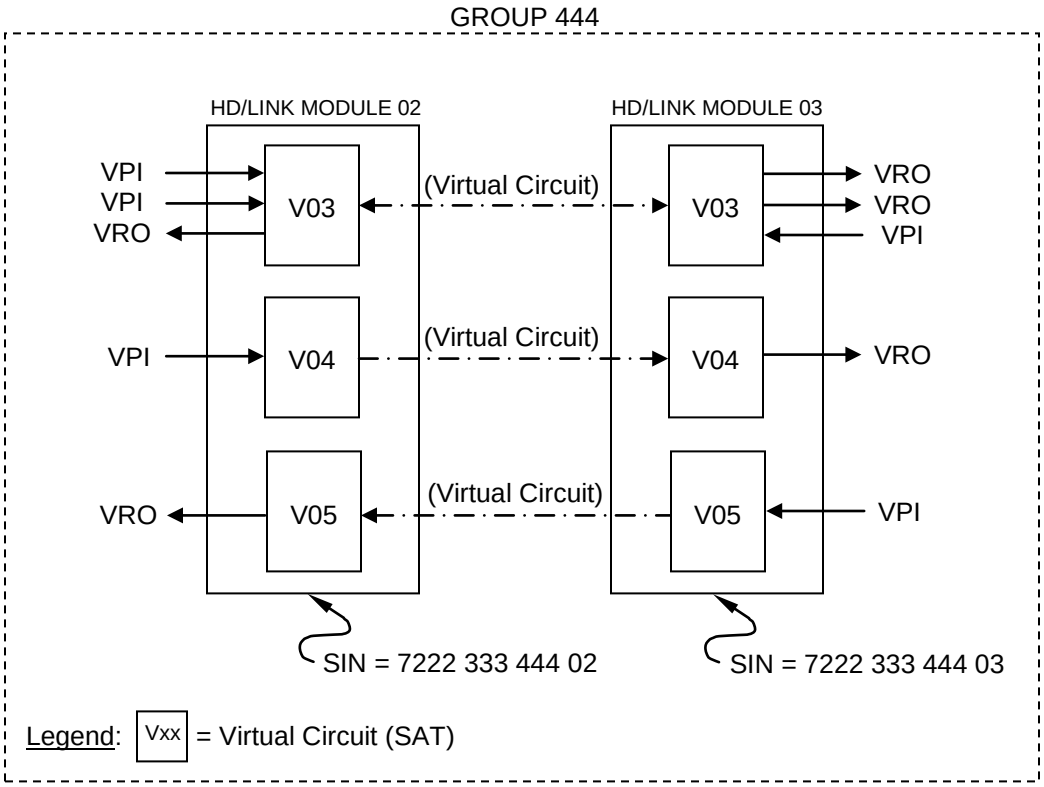


Figure 3-2. Two Modules in the Same Group Showing VSATS With Both Inputs and Outputs

Note that the Virtual Circuit SAT may have just inputs, just outputs or both inputs and outputs. Each Virtual Circuit SAT may have up to 24 inputs and 24 outputs.

NOTE

NOTE

SAT inputs can be any combination of VPI, Internal Channels and VROs used as inputs.

NOTE

NOTE

SAT outputs can be any combination of Internal Channels and VROs.

If the Virtual Circuit SAT has inputs, it can be viewed as having a server that is responsible for broadcasting the state of these inputs to a receiving client on the neighboring Virtual Circuit SAT. A Virtual Circuit SAT, with both inputs and outputs, has both a server and a client (refer to figure 3-3).

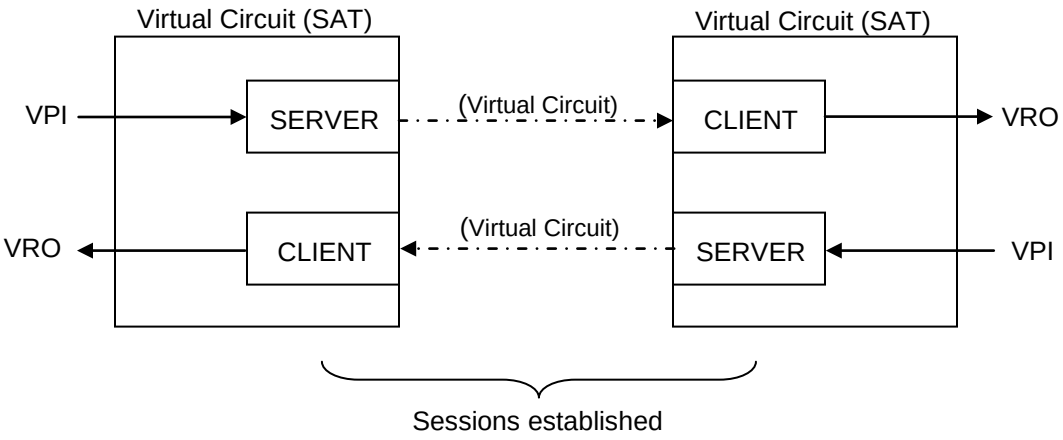


Figure 3-3. Virtual Circuit (SAT) Showing Client and Server

In order to transfer vital data containing the states of the inputs between the two Virtual Circuit SATs, a session has to be established between the two. When the client is in session it checks the messages it receives from the server. The client checks for the following criteria to ensure the data it receives is safe to use:

- Message is recent and not stale – using timestamp in message
- Message is in order – using a sequence number on each message
- Message is not corrupt - using a 32-bit CRC
- Message is correctly addressed – using unique ATCS source and destination address in message

3.1 SERVER UPDATE/CLIENT TIMEOUT

In order to protect against communication failures or failure of a neighboring module, the client uses a timeout function known as the *Client Timeout - Energized*. The *Client Timeout - Energized* value is configurable for each VSAT using the HD/LINKer configuration utility. If a message is not received within this time (minus 200ms to allow time for the module to process the message) the session is lost and the outputs of the VSAT are deenergized. The session is regained when the next valid *Data Update* message is received from the server. Thus in order to maintain the session the server sends regular messages to the client at a rate defined by the *Server Update Rate - Energized*.

In order to increase reliability, the Client Energized Output Timeout should be set to a value large enough to allow one or more messages to be missed before the session is lost (refer to Section IV, paragraph 4.1.3.1 for details).

In figure 3-2, three Virtual Circuits are being used between two modules. A configuration such as this would be used if it were necessary to have different timeouts for the VSATs. A more typical application would have the same timeout for each VSAT and would use a single Virtual Circuit to carry all the I/O (refer to figure 3-4). This has the advantage of reducing the bandwidth required (number of messages being transferred per second).

In figure 3-2 the upper Virtual Circuit uses a server at both VSATs, the middle Virtual Circuit only at the left neighbor VSAT, and the lower Virtual Circuit only at the right neighbor VSAT. Each of the four VSAT servers would send messages independently, whereas in figure 3-4, the same result is achieved with two VSAT servers, hence halving the message traffic. This is an important consideration when using the Spread Spectrum radio (see the SSR manual for details).

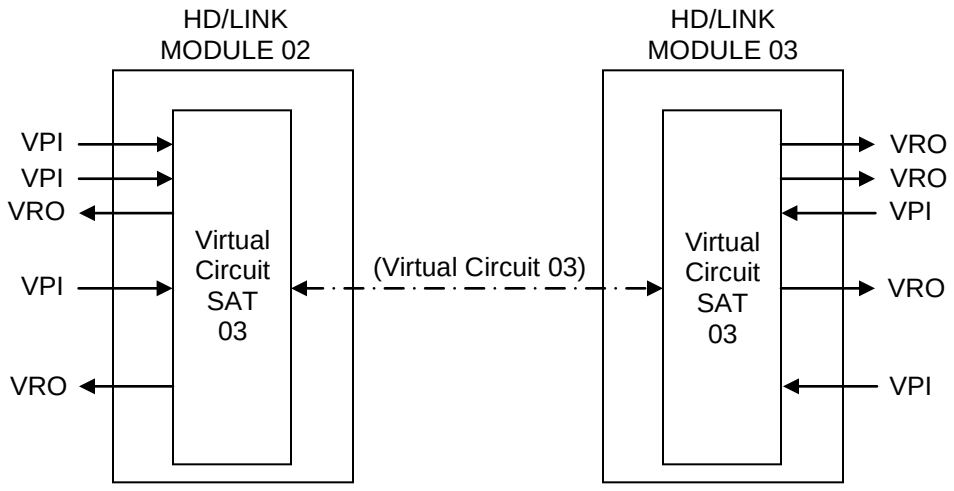


Figure 3-4. Bandwidth Optimization for Figure 3-2

Another parameter which can be used to reduce message traffic is the *Server Update Rate - Deenergized* and its corresponding *Client Timeout - Deenergized*. In order to maintain the session, messages are still transferred between server and client when the inputs are deenergized. The user can set the timeout and update rate to a lower value in this instance to reduce message traffic. All inputs to a Virtual Circuit must be deenergized in order for the SAT to use this rate.

3.2 SESSION INITIALIZATION

When modules are rebooted, the VSAT servers and clients must again establish a session. Figure 3-5 shows the different types of messages involved in session Initialization.

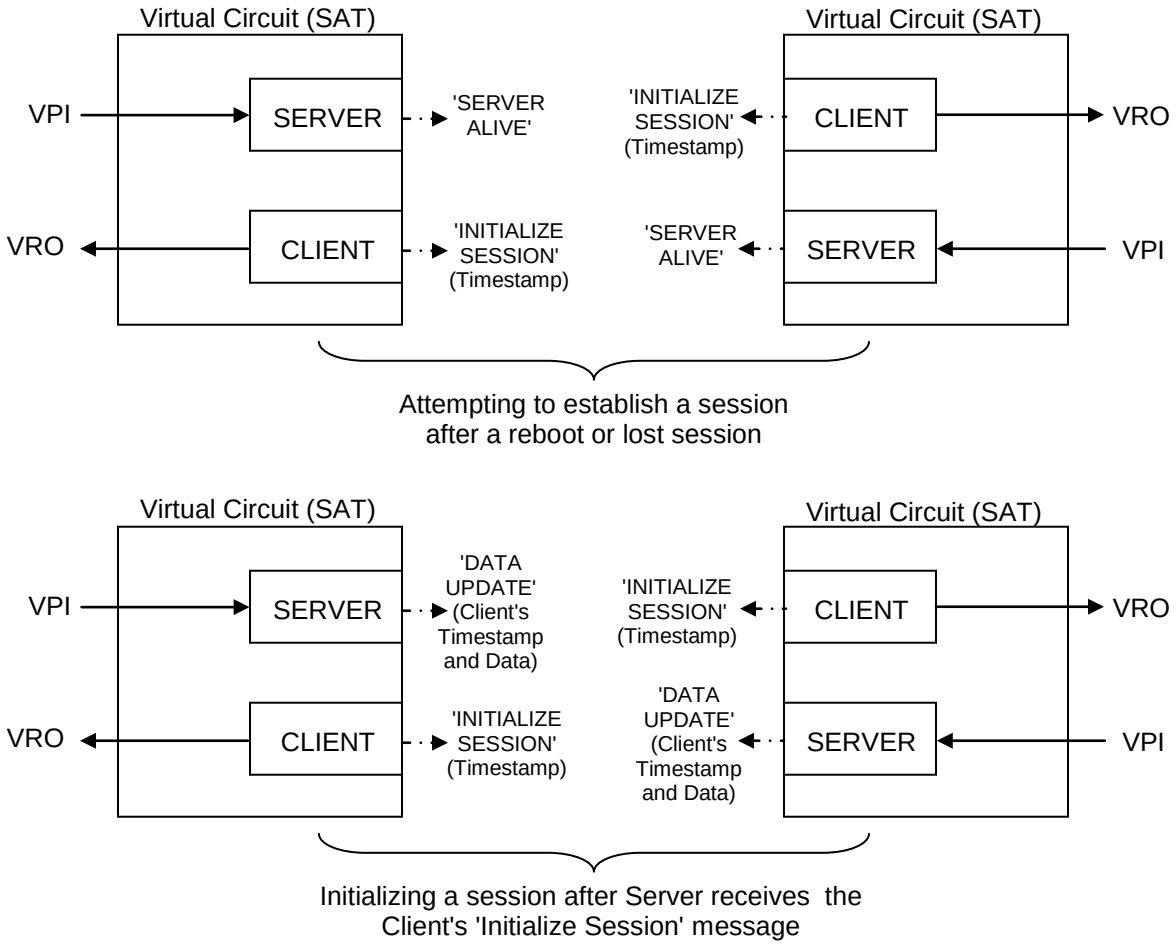


Figure 3-5. Client/Server Session Messages

After a reboot, the client sends out *Initialize Session* messages at an interval defined by *Client Session - Retry Rate*. After a time given by *Client Session – Attempt Timeout*, the client stops sending these messages, if a session has not been established, and waits to receive a *Server Alive* message from the server. The *Initialize Session* message contains a timestamp unique to the client sending the message. When the server receives the *Initialize Session* message it starts sending *Data Update* messages. These messages contain the state of the inputs to the server and the timestamp of the client.

After a reboot, the server sends *Server Alive* messages at an interval defined by *Server Session - Retry Rate*. When the client receives one of these messages it sends out an *Initialize Session* message.

When a session is lost, the client sends *Initialize Session* messages to try to reestablish the session. The session is reestablished when a valid *Data Update* message is received by the client. Table 3-1 summarizes the Client/Server Session Messages.

Table 3-1. Client/Server Session Messages

Message From:	Message:	Message Interval Defined By:	Message Sent:
Client	Initialize Session	Client Session - Retry Rate	After reboot
			After receiving Server Alive message.
			Periodically, defined by Client Timestamp Refresh Rate
Server	Server Alive	Server Session - Retry Rate	After reboot
	Data Update	(n/a)	After receiving Initialize Session message

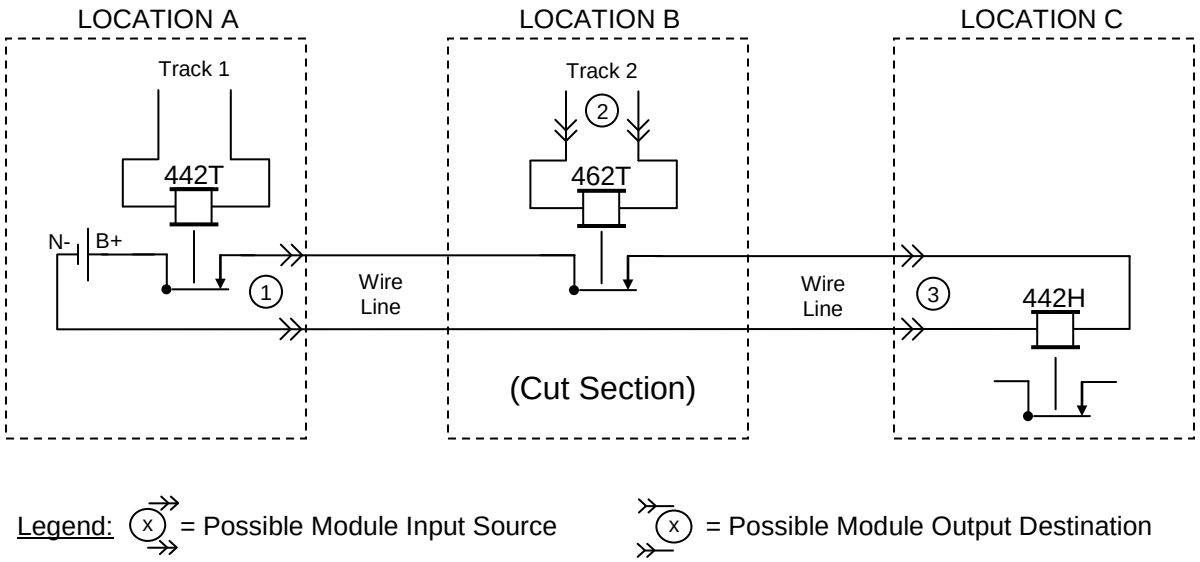
3.3 CUT SECTION SATS

The HD/LINK module supports another type of SAT: the Cut Section SAT (CSAT). The CSAT allows the Virtual Circuit between two VSATs to be broken with a track relay, slide fence, hazard detector etc. Figure 3-6 is an example of the use of a Cut Section SAT and its Pole Line equivalent. When the input to the Cut Section SAT on the module at Location B is energized, the state of the input to the module at Location A is transmitted to the module at Location C. When the input to the Cut Section SAT on the module at Location B is deenergized, a deenergized state is transmitted to the module at Location C regardless of the state of the input on the module at Location A.

The Cut Section SAT incorporates a timer which delays the energization of the Cut Section input. This can be used, for example in figure 3-6, to ensure that a train causes track 1 to drop before track 2 picks for a train moving from right to left.

A Cut Section SAT always has two SAT neighbors (can be VSATs or CSATs).

POLE LINE CIRCUITS



HD/LINK CIRCUITS

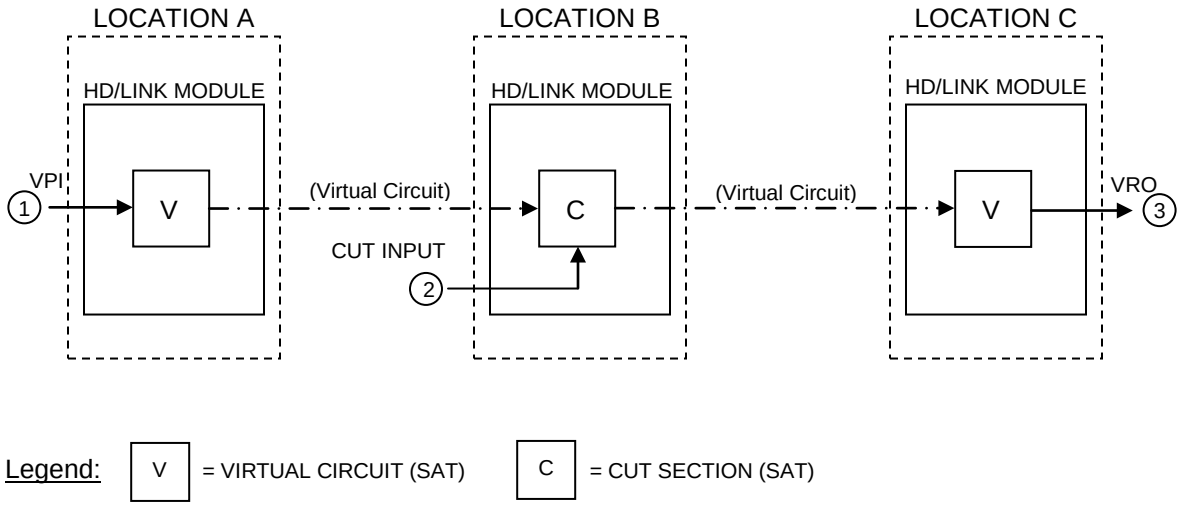


Figure 3-6. Use Of Cut Section (SATS)

One CSAT can be used to cut all the circuits connected to its VSAT neighbor (refer to figure 3-7A).

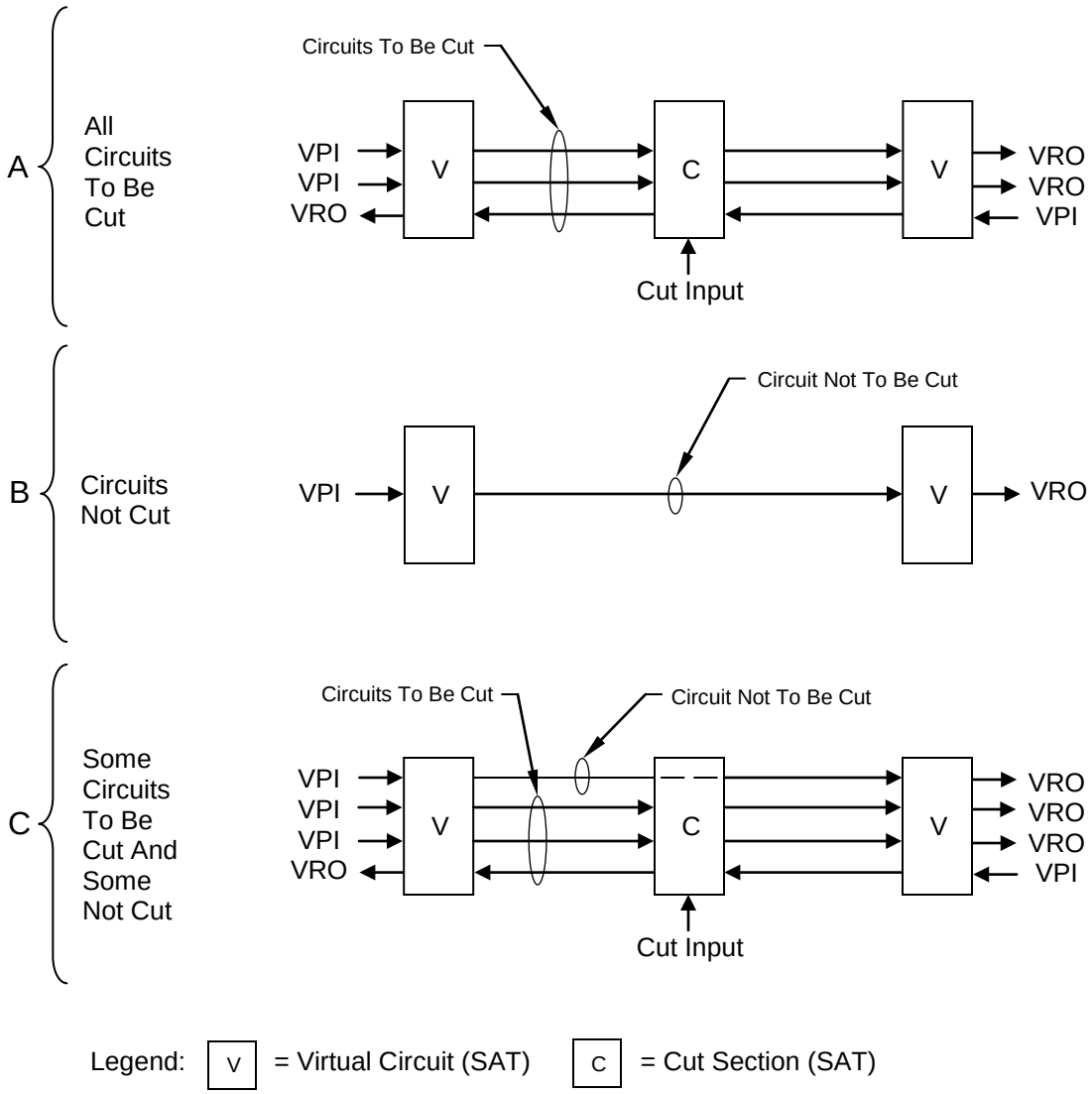
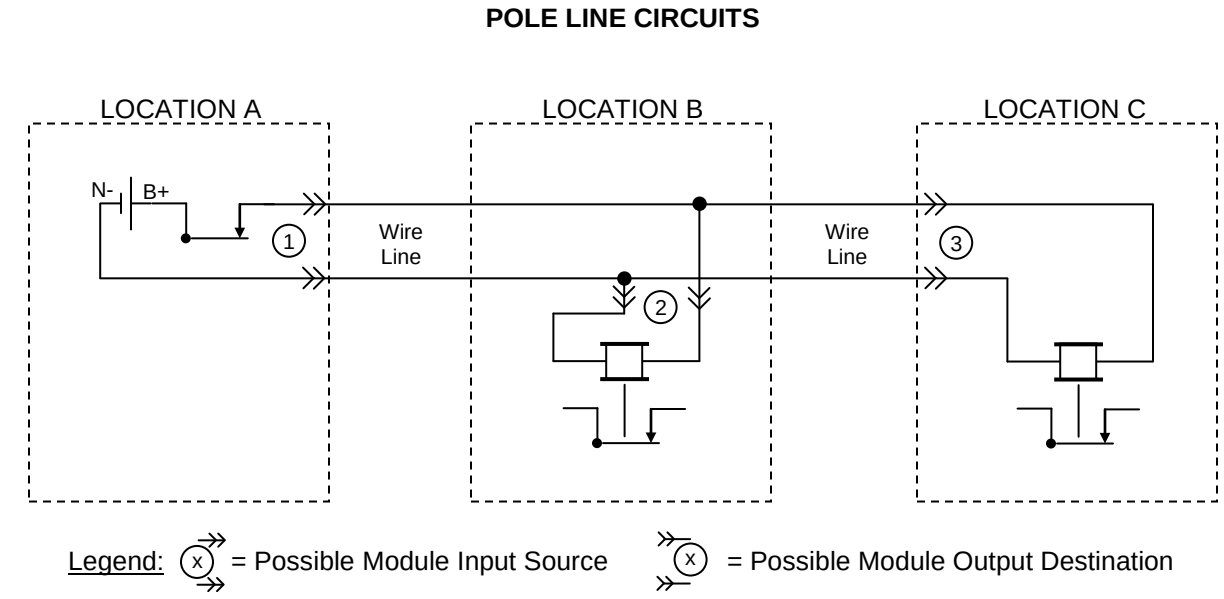


Figure 3-7. Circuit Optimization Using Cut Section SAT

In order to reduce message traffic, circuits can be routed through a Cut Section SAT and not be cut, by using a Bypass Cut. The Virtual Circuit in figure 3-7B does not use Cut Section SATs, but is equivalent to a circuit using a Bypass Cut. The circuit of figure 3-7B can be eliminated, thus saving the Virtual Circuits, by using a spare circuit of figure 3-7A and configuring a Bypass Cut (refer to the resulting circuits in figure 3-7C). In this manner the number of Virtual Circuits has been reduced by routing a non-cut circuit (Bypass Cut) through a Cut Section SAT. Refer to the HD/LINKer manual for how to configure a Bypass Cut.

3.4 INPUTS USED TO DRIVE MULTIPLE OUTPUTS

Figure 3-8 shows how Virtual Circuits can be used to allow an input at one location to drive outputs at many locations without having to wire the inputs and outputs externally.



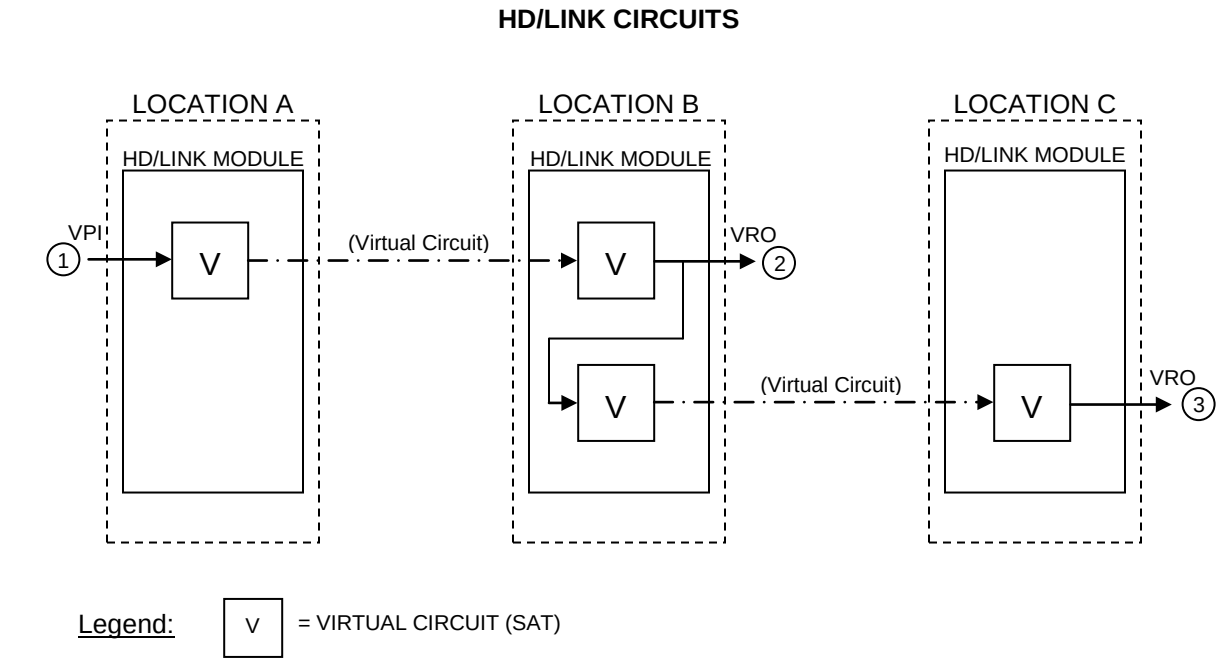
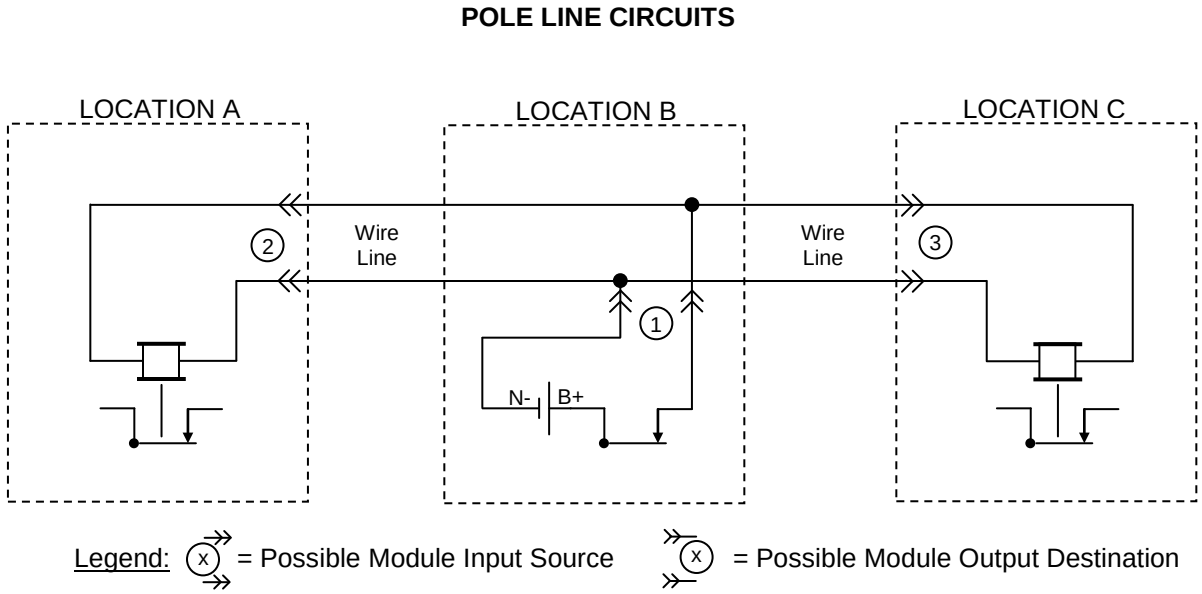


Figure 3-8. Cascading Vital Relay Outputs

Figure 3-9 shows how a vital input fed from a center location can be used to drive outputs at many locations without having to wire the inputs and outputs externally.



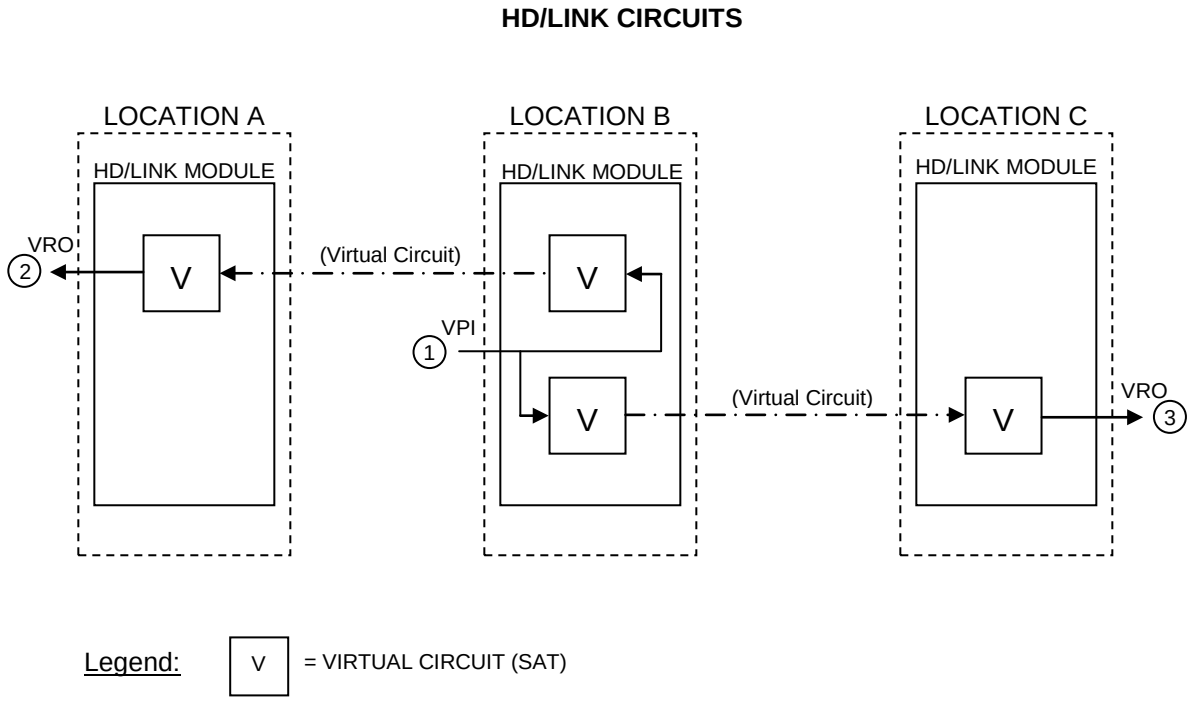
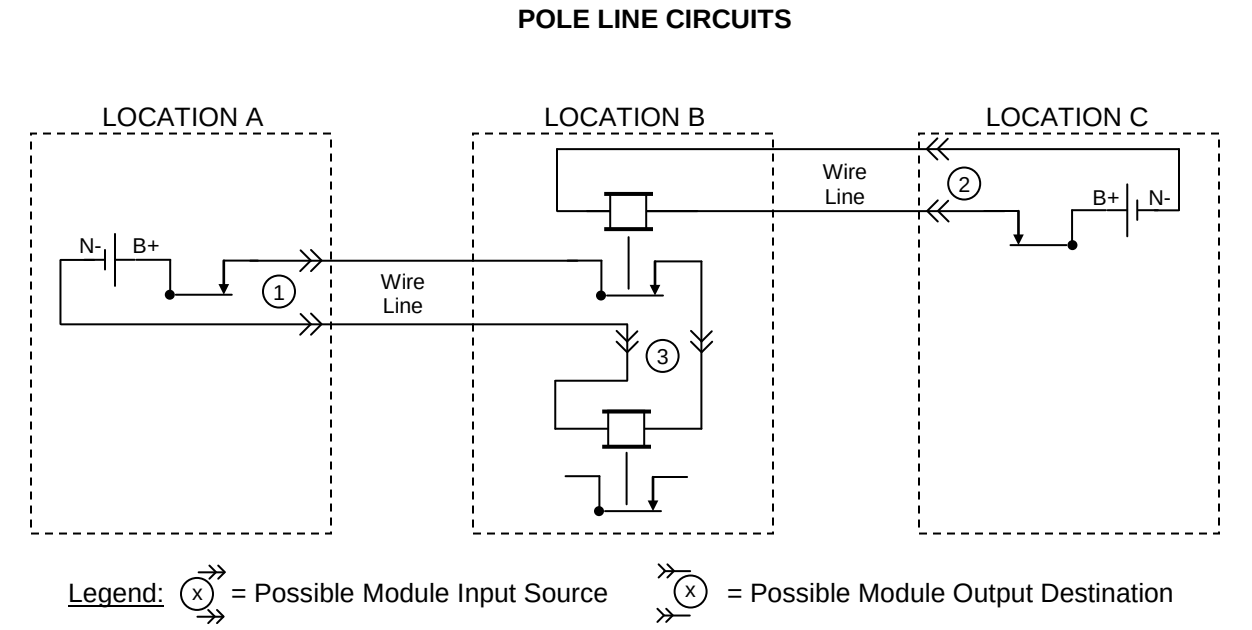


Figure 3-9. Center-Fed Vital Parallel Input

3.5 INTERNAL CHANNELS

Internal Channels are internal I/O states of the module. These can be connected to VSATs in the same manner as VPIs and VROs, however they are not connected to external I/O. A typical use of an internal state is shown in figure 3-10, where a remote input is brought in to cut a circuit.



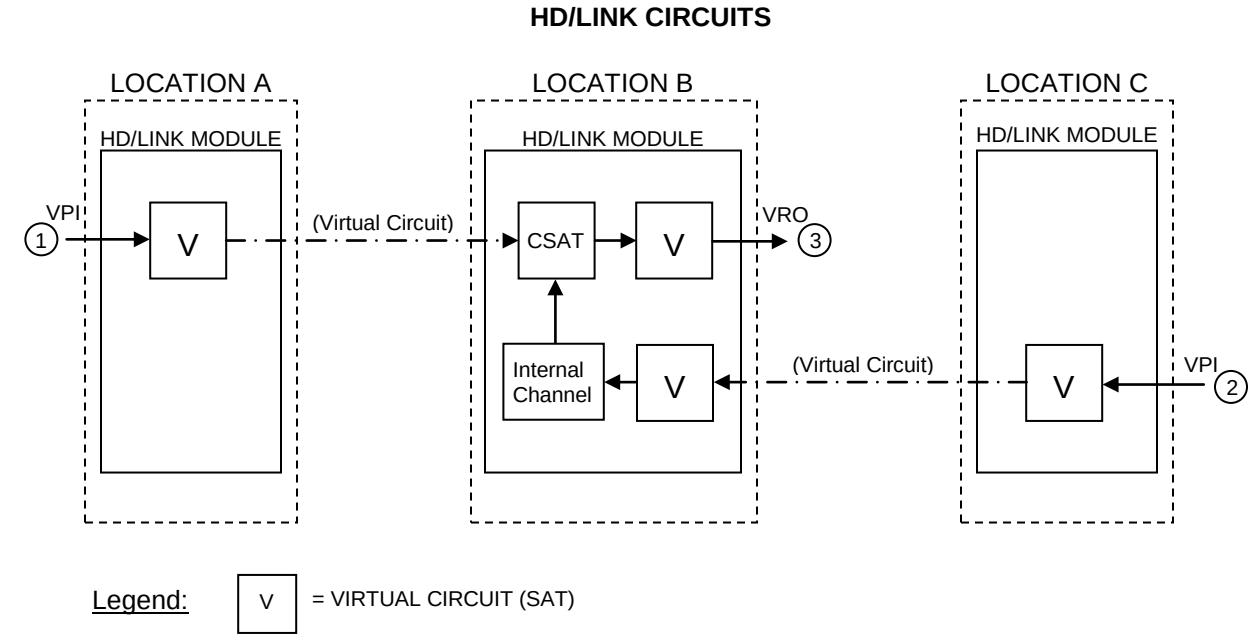


Figure 3-10. Internal Channels

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SECTION IV

HD/LINK MODULE CONFIGURATION PARAMETERS

4.0 GENERAL

HD/LINK modules can be configured to perform as vital input/output devices, and as vital timers. Module configuration is established in a Module Configuration File (MCF).

4.1 TIMERS

Timers in the HD/LINK module include: VRO timers, Cut Section timers, I/O state timers, startup timers, and synchronization timers. There are instances when a vital timer must be guaranteed not to exceed a certain value, and instances when a vital timer must be guaranteed to at least reach a certain value. The following terms are used to describe the two types of vital timer:

Never Time Long Timer: A Never Time Long timer is guaranteed to never time for longer than its configured time, even under failure conditions. An example of this is the Client Timeout – Energized timer. The Client Timeout – Energized timer must guarantee that the outputs are deenergized when the timeout expires. In order to account for processing delays, 200ms is subtracted from the configured time. Thus a timeout configured for 2s actually times out at 1.8s, under normal conditions. In the worst case, the timer may expire immediately, and the safe deenergized state is achieved – for example, if the module reboots.

