Symmetricom

TimeHub 5500

System Manual

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WARNING: This equipment generates, uses, and can radiate radio frequency energy, and if not used in accordance with the instruction guide, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

What's New in This Version

Issue 6 of this document contains the following updates from the previous issue.

Chapter 1, Description

- Figure 1-1, Shelf: Revised figure.
- Section 1.3.5, Clock Cards: Revised section.
- Section 1.3.5.1, Passthrough Mode: Revised section with latest information on Passthrough Mode.
- Section 1.3.7, Alarms: Revised section.

Chapter 4, Operational Verification & Configuration

- Renamed Chapter 4 from "Test" to "Operational Verification and Configuration".
- Section 4.7.1.1, Office: Replaced note after third paragraph.

Chapter 5, Maintenance

- Table 5-2, Output Driver Card Front Panel Items: Revised table.
- Table 5-3, Management Card Front Panel Items: Revised table.
- Added information on EC Card in Figures 5-4 and 5-7, Table 5-4, and Procedures 5-4 and 5-8.

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Chapter 1

Description

This chapter includes:

1.1 Overview

The TimeHub 5500 is a building integrated timing supply (BITS) redundant timing distribution system for 1.544 Mb/s primary rate networks. The system tracks incoming timing references, qualifies the signals against network timing standards, then filters and distributes precise timing to all network elements in the node.

The TimeHub 5500 clock uses precision timing references such as Primary Reference Clocks (PRCs) (cesium frequency standards), GPS Primary Reference Source (PRS) receivers, and DS1 input references from other nodes to generate synchronized composite clock (CC) (64 kb/s) and DS1 (1.544 Mb/s) timing output signals. These signals provide timing synchronization inputs to various network elements. If required, the TimeHub 5500 provides SmartClock holdover that exceeds Stratum 2 accuracy.

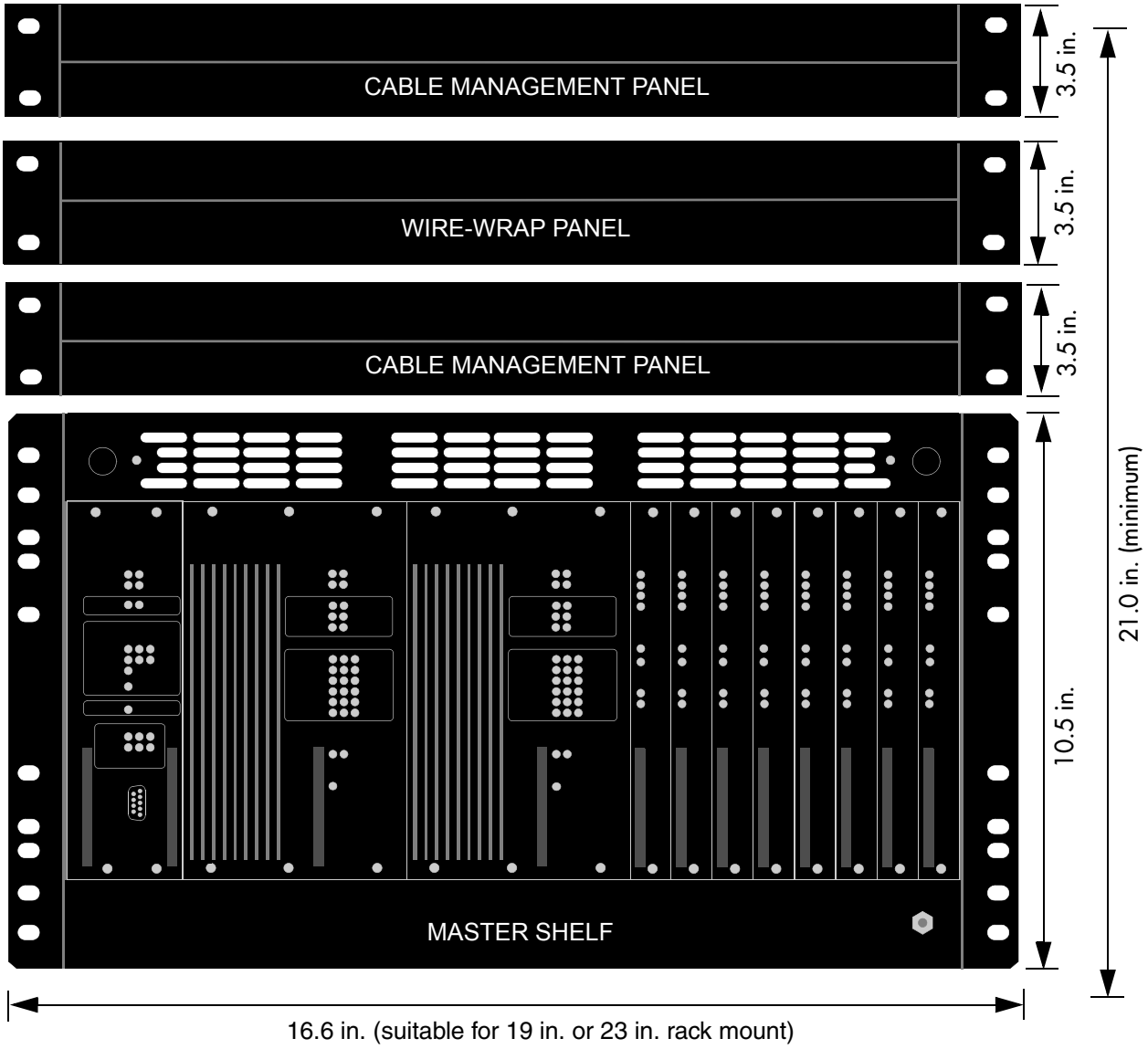
TimeHub 5500 applications include providing timing synchronization for ATM, SONET, and digital wireless networks.

1.2 Physical Description

The TimeHub 5500 consists of a shelf, wire-wrap panel(s), plug-in cards, connector modules, cables, hardware, and software. Options include clock cards with four additional DS1 inputs for a total of nine inputs.

The shelf (Figure 1-1) and the connection panel(s) can be mounted in a 19 inch rack or a 23 inch rack. Other than a communications connector on the management card at the front of the shelf, all connectors are at the rear of the shelf and connection panel(s).

Figure 1-1. Shelf



1.3 Functional Description

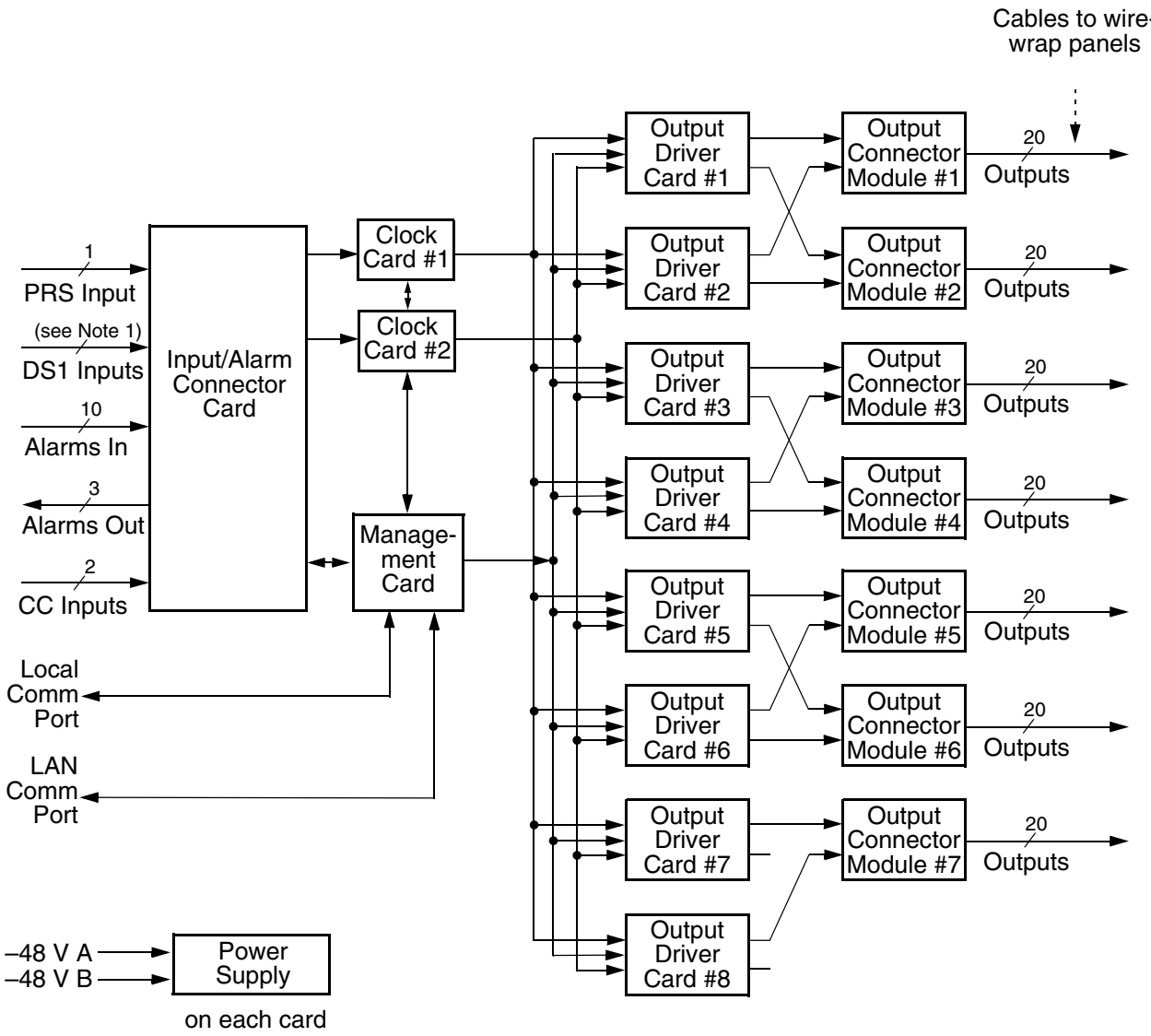
The TimeHub 5500 System accepts up to five incoming signals, selects one of the qualified references (inputs 1–5) as the active tracked reference using criteria programmed by a system administrator, then filters and distributes precise timing signals to the office equipment. Inputs 6–9 can be monitored for performance but not selected as the active source driving the outputs.

Figure 1-2 shows a block diagram of a TimeHub 5500 with redundant clock cards and 140 protected outputs. The outputs of each clock card and the management card are connected to all output driver cards. Expansion shelves are capable of providing 320 protected outputs.

If all reference inputs fail, the system continues to provide timing by using its own internal reference as a source (holdover).

If both clock cards are removed, the management card has a feature which allows the system to provide an unfiltered version of an input to the output cards (passthrough). This feature is available in the master shelf only. In the future, it will be available on the remote shelf.

Figure 1-2. Block Diagram



Note 1: 4 DS1 reference inputs or 4 DS1 reference inputs and 4 DS1 monitor signals.

1.3.1 Communication Ports

1.3.1.1 LAN

The LAN connection provides a means for the TimeHub 5500 to be accessed via Ethernet. Network parameters are configured using TL1 commands. TimeHub 5500 can support up to 10 simultaneous network sessions.

1.3.1.2 Local

There are two Local port connections: one on the rear of the shelf and one on the management card. Dual connections are provided for access convenience and both are physically connected to the same serial port. These ports provide a means for TL1 command access to the TimeHub 5500.

NOTE: Communication cannot be established to both of the Local ports simultaneously; only one port can be used at a time.

1.3.2 Power Supply

Each card is provided with its individual power supply unit. Two external power inputs supply the voltage to each card on the shelf.

1.3.3 Timing Inputs

The TimeHub 5500 Shelf has five timing inputs: one PRC input and four DS1 inputs. Optionally, four additional DS1 timing inputs can be monitored, depending on the type of clock card used.

DS1 inputs 1–4 can be used as a reference or can be monitored. (DS1 inputs 5–8 can only be monitored.) If used as a reference, the input may be used for tracking and can cause events or alarms if not qualified. Performance monitoring is also available for inputs used as references. If monitored only, the input is monitored without being used for tracking and no alarms occur, but the signal status is indicated via the TL1 interface.

1.3.4 Synchronization Status Messaging

The TimeHub 5500 supports input and output of SSM (Synchronization Status Messaging). SSM provides a method for providing clock quality information to any equipment that uses synchronization inputs. For DS1 signals, SSM information can be encoded on ESF (Extended Super Frame)

signals. D4 (also known as SF) DS1 signals are not capable of transporting SSM.

The relationship between SSM quality level and the meaning attached to each level is listed in Table 1-1.

Table 1-1. SSM Quality Level and Meaning

Description	Quality Level	Abbreviation
Stratum 1 Traceable	1	PRS
Synchronized - Traceability Unknown	2	STU
Stratum 2 Traceable	3	ST2
Transit Node Traceable	4	TNC
Stratum 3E Traceable	5	ST3E
Stratum 3 Traceable	6	ST3
SONET Minimum Clock Traceable (20 ppm clock)	7	SMC
Stratum 4 Traceable	8	ST4
DON'T USE for synchronization	9	DUS
Reserved	10	RES

1.3.4.1 Input SSM

The TimeHub 5500 provides several input-related SSM capabilities.

Foremost is the ability to extract and report the encoded SSM value on any of the timing inputs. The TL1 keyword CURRSSM provides this capability. For detailed syntax, see the description of this keyword in the TL1 Reference Manual. It provides the capability to select any of the inputs and retrieve the SSM value currently associated with that particular input. The value returned is the Quality Level in Table 1-1. There are several considerations that need to be understood when using CURRSSM:

- Some types of inputs are not capable of providing SSM information (for example, D4 framed DS1 and 5/10 MHz inputs). However, it is necessary to allow such inputs to have an associated SSM value to support SSM-based selection of the input to use as the active timing reference. Otherwise, if only ESF signals with valid SSM information were allowed, the non-SSM carrying inputs could never become the active reference when the synchronization mode is set to SSM (see SYNCMDE description below). The QLEVEL keyword provides this capability. Using QLEVEL, an assumed SSM

value can be assigned to each of the inputs. For all inputs, if the SSMENB setting is "N" (see next comment), CURRSSM will simply respond with the QLEVEL setting.

- The SSMENB (SSM Enable) keyword is used to tell the TimeHub that this input should actually extract SSM information from the input (as opposed to using the QLEVEL setting for the input). When an input is enabled for actual SSM extraction, the extracted value is retrieved using the CURRSSM keyword. Thus, CURRSSM always returns the SSM quality level associated with the selected input, regardless of whether this quality level is obtained from the QLEVEL setting (SSMENB disabled) or from the input itself (SSMENB enabled).

- With SSMENB enabled (meaning that SSM information is to be extracted from that particular input), there are several situations to consider:

  - If no valid SSM value has yet been read on that input and the input is qualified (otherwise determined to be usable as a timing reference) its quality level will be reported as 2.

  - If the SSM value is actually being read from the input, the quality level will be reported according to the extracted value. This would be the normal situation for using this feature.

  - If the SSM value has been read but then becomes no longer readable for a period of about 10 seconds (even though the input otherwise remains usable as a timing reference), the reported quality level will be 255. This special value is used to uniquely identify this situation. If SSM values subsequently become readable, the actual SSM value will again be reported via CURRSSM. If SSM remains unreadable, disabling and re-enabling SSMENB will re-initialize the input to report a quality level of 2, since this returns the input to the situation of no valid SSM value has yet been read (same as first situation above).

1.3.4.2 Using SSM to Determine the Active Timing Reference

It is possible to use the input SSM values for determination of which input will be selected as the active timing reference. The SYNCMDE keyword provides this control. There are four settings, one of them being "SSM". When SSM is selected, the CURRSSM value is the primary decision-maker for selecting the input to use (the input must be otherwise qualified for use to be selected). Given that SYNCMDE has been set to SSM, there are several considerations:

- The qualified input with the numerically lowest SSM quality level

will be selected as the active timing reference. The quality level associated with each input can be read using the CURRSSM keyword. There is no preference given to an input that is actually extracting SSM values (requires enabling SSMENB) compared with one that is using an assumed SSM quality level (SSMENB disabled).

- If more than one qualified input has the same SSM quality level, the SSMPRI (SSM Priority) setting completes the selection. In such a case, the qualified input with the numerically lowest SSMPRI setting will be selected as the active reference.

- If the CURRSSM quality value for an otherwise qualified input is numerically higher than the quality level of the internal reference oscillator in the clock card, that input will be disqualified and hence cannot be selected as the active timing reference. The rationale for this is that the internal reference oscillator will provide a better timing reference than any input with a lower quality level. The quality levels for TimeHub 5500 internal oscillators are 3 for any rubidium type clock (090-55513-01 and 090-55514-02) (Stratum 2 traceable) and 5 for any quartz type clock (090-55511-01 and 090-55512-02) (Stratum 3E traceable). The QCUTOFF keyword can be used to set an additional quality value that will disqualify any input whose CURRSSM value is larger than the selected QCUTOFF value.

1.3.4.3 Output SSM

SSM encoding will occur for any DS1 output that has been selected to have ESF framing. Normal operation will automatically provide an appropriate SSM quality level on such outputs, but there is also provision to override the automatic setting and manually set the quality level to be encoded on DS1 ESF outputs. Here are some details regarding how the SSM quality level is set for ESF outputs:

- During normal operation, where a qualified input is being used as the active timing reference, the SSM quality level of that input will be copied to all DS1 ESF outputs. This quality level can be read by retrieving the CURRSSM value, selecting the currently active timing reference. If the active reference changes to a different input, the SSM output will become that of the newly selected input. Note that the SSM value is output on DS1 ESF outputs regardless of the selected synchronization mode (see SYNCMDE discussion above). It isn't necessary for SYNCMDE to be set to "SSM" for outputs to encode SSM information.

- When the TimeHub 5500 is using an internal oscillator as the timing reference source, the output SSM quality level will be the quality level appropriate to the performance level of that internal

oscillator. This will be a quality level of 3 for any rubidium type clock (090-55513-01 and 090-55514-02) (Stratum 2 traceable) and 5 for any quartz type clock (090-55511-01 and 090-55512-02) (Stratum 3E traceable). This will typically occur in a couple of situations:

- Following warm-up, the clock card will enter freerun mode (indicated by front-panel LED) while input references are being qualified. During this time the internal oscillator on the active clock card is the active timing reference.

- If, for some reason, all external timing references become disqualified (for example, signal is lost), the TimeHub 5500 will enter either Freerun or Holdover mode (indicated by front-panel LED). In either mode, the internal oscillator on the active clock card becomes the active timing reference. If external timing references later become re-qualified, the TimeHub 5500 will return to normal operation, no longer using the internal oscillator as the active timing reference.

- It is possible to override the normal behavior for setting of SSM values on DS1 ESF outputs by using the OMANSSM (Output Manual SSM) keyword. This provides the capability to select a specific SSM quality level to be output on a per output card basis. By enabling OMANSSM (set to "Y") for a particular output card, any DS1 ESF outputs associated with that card will output the quality level set via the OQLEVEL (Output Quality Level) keyword. A primary reason for providing this capability is to allow information such as "DON'T USE for synchronization" (quality level 8) to be sent to downstream equipment during maintenance operations.

TL1 commands are used to enable SSM and assign quality levels.

1.3.5 Clock Cards

Clock cards provide input monitoring, selection, and holdover. Two types of clock cards are available:

- Standard clock cards: These cards are equipped with five inputs (four DS1 and one 5/10 MHz) and do not support expansion shelves).

  - Five-input with an ST2E rubidium oscillator (090-55513-01)

  - Five-input with an ST3E quartz oscillator (090-55511-01)

- Extended capacity clock cards: These cards are equipped with nine inputs (four DS1, four monitoring inputs, and one 5/10 MHz) and do support expansion shelves. Please note that if you will have an

expansion shelf (or shelves) attached to a master shelf, you require extended capacity clock cards.

- Nine-input with an ST2E rubidium oscillator (090-55514-02)
- Nine-input with an ST3E quartz oscillator (090-55512-02)

Two clock cards are required for redundancy; oscillator types can be mixed.

Each clock card receives the input reference signals from the Input/Alarm Connector card, determines their quality for use by the system, and selects the most appropriate input signal to use as the active reference. During normal operation, the active clock tracks the active input signal, and produces a precise frequency for the output driver cards based on the input reference. The standby clock does the same thing except its output is not used by the output driver cards. The standby clock backs up the active clock, ready to become active when necessary.

If the input reference is disqualified, the clock card selects another qualified input signal as the reference. If no input references are qualified, the clock card goes into holdover, using its own oscillator as the system reference.

1.3.5.1 Passthrough Mode

The TimeHub 5500 supports a capability to provide a usable clock in a situation where both clock cards are removed. The capability is called Passthrough and resides on the TimeHub management card. The management card has connection to the timing inputs, which it continually monitors for signal presence.

Passthrough mode occurs in the following instances:

- Passthrough will only be possible when a clock card has qualified at least one input since the management card was powered. The management card monitors the clock cards for qualified inputs; if no qualified input has been detected, Passthrough will not enable upon removal of clock card clocks. When the management card has determined that Passthrough is ready, an automatic message, PTAVAIL, is issued. Passthrough readiness can be checked at any time via the TL1 RTRV-COND command.
- When Passthrough mode is activated, the input selected as the reference is based upon the following hierarchy:
  - The first choice will be the active reference that had most recently been selected by the clock card before it was removed.
  - If the first choice is not available (due to loss of signal), Passthrough will attempt to select from the other inputs that

had most recently been qualified by the clock card before it was removed. The attempt will begin with the lowest numbered input.

- If none of the inputs that had been most recently qualified are available (due to LOS), Passthrough will select any other input that is providing a signal. The selection attempt will start with the lowest numbered input.

- For example, if inputs 1,3, and 4 had been qualified by the active clock card and input 3 was the active reference just prior to removal of the clock card:

  - Input 3 will be the first choice. If it is not providing a signal then

  - Input 1 will be the next choice since it had been qualified by the clock and it is the lowest numbered such input. If it is not providing a signal then

  - Input 4 will be the next choice since it had been qualified and is the next lowest numbered such input. If Input 4 was selected and it goes away, Passthrough will cycle through the set of previously qualified inputs, in case one has returned. If it is not providing a signal then

  - If none of the qualified inputs are available, Passthrough will look on the remaining inputs for a signal. In this case, the only remaining inputs would be 0 (the 5/10 MHz input) and input 2 (DS1 input). Starting with 0, if an input is detected, it will be selected as the active reference.

- If no timing input is providing a signal while in Passthrough, the outputs will disable and Passthrough mode will end. Unlike clock cards, which have the ability to provide holdover capability when all timing inputs are removed (and thus maintain output timing), the management card cannot provide holdover. Hence, outputs are disabled if there is no timing input when in Passthrough mode.

There is a lamp on the management card that will illuminate if Passthrough mode becomes active. An automatic message is also provided on both communication ports whenever Passthrough operation begins or ends.

Details of the passthrough capability depend upon the firmware and hardware versions of the management (090-55542-01), clock (090-5551x-xx), and expansion controller (090-55545-01) cards. See note at end of this section for how to check firmware and hardware versions.

If either the management or clock cards contain firmware prior to 4315B or have hardware version A, then the passthrough capability will be as follows:

- Passthrough will function only if the shelf is configured as a master system. Passthrough will not function if the shelf is configured as a remote system.

- There are likely to be brief phase-hits on the outputs when entering and exiting passthrough mode.

- If an expansion shelf is connected to the master it will also operate in passthrough mode.

If the management and clock cards contain firmware version 4315B or later AND have hardware revision B or later, then the passthrough capability will be as follows:

- Passthrough will function when the shelf is configured as either master or remote. As should be expected, for a remote shelf the timing references must be CC1 inputs. For a master shelf the timing references must be DS1 or 5/10 MHz inputs.

- Phase-alignment between input and output is maintained during the transition into passthrough from normal operation, while in passthrough, and during the exit from passthrough back to normal operation.

  While this feature applies to both master and remote shelves, the easiest way to understand it is to consider a remote shelf that is timing a CC input prior to entering passthrough mode. Prior to passthrough mode, the alignment of the active CC input and any output CC will be nearly perfect. If you observed the positive bi-polar violations on the input and any CC output on an oscilloscope you would see that they are completely aligned. The Passthrough feature is that this alignment will be maintained while entering into Passthrough, while in Passthrough, and when exiting from Passthrough back to normal operation (which would occur when a clock card is re-inserted). Thus, the phase alignment between input and output is never lost during the entire passthrough episode.

If an expansion shelf is connected, it will also operate in Passthrough mode, but its behavior will depend on the firmware revision of the expansion controller cards:

- If an expansion controller card contains version A firmware, outputs from that expansion shelf will not maintain the pre-Passthrough phase-alignment while in Passthrough mode of operation.

- If an expansion controller card contains version B (or later) firmware, outputs from that expansion shelf WILL maintain pre-Passthrough phase-alignment while in Passthrough mode of

operation.

NOTE: Since Passthrough is not a normal operating mode, it should not be routinely used. It is intended to provide a mechanism to “keep alive” the outputs in a situation where both clock cards are inadvertently removed. The timing performance when in Passthrough mode cannot be assured.

There are several restrictions and special considerations that apply to Passthrough operation:

- There are likely to be brief phase hits on the outputs when entering and exiting Passthrough mode
- No configuration of clock or outputs is possible while in Passthrough mode
- Passthrough input qualification is as described previously. It does not have the capability to reject inputs with excessive jitter or that are significantly off frequency.
- Passthrough does not filter input-to-output in the same way as a clock card, so out-of-mask timing (for example, TDEV and MTIE) is possible.

To check firmware or hardware revision numbers, use the RTRV-NETYPE-ALL command as shown below.

- For firmware revision numbers, a higher numeric value indicates a later (newer) revision. For example, 4315B is newer than 4312A because 4315 is larger than 4312. Firmware version information always appears in the second comma-separated field after the product number information.
- For hardware revisions, later occurring letters indicate newer revisions (revision B is newer than revision A). The hardware revision information is appended to the product number information. For example, 090-55542-01-B indicates model number 090-55542-01 having hardware revision B. In cases where there is no hardware version indicated (just a product number), it means the hardware revision is A.

As an example, sending

```
RTRV-NETYPE-ALL:::SV73;
```

Produced the following response on a TimeHub shelf (entire response not shown):

```
 SYMMBITS 03-06-06 17:25:32
M  SV73 RTRV
   "EQPT:Symmetricom,5500,EQPT"
   "S0-IMC:,090-55542-01-B,,R4315B,J86753,D0TPN0VAAA,116737"
   "S0-CLK1:,090-55512-02-B,,R4315B,J45060,D0TPVP0AAA,267862"
   "S0-CLK2:,090-55512-02-B,,R4315B,L03149,D0TPVRKAAA,299460"
   "S0-OUT1A:,090-55581-01-A,,R4209A,00J21554,D0TPJN0AAA,267799,CC,DS1"
   "S0-OUT2A:,090-55581-01-A,,R4114C,00J21553,D0TPJN0AAA,267799,CC,DS1"

>

   SYMMBITS 03-06-06 17:25:32
M  SV73 COMPLD
   "S1-CLK1:,090-55545-01-A,,B,,D0C1ZZ0AAA,299465"
   "S1-CLK2:,090-55545-01-A,,B,,D0C1ZZ0AAA,299465"
   "S1-OUT1A:,090-55581-01-A,,R4209A,00J43238,D0TPJN0AAA,267799,CC,"
   "S1-OUT2A:,090-55581-01-A,,R4114C,00J63667,D0TPJN0AAA,267799,CC,"
   "S1-OUT12F:,090-55581-01-A,,R4209A,00J21578,D0TPJN0AAA,267799,DS1,"
   "S1-OUT13G:,090-55581-01-A,,R4236A,00J43224,DOTPJN0AAA,267799,,"
;
```

The lines that begin with "S0-" are providing information on the main shelf.

- The "IMC" row shows that the management card contains hardware revision B (appears just after the product number 090-55542-01) and firmware revision 4315B.
- The "CLK1" and CLK2" rows show that both clock cards contain hardware revision B (appears just after the product number 090-55512-02) and firmware revision 4315B.

The lines that begin with "S1-" are providing information on the expansion shelf.

- The "CLK" rows show that the expansion controller cards in this expansion shelf both contain hardware revision A (appears just after the product number 090-55545-01) and firmware version B. The firmware version info is the "B" that is located in the comma-separated field 2 positions to the right of the product number field.

Based on this example, this shelf has the full Passthrough capability since it meets all of the criteria indicated in the line "If the management and clock cards contain firmware version 4315B or later AND have hardware revision B or later..."

1.3.6 Management Card

The management card manages alarms to and from the TimeHub 5500 System, and provides local and Ethernet LAN communication interfaces.

If an alarm condition occurs, the management card determines whether the alarm state is critical, major, or minor, actuates the corresponding alarm relays, causes the appropriate lamps to light, and generates TL1 alarm message(s) via the local or LAN communication interface.

1.3.7 Alarms

Alarms are indicated by shelf and card status lamps, and TL1 messages reported via the local or LAN communication interface. In addition, contact closures are provided.

As shown in Figure 4-6, there are front panel alarm LEDs for both "System" and "Shelf" alarms. A shelf alarm is one that occurs from within the TimeHub shelf, a system alarm is one that is sensed via one of the external alarm wirewrap inputs on the input/alarm card (see Figure 4-4). If an alarm is sensed on any of these 10 external alarm inputs, it will show as a "System" alarm on the management card front panel. All other alarms will be "Shelf" alarms.

If there should happen to be alarms simultaneously occurring that have different severity levels, only the one of highest severity will be shown on the front panel LEDs if the alarms are both either in the "System" or "Shelf" category. For example, if there are both MAJOR and MINOR shelf alarms present, only the MAJOR alarm LED will be lit in the "Shelf" alarm row. In this case, if the MAJOR alarm ends, then the MINOR alarm LED will light (assuming that the source of that alarm is still present) since this is now the highest severity shelf alarm.

If there is a MAJOR shelf alarm and a MINOR system alarm (any of the external alarms in 7 to 10 range) then the MAJOR LED will be lit for the shelf alarm row and the MINOR LED will be lit for the system alarm row. In other words, it is possible to have alarm LEDs of different severity illuminated if one is a shelf alarm and the other a system alarm.

In all cases, all current alarms will be reported via the TL1 command interfaces (serial and network) and can be retrieved at any time via the RTRV-ALM query (see TL1 reference manual). If there are multiple alarms of the same and different severity, all will be provided in the RTRV-ALM response.

1.3.7.1 Contact Closure Inputs

Up to 10 contact closure inputs are provided to connect to relay outputs of equipment external to the shelf.

1.3.7.2 Contact Closure Outputs

Contact closure outputs are provided to actuate visible and/or audible alarm indicators to inform the office of an alarm condition within the shelf.

NOTE: Contact closure outputs are generated by the management card. The management card is required in order to generate contact closure alarms or TL1 messages.

1.3.8 Output Driver Cards

Output driver cards provide non-protected or protected DS1 or CC outputs. A single output driver card provides 40 non-protected outputs. Two output driver cards functioning as a pair provide 40 protected outputs. A single output driver card can provide 20 DS1 and 20 CC outputs or 40 of either type. There can be up to 140 outputs per shelf, with a combination of DS1 and CC outputs.

1.3.8.1 Output Port Alarms in TimeHub 5500

The TimeHub output cards contain a sensing circuit whose purpose is to detect output signal failures. There is such a circuit associated with every output port. The intent of the sensing circuit is to detect and report on internal component failures associated with the port output circuitry.

When a port alarm is detected on a given output card, there are several responses:

- For output cards with FPGA version A, the Fail LED on the output card will illuminate. For output cards with FPGA version B or later, the Alarm LED on the output card will illuminate. (FPGA version can be seen at the end of output card version information in RTRV-NETYPE-ALL response).
- An OPPTFLXX (Output Port Fail) event is generated, where XX identifies the specific port number.
- If both output port cards in a redundant pair have detected port alarms on the same port, the OPTALMEXT (“Alarms on same ports - check external conditions”) event will be generated. See detailed description of this event in Table M of the TimeHub 5500 TL1 reference manual.
- If both output cards in a redundant pair have detected port alarms but not on the same ports, the OPPRFL event is generated. See detailed description in Table M of the TimeHub 5500 TL1 reference manual.

False Reporting of Output Port Alarms

When connecting an output signal from TimeHub to a single-ended device (such as an oscilloscope or other type of test equipment), it is possible that false port alarms may be reported. This can occur when the connection from the TimeHub differential outputs (Tip and Ring) to the single-ended device (which has signal and ground) is made improperly. Often this connection is made by connecting Tip or Ring to ground (shell of connector on test equipment) and the other signal (the one that was not connected to ground) to the signal input on the test equipment. Connecting in this way creates a path for ground-related noise coming from the test equipment ground (e.g., 60 Hz from utility, ground-loop effects, etc.) to be injected back into the alarm-sensing circuit in TimeHub (via the Tip or Ring that was connected to equipment ground). The result can be that the sensing circuit sees its detection thresholds exceeded (due to the induced noise) and reports a false port alarm. This same situation can also temporarily occur when connecting or disconnecting differentially with test equipment if the connection plug has the possibility of momentarily allowing either of the differential signals to contact the equipment ground. In this case a way to avoid the possible false port alarm is to enable the output only after the physical connection to the test equipment is completed.

Other than the possible alarm reporting, a measurement made with such a connection remains as valid as it would otherwise have been. While such a connection cannot be used in any case for evaluation of output signal characteristics such as mask compliance or amplitude levels (because the connection scheme is inherently improper due to direct connection of a signal line ground), it is an acceptable method for basic signal checking such as signal presence. Even though TimeHub may report a port alarm, the TimeHub output signal will still be generated. Also, this connection method will not damage the TimeHub output circuits.

So, while it is acceptable to directly connect as described previously (for limited types of tests), the recommended method for connecting from differential to single-ended is via a transformer, as is expected when connection is made to the equipment that will ultimately be timed by the output. With this type of connection, reporting of false port alarms should not occur.