Never Time Short Timer: A Never Time Short timer is guaranteed to never time shorter than its configured time, even under failure conditions. An example of this is the VRO energization delay and Cut Section Delay. These delay the energization of the outputs for at least the configured time. In the worst case the timer may never expire, and the safe deenergized state is maintained – for example if the module reboots or communications are lost.

⚠ WARNING

WARNING

THE RAILROAD SHOULD RECOGNIZE THE SAFETY-CRITICAL NATURE OF THE FOLLOWING TIMING PARAMETERS AND SET THEIR VALUES TO BE SAFE FOR THE INTENDED APPLICATIONS: CLIENT ENERGIZED OUTPUT TIMEOUT, MAXIMUM NETWORK DELAY, CLIENT TIME STAMP, VRO PICKUP AND DROP DELAY TIMES, AND CUT SECTION TIMER.

Timing parameters configured using the HD/LINKer configuration utility is listed in table 4-1.

Table 4-1. HD/LINK Module Timing Parameters

Parameters	Configurable	Type	Suggested Value
VRO Timers			
VRO Pickup delay	Yes	Never Time Short	Application dependent. Usually zero
VRO Drop delay	Yes	Never Time Long	Application dependent. Usually zero
Cut Section Timers			
Cut Section Timer	Yes	Never Time Short	Application dependent. Usually zero
I/O State Timers			
Client Timeout - Energized	Yes	Never Time Long	see paragraph 4.1.3.1
Client Timeout - Deenergized	Yes	Never Time Long	see paragraph 4.1.3.2
Server Update Rate - Energized	Yes	Never Time Short	see paragraph 4.1.3.3
Server Update Rate - Deenergized	Yes	Never Time Short	see paragraph 4.1.3.4
Startup Timers			
Client Session - Attempt Timeout	No	Never Time Short	1 minute
Client Session - Retry Rate	No	Never Time Short	2 seconds
Server Session - Retry Rate	No	Never Time Short	2 seconds
Synchronization Timers			
Client Time Stamp – Refresh Rate	No	Never Time Short	1 hour
Client Time Stamp - Net Delay	Yes	Not applicable	See paragraph 4.1.5.3
Server Time Stamp – Refresh Timeout Interval	No	Never Time Short	2 hours 2 seconds

4.1.1 VRO Timers

The timers that can be configured for VROs are Pickup Delay and Drop Delay. These enable the HD/LINK module to:

- Emulate slow-to-pick and slow-to-drop relay functions
- Compensate for timing problems caused by communication delays

4.1.1.1 VRO Pickup Delay

VRO Pickup (or Pick) Delay is a settable time period used to delay the energization of the vital output after a message has been received to energize the output. The Pickup Delay allows the HD/LINK module to be used as a vital timer. The Pickup Delay can be set for a maximum of 2.7 hours.

The VRO Pickup Delay is a *never time short* timer. That means the configured time, as a minimum, is guaranteed to elapse before the output is energized.

The timer is accurate to approximately configured time (+ 300ms).

4.1.1.2 VRO Drop Delay

VRO Drop Delay is a settable time period used to delay the deenergization of the vital output after a message has been received to deenergize the output. The Drop Delay allows the HD/LINK module to be used as a vital timer. The delay can be set up to 2.7 hours. The timer is accurate to approximately 300ms.

The VRO Drop Delay is a *never time long* timer. That means the configured time is the maximum time that ever elapses before the output is deenergized. The timer usually expires, and the outputs deenergize, 200ms before the configured time.

The timer is accurate to approximately configured time (- 200ms).

⚠ WARNING

WARNING

THE SESSION TIMEOUTS AND VRO DROP DELAY TIMES ARE CUMULATIVE.

If the Client Timeout - Energized is set to a value of *x* seconds and the VRO Drop Delay time to y seconds, then the outputs do not deenergize for *x+y* seconds if the remote module stops sending update messages. Under failure conditions, such as a communication loss, the VRO deenergization time is never longer than the sum of the VRO Drop Delay time and the client timeout.

⚠ WARNING

WARNING

UNDER FAILURE CONDITIONS THE OUTPUTS MAY DEENERGIZE IN LESS THAN THE CONFIGURED TIME - AT WORST THEY MAY DEENERGIZE IMMEDIATELY.

NOTE

NOTE

The above Pickup and Drop Delay times do not include communication delays. The timers are started when a message is received from the neighbor indicating the new state of the input. Thus from a change in state of an input relay, the collective communication delays need to be considered.

Table 4-2 presents a breakdown of typical delays involved from an initial input change to the final output change.

Table 4-2. Breakdown of Typical Delays

Event	Response Time
Input Relay deenergizes	0 (initial change)
Input Relay change detected	250-500ms after change, generally about 330ms
Message transmitted to radio	50-500ms, generally 100ms
Communication delay on radio network	500-1000ms, generally 500ms
Message processing time	50-500ms, generally about 100ms
VRO Pickup delay started	(at end of message processing time)
VRO drop delay elapses	1.8s (for a configured 2s delay)
Output Relay deenergized	200ms
Typical Total Time from input change	3.3s

4.1.2 Cut Section Timers

A Cut Section Timer is used to delay the energization of the Cut Section after its input becomes energized. Thus the Cut Section Timer may be used to prevent loss of shunt. The timer is accurate to 300 ms and may be set for up to a 2.7 hour delay. The cut energization delay is a *never time short* timer.

4.1.3 I/O State Timers

I/O state timers are used to control:

- The rate at which messages are sent form one HD/LINK module to its neighbor (*Server Update Rate - Energized*, and *Server Update Rate - Deenergized*)
- The amount of time that the relay outputs remain energized after a communication failure before reverting to their deenergized state (*Client Timeout - Energized*)
- The amount of time that the client waits when the outputs are deenergized after a communication failure before a session is considered to be lost (*Client Timeout - Deenergized*)

4.1.3.1 Client Timeout – Energized

The purpose of this timer is to deenergize the outputs on a particular circuit if the client stops receiving messages from its server. This protects against equipment and communication failures. The timer is a *never time long* timer. In order to guarantee this, 200ms is subtracted from the configured time. Thus if an 8s timeout is specified, the timeout occurs after 7.8s.

The *Client Timeout - Energized* and *VRO Drop Delay* are cumulative, therefore a relay may remain energized for up to the sum of these times if communications are lost or the remote equipment has failed.

⚠ WARNING

WARNING

UPON LOSS OF COMMUNICATION TO THE REMOTE HD, A RELAY MAY REMAIN ENERGIZED FOR A TIME EQUAL TO THE SUM OF THE 'CLIENT TIMEOUT - ENERGIZED' AND THE VRO DROP DELAY.

The railroad must therefore choose a value for C*lient Timeout – Energized* appropriate for the particular application in which it is used.

When using an RF link, for reliability reasons Siemens Rail Automation recommends that this timeout be set so that at least two or three messages can be missed without the client timing out. This implies that the timeout be two or more times as large as the *Server Update Rate - Energized*.

4.1.3.2 Client Timeout – Deenergized

This timer to used to detect that the server has stopped responding in the case where the expected outputs are deenergized. When the timeout occurs, the session is lost and the client attempts to reestablish session by sending *Initialize Session* messages to the server.

4.1.3.3 Server Update Rate – Energized

This is the time between data update messages, when the input end of the circuit is energized. In order to maintain an energized output the client must receive a periodic message from the server indicating that the remote input is still energized. Note that when an input changes state a message is sent out immediately; this server update rate controls the time for subsequent updates of this data.

4.1.3.4 Server Update Rate – Deenergized

This is the time between data update messages when the input end of the circuit is deenergized. In order to maintain a session, the client must receive a periodic message from the server indicating that the remote module is still communicating.

4.1.4 Startup Timers

Startup timers are used on start-up, or when a session is lost, to try to reestablish the session. These parameters are not user-selectable in the HD/LINKer configuration utility; they have pre-assigned values established by Siemens Rail Automation. However, if the Railroad requires a different set of values, the values can easily be changed (refer to the File Management section of the HD/LINKer manual for details).

4.1.4.1 Client Session - Retry Rate

On start-up, or after a session is lost, the client sends *Initialize Session* messages to the server to try to establish a session. The *Client Session – Retry Rate* parameter defines the interval at which these messages are sent.

4.1.4.2 Client Session - Attempt Timeout

After a reboot or a lost session, the client tries sending *Initialize Session* messages to the server for this length of time before stopping. If a session is not established during that time, the client waits to receive a *Server Alive* message from the server and then resumes sending *Initialize Session* messages.

4.1.4.3 Server Session - Retry Rate

On start-up, or after a session is lost, the server sends *Server Alive* messages to the client to inform the client that the server is present and responding. This parameter defines the interval at which these messages are sent.

4.1.5 Synchronization Timers

The vital data update messages contain timestamp information as part of the vital protocol protection against stale messages. The timestamps are independent of the real-time clock; resetting the time and date of the module in no way effects the message timestamps.

4.1.5.1 Client Time Stamp - Refresh Rate

The *Client Time Stamp - Refresh Rate* timer is used to ensure that the timestamp does not gradually drift out of synchronization. The client sends out an *Initialize Session* message with a new timestamp at an interval defined by this parameter.

4.1.5.2 Server Time Stamp - Refresh Timeout Interval

The *Server Time Stamp - Refresh Timeout Interval* timer is used to ensure that the timestamp does not gradually drift out of synchronization. The server expects to see a periodic update of its timestamp. If an update is not received within the time defined by this parameter, the server assumes that the client is not present and goes out of session. The server then starts sending *Sever Alive* messages to reestablish the session.

4.1.5.3 Client Time Stamp – Net Delay

This parameter represents the maximum network delay in transferring a message from the server to the client. Network delay may be affected by the number of sites and nodes (such as modules, LAN connections, and radio links) utilized as repeaters in transferring the message.

This parameter is used by the module to determine whether a message is stale. A stale message is a message that does not represent the most recent state of the input.

WARNING

A LARGE VALUE FOR CLIENT TIME STAMP - NET DELAY DEGRADES THE ABILITY OF THE HD/LINK MODULE TO DISCRIMINATE BETWEEN RECENT AND STALE MESSAGES.

4.1.6 Relationships Between Timer Values

Certain relationships must be maintained between selected values in I/O State Timers, Startup Timers, and Synchronization Timers, and these relationships should be taken into consideration when configuring timers.

4.1.6.1 I/O State Timers

The following relationships state that update messages must be received within the timeout periods. Account is taken of processing delays and the need to be able to tolerate missed messages.

When configuring I/O State timers, the following relationships must be maintained for sessions in the same module or between modules at the same location:

(*Client Timeout – Energized* minus 0.2s) > (*Server Update Rate – Energized*)'

(*Client Timeout – Deenergized* minus 0.2s) > (*Server Update Rate – Deenergized*)'

This rule merely states that a server update rate must take into consideration the client timeout and processing delay (or vice-versa), otherwise the client might never receive the server's *Data Update* message.

When configuring I/O State timers, the following relationships must be maintained for sessions between modules via one radio hop:

(*Client Timeout – Energized* minus 0.2s) > (n+1) times (*Server Update Rate – Energized*)

(*Client Timeout – Deenergized* minus 0.2s) > (n+1) times (*Server Update Rate – Deenergized*)

where: ‘n’ is the permissible number of missed messages (recommend n = 3).

For example, to allow for two missed messages with a 1s update rate, the client timeout would need to be 3*1+0.2 = 3.2s.

This rule merely states that a server update rate must take into consideration the client timeout and processing delay and permissible number of missed messages (or vice-versa), otherwise the client might never receive the server's *Data Update* message.

4.1.6.2 Startup Timers

Startup timers (and their relationships for server-client sessions) are set by Siemens Rail Automation at the factory and are not configurable. In the event other values for *Client Session - Retry Rate*, *Server Session - Retry Rate*, or *Client Session - Attempt Timeout* are required than those set up, contact Siemens Rail Automation Engineering.

4.1.6.3 Synchronization Timers

When configuring Synchronization Timers, the following relationships must be maintained for sessions in the same module or modules at the same location:

Client Time Stamp - Net Delay > 5s

Client Time Stamp - Net Delay > Client Timeout – Energized

The Client Time Stamp - Refresh Rate and *Server Time Stamp - Refresh Timeout Interval* are set by Siemens Rail Automation at the factory and are not configurable. In the event other values are required than those set up, contact Siemens Rail Automation Engineering.

Table 4-3 shows typical values for update rates and timeout periods.

Table 4-3. Typical Update Rates And Timeout Periods

Parameter	Single Radio Hop	1 Radio Repeater	Client and Server in Same Module*	Client and Server in Modules on the Same LAN
Client Timeout – Energized	8 seconds	8 seconds	8 seconds	4 seconds
Client Timeout – Deenergized	8 seconds	8 seconds	8 seconds	4 seconds
Server Update Rate – Energized	1.9 seconds	1.9 seconds	3.9 seconds	1.9 seconds
Server Update Rate – Deenergized	1.9 seconds	1.9 seconds	3.9 seconds	1.9 seconds
Client Time Stamp – Net Delay	10 seconds	10 seconds	10 seconds	5 seconds

*NOTE: The values of these timeouts and update rates are not critical, within relationship limits, since both the server and client are in the same module, hence equipment failure automatically causes deenergization of the outputs.

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SECTION V

HD/LINK FIELD COMMISSIONING

5.0 GENERAL

Field commissioning of the HD/LINK module consists of performing the module physical installation, configuring the module, verifying or testing the installation, and performing on-line, in-service testing before release for normal operation.

⚠ WARNING

WARNING

THE HD/LINK MODULE IS INTENDED FOR USE IN VITAL SIGNALING APPLICATIONS. AS SUCH, CERTAIN SAFETY PRECAUTIONS ARE NECESSARY WHEN APPLYING THE MODULE, AND THE WARNINGS IN THIS MANUAL SHOULD BE HEEDED.

Table 5-1 presents a list of items needed for commissioning.

Table 5-1. Items Needed For Commissioning An HD/LINK Module

Item	Description	Reference
1	Laptop PC with Installers DT Utility software	Section VII, paragraph 7.1, *Diagnostic Terminal (DT)*
2	RS-232 cable (straight through, pin-to-socket, DB-9 connector at HD end, other end depending on COM port used) from DT to Diagnostic port	Section VII, paragraph 7.1, *Diagnostic Terminal (DT)*
3	HD/LINKer configuration utility printouts – • MCF Installation Listing • MCF Contents Listing (or MCF Approval Listing) • HD/LINK Wiring List	 *Appendix C, Sample MCF Installation Listing* *Appendix D, Sample MCF Contents Listing (or Appendix E, Sample MCF Approval Listing)* *Appendix F, Sample HD/LINK Wiring List*

Table 5-1 Concluded

Item	Description	Reference
4	MCF created by the HD/LINKer configuration utility and transferred to floppy disk (or already loaded on PC hard drive)	Section I, paragraph 1.6, *Configuration System Overview*, and Section V, paragraph 5.2.2.1, *Procedure for Loading the MCF*
5	Railroad schematics from which the configuration was created	(n/a)
6	MEF software executive on floppy disk (only if needed)	Section V, paragraph 5.2.1, *HD/LINK Software Executive*
7	Wire strippers	Section V, paragraph 5.1.2.4, *Wire Preparation*
8	Screwdriver insertion tool	Section V, paragraph 5.1.2.5, *Wire Insertion*

For an example of the HD/LINKER Circuit Layout corresponding to the samples referenced in Appendices C through F, refer to Appendix G.

⚠ WARNING

WARNING

ALL HD/LINK INSTALLATIONS SHOULD BE FULLY TESTED AS SPECIFIED IN SECTION V, ON INSTALLATION OF THE MODULE OR WHENEVER A CHANGE IS MADE TO THE CONFIGURATION.

5.1 PHYSICAL INSTALLATION

The physical installation for the HD/LINK module consists of securely mounting the module and installing the interface connections. Refer to Appendix I for a typical HD/LINK installation.

5.1.1 Mounting The HD/LINK Module

The HD/LINK module is designed to be mounted on a Safetran ST relay compatible rack. Modules mounted in this fashion are quickly and easily replaceable. The module is one and one half times the width of a Safetran ST1 (single width) type relay. The interface connections are made through a connector (see below) attached to the top of the module to the site wiring harness. The Diagnostic Terminal (DT) interface and LED indicators are accessible from the front panel of the module.

The HD/LINK module can be wall mounted by using the rear plate of the module to secure to a flat surface.

5.1.2 Wiring Harness

The Wiring harness includes the HD/LINK module mating connector assembly (with ECD), and wires and cables to interfacing equipment. Wiring is in accordance with the HD/LINK Wiring List and railroad schematics. Twisted pair for the DC Power and Return wires to B12 and N12 and for inputs and outputs is recommended to minimize the effects of noise.

NOTE

NOTE

Siemens Rail Automation strongly recommends the use of primary arresters and equalizers on all external lines to provide adequate surge protection.

Refer to Appendix I for preferred surge protection wiring for an HD/LINK system.

5.1.2.1 Mating Connector

The HD/LINK module interfaces through a connector assembly, consisting of four WAGO® connectors with a total of 40 connections (mounted to an internal PCB) accessed from the top of the module. Each connection has two termination points. It is recommended to use the lower terminations for the I/O connections and the upper connection for jumper terminations.

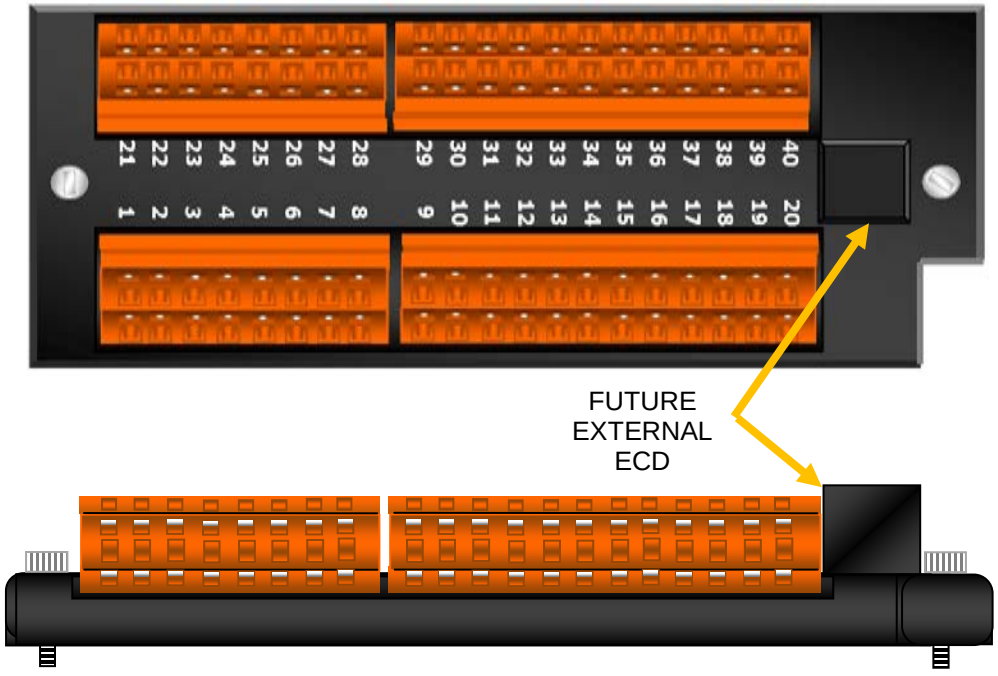

Figure 5-1. HD/LINK Module Mating Connector With ECD

The external mating connector for the HD/LINK module is an assembly (Siemens Rail Automation Part Number A53122-XXXX), composed of four WAGO® connectors with a total of 40 connections. Each connection has two termination points to provide for multiple connections. A

potted 8k x 8 Erasable EEPROM (referred to as the External Configuration Device, or ECD) with transient protection, is internally mounted inside the HD/LINKer unit. An external ECD will be available in a future release.(refer to figure 5-1). HD/LINK modules may be ordered with or without the mating connector, and the mating connector may also be ordered separately (refer to Section I, paragraph 1.9, *Ordering Information*).

5.1.2.2 SIN Label

A label has been placed on the connector for the purpose of marking the connector with the Site Identification Number to facilitate correct identification.

5.1.2.3 Wire Size And Type

The HD/LINK module interface connector accommodates #16AWG wire with a maximum outside insulation diameter of 0.145" (3.7mm) down to a size #26AWG. Recommended wire size for an HD/LINK system with short wire runs is 18AWG to 20AWG for power, signal and Echelon® connections (Belden cable #8461 is a suitable 18AWG stranded, unshielded twisted pair cable for power, signal and Echelon® connections). If multiple modules are used and connections are daisy-chained, current-carrying capacity must be taken into consideration for wire size. Stranded wire should be used for cage clamp type connectors.

NOTE

NOTE

To prevent wire breakage or cage clamp failure, use only stranded wire for connectors with cage clamps.

5.1.2.4 Wire Preparation

Strip 0.35" (9mm) of insulation from the end of the wire. It is recommended that a stripping tool be used which allows the strip length to be set accurately. The addition of ferrules is not required and is not recommended.

5.1.2.5 Wire Insertion

The stripped end of a wire should be inserted into the cage clamp after levering the cage clamp open. This is accomplished by pressing straight down with the recommended type of screwdriver in the rectangular slot in the connector next to the cage clamp. Care should be taken to ensure that the cage clamp is fully open before wire insertion.

The recommended screwdriver type is flat bladed with a blade size of 0.10" wide, 0.020" thick (2.5mm x 0.4mm). A suitable type is the Wago® 210-619.

⚠ CAUTION

CAUTION

USING THE CORRECT WIRE INSERTION TOOL IS NECESSARY TO PREVENT DAMAGE TO THE CONNECTOR.

NOTE

NOTE

Not more than one wire should be inserted into each cage clamp. Two cage clamps per connection are provided on the HD/LINK module connector.

After the stripped end of a wire is inserted into the cage clamp, hold the wire in place while removing the screwdriver to allow the cage clamp to close on the stripped end of the wire, securing it in place. All the wires are to be done in this fashion.

5.1.2.6 Strain Relief

NOTE

NOTE

Sufficient slack should be allowed in the bundle behind the module to allow for disengagement of the connector without requiring the removal of **any** of the wires from the cage clamps. This facilitates easy future removal and replacement of the HD/LINK module, if necessary.

5.2 HD/LINK MODULE CONFIGURATION

Vital operations (inputs read and outputs set) can only be done when the module has passed through the initialization state and the health and configuration checks have passed and the module can read the ECD data. Before vital operations can begin, the module must have the correct MCF, MEF, and UCN.

Because of possible failure in equipment or tools used to configure an application, steps must be taken to ensure that the application and the configuration do not contain incorrect data.

Changes can only be made to the system configuration when the vital processing has been shut down. During normal operation of the system, when any vital operations are being done, it is not possible to change the configuration of the system.

⚠ WARNING

WARNING

AFTER INSTALLATION OF A MODULE, OR WHENEVER A CHANGE IS MADE TO THE CONFIGURATION, THE INSTALLATION SHOULD BE FULLY OPERATIONS TESTED.

Configuration of the HD/LINK module consists of loading the MCF, the SIN, and the UCN. If the MEF is not the desired version, loading of the MEF may also be required. The MEF version may be checked by viewing Module Status from the Get menu of the DT Utility.

5.2.1 HD/LINK Module Software Executive

Changing the Module Executable File (MEF) for the HD/LINK module does not require changing any EEPROMs. The software is stored in flash memory and can be updated using a laptop computer running the Installers Diagnostic Terminal Utility.

NOTE

NOTE

Siemens Rail Automation provides HD/LINK modules already loaded with the latest HD/LINK software. Loading the MEF should not normally be required.

If a different HD/LINK software version is required than the one installed in a module, a new MEF can be loaded into the module.

⚠ WARNING

WARNING

LOAD HDL01_20 OR LATER VERSIONS OF MEF ONLY. DO NOT LOAD SOFTWARE VERSIONS HDL01_00 OR HDL01_10. REFER TO CUSTOMER SERVICE BULLETIN CSB4-98 FOR INFORMATION.

The procedure for loading new MEF software is as follows:

1. Enter the Configuration menu for the Installers Diagnostic Terminal Utility (fully described in Section VII) as follows:

   a. Power up the HD/LINK module.

   b. Connect the laptop PC COM port to the HD/LINK Diagnostic port and start the Installers Diagnostic Terminal Utility (as described in Section VII, paragraph 7.1.1, *Installers Diagnostic Terminal Utility*).

   c. Reset the module using the Reset Module command from the Reconfigure menu. Refer to Section VII, paragraph 7.1.1.3, *Installers Reconfigure Menu (<Alt> + <R>)* for instructions on using the Installers Reconfigure menu.

   d. The module begins to reboot. At the prompt to change the module setup, type 'Y' (Yes), and then press <ENTER>. This must be done within 5 seconds, otherwise the module bypasses the reconfigure option and starts executing the current MEF.

   e. After resetting the module and typing Y <ENTER> to change the module setup, the Setup program downloads and the MCF version, field SIN, field UCN, MEF version, module type, module subtype, and a menu of configure function key options are displayed as they are loaded.

2. From the menu of configure function key options, select the option to reconfigure the MEF by pressing 'Function Key 4' ('F4').

3. At the prompt asking whether to erase the existing MEF, type ‘Y’ (Yes).

4. The screen prompts for the path and filename of the MEF by displaying the default global location: *.MEF.

5. Select the path and filename (either from floppy disk or on the hard drive) of the desired MEF and press <ENTER>, or press <ENTER> after the default global location to browse the 'c:' drive, and then select the correct path and filename from the choices presented.

6. The new MEF downloads into the module.

7. The MCF, SIN, or UCN may be loaded at this point as described below, or if the MCF, SIN, and UCN have already been loaded, press ‘Function Key 8’ (‘F8’) to exit the Setup program and start execution of the MEF software. If the MEF has changed, a new UCN must be loaded.

NOTE

NOTE

Unlike most diagnostic features of the HD/LINK module, the downloading of MEF, MCF, SIN and UCN cannot be done remotely. The PC running the Installers DT Utility must be directly connected to the module being programmed.

5.2.2 HD/LINK Module Configuration

Three steps are required to configure the HD/LINK module as follows:

- Load the MCF (Module Configuration File).
- Load the SIN (Subnode Identification Number, or ATCS address).
- Load the UCN (Unique Check Number).

The MCF Installation Listing for the HD/LINK module generated by the HD/LINKer configuration utility provides the SIN and UCN for the particular module. Refer to Appendix C for an example of an MCF Installation Listing.

All of these items are loaded by entering the Configuration menu for the Installers Diagnostic Terminal Utility (fully described in Section VII) as follows:

1. Power up the HD/LINK module.

2. Connect the laptop PC COM port to the HD/LINK Diagnostic port and start the Installers Diagnostic Terminal Utility (as described in Section VII, paragraph 7.1.1, *Installers Diagnostic Terminal Utility*).

3. Reset the module using the Reset Module command from the Reconfigure menu. Refer to Section VII, paragraph 7.1.1.3, *Installers Reconfigure Menu (<Alt> + <R>)* for instructions on using the Reconfigure menu.

4. The module begins to reboot. At the prompt to change the module setup, type ‘Y’ (Yes), and then press <ENTER>. This must be done within 5 seconds, otherwise the module bypasses the reconfigure option and starts executing the MEF.

5.2.2.1 Procedure for Loading the MCF

1. After resetting the module and typing Y <ENTER> to change the module setup, the Setup program is downloaded and the MCF version, field SIN, field UCN, MEF version, module type, module subtype, and a menu of configure function key options are displayed as they are loaded.

2. From the menu of configure function key options, select the option to reconfigure the MCF by pressing ‘Function Key 3’ (‘F3’).

3. Before the MCF can be downloaded, the screen prompts for the path and filename of the MCF by displaying the default global location: *.MCF.

4. Select the path and filename (either from floppy disk or on the hard drive) of the MCF indicated on the MCF Installation Listing and press <ENTER>, or press <ENTER> after the default global location to browse the ‘c:’ drive, and then select the correct path and filename from the choices presented.

5. The new MCF downloads into the External Configuration Device (ECD) embedded in the interface connector as a message is displayed that it is "Burning the MCF".

6. After downloading has completed, the MCF version, field SIN, field UCN, MEF version, module type, module subtype, and a menu of configure function key options are displayed.

7. The SIN or UCN may be loaded at this point as described below, or if the SIN and UCN have already been loaded, press ‘Function Key 8’ (‘F8’) to exit the Setup program and start execution of the MEF software. If the MCF has changed, the new UCN must be loaded.

WARNING

THE CONFIGURATION FOR A MODULE AT ONE LOCATION SHOULD NEVER BE INSTALLED IN ANOTHER LOCATION, EVEN IF THE CIRCUITS ARE IDENTICAL, AS THIS WOULD DUPLICATE ATCS ADDRESSES.

5.2.2.2 Procedure for Loading the SIN

1. After the previous steps, the MCF version, field SIN, field UCN, MEF version, module type, module subtype, and a menu of configure function key options are displayed.

2. From the menu of configure function key options, select the option to reconfigure the SIN by pressing ‘Function Key 1’ (‘F1’).

3. Enter the 12-digit SIN (ATCS address) of this HD/LINK module as shown on the MCF Installation Listing (or MCF Approval Listing), and press <ENTER> when complete.

4. The UCN may be loaded at this point as described below, or if the UCN has already been loaded, press ‘Function Key 8’ (‘F8’) to exit the Setup program and start execution of the MEF software.

5.2.2.3 Procedure for Loading the UCN

1. From the menu of configure function key options, select the option to reconfigure the UCN by pressing ‘Function Key 2’ (‘F2’).

2. The screen prompts for a new UCN. Enter the 8-digit hexadecimal ‘Unique Check Number’ (UCN) for this HD/LINK module as shown on the MCF Installation Listing (or railroad schematics), and press <ENTER> when complete.

3. The configuration of the module is now complete. To exit the Setup program and start execution of the MEF software, press ‘Function Key 8’ (‘F8’). The display responds with "Setup finished" and the module reboots, displaying a refreshed Bootstrap screen.

5.2.3 Configuration Verification

After the module has completed its initial startup checks, which take about 1 minute, the module enters one of two states: *fully operational,* or *unconfigured* (the module state can be determined by one of several methods, as described in table 5-2). If the configuration is successful, the *fully operational* state is entered. If the configuration is unsuccessful, the *unconfigured* state is entered (refer to Section VIII, paragraph 8.1.4, *Problems with the HD/LINK module Configuration*).

Table 5-2. Module Status

Check:	Indication	Module Status
HEALTH LED	Flashing fast (approximately three times per second)	Unconfigured state
	Flashing slow (once every two seconds)	Fully operational state
Event Log	From the DT Utility Get menu, select Event Log and look at the end of the log, paging back if necessary, until the last 'module rebooted' Event is found. An entry in the log immediately following the last 'module rebooted' Event should indicate the state of the module	Fully Operational or Unconfigured
System State	From the DT Utility Get menu, select Module Status and look at System State	Fully Operational or Unconfigured

5.2.4 Diagnosing Configuration Problems

If the module is unconfigured, an Event in the Event Log should indicate the reason. Refer to table 8-4 in Section VIII, paragraph 8.1.4, *Problems With The HD/LINK module Configuration*, for possible error messages.

NOTE

NOTE

The module cannot be used for vital operation (reading inputs or driving outputs) if it is in the unconfigured state.

5.3 INSTALLATION AND COMMISSIONING CHECKLIST

The purpose of checks and testing, after installation or a configuration change, is to ensure that the wiring operation has been performed correctly, that the configuration has been specified and installed correctly and that timing parameters are correct. The circuit tests involve checking that a change in state of an input relay causes the intended state change in the output relay.

The configuration is defined as changing if the UCN changes. If a module is removed and a new module inserted with the same executive software (MEF), the configuration has not changed since the UCN has not changed, therefore there is no need to retest the installation.

However, a change to the software executable (MEF) or configuration file (MCF) requires a subsequent UCN change, and thus retesting is required.

⚠ WARNING

WARNING

WHENEVER THE MEF, MCF, OR UCN IS CHANGED OR THE MODULE IS FIRST INSTALLED, THE HD/LINK SYSTEM SHOULD BE TESTED AGAINST SIGNAL STANDARDS FOR THE SPECIFIC RAILROAD.

⚠ WARNING

WARNING

THE HD/LINKER PROCESS AND THE HD MODULE AUTOMATIC CHECKING DURING MODULE INSTALLATION DO NOT GUARANTEE PROPER CONFIGURATION BY THEMSELVES. TESTS SHOULD ALSO BE INCLUDED FOR TIMER VALUES, DEVICE DATA, INPUTS AND OUTPUTS, ETC.

Table 5-3 presents a summary of the checks or tests recommended for commissioning.

Table 5-3. Summary of Checks Recommended For Commissioning An HD/LINK Module

Check To Be Performed:	Covered In Paragraph Titled:	Paragraph Number:
Configured Location Name, MCF Filename, MCF Version, MCF Creation Date, SIN	Check Correct MCF Loaded	5.3.1
MEF Version	Check Correct MEF Loaded	5.3.2
Health of the module, In/Out Service Check Number	In Service/Out Of Service Check Number	5.3.3
Wiring configuration, VRO Pick/Drop Delay timers, Cut Section timers, SAT timers (timeout delays, update rates, network delays)	Circuit Checks	5.3.4
Message Transmission/Reception	Communication Statistics	5.3.5
Operational Reliability	Reliability Testing	5.3.6

For a sample MCF Approval Listing, refer to Appendix E.

5.3.1 Check Correct MCF Loaded

To verify that the MCF has been correctly loaded, perform the steps in the checklist of table 5-4.

Table 5-4. MCF Checklist

1. Using the DT Utility, from the Get menu, select *MCF File*, and save to a temporary file (use a temporary Filename) 2. View MCF (<Alt> + <F>, <View>, <ENTER>) 3. Check the following against the MCF Installation Listing (or MCF Approval Listing):	☐
Location (Group) Name	
MCF File Name	
MCF Version	
MCF Creation Date	
SIN	

5.3.2 Check Correct MEF Loaded

To verify that the MEF has been correctly loaded, perform the steps in the checklist of table 5-5.

Table 5-5. MEF Checklist

1. Using the DT Utility, from the Get menu, select *Module Status* 2. Check the following against the Module Summary of the MCF Contents Listing (or MCF Approval Listing):	☐
MEF Version (Name)	

5.3.3 In Service/ Out Of Service Check Numbers

If the configuration is correct, the HD/LINK module should be flashing its status (HEALTH LED) at the rate of approximately once every two seconds to indicate that the module is fully operational. To verify the health of the module and record the In Service/ Out of Service Check Number, perform the steps in the checklist of table 5-6.

Table 5-6. Module Health and In Service Check Number Checklist

To verify the module health and record the In Service Check Number, perform the following steps:	☐
Verify the HEALTH LED on the front panel is flashing at the rate of approximately once every two seconds	
Using the Diagnostic Terminal, determine when the module was last reset by looking at the Event Log and, paging back if necessary, locate the last occurrence of the 'module rebooted' Event[1] Immediately following the last 'module rebooted' Event, a message similar to the following indicating the operational state of the module should be displayed[1]: `ER0 98/12/20 00:01:06.9 Fully Operational, In Service Check Number: 4BC4`	
Record the In Service Check Number on the MCF Installation Listing. This number is needed (optional configuration item) by the HD/LINKer configuration utility in order to update this module as being in service.	

[1] An alternate method for finding the In Service Check Number for the HD/LINK module is to request HD Status (effective release HDL01_30 or later, only) when the module is operational.

If the HD/LINKer configuration utility is using the In Service/Out of Service Check Number option, when an MCF is taken out of Service, it is necessary for the user to:

- Use the *Reconfigure Module* option from the Diagnostic Terminal Utility to erase the MCF
- Look at the Event Log to find the *Out of Service Check Number*, and record this number on the Installation Listing. The message should be similar to the following:

  `ER0 98/12/31 10:21:06.7 Unconfigured, Out Of Service Check Number : C029`

- Give the MCF Installation Listing to the HD/LINKer configuration utility user

5.3.4 Circuit Checks

To verify that the HD/LINK module inputs and outputs are properly configured, the circuits should be checked against an MCF Contents Listing or an MCF Approval Listing, and against the railroad circuit plans from which the MCF data was generated. For an example of a Module Configuration File (MCF) Approval Listing, refer to Appendix E. For an example of an HD/LINKer Circuit Layout, refer to Appendix G.

When performing circuit checks using the Diagnostic Terminal Utility and the MCF Contents Listings or MCF Approval Listings, names of configurable timers as discussed in this manual

may be referred to by different names. Table 5-7 provides a cross-reference of the configurable timer names.

Table 5-7. Configurable Timers Name Cross Reference

HD/LINK Manual	MCF Contents Listing or MCF Approval Listing	Diagnostic Terminal Utility
Client Timeout - Energized	Energized Output Timeout	Non restrictive Timeout
Client Timeout - Deenergized	De-Energized Output Timeout	-
Client Timestamp - Net Delay	Maximum Network Delay	Maximum Timestamp Offset
VRO Pickup Delay	Pkup Delay	Energization Delay
VRO Drop Delay	Drp Delay	Deenergization Delay
Cut Section Delay	Cut Re-energize Delay	-
Server Update Rate - Energized	Energized Update Rate	-
Server Update Rate - Deenergized	De-energized Update Rate	-

Table 5-8 presents suggested lists of checks for the different circuit types: unipolar, bipolar, Cut Sections, bidirectional, and bipolar bidirectional. Since configurations can vary greatly, the testing process may vary depending on the configuration. Refer to Appendix H for some suggested test procedures for simple configurations. Actual testing may be more involved, requiring a combination of the testing checks described.

Table 5-8. Suggested Circuit Tests

No.	Circuit Type	Conditions	Checks Suggested (for each circuit of the specific type)
1	Unipolar	All inputs are deenergized	Verify all VPI and VRO LEDs are off and output relays are deenergized
2		The input relay for the circuit is energized	Verify the proper VPI and VRO LED and output relay states for the server and client
3			Verify the proper Pickup Delay time on the output relay (as specified on the Listing)
4		The server-to-client connection is interrupted[1] (with input relay energized)	Verify the proper deenergization time (VRO LED and output relay) in respect to *Client Energized Output Timeout, VRO Drop Delay,* and *Energized Update Rate*[2]
5		(n/a)	Verify the *Non restrictive Timeout* from the *SAT Timing Parameters* equals the *Energized Output Timeout* as specified on the Listing
6		(n/a)	Verify the *Maximum Timestamp Offset* from the *SAT Timing Parameters* equals the *Maximum Network Delay* as specified on the Listing
7		The input relay for the circuit is deenergized	Verify the proper VPI and VRO LED and output relay states for the server and client
8			Verify the proper Drop Delay time for the output relay (as specified on the Listing)
9	Bipolar	All inputs are deenergized	Verify all VPI and VRO LEDs are off and output relays are deenergized
10		The input relay for the circuit is positively energized[3]	Verify the proper VPI and VRO LED and output relay states for the server and client
11			Verify the proper Pickup Delay time on the output relay (as specified on the Listing)
12		The server-to-client connection is interrupted[1] (with input relay positively energized[3])	Verify the proper deenergization time (VRO LED and output relay) in respect to *Client Energized Output Timeout, VRO Drop* Delay, and *Energized Update Rate*[2]
13		(n/a)	Verify the *Non restrictive Timeout* from the *SAT Timing Parameters* equals the *Energized Output Timeout* as specified on the Listing
14		(n/a)	Verify the *Maximum Timestamp Offset* from the *SAT Timing Parameters* equals the *Maximum Network Delay* as specified on the Listing

Table 5-8 Continued

No.	Circuit Type	Conditions	Checks Suggested (for each circuit of the specific type)
15	Bipolar (continued)	The positively energized input relay[3] for the circuit is deenergized	Verify the proper VPI and VRO LED and output relay states for the server and client
16			Verify the proper Drop Delay time for the output relay (as specified on the Listing)
17		The input relay for the circuit is negatively energized[4]	Verify the proper VPI and VRO LED and output relay states for the server and client
18			Verify the proper Pickup Delay time on the output relay (as specified on the Listing)
19		The server-to-client connection is interrupted[1] (with input relay negatively energized[4])	Verify the proper deenergization time (VRO LED and output relay) in respect to *Client Energized Output Timeout, VRO Drop* Delay, and *Energized Update Rate*[2]
20		(n/a)	Verify the *Non restrictive Timeout* from the *SAT Timing Parameters* equals the *Energized Output Timeout* as specified on the Listing
21		(n/a)	Verify the *Maximum Timestamp Offset* from the *SAT Timing Parameters* equals the *Maximum Network Delay* as specified on the Listing
22		The negatively energized input relay[4] for the circuit is deenergized	Verify the proper VPI and VRO LED and output relay states for the server and client
23			Verify the proper Drop Delay time for the output relay (as specified on the Listing)
24	Cut Sections	All inputs are deenergized	Verify all VPI and VRO LEDs are off and output relays are deenergized
25		All the Cut Section relays for the circuit are energized	Verify the proper VPI and VRO LED and output relay states for the server and client (after longest Cut Section delay time)
26		The input relay for the circuit is energized (in addition to all Cut Section relays)	Verify the proper VPI and VRO LED and output relay states for the server and client
27			Verify the proper Pickup Delay time for the output relay (as specified on the Listing)
28		The server-to-client connection is interrupted[1] (with input relay and all Cut Section relays energized)	Verify the proper deenergization time (VRO LED and output relay) in respect to *Client Energized Output Timeout, VRO Drop* Delay, and *Energized Update Rate*[2]

Table 5-8 Continued

No.	Circuit Type	Conditions	Checks Suggested (for each circuit of the specific type)
29	Cut Sections (continued)	(n/a)	Verify the *Non restrictive Timeout* from the *SAT Timing Parameters* equals the *Energized Output Timeout* as specified on the Listing
30		(n/a)	Verify the *Maximum Timestamp Offset* from the *SAT Timing Parameters* equals the *Maximum Network Delay* as specified on the Listing
31		Each Cut Section relay is individually deenergized then reenergized	Verify the proper VPI and VRO LED and output relay states for the server and client
32			Verify the proper Drop Delay time for the output relay (as specified on the Listing)
33			Verify the proper Cut Section Reenergize Delay Time (as specified on the Listing) for each Cut Section relay
34		The input relay for the circuit is deenergized	Verify the proper VPI and VRO LED and output relay states for the server and client
35			Verify the proper Drop Delay time for the output relay (as specified on the Listing)
36	Bidirectional	All inputs are deenergized	Verify all VPI and VRO LEDs are off and output relays are deenergized
37		The left end input relay is energized	Verify the proper VPI and VRO LED and output relay states for the server and client
38			Verify the proper Pickup Delay time for the right end output relay (as specified on the Listing)
39		The server-to-client connection is interrupted[1] (with left end input relay energized)	Verify the proper deenergization time (right end VRO LED and output relay) in respect to *Client Energized Output Timeout*, *VRO Drop* Delay, and *Energized Update Rate*[2]
40		(n/a)	Verify the right end *Non restrictive Timeout* from the *SAT Timing Parameters* equals the *Energized Output Timeout* as specified on the Listing
41		(n/a)	Verify the right end *Maximum Timestamp Offset* from the *SAT Timing Parameters* equals the *Maximum Network Delay* as specified on the Listing

Table 5-8 Continued

No.	Circuit Type	Conditions	Checks Suggested (for each circuit of the specific type)
42	Bidirectional (continued)	The right end input relay is energized without deenergizing the left end input relay	Verify the LEDs and output relays for the server and client do not change
43		The left end input relay is deenergized without deenergizing the right end input relay	Verify the left end VPI LED is off and the right end VPI LED is lit; the left end VRO LED is lit and the right end VRO LED is off; the left end output relay is energized (after the Pickup Delay time), and the right end output relay is deenergized (after the Drop Delay time)
44			Verify the proper Drop Delay time for the right end output relay (as specified on the Listing)
45			Verify the proper Pickup Delay time for the left end output relay (as specified on the Listing)
46		The server-to-client connection is interrupted[1] (with left end input relay deenergized and the right end input relay energized)	Verify the proper deenergization time (right end VRO LED and output relay) in respect to *Client Energized Output Timeout, VRO Drop* Delay, and *Energized Update Rate*[2]
47		(n/a)	Verify the left end *Non restrictive Timeout* from the *SAT Timing Parameters* equals the *Energized Output Timeout* as specified on the Listing
48		(n/a)	Verify the left end *Maximum Timestamp Offset* from the *SAT Timing Parameters* equals the *Maximum Network Delay* as specified on the Listing
49		The left end input relay is energized without deenergizing the right end input relay	Verify the LEDs and output relays for server and client do not change

Table 5-8 Concluded

No.	Circuit Type	Conditions	Checks Suggested (for each circuit of the specific type)
50	Bidirectional (continued)	The right end input relay is deenergized without deenergizing the left end input relay	Verify the left end VPI LED is lit and the right end VPI LED is off; the left end VRO LED is off and the right end VRO LED is lit; the left end output relay is deenergized (after the Drop Delay time), and the right end output relay is energized (after the Pickup Delay time)
51			Verify the proper Drop Delay time for the left end output relay (as specified on the Listing)
52			Verify the proper Pickup Delay time for the right end output relay (as specified on the Listing)
53		The right end input relay is energized without deenergizing the left end input relay	Verify the LEDs and output relays for server and client do not change
54	Bipolar and Bidirectional	(n/a)	Use Bipolar circuit checks 9 through 23 and Bidirectional circuit checks 36 through 53

[1] To break the circuit, power down the radio or disconnect both LAN wires, as applicable. After the test is completed, reconnect the circuit and wait until the output is reenergized.
[2] Minimum deenergization time = (Client Energized Output Timeout) + (Client VRO Drop Delay) - (Server Energized Update Tate) - (200ms).
[3] A "positively energized input relay" indicates a direct correlation of the signal polarity to the HD/LINK module inputs (positive-to-positive and negative-to-negative).
[4] A "negatively energized input relay" indicates an inverted signal polarity to the HD/LINK module inputs (positive-to-negative and negative-to-positive).

5.3.5 Communication Statistics Checks

Purpose: To verify that no unexpected messages are being received. Perform the steps in the checklist of table 5-9.

Table 5-9. Communication Statistics Checklist

To verify the Communication Statistics, perform the following steps for each of the HD modules under test:	☐
1. Zero the Communication Statistics (<Alt> + <R>, select Reset Comms Statistics, <Y>)	
2. Wait 5 minutes while the Event Log monitors the system	

Table 5-9 Concluded

To verify the Communication Statistics, perform the following steps for each of the HD modules under test:	☐
3. At the end of 5 minutes check that no errors have been logged in the Event Log (there should be 'zero' occurrences of the following):	
Bad CRCs	
Incorrectly Addressed Packets	
Packets with invalid Q bit	
Packets with Invalid Packet Type	
Packets with Invalid Part Number	
Vital Packets with Invalid Facility Length	
Vital Packets with Invalid format	
Non Vital packets with invalid format	
Non Vital packets not assimilated	
Packets with out of range data	
Stale packets	
Out of order packets	
Invalid LAN Packets	
(Note: Invalid DT packets received may or may not be zero)	

5.3.6 Reliability Testing

Before the system is cut over into vital operation, Siemens Rail Automation recommends that a system using Spread Spectrum radios be tested during installation to ensure that the link has been installed correctly.

The radio manual specifies details of how to set up a radio link.

After the system has been installed and the RF signal strength determined to be sufficiently strong (refer to the SSR manual), the procedure described in table 5-10 should be followed to verify system operational reliability.

Table 5-10. Operational Reliability Checklist

To verify Operational Reliability, perform the following steps for all the HD modules under test:	☐
1. Set the verbosity of the HD modules to 2 (<Alt> + <R>, select Set Verbosity, <2>, <ENTER>)	
2. Clear the Event Logs (<Alt> + <R>, select Clear Event Memory, <Y>)	
3. Clear the comms statistics (<Alt> + <R>, select Reset Comms Statistics, <Y>)	
4. Wait for 5 minutes as the Event Logs monitor the system	
5. After the 5 minute period, check the Event Logs for the following Events:	
If any 'Lost Session' Events are observed, the link is not installed properly	
If more than one 'Lost Message' Event is observed, the link is not installed properly	
6. Diagnose and fix any radio link problems (see SSR Manual), then repeat steps 2 through 5 above	
7. If the link passes the tests in steps 2 through 5 above, wait as long as practically possible (at least 2 to 3 hours) as the Event Logs monitor the system, then check the Event Logs for the following Events:	
If any 'Lost Session' Events are observed, the link is not installed properly	
If more than two 'Lost Message' Events are observed per hour, the link is not installed properly (this can also be seen in the Comms Statistics)	

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SECTION VI

SURGE PROTECTION & GENERIC GROUNDING PROCEDURES

6.0 GENERAL

The HD/LINK system uses vital circuits. This fact requires careful attention paid to the issues of protecting equipment from electrical surges and ground differentials. For HD/LINK systems, Siemens Rail Automation recommends the following minimum surge protection and grounding guidelines where applicable:

- Ground resistance of 4 ohms to 15 ohms for site bungalow or instrument case
- Ground resistance of 5 ohms or less for site tower
- On small pole-mount instrument cases - minimum of one ground rod
- For areas of poor ground resistance (greater than 15 ohms), bungalows to have 2 copper and 2 chemical ground rods (on opposite corners)
- Coaxial cable ground boot at bottom of pole (on separate ground rod)
- Wood pole antenna support masts to have a ground conductor brought down from the metal antenna mounting pole to a ground rod and connected to the building ground system.
- Grounded metal antenna pole should project above highest mounted antenna element
- Chassis grounding of all modules at the site
- RF Surge Protector at the point the RF cable leaves instrument case or bungalow and solidly grounded to chassis of instrument case or bungalow
- Primary surge protection on every external wire (AC, battery, communication and relay signal) at the point of entry into instrument case or bungalow

The following paragraphs provide general recommendations for surge protection and grounding.

6.1 SURGE PROTECTION

Electrical surges experienced by railroad electrical equipment basically consist of natural or man-made sources. Two natural phenomenon: the movement of charged clouds over installations and direct lightning strikes to, or near, those installations, generally account for the natural sources. Man-made surges, although usually lower in strength than the natural variety, are more numerous, and because of the lower power involved compared to lightning-induced surges, are the easiest to protect against. Basically, two methods are used for combating surges: shielding and surge suppression. Many surge protection techniques use a combination of the two methods.

6.1.1 Shielding

Shielding is a means of protecting lines and circuits by encasing them or placing them next to metal conductors connected to ground to redirect stray energy to earth ground (providing the proper path to ground for stray energy is covered in paragraph 6.5, *Generic Grounding Procedures*). Although surges will not be completely eliminated by shielding, the magnitude of the surges will be greatly reduced. For example, a grounded wire strung above a signal wire in a pole line system greatly reduces surges in the signal wire, but does not eliminate the possibility of induced surges altogether.

6.1.2 Surge Suppression

Suppression-type protectors, usually called arresters, work by clamping surges to acceptable levels. Generally, there are two classes of arresters: Primary and Secondary. External primary arresters take the first step towards protecting electrical equipment by reducing the surge down to the two to three thousand volt range. For some equipment, this is sufficient protection. However, for equipment containing semiconductor technology, a secondary level of surge protection is required. The secondary protection is provided by arresters internal to the equipment that protect down to the range of twenty to five hundred volts.

6.1.3 Cables And Wiring

Cabling should be installed in a manner that minimizes inductive coupling that might otherwise allow surge energy to bypass the protective and isolating elements in the system. The input/output conductors entering the building should follow a path as short as possible to the air gap surge protectors. These conductors should not be within three inches of other conductors, including the signal wires from the surge protectors to the relay racks. The signal wires from the surge protectors to the relay rack should be dressed together and separated from power and other signal wires by at least three inches. The signal wires between the relay isolation and the Safetran equipment should be dressed together and separated from power or other signal wires by at least three inches. Where physical separation is not possible, the wires should be run at right angles to each other.

6.2 HD/LINK MODULE SURGE PROTECTION

The HD/LINK module is provided with built-in secondary surge protection (refer to table 6-1). The secondary surge protection further reduces surges below the levels reduced by the primary surge protection.

Table 6-1. HD/LINK Module Secondary Surge Protection

I/O Interface	Secondary Surge Protection	Comment on I/O
VPI (both input lines) & VRO (both output lines)	Built-in	Not restricted to protective building if provided with primary surge suppression
DC Power and Return	Built-in	Not restricted to protective building if provided with primary surge suppression
LonTalk™ LAN	Not provided	Restricted to inside protective building
Diagnostic Port	Not provided	Restricted to inside protective building

Primary surge protection is required to be used in conjunction with the secondary surge protection built into the HD/LINK module. Refer to Appendix I for preferred primary surge protection wiring for an HD/LINK system.

The HD/LINK module vital inputs, vital outputs and LonTalk™ LAN are isolated from battery and from each other by at least 2000Vrms.

All of the I/O lines on the interface connector to the HD/LINK module except for the LonTalk™ LAN should be further protected by adding primary surge protection.

⚠ WARNING

WARNING

IT IS THE RESPONSIBILITY OF THE RAILROAD TO ENSURE THAT PRIMARY SURGE PROTECTION IS FITTED TO THE HD/LINK MODULE CIRCUITS B12 AND N12, VPI'S AND VRO'S.

NOTE

NOTE

Do not place primary surge protection on the LonTalk™ LAN, as it may disrupt operation of the LAN circuitry.

6.3 SURGE PROTECTION DEVICES

For secondary surge protection (built into the HD/LINK modules, SSRs, and other site equipment) to be effective, primary surge protection devices must be installed on all external lines from these devices leaving the instrument case or protective building. For HD/LINK module I/O lines, Siemens Rail Automation recommends the surge protection products listed in table 6-2.

Table 6-2. HD/LINK Module Primary Surge Protection

I/O Interface	Recommended Primary Surge Protection Products
VRO + VRO - VPI + VPI -	Safetran's Clearview® family of arresters, or equivalent
B12 N12	Safetran's SP19 Battery Line Protector, or equivalent

Refer to Appendix I for preferred primary surge protection wiring for an HD/LINK system.

6.4 SURGE PANELS

Surge protection should be provided on battery/charger systems to prevent the system from rising to dangerous voltages with reference to building ground. The protectors should be installed

in series with a circuit breaker so that if they fail in the shorted mode, the circuit breaker will open to isolate the system from ground.

The proper primary surge protection can be provided by the use of Safetran surge panels that have the correct configuration of arresters and equalizers for the specific applications (refer to figure 1-9 in Section I and Appendix I for illustrations of AC/DC surge panels).

Refer to Section I, paragraph 1.3.4, *Surge Panel*, for recommended AC and DC surge panels for use in HD/LINK systems using instrument cases or houses. Appendix I presents preferred surge protection wiring for a typical HD/LINK system.

NOTE

NOTE

For information on surge protection products, contact Siemens Rail Automation, Engineering.

6.5 GENERIC GROUNDING PROCEDURES

All HD/LINK equipment and enclosures should be properly grounded to prevent ground differentials between the grounding points that can cause equipment damage. The following paragraphs present recommendations for grounding equipment and enclosures.

6.5.1 External Building Ground

Grounding electrodes should be a minimum of 8 feet in length and located approximately 2 feet away from each corner of the building with the top of each element at least 6 inches below grade (18 inches preferred). Spacing between electrodes should not exceed 15 feet. The ground elements should be bonded together with a ring of #2 AWG solid copper wire. All below-grade connections shall be Cadwelded (or equivalent exothermic weld). Refer to figure 6-1 for typical external ground connections.

The following items should be connected to the ground ring using a #2 AWG solid copper conductor:

- All hydro ground elements within 6 feet of the ground ring
- All metal objects within 50 feet of the building (e.g., fuel storage tanks, metal fences, guy wires, and other significant metal objects)
- Air gap surge protectors on the common ground side of the arresters (as direct as possible through the floor)
- A conductor from each ground electrode to the closest corner of the building, passed up through the floor and up the inside wall to connect with an internal ground ring located 6 inches from the inside ceiling (sides of buildings wider than 15 feet also use conductors from ground electrodes placed between the corners at maximum 15 foot intervals - see figure 6-1).

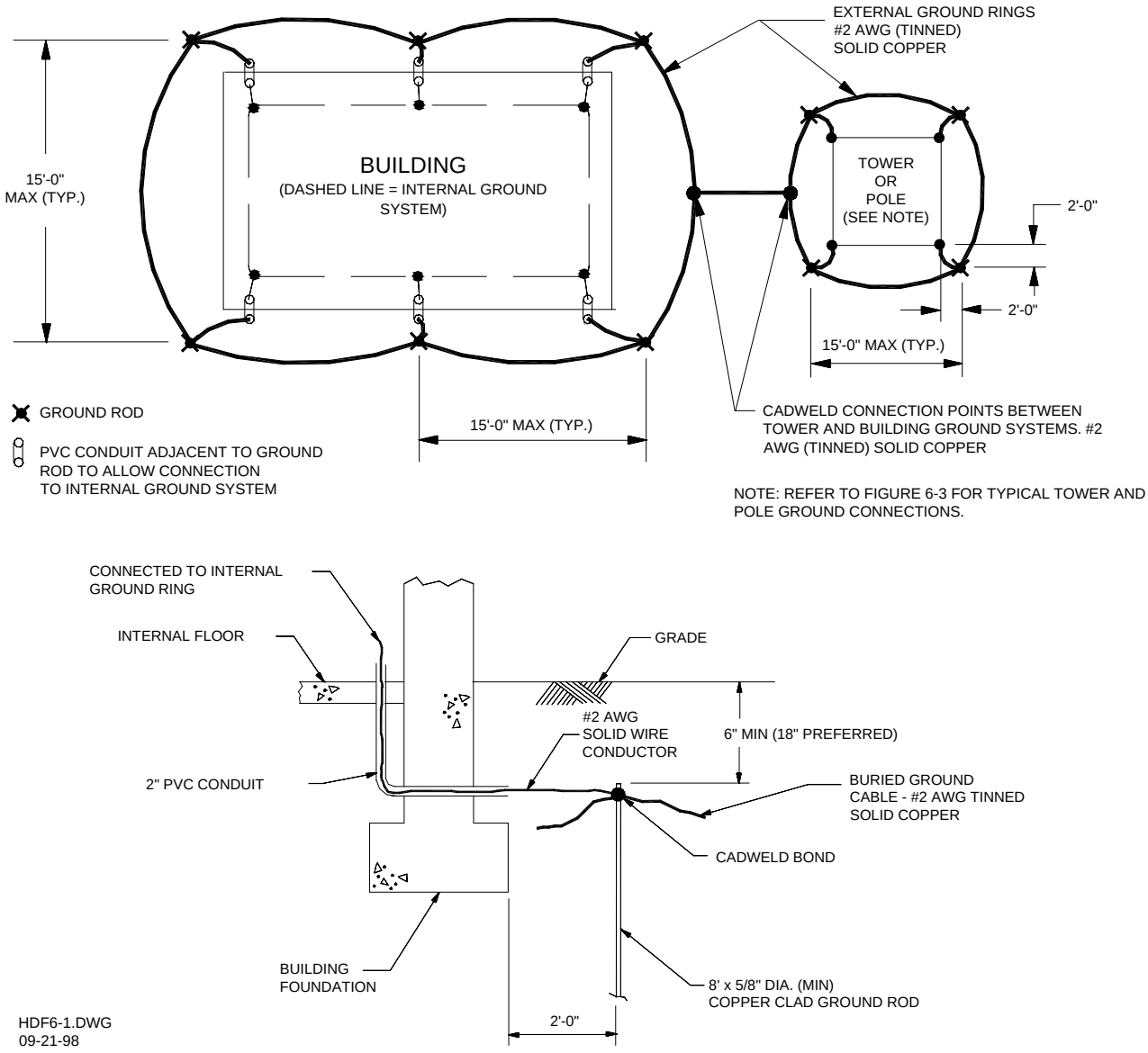

Figure 6-1. Typical External Ground Connections

6.5.2 Internal Building Ground

The internal ground ring (refer to figure 6-2) should be #2 AWG copper, and may be stranded or solid. Ground conductors should be short and as direct as possible, avoiding sharp bends. Ground ring and conductors should not be allowed to touch equipment, cable trays, structural members and metal walls except at the grounding point. The following items should be connected to the internal ground ring using a minimum #6 AWG stranded copper conductor (#2 is preferred):

- All relay racks (mounted modules should make a solid chassis ground connection)
- Standalone equipment (if the HD/LINK module and SSR are not rack mounted, they should be separately grounded).
- AC panels
- Battery system surge protectors
- Building metal door frames and doors
- Cable trays, structural members and metal walls

NOTE

NOTE

Bonding conductor connections to the interior ground ring should be made using split brass bolts or parallel brass connectors (see figure 6-4).

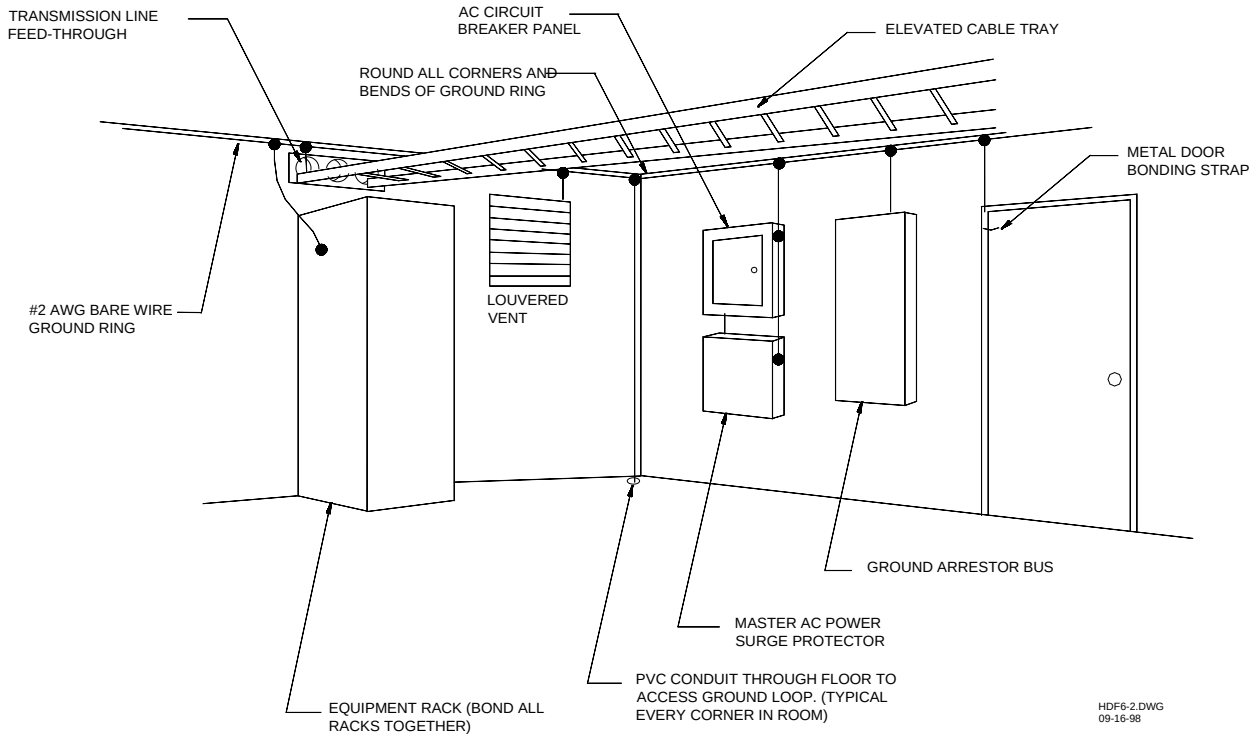

Figure 6-2. Typical Internal Ground Connections

6.5.3 Antenna Ground

A good RF ground will determine the quality of a radio antenna system. Poor grounds result in antennas not operating efficiently. RF power is dissipated in the ground resistance and it is possible to lose between 50 and 90 percent of the RF power in heating the ground losses under the antenna instead of propagating into the air. Ground resistances can vary from very low values of 5 ohms or less to more than 100 ohms. The following factors will affect the specific ground resistance:

- Conductivity of the soil
- Composition of the soil
- Water content of the soil

Note that the ideal ground depth depends on the level of the local water table; it is rarely at ground level and can be several feet below grade.

6.5.3.1 Antenna Ground – Roof-Mount Yagi

A roof-mounted Yagi antenna should have the pipe mast grounded to the outside grounding ring with a minimum #2 AWG solid copper conductor. The Heliax cable ground kit should be connected within 1 foot of the cable entry to the building and connected to the copper conductor. A lightning surge protector is not required if the Yagi antenna is less than 10 feet above the building roof. The inside terminating connector on the antenna Heliax should be bonded to the internal ground ring.

6.5.3.2 Antenna Ground – Towers and Poles

As with all elevated metal objects, antennas will attract lightning strikes. An adequate and effective antenna ground is required for proper radiation and to minimize electrical noise and interference. On tower and pole-equipped sites, the antenna should be well grounded by means of a #2 AWG solid copper conductor connection from the tower or pole grounding element(s) to the tower/pole ground ring (see figure 6-3). The tower ground system should have 5 ohms or less earth resistance and should be connected to the building ground system (see figure 6-1). The transmission line should be brought off the tower or pole with the sharpest bend permitted by the manufacturer's specifications to act as a spot impedance to the extremely high strike current. The antenna cable should be grounded to the tower/pole-grounding conductor prior to the bend on its way to the building (for antenna installation, refer to the radio manual).

The messenger wire for the cable should be bonded to the tower/pole ground and the external building ground ring. The antenna cable should be grounded outside the building, within 1 foot of the building entry, to the external building ground ring via a #2 AWG solid conductor. A lightning arrestor should be installed on the Heliax cable within 1 foot of the building entrance, and bonded to the internal ground ring.

Surge arrestors or a lightning protector should be installed at the point where the antenna cable enters the building or instrument case. The lightning protector should be properly grounded at the single-point chassis ground. Connectors must be weatherproofed to prevent corrosion to enable efficient grounding and a drip loop is recommended at the instrument case or bungalow.

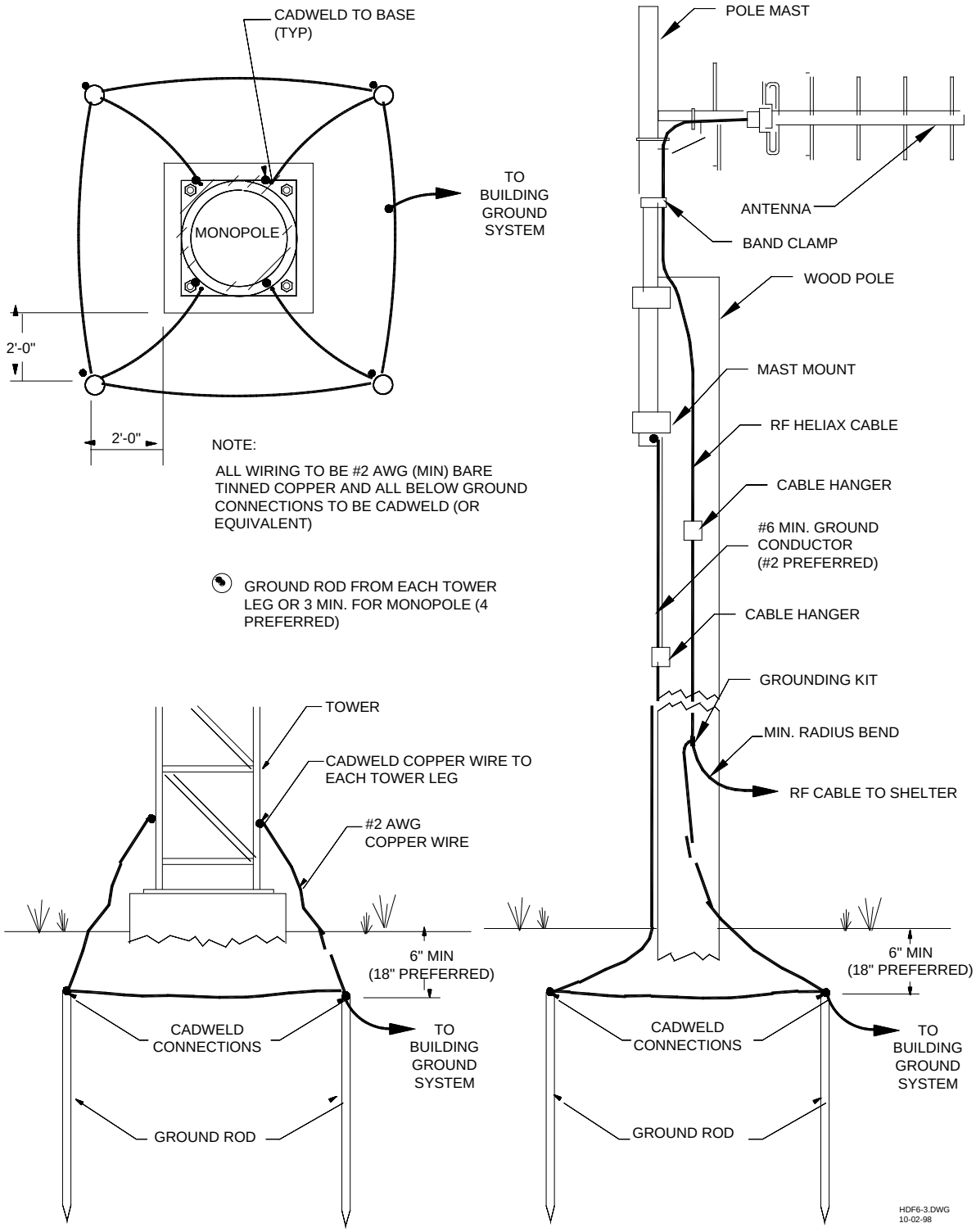

Figure 6-3. Typical Tower and Pole Ground Connections

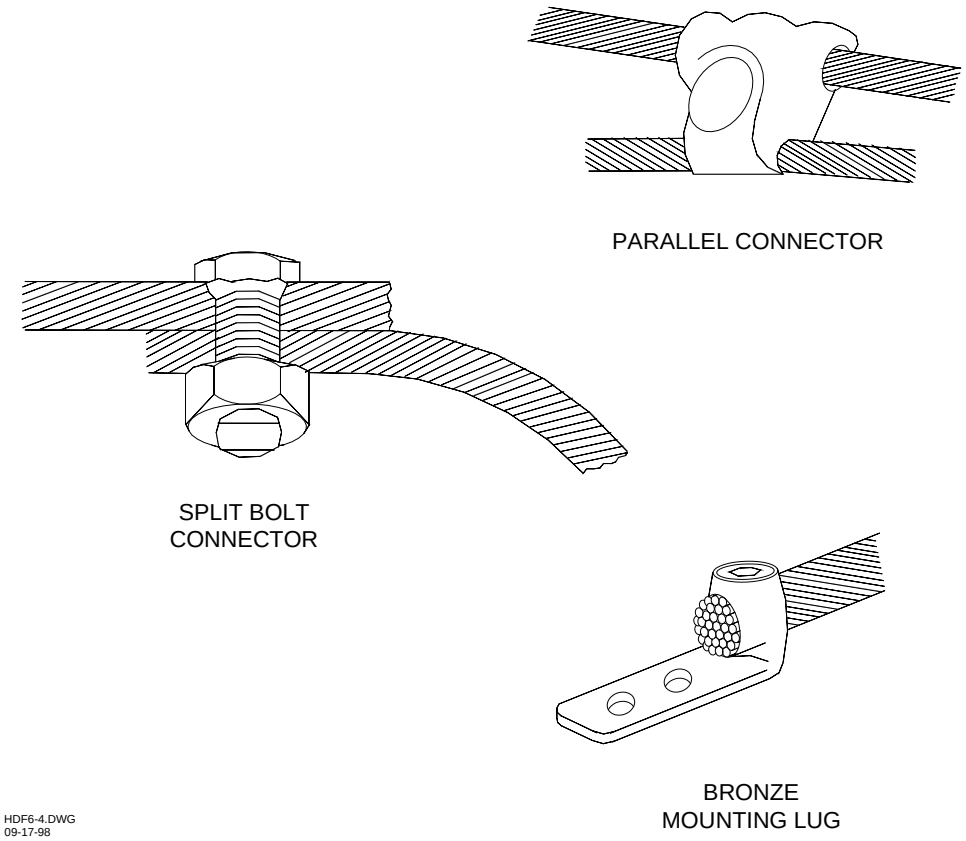

Figure 6-4. Typical Connections for Grounding and Bonding

6.5.4 AC Power Ground

AC power grounding should adhere to the standards set forth by the applicable local or regional electrical code. When bonding AC panels to the internal ground ring, the connection should be made to the outside surface of the panel (refer to figure 6-4 for an illustration of a bronze mounting lug). Hydro ground electrodes should be bonded to the building ground electrodes only if they are within 6 feet of each other. A surge protector should be installed on the main electrical panel (refer to figure 6-2) for any ungrounded electrical feed in or out of the building, and the connection to all air gap suppressors removed.

6.5.5 Communications Ground

All power and telephone company grounds should be made common to the communications ground. A surge arrester such as a Polyphaser™ should be installed at the point where the cable enters the building or instrument case.

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SECTION VII

HD/LINK DIAGNOSTICS

7.0 GENERAL

The diagnostic facilities for the HD/LINK system include messages recorded by the HD/LINK module Event Log, Diagnostic Request messages, remote diagnostics, and visual indicators on the front panels of the modules.

7.1 DIAGNOSTIC TERMINAL (DT)

The HD/LINK module provides a serial port on the front panel to allow for connecting Diagnostic Terminal utilities used for installing and maintaining the module.

The cable required to connect the Diagnostic port of the HD/LINK module to the Diagnostic Terminal (a PC in this case), needs to be an RS-232 serial, straight-through (contact-to-contact) cable with the connector at one end being a 9-pin D type (DB-9) containing pin contacts to mate with the socket contacts on the Diagnostic port of the module.

The other end requires a connector containing sockets to mate with the connector at the PC (pin contacts). The connector may be a 9-pin D type (DB-9) or a 25-pin D type (DB-25), depending on the port used on the PC. The port used by the PC can be selected from the Diagnostic Terminal Utility. Generally, COM1 is used, which requires a 9-pin D type (DB-9) connector. The only conductors required in the cable are pin 2 (RX), pin 3 (TX), and pin 5 (GND).

The Diagnostic Terminal can be any PC running DOS that has a serial port supporting one of the following Baud rates:

9600
19200
38400
56000 (DT Utility default baud rate)

7.1.1 Installers Diagnostic Terminal Utility

The Installers Diagnostic Terminal Utility is a DOS-based PC utility which allows the user to configure an HD/LINK module or obtain status and diagnostic information from the module. The utility is installed by copying the following files from a Siemens Rail Automation-supplied disk to a laptop PC:

- c53201.exe Program executable file
- c53201.ini Program initialization file
- 9v141a01.a Setup program file

The program executable file and initialization file are named after the part number of the HD/LINK module (53201), where *c* designates the Installers version of the software.

To run the program, at the DOS prompt, go to the directory in which the utility is kept and type the program name: C53201 <ENTER>. The display responds with the basic DT screen as shown in figure 7-1. For reference, the MENU BAR lists the user's four main menu options (File, Get, Reconfigure, and Setup) and the SCROLL BAR lists the keys (Home, End, PgUp, up arrow, PgDn, and down arrow) for scrolling through data. The MENU BAR also provides an area for displaying the identity of the HD/LINK module the DT is set to communicate with (refer to paragraph 7.4, *Remote Diagnostics* for a description of the Target HD function).

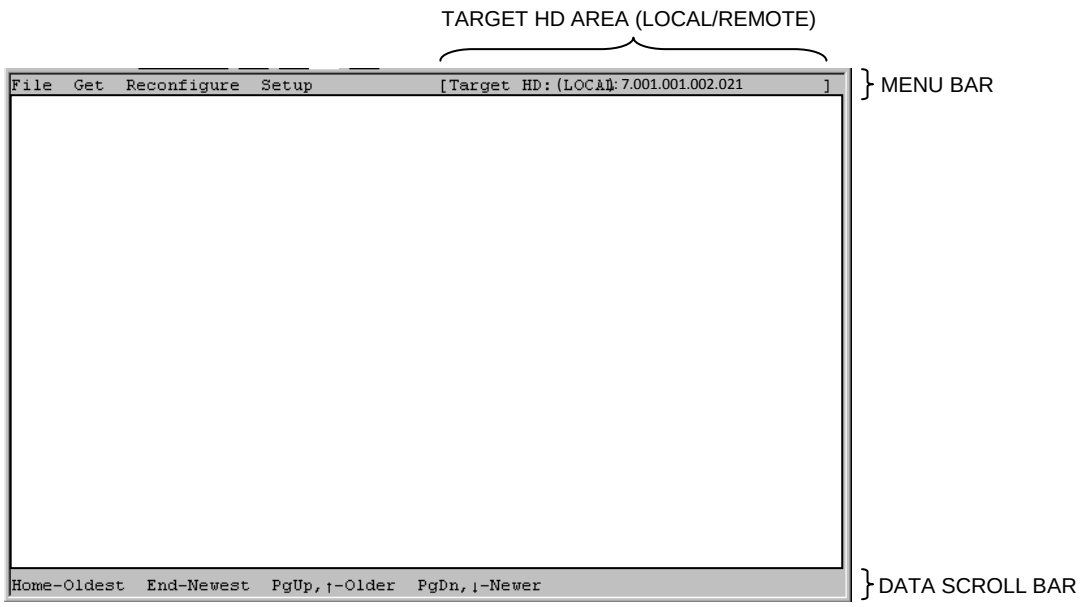

Figure 7-1. Basic DT Screen

The Installers Diagnostic Terminal Utility menu options are: File menu, Get menu, Reconfigure menu, and Setup menu. A Configuration menu is also available only upon rebooting. To select the menu options (except the Configuration menu), press the <ALT> key and the first letter of the menu option (for example, press <ALT> + <G> to pull down the *Get* menu).

To select a particular option in a menu, use the up and down arrow keys to scroll through the menu and highlight the desired option. When the desired menu option is highlighted, press <ENTER> to select it.

Refer to Appendix B for some typical displays using DT menu options.

7.1.1.1 Installers File Menu (<Alt> + <F>)

Table 7-1 lists the options in the Installers File menu.

Table 7-1. Installers File Menu Options

Option	Description
View	Allows the user to look at the header data of an MCF
Exit	Exits the DT program

7.1.1.2 Installers Get Menu (<Alt> + <G>)

Table 7-2 lists the options in the Installers Get menu.

Table 7-2. Installers Get Menu Options

Option	Description
Event Log	Displays the latest page of Events from the Event Log
Event File	Allows the Event Log contents to be saved to a text file of the specified name or user's choice
Comms Status	Displays the communication statistics for the module (see paragraph 7.3.2)
Module Status	Displays the status of the module (see paragraph 7.3.1)
IO Status	Displays the I/O status for the module (see paragraph 7.3.3) When the command is selected, the MCF is obtained from the module in order to obtain the label information for the I/O This option is not available if the module is in the unconfigured state
SAT Status	Displays the SAT status for a selected SAT (see paragraph 7.3.4) A list of the SATs is produced. Use the (←,→) keys to select a SAT and press <ENTER> When the command is selected, the MCF is obtained from the module in order to obtain the label information for the SATs This option is not available if the module is in the unconfigured state

Table 7-2 Concluded

Option	Description
Timing Parameters	Displays the configured timing parameters for the selected SATs (see paragraph 7.3.5) A list of the SATs is produced. Use the (←,→) keys to select a SAT and press <ENTER> When the command is selected the MCF is obtained from the module in order to obtain the label information for the SATs This option is not available if the module is in the unconfigured state
Date and Time	Displays the date and time currently set on the module
MCF File	Retrieves the MCF file from the module and allows the user to save this to a specified file The file is in binary format. The File-View option can be used to look at the header information in the file. It is not recommended that the file be given a name similar to or the same as files created by the HD/LINKer configuration utility, as the MCF obtained from the module does not include all the information of an MCF produced by HD/LINKer configuration utility This option is not available if the module is in the unconfigured state
Diagnostic Dump	Dumps the diagnostic memory - for Siemens Rail Automation use only

7.1.1.3 Installers Reconfigure Menu (<Alt> + <R>)

Table 7-3 lists the options in the Installers Reconfigure menu.