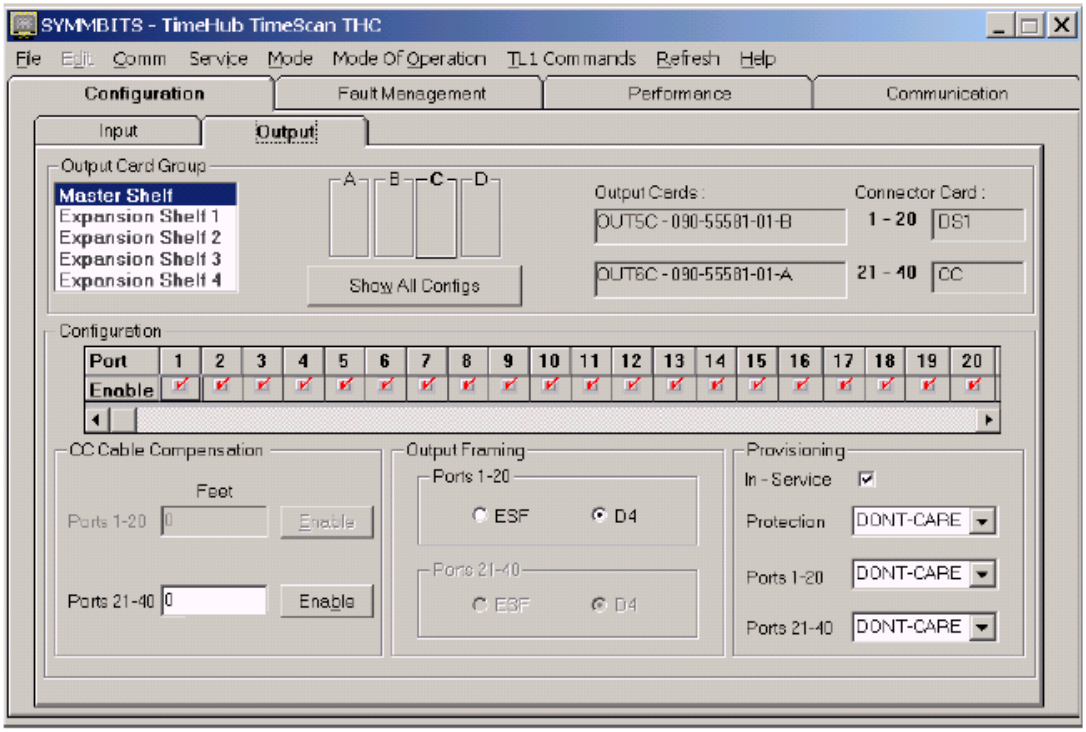
Clearing of False Port Alarms

A false port alarm will normally self-clear when the reason for its occurrence is removed. For example, if TimeHub Ring output connected to test equipment ground is the reason for a false port alarm, removing that connection will typically clear the alarm within a few seconds. If the alarm does not self-clear, the CLRPTALL keyword can be used to request an attempt to clear the alarm (see TimeHub 5500 TL1 reference manual, keyword CLRPTALL).

Using TimeScan THC software, the clear attempt can be activated via the following sequence:

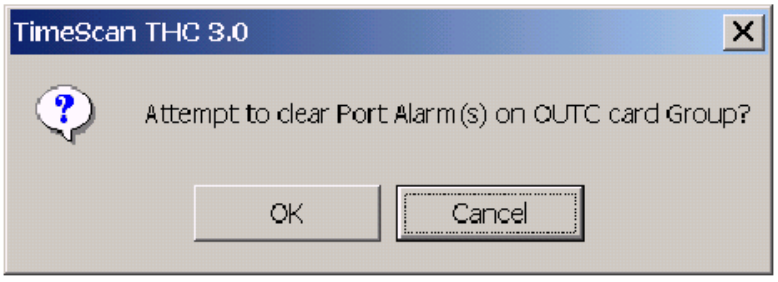
1. Select the **Configuration --> Output** screen (Figure 1-3) and identify the output card group that is to have port alarm clear attempted. In the example shown, the **C** output group on the Master shelf is selected.

Figure 1-3. Configuration --> Output Screen



2. Select the **Service --> Port Alarm Clear...** menu, which will bring up a screen similar to Figure 1-4.

Figure 1-4. Attempt to Clear Port Alarm Query Screen



NOTE: The screen identifies that the C card group is the target for clearing. Click the **OK** button to proceed with the attempt to clear the alarm.

NOTE: The circumstance where a false port alarm will not self-clear after the condition causing it is removed is when the false alarm had been generated on only one output card in a redundant pair. This could occur since each card independently senses port alarms and could be impacted slightly differently by injected noise. The effect could be that one card has its sense line near but slightly below the alarm threshold (hence no alarm); the other has its sense line near but slightly above the alarm threshold (hence it alarms). When only one card alarms (in a situation where there is a good standby) it effectively remains latched in the alarm state because it disables itself and becomes no longer able to test for poor alarms.

If there is only one output card in the card group (non-redundant), the sensing of a port alarm does not disable the output, hence it continues to sample for the port alarm condition. In this situation the false port alarm will always self-clear if the external cause is removed. Similarly, if the second card in a redundant pair senses a port alarm after the first card has sensed an alarm, the second card does not disable its outputs so it will always self-clear upon removal of the external cause of the false port alarm.

1.3.9 Output Connector Modules

There are two types of output connector modules: DS1 and CC Output Connector modules. Each module contains the hardware required to interface with the output type (DS1 or CC). The output driver card reads the output connector module to determine the appropriate voltage levels, frequency, and format for the corresponding output type.

1.3.10 Connection Panels

Timing output connections between the TimeHub 5500 System and network elements are made at the wirewrap connection panel. Each wirewrap connection panel can accommodate up to 160 outputs.

1.4 Master/Remote Shelf

The TimeHub 5500 can be configured for use as a master shelf or as a remote shelf. The essential difference between these configurations is that a

master shelf will accept PRS (5 or 10 MHz) and DS1 inputs as timing references whereas a remote shelf accepts Composite Clock (CC) inputs as the timing reference(s). Typically, a remote shelf takes its CC timing inputs from a TimeHub or DCD master shelf, both which are capable of providing CC outputs.

Another major difference between the two shelf configurations is that the remote shelf does not provide performance monitoring data, which is available for the PRS and all DS1 inputs on a master shelf. For more information on performance monitoring, see that section in the TimeHub 5500 TL1 Reference Manual (097-55501-02).

The passthrough capability is currently not available in the remote shelf.

1.5 Remote Shelf Capability

The TimeHub Remote Shelf provides the capability to effectively extend the timing capability of a master shelf to a location physically remote from the master (up to 3000 feet). The timing links between master and remote are CC signals output from the master and accepted as input timing references at the remote shelf. The remote shelf clocks follow the input CC signals closely, which allows phase alignment of CC in to CC out to be maintained on the remote shelf. Unlike a master shelf, which provides significant filtering of the input timing references (PRS or DS1 signals), the remote shelf adjusts the outputs very quickly as changes occur on the CC inputs. Since the input CCs are being distributed from a master shelf that has already performed the desired filtering on its inputs, only small timing variations would typically be expected at the remote shelf inputs.

The most significant difference between master and remote shelf operation is in the type of timing reference used for input. The remote shelf provides the same output distribution capability that is provided by a master shelf.

In addition to accepting up to two CC signals as timing references, the remote shelf can accept up to two DS1 inputs which are used to extract SSM information only.

NOTE: The DS1 lines will not be used to extract synchronization signals, just the SSM messages.

A typical setup for a master/remote shelf combination would include:

- Two CC outputs taken from master shelf connected as CC inputs on remote shelf. The reason to use two outputs is for redundancy. Toward this end, to isolate the signal paths as much as possible, each CC could be taken from a different output group on the

master shelf (for example, one from the "C" group, another from the "D" group). The cable length delay from master to remote shelf can be compensated at either the master or remote shelf via the CCDEL and CCDENB keywords. The preferred method is to compensate the delay at the master shelf.

- Two ESF-framed DS1 outputs from the master shelf are connected to the first two DS1 inputs on the remote shelf. This provides a redundant method for the remote shelf to receive SSM information from the master shelf.

1.5.1 Operational Specifics

This section details unique capabilities (capabilities not available on a master shelf) of the TimeHub remote shelf. The TimeHub clock cards are designed to operate in either a master or remote shelf configuration. Configuration information is provided in the section titled "Configuring the Shelf as Master or Remote" in Chapter 3. When configured for remote operation, the clock front panel information for the inputs is associated with labeling to the right side of the Input LEDs. See Figure 4-8, which shows this region. The relevant labels are CC 1 and 2 and DS1 1 and 2.

1.5.1.1 CC Timing Inputs

Timing references for the remote shelf are connected at the input/alarm connector module, located on the back right (when facing the back) of the shelf (refer to Figures 3-5 and 3-14). This module supports both master and remote operation. For remote operation, the available timing inputs are labeled CC IN 1 and CC IN 2, located on the upper left of the module. This is where the Composite Clock (CC) references should be connected. Typically these signals will be provided from a TimeHub or DCD master shelf.

Procedure 1-1 describes setting up the CC1 input as a timing reference. This procedure is identical for CC2 by replacing any references to CC1 with CC2.

Procedure 1-1. Timing Reference Input Setup

Step	Action
1	Connect the CC signal that will be used for timing to the input labeled CC IN 1 on the input/alarm connector module (refer to Figures 3-5 and 3-14).

Procedure 1-1. Timing Reference Input Setup (Cont'd)

Step	Action
2	Verify that the input is enabled by checking the "E" lamp on either clock front panel (refer to Figure 4-8). Note that the clock panel labeling is to the right of the LEDS in the INPUTS section. The first row of three LEDs is labeled CC1. In this step, verify that the "E" LED in that row is lit. Note that when the "E" lamp is lit it does not indicate that a valid input is connected. It simply indicates that the input has been selected as a possible timing reference.

3	If the "E" lamp is not lit, enable the lamp using the TL1 keyword ENABLE. Procedure 4-9 describes how to connect to the TL1 interface. Specifically, the command needed to enable the CC1 input is:
	
	`ED-SYNC::CLK-10:SC1:::ENABLE=Y;`
	
	This should light the LED. The only change needed to enable CC2 is that CLK-10 changes to CLK-11.
	
	The following TL1 command can be used to verify that the input is enabled:
	
	`rtrv-sync::clk-10:SV16:::parameter=enable;`

4	Verify that the input is qualified by checking that the "Q" LED is lit. This is the "Q" LED in the same row as the "E" LED referred to in prior steps. It could take up to a couple of minutes for the "Q" LED to light after the "E" has been lit. "Q" stands for qualification. When this LED lights it means that the input has been evaluated to meet all requirements for use as a timing source (signal presence, framing, within frequency pull-in range all confirmed). If the "Q" LED does not light, there is most likely a problem with the input. Typical causes are no signal present or improper connection to input/alarm module. *Note:* Progress toward qualification can be observed via either the local or LAN communications port. Once connected, the TL1 RTRV-COND command provides this information (for example, input loss of signal or out of frame can be observed via RTRV-COND). Refer to the TimeHub 5500 TL1 Reference Manual for details.

Procedure 1-1. Timing Reference Input Setup (Cont'd)

Step	Action
5	Assuming that CC1 is the only qualified input, the "A" LED should also light, indicating that this is the Active timing reference, the one being used to drive any outputs provided by this shelf. Once either the CC1 or CC2 input has been qualified it will then be possible to generate outputs from the remote shelf. Note that it is possible to get the TimeHub remote shelf to produce output in Freerun mode (in other words, without a qualified input) by using the FREEACT TL1 keyword. The default setting for FREEACT on a remote shelf is SQUELCH, which means no output is possible when in Freerun mode. By setting it to CONTINUE output is allowed in when in Freerun. See TL1 reference for details.

End of Procedure

1.5.2 DS1 SSM Inputs

The TimeHub remote shelf accepts ESF-framed DS1 inputs as a method for receiving encoded SSM information from the master shelf that is supplying the CC timing reference(s). This feature provides a solution to the problem that the remote shelf timing references (CC signals) are not capable of carrying the SSM information. To overcome this, DS1 inputs are accepted since they can carry SSM. It is important to note that the sole function of these DS1 inputs is for SSM decoding, they are NOT used as timing references. By connecting one or two (for redundancy) DS1 inputs from the master shelf to the remote shelf, the remote shelf can pass onto its outputs the SSM of the master shelf. This allows the remote shelf to properly convey the synchronization status of its CC timing inputs.

The DS1 inputs for SSM decoding are connected to the wirewrap pins labeled "DS1 TERM IN", rows 1 and/or 2 on the input/alarm connector module (refer to Figures 3-5 and 3-14).

Procedure describes setting up the DS1 input 1 as an SSM source. The procedure is identical for DS1 input 2 by replacing any references to input 1 with input 2.

Procedure 1-2. Using DS1 Inputs for SSM Decoding on a Remote Shelf

Step	Action
1	Connect the DS1 signal to be used as a source of SSM to the input/alarm connector module wirewrap pins labeled "DS1 TERM IN" on the row labeled "1" (refer to Figures 3-5 and 3-14). Typically, this could be any ESF-framed DS1 output from the main shelf. Such a signal will always contain SSM encoding reflecting the current synchronization quality level of the main shelf.
2	Check to see if the "E" LED on the clock card is lit (if there are two clock cards in the shelf, observe this LED status on either one). For the DS1 input 1 signal, this will be the third row of LEDs in the INPUTS section. Note that this row is labeled DS1-1, indicating that it is providing status on any signal connected to the DS1 input 1 pins on the input module. The "E" LED, when lit, indicates that this input can be used for SSM decoding. If the "E" LED is not lit, that input will not be used for SSM decoding even if the input is present and valid.

3	If the "E" LED was not lit, it can be enabled using the TL1 keyword ENABLE. Procedure 4-9 describes how to connect to the TL1 interface. Specifically, the command needed to enable the DS1 input 1 is:
	
	`ED-SYNC::CLK-1:SC1:::ENABLE=Y;`
	
	This should light the LED. The only change needed to enable DS1 input 2 is that CLK-1 changes to CLK-2.
	
	The following TL1 command can be used to verify that the input is enabled:
	
	`rtrv-sync::clk-1:SV16:::parameter=enable;`

4	If the connected DS1 signal is carrying valid SSM, the "Q" LED will light within a few seconds. This LED, when lit, indicates that the input has be qualified as providing decodable SSM information. If the "Q" LED doesn't illuminate (and the "E" LED is illuminated) most likely causes are: • No signal. Check the configuration at the source. • Signal is present but it isn't an ESF-framed DS1. DS1 SF-framed (also known as D4 framing) signals are not capable of SSM encoding. The remedy would be to change the configuration at the source so the framing of this signal is ESF.

Procedure 1-2. Using DS1 Inputs for SSM Decoding on a Remote Shelf (Cont'd)

Step	Action
5	If the previous step of this procedure succeeded, the remote shelf is now able to use this DS1 input 1 signal as an SSM source. The "A" (Active) LED indicates that this input is currently being used as the source of SSM information for the remote shelf. When lit, any outputs carrying SSM will be encoded with the same SSM value that is being decoded on this input. The "A" LED will illuminate as long as none of the following conditions are present: • There isn't also a qualified SSM input in the DS1 input 2 row. If there is, it is possible that this input will be selected as the active SSM source instead of the DS1 input 1 signal. When both SSM inputs are valid the one that will be used is determined by the setting of the PRIORITY keyword. The default is that the DS1-1 input has the higher priority, so it will be selected when both inputs are qualified. See TL1 manual for details. • There isn't an active CC timing reference. If the remote shelf isn't actively following one of its CC timing inputs (which means the shelf is in holdover operation) it doesn't make sense to use either of the DS1 SSM inputs. The intent of these SSM inputs is to convey the SSM of the CC timing references so, if the CCs aren't being used, the SSM inputs shouldn't be either. If this condition is present (easily verified by no "A" LED on either CC input row), follow the procedure "Procedure for Configuring and Using Either CC1 or CC2 as Timing Reference" to activate a timing reference. Once accomplished the "A" LED on the DS1 input 1 row should also light.

End of Procedure

1.5.3 Details of Remote SSM Behavior

Table identifies how the source of SSM will be determined in a remote shelf for a variety of conditions. Other than the special case where the OMANSSM keyword is used to manually set the output SSM value (see TL1 Reference manual for details), the SSM source determines the SSM that will be encoded on any ESF-framed DS1 outputs generated on the remote shelf.

Table 1-2. SSM Source Determination for Remote Shelf

Condition	SSM Source
Shelf has no active timing reference ("A" is not lit in either CC1 or CC2 row).	The SSM value is that of the internal oscillator in the active clock card (see HFQLEVL keyword in TimeHub TL1 Reference Manual).

Table 1-2. SSM Source Determination for Remote Shelf (Cont'd)

Condition	SSM Source
Shelf has at least one active timing reference ("A" is lit in either CC1 or CC2 row).	The SSM value is taken from the "assumed" SSM value (see QLEVEL keyword in TimeHub TL1 Reference Manual) associated with the active timing reference. For example, if CC2 is the active timing reference, the SSM will be taken from QLEVEL setting for channel 11 (Channel 11 is the TL1 reference to CC2).
There are no valid SSM inputs. (No signal/or non-decodable signal connected to DS1-1 and DS1-2) OR neither SSM input is enabled ("E" LED not lit in both DS1-1 and DS1-2 rows).	
Shelf has at least one active timing reference ("A" is lit in either CC1 or CC2 row)	The SSM value is being decoded from the DS1 input that is showing "E", "Q", and "A".
There is a single valid SSM input ("E", "Q", and "A" lit on one DS1 input, the other one doesn't have "Q" lit)	
Shelf has at least one active timing reference ("A" is lit in either CC1 or CC2 row)	The SSM value is taken from the DS1 input that has the higher PRIORITY (lower numerical value) setting. This is the one that will have "A" lit. See TimeHub TL1 Reference Manual for details on PRIORITY keyword.
Both DS1-1 and DS1-2 are decoding valid SSM information ("E" and "Q" are lit for both DS1-1 and DS1-2 rows). Only one of these rows can indicate "A".	

1.6 Master Shelf Capabilities Supporting Remote Operation

When configured as a master shelf, there are several capabilities provided to facilitate operation of the shelf with a downstream remote shelf. These are the ability to phase align the master shelf CC outputs to a CC input and the ability to time-shift (advance or delay) the CC outputs from master shelf (which can facilitate cable-delay compensation). These capabilities are covered in this section.

1.6.1 Phase Alignment of CC Input and CC Output

The master shelf provides the capability to accept a CC input that can be used to phase-align any CC outputs that are being generated by the master shelf. "Phase-align" means that the bipolar violations will be adjusted on the output so that they are phase-matched (time-aligned) to the bipolar

violations (same polarity) on the input. The alignment will be to within tens of nanoseconds. See Figure for an example of a CC waveform.

To perform an alignment use the following procedure:

- Connect the CC signal that the master shelf is to align with to the CC IN 1 input on the input connector card (located on the back of the shelf, right hand sign as you face the back of the shelf). See Figure for the location of the CC IN 1 connections on the input connector card. There is no visual indication as to whether the signal you have connected is actually being received and decoded properly.

- To activate the alignment use the TL1 keyword CCALIGN. The exact syntax is shown in the TL1 Reference. When CCALIGN is set to Y, all output CC signals will be continually aligned with the CC IN 1 input. A good way to verify that the alignment is occurring is to observe the CC input (perhaps another one coming from the same source) and a CC output from the master shelf on a scope. It is easy to see if the alignment has occurred. Since the CC signals are balanced and a scope is a single-ended device some provision should be made to adapt the signals being observed, such as use of a differential probe or use of an in-line transformer to isolate the balanced and single-ended sides. However, even without these steps a reasonable observation of timing relationship between the two CC signals is usually possible.

If the input and output are not observed to be aligned, possible reasons include:

- The CC input has a problem, such as no signal is present, signal levels are incorrect or it has a formatting problem (such as it does not contain bipolar violations).

- There is a non-zero CC delay enabled on the CC output being observed. This is covered in the next topic, but the easiest thing to do is to temporarily disable the CC delay so that alignment is expected to occur without any timing offset. An alternative is to take into account the CC delay value that has been programmed when observing the timing relationships on the scope. For example, if a 3 us CC delay value has been set (and is enabled) the expectation on the scope measurement is that alignment is successful when a 3 us time difference is observed between the CC input and CC output.

NOTE: DS1 outputs on the master shelf are also phase-adjusted during the CC alignment process.

- Once the phase alignment is as expected, disable the alignment process by setting CCALIGN to N. This causes the master shelf to no longer use the CC IN 1 input as a reference, returning to normal operation using either PRS or DS1 inputs. When the shelf stops using the CC input, the phase alignment will be maintained. In other words, the phase of the active timing reference that is used upon setting CCALIGN to N will not cause a sudden shift in the CC output phase.

1.6.1.1 Programmable Delay of CC Outputs

For both master and remote shelves, the CC outputs can have a selectable amount of timing offset applied. The primary purpose for this capability is to provide a method for compensating time delay associated with long cable runs.

The capabilities of this feature are:

- Settable in 80 nanosecond increments.
- Range is plus or minus 10 µs. A value of 0 means that no additional offset is applied. Positive values delay the CC output by the amount specified. Negative values advance (make earlier in time) the CC output by the specified amount. To compensate for cable delay a negative value would be used. For example, suppose a master shelf is providing a CC output to a remote shelf and the cable delay has been determined to be 1.9 µs. By setting the CCDEL value to -1900 (value is set in nanoseconds) the alignment of the CC signal(s) at the remote shelf will be matched with a non-delayed CC output signal generated at the master shelf.
- Delay setting is accomplished using the CCDEL keyword. See TL1 Reference for details.
- For convenience, the delay compensation can also be set based on feet of cable. See CBCOMP keyword in TL1 Reference Manual.
- Each group of 20 ports on each output card group can have a unique delay value. For example, a CC delay value can be assigned to the first 20 ports of the "A" output group, a different value to ports 21-40 of the "A" output group, a different value to ports 1-20 of the "B" group, and so on.

Each individual output port can be selected to have the delay feature enabled or disabled. For example, it is possible to delay ports 29 and 30 of a given card group while not delaying any of the other ports in that group. The CCDENB keyword is used to enable/disable the CC delay capability of individual output ports. See TL1 Reference for details.

1.7 Expansion Shelf Capabilities

For situations requiring more outputs than can be provided by a master shelf, the TimeHub 5500 supports an expansion shelf capability. Each expansion shelf provides up to a maximum of 320 protected inputs. Up to four expansion shelves can be added to a master shelf for a total possible protected output capacity of 1420 outputs per TimeHub system.

NOTE: In order to support expansion shelves, the master shelf should be equipped with extended capacity clock cards (090-55512-02 and/or 090-55514-02). Standard clock cards (090-55511-01 and/or 090-55513-01) do not support expansion shelves. If your system has standard clock cards, you first have to upgrade to extended capacity clock cards before using expansion shelves.

1.7.1 Functions Associated with Expansion Shelf Front Side

Figure 1-5 shows the front side of the expansion shelf. There are two types of plug-in cards used with an expansion shelf: output driver cards (p/n 090-55581-01) and expansion controller cards (p/n 090-55545-01).

1.7.2 Output Driver Card (090-55581-01)

These are the same cards used on the master shelf. They can be used interchangeably in either a master or expansion shelf (see note). Each card provides 40 outputs, which can be provisioned as all DS1, all CC, or 20 outputs of each type. The front-panel LEDs indicate the actual provisioning. The provisioning is determined by the configuration of output connector modules on the rear of the expansion shelf (see Expansion Output Connector Modules).

By pairing output driver cards a redundant protection scheme is achieved. The cards work together such that if either card experiences a failure the output integrity will be maintained. When cards are paired, insertion or removal of either card has negligible impact on output timing or signal integrity. Each protection pair supports 40 outputs. As indicated on the expansion shelf panel, the protection groups are labeled "A", "B", ..., "H". For example, to protect the "B" group of 40 ports, output driver cards are inserted into the two slots associated with "B".

Figure 1-5. TimeHub 5500 Expansion Shelf – Front View

Specific capabilities of the output driver card include:

- Drive up to 40 outputs (40 DS1, 40 CC, or 20 CC & 20 DS1)
- DS1 framable D4 or ESF, with full SSM support for ESF
- Selective enable for every port
- Controllable CC cable delay compensation. Each port can have delay compensation enabled or not. Each group of 20 ports (1-20 and 21-40) can have a specific delay amount applied.

NOTE: Output Driver Cards (p/n 090-55581-01) with version R4114C firmware will not function properly in expansion shelf slot 16H (this is the output card slot farthest to the right). These cards will function properly in any of the other output card slots in the expansion shelf. Inserting an output card having this firmware version in slot 16H will not affect service but the card will continually reset itself and not become operational. A firmware upgrade is availabel to allow such output cards to become usable in slot 16H. Contact Symmetricom Customer Assistance Center (CAC) for details. Firmware revision 4209A and higher will function properly in any slot.

To check the firmware version of an Output Driver Card, perform a RTRV-NETYPE-ALL query and observe the lines associated with output driver cards, each of which will contain firmware version information. Refer to the following example:

```
rtrv-netype-all:::sc1;        sending this command produced the response of
the following lines

   SYMMBITS 99-10-03 20:55:19
M  sc1 RTRV
   "TSG:Symmetricom,5500,TSG"
   "S0-IMC:,090-55542-01-A,,W0320A,J20280,D0TPN0JAAA,297085"
   "S0-CLK1:,090-55512-01-A,,R4209A,0000000,D0TPVPJAAA,296936"
   "S0-CLK2:,090-55514-01-A,,R4209A,0000000,D0TPKPJAAA,296939"
   "S0-OUT5C:,090-55581-01-A,,R4209A,00J21559,D0TPJN0AAA,267799,DS1,"
   "S0-OUT6C:,090-55581-01-A,,R4114C,00J43212,DOTPJN0AAA,267799,DS1,"

>

   SYMMBITS 99-10-03 20:55:19
M  sc1 COMPLD
   "S2-CLK1:,090-55545-01-B,,4209A,,D0C1ZZ0AAA,299465"
   "S2-CLK2:,090-55545-01-B,,4209A,,D0C1ZZ0AAA,299465"
   "S2-OUT12F:,090-55581-01-A,,R4209A,00000000,D0TPJN0AAA,267799,,"
   "S2-OUT14G:,090-55581-01-A,,R4114C,00J21577,D0TPJN0AAA,267799,DS1,DS1"
```

In the above response, there are four output cards identified. The lines starting with S0-OUT5C and S0-OUT6C identify output cards in slots 5 and 6 of the master shelf. In bold type on each of these lines is shown the firmware version of the output cards. The one in slot 5C contains R4209A so it will work fine in expansion shelf 16H. The card in 6C contains R4114C, so it needs to be upgraded if it is planned to be used in expansion shelf slot 16H. The 2nd section of responses shows cards in the expansion shelf (configured with rotary switch set to 2 - see installation instructions for details). This expansion shelf has output driver cards in locations 12F and 14G. The card in 14G contains firmware version R4114C, so it would also need to be upgraded before it could be used in 16H.

1.7.3 Expansion Controller Card (090-55545-01)

This plug-in card is only used in the expansion shelf. At least one expansion controller (EC) card is required for the expansion shelf to function properly. An EC card can be inserted at the leftmost (EC1) or rightmost (EC2) slot on the expansion shelf (see Figure 1-5). The overall function of the EC card is the same regardless of which of these locations are used. The reason to use two EC cards in the shelf is entirely to support redundancy. If one card should fail, the other will maintain proper operation.

The EC card provides the following basic functionality:

- Buffering of timing and framing signals sourced by clock cards in the master shelf, and delivery of those signals to the expansion

shelf output cards.

- Communication (bi-directional) between master and expansion shelves.
- Expansion shelf power monitoring and alarm reporting
- Redundancy management
- Signal integrity monitoring

1.7.3.1 Front Panel Indicators

Figure 1-6 shows the EC card front panel indicators.

Figure 1-6. EC Card Front Panel Indicators

The indicators are, in order from top to bottom:

- Power LED. This LED will be green whenever the EC card is properly powered.
- Fuse LED. The EC card has an on-board fuse. If the fuse becomes open this indicator will illuminate red (assuming the expansion shelf remains powered).
- Shelf Alarm LED. When red, this indicates that an alarm condition is detected by the expansion controller card. The alarm will be reported back through the master shelf management card. Specific

alarms detected are:

- Shelf Power A or B not detected. This will illuminate the Alarm LED as well as appropriate Shelf Power LED (red). Associated TL1 events are EXPWRA and EXPWRB (Expansion Power Fail on terminal A or B).

- Problem with Link A or Link B. See detailed description in item below on expansion link LEDs.

- The expansion controller card is receiving a good link but it is not associated with its "preferred" master shelf clock.

  The concept of a "preferred" clock is used to better support redundancy. The idea is that during normal operation each expansion controller card will be taking its clock from a different clock card. However, an expansion controller card is able to take its clock from either clock card so it is not critical that an EC card get its clock from its preferred source. This alarm is reported simply to indicate the situation when this card is currently not getting its clock from the preferred source. Specifically:

  > An EC card inserted into the EC1 (leftmost) slot "prefers" to take its clock from CLK1 (leftmost clock card on master shelf). If it is only able to get a valid link by using CLK2, the alarm LED will light.

  > An EC card inserted into the EC2 (rightmost) slot "prefers" to take its clock from CLK2 (rightmost clock card on master shelf). If it is only able to get a valid link by using CLK1, the alarm LED will light.

  The preference association is easy to remember by realizing that the leftmost clock card and leftmost EC card are a preferred pair while the rightmost clock card and rightmost EC card are a preferred pair.

- Fail LED. This will be red if the card experiences a failure condition (e.g., the card cannot power-up successfully).

- Shelf Power A, B LEDs. These LEDs provide indication of expansion shelf power status. Green indicates that power is being successfully supplied to the associated shelf power terminal (A or B). Red indicates that power is not being successfully supplied to the associated power terminal.

- Expansion Links 1, 2 LEDs. These LEDs indicate status of the cable links that connect the master shelf to this expansion shelf.

- If the LED is not lit it most likely indicates that the link cable is not connected. This can also occur if there are no clocks in the master shelf that are producing timing outputs. For example, this would happen if both master shelf clocks were still in Warmup.

- If the LED is red it indicates that the link cable is attached but there is a problem receiving either clock timing, clock framing, or communication from the master shelf. If any one of these three conditions is not met, the LED will be red.

- If the LED is green it indicates that this EC card is receiving proper timing, framing, and communication from the master shelf.

1.7.4 Functions Associated with Expansion Shelf Rear Side

The rear side of the expansion shelf contains the following types of connections.

1.7.4.1 Connectors for the Expansion Link Cables

There are four 25 pin connectors along the top of the shelf rear, two (in and out) for link 1 and two (in and out) for link 2. They are clearly labeled as to their function. This is described in detail in the next section.

1.7.4.2 Connections for Output Connector Modules

These modules define the output signal type (DS1 or CC) for outputs driven by output driver cards inserted in the shelf front. The expansion shelf can accept up to 16 connector modules (of either type), each providing 20 outputs of the selected type. Additional detail provided in later section.

1.7.4.3 Terminal Blocks for Connecting Power to the Expansion Shelf

There are redundant connections A (shelf upper left) and B (shelf upper right). See Figures 4-2 and 4-3, and Procedure 4-1, in Chapter 4 for connection detail.

1.7.5 Expansion Link Cables

The interconnection between master and expansion shelves is via the link cable. There are two identical links, termed "expansion link 1" and "expansion link 2". Each link provides identical signaling. The purpose for

having two links is to support redundancy, so that a missing or failed link cable won't halt expansion shelf operation. Types of information carried on the link cable include clock timing and framing (from both master shelf clocks) and communication (used for expansion output card configuration and status monitoring).

Figure 1-7 shows the actual connection points for the link cables.

Note the following:

- Link 1 and Link 2 connection paths are separated by left (link 1) and right (link 2) when facing the rear of the shelves to be connected. The connectors are clearly labeled.

- The link cable is designed so that it can be used for either link 1 or link 2 shelf interconnections. To minimize the possibility of a connection error the connector gender sequence is opposite for the link 1 and link 2 connection paths. For example, the link 1 cable connection from master to expansion shelf is female to male whereas the link 2 connection from master to expansion is male to female. In either case the same link cable is used by orienting the cable as needed.

- Multiple expansion shelves are supported. Each expansion shelf provides two link connections for link 1 and two link connections for link 2 (four link connections in total). For each link (1 or 2), one connection is used to receive signaling (in) from the prior shelf (which could be the master or another expansion), the other connection is used to transmit signaling (out) to the next expansion shelf or to terminate the link.

  It is important to note that the expansion shelves are passive with respect to signals received and passed-on to attached expansion shelves. Hence, an intermediate expansion shelf need not even be powered up in order for the following expansion shelves to properly receive link signals sourced by the master shelf. What is required is a continuous path from the Master to that expansion shelf via either link 1 or link 2.

NOTE: An expansion shelf will not work if its only path from master to itself through an intermediate expansion shelf requires that different links be used. For example, if only link 1 is used to connect from master to expansion shelf 1 and only link 2 connects expansion shelf 1 to expansion shelf 2, expansion shelf 2 will not receive a good link since its path from the master is not continuous on a single link.