Table 7-3. Installers Reconfigure Menu Options

Option	Description
Set Verbosity	Sets the level of detail stored in the Event Log (see paragraph 7.2.3)
Set Date and Time	Sets the date and time for the module The date and time used is that currently set on the PC running the utility. Before sending the command to the module, the utility displays the date and time to be set and give the user chance to cancel this if it is not correct. The user can then reset the date and time on the PC and then reselect the option
Set field SIN	Change the Subnode Identification Number (SIN, or ATCS address) of the module. The user is requested to type in the new value This option is only available if the module is in the unconfigured state
Set field UCN	Changes the Unique Check Number (UCN) of the module. The user is requested to type in the new value This option is only available if the module is in the unconfigured state
Reset Comms Statistics	Resets all the communication statistics to zero. The date and time in the statistics is reset to the current date and time of the module
Clear Event Memory	Clears the contents of the Event memory
Unconfigure Module	Takes the module out of service by erasing the MCF and UCN, and then rebooting the module. After the reboot, the module returns to the unconfigured state
Reset Module	Resets the module. The module reboots, and the user gets the opportunity to change the module's configuration via the configuration menu

7.1.1.4 Installers Setup Menu (<Alt> + <S>)

Table 7-4 lists the options in the Installers Setup menu.

Table 7-4. Installers Setup Menu Options

Option	Description
Target HD	Allows the user to communicate with a different HD/LINK module from the one currently connected to Selectable options of the Target HD/LINK menu are: Local HD/LINK - selects communication with the module to which the DT is currently connected. The menu bar displays: **(LOCAL):** followed by the ATCS address of the local HD/LINK Remote HD/LINK - prompts the user for the ATCS address of the remote module (see paragraphs 7.3 & 7.4) desired to communicate with in the system When connected to a remote HD/LINK, the ATCS address of the remote module is displayed on the menu bar (example: **REMOTE @ SIN 7620005395021**)
About	Displays version information about the DT utility
Serial Port	Selects the COM port to be used. The default is COM1
Max Baudrate	Selects the baud rate to be used when downloading MCFs and MEFs. This should be set to the maximum that the PC running the utility can support. The default is 56000
Product	Allows the user to select the configuration utility for the radio type and software version being communicated with from the HD

7.1.1.5 Installers Configuration Menu

In order to access the Configuration menu, the HD/LINK module must be rebooted (this option is only accessible from the Bootstrap screen). The usual way to do this is as follows:

If the module is in the unconfigured or fully operational state (HEALTH LED flashing), reboot the module by selecting the ‘Reconfigure - Reset’ or ‘Reconfigure - Unconfigure’ menu option.

The power can also be cycled on the module to reboot the module.

After the reset/power cycle, the Bootstrap screen displays the current versions of boot code, MEF and MCF. The user is prompted to reconfigure the module. To reconfigure the module, press ‘Y’ (Yes) and then press <ENTER>. If Y + <ENTER> is not pressed within 5 seconds of being prompted to reconfigure the module, the program bypasses setup and starts executing the MEF, causing the user to have to the reboot the module again as previously described.

After selecting 'Y' (Yes to reconfigure the module) and pressing <ENTER>, the Setup program downloads, displaying a menu of configure function key options as shown in table 7-5.

Table 7-5. Installers Configure Menu Function Key Options

Function Key	Description
Function Key 1 - F1	Changes the SIN. The user is prompted to enter the new SIN. Press <ENTER> when finished
Function Key 2 - F2	Changes the UCN. The user is prompted to enter the new UCN. Press <ENTER> when finished
Function Key 3 - F3	Changes the MCF. The user is prompted with a window where the drive, path and MCF filename can be typed. If the user types *.MCF the program allows the user to browse the selected disk to find the desired file
Function Key 4 - F4	Changes the MEF The user is prompted with a window where the drive, path and MEF name can be typed. If the user types *.MEF the program allows the user to browse the selected disk to find the desired file
Function Key 8 - F8	Exits the Setup program and starts execution of the MEF software

7.1.2 Maintainers Diagnostic Terminal Utility

The Maintainers Diagnostic Terminal Utility is a DOS- based PC utility which allows the user to obtain status and diagnostic information from the HD/LINK module. This utility is a cut down version of the Installers Diagnostic Terminal Utility (does not allow the user to change the HD/LINK configuration). The program executable and initialization files are named after the part number of the HD/LINK module (53201), where *m* designates the Maintainers version of the software.

To run the program, at the DOS prompt, go to the directory in which the utility is kept and type the program name: M53201 <ENTER>. The display responds with the basic DT screen (refer to figure 7-1).

The Maintainers Diagnostic Terminal Utility menu options are: File menu, Get menu, Reconfigure menu, and Setup menu (the Configuration menu is not available in this utility). To select the menu options, press the <ALT> key and the first letter of the menu option (for example, press<ALT> + <G> to pull down the *Get* menu).

To select a particular menu option, use the up and down arrow keys to scroll through the menus and highlight the desired option. When the desired menu option is highlighted, press <ENTER> to select it.

7.1.2.1 Maintainers File Menu (<Alt> + <F>)

Table 7-6 lists the options in the Maintainers File menu.

Table 7-6. Maintainers File Menu Options

Option	Description
View	Allows the user to look at the header data of an MCF
Exit	Exits the DT program

7.1.2.2 Maintainers Get Menu (<Alt> + <G>)

Table 7-7 lists the options in the Maintainers Get menu.

Table 7-7. Maintainers Get Menu Options

Option	Description
Event Log	Displays the latest page of Events from the Event Log
Event File	Allows the Event Log contents to be saved to a text file of the specified name or user's choice
Comms Status	Displays the communication statistics for the module (see paragraph 7.3.2)
Module Status	Displays the status of the module (see paragraph 7.3.1)
IO Status	Displays the I/O status for the module (see paragraph 7.3.3) When the command is selected, the MCF is obtained from the module in order to obtain the label information for the I/O This option is not available if the module is in the unconfigured state

Table 7-7 Concluded

Option	Description
SAT Status	Displays the SAT status for a selected SAT (see paragraph 7.3.4) A list of the SATs is produced. Use the (←,→) keys to select a SAT and press <ENTER> When the command is selected, the MCF is obtained from the module in order to obtain the label information for the SATs This option is not available if the module is in the unconfigured state
Timing Parameters	Displays the configured vital timing parameters for the selected SATs (see paragraph 7.3.5) A list of the SATs is produced. Use the (←,→) keys to select a SAT and press <ENTER> When the command is selected, the MCF is obtained from the module in order to obtain the label information for the SATs This option is not available if the module is in the unconfigured state
Date and Time	Displays the date and time currently set on the module
MCF File	Retrieves the MCF file from the module and allows the user to save this to a specified file or the user's choice The file is in binary format. The File-View option can be used to look at the header information in the file. It is not recommended that the file be given a name similar or the same as files created by HD/LINKer configuration utility, as the MCF obtained from the module does not include all the information of an MCF produced by HD/LINKer configuration utility This option is not available if the module is in the unconfigured state

7.1.2.3 Maintainers Reconfigure Menu (<Alt> + <R>)

Table 7-8 lists the options in the Maintainers Reconfigure menu.

Table 7-8. Maintainers Reconfigure Menu Options

Option	Description
Set Verbosity	Sets the level of detail stored in the Event Log (see paragraph 7.2.3)
Set Date and Time	Sets the date and time for the module The date and time used is that currently set on the PC running the DT utility. Before sending the command to the module, the utility displays the date and time to be set and give the user chance to cancel this if it is not correct. The user can then reset the date and time on the PC and then reselect the option

7.1.2.4 Maintainers Setup Menu (<Alt> + <S>)

Table 7-9 lists the options in the Maintainers Setup menu.

Table 7-9. Maintainers Setup Menu Options

Option	Description
Target HD	Allows the user to communicate with a different HD/LINK module from the one currently connected to Selectable options of the Target HD/LINK menu are: Local HD/LINK - selects communication with the module to which the DT is currently connected (**LOCAL** is displayed on the menu bar) Remote HD/LINK - prompts the user for the ATCS address of the remote module (see paragraphs 7.3 & 7.4) desired to communicate with in the system When connected to a remote HD/LINK, the ATCS address of the remote module is displayed on the menu bar (example: **REMOTE @ SIN 7620005395021**)
About	Displays version information about the DT utility
Serial Port	Selects the COM port to be used. Most PCs use COM1

7.2 EVENT MESSAGES

The HD/LINK system provides Event recording facilities. Each piece of information recorded is known as a Recordable Event, time and date stamped and added to the Event Log.

Information that is retrievable from the Event Log includes the following:

- Health information- Error messages are recorded for hardware, software, diagnostics, communication, and power supply.

- Status information- Events such as changes in the states of the VPI channels, VRO channels, the data received by SATs, communication statistics, general Events, and configuration messages during rebooting.

The Event Log allows the time and date stamped Events to be stored (refer to Section II, paragraph 2.1.5, *Event Log*, for information on message logging). The Event messages are preceded by ER0. As the HD/LINK system is typically not continuously monitored by the office, the Event Log should typically store several days worth of data.

The Event Log has a finite amount of storage space, so in the interest of conserving space for storing messages, the Event Log can be configured to store different levels of detail as required, controlled by setting the verbosity level. The verbosity level can be set using the DT Utility or via the LAN. This enables the office and maintenance personnel to configure the verbosity level for individual ATCS devices, which allows them to choose to record more or less detail about the system.

The default verbosity level set at the factory is level 1 (basic level), but the level can be subsequently set to another value in the field. The set level is stored in non-volatile RAM and is *not* reset to the default value when the module is reset.

The basic level - Verbosity level 1, records changes of state of inputs (VPIs) and outputs (VROs) and the ATCS messages which caused these state changes. Any abnormal behavior of the module is also recorded at this level.

The Event Log can store up to 2340 I/O Events at verbosity level 1. This corresponds to 146 train moves if each train move causes two changes of state of four VPIs and four VROs (energized->deenergized->energized).

Verbosity level 2 would be used to help diagnose poor RF communications. This level includes the Events of verbosity level 1 and also information about communications such as missed or stale vital messages.

Verbosity level 3 would be used to help diagnose message timing problems and poor communications. This level includes the information of levels 1 and 2 and also logs every vital ATCS message received by the module.

The Event memory for a local or remote module can be cleared from the Installers Diagnostic Terminal Utility or from the office via radio link and LAN.

The Event memory is non-volatile. If power is removed from the module, the Events are retained in the Event Log for at least 14 days.

7.2.1 Event Log List Commands

List commands for accessing the Event memory are displayed at the bottom of the screen for the user's reference as follows:

Home - Oldest End - Newest PgUp, ↑ - Older PdDn, ↓ - Newer

Refer to Table 7-10 for a list of the commands and their functions.

Table 7-10. HD/LINK Module Event Log List Commands

Pressing the following key:	Displays the following:
<Home>	Oldest page of Events
<End>	Newest page of Events
<Page Up>	Previous (older) page of Events
<Page Down>	Next (newer) page of Events
<up arrow, ↑>	Single previous Event
<down arrow,↓>	Single next Event

7.2.2 I/O Events

The Event Log records date and time-stamped messages when a change occurs at an input or an output.

The following are examples of Events resulting from change in states of inputs and outputs. These types of Events are recorded at verbosity level 1.

```
ER0 96/12/16 00:00:22.4 VPI Channel 8   energized

ER0 96/12/16 00:00:23.7 VRO Channel 1   energized

ER0 96/12/16 00:00:32.0 Internal Channel  1   energized
```

If an input is energized which has not been configured as being used, the following Event is logged:

```
ER0 96/12/16 00:00:23.7 Unused VPI Channel      1   energized
```

The following is an example of the Events logged when VRO 1 has a Drop Delay of 1s (actually drops relay in 800ms) and VRO 2 has a pickup delay of 3s.

```
ER0 96/12/20 00:02:44.3 VRO Channel 1   deenergization delay started

ER0 96/12/20 00:02:45.1 VRO Channel 1   deenergized

ER0 96/12/20 00:02:48.3 VRO Channel 2   energization delay started

ER0 96/12/20 00:02:51.3 VRO Channel 2   energized
```

7.2.3 SAT Events

The Event Log records date and time-stamped messages when a change occurs in the state of serial data sent or received by SATs, change of state of Cut Sections, etc. Three verbosity levels are used, as described below.

7.2.3.1 Verbosity Level 1

The following are the Events resulting from changes in message data sent or received by a SAT. These are recorded at verbosity level 1.

```
ER0 96/12/16 00:01:31.6 Msg chg sent:SAT 11 to  4440217 .++...+..+....+..+...++.

ER0 96/12/16 00:01:31.6 Msg chg rcvd:SAT 17 frm 4440211 .++...+..+....+..+...++.

ER0 96/12/16 00:01:31.6 Msg chg sent:SAT 17 to  4440323 ......+..+....+..+......

ER0 96/12/16 00:04:05.4 Msg chg sent:SAT 62 to  0200360 ++.....................

ER0 96/12/16 00:04:05.7 Msg chg rcvd:SAT 60 frm 0200360 ++.....................

                                        dd     gggssdd  message data contents
```

For the ‘msg change sent’ Events: the two digit *dd* number represents the ATCS device number of the SAT that sent the message. The *gggssdd* is the ATCS group, subnode and device of the neighbor to which the message was sent, or from which the message was received.

The message data contents are represented by a series of “.” and “+”. The “+” represents an energized state being transferred in the message (referred to in this manual as "energized data"). The “.” represents a deenergized or unused state being transferred in the message.

The following are examples of Events resulting from Cut Section SATs changing state:

```
ER0 96/12/16 00:00:02.3 Cut delay:              :SAT 90

ER0 96/12/16 00:00:02.3 Cut in delay:           :SAT 90

ER0 96/12/16 00:00:10.3 Uncut                   :SAT 90
```

The following are examples of Events resulting from establishment and loss of communication sessions:

```
ER0 97/01/16 00:02:50.4 Session established      :SAT 60 with 4440260

ER0 97/01/16 00:02:50.3 Session lost             :SAT 60 with 4440260
```

The following Event occurs when the client is unable to get a response from the server, and its Client Timeout time elapses:

```
ER0 97/01/16 00:03:25.7 Server not found         :SAT 60 with 4440260
```

7.2.3.2 Verbosity Level 2

The following are examples of Events resulting from changes in inputs and outputs to SAT. These are recorded at verbosity level 2:

```
ER0 96/12/16 00:01:51.1 OP data chg :SAT 90            ...++...................

ER0 96/12/16 00:02:20.4 IP data chg :SAT 89            +.+.....................
```

The following is an example of a stale message being received. The timestamp is outside the permissible range:

```
ER0 97/01/16 00:01:34.5 Stale msg received       :SAT 60 from 4440260
```

The following is an example of a message (number 42) that has been received out of order, resulting in two Events:

```
ER0 97/01/16 00:02:50.4 Lost vital msg, new 42 ,old 57 :SAT 0200260 from 4440260

ER0 97/01/16 00:02:55.6 Out of order message rcvd:SAT 60 from 4440260
```

If a single message has been missed, the following type of Event is logged:

```
ER0 97/01/16 00:02:50.4 Lost vital msg, new 62 ,old 60 :SAT 0200260 from 4440260
```

The following Events are logged at verbosity level 2 to indicate session activity. The first is the receipt of the *Initialize Session* message by the server. The second is the receipt of a valid data update from the server to establish the session. The third is logged if the server loses session and starts to send ‘Server Alive’ messages to the client.

```
ER0 97/01/16 00:10:56.9 Server initialized       :SAT 60 with 0200211

ER0 97/01/16 00:02:50.5 Client established       :SAT 60 with 4440260

ER0 97/01/16 00:02:50.5 Client contact attempted :SAT 60 with 4440260
```

7.2.3.3 Verbosity Level 3

The following are examples of Events resulting from regular updates of messages received by a SAT. These are recorded at verbosity level 3. Note that the *vital message received* Event, containing the sequence number of the message, is only recorded for messages received from sources outside the module.

```
ER0 96/12/16 00:01:48.3 Msg upd rcvd:SAT 60 frm 0200262 .+.....................
```

```
ER0 96/12/16 00:01:49.0 Msg upd rcvd:SAT 02 frm 0200303 .....................

ER0 96/12/16 00:01:49.7 Vital msg rcvd:   seq num = 41 :SAT 0200390 from 0200202

ER0 96/12/16 00:01:49.7 Msg upd rcvd:SAT 90 frm 0200202 +.....................
```

7.2.4 General Events

The Events recorded in the Event memory for General Events include resets, reboots, and time updates. All Events are time and date stamped. Table 7-11 presents general Event messages.

Table 7-11. HD/LINK Module General Event Messages

Event Message Text	Definition
`Reset System Request Received`	A request to reset the module has been received. The module reboots
`Module rebooted`	Whenever the module is rebooted this Event is logged
`Reconfigure System Request Received`	A request to reconfigure the module has been received. The MCF and UCN are erased and the module is rebooted
`ER0 96/12/16 00:16:24.5 System time prior to update` `ER0 97/01/16 00:01:30.5 System Time Updated`	The time and date have been reset in the module. Two Events are logged showing the old and new time/date
`Verbosity changed to` *x*	Where *x* is 1, 2, or 3. When the verbosity is changed, an Event is logged
`Event memory cleared`	The MEF version has been changed, the MEF has become corrupted, or there has been an extended power failure

7.2.5 Configuration Messages

When the module reboots, it performs configuration checks, then it comes up either in fully operational state, or unconfigured state. The following are examples of the Events logged when rebooting. The In Service Check Number or Out of Service Check Number should be recorded on the MCF Installation Listing. Alternatively, the In Service Check Number can be obtained by requesting HD Status.

```
ER0 96/12/20 00:01:05.0 UCN calculated over the MCF only

ER0 96/12/20 00:01:05.0 UCN calculated over the MEF and MCF
```

```
ER0 96/12/20 00:01:06.9 Fully Operational, In Service Check Number:  4BC4

ER0 96/12/31 10:21:06.7 Unconfigured, Out Of Service Check Number:  C029
```

NOTE

NOTE

Only one or the other of the following messages can be recorded: “UCN calculated over the MCF only” or “UCN calculated over the MEF and MCF”. Only one or the other of the following messages can be recorded: “Fully Operational, In Service Check Number: xxxx” or “Unconfigured, Out Of Service Check Number: xxxx”.

If an error is found with the configuration, the module assumes the unconfigured state (HEALTH LED flashing fast) and one or more of the following messages may be logged:

```
ER0 96/12/31 10:21:06.7 Startup Check Error:  50, UCN check failed

ER0 97/01/01 00:00:37.1 Startup Check Error:  51, SIN check failed

ER0 97/01/01 00:00:37.1 Startup Check Error:  52, MCF checksum failed

ER0 97/01/01 00:00:37.1 Startup Check Error:  53, HW SW Compatibility

ER0 97/01/01 00:00:37.1 Startup Check Error:  54, MEF MCF Compatibility

ER0 97/01/01 00:00:37.1 Startup Check Error:  55, Hardware Fault Detected
```

If, while in the unconfigured state the SIN or UCN are reset, an Event such as the following is logged.

```
ER0 97/01/01 00:00:09.9 New SIN Received:       780210012302

ER0 97/01/01 00:00:12.9 New UCN Received
```

7.2.6 Error Messages

The HD/LINK system reports abnormal behavior through error messages recorded by the HD/LINK module's Event Log. Types of Error Messages that may be reported include the following:

- HD/LINK Module Diagnostic Terminal Errors- errors occurring over the Diagnostic port
- HD/LINK Module Communication Errors- errors detected with ATCS messages
- HD/LINK Module Hardware Errors- errors detected with module hardware
- HD/LINK Module Power Supply Errors- power supply anomalies
- HD/LINK Module Wiring or Module Configuration Errors - errors in the application or configuration

- HD/LINK Module Software Errors- errors which may be attributable to software failures
- SSR Linear Network Runtime Errors- Spread Spectrum Radio errors

7.2.6.1 Diagnostic Terminal Errors

Table 7-12 presents Diagnostic Terminal Errors.

Table 7-12. HD/LINK Module Diagnostic Terminal Errors

Error Text	Interpretation	Corrective Action
`DT message lost`	A message from the DT has been lost	None
`No End of DT msg received`	The end of message marker was missing from the message	None
`Corrupt DT message received`	The CRC of the DT message was incorrect	None
`DT buffer full, DT message discarded`	The buffer is full, and the HD/LINK module was unable to send the non-vital reply message	None
`Incorrectly Addressed DT Message received`	The addressing in the DT message was incorrect	None

7.2.6.2 Com

7.2.6.3 munication Errors

Table 7-13 presents Communication Errors.

Table 7-13. HD/LINK Module Communication Errors

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 31`	Non-vital message received with unexpected data	Identify source of message [1]

Table 7-13 Continued

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 32`	Incorrect addressing on received non-vital message	Identify source of message [1]
`Safetran Error: 33`	Message received and discarded due to incorrect addressing	Identify source of message [1]
`Safetran Error: 34(7`*`xx`*`701)`	Error message from Spread Spectrum Radio (except for 53308 with software version SSR01_20, or later). *xx* = 2 digit radio error code	Refer to table 7-19 for SSR error codes
`Safetran Error: 34`	53308 with software version SSR01_20, or later: Invalid message format (Q bit incorrect).	Identify source of message [1]
`Safetran Error: 35`	Message received with unexpected packet type in ATCS header	Identify source of message [1]
`Safetran Error: 36`	Message received with invalid part number	Identify source of message [1]
`Safetran Error: 37`	Message received with unknown message type	Identify source of message [1]
`Safetran Error: 38`	Unknown message packet received in multipacket message	Identify source of message [1]
`Safetran Error: 39`	Multipacket message discarded as not all packet received	Identify source of message [1]
`Safetran Error: 40`	Message buffers are full, unable to send non-vital message. Attempt to download too much from module in too short a period	Slow down requests for data.
`Safetran Error: 41`	Corrupt vital message, ATCS transport CRC check failed	Report problem to Siemens Rail Automation Engineering
`Safetran Error: 42`	Received non-vital message with invalid facility length	Identify source of message [1]

Table 7-13 Concluded

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 43`	Received vital message with invalid format	Report problem to Siemens Rail Automation Engineering
`Safetran Error: 44`	Received vital message with invalid ATCS address. Indication of duplicate ATCS addresses	Check configuration
`Safetran Error: 45`	Received vital message with invalid length. Indication of configuration problem	Check configuration. Report problem to Siemens Rail Automation Engineering, if cause not solved
`Safetran Error: 66`	Received a message which cannot be acted upon in this system state	No action
`Safetran Error: 67`	Received a message of unknown format	Identify source of message [1]
`Safetran Error: 68`	Received too many non-vital requests, request has been discarded	Slow down requests for data.

[1] Symptoms are indicative of another ATCS-based product trying to communicate with module and not using correct message format. Try to identify the cause of the message. If problem persists, contact Siemens Rail Automation Engineering.

7.2.6.4 Hardware Errors

Table 7-14 presents Hardware Errors.

Table 7-14. HD/LINK Module Hardware Errors

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 64`	Hardware error on module or connector	[1]
`Safetran Error: 65`	Hardware error on module or connector	[1]
`Safetran Error: 87`	Hardware error in I/O	[1]

Table 7-14 Continued

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 88`	Hardware error in I/O	[1]
`Safetran Error: 90`	Hardware error in I/O	[1]
`Safetran Error: 91`	Hardware error in I/O	[1]
`Safetran Error: 92`	Hardware error in I/O or Output shorted	[1]
`Safetran Error: 98`	Hardware error in LAN	[1]
`Safetran Error: 99`	Hardware error in LAN	[1]
`Safetran Error: 108`	Hardware error in RAM or transient RAM fault	[1]
`Safetran Error: 109`	Hardware error flash memory or transient fault	[1]
`Safetran Error: 112-114`	Hardware error. Timing reference failed.	[1]
`Safetran Error: 115-116`	Software error	Report the problem to Siemens Rail Automation Engineering
`Safetran Error: 120`	Software error, module cycling too slowly. Configuration is too large to be reliably handled	Combine circuits into same comms sessions or use other optimization techniques for reducing bandwidth.
`Safetran Error: 121`	ECD hardware error	[1]
`Safetran Error: 122-123`	LAN hardware error	[1]

Table 7-14 Concluded

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 124`	Real time clock hardware error	[1]
`Safetran Error: 125-142`	Software error	Report the problem to Siemens Rail Automation Engineering

[1] Cycle the power on the module. If the problem persists, return the module to Siemens Rail Automation.

7.2.6.5 Power Supply Errors

Table 7-15 presents Power Supply Errors.

Table 7-15. HD/LINK Module Power Supply Errors

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`12V Power Supply Failure`	12V power supply dropped below 8.75VDC	Check power source. If OK and problem persists, return module to Siemens Rail Automation
`Safetran Error: 111`	5V power supply failed	Cycle the power on the module. If the problem persists, return the module to Siemens Rail Automation
`Safetran Error: 110`	-5V power supply failed	Cycle the power on the module. If the problem persists, return the module to Siemens Rail Automation

Table 7-15 Concluded

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Low Battery Voltage Detected`	Battery has dropped below normal operating tolerance, but not low enough to reboot module	Check power source. If OK and problem persists, return module to Siemens Rail Automation
`Battery Voltage has returned back to normal level`	Battery voltage has returned from below normal operating tolerance to its normal range	Check power source. If OK and problem persists, return module to Siemens Rail Automation
`Reset date. Year lost due to power failure or corruption`	The year and century for the real time clock are stored in non-volatile memory, however a power loss for several days causes this information to be lost. Note: This error or the following errors may be logged for a new HD/LINK module which has not had power applied.	Reset the date and time
`Year corrupted`	An extended power loss may cause the year used by the clock to be lost or corrupted.	Reset the date and time
`Century corrupted`	An extended power loss may cause the century used by the clock to be lost or corrupted.	Reset the date and time

7.2.6.6 Wiring or Module Configuration Errors

Table 7-16 presents Wiring or Module Configuration Errors.

Table 7-16. HD/LINK Module Wiring or Module Configuration Errors

Error	Interpretation	Corrective Action
`Bipolar VPIs` *x* `and` *y* `energized simultaneously`	Two inputs (where *x* and *y* are their respective input numbers) configured as bipolar have both been simultaneously energized	Check wiring

7.2.6.7 Software Errors

Table 7-17 presents Software Errors.

Table 7-17. HD/LINK Module Software Errors

Error Text *(s/w version: HDL01_20 & up)*	Interpretation	Corrective Action
`Safetran Error: 69`	A corruption was detected in the Event memory. The Event memory has been cleared	(none)
`Safetran Error: 80-85`	Configuration Error	Report problem to Siemens Rail Automation Engineering
`Safetran Error: 89`	Configuration Error	Report problem to Siemens Rail Automation Engineering
`Safetran Error: 93-97`	Configuration Error	Report problem to Siemens Rail Automation Engineering
`Safetran Error: 100-107`	Configuration Error	Report problem to Siemens Rail Automation Engineering

7.2.6.8 SSR Linear Networking Runtime Errors

In order to provide the capability to diagnose communications problems or faults with an SSR, the SSR generates error messages which are viewable in real-time by connecting a dumb terminal or PC to one of the serial ports of the SSR. In addition, the SSR sends the error messages via the Echelon® LAN to any HD/LINK modules on the LAN to be logged with a timestamp. The format of the real-time messages and of the messages logged in the HD/LINK module's Event Log depends on the version of HD and SSR software involved, as shown in Table 7-18.

Table 7-18. SSR Linear Networking Runtime Error Format Versus Software Versions

HD/LINK Module Software	Radio Type	Radio Software version	Error Message Format	Refer to:
HDL01_20	53301/53304	All revisions	Safetran Error: 34	Figure 7-19
	53308	SSR01_00, SSR01_10	Safetran Error: 34	Figure 7-19
		SSR01_20 & later	SSR ERR: (message text)	Figure 7-20

The **Safetran Error: 34** messages (refer to table 7-18) are presented in a format similar to the following:

```
Safetran Error: 34(7xx 701)
```

where *xx* = a 2 digit SSR error code (refer to table 7-19 for the SSR Linear Networking Runtime Errors in "Safetran Error: 34" format).

For SSR software version SSR01_20 and later, the text message format is as follows:

SSR ERR: "*message text*"

For example, an error message in real-time might be displayed on the screen as follows:

SSR ERR: SID timed out

The same message would be logged in the HD/LINK module Event Log as:

ER0 98/04/28 12:34:24.2 SSR ERR: SID timed out

Refer to table 7-20 for the SSR Linear Networking Runtime Errors in "SSR ERR:" format**.**

Errors that are identified as being "fatal" use software to initiate an automatic reboot of the radio.

Table 7-19. SSR Linear Networking Runtime Errors (Safetran Error: *xx* Format)

Error Code	Error Message	Interpretation	Corrective Action
00	System Restart	Radio has been rebooted	Check for any fatal error messages prior to restart Check for continuous rebooting
01	Echelon Watchdog Timeout	Software Echelon® watchdog timer timed out (Fatal error - SSR is reset)	Check Echelon® connections
02	RF Watchdog Timeout	Software RF watchdog timer timed out (Fatal error - SSR is reset)	Verify activity on RF LEDs after reboot (especially RF RX LED)
03	POOL Out Of Memory	Memory POOL is empty (Fatal error - SSR is reset)	(none)
04	Echelon MIP No Buffers	Echelon® MIP out of buffers (Fatal error - SSR is reset)	Configuration problem - contact Siemens Rail Automation
05	T2 Bad Interrupt	Bad interrupt - Timer 2 (Fatal error - SSR is reset)	Check for hardware problem
06	PFI Bad Interrupt	Bad interrupt - Power failure (Fatal error - SSR is reset)	Check for hardware problem
07	SCON1 Bad Interrupt	Bad interrupt - Serial port (Fatal error - SSR is reset)	Check for hardware problem
08	EX2 Bad Interrupt	Bad interrupt - External 2 (Fatal error - SSR is reset)	Check for hardware problem
09	EX3 Bad Interrupt	Bad interrupt - External 3 (Fatal error - SSR is reset)	Check for hardware problem
10	EX4 Bad Interrupt	Bad interrupt - External 4 (Fatal error - SSR is reset)	Check for hardware problem

Table 7-19 Continued

Error Code	Error Message	Interpretation	Corrective Action
11	EX5 Bad Interrupt	Bad interrupt - External 5 (Fatal error - SSR is reset)	Check for hardware problem
12	WDTI Bad Interrupt	Bad interrupt - System watchdog (Fatal error - SSR is reset)	Check for hardware problem
13	System Watchdog Timeout	System watchdog hardware timer has timed out - system watchdog hardware timer forces SSR to reset	Check power
14	(not used)		
15	RX RF Aux Queue Overflow	RX RF auxiliary queue full (256 bytes)	Check for excessive RF noise
16	RX RF Data Queue Overflow	RX RF data queue full (256 bytes)	Check for excessive RF noise
17	RX RF Message Too Big	RX RF message > maximum buffer size (233 bytes)	Check for excessive RF noise
18	Error Transmitting Sync	TX RF msg queue full - sync msg not sent	Check for excessive RF noise
19	Error Transmitting Sync Ack	TX RF msg queue full - sync acknowledge message not sent	Check power
20	No PLL Lock	Hardware PLL error	Check power
21	Genisys Queue Full	TX Genesis queue full (25 entries)	Check Serial Port configuration
22	Command Queue Full	RX command queue full (25 entries)	Check Serial Port configuration
23	Echelon Message Too Big	TX Echelon® message too big (120 bytes)	Check power
24	Genisys TX Retry Limit	Retry limit reached (3) - drop TX message	Check Serial Port configuration

Table 7-19 Concluded

Error Code	Error Message	Interpretation	Corrective Action
25	Reset Echelon MIP	Performing reset of Echelon® MIP	Check power
26	RX Message Lost - NR Skipped	HDLC NR sequence number error	Check for excessive RF noise
27	TX RF Output Queue Full	TX RF message queue full (25 entries)	Check power
28	RX RF CRC Error	RX RF checksum error	Check for excessive RF noise
29	Lost Sync To Right	Synchronization lost to right	Check for excessive RF noise [1]
30	Lost Sync To Left	Synchronization lost to left	Check for excessive RF noise [1]

[1] Symptoms are indicative of a marginal RF link. Check RSSI (Received Signal Strength Indication). Refer to Section VIII, paragraph 8.2.5.*4, Signal Strength Reporting*.

Table 7-20. SSR Linear Networking Runtime Errors (SSR ERR Format)

Error Code	Error Message	Interpretation	Corrective Action
00	`SSR ERR: Rebooted`	Radio has restarted	Check for any fatal error messages prior to restart Check for continuous rebooting
01	`SSR ERR: Receiver auxiliary queue overflow.`	RX RF auxiliary queue full (256 bytes) (Fatal error - SSR is reset)	Check for excessive RF noise
02	`SSR ERR: Receiver queue overflow.`	RX RF data queue full (256 bytes) (Fatal error - SSR is reset)	Check for excessive RF noise
03	`SSR ERR: RF buffer overflow`	RX RF message > max. buffer size (233 bytes) (Fatal error - SSR is reset)	Check for excessive RF noise

Table 7-20 Continued

Error Code	Error Message	Interpretation	Corrective Action
04	`SSR ERR: Watchdog echelon time-out`	Software Echelon® watchdog timer timed out (Fatal error - SSR is reset)	Check Echelon® connections
05	`SSR ERR: Watchdog RF time-out`	Software RF watchdog timer timed out (Fatal error - SSR is reset)	Verify activity on RF LEDs after reboot (especially RF RX LED)
06	`SSR ERR: POOL out of memory`	Memory POOL is empty (Fatal error - SSR is reset)	(none)
07	`SSR ERR: T2 bad interrupt vector triggered`	Bad interrupt - Timer 2 (Fatal error - SSR is reset)	Check for hardware problem
08	`SSR ERR: PFI bad interrupt vector triggered`	Bad interrupt - Power failure (Fatal error - SSR is reset)	Check for hardware problem
09	`SSR ERR: SCON1 bad interrupt vector triggered`	Bad interrupt - Serial port (Fatal error - SSR is reset)	Check for hardware problem
10	`SSR ERR: EX2 bad Interrupt vector triggered`	Bad interrupt - External 2 (Fatal error - SSR is reset)	Check for hardware problem
11	`SSR ERR: EX3 bad Interrupt vector triggered`	Bad interrupt - External 3 (Fatal error - SSR is reset)	Check for hardware problem
12	`SSR ERR: EX4 bad Interrupt vector triggered`	Bad interrupt - External 4 (Fatal error - SSR is reset)	Check for hardware problem
13	`SSR ERR: EX5 bad Interrupt vector triggered`	Bad interrupt - External 5 (Fatal error - SSR is reset)	Check for hardware problem
14	`SSR ERR: WDTI bad interrupt vector triggered`	Bad interrupt - System watchdog (Fatal error - SSR is reset)	Check for hardware problem
15	`SSR ERR: SID EEPROM mismatch`	The SID is updating the EEPROM and the SSR must now be reset (Fatal error - SSR is reset)	None - This does not normally indicate a problem[1]

Table 7-20 Continued

Error Code	Error Message	Interpretation	Corrective Action
16	`SSR ERR: Echelon MIP no buffers`	Echelon® MIP is out of buffers[2] (Fatal error - SSR is reset)	Configuration problem - contact Siemens Rail Automation
17	`SSR ERR: Unprocessed packets`	The SSR has a software problem	Contact Siemens Rail Automation
18	`SSR ERR: EEPROM configuration read error`	The radio configuration information stored in the EEPROM is not compatible with the current software version	The radio forces in the factory default (AT&F0) - Reconfigure as required
19	`SSR ERR: Wrong radio`	The SSR has a software problem	Contact Siemens Rail Automation
20	`SSR ERR: Watchdog timeout hardware watchdog`	System watchdog hardware timer has timed out - system watchdog hardware timer forces SSR to reset	Check power
21	`SSR ERR: Received a packet that was too long`	A false start character was received because of RF noise	Check for excessive RF noise
22	`SSR ERR: Error transmitting the synchronize message`	TX RF message queue full - sync message not sent	Check for excessive RF noise
23	`SSR ERR: Error transmitting the synchronize acknowledge message`	TX RF message queue full - sync acknowledge message not sent	Check power
24	`SSR ERR: No PLL lock`	Hardware PLL error	Check power
25	`SSR ERR:MAC queue full`	The radio is being overloaded by messages to go across the RF link, but the RF link is down	Check why the RF link between neighbors is down
26	`SSR ERR: Echelon queue full`	Too many messages sent to the Echelon® driver before the driver can send them out on the Echelon® Interface	Check the Echelon® board
27	`SSR ERR: Genesis queue full`	TX Genesis queue full (25 entries)	Check Serial Port configuration

Table 7-20 Continued

Error Code	Error Message	Interpretation	Corrective Action
28	`SSR ERR: Command queue full`	RX command queue full (25 entries)	Check Serial Port configuration
29	`Router Queue Full`	The SSR has a software problem	Contact Siemens Rail Automation
30	`ATCS Queue Full`	The SSR has a software problem	Contact Siemens Rail Automation
31	`SSR ERR: Router out of memory`	The SSR has a software problem	Contact Siemens Rail Automation
32	`SSR ERR: Echelon message too big for MIP`	TX Echelon® message too big (120 bytes)	Check power
33	`SSR ERR: Genesis transmit retry limit reached`	Retry limit reached (3) - drop TX message	Check Serial Port configuration
34	`SSR ERR: Reset echelon MIP`	Performing reset of Echelon® MIP	Check power
35	`SSR ERR: Receive message lost - NR skipped`	HDLC NR sequence number error	Check for excessive RF noise
36	`SSR ERR: Receive RF CRC error`	RX RF checksum error	Check for excessive RF noise
37	`SSR ERR: RF output queue full`	TX RF message queue full (25 entries)	Check power
38	`SSR ERR: Right lost sync`	Synchronization lost to right	Check for excessive RF noise[3]
39	`SSR ERR: Left lost sync`	Synchronization lost to left	Check for excessive RF noise[3]
40	`SSR ERR: Illegal Pool free`	The SSR has a software problem	Contact Siemens Rail Automation
41	`SSR ERR: Pool stack full`	The SSR has a software problem	Contact Siemens Rail Automation
42	`SSR ERR: Pool freed twice`	The SSR has a software problem	Contact Siemens Rail Automation

Table 7-20 Continued

Error Code	Error Message	Interpretation	Corrective Action
43	SSR ERR: SID ok response	Used internally by the radio - The user should never see this message	Contact Siemens Rail Automation if this message is seen
44	SSR ERR: SID no space	The Site ID module is out of memory	Contact Siemens Rail Automation
45	SSR ERR: SID duplicate tag	The Site ID module has a software problem	Contact Siemens Rail Automation
46	SSR ERR: SID Tag unknown	The Site ID module does not contain radio configuration data	Configure the radio as desired, then perform an AT&W command to write the radio configuration into the SID module
47	SSR ERR: SID out of memory bounds	The Site ID module has a software problem	Contact Siemens Rail Automation
48	SSR ERR: SID checksum error	The Site ID module has a software problem	Contact Siemens Rail Automation
49	SSR ERR: SID operational error	The Site ID module has a software problem	Contact Siemens Rail Automation
50	SSR ERR: SID data size too big	The Site ID module has a software problem	Contact Siemens Rail Automation
51	SSR ERR: SID message version not supported	Radio and SID software are not compatible	Contact Siemens Rail Automation
52	SSR ERR: SID unwritten tag	The Site ID module has a software problem	Contact Siemens Rail Automation
53	SSR ERR: SID object error	The SSR has a software problem	Contact Siemens Rail Automation

Table 7-20 Concluded

Error Code	Error Message	Interpretation	Corrective Action
54	SSR ERR: SID locked out see S register 137 bit 128 is set	The Site ID module lockout bit has been set - Setting this bit to cause lockout safeguards the configuration data currently in the EEPROM and does not allow the configuration in the SID module to overwrite it	If the configuration data in the SID is the desired data, type ATS137=60&W with the SID powered down or disconnected, then power up the SID (or reconnect it) and then reboot the radio If configuration data in the radio's EEPROM is the desired data, write it to the SID by typing ATS137=60&W
55	SSR ERR: SID configuration not valid bad configuration version	The radio configuration data stored in the SID is not compatible with the radio software	Reconfigure the radio and write the new configuration to the SID
56	SSR ERR: SID timed out	The SID module is not responding to radio commands	Check the SID module (if installed)[4]
57	SSR ERR: RSSI not calibrated	The RSSI value is displayed in raw form instead of in dBm	Configuration problem - Contact Siemens Rail Automation
58	SSR ERR: Com destination illegal	The SSR has a software problem	Contact Siemens Rail Automation
59	SSR ERR: Source of ATCS message illegal	The SSR has a software problem	Contact Siemens Rail Automation
60	SSR ERR: ATCS Message not supported	The SSR has a software problem	Contact Siemens Rail Automation
61	SSR ERR: ATCS message version mismatch	The SSR has a software problem	Contact Siemens Rail Automation
62	SSR ERR: ATCS Output Setup Error	The SSR has a software problem	Contact Siemens Rail Automation

[1] This message is normal when an SSR has been reconfigured or replaced (and configuration in EEPROM is different from that in SID). It is implemented as a fatal error to initiate a reboot in order to activate the configuration data just written from SID. If this message appears after a reboot for a system that has been operating normally, a hardware problem is indicated.
[2] This error prevents the error message from being logged in the HD/LINK module event log. This error message can be viewed in real time from a laptop PC connected to a serial port.
[3] Symptoms are indicative of a marginal RF link. Check RSSI (Received Signal Strength Indication). Refer to Section VIII, paragraph 8.2.5.4*, Signal Strength Reporting*.
[4] The "SID timed out" error message occurs when an installed SID Module is not responding or when a SID Module is not installed. In the first case it indicates a problem with the SID Module or its connections, and in the latter case it does not represent a problem (SID is not required). In either case it does not hinder system operation (current EEPROM configuration is used), provided the current EEPROM configuration is correct.

7.3 DIAGNOSTIC REQUEST MESSAGES

The user can query an HD/LINK module directly using the DT Utility via the Diagnostic port (Diagnostic Terminal or modem) or remotely via the LonTalk™ LAN (using radio, modem, remote module, etc.) in order to determine its status. Refer to Appendix B for a typical DT screen dump showing module status, communications status, Event Log, Event file, and MCF viewer. The HD/LINK system supports the following diagnostic messages:

- Module Status, executive and MCF software version information, SIN, verbosity level
- Module Time, current time and date for the module
- Event Log
- Communication Statistics
- MCF

7.3.1 Module Status

Descriptive information and operational status on the module can be reviewed by displaying module status. Table 7-21 describes the module status parameters.

Table 7-21. HD/LINK Module Status

Parameter	Description
`Module type:`	HD/LINK module
`MEF version:`	The current executable software version
`MCF version:`	The current configuration software version
`MEF/MCF compatibility index:`	Parameter defining compatibility of software and configuration file

Table 7-21 Concluded

Parameter	Description
`MEF/HW digital compatibility index:`	Parameters defining compatibility of software and hardware
`MEF/HW analog 1 compatibility index:`	Parameters defining compatibility of software and hardware
`MEF/HW analog 2 compatibility index:`	Parameters defining compatibility of software and hardware
`System state:`	Fully Operational or Unconfigured
`Verbosity level:`	The verbosity level at which the Event Log is currently set
`Module SIN:`	The ATCS address of this module
`Battery voltage:`	The HD/LINK module samples the battery voltage[1]
`Service Check Number:`	The check number calculated at the end of initial configuration checks is provided. If the system is unconfigured, this will be the Out Of Service Check Number. If fully operational, this will be the In Service Check Number.
`UCN:`	The UCN for this HD/LINK module, updated on system initialization or when re-entered, is provided. If the entered value does not match the calculated UCN, this value will be reported as zero.

[1] Set for a nominal situation. If no VROs are energized, the HD/LINK module senses the battery voltage as 0.3V lower than actual value; if all VROs are energized, the HD/LINK module senses the battery voltage as 0.3V higher than actual value.

7.3.2 Communications Status (Comms Status)

The communications status provides statistical data on the number of messages of different types received and of the number and type of communication errors which occurred.

Each communication statistic has a maximum value of 32767. Some of the communication statistics wrap around to zero when the limit is reached and some peg out and remain fixed at 32767. The reason for this is that statistics counting regular occurrences such as ‘vital messages

received' naturally wraps around, whereas if something erroneous is occurring, evidence for this should always be present in the statistics.

The comms status for a local or remote module can be reset using the Installers Diagnostic Terminal Utility or from the office. The date and time at which they were last reset is stored as part of the statistics. Table 7-22 presents the Communications Status.

Table 7-22. HD/LINK Module Communications Status

Statistic	Type	Description
`Vital packets sent:`	Wrap around	Number of vital messages sent by the module to another module
`Nonvital packets sent:`	Wrap around	Number of non-vital messages sent by the module to another module
`Vital packets received:`	Wrap around	Number of vital messages received by the module from another module
`Nonvital packets received:`	Wrap around	Number of non-vital messages received by the module from another module
`Internal vital messages:`	Wrap around	Number of vital messages sent from one SAT inside the module to another SAT inside the module
`External packets:`	Wrap around	Number of messages routed from the DT to the LAN or Number of messages routed from the LAN to the DT
`Bad CRCs:`	Pegged	Number of vital messages with incorrect vital CRCs received
`Incorrectly addressed packets:`	Pegged	Number of incorrectly addressed vital messages received
`Packets with invalid Q bit:`	Pegged	Number of messages received with invalid Q bit in ATCS header
`Packets with invalid packet type:`	Pegged	Number of messages received with invalid packet type in ATCS header
`Packets with invalid part number:`	Pegged	Number of messages received with invalid part number
`Vital packets with bad facility length:`	Pegged	Number of vital packets received with non-zero facility length
`Vital packets with bad format:`	Pegged	Number of vital packets received with an invalid format

Table 7-22 Continued

Statistic	Type	Description
`Vital packets with bad message length:`	Pegged	Number of vital packets received with an invalid message length
`Nonvital packets with invalid format:`	Pegged	Number of non-vital packets received with an invalid format
`Nonvital packets not assimilated:`	Pegged	Number of non-vital packets received which are part of a multipacket messages but could not be placed in the message
`Packets with out of range data:`	Pegged	Number of non-vital packets received which have invalid data
`Vital packets with stale data:`	Pegged	Number of stale vital packets received
`Vital Packets out of order:`	Pegged	Number of out of order vital packets received
`DT packets sent:`	Wrap around	Number of packets the module has sent to the Diagnostic Terminal
`Valid DT packets received:`	Wrap around	Number of valid packets the module has received from the Diagnostic Terminal
`Invalid DT packets received:`	Pegged	Number of invalid packets the module has received from the Diagnostic Terminal
`LAN packets sent:`	Wrap around	Number of packets the module has sent to the LonTalk™ LAN
`Valid LAN packets received:`	Wrap around	Number of valid packets the module has received from the LonTalk™ LAN
`Invalid LAN packets received:`	Pegged	Number of invalid packets the module has received from the LonTalk™ LAN
`Missed 1 message number:`	Pegged	Number of times that there has been a single vital packet missed as determined by a difference of two in the message sequence numbers
`Missed 2 message number:`	Pegged	Number of times that there has been two packets missed as determined by a difference of three in the message sequence numbers

Table 7-22 Concluded

Statistic	Type	Description
`Missed 3 plus message number:`	Pegged	Number of times that there has been three, or more, packets missed as determined by a difference of four or more in the message sequence numbers. Note that if a session is lost, the module reboots etc., this statistic is incremented
`Total lost sessions:`	Pegged	Count of the total number of sessions lost in the HD/LINK module

7.3.3 I/O Status

The I/O status shows the current state of all the vital inputs, vital outputs and internal channels on the module. The positive and negative pin labels assigned to the inputs and outputs during the configuration process are displayed in order that the I/O can be easily identified.

7.3.4 SAT Status

The SAT status shows the last data that the selected SAT sent to its neighbor and the last data it received from its neighbor. The format of the output as displayed on the Diagnostic Utility is similar to that in the Event Log (the DT presents sets of eight positions separated by spaces; the Event Log presents 24 uninterrupted positions).

As an example, consider a Virtual Circuit SAT driving three outputs and reading five inputs (refer to the DT display below). The 'received' row shows that the SAT received a message setting outputs 1 and 2 energized and 3 deenergized. The 'sent' row indicates that the last message sent indicated that inputs 1,3,4,5 were deenergized and input 2 was energized. The '-' implies that the input/output is not used.

```
SAT Status for VSAT 2:

Received    : ++.----- -------- --------

Sent        : .+...--- -------- --------
```

NOTE

NOTE

The input/output positions indicated in a DT display or the Event Log represent the input numbers in relation to the SAT, not the actual VPI and VRO numbers. Each Virtual Circuit SAT may have up to 24 inputs and 24 outputs.

7.3.5 SAT Timing Parameters

The SAT timing parameters allow the values of safety-critical timing information in the MCF to be examined for each SAT. The *Client Timeout - Energized* and *Client Time Stamp - Net Delay* can be displayed.

7.3.6 MCF

By using the Diagnostic Terminal, the MCF can be retrieved and stored to a file. The header information in the MCF can be viewed using the *File-View* command in the Diagnostic Terminal. Refer to paragraph 7.1.2, *Maintainers Diagnostic Terminal Utility*, for instructions on using the DT Utility for retrieving the MCF.

NOTE

NOTE

The MCF loaded in a module cannot be used to restore or replace the MCF in the office, as certain information required by the HD/LINKer configuration utility is discarded when downloaded into a module.

7.4 REMOTE DIAGNOSTICS

The HD/LINK system offers two methods of using remote diagnostics: NMS and DT, as described in the following paragraphs.

7.4.1 Network Management System (NMS)

The HD/LINK and Spread Spectrum Network can be made part of a wider area network by using Safetran's WCP/BCP and office utilities. Any ATCS node on the network, HD/LINK module, radio or other Safetran ATCS equipment can be communicated with from the office. Refer to the Safetran Network Management System manual for details.

7.4.2 Diagnostic Terminal (DT) Utility

A PC running the Diagnostic Terminal (DT) Utility can be connected via its serial port to an HD/LINK module. The utility allows the user to communicate with a remote HD/LINK module, provided that the selected module is on the same radio network. The user selects the ATCS address of the desired module and then uses the utility as normal to request information such as Event Logs and communication statistics.

By targeting a remote module on a network using its ATCS address and accessing that module's Get Menu, the following information for that module may be retrieved:

- Event Log - the latest page of Events from the Event Log
- Event File - allows the contents of the Event Log to be saved to a text file
- Comms Status - the communication statistics for the module
- Module Status - information and status on the module

- IO Status - status of the module inputs and outputs (only if module is fully operational)
- SAT Status - status of a selected SAT from a list produced by the module (only if module is fully operational)
- Timing Parameters - the configured vital timing parameters for a selected SAT from a list produced by the module (only if module is fully operational)
- Date and Time - date and time as currently set on the module
- MCF File - allows retrieval and saving of the MCF file from the module (only if module is fully operational)

Refer to paragraph 7.3, *Diagnostic Request Messages*, for information on querying a module for status and other information on the HD/LINK system. Refer to paragraph 7.1.1.4, or paragraph 7.1.2.4 for the Target HD menu option. Refer to Section VIII for module troubleshooting.

NOTE

NOTE

The MCF, MEF, SIN or UCN for a remote module cannot be reconfigured from the DT Utility.

The following presents a typical procedure for reviewing the Event Log of a remote HD/LINK module on a network (other information is retrievable in a similar manner):

1. Launch the DT Utility at a local module on the network.

2. Using the DT Utility, select the Setup menu.

3. From the Setup menu, select Target HD.

4. From the Target HD menu, select Remote HD/LINK, and answer the prompt for the ATCS address of the target module.

5. The screen displays the ATCS address of the remote module in the MENU BAR as shown in the following example:

REMOTE @ SIN 7620005395021

6. Using the DT Utility, select the Get menu (remote module).

7. Using the DT Utility, select the Event Log (remote module) to view recorded Events.

7.5 VISUAL INDICATORS

The HD/LINK module and the SSR module have LED indicators on their front panels for monitoring module operation. Adjacent to the SERVICE LED on the HD/LINK module is a recessed push button. When pushed, the SERVICE LED lights and the Echelon® Neuron is reset. This button is unused in the HD/LINK module.

Refer to table 2-1 for the functions of the LEDs for the HD/LINK module, and table 9-1 for the functions of the LEDs for the SSR.

⚠ WARNING

WARNING

ALL DIAGNOSTIC UTILITIES AND TEST EQUIPMENT MUST BE DISCONNECTED FROM THE SYSTEM WHILE IN NORMAL SERVICE TO PREVENT POTENTIAL GROUNDING.

7.6 SSR CONFIGURATION & DIAGNOSTICS

To access the configuration and diagnostic registers of the Spread Spectrum Radio, two RS232 serial ports are available for use: the 9-pin Diagnostic connector, or the 25-pin data interface connector (if it is not already in use). Selection of the serial port used for command mode is set by the "Comm Port Command Mode" S-register (default is 'automatic selection'). It is necessary to connect a dumb terminal or a PC to one of these two asynchronous RS232 ports.

Since the 25-pin port may also be used to send and receive operational data, it is necessary to place the radio in Command Mode prior to configuration. When power is initially applied to the radio, the radio is in either the Command Mode or the Data Mode, depending upon the setting of the power-up mode bit position of the "Bit Map" S-register (refer to the radio manual for configuring S-registers). The unit can be placed in the Command Mode by entering an escape sequence ("**+++**").

Communications parameters for the RS232 port should be set as follows:

Parameter	53301/53304 Radios	53308 Radio
baud rate:	2400	9600
parity:	none	none
stop bit:	1	1
bits per character:	8	8

NOTE

NOTE

The baud rate may be different if the "DTE Baud Rate" S-register configuration has been altered from the factory default settings.

When in the Command Mode, the unit responds to a subset of the Hayes AT command set and is compatible with most commercial communications programs. Hayes commands not listed in the subset are ignored.

Once the desired configuration is entered, it can be permanently saved with the AT&W command. The radio unit must be reset after saving the new configuration to enable the new configuration to take effect.

7.6.1 Configuration Guidelines

The following guidelines should be observed during initial configuration of the Spread-Spectrum Radio, and also after installation and configuration are complete, to verify proper operation.

1. If the radio is currently in the Command Mode, pressing the ENTER key on the terminal keyboard results in an OK prompt from the radio (indicating that keyboard entry is enabled). If the radio is in the Data Mode (no OK response), press the "+" key on the terminal keyboard three times in rapid succession to switch to Command Mode. The radio then responds with the OK prompt.

NOTE

NOTE

Due to the default guard time set in the "Guard Time" S-register, the "+++" sequence must not be preceded or followed by any input for a minimum of 1 second.

2. Enter the desired configuration commands and S-register settings (refer to the SSR manual). To read the value of an S-register, enter the command "ATSnnn?" where nnn is the S-register number. To change the value of an S-register, enter the command "ATSnnn=xxx", where xxx is the desired decimal value.

3. When the radio has been configured, the data should be saved to permanent memory with the "AT&W" command. Failure to save the configuration data results in the new configuration being lost upon a power-down or reset of the radio.

4. The factory default configuration can be restored with the "AT&F*x*" command, where *x* is a value from 1 to 6 that specifies the RF operating frequencies.

5. The AT&T1 command (transmit continuous BER mode) can be used to confirm SSR operation. The RF TX LED should begin flashing after entering the command.

6. The "AT&T9" command may be used to verify that the RF channel is free of interference or, alternatively, to find a suitable free channel for operation. This command is to be used only during path analysis, and not during operation of a Linear Networking system (refer to *S3/Link™ Spread-Spectrum Radio, Instruction & Installation Manual, Documents COM-00-94-04 or COM-00-97-21*).

⚠ WARNING

WARNING

DO NOT USE THE AT&T1 OR THE AT&T9 COMMAND WITH AN OPERATING LINEAR NETWORKING SYSTEM AS DISRUPTION OF THE LINEAR NETWORK RESULTS.

7. The radio can be returned to the Data Mode with the "ATD" command, except to exit the AT&T1 test mode a power-on reset is required.

Refer to the S^3Link™ - Spread Spectrum Radio Manual for supported Hayes commands and proper configuration selections.

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SECTION VIII

TROUBLESHOOTING

8.0 GENERAL

An HD/LINK module is generally an integral part of an HD/LINK system, therefore troubleshooting in this manual is covered at the system level. When a problem occurs within the HD/LINK system, maintenance personnel should attempt to isolate the cause of the problem before replacing components or modules.

⚠ WARNING

WARNING

HD/LINK MODULES CONTAIN NO USER-SERVICABLE COMPONENTS. MODULES DETERMINED TO BE DEFECTIVE SHOULD BE RETURNED TO SIEMENS RAIL AUTOMATION FOR DIAGNOSIS AND REPAIR.

Troubleshooting of the HD/LINK system is generally accomplished by connecting a laptop PC, with a Diagnostic Terminal Utility installed, to the Diagnostic port on an HD/LINK module with an RS-232 cable (straight through, pin-to-socket, DB-9 connector at HD end, other end depending on COM port used, and observing messages (refer to Section VII, paragraphs 7.2 and 7.3), either in the Event Log, or by way of diagnostic request messages. Troubleshooting and corrective action for the HD/LINK module may also require the installation MCF, the MEF (only if needed), MCF Installation Listing, MCF Contents Listing, the HD/LINK Wiring List, and the Railroad schematics. The SSR can be diagnosed or reconfigured by connecting a PC to the Diagnostic port on the front panel of the radio.

Other means of troubleshooting are provided by observing LEDs on the modules' front panels, or by connecting test equipment (for example, to measure power supply voltage).

Refer to paragraph 8.1 for troubleshooting the HD/LINK module and paragraph 8.2 for troubleshooting the radio link.

8.1 TROUBLESHOOTING THE HD/LINK MODULE

If the configuration is correct, the HD/LINK module should be flashing its status (HEALTH LED) at the rate of approximately once every two seconds to indicate that the module is fully operational. Observe the HEALTH LED on the front panel of the HD/LINK module to verify the health of the module.

8.1.1 HD/LINK Module System States

To fully understand what is occurring in the HD/LINK system when a problem is encountered, it may be necessary to determine what state an HD/LINK module is in. The module may be in one of four states: initial, unconfigured, operational, or fault state.

8.1.1.1 Initial State

The initial state is entered upon receiving a Power On Reset or a System Reset. A Power On Reset occurs when the module is first powered up. A System Reset is a reset caused internally by the system due to a request from the office or maintenance personnel or during recovery after failure.

In this state checks are performed to ensure that the system is healthy and properly configured. These include checks on the system hardware and on the software (integrity and compatibility of the MEF and MCF).

When in the initial state, no vital outputs can be set, or vital ATCS messages transferred. When the initial state has finished its checks successfully, the module enters the fully operational state (the HEALTH LED flashes at a slow rate). If the configuration checks fail, the module enters the unconfigured state (the HEALTH LED flashes at a fast rate). If the health checks fail, the module enters the fault state (the HEALTH LED remains off).

When in the initial state, the Event Log and the Module Status (from the Get menu) are not accessible. The only visible indication that the module may be in the initial state is that all LEDs are off except for POWER, which should be on. A DT connected to the Diagnostic port of the module and running the DT Utilities displays boot-up information on the Safetran HD/LINK Bootstrap screen.

8.1.1.2 Unconfigured State

If the checks in the initial state find that the system is incorrectly configured or not configured, or if a request from the office or maintenance personnel is received to enter the unconfigured state, the module is placed in the unconfigured state (the HEALTH LED flashes at a fast rate).

This state allows the system configuration data to be updated (SIN updated, UCN updated or MCF downloaded). In this state no vital outputs can be set, or vital ATCS messages transmitted. The Out of Service Check Number is logged on entry to this state.

8.1.1.3 Fully Operational State

This is the normal operating state of the system- vital inputs can be read, vital outputs can be set and vital ATCS messages passed over the LAN interface. In this state, remote and local diagnostic facilities are available using the DT Utilities. The In Service Check Number is logged on entry to this state. When in the fully operational state the HEALTH LED flashes at a slow rate to give a visible indication of module health.

8.1.1.4 Fault State

The fault state is entered when a fault in the system is detected. This state is only transitory- after information has been saved to determine the cause of the fault, the system performs a System Reset. System Resets are set to occur automatically in order to attempt to put the system back into operation, if possible, without having to wait for the availability of maintenance personnel to locate and correct the fault.

The symptoms of this state are identical to those of the initial state. However, a continuous fault in the system such as a hardware failure can result in the module continuously rebooting. The fault still exists after rebooting, therefore the fault state performs resets at about 20-second intervals. This condition is detectable from the Diagnostic port using the DT utilities Bootstrap screen during the boot-up process.

8.1.2 HD/LINK Module Power Supply Problems

If the input power to the HD/LINK module is not correct, it must be determined if the problem is caused by the input voltage source or the module itself. Table 8-1 presents the HD/LINK module's reaction to different power input voltages. Refer to Section VII, paragraph 7.2.6.4, *Power Supply Errors* for a list of error messages involving the power supply.

Table 8-1. Reaction of The HD/LINK Module to Different Power Input Voltages

Voltage (V)	Module Behavior	Visual Indications
V >16.5VDC	Module is above specified operating range- Vital outputs are deenergized and module continuously reboots while V is above 16.5VDC	All LEDs except POWER which is off- Continuous rebooting can be determined by connecting a DT (Diagnostic Terminal) to the Diagnostic port of the HD/LINK module.
9.0VDC ≤ V ≤ 16.5VDC	Normal operating range	HEALTH LED flashes at a slow rate (module is fully operational), at fast rate (module is unconfigured) or off (during startup or when faulted).
9.0VDC ≤ V ≤ 10.1VDC[1]	The module continues to operate normally; a warning of low voltage is logged by the Event Log (once per hour while condition persists) [1] The point at which the module detects a low voltage may vary ±0.25VDC, depending on the number of VROs that are energized	No visual indications- Event Log can be reviewed by using a DT connected to the Diagnostic port.

Table 8-1 Concluded

Voltage (V)	Module Behavior	Visual Indications
Approx. 7VDC < V < 9.0VDC	The software detects an input voltage below the specified operating voltage, an error is logged in the Event Log and the module reboots. The module continues to reboot while the input voltage is within this range	All LEDs except POWER which is off- Continuous rebooting can be determined by connecting a DT (Diagnostic Terminal) to the Diagnostic port of the HD/LINK module.
V < approx. 7VDC	Software detects an input voltage below the specified operating voltage- The module is held in the reset state. Rebooting (with a **Module Rebooted** event recorded in the Event Log) commences when V reaches approximately 7VDC.	All LEDs except POWER which is off- When V returns to normal, the Event Log can be reviewed by using a DT connected to the Diagnostic port of the HD/LINK module.

8.1.3 Problems With The HD/LINK Software Executive (MEF)

To verify that the MEF has been correctly loaded, perform the steps in the checklist of table 8-2.

Table 8-2. HD/LINK Module MEF Checklist

1. Using the DT Utility, from the Get menu, select *Module Status* 2. Check the following against the Module Summary of the MCF Contents Listing (or MCF Approval Listing):	☐
MEF Version (Name)	

NOTE

NOTE

Siemens Rail Automation provides HD/link modules which are already loaded with the latest hd/link software, therefore loading the mef should not normally be required.

If it is determined that an HD/LINK module is using the wrong version of executive software, the Module Executable File (MEF) should be changed. Changing the MEF for the HD/LINK module does not require changing any EEPROMs. The software is stored in flash memory and can be updated using a laptop computer running the Installers Diagnostic Terminal Utility.

NOTE

NOTE

Unlike most diagnostic features of the HD/LINK module, the downloading of MEF, MCF, SIN and UCN cannot be done remotely. The PC running the Installers DT Utility must be directly connected to the module being programmed.

If the MEF is corrupted, the wrong version, or missing, it is often detected by observing the Bootstrap screen from the DT Utilities during the boot-up process (refer to paragraph 8.1.5, *HD/LINK Module Boot Up*, for information on boot up and module setup).

8.1.4 Problems With The HD/LINK Module Configuration

After the module has completed its initial startup checks, which take about 1 minute, the module enters one of two states: *fully operational,* or *unconfigured*. If the configuration is unsuccessful, the *unconfigured* state is entered. If the configuration is successful, the *fully operational* states is entered. The module state can be determined by several methods, as described in table 8-3.

Table 8-3. Determination of HD/LINK Module State

Check:	Indication	Module Status
HEALTH LED	Flashing fast (approximately three times per second)[1]	Unconfigured state
	Flashing slow (approximately once every two seconds)[2]	Fully operational state
Event Log	From the DT Utility GET menu, select Event Log and look at the end of the log, paging back if necessary, until the last 'module rebooted' Event is found. An entry in the log immediately following the last 'module rebooted' Event should indicate the state of the module	Fully Operational or Unconfigured
System State	From the DT Utility GET menu, select Module Status and look at System State	Fully Operational or Unconfigured

[1] Actual programmed time for 'unconfigured' state flash cycle is 175ms on and 175ms off.
[2] Actual programmed time for 'fully operational' state flash cycle is 1 second on and 1 second off.

NOTE

NOTE

The module cannot be used for vital operation (reading inputs or driving outputs) if it is in the unconfigured state.

If VPIs are off when they should be energized (i.e., inputs are active), the module is either unconfigured, or in the initial or fault states. If the module is unconfigured, the Event Log should indicate the reason by logging a Startup Check Error followed by an Event that the module is unconfigured and logging the Out of Service Check Number. Table 8-4 lists possible Startup Check Error messages.

Table 8-4. HD/LINK Module Configuration Error Messages

Message[1]	Cause	Corrective Action
Startup Check Error: xx, UCN check failed	The UCN was incorrect for this combination of MEF/MCF	• Check that the SIN, MCF, MEF and UCN are as specified on the MCF Installation and MCF Contents Listings • Reconfigure as required
Startup Check Error:xx, SIN check failed	The SIN entered into the module is different from that stored in the MCF	• Check that the SIN and MCF are as specified on the MCF Installation and MCF Contents Listings • Reconfigure as required
Startup Check Error:xx, MCF Checksum Failed	The MCF was corrupted during the download	• Reload the MCF
Startup Check Error:xx, HW SW Compatibility	The hardware version is incompatible with the software version	• Check that the hardware and software versions are as specified on the MCF Installation and MCF Contents Listings • Reconfigure as required
Startup Check Error:xx, MEF MCF Compatibility	The software version is incompatible with the configuration file version	• Check that the correct software and MCF versions have been loaded as specified on the MCF Installation and MCF Contents Listings • Check that the latest HD/LINKer has been used to generate the MCF • Reconfigure as required
Startup Check Error: nn , Hardware Fault Detected	The HD/LINK module has a hardware fault (where *nn* = 55, 56, or 57)	• Replace module and return the faulty module to Siemens Rail Automation

[1] The error code (*xx*) may vary depending on software version. The error code is used by programmers only.

To verify that the correct MCF has been loaded, perform the steps in the checklist of table 8-5.

Table 8-5. HD/LINK Module MCF Checklist

1. Using the DT Utility, from the Get menu, select *MCF File*, and save to a temporary file (use a temporary Filename) 2. View MCF (<Alt> + <F>, <View>, <ENTER>) 3. Check the following against the MCF Installation Listing (or MCF Approval Listing):	☐
Location (Group) Name	
MCF File Name	
MCF Version	
MCF Creation Date	
SIN	

If it is determined that an HD/LINK module is using the wrong MCF, the correct version should be obtained and downloaded into the module using the Installers Diagnostic Terminal Utility.

Timing problems such as relationships between timer values, incorrect state timers, incorrect VRO timers, incorrect Cut Section timers, or Maximum Network Delay are configuration problems that must be corrected by changing the configuration data using the HD/LINKer Utility and then replacing the MCF using the Installers Diagnostic Terminal Utility. Startup timer problems are not configurable and indicate either hardware or software problems (refer to Section IV, paragraph 4.1.4 for information on startup timers).

8.1.5 HD/LINK Module Boot Up

When the HD/LINK module is booted (or reset), the user can monitor the initialization process or change the module setup by connecting a DT to the Diagnostic port of the module and running the Diagnostic utility (Maintainers or Installers DT utilities- refer to Section VII, *HD/LINK Diagnostics* for information on using the utilities).

Refer to figure 8-1 for a typical Safetran HD/LINK Bootstrap screen for a normal HD/LINK module boot-up process. Notice that just before the prompt for changing the module setup appears, the message "MEF CRC approved" appears, which indicates that the MEF was loaded without corruption. The user has 5 seconds in which to answer the prompt to change module setup (if setup needs changing) before the system starts executing the MEF.

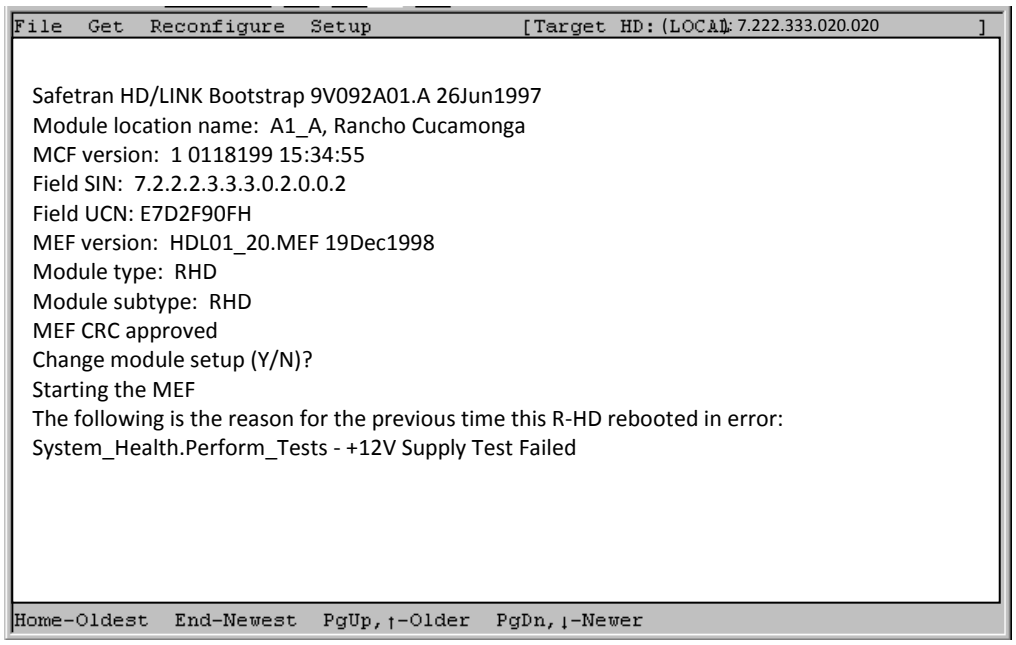

Figure 8-1. Typical Bootstrap Screen For A Normal HD/LINK Module

When the Bootstrap program begins to execute the MEF, the screen displays "Starting the MEF". An explanatory message is displayed next, followed by an error message. The explanatory message preceding the error message indicates that the error message represents the latest fatal error message that was logged by the HD/LINK module Event Log (refer to figure 8-1). The presence of this error message on the Bootstrap screen does not necessarily mean a problem exists, and a successful boot up can generally occur. The latest logged fatal error message is displayed on the Bootstrap screen to provide possible troubleshooting information in the event the HD/LINK module is continuously rebooting. In such an instance the only recourse for viewing error messages is from the Bootstrap screen during boot up.

The Bootstrap screen is displayed at boot up, but besides displaying boot up messages and providing for changing the module setup, the Bootstrap screen is useful for determining the following information:

- Module location name
- MCF version
- Field SIN
- Field UCN
- MEF version
- Module type
- Module subtype

Refer to figure 8-2 for a typical Safetran HD/LINK Bootstrap screen for a failed boot up due to a missing MEF. Notice that when attempting to boot the module (in the first part of the display of figure 8-2), the message "No valid MEF" appears followed by a prompt to change the module setup (allows the user to erase the old MEF and download a new MEF). Since there is no MEF to

run, the 5-second timeout for the prompt does not occur, and the prompt continues to be displayed indefinitely until the user takes some action. When the user answers yes (Y) to the prompt followed by pressing <ENTER>, the screen displays the message "Downloading the Setup program".

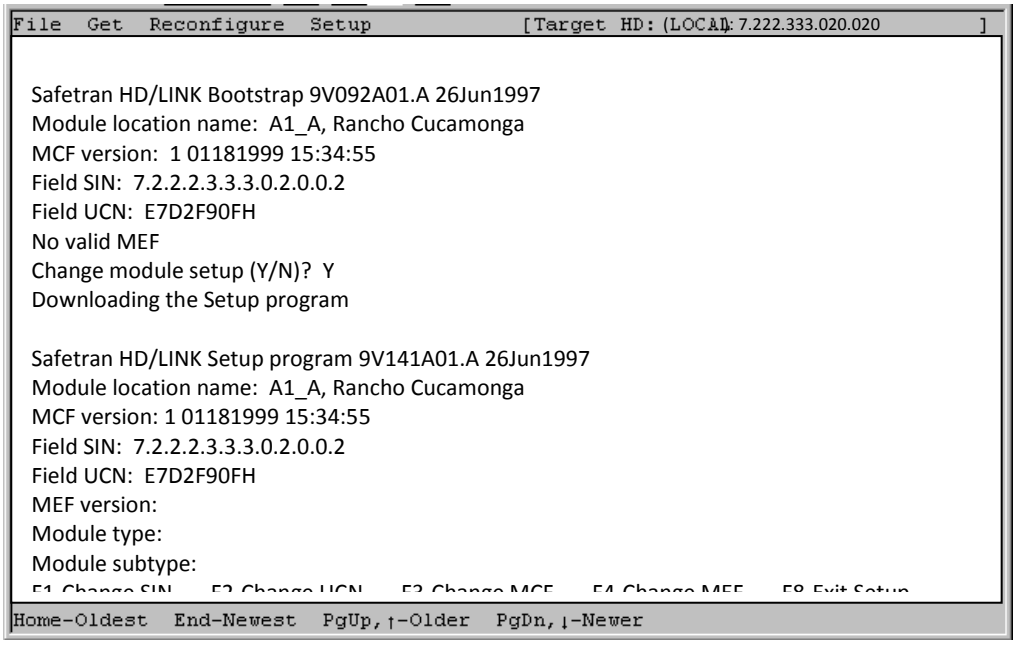

Figure 8-2. Typical Bootstrap Screen For An HD/LINK Module With Missing MEF

After the Setup program is downloaded, the Bootstrap screen is refreshed (the second part of the display of figure 8-2) with the Setup program to provide the user with an opportunity to change the MEF (erase the old MEF and download a new MEF). Notice that before a valid MEF is loaded, the screen does not display an MEF version number, Module type or subtype.

After the user selects changing the MEF (by pressing the F4 function key), the Bootstrap screen displays the prompt "Erase the MEF (Y/N) ?" (refer to figure 8-3). The user should type "Y" and press <ENTER>. The display responds with the message "Erasing the Flash MEF area" followed by the message "Downloading and burning the MEF (ESC to cancel)". The user should select the proper MEF file for downloading (from the pop-up dialog box that appears) and press <ENTER>.

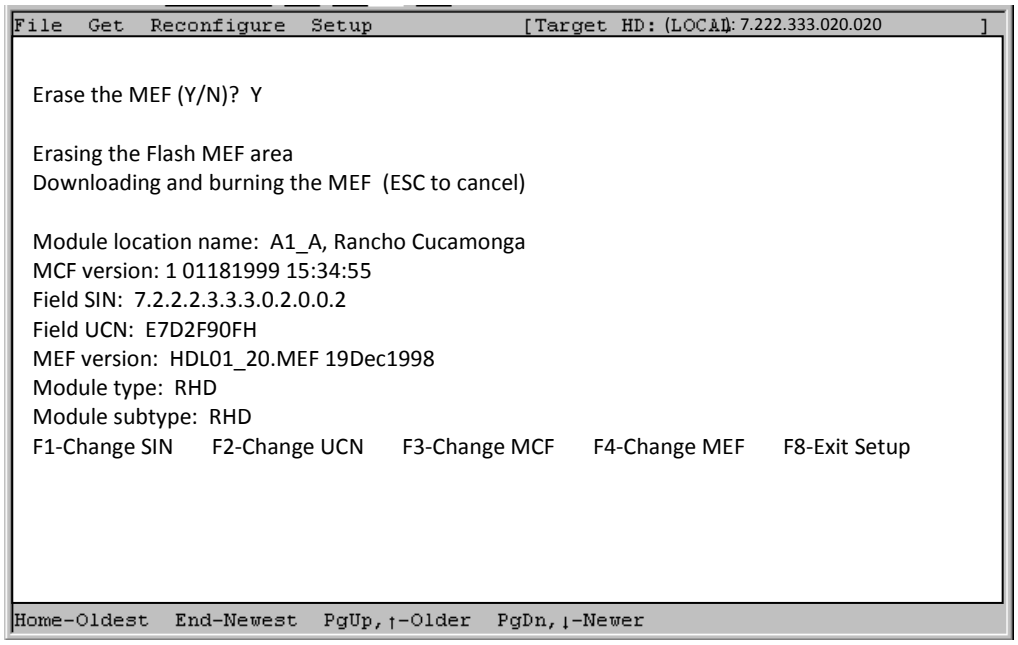

Figure 8-3. Typical Bootstrap Screen For Erasing And Burning A New MEF

A pop-up window appears to indicate that the selected file is being sent to the host and provides a running count of the percentage of completion. After downloading is completed, the Bootstrap screen is refreshed again with the Setup program, and setup options are once more presented to the user. Notice that the MEF version number, Module type and subtype are now displayed.

To exit the setup mode, the user should press the F8 function key. The display responds with the message "Setup finished" and the module is rebooted. The Bootstrap screen is refreshed again as the module reboots and should display a normal boot up similar to that of figure 8-1.

If the MEF that was downloaded and burned was corrupted or some other fault existed, an error message would be displayed on the Bootstrap screen (refer to figure 8-4 for an example of a corrupted MEF). Possible error messages are listed in table 8-6.

In this case the MEF would have to be erased and a new valid MEF loaded (by pressing the F4 function key).

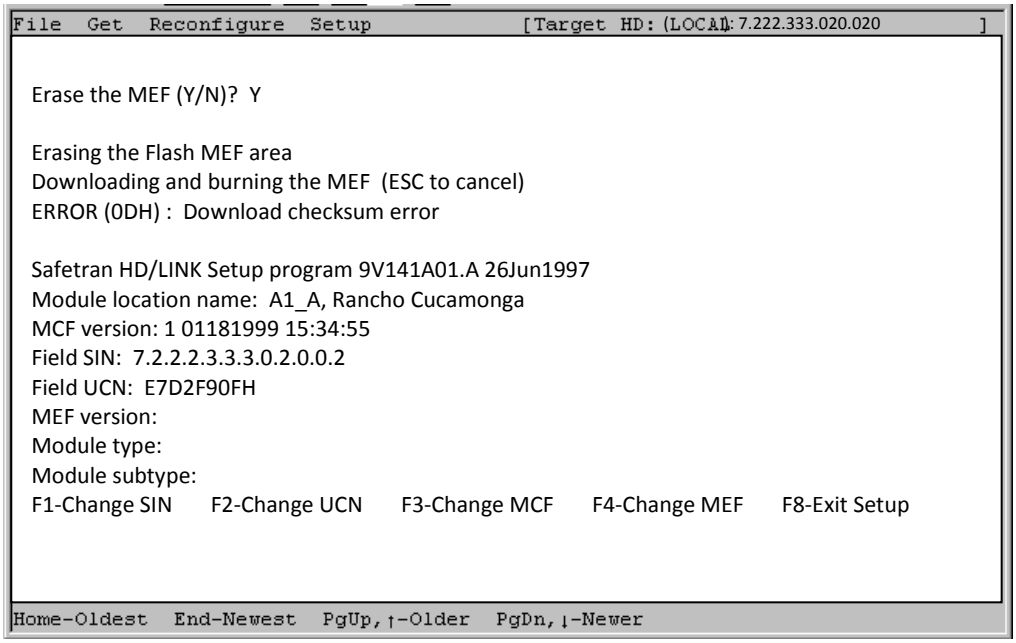

Figure 8-4. Typical Bootstrap Screen For A Corrupted MEF

8.1.5.1 Bootstrap Screen Error Messages

If an error is detected during the boot-up process or module setup procedure, the boot process is shut down and an error string is displayed which includes a hexadecimal error code. Table 8-6 presents the Bootstrap screen error messages.