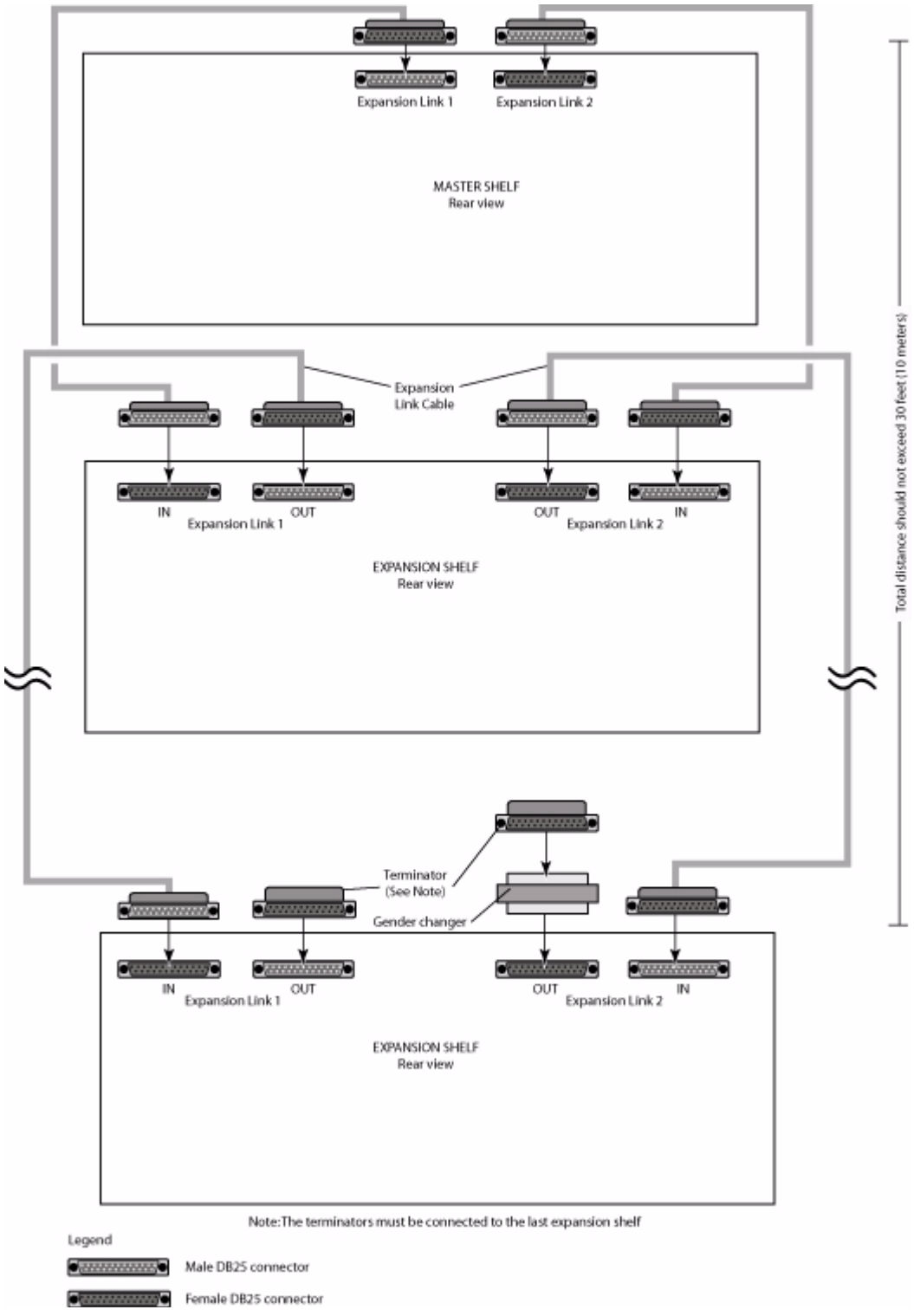
- To provide appropriate signal integrity the last expansion shelf in

the link sequence uses a termination connector (p/n 090-55505-01). The termination connector is connected to the same physical location where a link cable would otherwise be connected to connect to the next shelf (the connection labeled "OUT"). The supplied gender adaptor (p/n 128-55501-01) can be used as needed in conjunction with the termination connector to complete the link termination. These parts are supplied with the expansion shelf kit (990-55505-0x).

Figure 1-7 shows the master shelf and expansion shelf interconnection. When referring to Figure 1-7 to assist in connecting the expansion shelf to the master shelf, be sure to do the following:

- Use termination connector (p/n 190-55501-01)
- Use termination connector (p/n 190-55501-01) with gender changer (p/n 128-55501-01)
- All link cables are p/n 060-55501-01.

Figure 1-7. Master Shelf and Expansion Shelf Interconnection



1.7.6 Expansion Output Connector Modules

Two types of output connector modules are available for the expansion shelf. One type provides 20 DS1 outputs; the other provides 20 CC outputs. These cards are similar in design to the output connector cards used on the master shelf, although the form factor of the expansion output connector modules is different.

The cable connection from the output connector module is the same (form factor and pinout) on the master and expansion shelf output connector modules, so cabling used to connect master shelf outputs to a wirewrap panel will also work on an expansion shelf. There are two options available for cabling from expansion (or master) shelf output modules.

1. The flat ribbon cable (060-55591-01) can be used to connect any TimeHub output connector module to the 80-output wirewrap panel (090-41902-01).

2. To reduce cabling congestion that could be associated with wiring for the 320 outputs available on the expansion shelf, a new cable and wirewrap panel have been developed. The new cable provides connection from any output connector module to the new wirewrap panel. Each output module (990-5559x-02) includes this cable. A primary benefit of the newer cable is that it is a small, round, flexible cable which lends itself to taking up less space and being more routable than the flat ribbon cable. The new wirewrap panel can accommodate 160 outputs (compared with 80 on the older panel) so it is also more space efficient. Note that the new cable/wirewrap panel combination can be used with either a master or expansion shelf. This wirewrap panel is included as part of the expansion shelf.

The expansion shelf (990-55505-01) includes one wirewrap panel (groups A through D) and the expansion shelf (990-55505-02) includes two wirewrap panels (groups A through D and groups E through H). Additional wirewrap panels can be ordered separately. Wirewrap panel labeled A through D has part number 093-55595-01, and wirewrap panel labeled E through H has part number 093-55595-02.

Because of their smaller size (compared with master shelf output connector modules), some extra care is needed when installing or removing an expansion output connector module. To insert an expansion output connector module:

- Align the module-to-shelf connector (side opposite to the two spring-loaded screws) with the connector on the shelf.

- Once aligned, carefully push the card in by pressing either on the corners of the board or the screws at top and bottom of the module. Ensure that the module slides onto the connector.

- Once the connectors have adequately engaged, tighten the screws at top and bottom. This will ensure a good connection and conductive seal around the module perimeter.

To remove an expansion output connector module:

- Loosen the screws at top and bottom of the module. Make sure that they have actually released from the threads in the shelf.
- Grasping the now loosened screw heads, carefully rock the board back off the module-to-shelf connector.
- As the board starts to release from the connector, the removal can be completed by continuing to pull on the screw heads.

1.8 Relationship between Output Driver Cards and Expansion Output Connector Modules

The key to understanding how the output driver cards (inserted on the front of the shelf) relate to the output connector modules (attached on the rear of the shelf) is to understand the meaning of the letter designations "A", "B", … "H" which appear on labels on both sides of the shelf. An output driver card inserted into a given letter category will have its outputs generated by output connector modules that are attached to that same letter category on the back of the shelf. So, for example, if an output driver card is inserted in either slot of the "D" group, the output connector modules that will provide output from that driver card will be found in the "D" group on the back of the shelf. Another helpful thought is to think of the output driver cards connecting to their associated output connector modules straight through the shelf. Thinking this way, it is easy to see that the leftmost output driver cards ("A" group looking at the front of the shelf) connect to the leftmost (still looking at front of shelf) output connector modules.

There are two output connector module locations for each letter group. As the labeling on the back of the shelf indicates, they are stacked vertically. The upper (top) module provides outputs 1 through 20 for that particular letter group, the lower module provides outputs 21 through 40 for that same letter group. If 20 or fewer outputs of the same type are desired, there is no need to load both output connector module locations.

The output driver cards (shelf front) have LEDs which indicate whether there are associated output connector modules attached on the back of the shelf. Indicators are provided for both ports 1 through 20 and 21 through 40. If neither the CC nor DS1 LED is lit it means that there is no connector module present in that location. Keep in mind that the purpose for having

two output driver slots (shelf front) for each letter group is for redundancy, not to provide additional outputs. A single output driver card supplies 40 outputs, a pair of output driver cards in a letter grouping also supplies 40 outputs with the enhancement that those outputs are protected in the event of a single output driver card failure.

1.9 Redundancy Considerations

The interconnections between the master and expansion shelf are designed to support redundancy in several areas. Each of these areas is independent of the others. In other words, if one type of redundancy is lost the other areas of redundancy are not compromised.

1.9.1 Clock Redundancy

Clock timing, framing, and communication are provided to the expansion shelves by both master shelf clock cards (CLK1 and CLK2). If either clock card is removed, the expansion shelf continues to receive the necessary signaling from the other clock card. This behavior is essentially the same as the way clock cards provide redundant timing to output cards on a master shelf, except that for expansion shelves the redundant clock signaling is conveyed between shelves via the link cables.

1.9.2 Link Cable Redundancy

Each link cable conveys identical information from the master shelf to the expansion shelf. Master shelf CLK1 and CLK2 signaling is present on both link cables so that as long as one of the link cables is attached and working properly, the expansion shelf is able to receive timing from any clocks that are present in the master shelf.

1.9.3 Expansion Controller Card Redundancy

Each EC card receives complete signaling information from both link cables. This means that, when both links are present, each EC card is receiving two sets of identical signaling. If either EC card is removed, the remaining EC card provides all of the necessary signaling between the output cards in the expansion shelf and the clocks in the master shelf.

1.9.4 Output Card Redundancy

Each output card in an expansion slot-pair (i.e. "A", "B", …, "H") receives clocking information from whichever clocks are installed in the master shelf.

If both clocks are in the master shelf then each output card will receive clocks from each, with preference given to the clock that is active (as seen on the master shelf clock card). Only one output card is needed for full functionality. Adding a second output card to the slot-pair provides protection in the event that either of these output cards experiences a failure.

To summarize, a given output on an expansion shelf can be expected to function as long as there is at least:

- One clock card active in the master shelf AND
- One link cable connected (and operating properly) between the master and expansion shelf AND
- One expansion controller card in the expansion shelf AND
- One output card in the slot-pair associated with the output of interest.

NOTE: An expansion shelf will not work if its only path from master to itself through an intermediate expansion shelf requires that different links be used. For example, if only link 1 is used to connect from master to expansion shelf 1 and only link 2 connects expansion shelf 1 to expansion shelf 2, expansion shelf 2 will not receive a good link since its path from the master is not continuous on a single link.

1.10 Controlling Whether or Not an Expansion Shelf is Expected in the TimeHub System

It is important for the software in the TimeHub cards to have knowledge of whether or not the user expects that there should be an expansion shelf (or shelves) as part of the system. Without this information, it becomes impossible for the software to know when an alarm/event should be reported that has to do with an expansion shelf. As an example, suppose that an expansion shelf has been configured into a TimeHub system but the link cables have both been removed. In such a case, the user expects a problem to be reported, to be informed that communication with the expansion shelf has been lost. But what about a scenario where there is only supposed to be a master shelf? In either of these situations, the software in the master shelf detects that it cannot communicate with an expansion shelf. In the first situation, the user wants to have a problem reported. In the second situation, there is no problem.

To handle this, a TL1 keyword was created: ECLKEXP. This keyword is detailed in the TL1 manual, but it essentially works as follows:

- By default, the software in the TimeHub master shelf does not expect that an expansion shelf is intended to be part of the configuration. Hence no expansion shelf-related events will be reported.

- However, the software in the master shelf continually attempts to connect to an expansion shelf. If a communication response ever occurs from any expansion controller card then that card is automatically set to be expected (the value of ECLKEXP for that particular card is set from N to Y). This enables any future communication problems with that card to be automatically reported. For a typical expansion shelf configuration, there will be two expansion controller cards, both of which will be detected by the master shelf and thereafter expected to be present.

- Suppose one of the expansion controller cards is then removed. An event (keyword EXCLKGONE) will be reported indicating that this expected card is missing. If the card is returned, the event will be cleared.

- As described previously, the TimeHub master shelf automatically sets expansion shelf expectations whenever communication occurs with an expansion controller card in a given expansion shelf. TimeHub will never automatically remove this expectation. However, the user can remove the expectation by explicitly setting the value of ECLKEXP to N (for the targeted EC card). If communication is still occurring with this card when the user sets it to N, it will immediately be set back to Y. On the other hand, if the card is actually removed (for example, expansion shelf is being removed from the setup) then the setting will remain as N and any events associated with the expansion card will be cleared.

- If the user wants to manually set the expectation that there should be an expansion shelf (even though there currently may not be one), the ECLKEXP setting can be set to Y. Events associated with that expansion card will then be reported.

Chapter 2

Engineering & Ordering

This chapter includes:

- *Shelf Considerations*
- *Wirewrap Panels*
- *Timing Output Guidelines*
- *LAN Communication Port*
- *Ordering and Parts List*
- *User-Supplied Tools and Materials*

2.1 Shelf Considerations

2.1.1 Site Survey

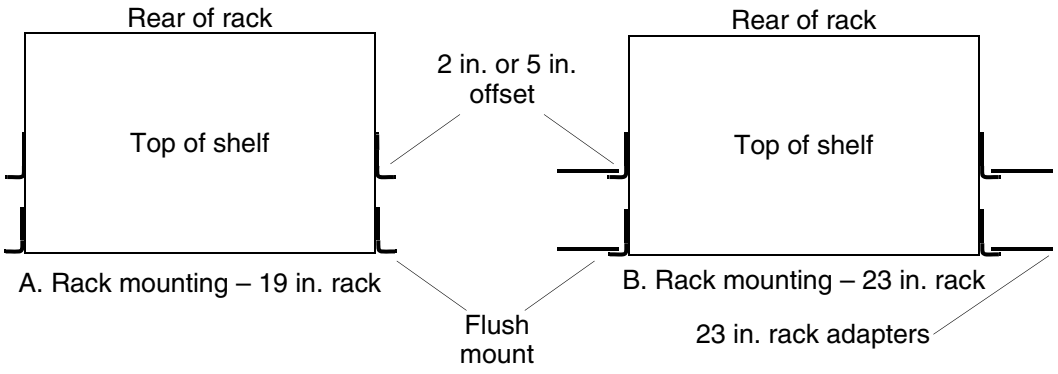
Before ordering the system, determine the shelf location, the –48 volt power source(s), and the grounding for the shelf. Remember to locate the shelf close to the equipment to be synchronized and far away from electrical noise sources, such as air conditioners, elevator motors, power systems, etc.

2.1.2 Rack Mounting

Position the mounting ears, as shown in Figure 2-1, for flush mounting or 2 or 5 inch offset mounting in either a 19 inch rack (Figure 2-1A) or a 23 inch rack (Figure 2-1B). Leave one RU (1.75 inches) of air space above the shelf for proper ventilation. Mount the shelf in the rack according to standard company practices.

NOTE: Two screws can be used in both mounting ears if the holes in the rack are spaced 1.75 inches apart.

Figure 2-1. Rack Mounting Options



2.2 Wirewrap Panels

2.2.1 Existing and New

If using an existing panel (e.g., 090-41902-01), leave the panel in the rack, and remove the ribbon cables from the panel before mounting the shelf in the rack.

For the master shelf, if installing a new panel, mount the panel in the rack after mounting the shelf in the rack. Mount the panel just above or below the shelf, leaving enough space (2 RU) for cable management above and below the wirewrap panel.

If you are installing an expansion shelf, mount one wirewrap panel above the expansion shelf and the other below the expansion shelf, leaving enough space (2 RU) above and below each wirewrap panel.

2.3 Timing Output Guidelines

2.3.1 Output Connector Modules

On the master and remote shelf, up to seven output connector modules can be installed per shelf. For DS1 outputs, use DS1 Output Connector modules; for CC outputs, use CC Output Connector modules (refer to the Ordering and Parts List section for part numbers).

Output connector module types can be distinguished by the handle on the card. Each DS1 Output Connector module is labeled “DS1” and has a black handle; each CC Output Connector module is labeled “CC” and has a blue handle.

Output port designations are as shown in Figure 2-2. Each letter indicates a group of 40 ports and each number indicates a port.

For the expansion system, up to 16 output connector modules can be installed per shelf. For DS1 output signals, use DS1 output modules for the expansion shelf. For CC output signals, use CC connector modules for the expansion shelf (refer to Table in this section).

Output port designators are shown in Figure 2-3. Each letter indicates a group of 40 ports and each number indicates a port.

2.3.2 Shelf–to–Connection Panel Cabling

Figure 2-2 shows an example of shelf–to–wire-wrap panel connections with two wire-wrap panels (090-41902-01) with built-in wire-wrap pins.

At the rear of the shelf, each three-connector ribbon cable is connected from one connector on the output connector card to two of the connectors labeled “TO” or “OUTPUT” on the rear of the connector panel. The outputs are marked on each cable: one of the cables is marked “1–10”; the other cable is marked “11–20”.

Figure 2-3 shows an example of the shelf-to-wire-wrap panel for the expansion shelf.

Figure 2-2. Timing Output Connections – Master and Remote Shelf (Rear View)

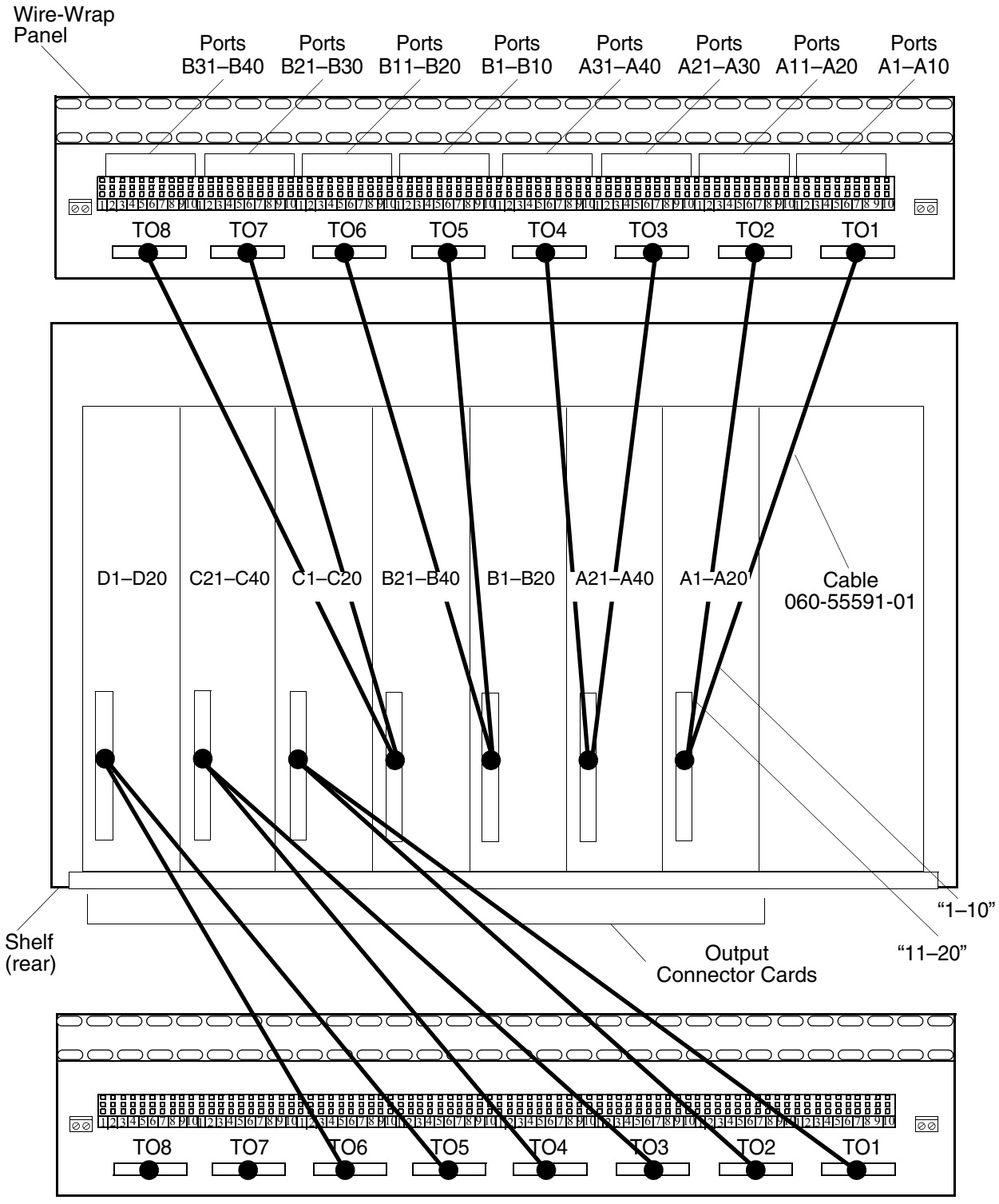
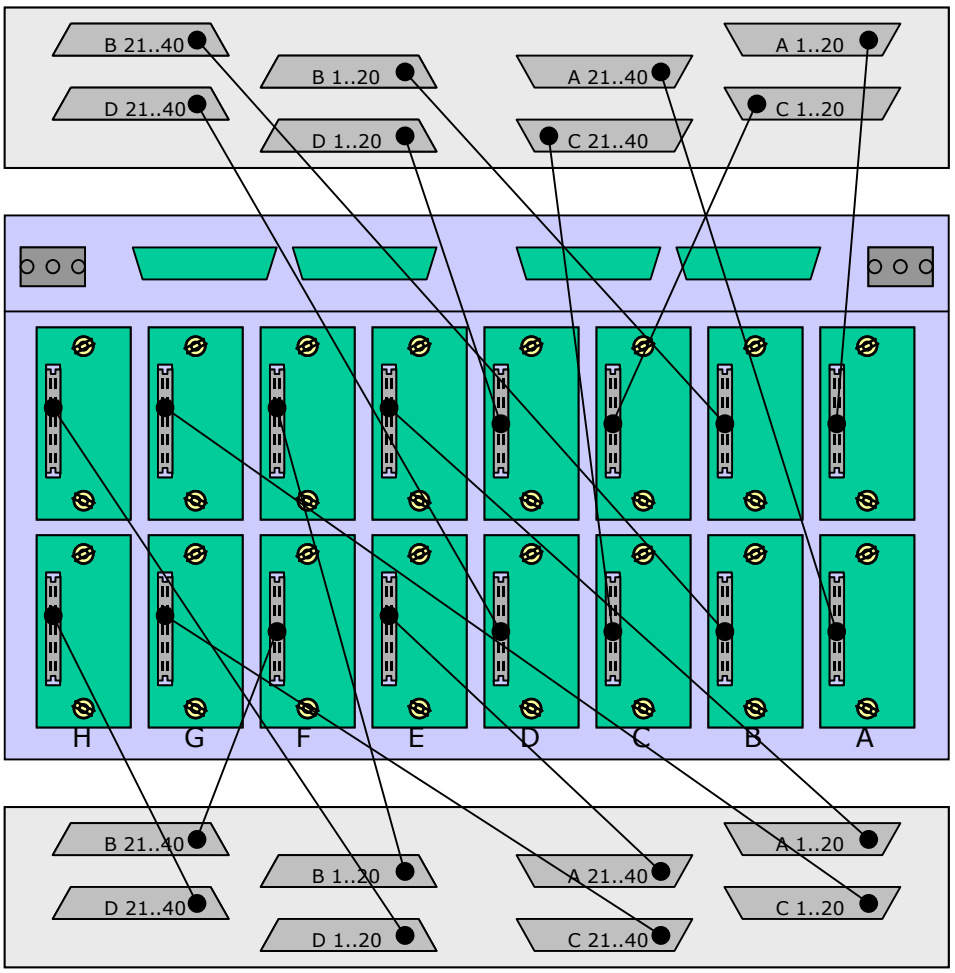


Figure 2-3. Timing Output Connections – Expansion Shelf (Rear View)



2.3.3 Output Driver Cards

For protected outputs, up to 8 output driver cards per master or remote shelf and up to 16 cards per expansion shelf can be installed. For unprotected outputs, up to 4 output driver cards per master or remote shelf and up to 8 cards per expansion shelf can be installed.

Output driver cards are inserted into slots located at the front of the shelf labeled “A” to “D” for the master or remote shelf and “A” to “H” for the expansion shelf. Each letter group supports 40 outputs.

For unprotected outputs, one card is inserted into either slot of each pair. For example, if one card is inserted into the left slot of the “A” group, 40 unprotected outputs are provided.

For protected outputs, a card is inserted into each of the slots of the pair. For example, if one card is inserted into each slot of the “A” group, 40 protected outputs are provided.

NOTE: Slot “D” on the master or remote shelf can only support 20 outputs.

2.3.4 Timing Output Cabling

Output port designations are as shown in Figure 2-2 for the master and remote shelf, and Figure 2-3 for the expansion shelf. Each letter indicates a group of 40 ports; each number indicates a port.

2.4 LAN Communication Port

Configuration of TimeHub network parameters for the master and remote shelf, such as IP address, subnet mask, and gateway IP can be set through the local RS-232 (serial) port, accessible either from the management card plug-in on the front of the shelf or the “local” connection along the top on the rear of the shelf. Once the IP address has been set and a LAN connection made, the TimeHub 5500 can be accessed remotely via network.

To do this, obtain network parameters values from the system administrator, connect the LAN cable from the network to the LAN connector on the rear of the shelf, then configure the network parameters using TL1 commands. See Procedure 4-9 for details (Chapter 4, under System Configuration).

2.5 Ordering and Parts List

Table 2-1 lists the basic components that should be ordered when ordering a master or remote shelf.

Table 2-1. Master and Remote Shelf Basic Components

Item	Part Number	Qty	Included Items
Master shelf kit	090-55500-01	1	• Master shelf (090-55501-03) • Wirewrap input module (090-55561-01) • Wirewrap panel (190-55595-01) x 1 • 19 in. and 23 in. mounting hardware • System manual
Management card kit	090-55542-01	1	• Management card (090-55542-01) • DB9 connection cable • CD with TimeScan THC and complete TimeHub documentation
Clock cards	090-5551x-0x	1 (minimum) 2 (recommended)	Quartz or rubidium clock card (order accordingly): • Quartz 5 input (090-55511-01) *Note:* This clock does not support expansion shelves. • Quartz 9 input (090-55512-02) *Note:* This clock supports expansion shelves. • Rubidium 5 input (090-55513-01) *Note:* This clock does not support expansion shelves. • Rubidium 9 input (090-55514-02) *Note:* This clock supports expansion shelves.
Output cards	090-55581-01	1 (minimum) 2 (recommended) up to 8 per master/remote	• Output card (090-55581-01)
DS1 output module kit	990-55591-01	1 (minimum) 2 (recommended) up to 7 DS1 and CC total per master/remote	• Round RJ-21 cable (060-55591-02) • DS1 output module (090-55591-01)
CC output module kit	990-55593-01	1 (minimum) 2 (recommended) up to 7 DS1 and CC total per master/remote	• Round RJ-21 cable (060-55591-02) • CC output module (090-55593-01)

Table 2-2 lists the basic components that should be ordered when ordering an expansion shelf.

Table 2-2. Expansion Shelf Basic Components

Item	Part Number	Qty	Included Items
Expansion shelf kit	090-55505-02	1	• Expansion shelf (090-55505-03) • Wirewrap panel (190-55595-01) x 1 • Wirewrap panel (190-55595-02) x 1 • Line terminator (190-55505-01) x 2 • Gender changer (128-55505-01) • Connection cable (060-55505-01) x 2 • 19 in. and 23 in. mounting hardware • System manual • CD with TimeScan THC and complete TimeHub documentation
Expansion controller card	090-55545-01	1 (minimum) 2 (recommended)	• Expansion controller card (090-55545-01)
Output cards	090-55581-01	1 (minimum) 2 (recommended) up to 16 per expansion shelf	• Output card (090-55581-01)
DS1 output module kit for expansion shelf	990-55591-02	1 (minimum) 2 (recommended) up to 16 DS1 and CC total per expansion shelf	• Round RJ-21 cable (060-55591-02) • DS1 output module (090-55591-02)
CC output module kit for expansion shelf	990-55593-01	1 (minimum) 2 (recommended) up to 16 DS1 and CC total per expansion shelf	• Round RJ-21 cable (060-55591-02) • CC output module (090-55593-02)
Blank panels for output card spaces	093-55598-02	16 minus amount of output cards	• Optional to fill out output card space

Table 2-3 lists the additional accessories and spare parts that can be ordered separately.

Table 2-3. Additional Accessories and Spare Parts

Item	Part Number	Description
	Accessories	
Blank panel for clock card	093-55598-01	Blank panel to cover slot of uninstalled input/clock card. Master/remote shelf only.
Blank panel for output card	093-55598-02	Blank panel to cover slot of uninstalled output card. Master/remote or expansion shelf.
Blank panel for Expansion Controller Card	093-55598-03	Blank panel to cover slot of uninstalled Expansion Controller Card. Expansion shelf only.
Blank panel for output module (Master)	093-55599-01	Blank panel to cover space of unused output module. Master/remote shelf only.
Short blank panel for output module (Expansion)	093-55599-02	Blank panel to cover space of unused output module slot. Covers one module space. Expansion shelf only.
Blank panel for output module (Expansion)	093-55599-03	Blank panel to cover space of unused output module slot. Covers two module spaces (one group). Expansion shelf only.
	Spare Parts	
Wirewrap input module	090-55561-01	Wirewrap input board. Master/remote shelf only.
High capacity wirewrap panel kit	093-55595-01	Wirewrap panel with 160 outputs labeled A through D. Includes kit to mount on 23 in. rack.
High capacity wirewrap panel kit	093-55595-02	Wirewrap panel with 160 outputs labeled E through H. Includes kit to mount on 23 in. rack.

2.6 User-Supplied Tools and Materials

User-supplied tools and materials are listed below.

- Phillips-head screwdriver for installing the TimeHub 5500 Shelf in a rack
- ESD wrist strap for installing cards
- Digital multimeter (Fluke 77 or equivalent) for verifying power connections to the shelf
- Dual-channel oscilloscope with 100 MHz minimum bandwidth for verifying clock input signal(s) are within the specified input voltage range and checking output waveforms
- Laptop computer with communications software (e.g., Windows Hyperterminal, ProComm Plus, CrossTalk) or TimeScan THC software for setting system parameters

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Chapter 3

Installation

This chapter includes:

- *Overview*
- *Unpacking*
- *Rack Mounting*
- *Configuring the Shelf as Master or Remote*
- *Configuring an Expansion Shelf*
- *Connector Module Installation*
- *Blank Panels*
- *Cabling*

3.1 Overview

Install the TimeHub 5500 using the sequence given in this chapter. To take the TimeHub 5500 to full operational status, complete both this chapter (Installation) and the next chapter (Operational Verification & Configuration). This chapter covers steps to install the TimeHub 5500 system in preparation for power-up. The next chapter covers steps to be taken once power has been applied.

If any difficulties are encountered during the installation process, contact Symmetricom's CAC. Refer to the Technical Assistance section of the Maintenance chapter for telephone numbers.

CAC includes Product Technical Support for technical information, and Customer Service for information about an order, RMAs, and other information.

3.2 Unpacking

WARNING: When handling electronic equipment, use local office procedures regarding electrostatic discharge (ESD) including:

- Use grounded wrist straps connected to equipment frame ground when handling cards.
- Store cards only in antistatic packaging provided by the factory.

NOTE: Save packing material. All equipment returned must be packed in the original packing material. Contact Customer Service if additional packaging is needed.

Unpack equipment carefully; check for completeness against the purchase order. Notify Symmetricom if items are missing.

Inspect equipment for shipping damage, including bent or loose hardware, and broken connectors.

If equipment was damaged in transit, contact Customer Service to request an RMA, and notify the carrier.

3.3 Rack Mounting

The procedure for rack mounting either a master shelf or an expansion shelf is identical.

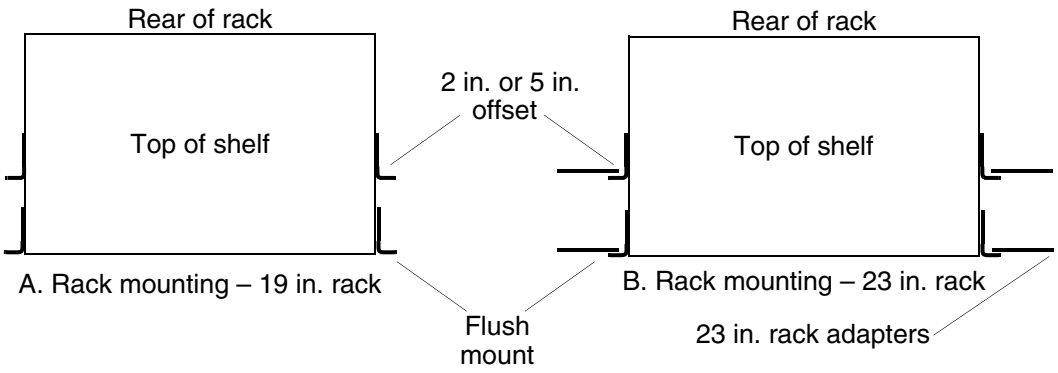
NOTE: If using an existing connection panel, leave the panel in the rack, remove the ribbon cables from the panel, and skip the "Wirewrap Panel" subsection.

3.3.1 Shelf

The mounting ears, as shown in Figure 3-1, can be positioned for flush mounting or 2 inch offset mounting in either a 19 inch or a 23 inch rack.

To mount the shelf, position the mounting ears as required, then mount the shelf in the rack according to standard company practices.

Figure 3-1. Shelf Mounting Options



3.3.2 Wirewrap Panel

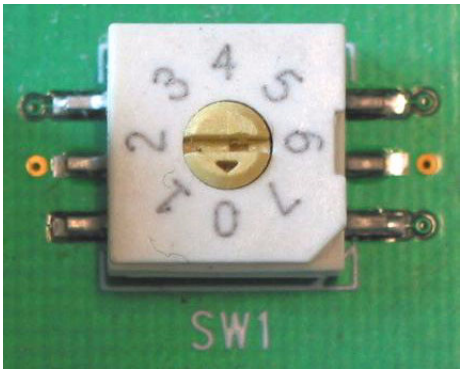
Mount the wirewrap panels in the rack just above, below, or one above and one below the TimeHub 5500, leaving enough room for cable management and following standard company practices.

3.4 Configuring the Shelf as Master or Remote

A TimeHub shelf can be configured for either master or remote operation without any change of equipment. In other words, the shelf and associated plug-ins are compatible with either mode of operation. There is only a single setup step required to establish whether the shelf will be a master or remote.

There is an eight-position rotary switch (Figure 3-2) attached to the backplane printed circuit board that is part of the shelf. If looking directly at the front of the shelf (the side where you slide in each of the plug-in cards), the switch is located near the bottom at the left side, in the area occupied by the Management Card (090-55542-01) when it is inserted. You will only be able to see the rotary switch if the Management Card is not inserted in the shelf.

Figure 3-2. TimeHub Rotary Switch



To set the rotary switch, do the following:

1. Make sure that power is not being applied to the shelf. Power is received by the shelf via the power terminals located on the back of the shelf.

2. If necessary remove the Management Card in order to obtain access to the rotary switch. If convenient, it can be helpful to also remove CLK1 card from the shelf. Doing so provides improved access to the switch and better visibility. Also, depending on lighting conditions it can be helpful to use a flashlight to obtain a better view of the switch and its value setting.

3. Using a long shafted screwdriver with a small slot blade (or any other implement that provides similar function), insert the blade into the slot in the rotary switch and rotate to the desired position.

There is a small arrow on the rotary switch that identifies the selected setting. In case you cannot see it clearly, the arrow points 90 degrees away from the direction of the slot. In other words, if the slot is exactly horizontal the arrow will be pointing exactly vertical (either straight up or straight down).

- As shown in Table 3-1, if setting the shelf to be a master, set the switch value to 0. This is the factory setting, so if this shelf has never been set as a remote, there should be no need to change the switch value.

- As shown in Table 3-1, if setting the shelf to be a remote, set the switch value to 7. Since this is not the factory setting this step will most likely be necessary.

Table 3-1 shows the function associated with the rotary switch settings.

Table 3-1. Rotary Switch Settings and Functions

Rotary Switch Position	Function	Confirmation
0 (factory setting)	The shelf will be configured as master	“Remote” LED will NOT light following Warmup
1 – 6	Reserved for future use	–
7	The shelf will be configured as remote	“Remote” LED will light following Warmup

3.5 Configuring an Expansion Shelf

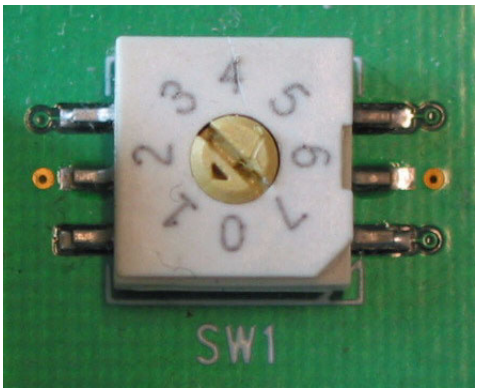
Use the following sequence as a guide for installing a TimeHub expansion shelf with a master (or remote) shelf. Not all steps may be necessary and it may make sense to do some of them in a different sequence depending on circumstances of this particular installation.

1. Set the rotary switch on the expansion shelf.

   There is an eight-position rotary switch attached to the backplane printed circuit board that is part of the shelf. If looking directly at the front of the shelf (the side where you slide in each of the plug-in cards), the switch is located near the bottom at the left side, in the area behind expansion controller card 1 when it is inserted (labeled EC1). For an expansion shelf, the meaningful settings are “1”, “2”, “3”, and “4”. These numbers uniquely identify the expansion shelf. The factory default is “1”, so if you are adding

only one expansion shelf the rotary switch should already be set properly. Refer to Figure 3-3.

Figure 3-3. TimeHub Expansion Shelf Rotary Switch



Procedure 3-1 describes how to set the expansion shelf rotary switch.

Procedure 3-1. Setting Expansion Shelf Rotary Switch

Step	Action
1	Ensure that power is not being applied to the shelf. Power is received by the shelf via the power terminals located on the back of the shelf.
2	If desired, remove the EC1 card to gain access to the rotary switch.
3	Insert the slot blade of a long-shafted screwdriver (or any other implement that provides a similar function) into the slot in the rotary switch and rotate to the desired position. A small arrow on the rotary switch identifies the selected setting. *Note:* A later step will confirm that the rotary switch has been set properly.

End of Procedure

Table 3-2 shows the function associated with the rotary switch settings.

Table 3-2. Expansion Shelf Rotary Switch Settings and Functions

Rotary Switch Position	Function	Confirmation
1 – 4 (expansion shelf)	The expansion shelf will use the setting as its unique address	TL1 responses originating at this shelf will be prepended with Sx, where x is the value of the rotary switch

Table 3-2. Expansion Shelf Rotary Switch Settings and Functions (Cont'd)

Rotary Switch Position	Function	Confirmation
All other positions	Reserved for future use	–

2. Mount the expansion shelf and associated wirewrap panels into the desired location. See "Rack Mounting" in chapter 3 for details and special considerations.

3. Connect the inter-shelf cabling. All of these steps take place on the rear of both master and expansion shelf. See Figure 3-4.

   c. Using cable 060-55505-01, connect from master shelf Link 1 (labeled "Expansion Link 1" to expansion shelf Link 1 input (labeled "Expansion Link 1 IN". Because of the gender differences on the cable, there will only be one way that this cable can be successfully connected. If it does not seem to fit at first, just turn the cable around.

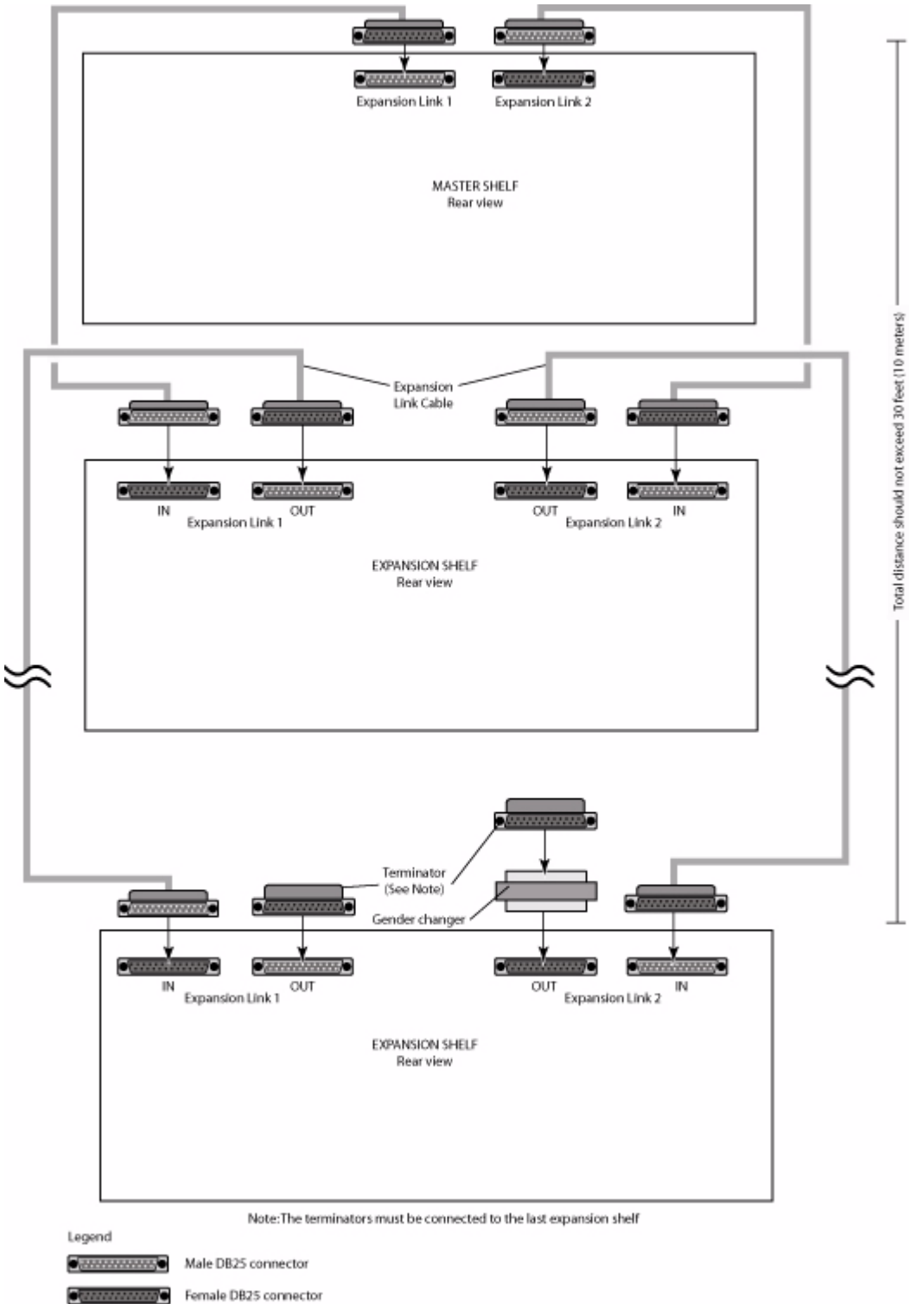
NOTE: If you are connecting between two expansion shelves, follow the orientation shown in Figure 3-4. Connect from innermost link 1 connector on expansion shelf you are coming from (labeled “Expansion Link 1 OUT”) to outermost link 1 connection on expansion shelf you are going to (labeled “Expansion Link 1 IN”).

   Remember to use the threaded posts to tighten the connections on to the shelves.

   d. Using the second 060-55505-01 cable, connect from master shelf Link 2 (labeled "Expansion Link 2" to expansion shelf Link 2 (labeled "Expansion Link 2 IN). This is the same cable used for connection link 1, except the cable connector orientation will be reversed.

NOTE: If connecting between two expansion shelves, follow the orientation shown in Figure 3-4. Connect from innermost link 2 connector on first expansion shelf (labeled “Expansion Link 2 OUT”) to outermost link 2 connection on second expansion shelf (labeled “Expansion Link 2 IN”).

Figure 3-4. Inter-Shelf Cabling Arrangements Block Diagram



e. If there are more expansion shelves to be connected, repeat steps **a** and **b**.

f. If this is the last expansion shelf in the sequence, connect the terminating connector to the available link 1 (labeled "Expansion Link 1 OUT") and link 2 (labeled "Expansion Link 2 OUT") locations on this shelf. Note that due to the gender differences of these locations in one case only the termination connector (p/n 090-55505-01) will be needed, in the other case the termination connector (p/n 090-55505-01) with gender changer (p/n 128-55505-01) will be needed. It is important to connect the termination since it provides proper impedance completion which minimizes reflections that could otherwise affect inter-shelf signal fidelity. Refer to Figure 3-4.

3.6 Connector Module Installation

3.6.1 Input/Alarm Connector Module (Master and Remote Shelf Only)

The Input/Alarm Connector module (part number 090-55561-01) is shown in Figure 3-5. To install the module, use the captive screws to attach the module to the rear of the shelf, at the right side (Figure 3-6).

Figure 3-5. Input/Alarm Connector Module

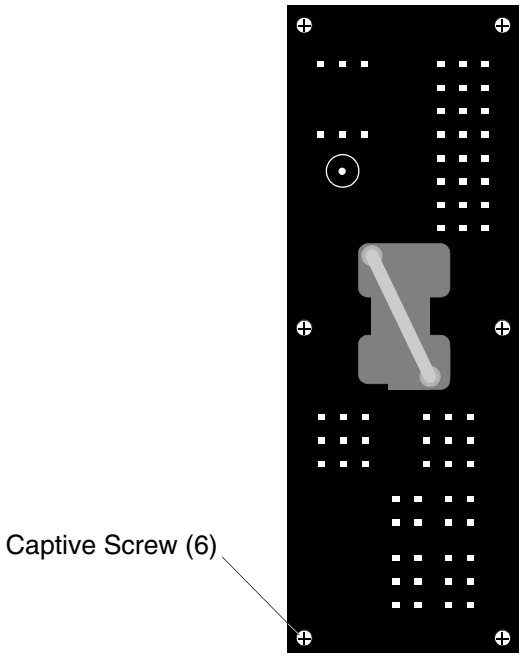
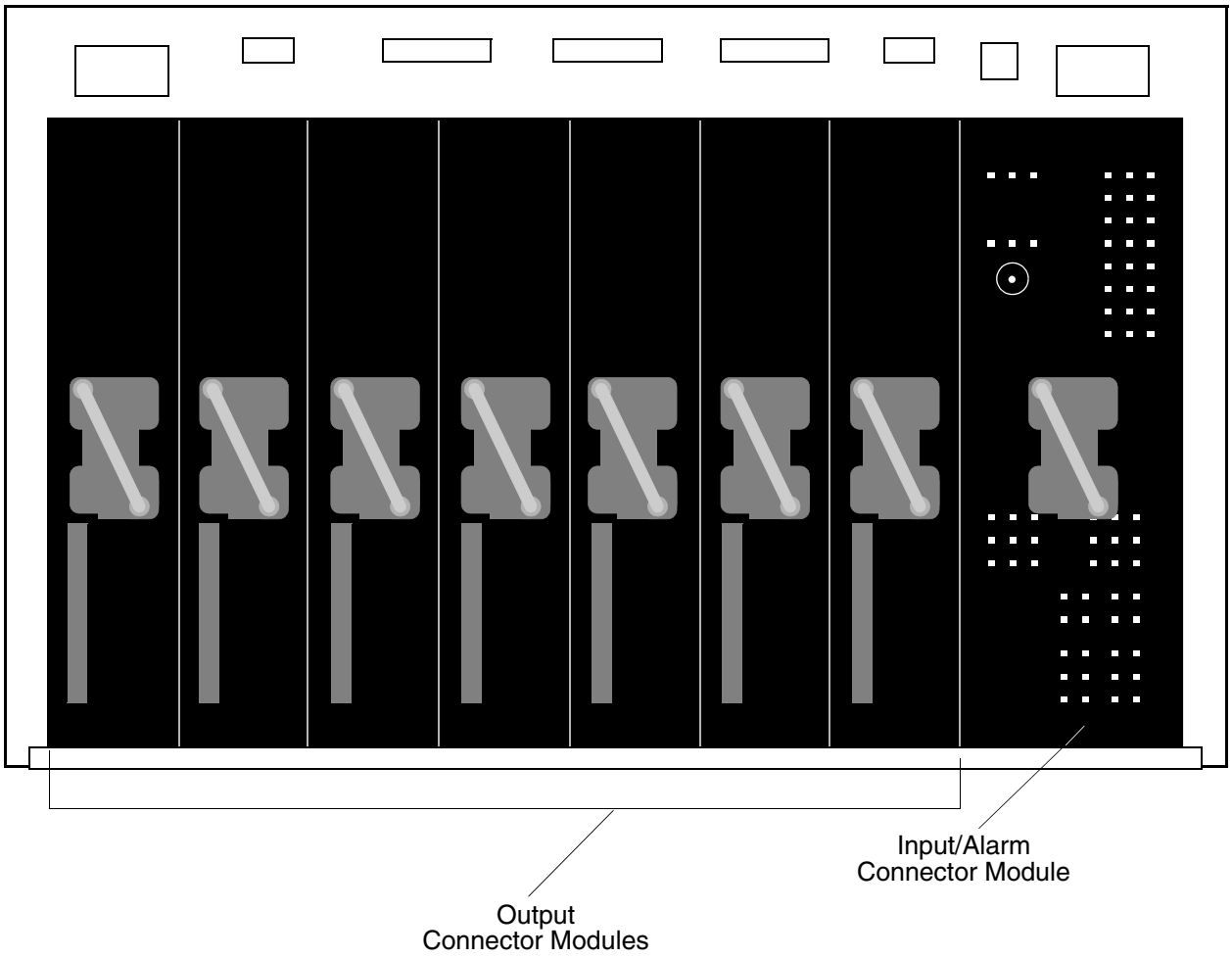


Figure 3-6. Shelf Rear with Connector Modules

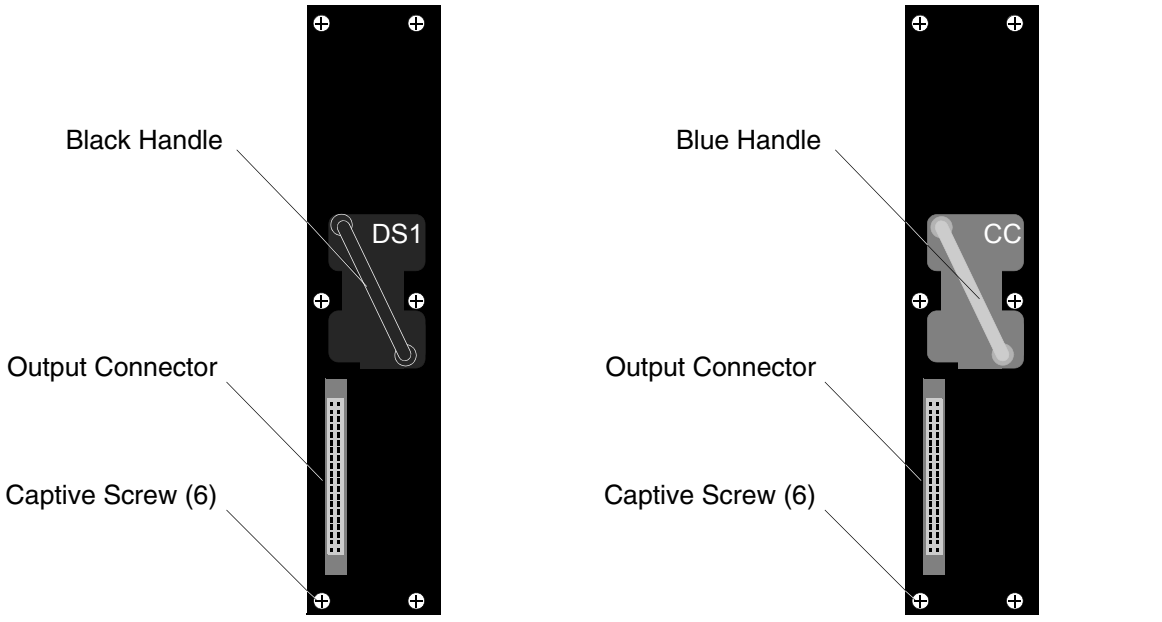


3.6.2 Output Connector Module (Master and Remote Shelf Only)

Install the appropriate output connector module (Figure 3-7) type.

- For DS1 outputs, use DS1 Output Connector modules (part number 090-55591-01), which are part of the DS1 Output Connector Module Kit (990-55591-01) (Figure 3-7A).
- For CC outputs, use CC Output Connector modules (part number 090-55593-01), which are part of the CC Output Connector Module Kit (990-55593-01) (Figure 3-7B).

Figure 3-7. Master and Remote Shelf Output Connector Modules



A. DS1 Output Connector Module

B. CC Output Connector Module

NOTE: Output connector module types can be distinguished by the handle on the module. Each DS1 Output Connector module is labeled “DS1” and has a black handle; each CC Output Connector module is labeled “CC” and has a blue handle.

To install the connector modules, use the captive screws to attach the output connector modules to the shelf (Figure 3-6). Up to seven output connector modules can be installed.

To better understand how location of connector modules relates to output driver cards (inserted in next chapter), see “Relationship Between Output Driver Cards and Expansion Output Connector Modules” in Chapter 1 of this guide. Although that topic is about expansion shelves, it is applicable to Master and Remote shelves.

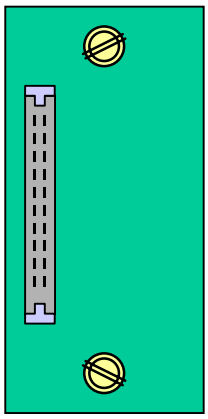
3.6.3 Output Connector Module (Expansion Shelf Only)

Install the appropriate output connector module (Figure 3-8) type.

- For DS1 outputs use connector module p/n 090-55591-02, which is part of the DS1 Output Module Kit (990-55591-02)

- For CC outputs use connector module p/n 090-55593-02, which is part of the CC Output Module Kit (990-55591-02)

Figure 3-8. Expansion Shelf Output Connector Module



To better understand how location of connector modules relates to output driver cards (inserted in next chapter), see “Relationship Between Output Driver Cards and Expansion Output Connector Modules” in Chapter 1 of this guide.

To install the connector modules, remove them from the captive screws and align them to the opening in the back on the expansion shelf. The vertical connector should be facing to the left and the small connector should be on the bottom facing towards the mate connector on the shelf. Tighten the screws by hand. Use a small screwdriver if preferred; however, do not overtighten the screws.

3.7 Blank Panels

3.7.1 Input/Clock Blank Panels (Master and Remote Shelf Only)

If a TimeHub system is configured with only one input/clock card, install the blank panel for input/clock card (090-55598-01) in the empty slot space reserved for the redundant card.

3.7.2 Output Driver Blank Panels (All Shelves)

Install blank panels for output driver cards in the empty slots where output driver cards are not installed.

3.7.3 Output Module Blank Panels (Master and Remote Shelf Only)

The blank panel (p/n 093-55599-01) can be used in the master and remote shelves only.

Install blank panels for output modules in the spaces where no output modules are installed.

3.7.4 Output Module Blank Panels (Expansion Shelf Only)

There are two types of output module blank panels for the expansion shelf.

- The blank panel p/n 093-55599-02 is a single height blank panel. It can be used to cover only one output module space.
- The blank panel p/n 093-55599-03 is a double height blank panel. It is used to cover a complete output group, covering both output module spaces of a group.

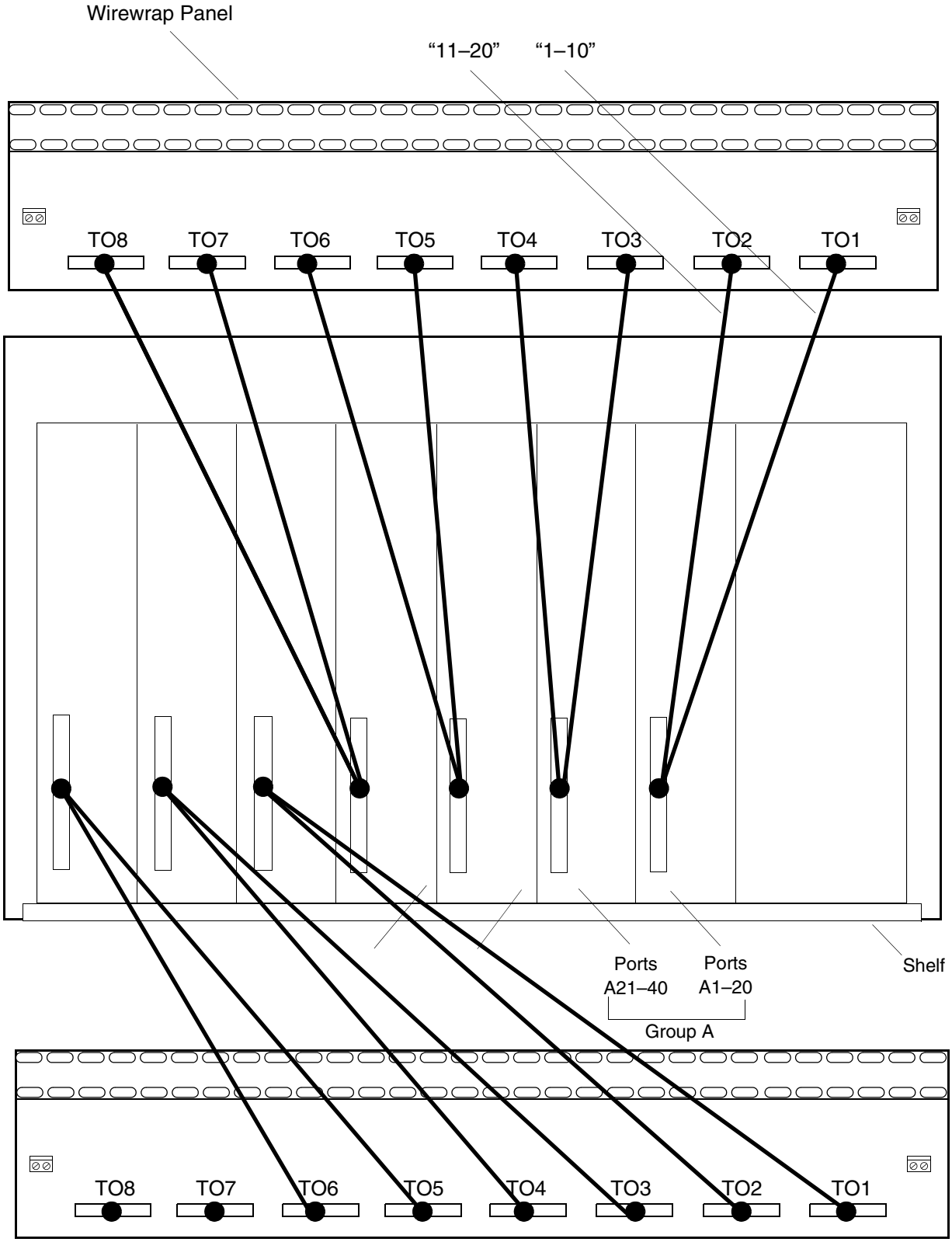
Order and install the desired output module blank panels in the back of the expansion shelf.

3.8 Cabling

3.8.1 Shelf–to–Connection Panel

Connect the factory-supplied three-connector ribbon cable from the connector on the output connector card on the rear of the shelf to two of the connectors labeled “TO” or “OUTPUT” on the rear of the connection panel. The outputs are marked on each cable (one of the cables is marked “1–10”; the other cable is marked “11–20”). Repeat as needed, depending on the number of outputs used. Refer to Figure 3-9.

Figure 3-9. Shelf–to–Wirewrap Panel Connections (Rear)

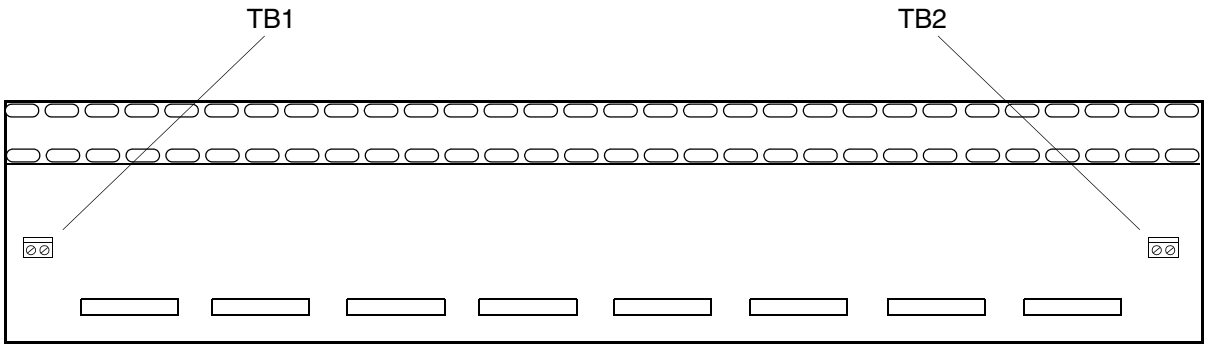


3.8.2 Wirewrap Panel Grounding

NOTE: If using an existing wirewrap panel, leave the wirewrap panel ground connection intact and skip to the “Shelf” subsection.

Frame ground is connected to terminal block TB1 or TB2. Refer to Figure 3-10 for the location of the terminal blocks.

Figure 3-10. Wirewrap Panel Ground Connection



Ensure the frame ground wire is long enough to go from the wirewrap panel to the frame ground connection. Use 16 AWG green insulated wire to connect a terminal of one of the terminal blocks to the frame ground.

Make the ground connection following one of the methods described below, depending on whether a ground rod is installed:

With ground rod

Solder the frame ground connection to one of the 6 AWG frame ground rods running vertically on each side of the rack. Use one of the following methods for connecting the wire from the terminal block to the 6 AWG rod.

- Crimp an appropriate-size spade lug to the ground wire from the terminal block, bend the lug around the 6 AWG rod, and solder.
- Strip enough insulation from the ground wire from the terminal block to permit three complete turns around the 6 AWG rod, and solder.

NOTE: Use an appropriate soldering iron to ensure the 6 AWG rod is heated sufficiently to prevent a cold solder connection.

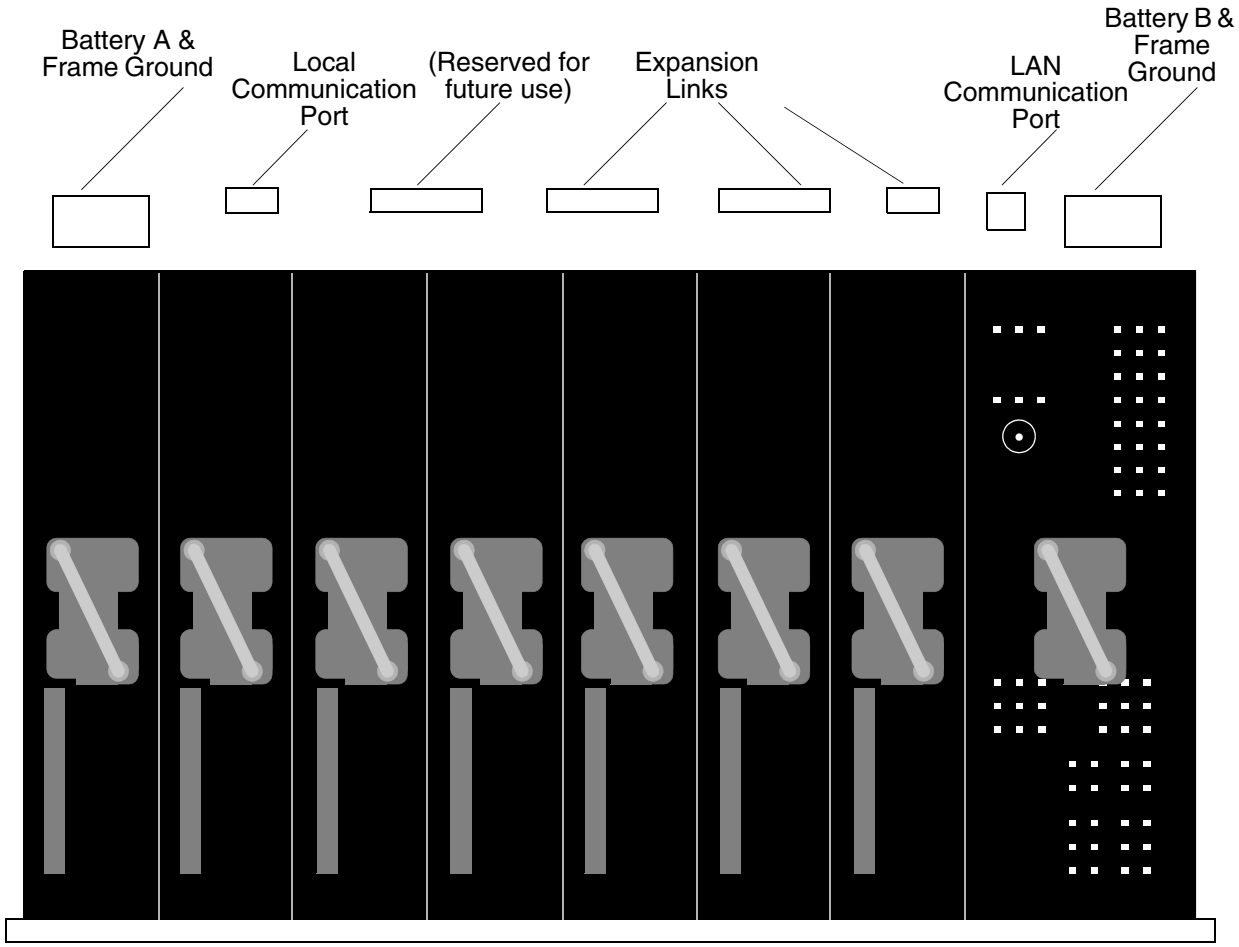
Without ground rod

Crimp an appropriate-sized spade lug to the wire from the terminal block, and secure the lug to a screw hole on the rack. Remove the paint, and sand the area around the screw hole, to ensure proper conductivity.

3.8.3 Shelf

Figure 3-11 shows the power, timing input, and communication port connectors on the rear of the shelf.

Figure 3-11. Shelf Rear Connectors



3.8.3.1 Frame Ground

Frame ground connections are made on power terminal blocks TB1 and TB2. Refer to Figure 3-11 for the location of the terminals, and refer to Figure 3-12 for the terminal connections.

The terminal connections are labeled. For convenience, the connection order is shown as well. For a master shelf (090-55501-01), the connections are as shown in Figure 3-12.

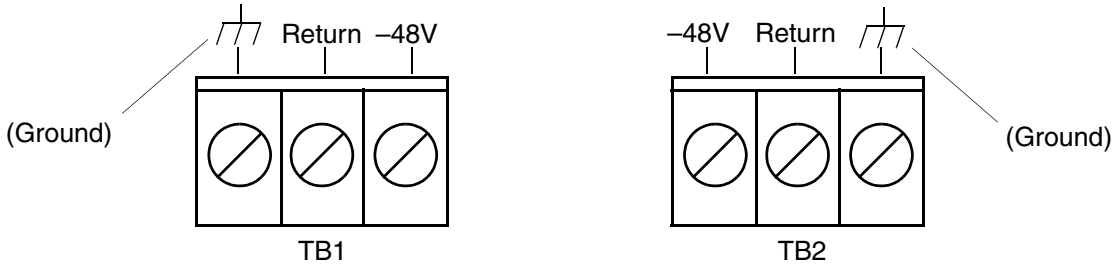
Figure 3-12. Battery Connections (Master Shelf)

A. TB1 Connections (Office Battery A)

B. TB2 Connections (Office Battery B)

For an expansion shelf (090-55502-01), the connections are as shown in Figure 3-13.

Figure 3-13. Battery Connections (Expansion Shelf)



A. TB1 Connections (Office Battery A)

B. TB2 Connections (Office Battery B)

Ensure the frame ground wires are long enough to go from the rear of the shelf to the frame ground connection. Use one 16 AWG green insulated wire to connect the ground terminal of power terminal block TB1 to the frame ground, and use another 16 AWG green insulated wire to connect the ground terminal of TB2 to frame ground.

Make the ground connection, following one of the methods described below, depending on whether a ground rod is installed:

With ground rod

Solder the connection to the 6 AWG frame ground rod that is run vertically on each side of the rack, if provided. Two methods are acceptable:

- Crimp an appropriate-size spade lug to the 16 AWG wire, bend the lug around the 6 AWG rod, and solder.
- Strip enough insulation from the 16 AWG wire to permit three complete turns around the 6 AWG rod and solder.

NOTE: Use an appropriate soldering iron to ensure the 6 AWG rod is heated sufficiently to prevent a cold solder connection.

Without ground rod

Crimp the supplied spade lug to the 16 AWG wire, and screw the lug to a screw hole on the rack. Remove the paint and sand the area around the screw hole to ensure proper conductivity. Coat the connection with an electrically conductive antioxidant compound, for example, Kopr-Shield spray.

Crimp the supplied spade lug to the other end of the 16 AWG wire, and connect it to the ground terminals on TB1 and TB2 (Figure 3-12).

3.8.3.2 Power

WARNING: This equipment is intended for installation in a restricted access location. Power source protective fusing must be provided as part of the installation.