Table 8-6. Bootstrap Screen Error Messages

Error Message (The "H" in the error code refers to Hexadecimal format)	Type	Message Definition
FATAL (01H) : Illegal exception	Boot	Illegal exception error
FATAL (02H) : Boot RAM test failed	Boot	Boot RAM error
ERROR (03H) : Boot Flash CRC error	Boot	Boot ROM error
ERROR (04H) : ECD initialize failed	Boot	ECD initialize error
ERROR (05H) : ECD read failed	Boot	ECD read error
ERROR (06H) : Diagnostic terminal overrun error	Boot	DT overrun error
ERROR (07H) : Diagnostic terminal noise error	Boot	DT noise error
ERROR (08H) : Diagnostic terminal framing error	Boot	DT framing error
ERROR (09H) : Diagnostic terminal parity error	Boot	DT parity error
ERROR (0AH) : Diagnostic terminal receive timeout	Boot	DT timeout error
ERROR (0BH) : Invalid download format (S-record start)	Boot	File being downloaded is bad

Table 8-6 Concluded

Error Message (The "H" in the error code refers to Hexadecimal format)	Type	Message Definition
ERROR (0CH) : Invalid download format (S-record type)	Boot	File being downloaded is bad
ERROR (0DH) : Download checksum error	Boot	File being downloaded has checksum error
ERROR (0EH) : Invalid download record count	Boot	File being downloaded is bad
ERROR (0FH) : Invalid download load address	Boot	File being downloaded is bad
ERROR (10H) : Setup program transfer address is zero	Boot	Setup file is bad
ERROR (11H) : Setup program CRC error	Boot	Download CRC error
ERROR (12H) : ECD write failed	Setup	Flash write error
ERROR (13H) : Unknown Flash device type	Setup	Flash detect error
ERROR (14H) : Flash erase failed	Setup	Flash erase error
ERROR (15H) : Flash write failed	Setup	Flash program error
ERROR (16H) : Odd S-record load address in MEF	Setup	MEF file is bad
ERROR (17H) : Odd S-record data length in MEF	Setup	MEF file is bad
ERROR (18H) : MCF checksum error	Setup	MCF checksum error

8.1.6 Replacing HD/LINK Modules

If, after following troubleshooting procedures, a module is determined to be defective, the module should be replaced. The procedure for replacing a module is as follows:

1. Remove the mating connector from the module. The connector removal procedure is as follows:

a. Turn the knurled head of the captive thumbscrews between the thumb and forefinger in a counter-clockwise direction until the screw is loose.

NOTE

NOTE

Older versions of the mating connector may contain a slotted captive screw instead of the thumbscrew. Use a small straight-slot screwdriver to loosen the screw in this case.

b. When the captive screw is loose, pull straight up on the front and rear of the mating connector.

c. Lift the mating connector far enough away from the module to allow room for removing the module.

⚠ CAUTION

CAUTION

BECAUSE BATTERY POWER IS STILL PRESENT ON THE MATING CONNECTOR WHEN DISCONNECTED, CARE SHOULD BE TAKEN NOT TO SHORT OUT ANY OF THE CONTACTS.

NOTE

NOTE

Removal of power and/or removal of the module interface connector for maintenance or repair forces the VPIs and VROs to the deenergized state. Operation resumes again safely after module replacement upon application of power, provided the configuration has not been changed.

2. Remove the faulty HD/LINK module.

3. Install a known good module, with the correct compatibility index and MEF loaded, in place of the faulty module.

NOTE

NOTE

In order to avoid having to reconfigure the module, the same software version (MEF) must be loaded in the replacement module, and the hardware version must have the same compatibility.

The compatibility of the hardware can be verified from the part number:

9000-53201-XXXX

Where - XXXX is the hardware configuration.

NOTE

NOTE

If a different software version (MEF) is loaded into the HD/LINK module, a new Module Configuration File (MCF) and unique check number (UCN) must be obtained and loaded. The installation must also then be tested.

4. Reconnect the A53122 mating connector to the module, using the following procedure:

Refer to Section II Figure 2-9 for a diagram of the connector assembly.

a. Position the connector with the notch facing the rear of the HD/LINKer unit.

b. Align the card connector with the PCB connector and push the connector assembly down.

c. Turn the knurled head of the captive thumbscrews between the thumb and forefinger in a clockwise direction until the screw is finger tight.

NOTE

NOTE

Older versions of the mating connector may contain a slotted captive screw instead of the thumbscrew. Use a small straight-slot screwdriver to tighten the screw in this case.

5. Return the defective module to Siemens Industry, Inc., Rail Automation for analysis and repair.

8.2 TROUBLESHOOTING THE SPREAD SPECTRUM RADIO

Some methods of determining SSR status and performing troubleshooting are:

- SSR LED indicators during system startup
- SSR LED indicators during normal operation
- SSR Linear Networking Runtime Error Messages time stamped and recorded in the HD/LINK module Event Log (over the LAN interface)
- Using a Diagnostic Terminal connected to a serial port (9-pin or 25-pin connector) of the SSR to observe error messages in real-time (during startup or normal operation) or to place the SSR in Test mode for analyzing SSR performance. A Diagnostic Terminal may consist of a dumb terminal or a computer with emulation software

8.2.1 Indications During SSR Startup

The startup process (system initialization) normally takes five to seven seconds. During this period, the following LED activity should be observed in the order listed:

1. RF RX LED flashes once - this signifies that hardware, software, and configuration parameters from EEPROM have been successfully initialized. If the RF RX LED becomes steadily lit or never lights at all, a major startup failure is indicated and the SSR should be replaced.

2. SERVICE LED flashes one to three times (typically twice) - this signifies that the Echelon® hardware has been initialized. If the SERVICE LED becomes steadily lighted or never lights at all, a major startup failure is indicated and the SSR should be replaced.

Figure 8-5 presents a flow diagram of the SSR boot process.

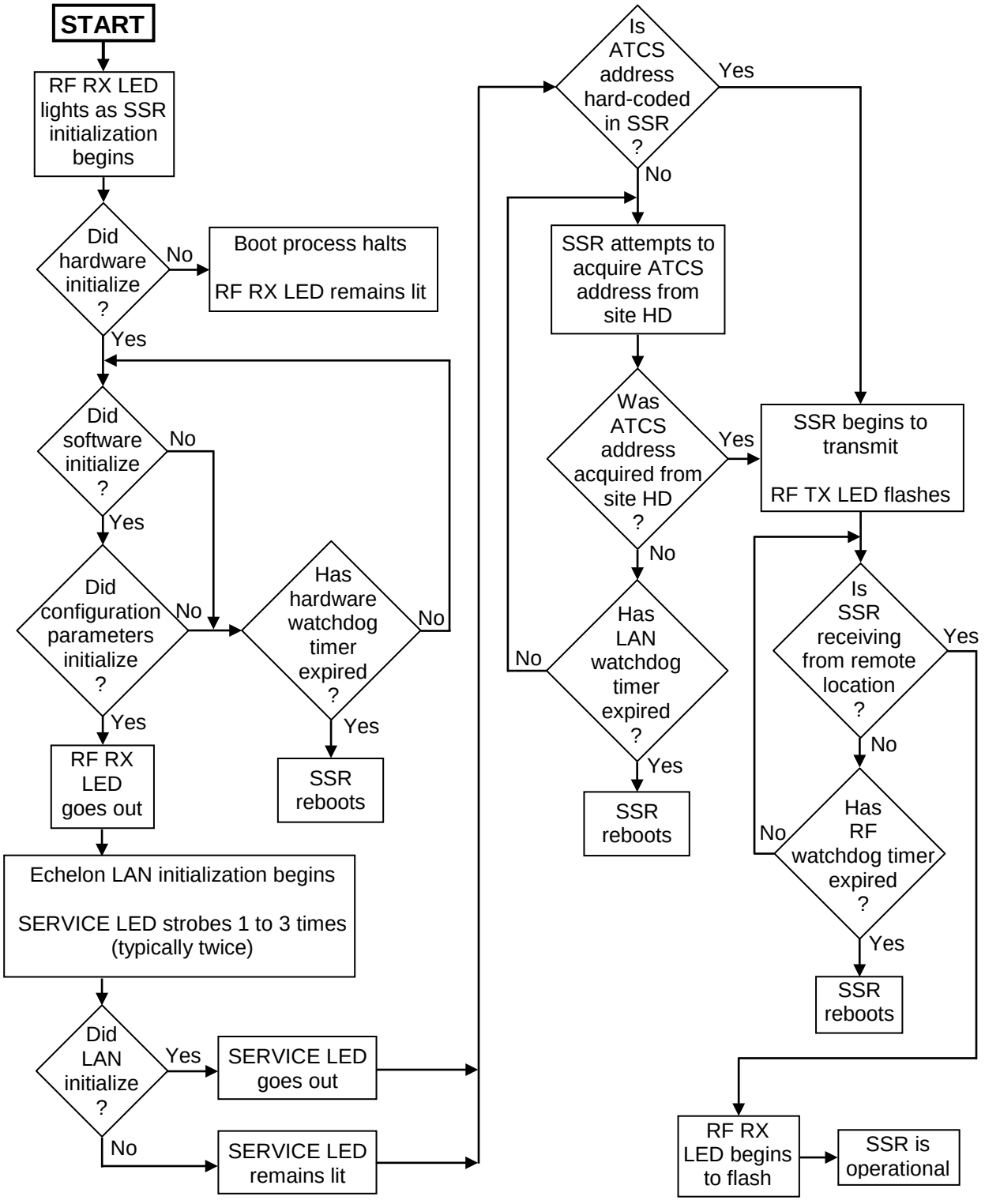

Figure 8-5. SSR Boot Process Flow Diagram

As part of the startup process, a check of the validity of the configuration parameters is performed. The configuration parameters for the Spread Spectrum Radio are stored in EEPROM.

Although it is unlikely, data in the EEPROM may conceivably become corrupted. Because the SSR maintains a checksum of the contents of the EEPROM, any corruption of configuration parameters that occurs is detectable. In this event the SSR performs the following steps:

1. One of the following error messages is sent out through the serial port of the SSR for displaying on a dumb terminal or a computer connected to the port:

Error Message	Cause
Error - bad system configuration data	EEPROM checksum failure
Error - revision mismatch	Revision mismatch

NOTE

NOTE

At the time one of the above error messages is sent out through the serial port, initialization of the LAN interface has not been completed, therefore the HD/LINK module Event Log can not detect any problems with the Spread Spectrum Radio or its configuration data. The HD/LINK Event Log will not contain event entries for these two error messages.

2. The 53308 radio and the 53301/53304 radios are programmed to respond differently for corruption of configuration data or revision mismatch, as follows:

- The 53308 radio is forced into a factory default frequency (F0) that is non-valid for linear networking (the link drops out). An ATCS address of 111 is written to the EEPROM, then the SSR reboots. All watchdog timers are disabled. This allows the radio to continue to run without rebooting on fatal errors, so the user is immediately able to enter Command Mode to write a valid configuration to the EEPROM or perform whatever steps are necessary to correct the problem.

- The 53301 or 53304 radios begin a 3-second timer, during which period the user is enabled to enter Command Mode. When in Command Mode, all watchdog timers are disabled, thereby allowing the user to write a valid configuration to EEPROM. After the user has written in configuration data, the user should reset power to the SSR in order to reboot (initialize the system) and implement the new configuration changes. If the 3 second timer expires without a request for Command Mode, the SSR resets itself and the startup procedure starts over again with the old configuration data. Until the user corrects the configuration data (by using the 3-second window to enter Command Mode), the SSR continuously reboots.

After system initialization is complete (assuming configuration parameters were valid), the SSR may or may not start RF transmission. This is determined by whether the SSR's ATCS address has been hard-coded into the "ATCS" S-registers (e.g., when a radio is set up as a repeater only). If the ATCS address resides in the S-registers, the SSR has a valid ATCS address and starts RF transmission immediately (RF TX LED blinking). Otherwise, the SSR attempts to ascertain its ATCS address by querying the HD/LINK module via the LAN. Until the SSR has determined its ATCS address, RF transmission cannot occur. If the HD/LINK module is in the process of booting (may take 45 to 60 seconds) during the query, the radio (which takes only five to seven

seconds to boot) may continue to reboot until contact is made with the HD/LINK module. Refer to the radio manual for configuring S-registers.

As an audit trail, a system restart message is sent to the HD/LINK module's Event Log every time the SSR is reset.

8.2.2 Indications During SSR Operation

The following SSR LEDs provide status information on the operation of the SSR:

- POWER Red LED should be steadily lighted to indicate the SSR is powered up.
- RF RX Green LED normally blinks in an HD/LINK system (system is receiving RF).
- RF TX Red LED normally blinks in an HD/LINK system (system is transmitting RF).
- SERVICE Red LED is normally off in an operating HD/LINK system (used only during system startup).

Since the SSR in an HD/LINK system communicates in an asynchronous mode (half-duplex), the RF channel cannot be utilized for transmitting and receiving signals at the same time. Therefore, The TX LED and the RX LED should never be on at the same time. Also, they normally blink very quickly and should never be steadily lighted.

NOTE

NOTE

RF LED activity does not signify that RF data is valid. This data may be corrupted. The RF LEDs only indicate the presence of RF.

8.2.3 SSR Resetting

Watchdog timers cause an SSR to reset if the unit is detected to be out of control, or if the RF or Echelon® ports are not periodically receiving data. The SSR maintains one system watchdog timer and two software watchdog timers, as follows:

- A hardware system timer is set to expire after 500ms if the system software fails to operate normally. A catastrophic error is generated and the SSR forces a system reset. This timer cannot be disabled.

- Software watchdog timers consist of the following:

1. RF watchdog timer - If a valid RF message is not received before this timer expires, a catastrophic error is generated and the SSR forces a system reset. An SSR error message is sent to the HD/LINK module for logging.

A bit position in the "Run Flags" S-register is used to enable/disable the RF watchdog timer (a 'one' enables and a 'zero' disables). The "RF Timeout Value" S-register (value in half-second increments) defines the duration of the timer and is defaulted to 13 seconds (a set value of 26) for

normal operation and switches to 10 seconds during continuous rebooting. Setting this value to 0 (zero) also disables this timer. Refer to the radio manual for configuring of S-registers.

2. Echelon® LAN watchdog timer - If a valid LAN message is not received from the HD/LINK module before this timer expires, a catastrophic error is generated and the SSR forces a system reset. An SSR error message is sent to the HD/LINK module for logging.

A bit position in the "Run Flags" S-register is used to enable/disable the Echelon® watchdog timer (a 'one' enables and a 'zero' disables). The "Echelon® Timeout Value" S-register (value in half-second increments) defines the duration of the timer and is defaulted to 30 seconds (a set value of 60) for normal operation and switches to 10 seconds during continuous rebooting. Setting this value to 0 (zero) also disables this timer. Refer to the radio manual for configuring of S-registers.

NOTE

NOTE

Because these errors are catastrophic, a text description of these errors is sent out the serial port for displaying on a diagnostic terminal.

8.2.4 SSR Linear Networking Runtime Error Messages

The SSR generates error messages when fatal or non-fatal errors occur in the system. Fatal errors cause the SSR to reboot; non-fatal errors generate messages without initiating a reboot.

These messages are viewable in real-time by connecting a dumb terminal or PC to one of the serial ports of the SSR. However, these messages are only displayed on the screen until scrolled off-screen by new data.

Linear Networking Runtime Error Messages are also sent via LAN to the HD/LINK module to be logged in its Event Log with a timestamp. Maintenance personnel can observe SSR error messages from the HD/LINK module's Event Log using the HD/LINK module DT Utility.

Linear Networking Runtime error messages are presented in two different formats, depending on radio type and software version (refer to Section VII, paragraph 7.2.6.7, *SSR Linear Networking Runtime Errors* for the formats). Refer to table 7-19 in Section VII, paragraph 7.2.6.7, *SSR Linear Networking Runtime Errors* for "Safetran Error: *xx*" error codes (where *xx* is either 34 or 36). Refer to table 7-20 in Section VII, paragraph 7.2.6.7, *SSR Linear Networking Runtime Errors* for "SSR ERR" format error codes.

8.2.5 SSR RF Problems

RF Problems may be due to the physical installation, the RF path, RF interference, or RF signal degradation due to antenna misalignment.

8.2.5.1 RF Installation

To check the SSR installation, perform the following:

1. Verify proper grounding of the antennas.

2. Use an ohmmeter to verify the integrity of the antenna cables.

⚠ WARNING

WARNING

A POOR OR INTERMITTENT RF CONNECTION MAY NOT BE DETECTABLE UNLESS THE CABLE IS FLEXED OR THE CONNECTORS JIGGLED WHILE TESTING IS PERFORMED.

8.2.5.2 RF Path Problems

Some problems concerning the RF path of a radio link are:

1. Signal fade (caused by multiple paths, precipitation, temperature inversions, etc.).

2. Atmospheric conditions affecting the radio horizon (especially with higher frequencies).

3. Line-of-sight obstructions.

Prior to installation, a careful point-to-point path analysis for the radio link should have been performed. However, factors effecting the original path planning tend to change over time, especially obstructions such as trees and new buildings. If RF path problems are suspected, a re-analysis of the RF path should be undertaken.

NOTE

NOTE

Refer to the S^3Link™ - Spread Spectrum Radio Manual for point-to-point radio path analysis.

8.2.5.3 Radio Frequency Interference (RFI)

Because a Spread Spectrum Radio operates over a complete band of frequencies, RFI from other sources can become a real possibility. The FCC requires the SSRs to tolerate other RF source interference and in turn requires the SSRs to not cause harmful interference to other RF transmissions/receptions in its operating band or in any band of frequencies.

If RFI is determined to be a problem, the radio link may need to select a different operating channel. Perhaps a different radio system configuration is required, such as using an Up/Down Converter, 53306 (refer to the S^3Link™ - Spread Spectrum Radio Manual, Siemens Rail Automation Documents COM-00-94-04 or COM-00-97-21).

To test for RF interference, perform the following steps:

1. Connect a Diagnostic Terminal (laptop PC) to the RS232 Asynchronous Diagnostic port (DB-9) or the Data Interface connector (DB-25) of the SSR.

NOTE

NOTE

Refer to tables 9-2 and 9-3 for pin-outs for the SSR serial ports.

2. Set up the Diagnostic Terminal for the radio type as follows:

Parameter	53301/53304 Radios	53308 Radio
baud rate:	2400	9600
parity:	none	none
stop bit:	1	1
bits per character:	8	8

3. Disable transmission by placing both SSRs of the radio link in Command Mode. This can be accomplished by using an escape code to access the Command Mode (Wait 1 second, then type a **+++** sequence on the keyboard followed by pressing <ENTER>, then wait 1 second). The unit responds with an "OK" prompt to indicate it will accept commands from the keyboard.

4. When the radio (connected to the Diagnostic Terminal) is in Command Mode, the keyboard of the Diagnostic Terminal may be used to enter commands.

5. Place the SSR in a test mode to scan all RF channels and report RSSI levels by entering **AT&T9** followed by pressing <ENTER> on the keyboard.

⚠ WARNING

WARNING

INVOKING THE AT&T9 COMMAND WILL DISRUPT LINEAR NETWORKING.

6. Check for channels with strong signal levels.

7. Remain in Command Mode for further testing or return to Data Mode by entering **ATD** followed by pressing <ENTER> on the keyboard.

8.2.5.4 Signal Strength Reporting

To enable signal strength reporting, perform the following steps:

1. Connect a Diagnostic Terminal (laptop PC) to the RS232 Asynchronous Diagnostic port (DB-9) or the Data Interface connector (DB-25) of the SSR.

NOTE

NOTE

Refer to tables 9-2 and 9-3 for pin-outs for the SSR serial ports.

2. Set up the Diagnostic Terminal for the radio type as follows:

Parameter	53301/53304 Radios	53308 Radio
baud rate:	2400	9600
parity:	none	none
stop bit:	1	1
bits per character:	8	8

3. Place the SSR in Command Mode. This can be accomplished by using an escape code to access the Command Mode (Wait 1 second, then type a **+++** sequence on the keyboard followed by pressing <ENTER>, then wait 1 second). The unit responds with an "OK" prompt to indicate it will accept commands from the keyboard.

4. When the radio (connected to the Diagnostic Terminal) is in Command Mode, the keyboard of the Diagnostic Terminal may be used to enter commands.

5. Place the SSR in a test mode to report the RSSI level for each received data packet by entering **AT&T8** followed by pressing <ENTER> on the keyboard.

6. Adjust the antennas of the radio link for optimum signal strength.

7. Remain in Command Mode for further testing or return to Data Mode by entering **ATD** followed by pressing <ENTER> on the keyboard.

8.2.6 SSR Hardware Configuration

If the SSR configuration is suspected of being incorrect, the radio configuration can be checked as follows:

1. The radio unit should have an external label identifying the part number. For linear networking, the part number of the radio should be one of the following:

   9000-53301-1611 SSR (903-927 MHz)

   9000-53304-1611 SSR (900 MHz/2.4 GHz Capable)

   9000-53308-0511 SSR SLOW (Note: FAST option is not used with linear networking)

   9000-53308-1511 SSR SLOW Using Up/Down Converter

2. The prefix of the part number on the label identifies radio hardware options and the suffix is used by the factory to set the configuration for the specific application (linear networking) as follows:

   a. The last digit of the prefix to the part number (zero) indicates the operating voltage of the radio (9V to 36V).

   b. The digits of the suffix to the part number indicate the following configuration parameters:

   1st digit - For 53301 and 53304, "1" indicates asynchronous mode
   For 53308, "0" indicates that Up/Down converter is not used, "1" indicates that Up/Down converter is used
   2nd digit - For 53301 and 53304, "6" indicates the selected protocol conversion option (linear networking)
   For 53308, "5" indicates the selected protocol conversion option (linear networking)
   3rd digit - For 53301 and 53304, "1" indicates RS232 serial interface
   For 53308, "1" indicates SLOW (1 megachip) PN code rate; the FAST (4 megachip) option is not used with linear networking
   4th digit - For 53301 and 53304, "1" indicates that the radio has the Echelon® module installed (required for linear networking)
   For 53308, "1" indicates that the radio has the Echelon® module installed (required for linear networking)

   c. The linear networking configuration to be set is determined for SSRs as follows:

   Power Supply board
   53005 board (on the 53301 and the 53304 Units) - 3 jumpers that can be installed (see below)
   53026 board (on the 53308 Unit) - 5 jumpers that can be installed (see below)

   Digital board
   53011 board (on the 53301 and 53304 Units) - 1 jumper that can be installed (see below)
   53024 board (on the 53308 Unit) - (n/a)

3. To verify operating mode jumpers are installed according to the proper operational mode software configuration (according to the part number label as indicated above) use the following procedure:

   a. Remove the six screws from the front panel securing the two side plates.

   b. Remove the screws (3 each) from the rear panel holding the left side plate (as viewed from the front).

c. Place the unit on its right side and remove the left side plate (as viewed from the front), exposing the printed circuit boards and the jumper locations.

d. Connectors for jumpering internal wiring for a specific configuration should be visible on the Digital and Power Supply boards.

e. Verify that shunts are positioned on these connectors for linear networking configuration as follows:

53301 or 53304 Units

JP2 (53011 board) - No shunt installed (RS232 standard interface selected)

J6 (53005 board) - "A" position (as indicated on printed circuit board)

J7 (53005 board) - "A" position (as indicated on printed circuit board)

J8 (53005 board) - "B" position (as indicated on printed circuit board)

53308 Unit

J4 (53026 board) - Shunt installed between pins 1 & 2 (to supply power to Up/Down Converter) when Up/Down Converter is used, or Shunt installed between pins 2 & 3 (power connection left open) for use without Up/Down Converter

J7 (53026 board) - Shunt installed on pins 2 & 3 (no term. resistor for LAN)

J8 (53026 board) - Shunt installed on pins 2 & 3 (no term. resistor for DTR)

J9 (53026 board) - Shunt installed on pins 2 & 3 (no term. resistor for RTS)

J10 (53026 board) - Shunt installed on pins 2 & 3 (no term. resistor for TD)

f. Verify that the circuit boards installed have the proper dash numbers for the linear networking configuration as follows:

For 53308 Unit SLOW PN code rate operation

RF board = 53025-01 (not 53025-04)
Digital board = 53024-01 (not 53024-04)

g. Replace the left side plate and reinstall the front and rear panels using the screws removed.

4. To rule out configuration problems, both SSR units of a link can be restored to their factory configuration. If communications with a unit cannot be achieved, the following restores (but does not write) the factory configuration:

a. Use the **AT&Fx** command to restore the SSR to factory default, where x is a value from 0 to 7. Valid linear networking frequencies are set by entering values 1 through 6, and value 7 is used to tie the upper channel (6) to the lower channel (1) when an HD/LINK system is made up of more sites than channels available (6). The value x (channel 1 through 6) sets transmit and receive frequency registers for left and right channels. The value 0 (factory default value) is not a valid operating frequency and is used for testing or to guarantee that a linear networking link drops out. Entering **AT&F** without entering a value results in the default value 0 being set, which prevents linear networking.

For linear networking, 3.8 MHz minimum adjacent channel spacing is recommended, although spacing down to 2.7 MHz can be used. In general, channel spacing in multiples of 2 MHz and 3 MHz should be avoided.

⚠ WARNING

WARNING

SETTING THE FACTORY CONFIGURATION CHANGES THE OPERATING FREQUENCY OF AN SSR, WHICH WILL AFFECT OPERATION OF LINEAR NETWORKING FOR LEFT AND RIGHT NEIGHBOR SSRs, PERHAPS TO THE EXTENT THAT THEIR HD/LINK VROS MAY DROP OUT. THIS PROBLEM MAY PROPAGATE THROUGHOUT THE ENTIRE LINEAR NETWORK.

b. Connect a Diagnostic Terminal (laptop PC) to the RS232 Asynchronous Diagnostic port (DB-9) or the Data Interface connector (DB-25) of the SSR.

NOTE

NOTE

Refer to tables 9-2 and 9-3 for pin-outs for the SSR serial ports.

c. Set up the Diagnostic Terminal for the radio type as follows:

Parameter	53301/53304 Radios	53308 Radio
baud rate:	2400	9600
parity:	none	none
stop bit:	1	1
bits per character:	8	8

d. Place the SSR in Command Mode. This can be accomplished by using an escape code to access the Command Mode (Wait 1 second, then type a **+++** sequence on the keyboard, then wait 1 second). The unit responds with an "OK" prompt to indicate it will accept commands from the keyboard.

e. Put one radio unit in continuous BER mode (**AT&T1**), and monitor bit error rate at the remote receiver using an external protocol analyzer.

⚠ WARNING

WARNING

INVOKING THE AT&T1 COMMAND WILL DISRUPT LINEAR NETWORKING.

f. Remain in Command Mode for further testing or return to Data Mode by entering **ATD** followed by pressing <ENTER> on the keyboard.

8.2.7 Replacing A Spread Spectrum Radio

If it becomes necessary to replace an SSR, the replacement radio must contain the proper configuration data. Configuration data is stored in flash memory and must be manually changed in the 53301 and 53304 radios.

In a system where the 53308 radio is used, a Site Identification (SID) Module (Siemens Rail Automation P/N53419) may be included at the location to act as a repository for the configuration data. In this case, a replacement radio acquires the configuration data from the SID over the LAN, therefore no manual configuration is required. If a SID Module is not installed at the location, replacement of an 53308 radio requires the configuration data to be manually changed using the command mode (refer to the radio manual for configuration).

To replace an SSR, perform the following steps:

1. Disconnect the 8-pin Power/LAN connector from the radio (use caution- this connector contains live DC power).

2. Disconnect the 9-pin and 25-pin serial connectors, if connected.

3. Disconnect the RF connector from the antenna jack on the radio.

4. Remove the radio and replace with another unit (observe configuration requirements as mentioned above).

NOTE

NOTE

In order for a replacement 53308 radio to acquire configuration data from a SID (if one is installed), the EEPROM must not be locked out. Normally, lockout is rarely used, but if the value in the "Run Flags" S-register is 128 or higher (decimal), the lockout bit has been set (the SID lockout bit position contains a value of 'one'). Refer to the radio manual for configuration of S-registers.

5. Reconnect cables in the reverse order.

NOTE

NOTE

53308 radios are not directly interchangeable with 53301 or 53304 radios in a linear network. The N12 power connection is different on these radios (see table 9-4) to prevent this substitution.

8.3 TROUBLESHOOTING GUIDE

A troubleshooting Guide (shown in table 8-7) is provided for the HD/LINK system, which presents a list of typical fault indications, possible causes, and suggested corrective action. Maintenance personnel must determine from the indications which corrective action to take for isolating the cause of the problem.

Table 8-7. Troubleshooting Guide

Indication	Possible Cause	Corrective Action
HD/LINK module Power LED is off	Power not connected	• Apply power
	Power source polarity incorrect	• Correct power source polarity
	Voltage too low	• Troubleshoot power source for cause of low voltage
	Hardware failure	• Replace module, and return faulty module to Siemens Rail Automation for analysis and repair
HD/LINK module HEALTH LED is off	Module is still performing startup checks	• Wait 100 seconds for module to complete startup checks
HD/LINK module HEALTH LED is off after waiting 100 seconds	Module is continuously rebooting	• Connect the DT Utility to the Diagnostic port of the HD/LINK module and look for the Bootstrap screen to be scrolling every few seconds (indicates the module is continuously rebooting) • If continuously rebooting, refer to corrective action for that indication
	No MEF loaded or MEF corrupted	• Connect the DT Utility to the Diagnostic port of the HD/LINK module, then look for the message "No valid MEF" on the Bootstrap screen If "No valid MEF" is displayed, a valid MEF must be loaded
	Module has been left in setup mode	• Connect the DT Utility to the Diagnostic port of the HD/LINK module, then look for the function key menu on the Bootstrap screen. Press 'F8' on the Diagnostic Terminal to exit setup mode, or recycle power to reboot (eg., remove and replace Interface connector)

Table 8-7 Continued

Indication	Possible Cause	Corrective Action
HD/LINK module HEALTH LED flashes fast (4 times/sec)	Module is unconfigured	• Check Event Log for the reason the module is not configured. One of the following tests will have failed: UCN Check MCF Checksum MEF MCF Compatibility SIN Check HW SW Compatibility Hardware • If the last module reboot Event is not present in the Event Log, reboot the module (remove and replace Interface connector) then check Event Log for the last module reboot Event
HD/LINK module continuously reboots	Power source voltage outside of operating range	• Check power source (refer to table 8-1)
	Incorrect version of MEF	• Compare the MEF version on the Bootstrap screen (scrolling) against the MCF Contents Listing or MCF Approval Listing If they do not agree, replace module or reload the MEF
	Event error	• Check the Bootstrap screen for the last logged error
	Hardware failure	• If the module is continuously rebooting (verified by the Bootstrap screen periodically blanking), check the Bootstrap screen for the last logged error to determine corrective action. If a module hardware failure is indicated, replace the module. If replacing the module does not correct the problem, a hardware failure external to the HD/LINK module is suspected.
HD/LINK module reboots when inputs are energized	Configuration problem, inputs configured as bipolar are wired as unipolar, or hardware problem	• Deenergize the inputs and look at the Event Log for the failure, then consult the manual for the specific indication

Table 8-7 Continued

Indication	Possible Cause	Corrective Action
HD/LINK module reboots when outputs are energized	Output shorted, configuration problem, or hardware failure	• Deenergize the outputs and look at the Event Log for the failure, then consult the manual for the specific indications
The HD/LINK module VRO LEDs occasionally blink and the output relay deenergizes for a short time (a few seconds)	The module is probably losing session	• Check the Event Log for Lost Session Events Set the verbosity to 2 and wait for the next time the outputs deenergize • Check the Event Log for lost messages Note how many messages were lost. If the outputs dropped and only one message was lost, the ratio of timeout to update interval is too small If multiple messages were lost then the radio link is unreliable. Refer to radio manual
HD/LINK module VPI LED does not illuminate when voltage is applied to VPI	Module not fully operational, or if operational: Input polarity is incorrect Insufficient or incorrect voltage on input Configuration is incorrect and VPI is listed as unused	• Check that module is fully operational (Event Log or HEALTH LED) If the module is fully operational, check wiring for incorrect polarity If the module is fully operational, check input for insufficient voltage or unstable, intermittent or AC voltage If the module is fully operational, check Event Log for unused VPI (configuration is incorrect and VPI is listed as unused) If the module is unconfigured, check the Event Log then configure module, or reboot

Table 8-7 Continued

Indication	Possible Cause	Corrective Action
HD/LINK module VRO LED does not illuminate when VRO should be energized	Corresponding VPI is not energized	• Check that the corresponding VPI is energized
	Not receiving messages from remote module	• To check for receiving messages, set verbosity level of Event Log to 3, then look for messages received, or look at Comms Status for LAN messages received • If not receiving messages, check that remote module is operational • If not receiving messages, check radio link, or Cut Section cutting the circuit
	Hardware failure	• Replace module, and return faulty module to Siemens Rail Automation for analysis and repair

Table 8-7 Continued

Indication	Possible Cause	Corrective Action
HD/LINK module outputs do not energize when remote inputs are energized	Module is not fully operational, remote HD/LINK not transmitting, radio failure, Cut Section cutting the circuit	• Check that the module is fully operational. If module is fully operational, check that messages are being received (LAN RX LED flashes) If module is fully operational but module is not receiving messages (LAN RX LED does not flash), check if remote HD/LINK is transmitting messages (view Comms Statistics for remote end of system), or check radio for failure If module is fully operational, check if the SAT is receiving messages (Event Log verbosity 3) If the SAT is not receiving messages (Event Log verbosity 3), check module configuration If module is fully operational and is receiving messages (Event Log verbosity 3), check if the SAT is receiving stale messages If the SAT is receiving stale messages, check the network delay parameter - SAT Timing Parameters for network delay that is larger than the expected maximum network delay. If it is not, then make it larger, otherwise reboot both the HD/LINK module and the remote module If module is fully operational, check if there are any Cut Sections cutting the circuit. If there are, check that these are energized and have been energized longer than their configured cut delay If module is fully operational, check if messages are carrying energized data (obtain SAT Status from Event Log and check if the bit position for this circuit contains a "+") If messages are carrying energized data (the bit position for this circuit contains a "+"), module has a hardware failure- replace module

Table 8-7 Continued

Indication	Possible Cause	Corrective Action
HD/LINK module is not receiving any ATCS messages (LAN RX LED is not flashing)	Module is not fully operational, radio is not communicating, remote module not functioning	• Check that module is fully operational • Check that the radio is communicating (TX, RX LEDs on radio flashing) • Check the module status of the remote module (if no response is received, the communication medium of the system may not be working) If a response is returned, check the ATCS address of the HD/LINK module against the Installation Listing and correct if necessary
HD/LINK module is not transmitting any ATCS messages (LAN TX LED is not flashing)	Module is not fully operational, session has been lost (radio is not communicating, or remote module not functioning)	• Check that module is fully operational • Check that the radio is communicating (TX, RX LEDs on radio flashing) • Check the module status of the remote module (if no response is received, the communication medium may not be working) If a response is returned, check the ATCS address of the HD/LINK module against the Installation Listing and correct if necessary
SSR Power LED is off	Power not connected	• Apply power
	Power source polarity incorrect	• Correct power source polarity
	Voltage too low	• Troubleshoot power source for cause of low voltage
	Hardware failure	• Replace SSR radio, and return faulty radio to Siemens Rail Automation for analysis and repair

Table 8-7 Continued

Indication	Possible Cause	Corrective Action
SSR POWER LED is on but SSR does not operate	Startup failure, configuration problem, or hardware failure	• Check RF RX LED- If steadily lighted, reboot radio If problem persists, hardware failure is indicated- replace radio • Check SERVICE LED- If steadily lighted, reboot radio If problem persists, hardware failure is indicated- replace radio • Connect terminal with emulation software to a serial port (9-pin or 25-pin) of the SSR, reboot radio, and check for any of the following error messages: **Error - bad system configuration data** **Error - revision mismatch** If an error is displayed, configuration parameters are corrupted- enter command mode, check and correct configuration data
SSR RF RX LED does not light	SSR is not receiving messages or LED is bad	• Connect terminal with emulation software to a serial port of the SSR (9-pin or 25-pin) and check for catastrophic error codes. • Connect the DT Utility to the Diagnostic port of the HD/LINK module and check Event Log for **SSR ERR: (msg. text)**, or **Safetran Error: *xx* (error code)** (where ***xx*** = 34 or 36). Refer to tables 7-19 and 7-20 for SSR Linear Networking Runtime Error codes). • Reboot SSR and observe LEDs during startup. If RF RX LED does not blink once during startup, a startup failure is indicated or the RF RX LED is bad - replace radio. If RF RX LED blinks once during startup, LED is ok- check remote radio

Table 8-7 Concluded

Indication	Possible Cause	Corrective Action
SSR RF TX LED does not light	SSR is not transmitting messages or LED is bad	• Connect terminal with emulation software to a serial port (9-pin or 25-pin) of the SSR and check for catastrophic error codes. • Connect the DT Utility to the Diagnostic port of the HD/LINK module and check Event Log for **SSR ERR: (msg. text)**, or **Safetran Error: *xx* (error code)** (where ***xx*** = 34 or 36). Refer to tables 7-19 and 7-20 for SSR Linear Networking Runtime Error codes). • Connect terminal with emulation software to a serial port (9-pin or 25-pin) of the SSR, enter command mode and type **AT&T1** (transmit continuous BER mode) while observing RF TX LED (Note: linear networking will be disrupted). If LED does not light, reboot SSR to exit test mode and check remote radio for receiving messages- if receiving messages, transmit function is ok but LED is bad- replace radio. If LED lights, reboot SSR to exit test mode and do the following: Check if SSR is failing to receive messages from the HD/LINK module by looking for a LAN watchdog catastrophic error displayed on the PC connected to the radio. Check if radio is continuously resetting (every 10 to 30 seconds or so)- if it is, radio is not receiving from HD/LINK module and LAN watchdog timer is timing out. Connect the DT Utility to the Diagnostic port of the HD/LINK module and check HD/LINK Event Log for repeated **Safetran Error: *xx*(700 701)** or **Safetran Error: *xx*(701 701)** messages (where ***xx*** = 34 or 36 - if either is being logged, check HD/LINK module for transmitting; if no SSR errors are being logged, check LAN connection.

SECTION IX

THE LINEAR NETWORKING SPREAD SPECTRUM RADIO

9.0 GENERAL

This section is included in this manual to provide information on the Spread Spectrum Radio (SSR) configured for linear networking operation and as an aid when troubleshooting the HD/LINK system. The SSR (S^3/Link™), with built-in RF modem, can be set up to serve as part of a wireless wide area network (WAN). Radio units used in an HD/LINK system are optimized for railroad signaling and communications applications. Radio transmit power at the antenna jack is software programmable to be 800mw (+29dBm), or less. With an effective radiated power (ERP) level of less than 4 watts (36 dBm) achieved through antenna gain, no FCC licensing is required. Refer to the specific radio manual for general information on the SSR.

9.1 SPREAD SPECTRUM RADIO DESCRIPTION

Communication between SSR units employs direct sequence spread spectrum operation with either QPSK or BPSK carrier modulation. Configuration for asynchronous communication is via a subset of the Hayes AT command set. Operation is half-duplex with CSMA/CA and configurable delay algorithms. Figure 9-1 presents a simplified block diagram for an SSR as configured for use in an HD/LINK system.