CAUTION: Make sure to remove the fuses in the fuse panel which will be used to power the TimeHub 5500 Shelf before connecting power. Also make sure to remove the fuses from the TimeHub 5500 Shelf before connecting power.

NOTE: Make sure to test for proper volt/polarity at the TimeHub 5500 Shelf and not at the fuse panel.

Power connections are made on power terminal blocks TB1 and TB2. Refer to Figure 3-11 for the location of the terminals on the rear of the shelf, and refer to Figure 3-12 for the terminal connections.

Ensure the power wires are long enough to go from the shelf rear panel to the office battery source connection.

Use 18 AWG stranded wire to connect –48 volts from office battery A to the –48V A terminal on TB1. Connect office battery A return to the Return A terminal on TB1.

Use 18 AWG stranded wire to connect –48 volts from office battery B to the –48V B terminal on TB2. Connect office battery B return to the Return B terminal on TB2.

CAUTION: Do not apply the office battery to the TimeHub 5500 at this time.

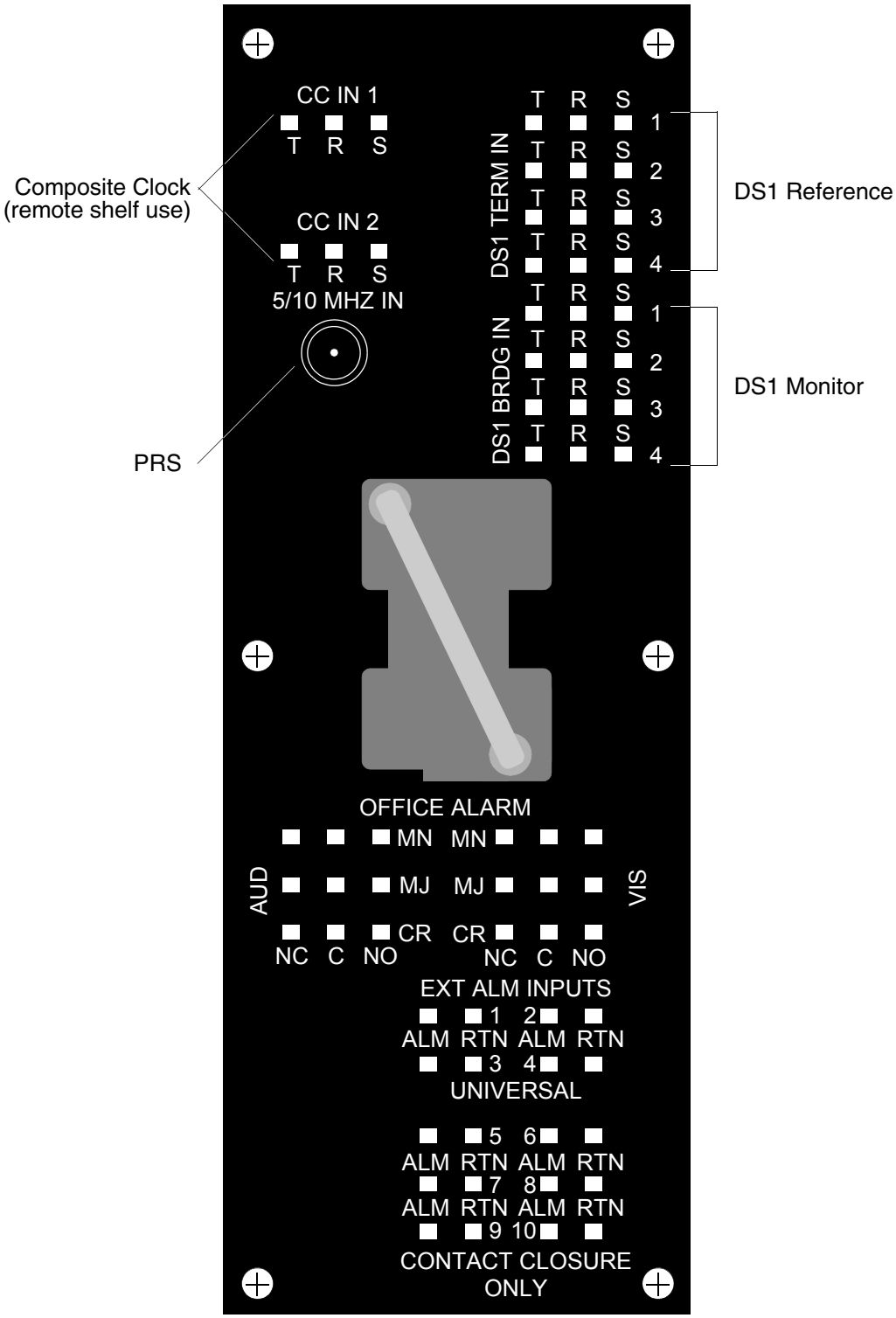
NOTE: Two separate office battery supplies (battery A and battery B) are highly recommended. If separate office battery supplies are not available, connect a single office battery to both inputs (TB1 and TB2) to avoid a standing battery-failure alarm.

3.8.3.3 Timing Inputs

DS1 Reference

Connect the DS1 reference inputs to the wirewrap pins labeled DS1 TERM IN on the Input/Alarm Connector module (Figure 3-14). Connect the tip wire to the pins labeled T, the ring wire to the pins labeled R, and the shield (if connected at the TimeHub 5500) to the pins labeled S.

Figure 3-14. Input/Alarm Connector Module Connections



DS1 Monitor

Connect the DS1 monitor inputs to the remaining DS1 Reference pins, or to the wirewrap pins labeled DS1 MON on the Input/Alarm Connector module (Figure). Nine-input clock cards (090-55512-02 or 090-55514-02) are required if the DS1 MON pins are used. Connect the tip wire to the pins labeled T, the ring wire to the pins labeled R, and the shield (if connected at the TimeHub 5500) to the pins labeled S.

PRS Input

Connect the PRS input to the BNC connector labeled 5/10 MHz IN on the Input/Alarm Connector module. See Figures and for the connector location.

3.8.3.4 Communication Ports

LAN

Connect the LAN cable from the network to the RJ-45 (10Base-T) connector labeled LAN on the rear of the shelf. Refer to Figure 3-11 for the connector location, and Table 3-3 for the connector pinouts.

NOTE: Each TimeHub 5500 will have its own IP address that can be set through the local RS-232 port. Once the IP address has been set and a LAN connection made, the TimeHub 5500 can be remotely accessed on a network.

Table 3-3. LAN Pinouts

Pin	Signal	Abbreviation	Direction
1	Transmit data +	TXD +	From TimeHub 5500
2	Transmit data –	TXD –	From TimeHub 5500
3	Receive data +	RXD +	To TimeHub 5500
6	Receive data –	RXD –	To TimeHub 5500

Note: Pins not listed are reserved for future use.

Local

To provide an RS-232 link for TL1 command access to the TimeHub 5500, connect to the data terminal equipment (DTE) equivalent communication port 1 at the nine-pin connector labeled Local on the rear of the shelf. See

Figure 3-11 for the location of the connector and Table 3-4 for the connector pinouts.

Table 3-4. Local Pinouts

Pin	Signal	Abbreviation	Direction
2	Transmit data	TXD	From TimeHub 5500
3	Receive data	RXD	To TimeHub 5500
5	Signal ground	GND	–
7	Clear to send	CTS	To TimeHub 5500
8	Request to send	RTS	From TimeHub 5500

Note: Pins not listed are reserved for future use.

Remote Communication

The Remote Comm connector is reserved for future use.

Expansion Link 1

The Expansion Link 1 connector is used to connect to the expansion shelf.

Expansion Link 2

The Expansion Link 2 connector is used to connect to the expansion shelf.

Chapter 4

Operational Verification & Configuration

This chapter includes:

4.1 Overview

Test, install cards, cable, and configure the TimeHub 5500 using the sequence given in this chapter after installing the shelf, and making power, clock, and communication port connections (Installation chapter sequence). If any difficulties are encountered during the installation process, contact Symmetricom's CAC. Refer to the Technical Assistance section of the Troubleshooting chapter for telephone numbers.

4.2 Power Test

To verify power connections to the TimeHub 5500, follow the steps in Procedure 4-1.

Procedure 4-1. Power Test

Step	Action
Test Equipment: Digital multimeter (Fluke 77 or equivalent)	
1	Ensure that all fuses that supply power to the TimeHub 5500 Shelf are removed from the fuse panel and from the front of the shelf, and no clock, management, or output driver cards are in the shelf.
2	Disconnect the –48V battery A and battery B leads from the shelf power terminal blocks TB1 and TB2 (Figures 4-1 and 4-2). (Leave the Return battery leads connected to the shelf.)
3	At the shelf end of the battery leads, use the multimeter to measure the voltage between the following test points: Test Point – Test Point – Result Battery A lead – Battery B lead – 0 V Battery A lead – TB1: Return A – 0 V Battery A lead – TB1: Ground – 0 V Battery B lead – TB2: Return B – 0 V Battery B lead – TB2: Ground – 0 V
4	Reconnect the –48V battery A and battery B leads to the power terminal blocks (TB1 and TB2) –48V A and –48V B terminal sets on the shelf.
5	In the power source fuse panel, install the A fuse.
6	Use the multimeter to measure the voltage between the –48V A and Return terminals on the TB2 terminal block on the shelf. Requirement: The multimeter indicates –42 V dc to –56 V dc.
7	In the power source fuse panel, install the B fuse.

Procedure 4-1. Power Test (Cont'd)

Step	Action
8	Use the multimeter to measure the voltage between the –48V B and Return terminal sets on the TB1 terminal block on the shelf. The multimeter indicates –42 V dc to –56 V dc.
9	Install both 3AG 10 A fuses (fuse A and fuse B) in the front of the shelf. Refer to Figure 4-1.

End of Procedure

Figure 4-1. Shelf Rear Connectors

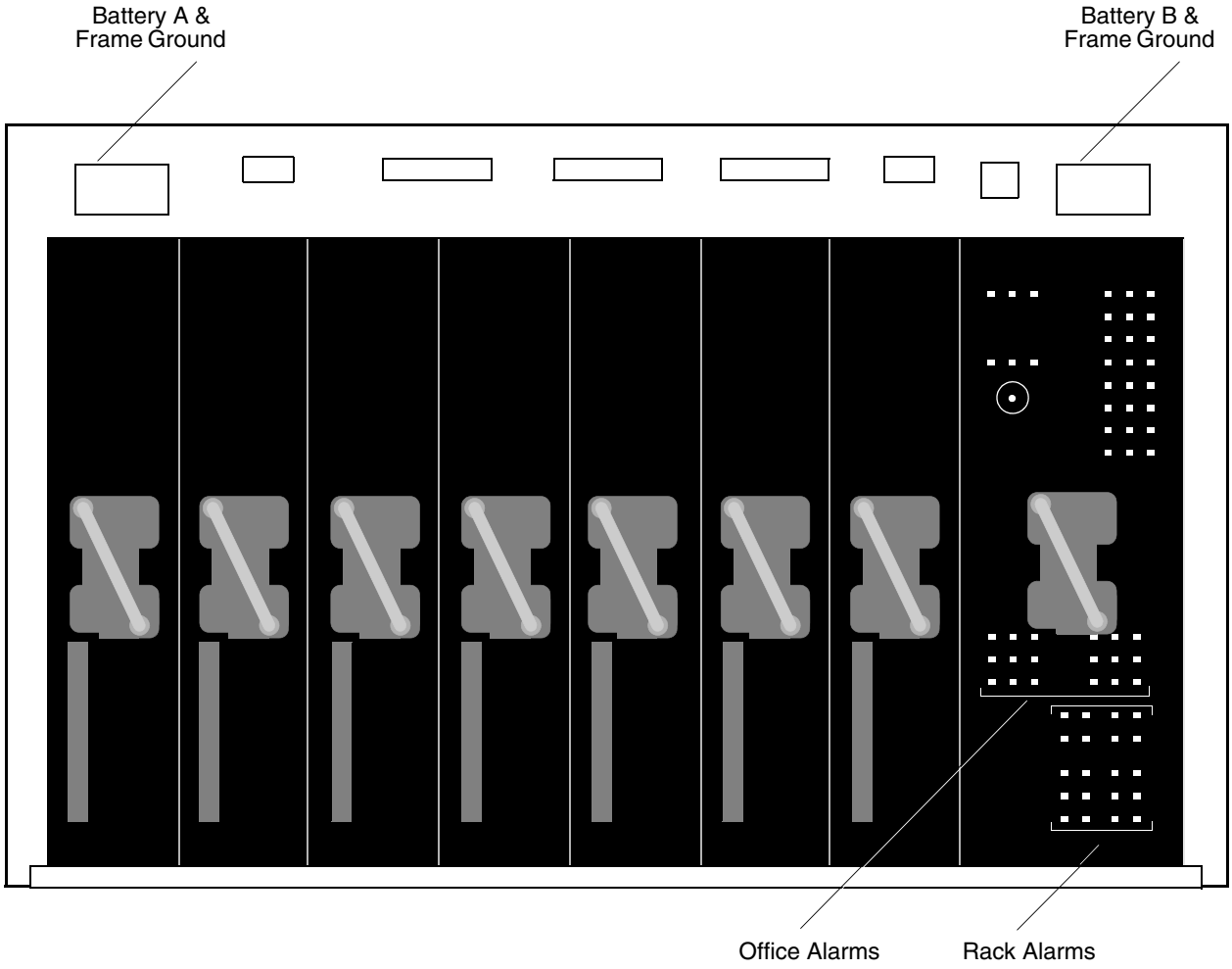


Figure 4-2. Battery Connections (Master Shelf)

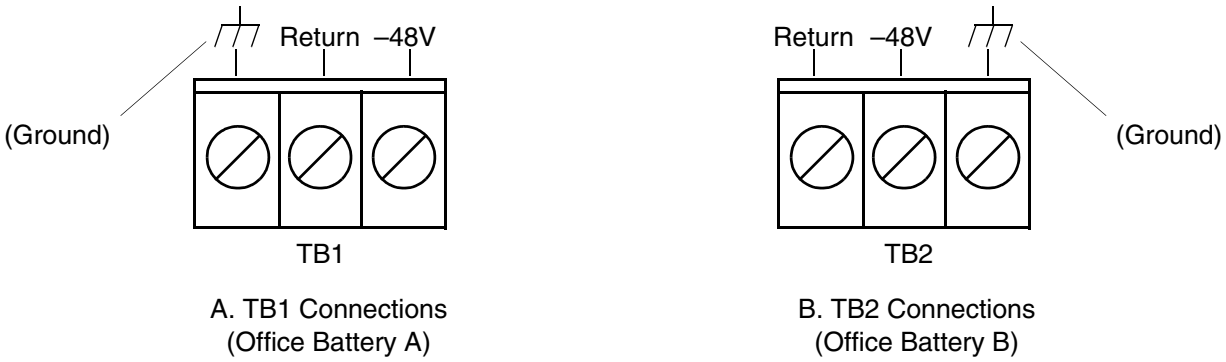
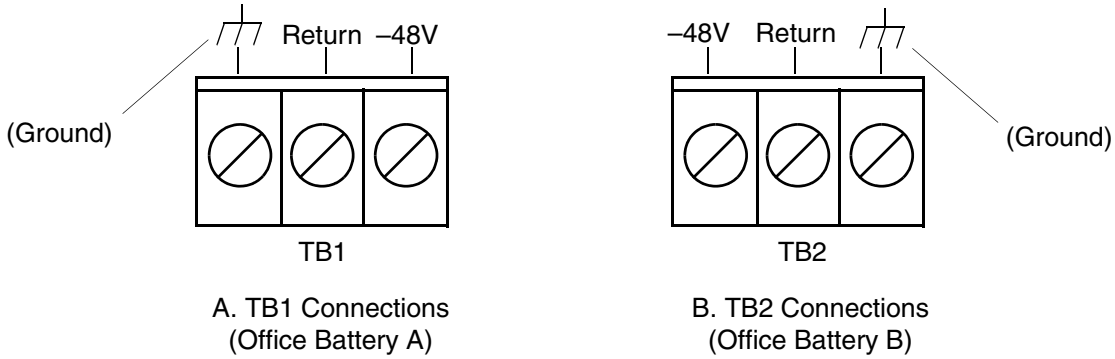


Figure 4-3. Battery Connections (Expansion Shelf)



4.3 Input Test

Prior to performing the input test, ensure that the following has been done:

- Connect each available DS1 reference to input connector DS1 input wirewrap pins. Terminated DS1s connect to any of the four labeled “DS1 TERM IN”; bridged DS1s connect to any of the four labeled “DS1 BRDG IN”.
- If you have a 5 MHz or 10 MHz PRS input reference, connect it to the BNC labeled “5/10 MHz IN”

Input signal level requirements for the PRS inputs, DS1 terminated inputs, and DS1 bridged inputs are covered in Chapter 6.

To verify the clock input signal(s) are within the specified input voltage range, follow the steps in Procedure 4-2.

Procedure 4-2. Input Test

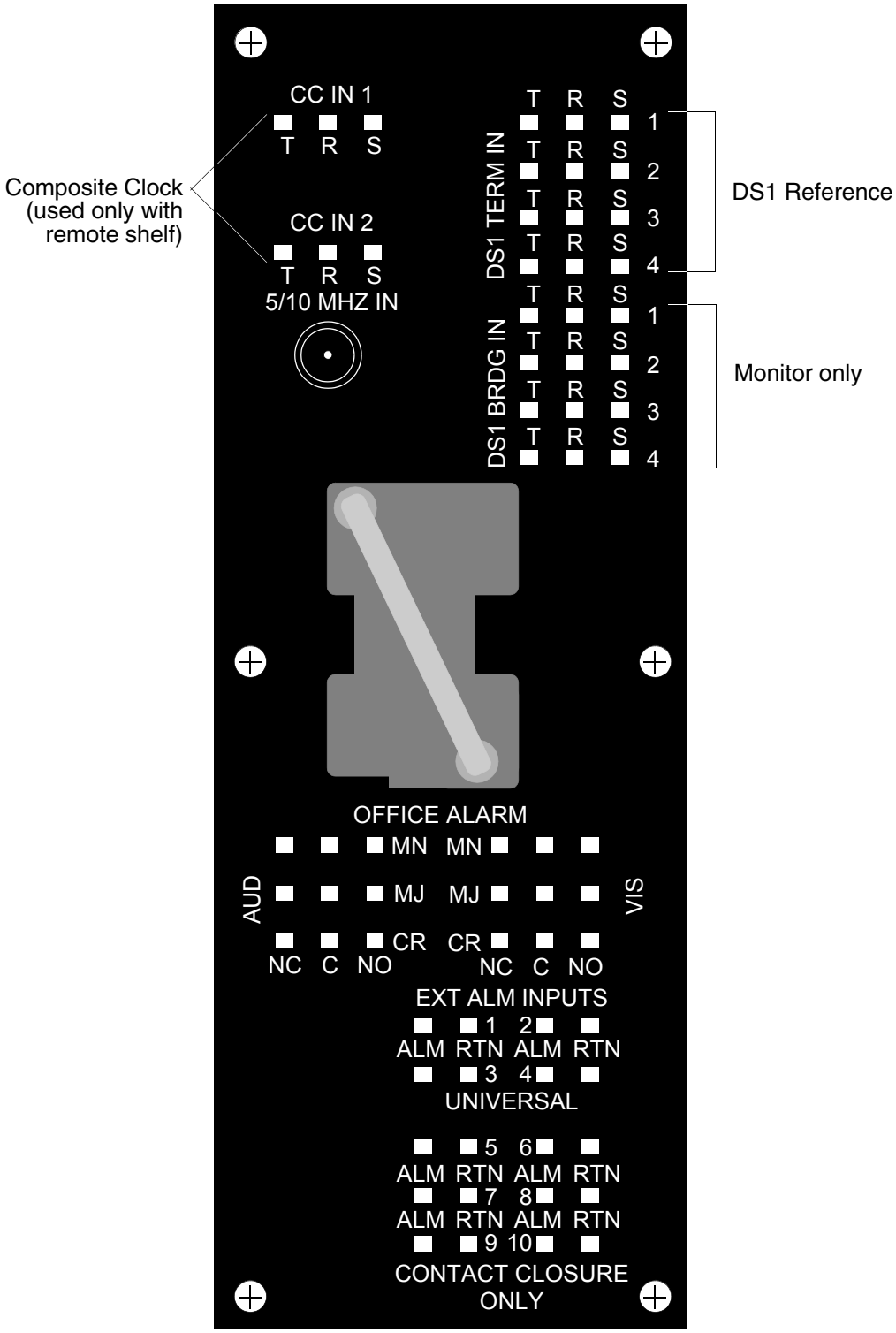
Step	Action
Test Equipment: Dual-channel oscilloscope with 100 MHz minimum bandwidth	
1	Obtain a dual-channel oscilloscope and set the controls as listed in Table 4-1. *Note:* Consult the oscilloscope manufacturer's manual for details and operating instructions.
2	Connect the X10 probes to the channel 1 and channel 2 oscilloscope inputs, and install a terminating resistor across the probes.
3	Connect the channel 1 and 2 probe ground leads together.
4	Connect the channel 1 and 2 probes (with resistor) to T and R of each DS1 reference input on the shelf Input/Alarm Connector module (refer to Figure 4-4).
5	Verify that the clock input signal(s) are within the specified input voltage range and meet the prescribed template. Consult local company Installation Job Specifications for the type of input signals installed and on which input connectors. Requirement: Input signal ranges are as follows: a. DS1 Terminated: 1.0 V to 3.5 V base-to-peak, 100 Ω terminated b. DS1 Bridged: 0.10 V to 0.35 V base-to-peak, 100 Ω terminated c. CC: 1.5 V to 4.0 V base-to-peak, 130 Ω terminated (only used with remote shelf)
End of Procedure	

Table 4-1. Typical Oscilloscope Settings

Control	Setting
Mode Trigger Switch	ADD
Invert Switch	INVERT
Ch1 and Ch2: Volts/Div Input Coupling Vert Position Control	 See Note AC mid-range
A Sweep Mode	AUTO-TRIGGER
Horizontal Display Switch	A
Time/Div Switch: for CC for DS1	 20 µs 500 ns
A Sweep	FULL
Horizontal Position Control	mid-range
A Triggering: Slope Coupling Source	 + or – AC INT

Note: Adjust the oscilloscope's volts-per-division scale to the appropriate level to get a measurable pulse amplitude on the screen; for example, to measure a 0 dB DSX (TERM) signal, set the volts-per-division scale to 1 V per division; to measure a -20 dB DSX (BRDG) signal, set the volts-per-division scale to 100 mV per division.

Figure 4-4. Input Wirewrap Pins



4.4 Card Installation

4.4.1 Management Card

To install the management card, follow Procedure 4-3.

Procedure 4-3. Management Card Installation

Step	Action
1	Set switch S1 on the management card as appropriate (see Figure 4-5 and Table 4-2).
2	Insert the management card into the IMC slot (located at the left front of the shelf): ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors. Requirements: On the management card: a. The Power lamp lights. b. The Alarm and ALARMS Shelf Critical lamps stay lit until the card self-test finishes. See Figure 4-6 for management card front panel items.
3	Remove the –48 volt A fuse by twisting in counterclockwise direction (Figure 4-7). Requirements: On the management card: a. The SHELF POWER –48V A Fail lamp lights b. The ALARMS Shelf Major lamp lights.
4	Press the AUDIBLE ALARM Cutoff pushbutton on the management card (Figure 4-6). Requirement: The card ALARMS Cutoff lamp lights.
5	Replace the –48 volt A fuse. Requirements: On the management card: a. The SHELF POWER –48V A Fail lamp turns off. b. The ALARMS Shelf Major lamp turns off within a few seconds. c. The ALARMS Cutoff lamp turns off.
6	Remove the –48 volt B fuse by twisting in counterclockwise direction (Figure 4-7). Requirements: On the management card: a. The SHELF POWER –48V B Fail lamp lights. b. The ALARMS Shelf Major lamp lights.
7	Press the ALARMS Cutoff pushbutton on the management card. Requirement: The card ALARMS Cutoff lamp lights.

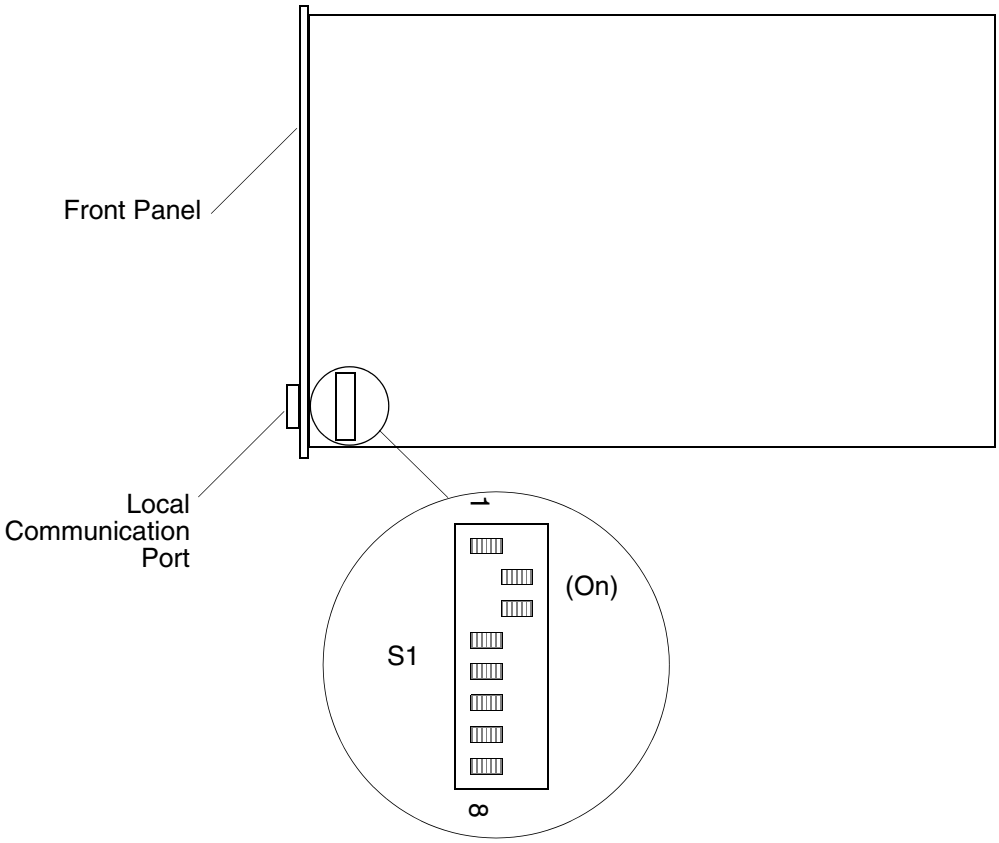
Procedure 4-3. Management Card Installation (Cont'd)

Step	Action
8	Replace the –48 volt B fuse. Requirements: On the management card: a. The SHELF POWER –48V B Fail lamp turns off. b. The ALARMS Shelf Major lamp turns off within a few seconds. c. The ALARMS Cutoff lamp turns off.
9	Remove both A and B fuses from the shelf. Requirements: a. The shelf lamps next to the fuses light. b. All lamps on the management card turn off.
10	Replace both A and B fuses. Requirements: a. The shelf lamps next to the fuses turn off. b. On the management card, the ALARMS Shelf Critical, Major, and Minor lamps light, then turn off.

End of Procedure

NOTE: Do not tighten the mounting screws on the management card until instructed to do so in this chapter.

Figure 4-5. Management Card Switch S1



Note: Switch S1 is shown in the factory-set position.

Table 4-2. S1 Switch Settings

S1 Section	Position	Description	Factory Setting
1	On	Security enable	–
	Off	Security disable	X
2	On	Force disable local port (local port can be disabled by TL1 command)	X
	Off	Force enable local port (local port is enabled even if previously disabled by TL1 command)	–

Table 4-2. S1 Switch Settings (Cont'd)

S1 Section	Position	Description	Factory Setting
3	On	Enforce IP match enable (only communication from the addresses of the primary and/or alternate element managers [EM1 and EM2] will be accepted; communications from all other network addresses will be ignored)	X
	Off	Enforce IP match disable (communication from any network will be accepted)	–
4-8	Off	Reserved for future use	X

Figure 4-6. Management Card

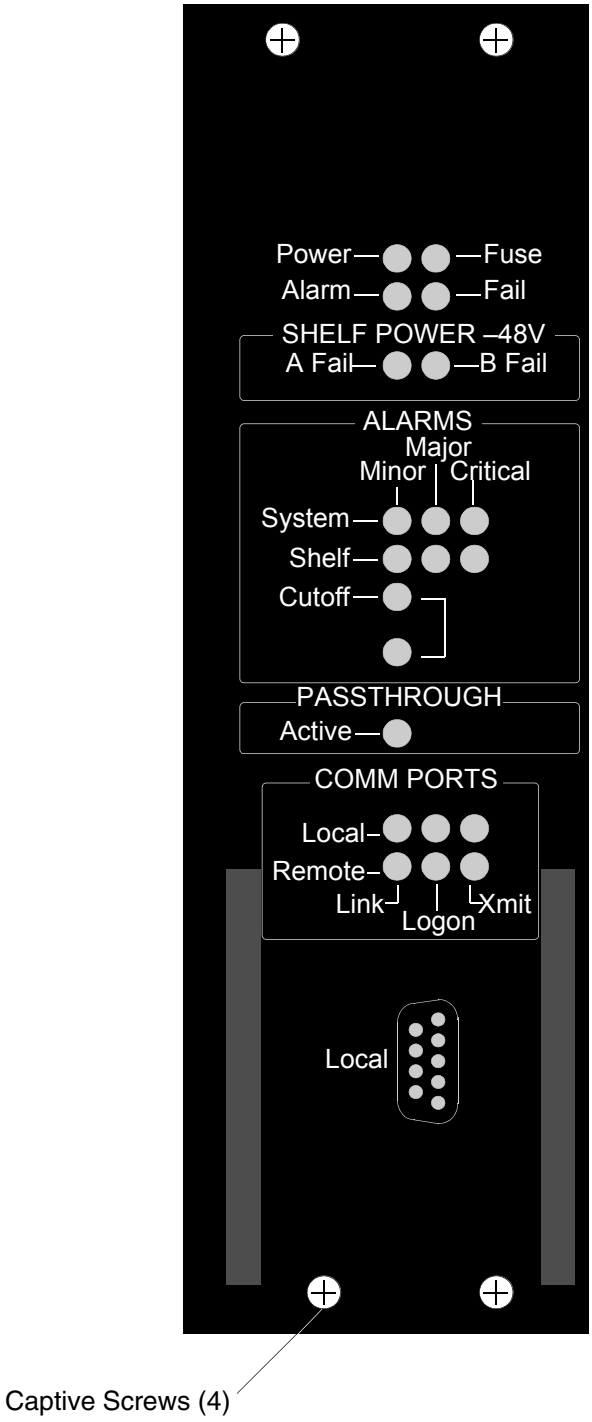
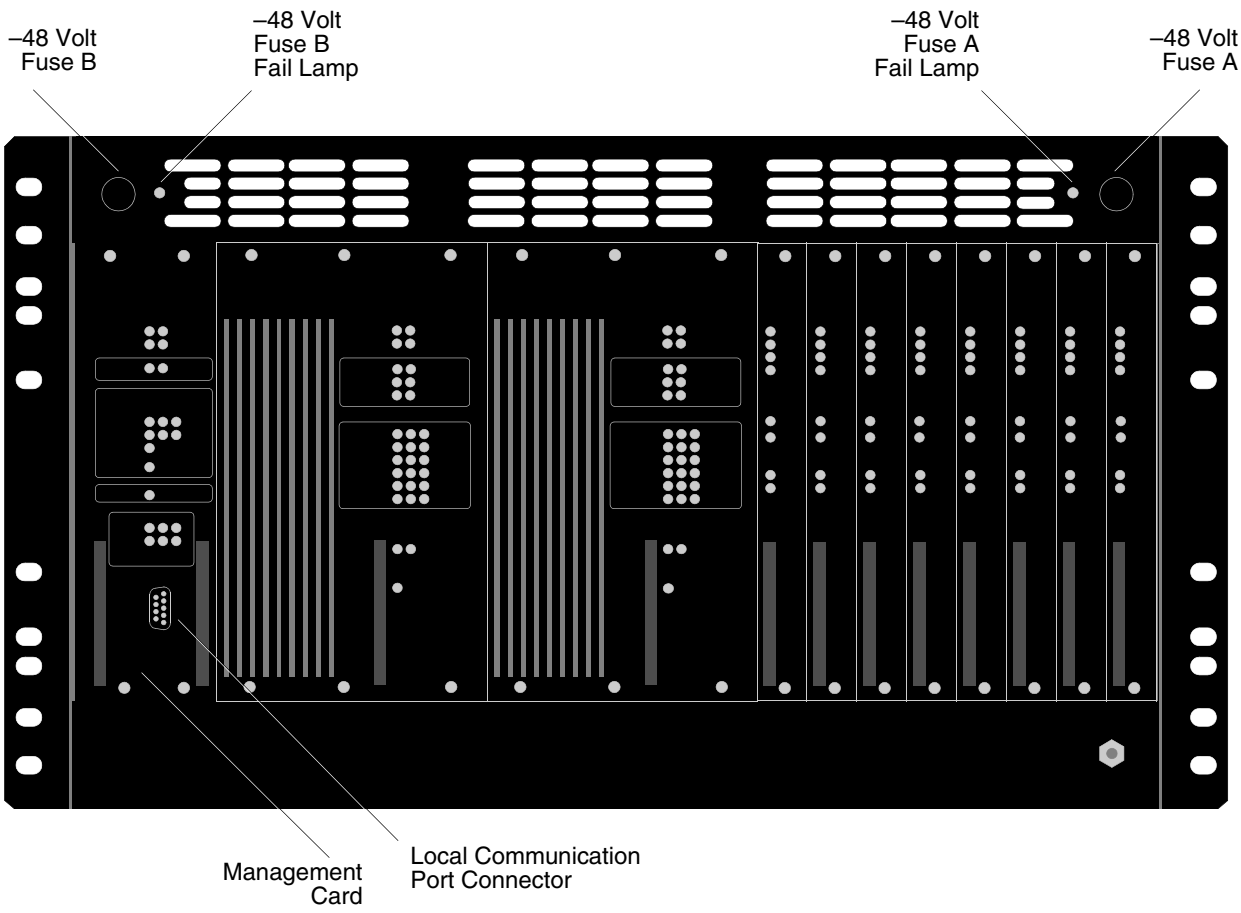


Figure 4-7. –48 Volt Fuses



4.4.2 Confirmation of Master or Remote Shelf Setting

To confirm that the shelf rotary switch has been set properly (see Table), power the shelf and insert a clock card into either the CLK1 or CLK2 slot. The clock card performs a self-test, then enters Warmup mode (the Warmup LED illuminates). When the card completes Warmup it will transition to Freerun mode (the Freerun LED illuminates). Following this transition, check the “Remote” LED per Table . As described, the “Remote” LED will only illuminate if the shelf has been configured for remote operation. See Figure for the location of the “Remote” LED. On the clock card front panel, its location is in the Input section, at the intersection of the row labeled “DS1 4” and the column labeled “A”. Proper configuration can also be verified by using the MAINCLK TL1 keyword (see TimeHub 5500 TL1 Reference Manual for details.)

If the “Remote” LED responded as expected, the shelf is now properly configured.

NOTE: It is expected that this same LED can illuminate during main shelf operation. This occurs if the DS1-4 input has been enabled, the input has been qualified, and is being used as the active timing reference. In such a case all three LEDs in the DS1-4 row are illuminated, so it is easy to to distinguish this main shelf operating mode from the use of the “Remote” LED as an indicator that the shelf is configured for Remote. When indicating Remote operation, the “E” and “Q” LEDs in the DS1-4 row will never be lit.

NOTE: Remote shelf capability is not supported in management (090-55542-01) and clock (090-55512-0x, 090-55514-0x) cards having firmware versions 4109x. The firmware version of each card can be retrieved via the TL1 RTRV-NETYPE-ALL command, which inventories the shelf contents. (See TimeHub 5500 TL1 Reference Manual for detailed information about this command.) If you have any of these firmware versions in your management or clock cards and are interested in remote shelf operation, contact the Symmetricom CAC for information about firmware upgrades.

4.4.3 Clock Cards

To install the clock cards, follow Procedure 4-4.

Procedure 4-4. Clock Card Installation

Step	Action
See Figure 4-8 for clock card lamps.	
1	Locate switch S1 on the right side panel of the clock cards (see Figure 4-9 and Table 4-3). If both clock cards are 55512 or both are 55514 (see front panel label), ensure that bit 1 on both clock cards is set to the ON position. If one clock card is a 55512 and the other clock card is a 55514, ensure that bit 1 on the 55512 is set to the OFF position and that bit 1 on the 55514 is set to the ON position.
2	Insert the first clock card into the CLK 1 slot (located at the front of the shelf): ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
3	Insert the second clock card into the CLK 2 slot: again, ensure that the card is aligned properly and is fully seated.
4	Wait for the Warmup lamp to turn off on both clock cards (approximately 2 minutes to 20 minutes per card) and the Tracking lamp on at least one of the cards is lit. Requirement: At least one of the inputs is qualified (one set of the INPUTS E, Q, and A lamps is lit on the card). *Note:* The clock cards are in freerun mode once the Warmup lamp is off. To ensure that an input is qualified on a card, refer to Procedure .

End of Procedure

NOTE: Do not tighten the mounting screws on the clock cards until instructed to do so in this chapter.

Figure 4-8. Clock Card

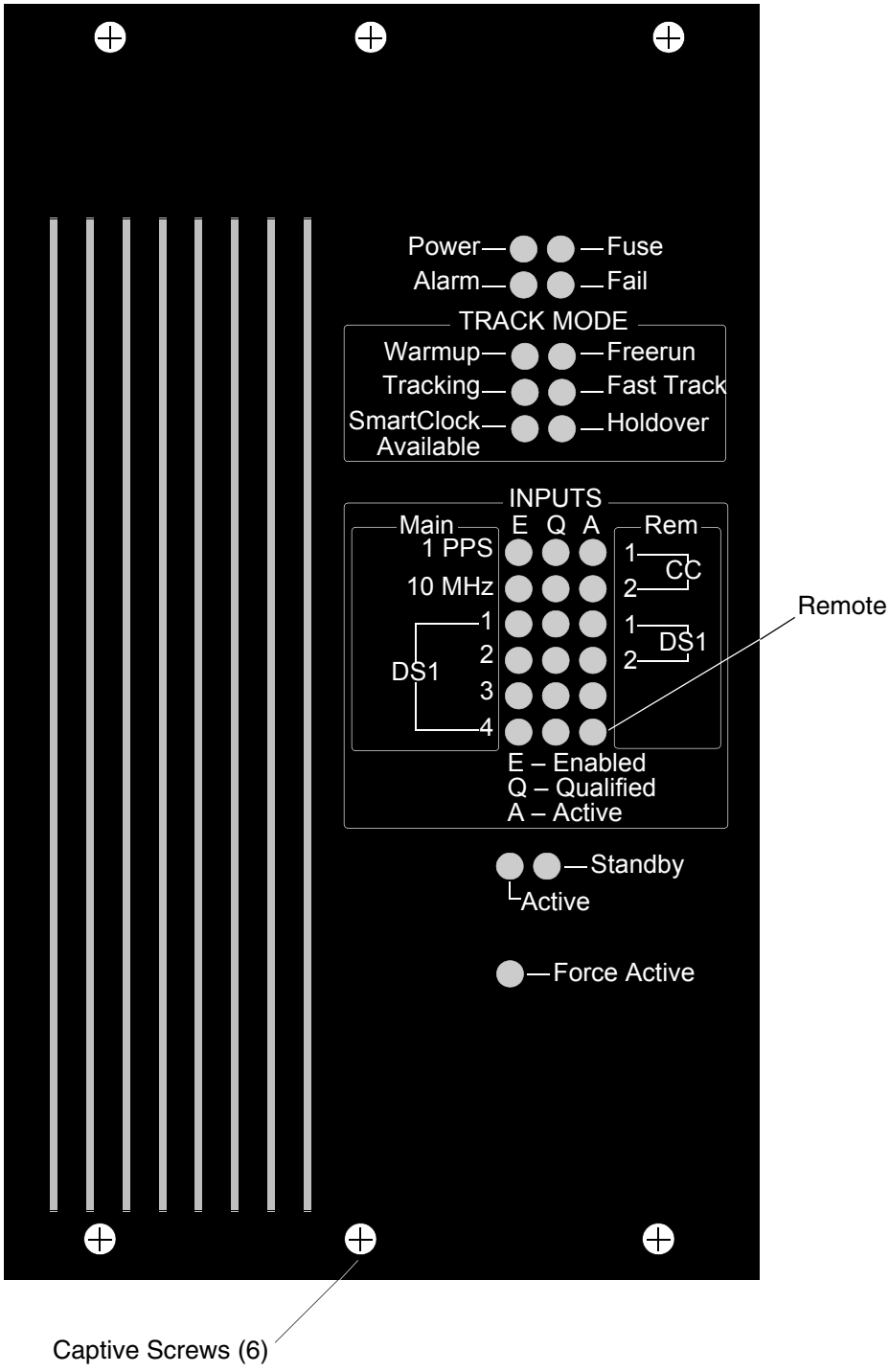
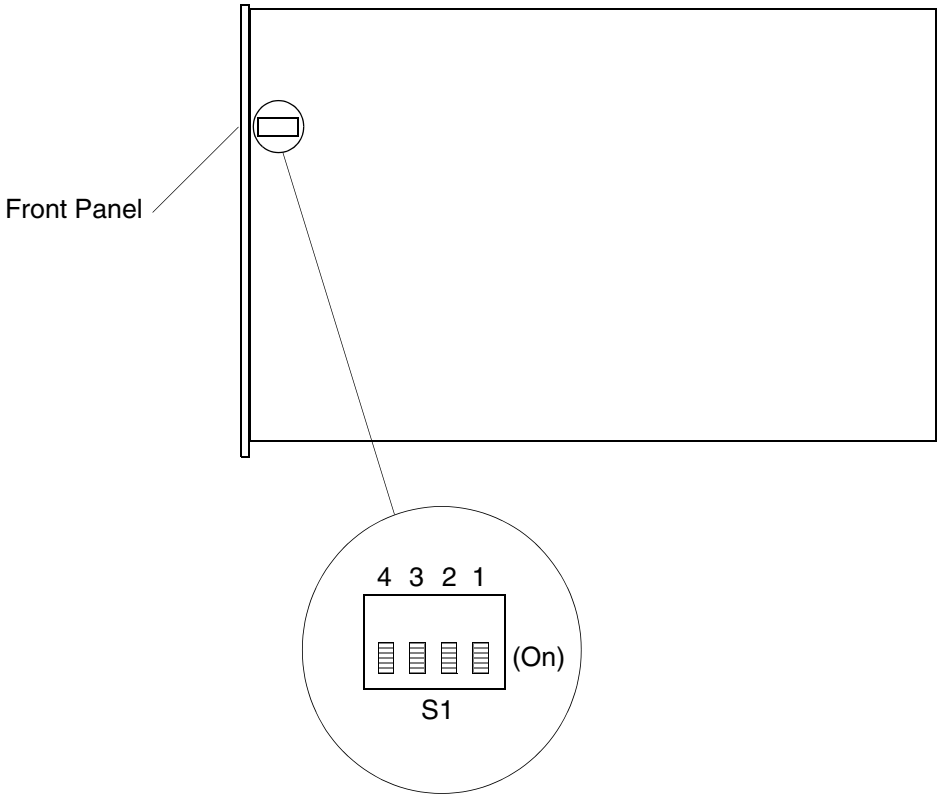


Figure 4-9. Clock Card Switch S1



Note: Switch S1 is shown in the factory-set position.

Table 4-3. S1 Switch Settings

S1 Section	Position	Description	Factory Setting
1	On	Normal operation	X
	Off	Mixed oscillator operation. This card contains a secondary oscillator	–
2-4	On	Not used	X

4.5 Input Qualification (Master Shelf)

To ensure that inputs are properly qualified for a clock card, follow Procedure 4-5.

For remote shelf input qualification, see Procedures and (optional) in Chapter 1.

Procedure 4-5. Input Qualification

Step	Action
1	Verify that the input is enabled by checking that the “E” lamp on the front panel is lit. *Note:* When the “E” lamp is lit, it does *not* indicate that a valid input is connected. It simply indicates that the input has been selected as a possible timing reference.
2	If the “E” lamp is not lit, enable the lamp using the TL1 keyword ENABLE once either a local or LAN communication port connection is established. Refer to Procedure for both establishing a port connection and using the ENABLE keyword.
3	Verify that the input is qualified by checking that the “Q” lamp on the front panel is lit. *Note:* When the “Q” lamp is lit, it indicates that the input has met all requirements to becoming the active timing reference.
4	If an input is connected to the 5/10 MHz BNC connection on the Input/Alarm card, verify that the 5/10 MHz BNC connection agrees with the actual input. This setting is controlled with the TL1 keyword PRC5MHZ. Placing the setting on Y indicates a 5 MHz input is expected. Placing the setting on N indicates a 10 MHz input is expected. Refer to Procedure for information on using the PRC5MHZ keyword.
5	For terminated DS1 inputs, verify that the framing setting (D4 or ESF) agrees with the framing of the actual input. This setting is controlled with the TL1 keyword ESF. Placing the setting on Y indicates ESF framing is expected. Placing the setting on N indicates D4 (also known as SF) framing is expected. *Note:* Bridged DS1 inputs (available only with clock cards 090-55512-02 and 090-55514-02) cannot be qualified. These connections are used exclusively to monitor timing performance of bridged DS1 signals.
6	If all conditions have been met to qualify an input, verify that the “Q” lamp lights within 2 min after warmup ends. *Note:* Progress toward qualification can be observed via either the local or the LAN communications port. Once connected, the TL1 RTRV-COND command provides this information (for example, input loss of signal or out of frame can be observed via RTRV-COND). Refer to the TimeHub 5500 TL1 Reference Manual for details.

End of Procedure

When the first input becomes qualified it will also become active, indicated by the “A” lamp column. The illuminated lamp means that this is the timing input that has been selected as the timing source for the outputs. If the clock card is “Active” (indicated by the Active lamp), then the “A” input is the one that will be used if this card becomes active. In general, both Active and Standby clock cards will qualify and select as “A” the same input(s).

NOTE: Many inputs can be qualified but only one input can be active on a clock card.

As additional inputs become qualified the chosen active input may change. There are numerous options for controlling the criteria for active input selection. Refer to the keyword SYNCMDE in the TimeHub 5500 TL1 Reference Manual for details.

The most basic setting defines a priority such that the topmost qualified input will be selected as active. Thus, if DS1 inputs 3 and 4 are the only ones qualified, 3 will be selected as active.

As soon as an input becomes qualified, the Freerun lamp will turn off, indicating that the active timing reference is no longer the internal oscillator.

4.5.1 Expansion Shelf Controller Cards

If configuring an expansion shelf, continue with this section. If configuring a main shelf only, skip to the next section. Chapter 1 provides a section covering many details about expansion shelves.

Throughout the process it may be helpful to connect a terminal program (such as Hyper Terminal) or, even better TimeScan THC which is the local craft software for TimeHub. Doing so will allow event status to be observed throughout the installation process. Instructions for connecting to the serial (craft) port connection on a TimeHub master shelf are covered in this manual. The TL1 manual contains detailed information about the command interface. TimeScan THC version 2.2 (or later) supports the expansion shelf capability (allows direct configuration of expansion shelf outputs). If you do not have this software and would like to have it, contact Symmetricom CAC. If you do have TimeScan THC version 2.2 (or later) things that may be useful to observe during configuration include:

- Automatic messages. You can bring up a separate form for this from a menu selection (Mode->Automatic Messages). This form will update whenever the TimeHub sends out a event message. For example, when an expansion controller card is inserted, an event indicating that the insertion has occurred will be generated.

- You can also bring up a form that shows generalized communication to and from the TimeHub. It is available from the same menu that brings up the automatic message form (Mode->Command Response). With this form in view, it is often useful to observe the responses to the following TL1 commands, each of which can be automatically generated from another menu selection:

  - RTRV-NETYPE-ALL (TL1Commands->RTRV-NETYPE-ALL or F2): This command retrieves the current hardware configuration of the TimeHub system (master and expansion shelves). During the configuration you may want to select this to see which components of the system have been identified so far.

  - RTRV-COND (TL1Commands->RTRV-COND or F3): This command retrieves any conditions that are currently active. They may or may not be alarm-generating.

  - RTRV-ALRM (TL1Commands->RTRV-ALRM or F4): This command retrieves only conditions that are active and alarm-generating. For example, if only one power terminal is connected on the expansion shelf, this would be reported in the response (as well as indicated on the expansion controller card(s) front panel(s)).

  - Finally, when the hardware configuration is complete, TimeScan THC can be used to configure expansion shelf outputs as desired. See the last step in configuration process for more info.

If you do not have TimeScan THC and use a terminal emulation program instead, all of the above actions can still be performed; it will just involve typing of commands or setting up scripts/special function keys to do so.

4. With no modules inserted in the expansion shelf, confirm that the shelf is receiving power from both terminals by twisting out the fuse connectors located at the upper left and upper right of the expansion shelf. When twisting off the fuse holder (which simulates a blown fuse on that terminal side), if the other terminal has power the red LED will illuminate (indicating that power is not currently being supplied by this terminal, which is of course expected since the fuse is removed).

   Thus, to check that terminal A is supplying power, temporarily remove fuse B. If the fuse B LED illuminates terminal A is supplying power (of course this doesn't confirm actual voltage and current supplying capability). Similarly, to check that terminal B is supplying power, temporarily remove fuse A. If the fuse A LED illuminates terminal B is supplying power.

5. If it is convenient this is a good point to check that the inter-shelf links are functioning properly. To do this requires that the master shelf and the expansion shelf are powered and there is at least one clock card installed on the master shelf.

   a. Insert an EC card (090-55545-01) into the EC1 (leftmost) slot on the front of the expansion shelf. If power has been supplied to both terminals on this shelf, there should be green Shelf Power A and B LEDs showing on this card. To test the links there must be at least one clock card in the master shelf that is in a mode where it is providing timing output in either "Tracking" or "Fast Track" mode.

      Given that above conditions are met, both link LEDs should show green. If so, this indicates that both link 1 and link 2 connections are properly functioning. If more detailed checking is desired, disconnect either of the link cables. The response should be seen on the corresponding link LED on the EC card.

   b. Assuming there is a second EC card for this expansion shelf, insert it into the EC2 slot. It should show Power and Link LEDs identically to the EC card in the EC1 slot. It should always be the case that if a link shows green in one EC card, it should also show green on the other EC card. This is because the EC cards are truly redundant – both EC cards are independently connected to and evaluating both links.

      The remaining link check steps are not critical since basic link operation is now established, but they can be performed to establish further confidence that all potential scenarios are working correctly.

   a. If the master shelf is not currently in service, confirm that the links remain okay when only CLK1 or only CLK2 is available from the master shelf. For example, to check CLK1 only, simply remove CLK2. In this configuration, obviously only CLK1 timing is available. It should be provided on both links, so both EC cards should still show both links as OK. Note that an alarm is expected in this case on the EC card that is not receiving it's preferred clock. For the example of only CLK1 providing timing, EC2 should show an alarm (but links OK) as an indication that it is not getting its link from CLK2.

      Perform a similar test where only CLK2 is installed. Again, the expectation is that all links should remain green. An alarm is expected on EC1 since it can't get its link from CLK1. Keep in mind that master shelf clock cards do not provide timing while powering up or when in the Warmup state, so a clock card in such a mode does not provide signals that can validate any link.

6. Insert the output driver cards (090-55581-01) where desired in the slots on the front side of the expansion shelf. Note that when a driver card is installed into a location that has corresponding connector modules attached at the back of the shelf, there should be confirmation that those modules are present on the output driver card LEDs.

7. Assuming that all prior steps have been successfully completed, the output driver cards should become initialized by the master shelf. The basic sequence to expect for each driver card is:

   a. The front-panel LEDs will blink as the card first powers up.

   b. The Power and Alarm LEDs will remain lit, as well as LEDs identifying any connector modules that are attached at the back of the shelf. The alarm LED is lit to indicate that the card has not yet been initialized (i.e., received configuration information from the master shelf).

   c. As the card becomes recognized by the master shelf, it will receive communication causing it to become initialized. Prior to initialization, an output card never generates any output, it waits to be told what to do. The initialization configures the output card according to whatever user configuration has been established for the slot into which the card is inserted. This consists of such settings as whether or not the outputs are enabled and what type of framing is desired.

      As each card becomes initialized, its Alarm LED will extinguish. At this point the card is configured per desired setup and is ready to be further configured if desired. If outputs have been enabled for that card, they should be active.

      Note that for a fully loaded shelf, the initialization process could take several minutes in total. If only a single output card is being inserted, the time will be much less than that.

8. Connect THC (or terminal program) to confirm (via RTRV-NETYPE-ALL command) that the shelf configuration is now as expected. If connected with TimeScan THC, this can be checked by bringing up a communication form (select menu "Mode->Command Response") and sending the RTRV-NETYPE-ALL query (select menu "TL1Commands->RTRV-NETYPE-ALL" or F2). Here is a typical response:

```
SYMMBITS 99-10-03 20:55:19
M  sc1 RTRV
   "TSG:Symmetricom,5500,TSG"
   "S0-IMC:,090-55542-01-A,,W0320A,J20280,D0TPN0JAAA,297085"
   "S0-CLK1:,090-55512-01-A,,R4209A,0000000,D0TPVPJAAA,296936"
   "S0-CLK2:,090-55514-01-A,,R4209A,0000000,D0TPKPJAAA,296939"
```

```
   "S0-OUT5C:,090-55581-01-
A,,R4209A,00J21559,D0TPJN0AAA,267799,DS1,"
   "S0-OUT6C:,090-55581-01-
A,,R4209A,00J43212,D0TPJN0AAA,267799,DS1,"

>

SYMMBITS 99-10-03 20:55:19
M  sc1 COMPLD
   "S2-CLK1:,090-55545-01-B,,4209A,,D0C1ZZ0AAA,299465"
   "S2-CLK2:,090-55545-01-B,,4209A,,D0C1ZZ0AAA,299465"
   "S2-OUT12F:,090-55581-01-
A,,R4209A,00000000,D0TPJN0AAA,267799,,"
   "S2-OUT14G:,090-55581-01-
A,,R4209A,00J21577,D0TPJN0AAA,267799,DS1,DS1"
```

The first set of responses (those that begin with "S0-") identify hardware in the master shelf. The second set of responses (those that begin with "S2-") identify hardware in the expansion shelf. For this example:

- S2- occurs because the rotary switch position was set to 2. If the switch had been set to 1, these responses would be S1-. If there were several shelves, the specific shelf is identified in this response by Sx, where x is the rotary switch value. Valid choices are 1, 2, 3, and 4.

- S2-CLK1 line identifies that there is an expansion controller card in the EC1 slot.

- S2-CLK2 line identifies that there is an expansion controller card in the EC2 slot.

- S2-OUT12F and S2-OUT14G identify that there are output driver cards in slots 12F and 14G. Note also that the card in 14G has 2 DS1 output connector modules (090-55591-02) attached in the G group on the back of the shelf.

To actually configure expansion shelf output settings, go to the Configuration->Output form. On this form you can (see online help for additional info):

- Select the shelf and output slot that you want to view or configure. Controls for this are in the upper left. Once selected, the software queries the TimeHub to determine if there are actually output driver cards and connector modules in the selected slot. If so, they will be identified on the form.

- For DS1 and CC ports you can individually enable/disable the selected port

- For DS1 ports you can select framing as either D4 or ESF for groups of 20 ports.
- For CC ports you can set a cable compensation value (groups of 20 ports) and individually select which ports will have the compensation applied.

4.5.2 Output Driver Cards

To install the output driver cards, follow Procedure . This procedure applies to output cards being installed in either a master or an expansion shelf.

NOTE: When connecting live output signals from TimeHub 5500 to test equipment it is possible, depending on how the connection is made, that false port alarms can occur. Such alarms are not actually indicating a problem with the output card. See “Output Port Alarms in TimeHub 5500” in the Functional Description section in Chapter 1.

Procedure 4-6. Output Driver Card Installation

Step	Action
Test Equipment: Dual-channel oscilloscope with 100 MHz minimum bandwidth See Figure 4-10 for output driver card lamps.	
1	For unprotected outputs, the single output card can be installed into either of the two slots available for that card group. The lamps on the card should initially illuminate, then only the Power and Alarm lamp will remain lit. The Alarm lamp will go off after the output card has been initialized by the clock card. This usually takes about 15 seconds, but could take slightly longer. *Note:* For unprotected outputs, insert one card into the left slot of each pair, for example, insert one card into the left slot of the “A” group. For protected outputs, insert two cards per each pair of slots, for example, insert a card in each slot of the “A” group. Requirements: On all output driver cards: a. The Power lamp is lit. b. The DS1 and/or CC lamps are lit according to the output connector cards installed (back of shelf). c. The Fail and Alarm lamps are off. (This will only be true if there is a warmed-up clock in shelf.)
2	Set the 100 MHz oscilloscope controls as listed in Table 4-1.

Procedure 4-6. Output Driver Card Installation (Cont'd)

Step	Action

3	To enable an output port of interest, the key steps are to put the card in-service, set the output framing (if appropriate), and enable the specific port. The following steps will accomplish this (note that it is easiest to accomplish this using TimeScan THC software - see end of this step for details):
	
	a. No output will be possible unless the output card is put in-service. This is accomplished with the following TL1 command.
	
	`ED-EQPT::S1-OUTC:SV267:::INSRVC=Y;`
	
	In the above example, the card being put in service is located in expansion shelf 1 (S1-), the card is in the C group (OUTC). SV267 is the ctag.
	
	Here is the response to the above command:
	
	`SYMMBITS 02-07-11 10:35:54`
	`M SV267 COMPLD`
	`;`
	
	The INSRVC setting can be checked with the following TL1 command:
	
	`RTRV-EQPT::S1-OUTC:SV268:::PARAMETER=INSRVC;`
	
	Which produces the following response, in this showing that this card is in-service (INSRVC = N would indicate that it is not in-service):
	
	`SYMMBITS 02-07-11 10:35:54`
	`M SV268 COMPLD`
	`"S1-OUTC::INSRVC = Y"`
	`;`

Procedure 4-6. Output Driver Card Installation (Cont'd)

Step	Action

3 (cont'd)	b. If this port is connected to a DS1 connector card, the output framing may need to be set to suit your needs. An example of the TL1 command to accomplish this is:
	
	`ED-EQPT::S1-OUTC-PG2:SV271:::OUTESF=Y;`
	
	In the example above, output card(s) in output group C (OUTC) in expansion shelf 1 (S1-) are having ports 21-40 (PG2) framing set to ESF. The ability to set framing on output cards is in groups of 20 ports. Ports 1-20 are referenced with PG1 (Port Group 1), ports 21-40 are referenced with PG2 (as shown in this example).To set the framing to D4 (also known as SF), the OUTESF value should be set to N. SV271 is the ctag.
	
	Here is the response to the above command.
	
	`SYMMBITS 02-07-11 10:43:40`
	`M SV271 COMPLD`
	`;`
	
	The framing setting can be checked with the following command:
	
	`RTRV-EQPT::S1-OUTC-PG2:SV272:::parameter=OUTESF;`
	
	which produces the following response:
	
	`SYMMBITS 02-07-11 10:43:40`
	`M SV272 COMPLD`
	`"S1-OUTC-PG2::OUTESF = Y"`
	`;`
	
	which shows that the output framing is, in fact, set to ESF.

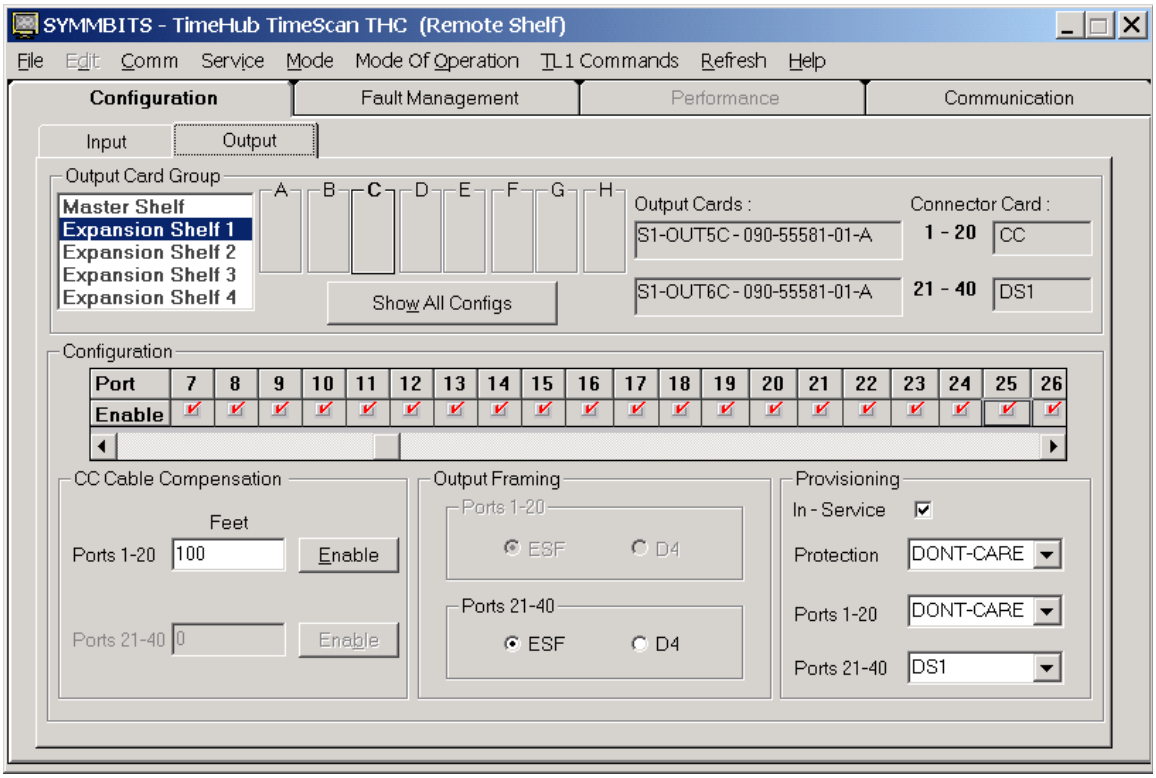
Procedure 4-6. Output Driver Card Installation (Cont'd)

Step	Action

3 (cont'd)	c. Finally, enable the specific port of interest. For example:
	
	`ED-SYNC::S1-OUTC-25:SV275:::SQUELCH=N;`
	
	This command enables port number 25 on output card(s) in group C (OUTC) of expansion shelf 1 (S1-). To turn off this individual port, the same command is used, but SQUELCH is set to Y. SC275 is a ctag.
	
	Here's the response to the above command:
	
	`   SYMMBITS 02-07-11 10:52:27`
	`M  SV275 COMPLD`
	`;`
	
	To check the setting for a specific output port, send the following command:
	
	`RTRV-SYNC::S1-OUTC-25:SV276:::PARAMETER=SQUELCH;`
	
	Which produces the following response:
	
	`   SYMMBITS 02-07-11 10:52:27`
	`M  SV276 COMPLD`
	`   "S1-OUTC-25::SQUELCH = N"`
	`;`
	
	showing that this specific port (port 25, group C, expansion shelf 1) is enabled (SQUELCH = N).

Procedure 4-6. Output Driver Card Installation (Cont'd)

Step	Action
3 (cont'd)	This same procedure can be easily accomplished using the TimeScan THC software Configuration->Output form. This software automatically generates the required TL1 commands, the same ones described in the procedure above. The example shown below is from version 2.2 (version information appears when application starts up or can be seen via menu Help->about).



From this form the basic procedure is:

a. Select the output card of interest. This could be a combination of output shelf (if the system has an expansion shelf) and card group. This is selected in the upper left portion of the form. Shown above is selection of Expansion shelf 1, card group C. The upper right portion of the form shows what is actually installed in that card group. There are 2 output cards, a CC connector card on ports 1-20 and a DS1 connector card on ports 21-40.
b. Put the cards in service by selecting the "In-Service" check-box in the "Provisioning" section of the form (lower right). As shown in the form above, the C output group is currently in-service.
c. To set the framing, select the appropriate choice in the "Output Framing" portion of this form (lower center of form). In this case, ports 21-40 are shown to be set to ESF framing. Note that ports 1-20 don't show a framing selection because those ports currently are associated with CC output (which has no framing choice).

Procedure 4-6. Output Driver Card Installation (Cont'd)

Step	Action
3 (cont'd)	d. Finally, enable any specific port of interest by checking the associated check box for the desired port. The control for this is in the center of the form, covering the entire width. What can be viewed in the above form shows that ports 7 thru 26 are all turned on. The scroll bar allows the other ports to be seen. Requirements: a. DS1 output waveforms must be as shown in Figure 4-11. b. CC output waveforms must be as shown in Figure 4-12. For DS1 output waveforms, only the positive pulse is shown. The negative pulse is an upside down, mirror image of the positive pulse.

End of Procedure

NOTE: Do not tighten the mounting screws on the output driver cards until instructed to do so in this chapter.

Figure 4-10. Output Driver Card

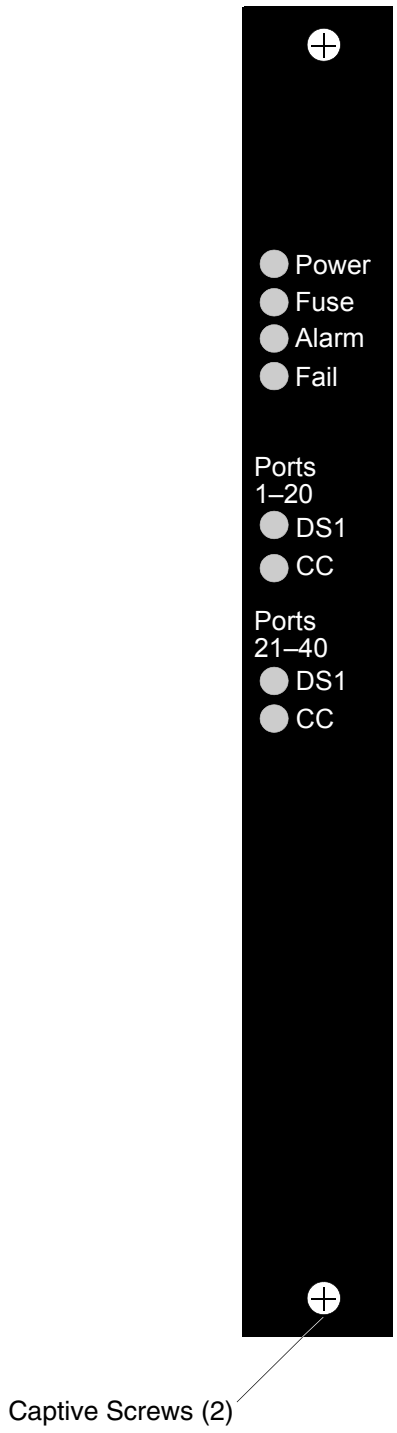
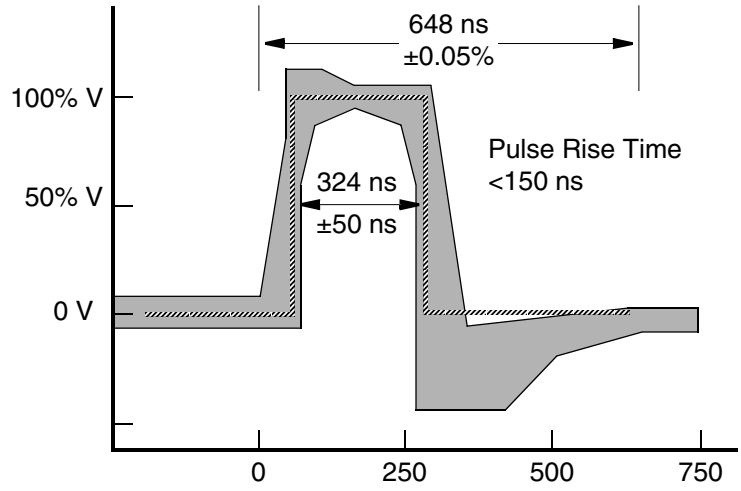


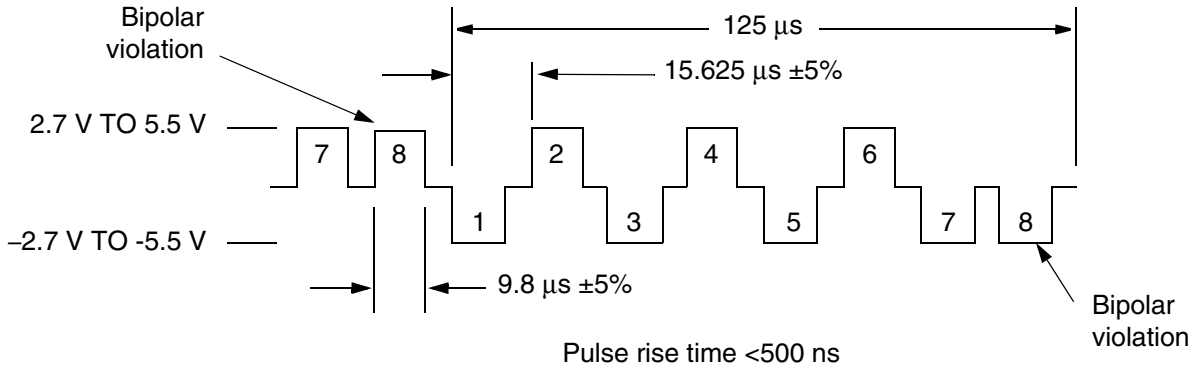
Figure 4-11. DS1 Output Waveforms



100% V = 2.4 V TO 3.6 V

Test load impedance: 100 Ω for 22 AWG twisted pair cable.