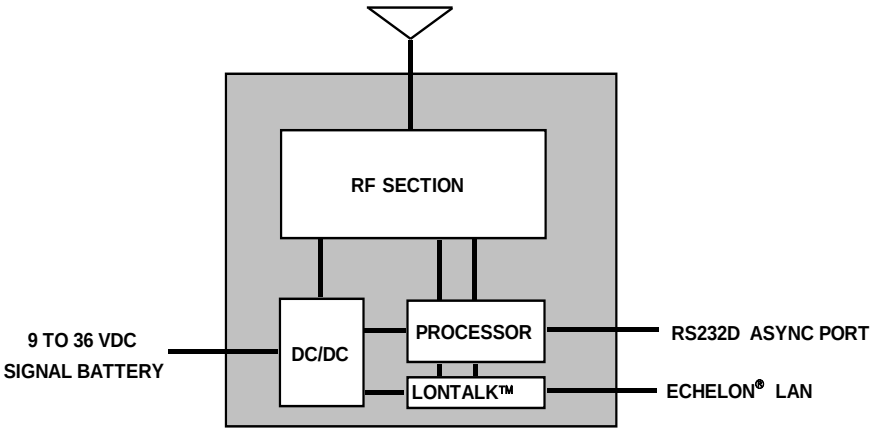

Figure 9-1. SSR Simplified Block Diagram For An HD/LINK System Application

An SSR operates at frequencies that are typically line-of-sight, so application requires careful path analysis and planning. Antennas can usually be mounted on existing structures, but at times require masts or poles. An SSR can also function as a repeater to enable communications around a bend in a river or over or around an intervening hill or building.

When used in conjunction with Safetran's HD/LINK Vital I/O Module (53201), the SSR is capable of performing HD pole line replacement and crossing DAXing/UAXing. For each of

these applications, the radio must include an optional internal Echelon® module. Refer to Section VIII, paragraph 8.2.6, *SSR Hardware Configuration*, for part numbers of radios used for linear networking.

9.1.1 SSR Front Panel Control and Indicators

Front-panel LED indicators are provided for power-on, transmit and receive indications, and Echelon® service. The front panel control and indicators, and the function of each, are listed in table 9-1. For an illustration of a Spread Spectrum Radio, refer to figure 1-2 in Section I.

Table 9-1. SSR Front Panel Control & Indicator Functions

Indicator/Control	Type	Function
POWER	Red LED	Lighted when power is applied to the radio
RF-RX	Green LED	Lighted to indicate radio is successfully synchronized to an incoming message
RF-TX	Red LED	Lighted when radio is keyed and transmitting
SERVICE	Red LED	Echelon® service indication. Normally extinguished. Lights to indicate Echelon® adapter is not configured or is malfunctioning. Also lights when the SERVICE push button is pressed.
SERVICE	Push-button Switch	The SERVICE pushbutton switch is not used during linear networking operation of the SSR. It may be using during installation to download custom configuration data to the radio.

9.1.2 SSR External Interface

The spread-spectrum radio is equipped with four connectors which include a 25-pin D-type connector, a 9-pin D-type connector, an 8-pin Power/LAN connector, and an antenna jack.

9.1.2.1 Data I/O Interface

The 25-pin, D-type data connector located on the top of the SSR unit is only used in a linear network as a gateway for external communication. This port must be configured for RS232 asynchronous operation via internal jumpers for the linear networking operation. Refer to Section VIII, paragraph 8.2.6, *SSR Hardware Configuration*, for information on positioning of shunts to establish the correct hardware configuration.

Table 9-2 lists the RS232 Asynchronous Mode pin assignments for the 25-pin connector.

Table 9-2. SSR Data I/O Connector Pin Assignments, RS232 Asynchronous Mode

Pin	Signal Name	Mnemonic	Direction
1	Protective Ground	GND	n/a
2	Async TX Data	TD	Input
3	Async RX Data	RD	Output
4	Request To Send	RTS	Input
5	Clear To Send	CTS	Output
6	Data Set Ready	DSR	Output
7	Signal Ground	SG	n/a
8	Carrier Detect	CD	Output
11	Echelon® Data B	TWP2	LAN
20	Data Terminal Ready	DTR	Input
24	Echelon® Data A	TWP1	LAN

9.1.2.2 Diagnostic Interface

The asynchronous signals on the 25-pin connector have been replicated on the female, 9-pin, D-type connector located on the front panel. The 9-pin connector provides a serial port to the radio diagnostic and configuration data during maintenance operations without the need to remove the 25-pin connector (note: only some SSRs in a linear network will use the 25-pin connector for sending data).

NOTE

NOTE

Care should be taken with the 53301 and 53304 radios when using the 9-pin port while the 25-pin connector is being used to send asynchronous data because data corruption and conflicts are likely to result. This is not a problem with the 53308 radio.

Refer to table 9-3 for pin assignments on the 9-pin Diagnostic Interface connector.

Table 9-3. SSR Diagnostic Connector Pin Assignments

Pin No. (9-Pin Connector)[1]	Radio	Function	Mnemonic	Corresponding Pin No. On 25-Pin Connector
2	53301/ 53304	Async RX Data	RD	25
	53308	Async RX Data	RD	25
3	53301/ 53304	Async TX Data	TD	2 (Jumpered for RS232 Asynchronous mode)
	53308	Async TX Data	TD	18
5	53301/ 53304	Signal Common	GND	7
	53308	Signal Ground	SG	7
7	53301/ 53304	Request To Send	RTS	4 (Jumpered for RS232 Asynchronous mode)
	53308	(n/a)	(n/a)	(n/a)
8	53301/ 53304	Clear To Send	CTS	5
	53308	(n/a)	(n/a)	(n/a)

[1] Pins 1, 4, 6 and 9 are currently unused in the radios listed above.

9.1.2.3 DC Power Input & LAN Interface

The SSR is designed to operate directly from a 12 volt DC signal battery and functions normally from a DC input range of 9VDC to 36VDC (a 36VDC to 80VDC option is also available for the 53308 radio). An internal DC-to-DC converter provides necessary ground isolation. The radio's power input is protected from reverse polarity by a combination of an in-line fuse and reverse-biased diode. Secondary surge protection and filtering are provided internally.

Typical current drain for the 53301 and 53308 radio modules is 250mA in standby mode, 400mA in receive mode, and 750mA in transmit mode. When used in conjunction with the Up/Down Converter (53306) for 2.4GHz operation, typical current drain for the 53304 and 53308 radio

modules is 450mA in standby mode, 650mA in receive mode, and 1.1A in transmit mode (power for the Up/Down Converter is supplied from the radio unit). Refer to Section VIII, paragraph 8.2.6, *SSR Hardware Configuration*, for radio part numbers when using the Up/Down Converter.

In addition to module input power, the same connector is used to connect to the Echelon® LonTalk™ LAN. The LAN interface is also available on the 25-pin D connector, but this LAN connection is not used in linear networking.

The DC power input & LAN interfaces are made through a male, 8-pin connector located on the top front of the module. Contacts are numbered from the front of the radio with pin 8 nearest the antenna. Table 9-4 lists the connector pin assignments.

Table 9-4. SSR Power Input & LAN Interface Connector Pin Assignments

Pin No.	Radio	Function	Mnemonic
1	All	+12 V	B12
2	53301/ 53304	Future Use	(n/a)
	53308	12 V Return	N12
3	53301/ 53304	12 V Return	N12
	53308	Future Use	(n/a)
4	All	Future Use	(n/a)
5	All	Future Use	(n/a)
6	All	Future Use	(n/a)
7	All	Echelon® Data A	TWP1
8	All	Echelon® Data B	TWP2

NOTE

NOTE

53308 radios are not directly interchangeable with 53301 or 53304 radios in a linear network. The N12 power connection is different on these radios (see table 9-4) to prevent this substitution.

9.1.2.4 Antenna Interface

The standard antenna is a linear polarized Yagi director, but options include various antenna gains, and configurations such as omnidirectional and directional. Transmit power is software selectable to comply with FCC requirements when using high gain antennas. Transmitter output power must be selected in consideration with antenna gain and antenna cable loss to guarantee a radiated power of no more than 4 watts (36.0 dBm). An antenna surge arrester may also be required in series with the antenna cable. Proper grounding of the antenna is extremely important, not only for lightning protection, but also to prevent electrical noise interference from local broadcast stations and other sources.

NOTE

NOTE

Safetran's Spread-Spectrum Radios have been approved by the FCC, however these radios must be installed by trained personnel only.

The antenna jack, located on the top of the radio near the back, is a standard Type-N female jack with a 5/8-24 external thread.

NOTE

NOTE

Verify the antenna is connected to the Spread Spectrum Radio antenna jack prior to applying power to the radio.

9.2 SSR OPERATION

Direct sequence spread-spectrum transmission distributes the energy over a wide band using a custom spreading (or PN code) at the transmit end and a correlation filter at the receiver to recover the data. Each data bit to be transmitted (0 or 1) is replaced with a pattern of data bits called chips (the PN code) and sent much faster than the actual data rate. One PN code represents a binary 1 and another a binary 0. The Spread-Spectrum radio can be configured for PN code lengths of either 31 or 63 chips, and a number of PN code options are available.

At the receiver, a correlation filter is used to match the received code with the known PN code. The receiver is able to statistically recognize a code, even when it is corrupted to some extent, thus providing the ability to withstand interference and to operate with a signal-to-noise ratio of less than one (processing gain).

The longer the PN code length used for each bit, the more processing gain can be achieved and the longer the distance over which the units can be operated. Line-of-sight distances of more than 10 miles can typically be achieved using a PN code length of 63 and a 15.873 kilobits/second (kbps) data rate, giving a theoretical processing gain of 18 dB. In other words, the radio can operate with a signal strength that is 18 dB below the noise floor.

Safetran’s Spread Spectrum Radios provide 8 non-overlapping or 12 partially overlapping channels in the 903-927MHz range. This can potentially provide many independent RF links within the same geographic area, and when combined with different PN combinations, concurrent operation on the same channel can provide four additional independent links per channel.

These channels have a 1MHz bandwidth (at the -3dBm points). The channels (231 center frequencies selectable in intermediate frequency steps of 100KHz in the 903-925MHz range) are set in the transmit and receive frequency code registers for the left and right neighbors (refer to the radio manual for configuring the transmit and receive frequencies for left and right neighbors).

9.2.1 RF Operation

The SSR RF channel operating in half-duplex mode is either listening, receiving, or transmitting data.

9.2.1.1 Transmitter RF Operation

The SSR initiates transmission dependent upon the mode of operation (Linear Networking mode of operation in HD/LINK systems). The transmit oscillator is turned on and allowed to stabilize for approximately 4 milliseconds after which the power amplifier is enabled. During this time, the transmitter is programmed to a different PN code to avoid false activation of the receive acquisition algorithm at the remote receiver. Exact power output is configurable to allow for applications with high-gain antenna systems.

The transmitter next starts sending a preamble consisting of all 0 bits. The preamble length is configurable depending on the requirements of the remote receiver, but is factory set for about 6 milliseconds.

Following the preamble, the transmitter switches to Data Mode and sends the (optional) HDLC start flag, followed by any necessary data as determined by the mode of operation. Automatic zero-bit insertion is performed if enabled.

At the end of transmission, the closing HDLC flag is sent and the transmitter shuts down.

9.2.1.2 Receiver RF Operation

In the quiescent state, the receiver correlation filter continuously monitors the received data and signal strength indication (RSSI). Trigger levels for both are configurable, and when the set values are met or exceeded, the radio switches to receive capture mode. During this time, the remote transmitter is transmitting a preamble of all 0 bits.

In receive capture mode, the remainder of the preamble period is used to fine-tune the receiver center frequency to the incoming signal. This is achieved by varying the local oscillator frequency up and down until correlation is lost, and then taking the arithmetic mean as the center frequency offset. In special applications, it is possible to preset the receiver frequency offset to the remote transmitter frequency, and shorten the preamble time by about 4 milliseconds.

Once the above tuning process is complete, the receiver switches to Data Mode. RF data is normally transmitted in the HDLC format, with zero-bit insertion. The receiver searches for the HDLC start flag to indicate the start of data transmission. Data is then either received into a FIFO buffer (asynchronous mode), or clocked directly out to the DTE device (synchronous mode).

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APPENDIX A

HD/LINK MODULE DETAILED INPUT AND OUTPUT SPECIFICATIONS

Parameter	Value
Vital Relay Outputs (VRO)	
Quantity Available	8 per module (unipolar configuration)
Output Voltage (deenergized)	0 to +1.0VDC
Relay drive	100Ω to 1000Ω coil impedance
Minimum Output Voltage (energized)	2.6 VDC @ 100Ω load impedance [1]
	3.8 VDC @ 200Ω load impedance [1]
	6.62 VDC @ 350Ω load impedance [1]
	8.28 VDC @ 450Ω load impedance [1]
	9.50 VDC @ 500Ω load impedance [1]
	10.8 VDC @ 800Ω load impedance [1]
	8.28 VDC @ 900Ω load impedance [1]
	8.80 VDC @ 1000Ω load impedance [1]
Vital Parallel Inputs (VPI)	
Quantity Available	8 per module (unipolar configuration)
Input Voltage (Deenergized)	-20VDV to 2.5VDC (<8Ω source impedance)
	-20VDC to 20VDC (>10kΩ source impedance)
Input Voltage (Energized) Minimum	7.5VDC to 20VDC (<8Ω source impedance)
Input impedance	800Ω to 1.2kΩ (1 kΩ nominal)
AC Frequency Rejection	25-220Hz

[1] Minimum output voltage requires an applied power supply voltage of 9.5 VDC or greater.

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APPENDIX B

TYPICAL DIAGNOSTIC TERMINAL SCREEN DUMPS

By using the Diagnostic Terminal Utility, different types of information may be acquired for the HD/LINK system. The following screen dumps (provided as samples only) represent data retrieved from an HD/LINK Module through its Diagnostic port and displayed on the screen.

DATE AND TIME option from the GET menu:

```
>> Module Date and Time <<
10 Jul 1998 14:41:37
```

SAT STATUS option from the GET menu:

```
>> SAT Status For VSAT3 <<
Received: .-------- -------- --------
Sent    : -------- -------- --------
```

TIMING PARAMETERS option from the GET menu:

```
>> Timing Parameters For VSAT3 <<
Maximum timestamp offset: 10 seconds
Non restrictive timeout:  5.000 seconds
```

MCF FILE option from the GET menu:

```
¦A53201:  C:\DT\TEMP.MCF
¦
+----------------MCF Info-----------------------------------------------------
--¦
¦Location name:                            grp 1
¦
¦Filename: 10003001.MCF    Version number: 001
¦
¦Creation date: 07081997   Creation time: 11:51:24
¦
¦Reviewer: Jon Wilkerson
¦
¦Approver: Roy Tamada
¦
¦Reviewer comments:
¦
¦
¦
```

MODULE STATUS option from the GET menu:

```
>> Module Status <<
Module type: R_HD
Module subtype: None
MEF version: HDL01_20.MEF
MEF/MCF compatibility index: 1
MEF/HW digital compatibility index:  1
```

```
MEF/HW analog 1 compatibility index: 1
MEF/HW analog 2 compatibility index: 1
System state: Fully Operational
Verbosity level: 1
Module SIN: 700100100202
Battery voltage: 12.0 Volts
```

EVENT LOG option from the GET menu:

```
>> Oldest Events <<
ER0 YY/MM/DD HH:MM:SS.H START OF EVENT BUFFER REACHED
ER0 97/07/07 07:12:27.9 Server initialized       :SAT 02 with 0010303
ER0 97/07/07 08:12:27.9 Server initialized       :SAT 02 with 0010303
ER0 97/07/07 09:12:27.8 Server initialized       :SAT 02 with 0010303
ER0 97/07/07 10:12:27.8 Server initialized       :SAT 02 with 0010303
ER0 97/07/07 11:12:27.8 Server initialized       :SAT 02 with 0010303
ER0 97/07/07 12:12:27.7 Server initialized       :SAT 02 with 0010303
ER0 97/07/07 13:11:12.6 Session lost             :SAT 02 with 0010303
ER0 97/07/07 13:11:12.6 OP data chg :SAT 02
.....................
ER0 97/07/07 13:11:12.6 VRO Channel            1   deenergized
ER0 97/07/07 13:13:36.1 Reset System Request Received
ER0 97/07/09 17:06:04.3 Module rebooted
ER0 97/07/10 11:24:28.6 Module rebooted
ERO 97/07/10 11:24:36.0 UCN calculated over the MCF only
ER0 97/07/10 11:25:05.6 Fully Operational, In Service Check Number:  DB73
ER0 97/07/10 11:25:05.7 Session lost             :SAT 02 with 0030302
ER0 97/07/10 11:25:25.0 Session established      :SAT 02 with 0030302
ER0 97/07/10 11:25:35.6 Session lost             :SAT 02 with 0030302
ER0 97/07/10 11:25:38.3 Session established      :SAT 02 with 0030302
ER0 97/07/10 11:27:06.6 Session lost             :SAT 02 with 0030302
ER0 97/07/10 11:27:09.4 Session established      :SAT 02 with 0030302
ER0 97/07/10 11:38:20.9 Session lost             :SAT 02 with 0030302
ER0 97/07/10 11:39:37.8 Msg upd rcvd:SAT 04 frm 1000303
.....................
ER0 97/07/10 11:39:38.0 Msg upd rcvd:SAT 05 frm 1000304
.....................
ER0 97/07/10 11:39:39.3 Msg upd rcvd:SAT 04 frm 1000303
.....................
ER0 97/07/10 11:39:39.5 Msg upd rcvd:SAT 05 frm 1000304
.....................
ER0 97/07/10 11:39:40.8 Msg upd rcvd:SAT 04 frm 1000303
.....................
ER0 97/07/10 11:39:41.0 Msg upd rcvd:SAT 05 frm 1000304
.....................
```

EVENT FILE option from the GET menu:

```
ER0 YY/MM/DD HH:MM:SS.H START OF EVENT BUFFER REACHED
ER0 00/01/01 00:02:04.8 Reset System Request Received
ER0 00/01/01 00:02:24.8 Module rebooted
ER0 00/01/01 00:03:08.1 Fully Operational, In Service Check Number:  9C18
ER0 00/01/01 00:03:08.3 Session lost             :SAT 03 with 0010402
ER0 00/01/01 00:03:08.3 Session lost             :SAT 05 with 0020305
ER0 00/01/01 00:03:08.4 Session lost             :SAT 02 with 0010303
ER0 00/01/01 00:03:08.6 Session established      :SAT 03 with 0010402
ER0 00/01/01 00:03:10.4 Session established      :SAT 02 with 0010303
```

```
ER0 00/01/01 00:03:13.6 Session established      :SAT 05 with 0020305
ER0 00/01/01 00:03:14.2 Verbosity changed to  1
ER0 00/01/01 00:03:14.9 System time prior to update
ER0 00/01/01 00:00:00.9 System Time Updated
ER0 00/01/01 00:00:02.4 VPI Channel            1   energized
ER0 00/01/01 00:00:02.4 Cut delay:               :SAT 02
ER0 00/01/01 00:00:02.4 Msg chg rcvd:SAT 02 frm 0010303
+.....................
ER0 00/01/01 00:00:02.4 Msg chg sent:SAT 02 to  0010403
+.....................
ER0 00/01/01 00:00:02.4 Uncut                    :SAT 02
ER0 00/01/01 00:00:02.5 Msg chg sent:SAT 02 to  0010403
+.....................
ER0 00/01/01 00:00:02.5 Msg chg rcvd:SAT 03 frm 0010402
+.....................
ER0 00/01/01 00:00:02.5 VRO Channel            1   energized
ER0 00/01/01 00:00:05.4 VPI Channel            1   deenergized
ER0 00/01/01 00:00:05.4 Cut:                     :SAT 02
ER0 00/01/01 00:00:05.4 Msg chg sent:SAT 02 to  0010403
+.....................
ER0 00/01/01 00:00:07.4 Msg chg rcvd:SAT 02 frm 0010303
.....................
ER0 00/01/01 00:00:07.4 Msg chg sent:SAT 02 to  0010403
.....................
ER0 00/01/01 00:00:07.5 Msg chg rcvd:SAT 03 frm 0010402
.....................
ER0 00/01/01 00:00:07.5 VRO Channel            1   deenergized
ER0 00/01/01 00:00:17.4 VPI Channel            2   energized
ER0 00/01/01 00:00:17.4 Msg chg sent:SAT 04 to  0020303
+.....................
ER0 00/01/01 00:00:40.0 VPI Channel            2   deenergized
ER0 00/01/01 00:00:40.0 Msg chg sent:SAT 04 to  0020303
.....................
ER0 00/01/01 00:01:07.0 Msg chg rcvd:SAT 05 frm 0020305
+.....................
ER0 00/01/01 00:01:07.0 VRO Channel            2   energized
ER0 00/01/01 00:01:16.4 Msg chg rcvd:SAT 05 frm 0020305
.....................
ER0 00/01/01 00:01:16.4 VRO Channel            2   deenergized
ER0 00/01/01 00:03:42.1 Session lost             :SAT 02 with 0010303
ER0 00/01/01 00:03:42.1 Msg chg sent:SAT 02 to  0010403
.....................
ER0 00/01/01 00:04:42.5 Session established      :SAT 02 with 0010303
ER0 00/01/01 00:15:52.0 Session lost             :SAT 05 with 0020305
ER0 00/01/01 01:15:52.1 Server not found         :SAT 05 with 0020305
ER0 00/01/01 16:11:57.1 Session lost             :SAT 02 with 0010303
ER0 00/01/01 16:11:57.1 Msg chg sent:SAT 02 to  0010403
.....................
ER0 00/01/01 17:11:57.1 Server not found         :SAT 02 with 0010303
ER0 00/01/02 20:09:02.3 System time prior to update
ER0 97/07/10 12:21:17.3 System Time Updated
ER0 YY/MM/DD HH:MM:SS.H END OF EVENT BUFFER REACHED
```

COMMS STATUS option from the GET menu:

```
>> COMMS Status <<
Date statistics last reset: 1999/06/03 at 09:27:29.25
                        Sent    Received
Vital packets           4070        4063
Nonvital packets           3           7

DT packets sent:           3
LAN packets sent:       4070
                        Valid   Invalid
DT packets received:       4           0
LAN packets received:   4066           0
                        Single  Double     Multiple
Missed vital messages:     2           0           0

Total lost sessions:       0
```

IO STATUS from the GET menu:

```
>> IO Status <<
VPI01 Energized      VRO01 Deenergized
VPI02 Deenergized    VRO02 Deenergized
VPI03 Deenergized    VRO03 Deenergized
VPI04 Deenergized    VRO04 Deenergized
VPI05 Deenergized    VRO05 Deenergized
VPI06 Deenergized    VRO06 Deenergized
VPI07 Deenergized    VRO07 Deenergized
VPI08 Deenergized    VRO08 Deenergized
INT01 Deenergized    INT09 Deenergized
INT02 Deenergized    INT10 Deenergized
INT03 Deenergized    INT11 Deenergized
INT04 Deenergized    INT12 Deenergized
INT05 Deenergized    INT13 Deenergized
INT06 Deenergized    INT14 Deenergized
INT07 Deenergized    INT15 Deenergized
INT08 Deenergized    INT16 Deenergized
```

DIAGNOSTIC DUMP option from the GET menu:

```
>> Diagnostic Dump Data <<
0002 002A 0000 2000 0028 0000 0000 0010
0000 0028 0000 0042 2309 0001 CF54 2010
0001 CF4C 0000 0015 0043 0003 0005 BFA0
```

ABOUT option from the Setup menu:

```
+---- About Diagnostic Terminal for DOS ----+
|                                            |
|    HD/LINK Installer Diagnostic Terminal   |
|                                            |
|    Version 1.16                            |
|                                            |
|    Copyright 1997 Safetran Systems         |
|                                            |
+--------------------------------------------+
```

APPENDIX C
SAMPLE MCF INSTALLATION LISTING

The Module Configuration File (MCF) Installation Listing that follows is for an imaginary system, presented as a sample only, and does not represent an actual railroad. The MCF Installation Listing provides the Unique Check Number (UCN) record for a module configuration and records installing and commissioning names, signatures, dates, and in and out of service Check Numbers.

NOTE

NOTE

Resemblance to any railroad, either existing or planned, is purely coincidental and unintentional.

NOTE

NOTE

For the corresponding MCF Contents Listing, refer to Appendix D.

NOTE

NOTE

For the corresponding MCF Approval Listing, refer to Appendix E.

NOTE

NOTE

For the corresponding HD/LINK Wiring List, refer to Appendix F.

NOTE

NOTE

For the corresponding HD/LINKer Circuit Layout, refer to Appendix G.

NOTE

NOTE

For information and instructions pertaining to the Listings, refer to the HD/LINKer manual.

Safetran Systems Corporation

MODULE CONFIGURATION FILE INSTALLATION LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
10303001.MCF
RAILROAD : 620
LINE : 100
11:02:54
LINE NAME : RLG. Ca
11:04:50
GROUP : 103

FILE NAME :
FILE VERSION : 001
FILE CREATED : 09/18/1997
FILE APPROVED : 09/18/1997
FILE PRINTED : 09/18/1997

Unique Check Number (UCN) : F8A54450

Commissioning Signature : _____

Commissioning Date : _____

Installer's Name : _____

In Service Check Number : _____

Authorizing Signature : _____

In Service Date : _____

Out of Service Check Number : _____

Authorizing Signature : _____

Out of Service Date : _____

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APPENDIX D
SAMPLE MCF CONTENTS LISTING

The Module Configuration File (MCF) Contents Listing that follows is for an imaginary system, presented as a sample only, and does not represent an actual railroad. The MCF Contents Listing provides the Module Summary and Device Data Summary for a module configuration.

NOTE

NOTE

Resemblance to any railroad, either existing or planned, is purely coincidental and unintentional.

NOTE

NOTE

For the corresponding MCF Installation Listing, refer to Appendix C.

NOTE

NOTE

For the corresponding MCF Approval Listing, refer to Appendix E.

NOTE

NOTE

For the corresponding HD/LINK Wiring List, refer to Appendix F.

NOTE

NOTE

For the corresponding HD/LINKer Circuit Layout, refer to Appendix G.

NOTE

NOTE

For information and instructions pertaining to the Listings, refer to the HD/LINKer manual.

Safetran Systems Corporation

MODULE CONFIGURATION FILE CONTENTS LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303 FILE NAME : 10303001.MCF
RAILROAD : 620 FILE VERSION : 001
LINE : 100 FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca FILE PRINTED : 09/18/1997 11:25:53
GROUP : 103 FILE STATUS : Approved

Module Summary

Module Type : R-HD
Module Subtype : None
Part Number : 9000-53201-0018-A
MEF Name : HDL01_00.MEF

Number of Termination Devices : 2
Number of Cut Devices : 1
External Inputs Used : 4
External Outputs Used : 2
Internals Used : 2
Name of Approver : Richard VanHuesen
Name of Reviewer : Carl Olsten
Comments :

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Safetran Systems Corporation

MODULE CONFIGURATION FILE CONTENTS LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303 FILE NAME : 10303001.MCF
RAILROAD : 620 FILE VERSION : 001
LINE : 100 FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca FILE PRINTED : 09/18/1997 11:25:53
GROUP : 103 FILE STATUS : Approved

Device Data Summary

Device Number 02
Device Type Termination
Circuit V01
Circuit Description

Circuit Type Bi-Polar/Bi-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
762010010103	SIN	N/A
02	Device	N/A
Temecula, Ca	Group Name	N/A
10103001.MCF	MCF Used	N/A
Approved	MCF Status	N/A
09/18/1997 11:03:26	MCF Created	N/A
	Client and Server Data	
5.0 Seconds	Energized Output Timeout	N/A
5.0 Seconds	De-energized Output Timeout	N/A
10.0 Seconds	Maximum Network Delay	N/A
1.5 Seconds	Energized Update Rate	N/A
1.5 Seconds	De-Energized Update Rate	N/A

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
1	VPI		21	V01	01	N-V01

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
1	VRO		29	V01	09	N-V01

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MODULE CONFIGURATION FILE CONTENTS LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303 FILE NAME : 10303001.MCF
RAILROAD : 620 FILE VERSION : 001
LINE : 100 FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca FILE PRINTED : 09/18/1997 11:25:53
GROUP : 103 FILE STATUS : Approved

Device Data Summary

Device Number 02
Device Type Termination
Circuit V02
Circuit Description

Circuit Type Bi-Polar/Uni-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
762010010103	SIN	N/A
02	Device	N/A
Temecula, Ca	Group Name	N/A
10103001.MCF	MCF Used	N/A
Approved	MCF Status	N/A
09/18/1997 11:03:26	MCF Created	N/A
	Client and Server Data	
5.0 Seconds	Energized Output Timeout	N/A
5.0 Seconds	De-energized Output Timeout	N/A
10.0 Seconds	Maximum Network Delay	N/A
1.5 Seconds	Energized Update Rate	N/A
1.5 Seconds	De-Energized Update Rate	N/A

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
N/A	N/A		N/A	N/A	N/A	N/A

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
1	INT		N/A	N/A	N/A	N/A

N/A

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Safetran Systems Corporation

MODULE CONFIGURATION FILE CONTENTS LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
FILE NAME : 10303001.MCF
RAILROAD : 620
FILE VERSION : 001
LINE : 100
FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca
FILE PRINTED : 09/18/1997 11:25:53
GROUP : 103
FILE STATUS : Approved

Device Data Summary

Device Number 03
Device Type Termination
Circuit V03
Circuit Description

Circuit Type Bi-Polar/Uni-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
N/A	SIN	762010010503
N/A	Device	02
N/A	Group Name	Elsinore, Ca
N/A	MCF Used	10503001.MCF
N/A	MCF Status	Approved
N/A	MCF Created	09/18/1997 11:03:44
	Client and Server Data	
N/A	Energized Output Timeout	N/A
N/A	De-energized Output Timeout	N/A
N/A	Maximum Network Delay	N/A
N/A	Energized Update Rate	1.5 Seconds
N/A	De-Energized Update Rate	1.5 Seconds

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp Delay
1	INT		N/A	N/A	N/A	N/A

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp Delay
N/A	N/A		N/A	N/A	N/A	N/A

N/A

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MODULE CONFIGURATION FILE CONTENTS LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
10303001.MCF
RAILROAD : 620
LINE : 100
11:02:54
LINE NAME : RLG. Ca
11:25:53
GROUP : 103

FILE NAME :
FILE VERSION : 001
FILE CREATED : 09/18/1997
FILE PRINTED : 09/18/1997
FILE STATUS : Approved

Device Data Summary

Device Number 03
Device Type Termination
Circuit V06
Circuit Description

Circuit Type Uni-Polar/Uni-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
N/A	SIN	762010010503
N/A	Device	02
N/A	Group Name	Elsinore, Ca
N/A	MCF Used	10503001.MCF
N/A	MCF Status	Approved
N/A	MCF Created	09/18/1997 11:03:44
	Client and Server Data	
N/A	Energized Output Timeout	N/A
N/A	De-energized Output Timeout	N/A
N/A	Maximum Network Delay	N/A
N/A	Energized Update Rate	1.5 Seconds
N/A	De-Energized Update Rate	1.5 Seconds

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
4	VPI		04	V06	24	N-V06
	N/A					

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
N/A	N/A		N/A	N/A	N/A	N/A
N/A						

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MODULE CONFIGURATION FILE CONTENTS LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
10303001.MCF
RAILROAD : 620
LINE : 100
11:02:54
LINE NAME : RLG. Ca
11:25:53
GROUP : 103

FILE NAME :
FILE VERSION : 001
FILE CREATED : 09/18/1997
FILE PRINTED : 09/18/1997
FILE STATUS : Approved

Device Data Summary

Device Number 04
Device Type Cut
Circuit V04 / V05
Circuit Description

Circuit Type Uni-Polar/Uni-Directional
Cut Condition Cut
Cut Re-energize Delay 3.0 Seconds

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
762010010103	SIN	762010010503
03	Device	03
Temecula, Ca	Group Name	Elsinore, Ca
10103001.MCF	MCF Used	10503001.MCF
Approved	MCF Status	Approved
09/18/1997 11:03:26	MCF Created	09/18/1997 11:03:44
	Client and Server Data	
5.0 Seconds	Energized Output Timeout	N/A
5.0 Seconds	De-energized Output Timeout	N/A
10.0 Seconds	Maximum Network Delay	N/A
N/A	Energized Update Rate	1.5 Seconds
N/A	De-Energized Update Rate	1.5 Seconds

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
3	VPI		23	V04	03	N-V04

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
N/A	N/A		N/A	N/A	N/A	N/A

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APPENDIX E
SAMPLE MCF APPROVAL LISTING

The Module Configuration File (MCF) Approval Listing that follows is for an imaginary system, presented as a sample only, and does not represent an actual railroad. The MCF Approval Listing provides the Validation Status, Module Summary and Device Data Summary for a module configuration.

NOTE

NOTE

Resemblance to any railroad, either existing or planned, is purely coincidental and unintentional.

NOTE

NOTE

For the corresponding MCF Installation Listing, refer to Appendix C.

NOTE

NOTE

For the corresponding MCF Contents Listing, refer to Appendix D.

NOTE

NOTE

For the corresponding HD/LINK Wiring List, refer to Appendix F.

NOTE

NOTE

For the corresponding HD/LINKer Circuit Layout, refer to Appendix G.

NOTE

NOTE

For information and instructions pertaining to the Listings, refer to the HD/LINKer manual.

Any MCF Approval Listing, as printed out, will consist of as many pages as required for the configuration. Make certain all pages are included in the document.

NOTE

NOTE

Total page count for the MCF Approval Listing can be verified in the warning following the Railroad and File general information on the first page.

Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN	: 762010010303	FILE NAME	: 10303001.MCF
RAILROAD	: 620	FILE VERSION	: 001
LINE	: 100	FILE CREATED	: 09/18/1997 11:02:54
LINE NAME	: RLG. Ca	FILE PRINTED	: 09/18/1997 11:05:01
GROUP	: 103	FILE STATUS	: Approved

Warning : Check that all pages are present.
Total pages = 8

Validation Status :

SIN: 762010010303
FILE NAME: 10303001.MCF
FILE CREATED: 09/18/1997 11:02:54
Tests Run: 09-18-1997 11:05:00

Validation Tests Results

MCF to Database Comparison Test
Test Passed

Range Consistency Test
Test Passed

Input/Output Test
Test Passed

Device - Input/Output Test
Test Passed

Unique Device Number Test
Test Passed

Device Consistency Test
Test Passed

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

Comments :

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Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN	: 762010010303	FILE NAME	: 10303001.MCF
RAILROAD	: 620	FILE VERSION	: 001
LINE	: 100	FILE CREATED	: 09/18/1997 11:02:54
LINE NAME	: RLG. Ca	FILE PRINTED	: 09/18/1997 11:05:01
GROUP	: 103	FILE STATUS	: Approved

Validation Status Continued...

Circuit Consistency Test
Test Passed

MCF Neighbor Test
Test Passed

Total Errors: 0
Total Warnings: 0

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
FILE NAME : 10303001.MCF
RAILROAD : 620
FILE VERSION : 001
LINE : 100
FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca
FILE PRINTED : 09/18/1997 11:05:01
GROUP : 103
FILE STATUS : Approved

Module Summary

Module Type : R-HD
Module Subtype : None
Part Number : 9000-53201-0018-A
MEF Name : HDL01_20.MEF

Number of Termination Devices : 2
Number of Cut Devices : 1
External Inputs Used : 4
External Outputs Used : 2
Internals Used : 2

Software Compatibility Index : 1
MDF Name : MDL01_00.MDF
MDF CRC : FCC32928
HDF Name : A5320101.HDF
HDF CRC : 5218133A
MEF CRC : 7EAB541E
Module Data Checksum : 00C8

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

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Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303 FILE NAME : 10303001.MCF
RAILROAD : 620 FILE VERSION : 001
LINE : 100 FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca FILE PRINTED : 09/18/1997 11:05:01
GROUP : 103 FILE STATUS : Approved

Device Data Summary

Device Number 02
Device Type Termination
Circuit V01
Circuit Description

Circuit Type Bi-Polar/Bi-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
762010010103	SIN	N/A
02	Device	N/A
Temecula, Ca	Group Name	N/A
10103001.MCF	MCF Used	N/A
Approved	MCF Status	N/A
09/18/1997 11:03:26	MCF Created	N/A
	Client and Server Data	
5.0 Seconds	Energized Output Timeout	N/A
5.0 Seconds	De-energized Output Timeout	N/A
10.0 Seconds	Maximum Network Delay	N/A
1.5 Seconds	Energized Update Rate	N/A
1.5 Seconds	De-Energized Update Rate	N/A

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
1	VPI		21	V01	01	N-V01

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
1	VRO		29	V01	09	N-V01

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

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Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
10303001.MCF
RAILROAD : 620
LINE : 100
11:02:54
LINE NAME : RLG. Ca
11:05:01
GROUP : 103

FILE NAME :
FILE VERSION : 001
FILE CREATED : 09/18/1997
FILE PRINTED : 09/18/1997
FILE STATUS : Approved

Device Data Summary

Device Number	02
Device Type	Termination
Circuit	V02
Circuit Description	
Circuit Type	Bi-Polar/Uni-Directional
Cut Condition	N/A
Cut Re-energize Delay	N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
762010010103	SIN	N/A
02	Device	N/A
Temecula, Ca	Group Name	N/A
10103001.MCF	MCF Used	N/A
Approved	MCF Status	N/A
09/18/1997 11:03:26	MCF Created	N/A
	Client and Server Data	
5.0 Seconds	Energized Output Timeout	N/A
5.0 Seconds	De-energized Output Timeout	N/A
10.0 Seconds	Maximum Network Delay	N/A
1.5 Seconds	Energized Update Rate	N/A
1.5 Seconds	De-Energized Update Rate	N/A

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
N/A	N/A		N/A	N/A	N/A	N/A

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
1	INT		N/A	N/A	N/A	N/A

N/A

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

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Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303 FILE NAME : 10303001.MCF
RAILROAD : 620 FILE VERSION : 001
LINE : 100 FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca FILE PRINTED : 09/18/1997 11:05:01
GROUP : 103 FILE STATUS : Approved

Device Data Summary

Device Number 03
Device Type Termination
Circuit V03
Circuit Description

Circuit Type Bi-Polar/Uni-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
N/A	SIN	762010010503
N/A	Device	02
N/A	Group Name	Elsinore, Ca
N/A	MCF Used	10503001.MCF
N/A	MCF Status	Approved
N/A	MCF Created	09/18/1997 11:03:44
	Client and Server Data	
N/A	Energized Output Timeout	N/A
N/A	De-energized Output Timeout	N/A
N/A	Maximum Network Delay	N/A
N/A	Energized Update Rate	1.5 Seconds
N/A	De-Energized Update Rate	1.5 Seconds

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp	Delay
1	INT		N/A	N/A	N/A	N/A	N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp	Delay
N/A	N/A		N/A	N/A	N/A	N/A	N/A

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

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Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
FILE NAME : 10303001.MCF
RAILROAD : 620
FILE VERSION : 001
LINE : 100
FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca
FILE PRINTED : 09/18/1997 11:05:01
GROUP : 103
FILE STATUS : Approved

Device Data Summary

Device Number 03
Device Type Termination
Circuit V06
Circuit Description

Circuit Type Uni-Polar/Uni-Directional
Cut Condition N/A
Cut Re-energize Delay N/A

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
N/A	SIN	762010010503
N/A	Device	02
N/A	Group Name	Elsinore, Ca
N/A	MCF Used	10503001.MCF
N/A	MCF Status	Approved
N/A	MCF Created	09/18/1997 11:03:44
	Client and Server Data	
N/A	Energized Output Timeout	N/A
N/A	De-energized Output Timeout	N/A
N/A	Maximum Network Delay	N/A
N/A	Energized Update Rate	1.5 Seconds
N/A	De-Energized Update Rate	1.5 Seconds

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
4	VPI		04	V06	24	N-V06

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
N/A	N/A		N/A	N/A	N/A	N/A

N/A

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

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Safetran Systems Corporation

MODULE CONFIGURATION FILE APPROVAL LISTING

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303 FILE NAME : 10303001.MCF
RAILROAD : 620 FILE VERSION : 001
LINE : 100 FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca FILE PRINTED : 09/18/1997 11:05:01
GROUP : 103 FILE STATUS : Approved

Device Data Summary

Device Number 04
Device Type Cut
Circuit V04 / V05
Circuit Description

Circuit Type Uni-Polar/Uni-Directional
Cut Condition Cut
Cut Re-energize Delay 3.0 Seconds

Left Neighbor Link Information	Device Data	Right Neighbor Link Information
762010010103	SIN	762010010503
03	Device	03
Temecula, Ca	Group Name	Elsinore, Ca
10103001.MCF	MCF Used	10503001.MCF
Approved	MCF Status	Approved
09/18/1997 11:03:26	MCF Created	09/18/1997 11:03:44
	Client and Server Data	
5.0 Seconds	Energized Output Timeout	N/A
5.0 Seconds	De-energized Output Timeout	N/A
10.0 Seconds	Maximum Network Delay	N/A
N/A	Energized Update Rate	1.5 Seconds
N/A	De-Energized Update Rate	1.5 Seconds

INPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
3	VPI		23	V04	03	N-V04

N/A

OUTPUTS

Input	Input Type	+Pin	+Pin Label	-Pin	-Pin Label	Pkup/Drp
Delay						
N/A	N/A		N/A	N/A	N/A	N/A

N/A

File CRC : 69112C10

Reviewed By : Carl Olsten

Signature : _____ Date : _____

Approved By : Richard VanHuesen

Signature : _____ Date : _____

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APPENDIX F
SAMPLE HD/LINK WIRING LIST

The HD/LINK Module Wiring List that follows is for an imaginary system, presented as a sample only, and does not represent an actual railroad. The HD/LINK Wiring List provides the module interface connector signal pinouts and jumper wiring, if required, for a module configuration.