Figure 4-12. CC Output Waveforms



Pulse rise time <500 ns

Test load impedance: 133 Ω for 22 AWG twisted pair cable

4.6 Card Tests

The following card tests verify that simulated failures generate appropriate alarms. See Figure for management card lamps, Figure for clock card lamps, and Figure for output driver card lamps.

4.6.1 Reference Switching

To test reference input signal switching, follow Procedure 4-7.

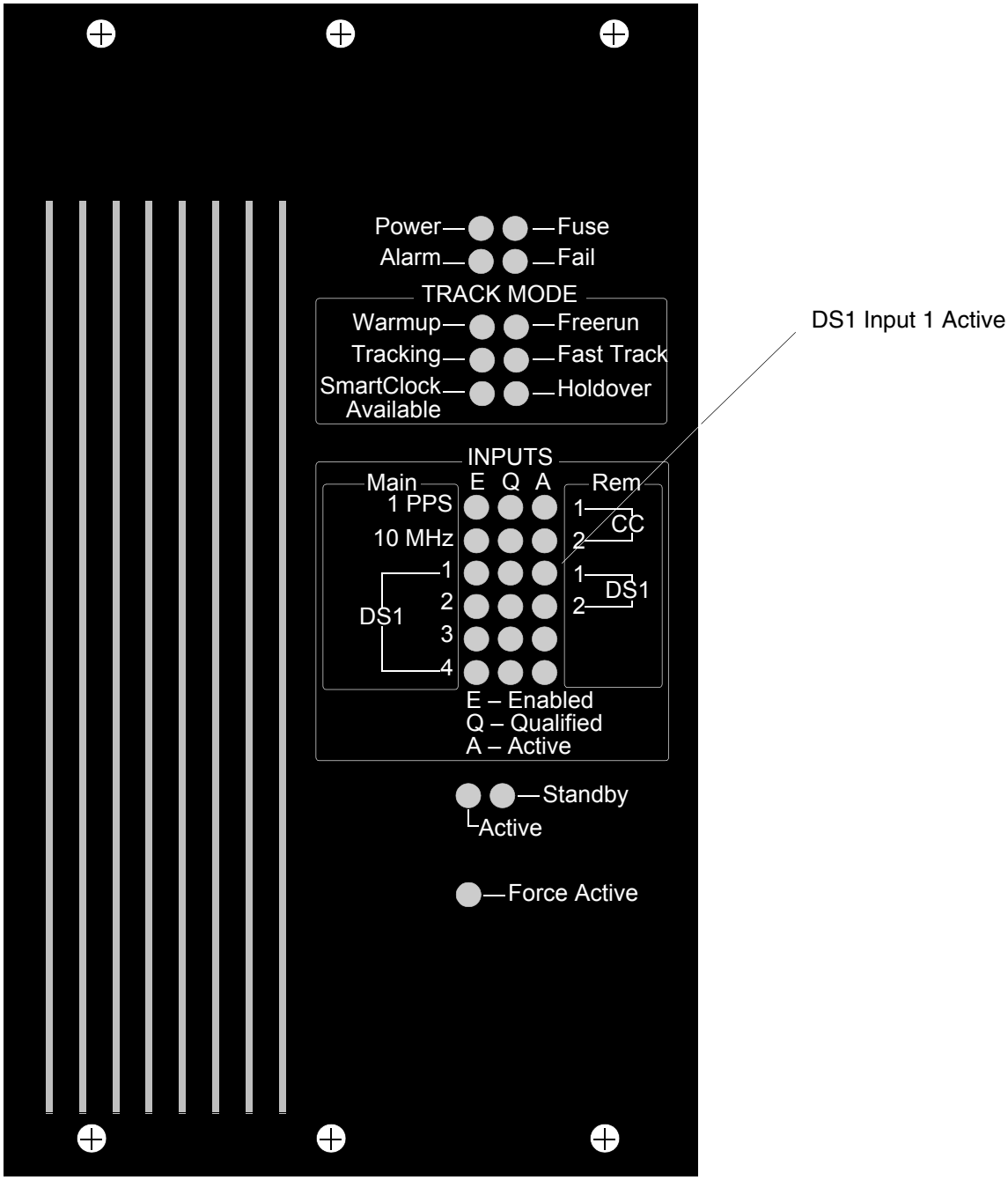
NOTE: To perform this test, two enabled and qualified inputs are required.

Procedure 4-7. Reference Switching

Step	Action
1	Disconnect the active reference input signal. This is indicated by the lit “INPUTS DS1 A” lamp (for example, Figure 4-13 identifies the DS1 Input 1 Active lamp). *Note:* “E” (Enabled) indicates that this input is allowed to become active , “Q” (Qualified) indicates the input is qualified for use, and “A” (Active) indicates the input is the reference being used to drive the outputs. Requirements: a. On both clock cards, the DSI Q and A lamps for the disconnected reference input signal turn off. E remains lit, indicating that this input will continue to attempt input qualification (which it cannot do because of LOS). b. On both clock cards, the DS1 A lamps for the reference input signal now being tracked light. c. On both clock cards, the Alarm lamps light. d. On the management card, the Shelf Minor Alarm lamp lights. This alarm is caused by an enabled input that is not qualified (INDISQ). Specific alarm information is logged on each clock card and automatically output on communication ports.
2	Reconnect the reference input signal disconnected in Step 1, and wait at least 3 minutes for the signal to requalify. Requirements: On both clock cards: a. The DS1 Q and A lamps for the reconnected reference input signal light. b. The DS1 A lamps for the reference input signal no longer being tracked turn off. c. The Alarm lamps turn off.

End of Procedure

Figure 4-13. Active DS1 Input Signal Indication



4.6.2 Clock Card Removal

To test which alarms result from active clock card failure, follow Procedure 4-8.

Procedure 4-8. Clock Card Removal

Step	Action
1	Remove the clock card with the Active lamp lit. Requirements: a. On the remaining clock card in the shelf, the Standby lamp turns off. b. On the remaining clock card in the shelf, the Active lamp lights. c. On the management card, the Shelf Major alarm lamp lights.
2	Install the clock card removed in Step 1, and wait for it to enter, then exit warmup (as indicated by lamp). The Freerun lamp will light. Requirements: On the clock card just installed: a. The Standby lamp lights. b. The remaining lamps are the same as the other clock card. c. The shelf major alarm turns off on the management card.
3	Press the Force Active pushbutton on the re-installed clock card to make it the active clock card. Requirement: The Active lamp lights on the re-installed clock card.

End of Procedure

4.6.3 Card Securement

Using a Phillips-head screwdriver, secure all the cards to the shelf by tightening the captive screws at the top and bottom of the card front panels (see Figures 4-6, 4-8, and 4-10).

4.7 Cabling

4.7.1 Alarms

4.7.1.1 Office

Connect the office alarms to the OFFICE ALARM critical (CR), major (MJ), and minor (MN) wirewrap pins on the Input/Alarm Connector module. See Figure 4-1 for the location of the alarm pins and Figure 4-14 for the connections.

Connect to the group of pins on the left (AUD) for audible alarms and to the group of pins on the right (VIS) for visible alarms. Connect the alarm circuit between the NO and C pins for normally open contacts, or between the NC and C pins for normally closed contacts. If required, use the pins (VIS) on the right to connect to the remote telemetry equipment.

The Alarm Cutoff pushbutton (front panel of management card) can be used to de-activate alarm output on all of the audible (AUD) alarm wirewrap pins. When an alarm occurs, the appropriate alarm lamp will light on the management card front panel. The alarm will be asserted on the appropriate AUD and VIS wirewrap pins. Pressing the cutoff pushbutton for approximately 10 s will de-assert the alarm on the AUD pins and the cutoff lamp will light (indicating that audible alarms have been cut off). Any alarm asserted on the VIS wirewrap pins is unaffected by the cutoff pushbutton. The alarm lamp and cutoff lamp will remain lit until the condition causing the alarm is no longer present. Should new alarms occur later, the AUD alarm will activate again.

NOTE: If there should happen to be alarms simultaneously occurring that have different severity levels, only the one of highest severity will be shown on the front panel LEDs if the alarms are both either in the “System” or “Shelf” category. For example, if there are both MAJOR and MINOR shelf alarms present, only the MAJOR alarm LED will be lit in the “Shelf” alarm row. In this case, if the MAJOR alarm ends, then the MINOR alarm LED will light (assuming that the source of that alarm is still present) since this is now the highest severity alarm.

If there is a MAJOR shelf alarm and a MINOR system alarm (any of the external alarms in 7 to 10 range), then the MAJOR LED will be lit for the shelf alarm row and the MINOR LED will be lit for the system alarm row. In other words, it is possible to have alarm LEDs of different severity illuminated if one is a shelf alarm and the other a system alarm.

4.7.1.2 External

Connect the external alarm inputs (customer-configured alarm inputs) to RACK ALM INPUTS wirewrap pins 1 through 10 on the Input/Alarm Connector module. See Figure 4-1 for the location of the alarm pins and Figure 4-14 for the connections.

The external alarm inputs provide the capability for the TimeHub 5500 to accept alarms from external equipment. When an alarm is accepted,

- an alarm lamp will light in the “system” row on the management card
- appropriate alarm output wirewrap pins (AUD and VIS) will activate on the alarm connector card
- an automatic message will be sent out from both communications ports (serial and LAN, see management card). This provides the capability for a remote management system to become aware of the external alarm condition.

There are two types of external alarm inputs: contact closure only and universal.

Contact Closure Only External Alarms

These six sets of alarm inputs (5-10) will operate with any relay contact closure. Severity levels associated with these alarm inputs are:

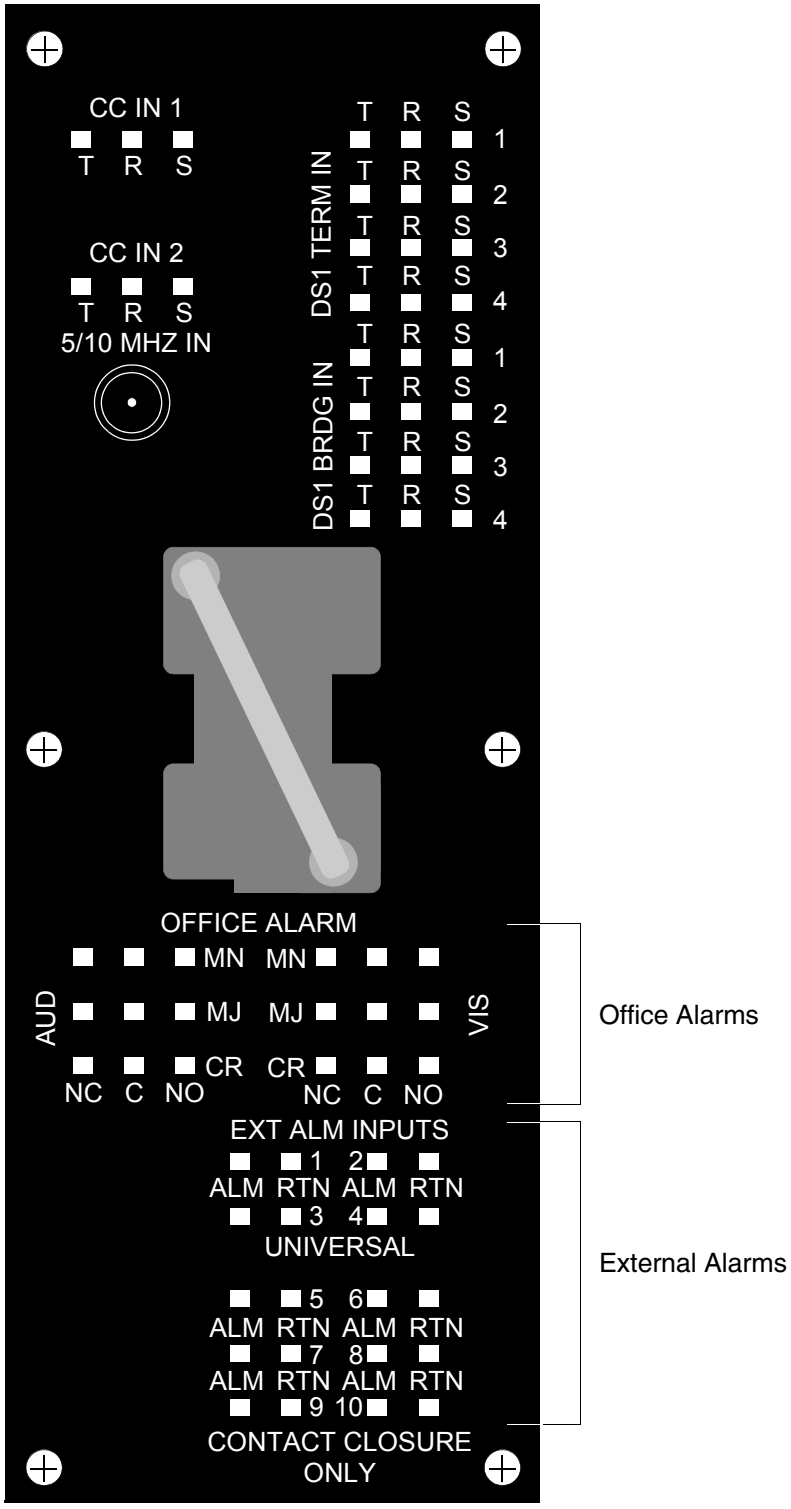
- MAJOR inputs 5 and 6
- MINOR inputs 7-10

Universal External Alarms

These four sets of alarms will operate with any relay contact closure. They are also capable of accepting alarms produced by a source transition to and from –48 V. Transition from –48 V to 0 will generate an alarm; transition from 0 to –48 V will clear the alarm. Severity levels for the universal alarms are:

- MAJOR inputs 1, 2
- MINOR inputs 3, 4

Figure 4-14. Input/Alarm Connector Module Connections

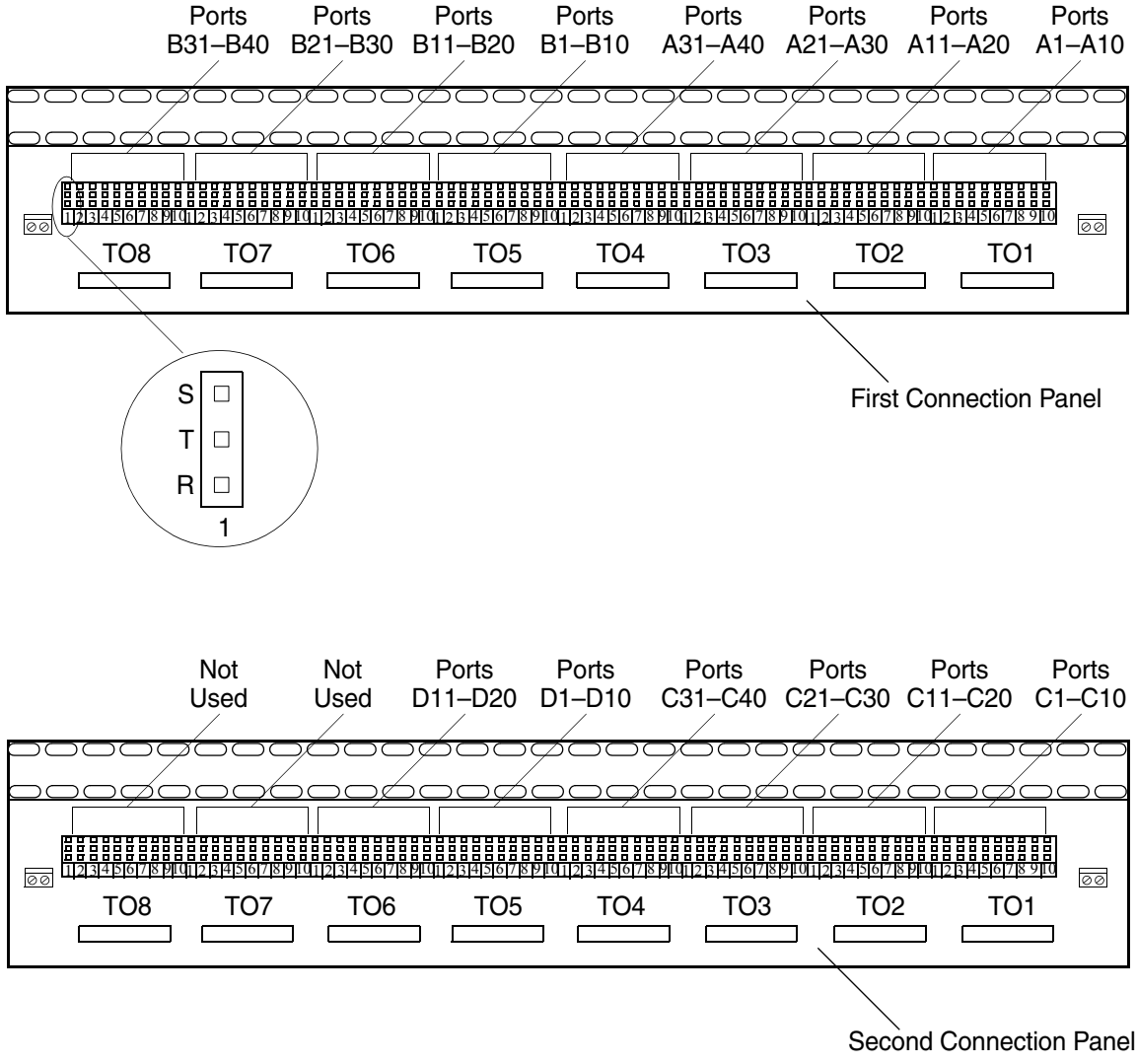


4.7.2 Timing Outputs

Connect the DS1 or composite clock outputs to the wirewrap pins on the connection panel. Connect the tip wire to the pins labeled T, the ring wire to the pins labeled R, and the shield to the pins labeled S. See Figure 4-15 for the connections on 090-41902-01 wirewrap panels.

NOTE: The shield pin is provided to ground the cable shield at the shelf, if required. Normally, the shield is grounded at the source. Grounding the shield at both ends is not recommended.

Figure 4-15. Timing Output Connections (090-41902-01) Wirewrap Panel



4.7.3 GPS Input

The GPS connector is reserved for future use.

4.7.4 Local Communication Port

If not using the Local connector on the rear of the shelf to provide an RS-232 link for TL1 command access to the TimeHub 5500, connect to the data terminal equipment (DTE) equivalent communication port 1 at the nine-pin connector labeled Local on the management card. See Figure 4-7 for the location of the connector and Table 4-4 for the connector pinouts.

NOTE: The Local communincation port on the management card provides the same function as the Local communication port on the rear of the shelf.

NOTE: Cable connections cannot be made to both of the Local ports simultaneously; only one port can be used at a time.

Table 4-4. Local Pinouts

Pin	Signal	Abbreviation	Direction
2	Transmit data	TXD	From TimeHub 5500
3	Receive data	RXD	To TimeHub 5500
5	Signal ground	GND	–
7	Clear to send	CTS	To TimeHub 5500
8	Request to send	RTS	From TimeHub 5500

Note: Pins not listed are reserved for future use.

4.8 Cover Installation

Fit the plastic cover over the rear of the shelf and attach at the upper right and left corners of the shelf using the captive screws on the cover.

4.9 System Configuration

To set input and output port parameters, and configure network parameters, follow the steps in Procedure . Before starting this procedure, be sure the shelf and all connections appropriate for this installation have been installed, the tests in this chapter have been performed, and the host computer is set to communicate with the TimeHub 5500.

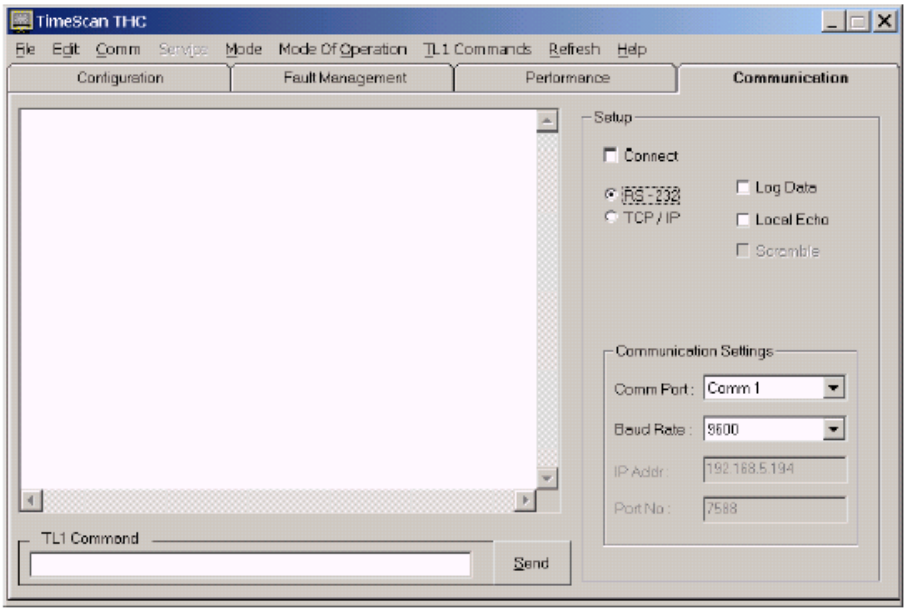
NOTE: When connecting live output signals from TimeHub 5500 to test equipment it is possible, depending on how the connection is made, that false port alarms can occur. Such alarms are not actually indicating a problem with the output card. See “Output Port Alarms in TimeHub 5500” in the Functional Description section in Chapter 1.

Procedure 4-9. System Configuration

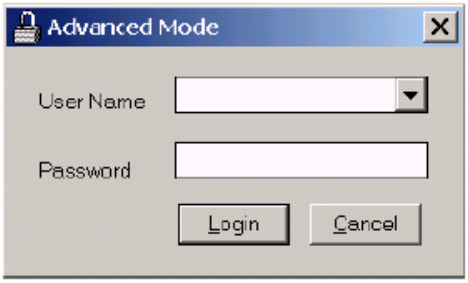
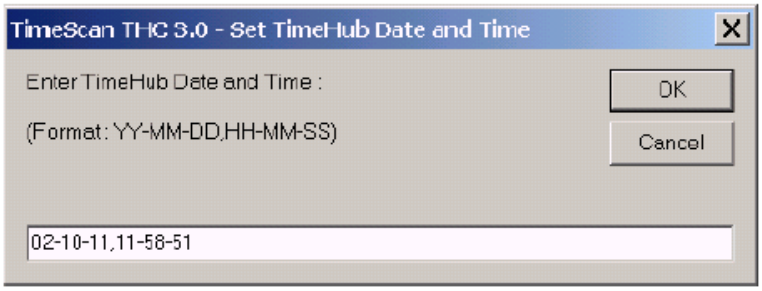
Step	Action
Test Equipment: Computer with RS-232 communications capability. This procedure illustrates configuration directly via TL1 as well as via TimeScan THC applications software. Using TimeScan THC greatly simplifies the effort since no TL1 commands need to actually be typed. If configuring directly via TL1, some type of terminal communication software will be needed, such as HyperTerminal or ProComm.	
Establish RS-232 communication between the TimeHub 5500 and computer	
1	Connect a nine-pin male-to-female RS-232 interface cable from the computer communication port to the local port on the TimeHub 5500. The connection on TimeHub can be made either on the Management Card (far left side of shelf) or on the back of the shelf (upper left - see Figure).

Procedure 4-9. System Configuration (Cont'd)

Step	Action

2	If using TimeScan THC:
	
	a. Start up the application, which displays the following screen:
	 
	b. On this screen, select the appropriate Comm port based on the computer connection. As shown, the application defaults to Comm 1. The baud rate setting should be 9600.
	c. Select the **Connect** check box to attempt the actual connection. A successful connection will result in text appearing (showing the communication) in the text area of this screen. If the connection is unsuccessful, a timeout message appears after approximately 30 seconds.
	
	If using terminal software such as HyperTerminal:
	
	Type "**;**" (semicolon), which is the TL1 termination character. If the connection is set up correctly, a response similar to
	
	`SYMMBITS 02-12-11 23:17:08`
	`M 0 DENY`
	`"IICT"`
	`/* Input, Invalid Correlation Tag (CTAG) */`
	`;`
	
	should appear. If there is no response, check the system installation and setup.

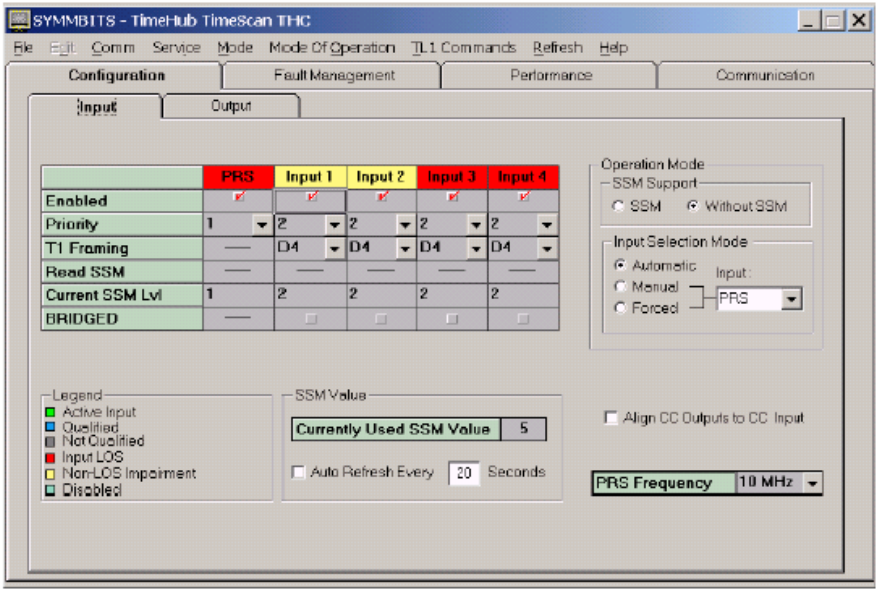
Procedure 4-9. System Configuration (Cont'd)

Step	Action
	Set date and time
3	Setting of date and time ensures that reported and logged events will correctly indicate time of occurrence. If using TimeScan THC: a. As a security measure, a logon to the THC software is needed to allow attempting of configuration actions. This only needs to be done once each time the software is started. Select the **Mode of Operation -> Advanced Mode...** menu, which displays the following screen:  In the **User Name** field, select **admin** from the pull-down list. The default password is also **admin**, so type **admin** into the Password field. Then select Login. A screen appears indicating that THC is now in advanced mode, which means that configuration is now allowed. *Note:* It is possible to change users and passwords on this feature via the **Mode of Operation -> Advanced Mode...** menu, but that is beyond the scope of this procedure. It is assumed in this step that the default settings still apply. b. Set the date and time by selecting the **Service -> Set TimeHub Date and Time** menu, which displays this screen:  The software uses the PC time as a suggestion, but the entry can be changed as desired. This example shows that the date is set to 2002, October 11 and the time is set to 11:58:51. c. Select **OK** to actually set the date and time.

Procedure 4-9. System Configuration (Cont'd)

Step	Action

3 (cont'd)	If using terminal software, such as HyperTerminal, type in the TL1 command:
	
	`ED-DAT:::SV25::02-10-11,12-05-44:;`
	
	which sets the date to 2002, October 11 and the time to 12:05:44. TimeHub will respond with something similar to:
	
	`SYMMBITS 02-10-11 12:05:44`
	`M SV25 COMPLD`

	Provision inputs for Master Shelf
4	Steps 4 through 11 apply to input provisioning for a Master shelf. If you are provisioning inputs on a Remote shelf, go to step 12. Select which inputs will be enabled or disabled. The default is that all inputs are enabled. The enable status of inputs can also be seen on the front panel of each clock card. Enabling an input means that it can be used as an input timing reference. The reason to disable inputs that are not intended to be used is to prevent unused inputs from generating alarms (such as **Input Disqualified**). By enabling only those inputs that are expected to be used, such alarms will be more relevant. If using TimeScan THC: a. Display the Input Configuration screen by selecting the **Configuration** tab and the **Input** subtab.  The set of possible inputs is shown in the columns in the table on this screen. The top row in this table, labeled "Enabled", shows which inputs are enabled.

Procedure 4-9. System Configuration (Cont'd)

Step	Action

4 (cont'd)	b. Based on the timing references planned for this installation, set the enabled row appropriately. Check inputs to be used, uncheck inputs that will not be used. PRS is the BNC connection on the input connector card (see Figure , 5/10 MHZ IN). Inputs 1 through 4 are the DS1 inputs shown in the upper right of that same figure.
	
	If using terminal software, such as HyperTerminal, the general TL1 command form for enabling or disabling an input is:
	
	`ED-SYNC::CLK-a:<ctag>:::ENABLE=b;`
	
	Where a = 0 - 4 to identify the input (PRS=0) and b = Y to enable, N to disable the input.
	
	Based on the inputs you will actually use, enable or disable inputs as appropriate. For example, to disable DS1 input 2, type the command:
	
	`ED-SYNC::CLK-2:SV343:::ENABLE=N;`
	
	The corresponding retrieval command:
	
	`RTRV-SYNC::CLK-a:<ctag>:::PARAMETER=ENABLE;`
	
	is used to determine the enable setting of a selected input.

5	Select which inputs will not be monitored, if any. The TimeHub is capable of selectively monitoring inputs for conditions such as LOS or Loss of Framing even if that input is not enabled. The reason for doing so could be to performance monitor that input without allowing it to be used as a timing reference. By disabling that input but keeping MONITOR enabled, the status of such an input can be observed (via RTRV-COND) and logged without causing an alarm if that input has a problem. The default for inputs 0 - 4 is that monitoring is enabled.
	
	To enable or disable monitoring for an input, the TL1 command form is:
	
	`ED-SYNC::CLK-a:<ctag>:::MONITOR=b;`
	
	Where a = 0 - 4 to identify the input (PRS=0) and b = Y to enable monitoring, N to disable monitoring of that input.
	
	If you want to prevent retrieval of status information for any disabled inputs, disable the monitoring capability. For example, to disable monitoring of the DS1 input 2, type the command:
	
	`ED-SYNC::CLK-2:SV343:::MONITOR=N;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action
5 (cont'd)	The corresponding retrieval command: `RTRV-SYNC::CLK-a:<ctag>:::PARAMETER=MONITOR;` is used to determine the enable setting of a selected input. If using TimeScan THC: Since this setting is rarely used, there is no built-in command to change the MONITOR setting. Instead, type the desired TL1 command on the Communications screen (see step 2) into the "TL1 command" area and select "Send". If using terminal software, such as HyperTerminal, type and enter the desired command.

6	Set PRS Input frequency, if needed. The PRS reference frequency can be set to expect either a 5 or 10 MHz input. The default is 10 MHz. If necessary, change the setting.
	
	If using TimeScan THC:
	
	Use the control labeled **PRS Frequency** in the lower right of the **Configuration -> Input** screen to set the PRS frequency appropriately.
	
	If using terminal software, such as HyperTerminal, to set the PRS Frequency to 5 MHz, type and send:
	
	`ED-SYNC::CLK-0:SV347:::PRC5MHZ=Y;`
	
	Setting the value to N will set expected PRS Frequency to 10 MHz. The current setting can be retrieved with:
	
	`RTRV-SYNC::CLK-0:SV348:::PARAMETER=PRC5MHZ;`

7	Change priorities if desired. The priority setting provides a way to prefer a particular input for use as the active timing reference when more than one input has been qualified. The lower the number, the higher the priority. The default is that the PRS input has highest priority and all others are equal. If, for some reason, you wanted DS1 input 2 to be preferred over DS1 input 1 the priority could be changed to make this so. Either the input 1 priority could be lowered or the input 2 priority could be raised. To change priority if using TimeScan THC: Use the **Priority** row on the **Configuration -> Input** screen to change the priority of the selected input as desired.

Procedure 4-9. System Configuration (Cont'd)

Step	Action

7 (cont'd)	To change priority if using terminal software, such as HyperTerminal, the TL1 general form for priority setting is:
	
	`ED-SYNC::CLK-a:SV380:::PRIORITY=b;`
	
	Where a = 0 - 4 to identify the input (PRS = 0) and b = 0 - 9 to set the actual priority value.
	
	To set input 2 priority to 3, type and send:
	
	`ED-SYNC::CLK-2:SV380:::PRIORITY=3;`
	
	Priority setting for input 2 can be retrieved with:
	
	`RTRV-SYNC::CLK-2:SV381:::PARAMETER=PRIORITY;`

8	Set Framing for enabled DS1 inputs, if needed. DS1 inputs may have either D4 (also known as SF) or ESF framing. TimeHub defaults DS1 inputs to expect D4 framing, so if you have ESF inputs the setting needs to be changed.
	
	To change framing if using TimeScan THC:
	
	Use the **T1 Framing** row on the **Configuration -> Input** screen to change the framing of selected input as needed.
	