NOTE

NOTE

Resemblance to any railroad, either existing or planned, is purely coincidental and unintentional.

NOTE

NOTE

For the corresponding MCF Installation Listing, refer to Appendix C.

NOTE

NOTE

For the corresponding MCF Contents Listing, refer to Appendix D.

NOTE

NOTE

For the corresponding MCF Approval Listing, refer to Appendix E.

NOTE

NOTE

For the corresponding HD/LINKer Circuit Layout, refer to Appendix G.

NOTE

NOTE

For information and instructions pertaining to the Listings, refer to the HD/LINKer manual.

Safetran Systems Corporation

HD/LINK WIRING LIST

LINE NAME: RLG, Ca **GROUP NAME: Murrieta, Ca**

SIN : 762010010303
FILE NAME : 10303001.MCF
RAILROAD : 620
FILE VERSION : 001
LINE : 100
FILE CREATED : 09/18/1997 11:02:54
LINE NAME : RLG. Ca
FILE APPROVED : 09/18/1997 11:04:50
GROUP : 103
FILE PRINTED : 09/18/1997

Label	Channel	Pin	Pin	Channel	Label
N-V01	VPI 1-	01	21	VPI 1+	V01
V01	VPI 2+	02	22	VPI 2-	N-V01
N-V04	VPI 3-	03	23	VPI 3+	V04
V06	VPI 4+	04	24	VPI 4-	N-V06
		05	25		
		06	26		
		07	27		
		08	28		
N-V01	VRO 1-	09	29	VRO 1+	V01
V01	VRO 2+	10	30	VRO 2-	N-V01
		11	31		
		12	32		
		13	33		
		14	34		
		15	35		
		16	36		
	+5V	**17	37**	I2C_Clock	
	0V	**18	38**	I2C_Data	
	ECH TWP 1	19	39	ECH TWP 2	
	BATT+	20	40	BATT-	

**Factory Pre-wired

Pin Label	Pins To Jumper
V01	21, 22, 29, 30
N-V01	01, 02, 09, 10

THE OPERATION OF THE ORGANIZATION REPRESENTED HEREON CANNOT BE CHECKED FINALLY UNTIL ALL CIRCUITS AND DEVICES ARE CONNECTED TO FORM A COMPLETE SYSTEM OR AN EFFECTIVE PORTION THEREOF. SUCH A SYSTEM OR PORTION THEREOF, MUST BE GIVEN A COMPLETE CIRCUIT AND OPERATIONAL TEST BEFORE BEING PLACED IN REGULAR SERVICE.

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APPENDIX G

SAMPLE HD/LINKer CIRCUIT LAYOUT

The HD/LINKer Circuit Layout that follows is for an imaginary system, presented as a sample only, and does not represent an actual railroad. The HD/LINKer Circuit Layout provides a diagram of the circuit connections for a module configuration.

NOTE

NOTE

Resemblance to any railroad, either existing or planned, is purely coincidental and unintentional.

NOTE

NOTE

For the corresponding MCF Installation Listing, refer to Appendix C.

NOTE

NOTE

For the corresponding MCF Contents Listing, refer to Appendix D.

NOTE

NOTE

For the corresponding MCF Approval Listing, refer to Appendix E.

NOTE

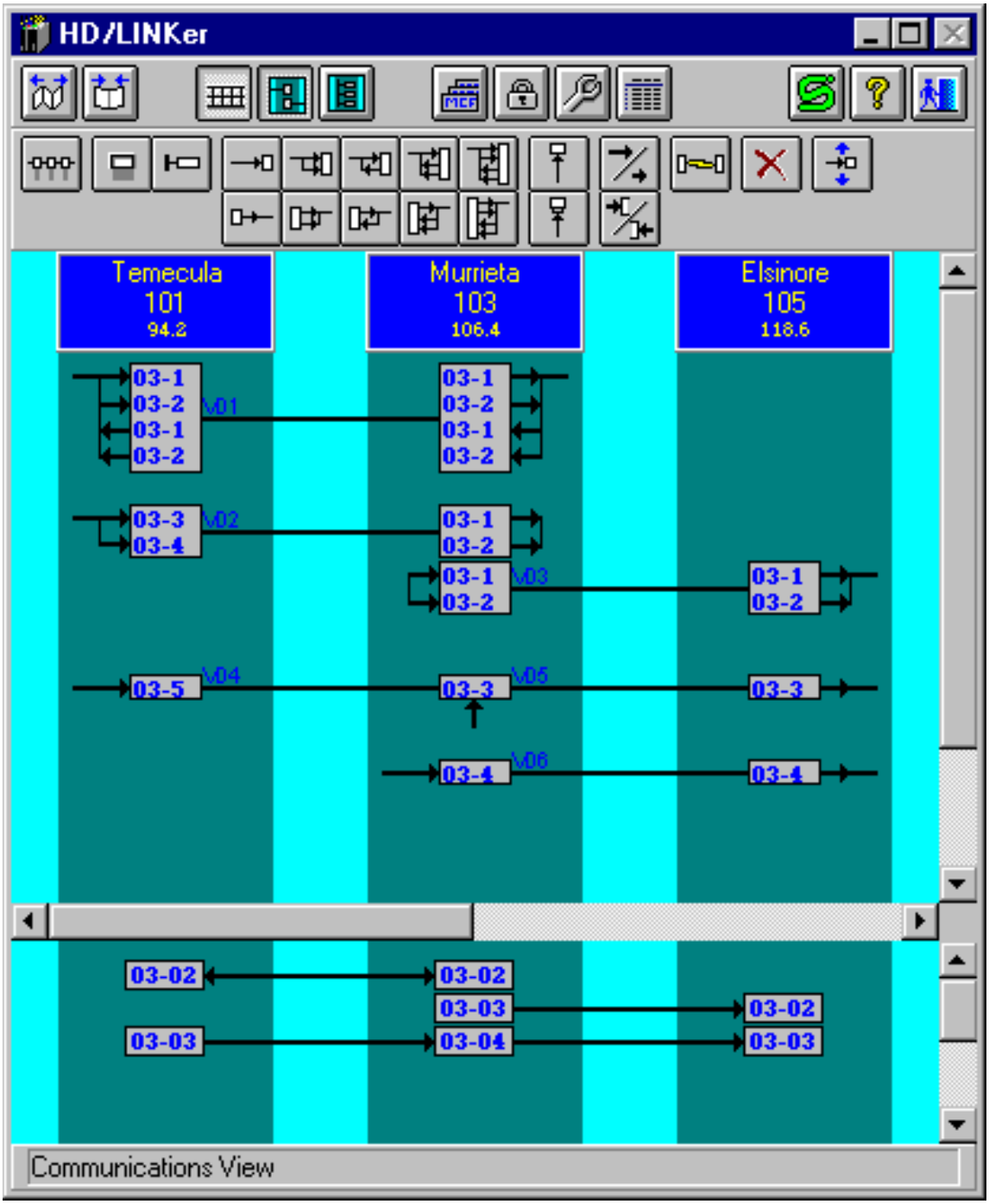
NOTE

For the corresponding HD/LINK Wiring List, refer to Appendix F.

NOTE

NOTE

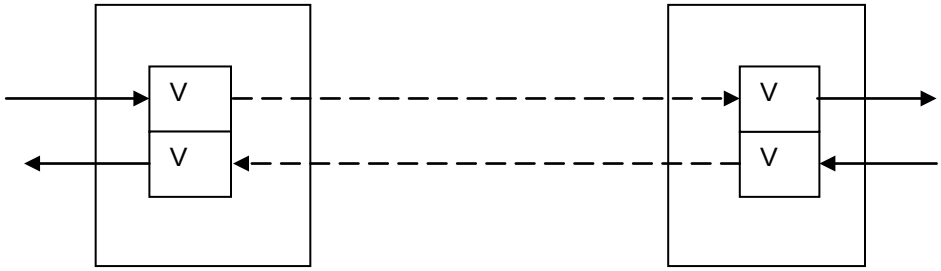
For information and instructions pertaining to the Listings, refer to the HD/LINKer manual.


HD/LINKer
Temecula
101
94.2
Murrieta
103
106.4
Elsinore
105
118.6
03-1
03-2
03-1
03-2
V01
03-1
03-2
03-1
03-2
03-3
03-4
V02
03-1
03-2
03-1
03-2
V03
03-1
03-2
03-5
V04
03-3
V05
03-3
03-4
V06
03-4
03-02
03-03
03-02
03-03
03-04
03-02
03-03
Communications View

APPENDIX H
SUGGESTED SIMPLE CIRCUIT TESTS

Simple Unipolar Circuit Checks

Purpose: To ensure that all unipolar circuits without cut sections (see Figure below) are wired correctly, the MCF is correct, and relay pickup and drop times are correctly set. Perform the steps in the checklist in the table.



Simple Unipolar Circuits

Unipolar Circuits Checklist

To verify the unipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
1. Deenergize all inputs (can be verified by viewing IO Status)	
2. Energize the input relay under test by reference to the pin label in the Listing, and perform the following checks:	
Verify that the VPI LED corresponding to the input is illuminated (by reference to the Listing)	
Verify that no other VPI LEDs are illuminated	

Unipolar Circuits Checklist Continued

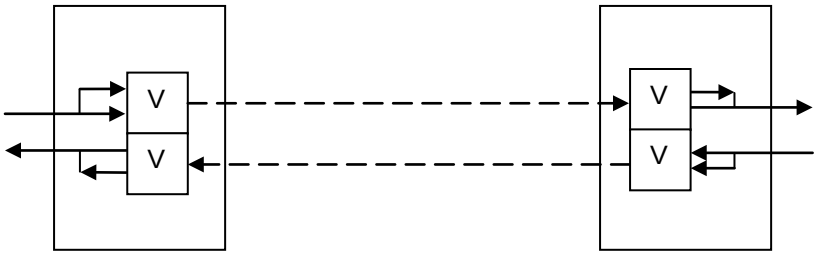
To verify the unipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
3. Using the Listing for the neighbor (as given by Right or Left Neighbor Link Data), find the output end of the circuit under test, and perform the following checks:	
Verify that the correct VRO LED is illuminated, as given by the Output number on the Listing	
Verify that the correct relay is energized, as given by the + and - output pin labels	
Verify that no other VRO LED illuminates or output relay becomes energized	
By looking at the Event Log, verify that the delay from when the input relay is energized to when the output relay energizes, is equal to the VRO energization time for that output (plus 0-300ms), as specified on the Pickup Delay column of the Listing (Note: A VRO energization timer is a Never Time Short timer)	
4. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	
5. Using the DT Utility, obtain the SAT Timing Parameters for the SAT on which the circuit resides, and perform the following checks:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	

Unipolar Circuits Checklist Concluded

To verify the unipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
6. Reconnect the circuit and wait until the output is reenergized	
7. Deenergize the input relay under test, and perform the following checks:	
Verify that the correct VPI LED is turned off, as given by the Input number on the Listing	
Verify that no other VPI LEDs changed state	
Verify that the correct VRO LED is turned off, as given by the Output number on the Listing	
Verify that no other VRO LEDs changed state	
By looking at the Event Log, verify that the previously energized relay is deenergized at the end of the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	

Simple Bipolar Circuit Checks

Purpose: To ensure that bipolar circuits (see Figure below) are wired correctly, the MCF is correct and relay pickup and drop times are correctly set. Perform the steps in the checklist in the table.



Simple Bipolar Circuits

NOTE

NOTE

When positively energizing a bipolar circuit, a positive voltage is applied to the positive VPI input with respect to the negative VPI input. When negatively energizing a bipolar circuit, a positive voltage is applied to the negative VPI input with respect to the positive VPI input.

Bipolar Circuits Checklist

To verify the bipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
1. Deenergize all inputs (can be verified by viewing IO Status)	
2. Positively energize the input relay under test by reference to the pin label in the Listing, and perform the following checks:	
Verify that the VPI LED corresponding to the input is illuminated (by reference to the Listing)	
Verify that no other VPI LED is illuminated	
3. Using the Listing for the neighbor (as given by Right or Left Neighbor Link Data) find the output end of the circuit under test, and perform the following checks:	
Verify that the correct VRO LED is illuminated as given by the Output number on the Listing	
Verify that the correct relay is positively energized as given by the output pin labels	
Verify that no other VRO LED illuminates or output relay becomes energized	
By looking at the Event Log, verify that the delay from when the input relay is energized to when the output relay energizes, is equal to the VRO energization time for that output (plus 0-300ms), as specified on the Pickup Delay column of the Listing (Note: A VRO energization timer is a Never Time Short timer)	

Bipolar Circuits Checklist Continued

To verify the bipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
4. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	
5. Using the DT Utility, obtain the SAT Timing parameters for the SAT on which the circuit resides, and perform the following checks:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	
6. Reconnect the circuit and wait until the output is reenergized	
7. Deenergize the input relay under test, and perform the following checks:	
Verify that the correct VPI LED is turned off as given by the Input number on the Listing	
Verify that no other VPI LED changed state	
Verify that the correct VRO LED is turned off as given by the Output number on the Listing	
Verify that no other VRO LED changed state	
By looking at the Event Log, verify that the previously energized relay is deenergized after the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	

Bipolar Circuits Checklist Continued

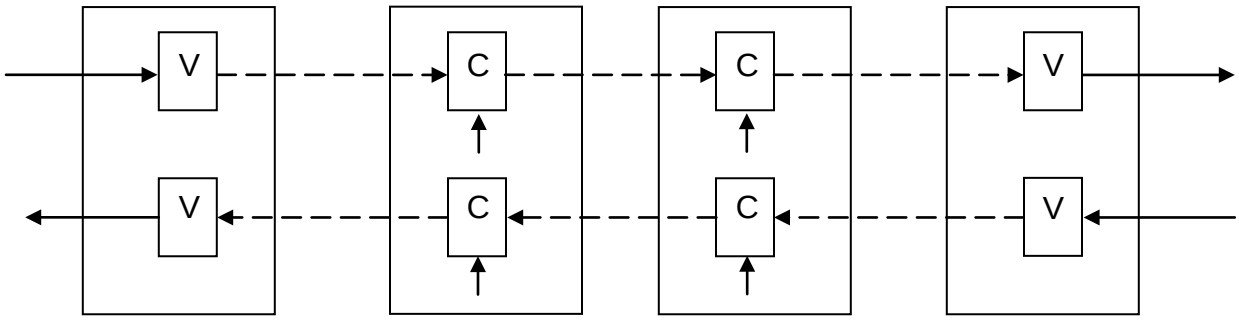
To verify the bipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
8. Negatively energize the input relay under test by reference to the pin label in the Listing, and perform the following checks:	
Verify that the VPI LED corresponding to the input is illuminated (by reference to the Listing)	
Verify that no other VPI LED is illuminated	
9. Using the Listing for the neighbor (as given by Right or Left Neighbor Link Data), find the output end of the circuit under test, and perform the following checks:	
Verify that the correct VRO LED is illuminated as given by the Output number on the Listing	
Verify that the correct relay is negatively energized as given by the output pin labels	
Verify that no other VRO LED illuminates or output relay becomes energized	
By looking at the Event Log, verify that the delay from when the input relay is energized to when the output relay energizes, is equal to the VRO energization time for that output (plus 0-300ms) as specified on the Pickup Delay column of the Listing (Note: A VRO energization timer is a Never Time Short timer)	
10. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	

Bipolar Circuits Checklist Concluded

To verify the bipolar circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
11. Using the DT Utility, obtain the SAT Timing parameters for the SAT on which the circuit resides, and perform the following checks:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	
12. Reconnect the circuit and wait until the output is reenergized	
13. Deenergize the input relay under test, and perform the following checks:	
Verify that the correct VPI LED is turned off as given by the Input number on the Listing	
Verify that no other VPI LED changed state	
Verify that the correct VRO LED is turned off as given by the Output number on the Listing	
Verify that no other VRO LED changed state	
By looking at the Event Log, verify that the previously energized relay is deenergized after the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	

Circuit Checks Of Circuits With Cut Sections

Purpose: To ensure that circuits with cut sections (see figure below) are wired correctly, the MCF is correct, relay pickup and drop times are correctly set and that cut sections are able to cut the correct circuits. Perform the steps in the checklist in the table.



Simple Circuits With Cut Sections

Circuits With Cut Sections Checklist

To verify the circuits with cut sections, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
1. Deenergize all inputs (can be verified by viewing IO Status)	
2. Energize all cut input relays for cut sections on the circuit by reference to the Listing Wait for a time corresponding to the largest Cut Section Delay, then perform the following checks:	
Verify that the VPI LEDs corresponding to these Cut Section inputs are illuminated (by reference to the Listing)	
3. Energize the input relay under test by reference to the pin label in the Listing, and perform the following checks:	
Verify that the VPI LED corresponding to the input is illuminated (by reference to the Listing)	
Verify that no other VPI LEDs are illuminated	

Circuits With Cut Sections Checklist Continued

To verify the circuits with cut sections, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
4. Using the Listing for the neighbor (as given by Right or Left Neighbor Link Data), find the output end of the circuit under test, then perform the following checks:	
Verify that the correct VRO LED is illuminated as given by the Output number on the Listing	
Verify that the correct relay is energized as given by the output pin labels	
By looking at the Event Log, verify that the delay, from when the input relay is energized to when the output relay energizes, is equal to the VRO energization time for that output (plus 0-300ms) as specified on the Pickup Delay column of the Listing (Note: A VRO energization timer is a Never Time Short timer)	
Verify that no other VRO LED illuminates or output relay becomes energized	
5. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	
6. Using the DT Utility, obtain the SAT Timing parameters for the SAT on which the circuit resides, and perform the following check:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	
7. Reconnect the circuit and wait until the output is reenergized	

Circuits With Cut Sections Checklist Continued

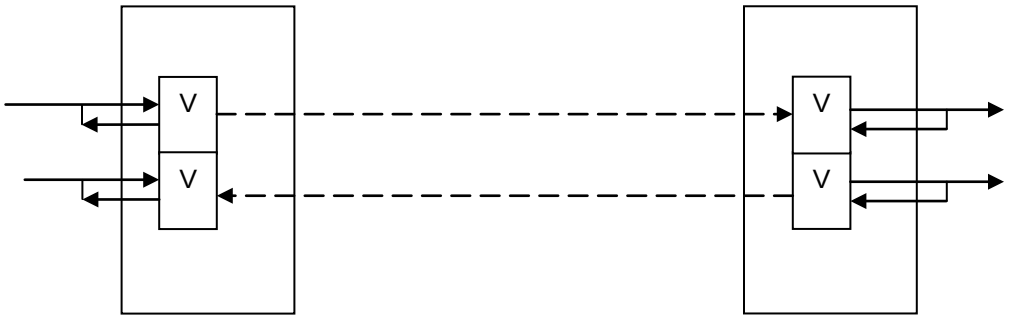
To verify the circuits with cut sections, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
8. Deenergize each of the Cut Section inputs on the circuit (one at a time), and perform the following checks:	
Verify that the VPI LED for the Cut Section input is turned off	
Verify that no other VPI LED changed state	
Verify that the correct VRO LED is turned off as given by the Output number on the Listing	
Verify that no other VRO LED changed state	
By looking at the Event Log, verify that the previously energized relay is deenergized after the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	
9. Reenergize each of the Cut Section inputs on the circuit (one at a time), and perform the following checks:	
Verify that the VPI LED corresponding to the cut section input is illuminated (by reference to the Listing)	
Verify that the correct VRO LED is illuminated as given by the Output number on the Listing	
Verify that the correct relay is energized as given by the output pin labels	
Verify that no other VRO LEDs are illuminated	
By looking at the Event Log, verify that the delay from when the Cut Section input relay is reenergized to when the output relay reenergizes is equal to the Cut Section Delay Time (plus 0-300ms) as specified on the Listing (Cut Re-energize Delay) (Note: A cut re-energization timer is a Never Time Short timer)	

Circuits With Cut Sections Checklist Concluded

To verify the circuits with cut sections, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
10. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	
11. Using the DT Utility, obtain the SAT Timing parameters for the SAT on which the circuit resides, and perform the following checks:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	
12. Reconnect the circuit and wait until the output is reenergized	
13. Deenergize the input relay under test, and perform the following checks:	
Verify that the correct VPI LED is turned off as given by the Input number on the Listing	
Verify that no other VPI LED changed state	
Verify that the correct VRO LED is turned off as given by the Output number on the Listing	
Verify that no other VRO LED changed state	
By looking at the Event Log, verify that the previously energized relay is deenergized after the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	

Bidirectional Circuit Checks (Simple Circuits)

Purpose: To ensure that bidirectional circuits (see Figure below) are wired correctly, the MCF is correct and relay pickup and drop times are correctly set. Perform the steps in the checklist in the table.



Bidirectional Circuits

Bidirectional Circuits Checklist

To verify the bidirectional circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
1. Deenergize all inputs (can be verified by viewing IO Status)	
2. Energize the input relay (left end) under test by reference to the pin label in the Listing, and perform the following checks:	
Verify that the VPI LED corresponding to the input (left end) is illuminated (by reference to the Listing)	
Verify that no other VPI LEDs are illuminated	
For the input module, verify that the VRO LED for that circuit (by reference to the Listing) is not illuminated	

Bidirectional Circuits Checklist Continued

3. Using the Listing for the neighbor (as given by Right or Left Neighbor Link Data), find the output end of the circuit under test, then perform the following checks:	
Verify that the correct VRO LED (right end) is illuminated as given by the Output number on the Listing	
Verify that the correct relay (right end) is energized as given by the output pin labels on the Listing	
Verify that no other VRO LED illuminates or output relay is energized	
By looking at the Event Log, verify that the delay, from when the input relay is energized to when the output relay energizes, is equal to the VRO energization time for that output (plus 0-300ms), as specified on the Pickup Delay column of the Listing (Note: A VRO energization timer is a Never Time Short timer)	
For the output module, verify that the VPI LED for that circuit (by reference to the Listing) is not illuminated	
4. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	
5. Using the DT Utility, obtain the SAT Timing parameters for the SAT on which the circuit resides, and perform the following checks:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	
6. Reconnect the circuit and wait until the output is reenergized	

Bidirectional Circuits Checklist Continued

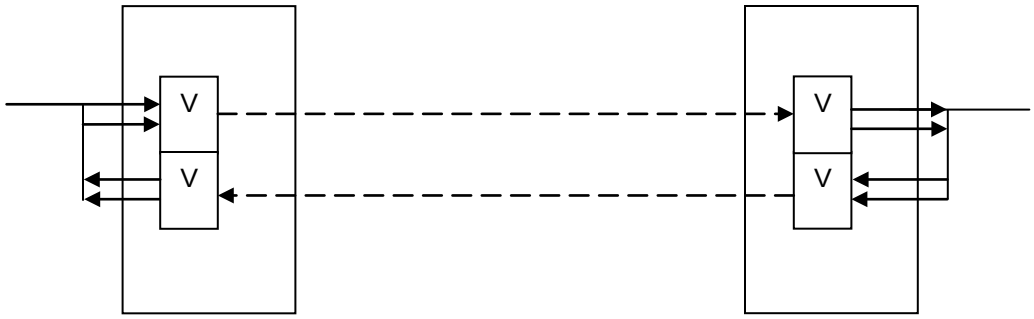
To verify the bidirectional circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
7. Without deenergizing the left end input, energize the input relay (right end) under test by reference to the pin label in the Listing, then perform the following checks:	
Verify that the same VRO LED (right end) remains illuminated	
Verify that no other VRO LED illuminates	
Verify that the same relay (right end) remains energized	
Verify that no other output relay is energized	
Verify that the same VPI LED (left end) remains illuminated	
Verify that no other VPI LED illuminates	
8. Without deenergizing the right end input, deenergize the input relay (left end) under test, then perform the following checks:	
Verify that the correct VPI LED (left end) is turned off and that the correct VPI LED (right end) is illuminated, as given by the Input numbers on the Listing	
Verify that no other VPI LEDs are illuminated	
Verify that the correct VRO LED (right end) is turned off and that the correct VRO LED (left end) is illuminated, as given by the Output numbers on the Listing	
Verify that the correct relay (left end) is energized as given by the output pin labels in the Listing	
Verify that no other VRO LED illuminates or output relay is energized	
By looking at the Event Log, verify that the previously energized relay (right end) is deenergized after the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	
By looking at the Event Log, verify that the previously deenergized relay (left end) is energized after the VRO energization time (plus 0-300ms) for that output, as specified on the Pickup Delay column of the Listing (Note: A VRO energization timer is a Never Time Short timer)	

Bidirectional Circuits Checklist Concluded

To verify the bidirectional circuits, perform the following steps for each circuit listed on the Device Data Summary of the Contents Listing (or MCF Approval Listing):	☐
9. Break the circuit (power down the radio or disconnect both LAN wires) and time the deenergization of the output for the circuit as indicated by the output relay dropping and the VRO LED turning off Verify that the deenergization of the output occurred between the minimum and maximum calculated values as follows: Min = Client *Energized Output Timeout* plus client *VRO Drop Delay* minus server *Energized Update Rate* minus 200ms, as specified on the Listing for that circuit Max = Client *Energized Output Timeout* plus client *VRO Drop Delay*, as specified on the Listing for that circuit Repeat the procedure several times, as different results are possible. All results must fall between the calculated minimum and maximum values	
10. Using the DT Utility, obtain the SAT Timing parameters for the SAT on which the circuit resides, and perform the following checks:	
Verify that the Non restrictive Timeout from the SAT Timing Parameters equals the Energized Output Timeout for this circuit, as specified on the Listing	
Verify that the Maximum Timestamp Offset from the SAT Timing Parameters equals the Maximum Network Delay for this circuit, as specified on the Listing	
11. Reconnect the circuit and wait until the output is reenergized	
12. Deenergize the input relay (right end) under test, then perform the following checks:	
Verify that the correct VPI LED (right end) is turned off as given by the Input number on the Listing	
Verify that the correct VRO LED (left end) is turned off as given by the Output number on the Listing	
By looking at the Event Log, verify that the previously energized relay (left end) is deenergized after the VRO deenergization time (minus 0-200ms) for that output, as specified on the Drop Delay column of the Listing (Note: A VRO deenergization timer is a Never Time Long timer)	
Verify that no unexpected VRO LEDs are illuminated	

Bidirectional Bipolar Circuits

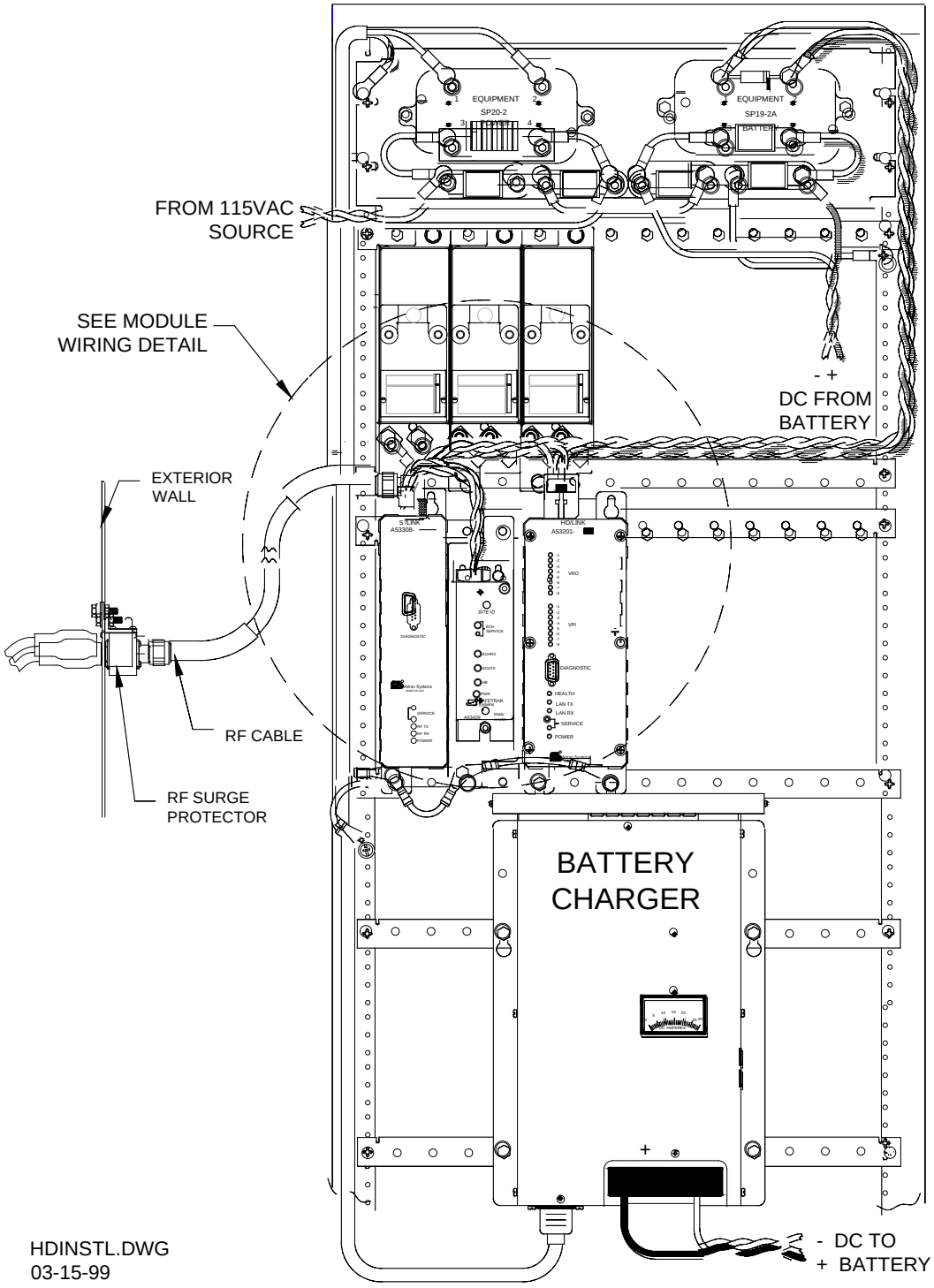
For circuits that are bipolar *and* bidirectional (see Figure below), the bipolar part of the circuit should be tested as per the Bipolar checklist and the bidirectional part tested as per the Bidirectional checklist.



Bipolar Bidirectional Circuit

APPENDIX I

TYPICAL HD/LINK INSTALLATION
POWER, GROUND & ECHELON® WIRING



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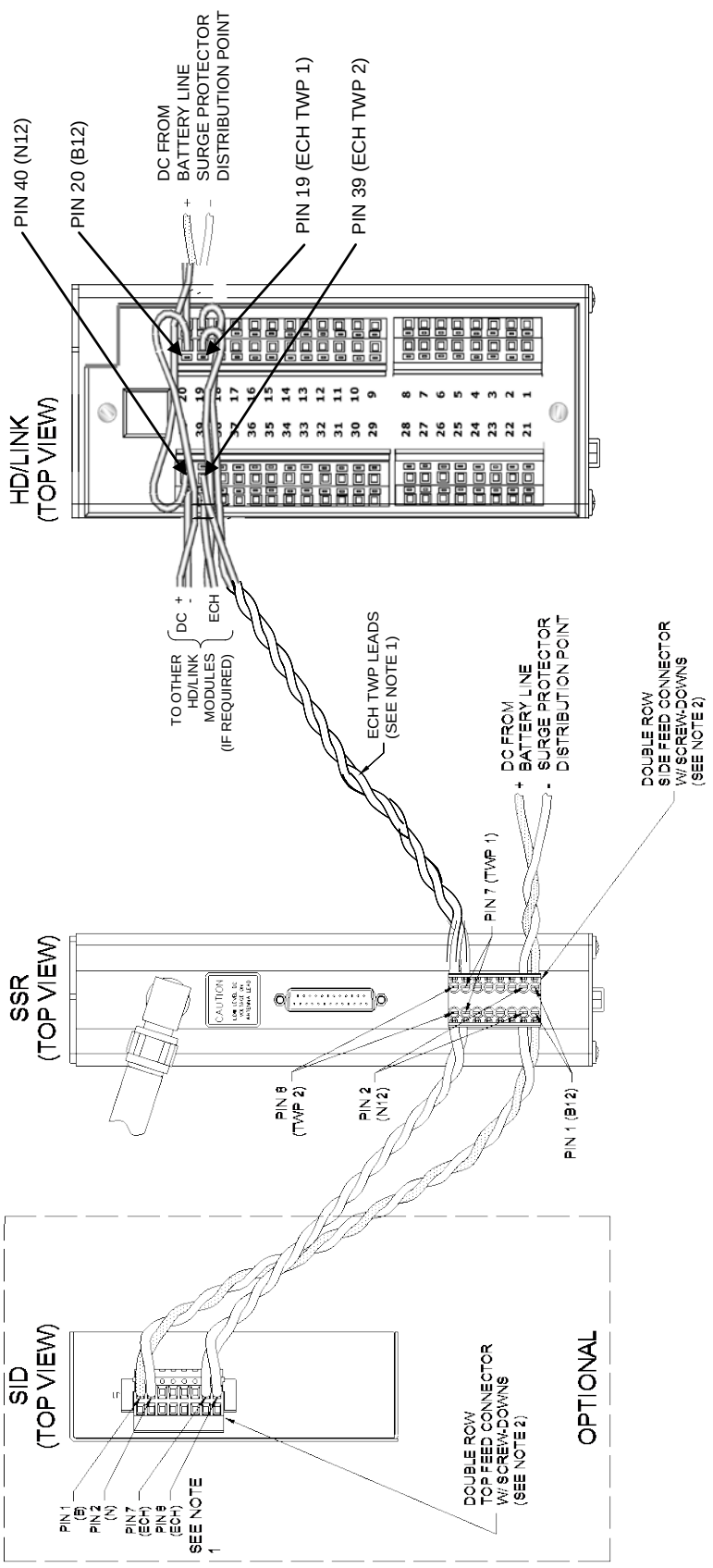
Version No.: B.2
June 1999, Revised May 2014

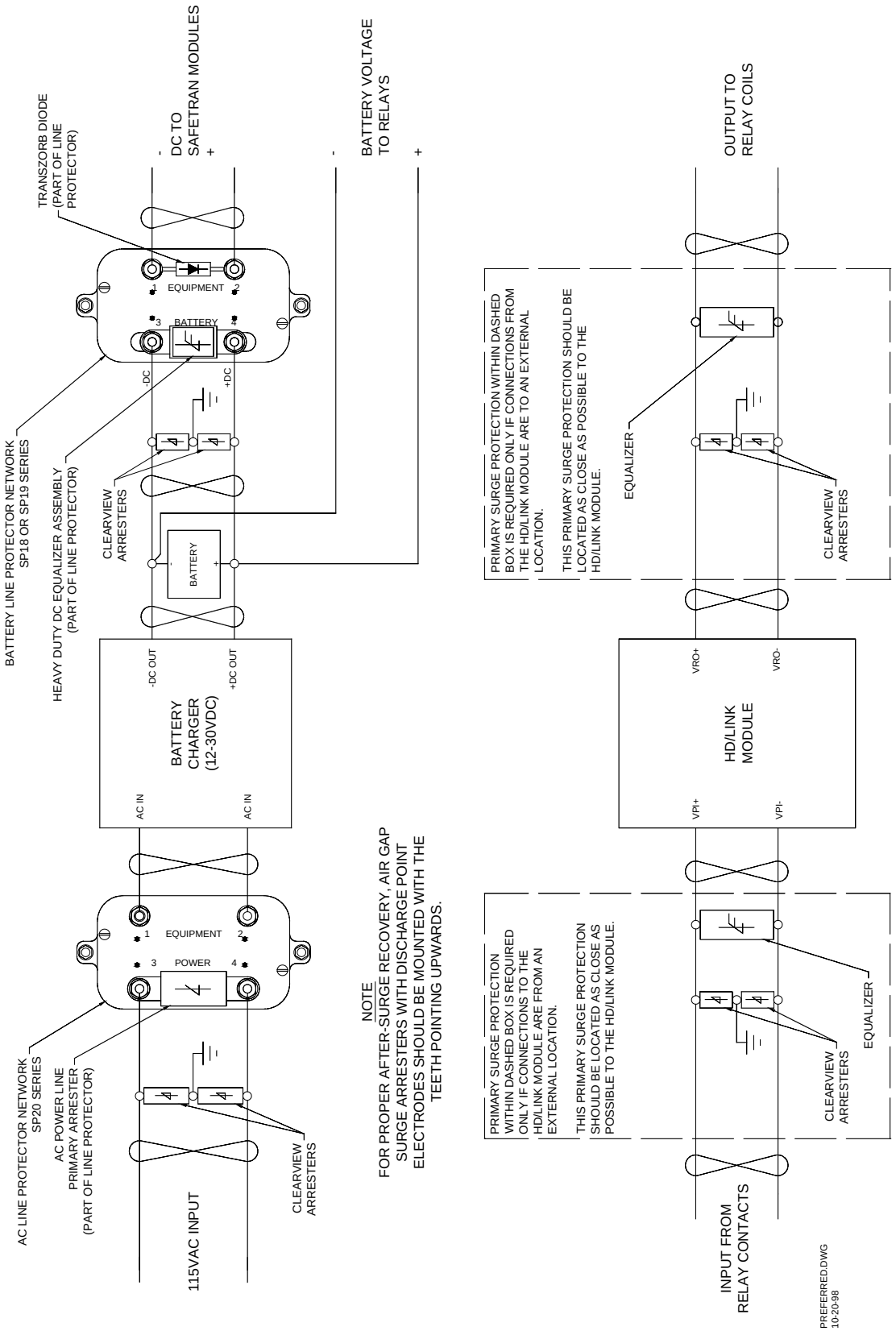


NOTES

1. POLARITY OF THE ECHELON (ECH/TWP) LEADS IS ARBITRARY
2. IF DAISYCHAINING IS NOT REQUIRED, SINGLE ROW CONNECTORS MAY BE USED.
3. USE ONLY STRANDED WIRE FOR INSERTION IN CONNECTORS WITH CAGE CLAMPS
4. SUGGESTED WIRE IS STRANDED #16AWG (RED/BLACK) FOR POWER, AND #22AWG TO #18AWG (BLACK/WHITE) FOR ECHELON CONNECTIONS.

DETAILDWG
05-22-13 CAP

MODULE WIRING DETAIL



HD/LINK SYSTEM PREFERRED SURGE PROTECTION WIRING

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