	To change framing if using terminal software, such as HyperTerminal, the TL1 general form for framing setting is:
	
	`ED-SYNC::CLK-a:SV382:::ESF=b;`
	
	Where a = 1 - 8 to identify the input whose framing is being set (note that some TimeHub models can accept up to eight DS1 inputs) and b = Y for ESF framing, N for D4 framing.
	
	To set input 4 framing to ESF, type and send:
	
	`ED-SYNC::CLK-4:SV382:::ESF=Y;`
	
	The Framing setting for input 4 can be retrieved with:
	
	`RTRV-SYNC::CLK-4:SV383:::PARAMETER=ESF;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action

9	Set Bridged mode for enabled DS1 inputs, if needed. Generally, DS1 inputs connected to TimeHub will be terminated at the input. However, if the reference signal is bridged (which means it will be nominally 20 dB lower in amplitude), the bridged selection should be set for any such input. The default setting is that bridged inputs are not expected for inputs 1 - 4.
	
	To change bridged setting if using TimeScan THC:
	
	Use the **BRIDGED** row on the **Configuration -> Input** screen to change the setting for any appropriate inputs.
	
	To change bridged setting if using terminal software, such as HyperTerminal, the TL1 general form for bridged setting is:
	
	`ED-SYNC::CLK-a:SV382:::BRIDGED=b;`
	
	Where a = 1 - 4 to identify the input whose bridged state is being set and b = Y for Bridged expected, N for Bridged not expected (i.e., terminated).
	
	To set input 1 to expect a bridged signal level, type and send:
	
	`ED-SYNC::CLK-1:SV385:::BRIDGED=Y;`
	
	The bridged setting for input 1 can be retrieved with:
	
	`RTRV-SYNC::CLK-1:SV386:::PARAMETER=BRIDGED;`

10	Configure inputs to use SSM, if desired. If you have ESF-framed DS1 inputs providing SSM messages that you want to use as part of the input qualification process, follow steps 10 and 11 to enable the SSM capability. The default is that SSM is not used for qualifying inputs. If you do not want to use SSM for input qualification, skip to step 12. If using TimeScan THC: In the upper right of the **Configuration -> Input** screen, there is a section titled **SSM Support**. Select **SSM** to use SSM as an input qualification criteria. Selecting **Without SSM** will cause the TimeHub to not use SSM as a consideration for input qualification. If using terminal software, such as HyperTerminal, to select SSM to be used as an input qualification criteria, type and send: `ED-EQPT::CLK:SV41:::SYNCMDE=SSM;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action

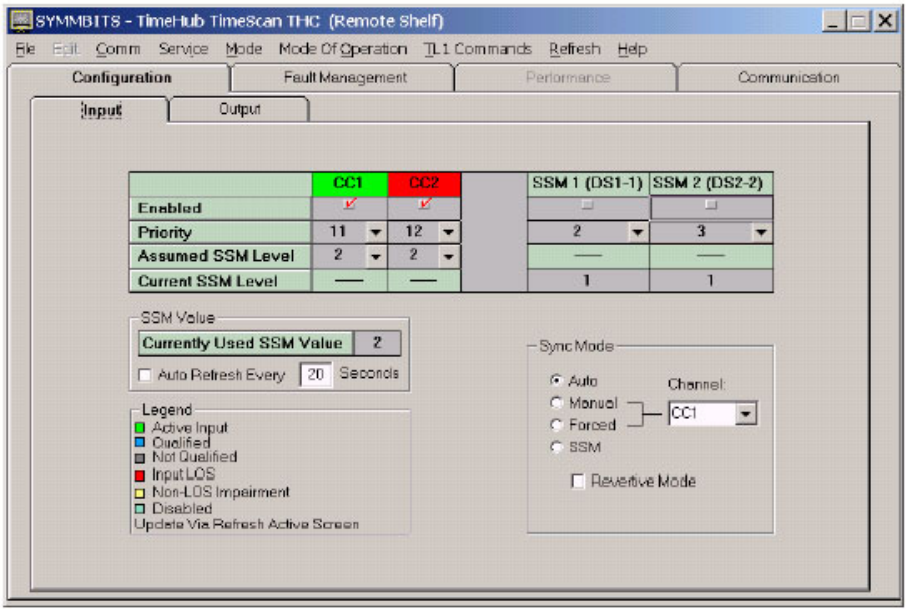
10 (cont'd)	To not use SSM as input qualification criteria, type and send:
	
	`ED-EQPT::CLK:SV43:::SYNCMDE=AUTO;`
	
	The current selection can be retrieved with:
	
	`RTRV-EQPT::CLK:SV42:::PARAMETER=SYNCMDE;`

11	Enable SSM reading for ESF-framed DS1 inputs. Inputs that are incapable of SSM decoding (such as PRS or D4-framed DS1) use an assumed SSM value (the changing of which is not described here since that is an advanced feature - see keyword QLEVEL in the TimeHub 5500 TL1 Reference Manual). The ESF-framed DS1 inputs will also use an assumed value unless reading of SSM is enabled.
	
	If using TimeScan THC:
	
	On the **Configuration -> Input** screen, use the **Read SSM** row to enable actual SSM decoding for ESF-framed DS1 inputs. Note that D4-framed DS1 inputs and the PRS input do not show the **Read SSM** selection since they are not capable of SSM decoding.
	
	If using terminal software, such as HyperTerminal, to enable actual SSM decoding for a given ESF-framed DS1 reference, type and send:
	
	`ED-SYNC::CLK-a:<ctag>:::SSMENB=b;`
	
	Where a = 1 - 8 and is the input reference that should decode SSM. Decodong can be disabled by setting SSMENB=N.
	
	For example, to enable SSM decoding on input 1 (first DS1 input), send:
	
	`ED-SYNC::CLK-1:SV48:::SSMENB=Y;`
	
	Current setting of SSM decoding for input 1 can be retrieved with:
	
	`RTRV-EQPT::CLK-1:SV49:::PARAMETER=SSMENB;`
	
	To complete provisioning inputs for Master shelf, continue to step 14.

	Provision inputs for Remote Shelf
12	Select which CC inputs will be enabled or disabled. The default is that both inputs are enabled. The enable status of inputs can also be seen on the front panel of each clock card. Enabling an input means that it can be used as an input timing reference. The reason to disable inputs that are not intended to be used is to prevent unused inputs from generating alarms (such as **Input Disqualified**). By enabling only those inputs that are expected to be used, such alarms will be more relevant.

Procedure 4-9. System Configuration (Cont'd)

Step	Action
12 (cont'd)	If using TimeScan THC: a. Bring up the **Input Configuration** screen by selecting the **Configuration** tab and the **Input** subtab.



The columns labeled **CC1** and **CC2** identify the inputs that can be selected as timing references. The other columns (**SSM 1** and **SSM 2**) are advanced features that are not covered here. The top row in this screen, labeled **Enabled**, shows which inputs are enabled.

b. Based on the timing references planned for this installation, set the enabled row appropriately. Check CC inputs to be used, uncheck CC inputs that will not be used.

If using terminal software, such as HyperTerminal, the general TL1 command form for enabling or disabling an input is:

```
ED-SYNC::CLK-a:<ctag>:::ENABLE=b;
```

Where a = 10 or 11 (10 = CC1, 11 = CC2) and b = Y to enable, N to disable the input.

Based on the inputs you will actually use, enable or disable inputs as appropriate. For example, to disable CC2, type and send the command:

```
ED-SYNC::CLK-11:SV460:::ENABLE=N;
```

The enable state of CC2 can be retrieved with:

```
RTRV-SYNC::CLK-11:SV461:::PARAMETER=ENABLE;
```

Procedure 4-9. System Configuration (Cont'd)

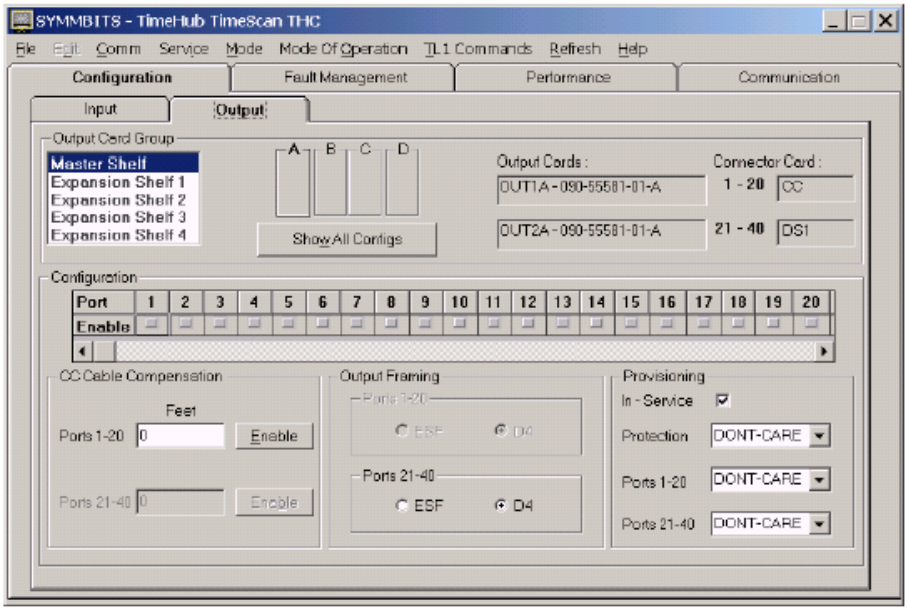
Step	Action

13	Set the priority if desired. The priority setting provides a way to prefer one of the CC inputs when both have been qualified. The lower the number, the higher the priority. The default is that the CC1 has higher priority than CC2, so CC1 will always be used if it is qualified.
	
	To change priority if using TimeScan THC:
	
	Use the **Priority** row on the **Configuration -> Input** screen to change the priority of either CC1 or CC2 as desired.
	
	To change priority if using terminal software, such as HyperTerminal, the TL1 general form for priority setting is:
	
	`ED-SYNC::CLK-a:SV380:::PRIORITY=b;`
	
	Where a = 10 or 11 (10 = CC1, 11 = CC2) and b = 0 - 12 to set the actual priority value.
	
	To set CC2 priority to 3, type and send:
	
	`ED-SYNC::CLK-11:SV380:::PRIORITY=3;`
	
	Priority setting for CC2 can be retrieved with:
	
	`RTRV-SYNC::CLK-11:SV381:::PARAMETER=PRIORITY;`

14	If the shelf will normally operate with a single clock card, the SNGLCK keyword can be used to disable the alarm that is usually associated with this mode of operation. See the TimeHub 5500 TL1 Reference Manual for more information about the SNGLCK keyword.
	Provision outputs
15	There are three basic steps to provisioning an output: 1. Putting the output card group that supplies that output in service. 2. Selecting the framing for the output, if appropriate. 3. Enabling the specific output port so that a signal will be produced on that port. For a given port to actually generate output, that port must be enabled AND the card group that contains that port (i.e., A, B, C, or D for master shelf) must be put in service.

Procedure 4-9. System Configuration (Cont'd)

Step	Action

15 (cont'd)	To put an output card in service using TimeScan THC:
	
	a. Select the **Configuration -> Output** screen, which will display the following:
	 
	
	b. Select the output card group that is to be put into service. On the upper left is a selection for master or specific expansion shelf. To the right of that is a selection for the specific card group. As shown in the screen, the master shelf is selected (which contains card groups A - D) and the **A** group is selected. Note that the output cards and associated connector cards in that group are also shown in this screen.
	c. Put this card group into service by checking the **In-Service** box in the **Provisioning** field of this screen (located in lower right corner).
	
	To put an output card in service using terminal software, such as HyperTerminal, the general TL1 form is:
	
	`ED-EQPT::OUTa:<ctag>:::INSRVC=b;`
	
	Where a = A, B, C, or D and indentifies the card group (E, F, G, H also okay for expansion) and b = Y to put card group in service, b = N to take card group out of service.
	
	For example, to put card group C in service, type and send:
	
	`ED-EQPT::OUTC:SV1203:::INSRVC=Y;`
	
	To retrieve in-service status of card group C, send:
	
	`RTRV-EQPT::OUTC:SV1204:::PARAMETER=INSRVC;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action
15 (cont'd)	*Note:* To address an expansion shelf, an Sx- must be prepended prior to the OUT, where the x identifies the expansion shelf number. This applies to both setting and retrieving. For example, to set in-service for group H on expansion shelf 3, send: `ED-EQPT::S3-OUTH:SV1203:::INSRVC=Y;`

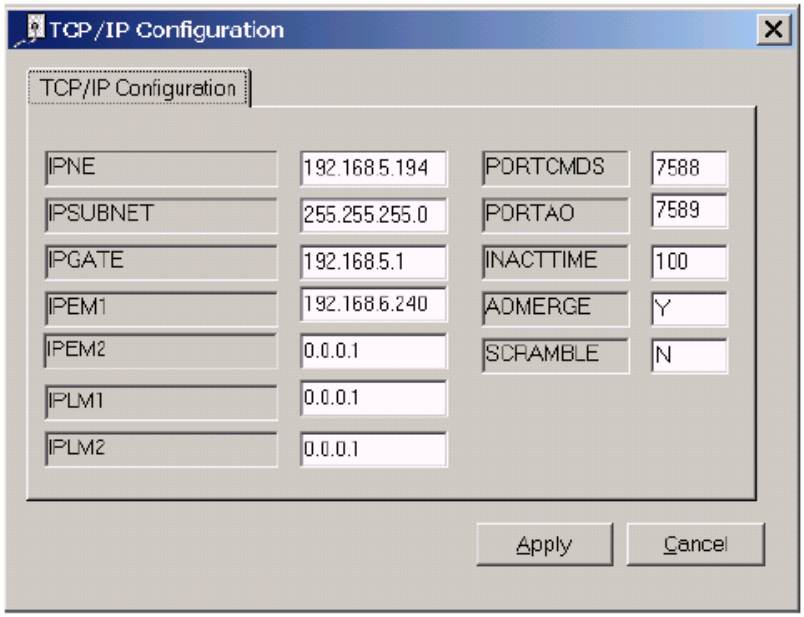
16	For DS1 inputs, set the framing if needed. DS1 output framing can be either D4 or ESF and is settable in groups of 20 ports. For a given output card group the first 20 ports may have one type of framing, while the last 20 ports may have a different framing.
	
	To set DS1 output framing using TimeScan THC:
	
	a. As with step 15, bring up the **Configuration -> Output** screen and select the specific card group of interest.
	b. For any output port groups that have DS1 outputs, the associated Output Framing selection area will be enabled. In the example screen, there is a DS1 connector card associated with the A group, ports 21 - 40. Because of this, the Output Framing Ports 21 - 40 area is enabled (lower center of screen).
	c. In the Output Framing area, select the desired framing (ESF or D4) for those 20 outputs.
	
	To set DS1 output framing using terminal software, such as HyperTerminal, the general TL1 form is:
	
	`ED-EQPT::OUTa-PGb:<ctag>:::OUTESF=c;`
	
	Where a identifies the card group (A, B, C, and D for master, A - H for expansion), b is the port group (1 = ports 1 -20, 2 = ports 21 - 40), and c = Y (framing is ESF), c = N (framing is D4).
	
	For example, to set ports 21 - 40 of the C card group on the master shelf to ESF framing, type and send:
	
	`ED-EQPT::OUTC-PG2:SV170:::OUTESF=Y;`
	
	The framing setting of ports 21 - 40 of the C card group can be retrieved with:
	
	`RTRV-EQPT::OUTC-PG2:SV171:::PARAMETER=OUTESF;`
	
	Note: To address an expansion shelf, an Sx- must be prepended prior to the OUT, where the x identifies the expansion shelf number. This applies to both setting and retrieving. For example, to set D4 framing for ports 1 - 20 of group H on expansion shelf 2, send:
	
	`ED-EQPT::S2-OUTH-PG1:SV170:::OUTESF=N;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action

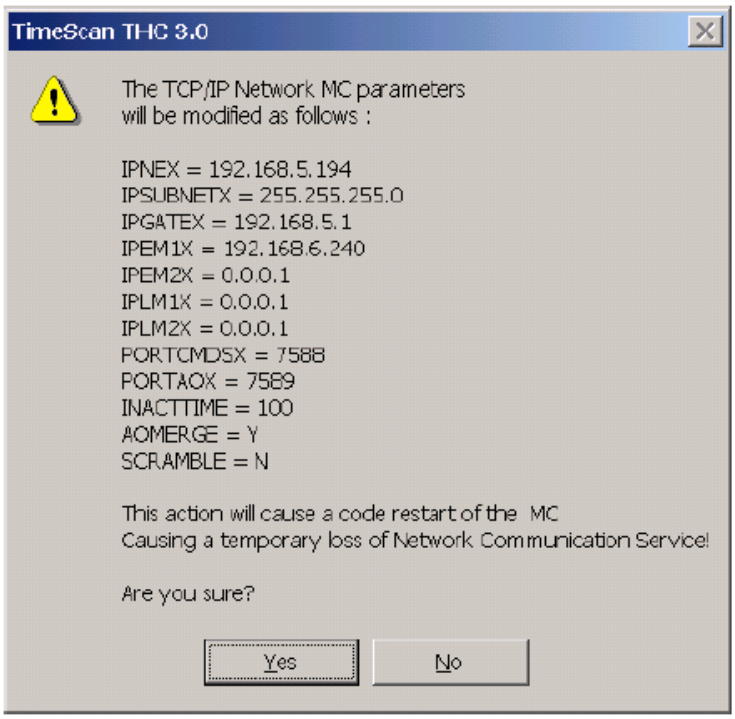
17	Enable the output port so that a signal is actually being output. Each port can be individually enabled.
	
	To enable an output port using TimeScan THC:
	
	a. As with step 16, bring up the **Configuration -> Output** screen and select the specific card group of interest.
	b. The output ports are shown as a narrow horizontal table in the middle of the screen. Ports beyond 20 can be viewed by using the scroll bar that is part of that control.
	c. To enable a specific port, check the enable box associated with it.
	
	To enable an output port using terminal software, such as HyperTerminal, the general TL1 form is:
	
	`ED-SYNC::OUTa-b:<ctag>:::SQUELCH=c;`
	
	Where a identifies the card group (A, B, C, and D for master shelf, A - H for expansion shelf), b is the specific port (1 - 40), and c = Y means port is squelched (no output), c = N means port is not squelched (port will generate output).
	
	For example, to enable port 17 of card group C on the master shelf to produce output, type and send:
	
	`ED-SYNC::OUTC-17:SV272:::SQUELCH=N;`
	
	The status of that same port can be retrieved by typing:
	
	`RTRV-SYNC::OUTC-17:SV271:::PARAMETER=SQUELCH;`
	
	Note: To address an expansion shelf, an Sx- must be prepended prior to the OUT, where the x identifies the expansion shelf number. This applies to both setting and retrieving. For example, to set disable output on port 36 of card group E on expansion shelf 1, type and send:
	
	`ED-SYNC::S1-OUTE-36:SV272:::SQUELCH=Y;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action
	Configure network parameters
18	If not using a LAN (network) connection for accessing the TimeHub 5500, skip to the end of this procedure. Otherwise, continue with this procedure to set up the network connection. To set up network connection using TimeScan THC: a. Since the network connection is being established, the THC connection is made via serial port. Bring up the TCP/IP configuration screen by selecting the **Service -> Configure TCP/IP...** menu. A screen similar to the following appears:  b. It is beyond the scope of this procedure to define the function of each of these parameters. See the TimeHub 5500 TL1 Reference Manual for details. Set the parameters on this form appropriately for the network in which the TimeHub will be used. Most important is IPNE, which is the IP address to be set for the TimeHub shelf. c. Once the settings are as desired, select **Apply**, which will display a screen requesting you to confirm that you want to make these changes. If you do, respond by selecting **Yes**.

Procedure 4-9. System Configuration (Cont'd)

Step	Action
18 (cont'd)	d. Selecting Yes displays a screen similar to the following:



Check once again that the settings are as desired and, once satisfied, select Yes. As described on the screen, the management card restarts so that it can actually utilize the new settings. Once it comes up, the settings will be as you selected.

To configure network settings using terminal software, such as HyperTerminal, continue with the rest of this procedure.

Procedure 4-9. System Configuration (Cont'd)

Step	Action

19	Use the Edit Equipment command to specify whether the automatic output messages, and commands and responses will be carried separately on two different ports or combined on one port.
	
	`ED-EQPT:::<ctag>:::AOMERGE=a;`
	
	Where a = Y (combines automatic output messages, and commands and responses on one port) or N (provides separate ports for automatic output messages, and commands and responses)
	
	Notes:
	1. To verify the parameter, use the Retrieve Equipment command.
	
	`RTRV-EQPT:::<ctag>:::PARAMETER=AOMERGE;`
	
	2. If the IP address of the manager matches ILPM1 or IPLM2, the output will be merged, regardless of the AOMERGE value. In this case, the local manager software is used, which does not support having commands and events carried on separate ports. For details on the ILPM1 and IPLM2 parameters, refer to the TimeHub 5500 TL1 Reference Manual.

20	Use the Copy Network Memory command to copy the working memory to auxiliary memory. `CPY-MEM::NET:<ctag>::WKG,AUX;`

21	Use the Edit Equipment command to set the TimeHub 5500 IP address.
	
	`ED-EQPT:::<ctag>:::IPNEX=a;`
	
	Where a = a.a.a.a, where each is an independent value of 0 to 255
	
	Note: To verify the parameter, use the Retrieve Equipment command.
	
	`RTRV-EQPT:::<ctag>:::PARAMETER=IPNEX;`

22	Use the Edit Equipment command to set the subnetwork mask IP address.
	
	`ED-EQPT:::<ctag>:::IPSUBNETX=a.b;`
	
	Where a = a.a.a, where each is an independent value of 0 to 255, and b = 0 or 128; the last 7 bits of the subnetwork mask IP address must be 0
	
	Note: To verify the parameter, use the Retrieve Equipment command.
	
	`RTRV-EQPT:::<ctag>:::PARAMETER=IPSUBNETX;`

Procedure 4-9. System Configuration (Cont'd)

Step	Action
23	Use the Edit Equipment command to set the gateway IP address. ED-EQPT:::<ctag>:::IPGATEX=a; a = a.a.a.a, where each is an independent value of 0 to 255 *Note:* To verify the parameter, use the Retrieve Equipment command. RTRV-EQPT:::<ctag>:::PARAMETER=IPGATEX;
24	Use the Edit Equipment command to set the element manager IP address. ED-EQPT:::<ctag>:::IPEM1X=a; a = a.a.a.a, where each is an independent value of 0 to 255 *Note:* To verify the parameter, use the Retrieve Equipment command. RTRV-EQPT:::<ctag>:::PARAMETER=IPEM1X;
25	Use the Edit Equipment command to set the local manager IP address. ED-EQPT:::<ctag>:::IPLM1X=a; a = a.a.a.a, where each is an independent value of 0 to 255 *Note:* To verify the parameter, use the Retrieve Equipment command. RTRV-EQPT:::<ctag>:::PARAMETER=IPLM1X;
26	Use the Edit Equipment command to specify the port number for commands and responses. ED-EQPT:::<ctag>:::PORTCMDSX=a; a = 5001 to 20000 *Notes:* 1. To verify the parameter, use the Retrieve Equipment command. RTRV-EQPT:::<ctag>:::PARAMETER=PORTCMDSX; 2. If AOMERGE was set to Y, automatic output messages, and commands and responses will be combined on this port.

Procedure 4-9. System Configuration (Cont'd)

Step	Action
27	If AOMERGE was set to Y, skip to Step 28. If AOMERGE was set to N, use the Edit Equipment command to specify the port number for automatic output messages. ED-EQPT:::<ctag>:::PORTAOX=a; a = 5001 to 20000 *Notes:* 1. The PORTAOX value must be different than the PORTCMDSX value. 2. To verify the parameter, use the Retrieve Equipment command. RTRV-EQPT:::<ctag>:::PARAMETER=PORTAOX;
28	Use the Copy Network Memory Security command to copy the data from auxiliary to working memory. CPY-MEM-SECU::NET:<ctag>::AUX,WKG;

End of Procedure

4.10 Setting the Configuration to Factory Defaults

If it is desired to reset all sychronization-related settings to their factory default settings, use Procedure 4-10. This procedure will result in all outputs being disabled (since that is the factory default), so it is not recommended for a fully operational shelf.

Procedure 4-10. Setting the Configuration to Factory Defaults

Step	Action
1	Remove the clock cards from the shelf.
2	On one of the clock cards, observe the S1 switch 1 position (see Figure 4-8). Move S1 switch to the opposite position. If it was On, set it to Off. If it was Off, set it to On.
3	Insert this clock card into the shelf. Wait for it to come out of warm-up.
4	Remove the clock card and return the S1 switch 1 position to its original position. It should end up in the same position as when you observed it in step 2.

Procedure 4-10. Setting the Configuration to Factory Defaults (Cont'd)

Step	Action
5	Insert this clock card into the shelf again and wait for it to come out of warm-up. It now contains factory default settings.
6	Insert the second clock card if there is one. It will receive the factory default settings from the first clock.

End of Procedure

4.11 System Operation Check

When the signals have been acquired and the outputs are stable enough to output PRS, the TimeHub 5500 enters its normal operation mode. During normal operation, the following conditions exist:

- These should be observed on both clock cards:
  - Enabled inputs show E lamp lit
  - Qualified inputs show Q lamp lit
  - The active input reference shows A lamp lit
  - One clock card should light Active lamp; the other clock card should light Standby lamp
- DS1 and/or CC outputs are functioning according to specifications

Chapter 5

Maintenance

This chapter includes:

- *Troubleshooting with Card Front Panel Items*
- *Card Replacement*
- *Fuse Replacement*
- *Repair and Return*
- *Technical Assistance*
- *Sales*
- *Manual Updates*

5.1 Troubleshooting with Card Front Panel Items

Use Tables 5-1, 5-2, 5-3, and to troubleshoot the system based on the clock, output driver, management, and EC card front-panel lamps.

5.1.1 Clock Card

Clock card front-panel items are shown in Figure 5-1. The items are described in Table 5-1.

Figure 5-1. Clock Card Front Panel

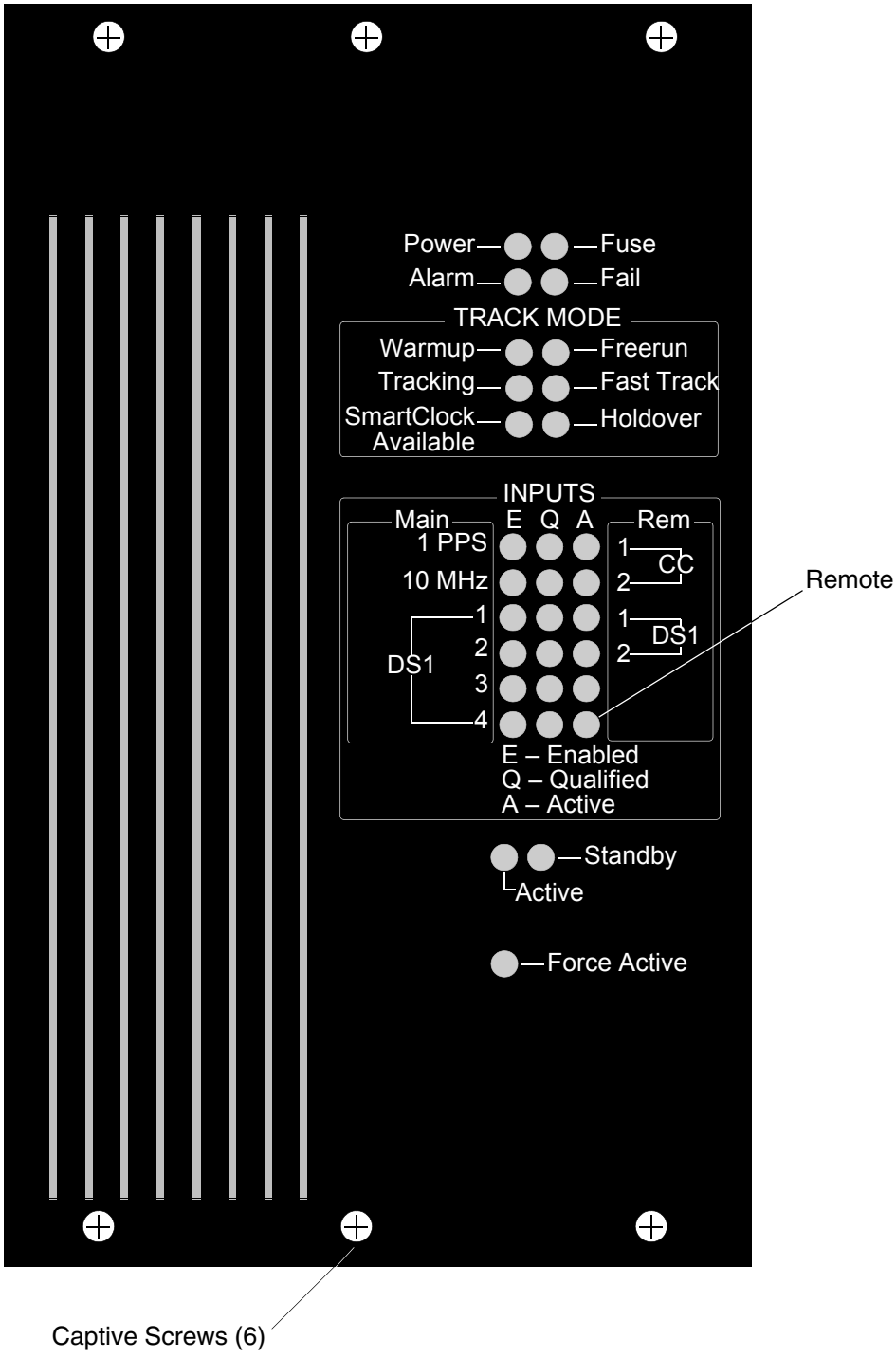


Table 5-1. Clock Card Front Panel Items

Name	State	Description	Action
Power	Off	Power is not present.	1. If all lamps on the system are off, apply power. 2. If all lamps on the system are off, troubleshoot the –48 V power source. 3. If all lamps on the clock card are off, replace the card using Procedure 5-1. 4. If the Fuse lamp is lit, replace the fuse using Procedure 5-5. 5. If the replacement fuse fails, replace the card using Procedure 5-1.
	Green	Power is present.	None required.
Fuse	Off	The clock card fuse is not open.	None required.
	Red	The clock card fuse is open.	1. Remove the clock card, and replace the fuse using Procedure 5-5. 2. If the replacement fuse fails, replace the card using Procedure 5-1.
Alarm	Off	There is no alarm condition.	None required.
	Red	An alarm condition exists.	If the Fail lamp is also lit, replace the card using Procedure 5-1. If not, check the clock card lamps and other card lamps, and/or troubleshoot the error message(s) to determine the cause of the alarm. Refer to the TL1 Reference for details on error messages.
Fail	Off	No hardware or firmware failure has occurred on the clock card.	None required.
	Red	A hardware or firmware failure has occurred on the clock card.	Replace the card using Procedure 5-1.

Table 5-1. Clock Card Front Panel Items (Cont'd)

Name	State	Description	Action
TRACK MODE Warmup	Off	The clock card is not in a warm-up state.	None required.
	Yellow	The clock card is warming up, and the card is not yet active.	None required.
TRACK MODE Freerun	Off	The clock card is not in a freerun state.	None required.
	Red	The clock card is generating an output without using any tracking information from a reference source.	Check whether both clock cards are in freerun. If both cards are in freerun, troubleshoot the input signal source. If only one card is in freerun: 1. Ensure that the clock card still qualifying input signals is the active card. (Use the Force Active pushbutton if needed.) 2. If the clock card entered freerun because the performance measurements disqualified the inputs, use the INIT-REG command to clear the performance measurements for each disqualified input. Refer to the TL1 Reference for details on the INIT-REG command.
TRACK MODE Tracking	Off	The clock card is not tracking a qualified input.	Check the state of the other TRACK MODE (Warmup, Freerun, Fast Track, Smart Clock Available, Holdover) lamps. Troubleshoot the other TRACK MODE lamp(s) per this table.
	Green	The clock card is tracking a qualified input.	None required.
TRACK MODE Fast Track	Off	The clock card is not in a fast track state.	None required.
	Green	The clock card has warmed up, is tracking, and is providing a usable output, but has not yet achieved Smart Clock (optimal quality) output.	None required.

Table 5-1. Clock Card Front Panel Items (Cont'd)

Name	State	Description	Action
TRACK MODE Smart Clock Available	Off	The system has not gathered sufficient information during tracking to provide Smart Clock (optimal quality) holdover output if necessary.	None required if the system has been in fast track for less than 32 h. If the system has been in fast track for more 32 h, troubleshoot the input signal source.
	Green	The system has gathered sufficient information during tracking to provide Smart Clock (optimal quality) holdover output if necessary.	None required.
TRACK MODE Holdover	Off	The system is not in a holdover state.	None required.
	Red	All inputs are lost or unacceptable, and the system is now using the internal oscillator which is using recent tracking data from a qualified reference to provide the output.	Check whether both clock cards are in holdover. If both cards are in holdover, troubleshoot the input signal source. If only one card is in holdover: 1. Ensure that the clock card still qualifying input signals is the active card. 2. If the clock card entered holdover because the performance measurements disqualified the inputs, use the Initialize Register (INIT-REG) command to clear the performance measurements for each disqualified input. Refer to the TL1 Reference for details on the INIT-REG command.
INPUTS E	Off	The associated reference input is not enabled (E) for tracking.	None required. If desired, enable the reference input using the Edit Sync command (refer to the TL1 Reference for details).
	Green	The associated reference input is enabled (E) for tracking.	None required.

Table 5-1. Clock Card Front Panel Items (Cont'd)

Name	State	Description	Action
INPUTS Q	Off	The associated reference input is not qualified (Q) for tracking.	If the INPUTS E lamp is off or if the Warmup lamp is lit, none required. If the Freerun lamp is lit longer than 1 min, troubleshoot the input signal source. If the INPUTS Q lamp is lit on the other clock card over 200 s: 1. Remove, then insert this card (refer to Procedure 5-1). 2. Replace this card using Procedure 5-1.
	Green	The associated reference input is qualified (Q) for tracking.	None required.
INPUTS A	Off	The associated reference input is not being actively (A) used for tracking.	None required.
	Green	The associated reference input is being actively (A) used for tracking. In a remote system , this light indicates the shelf being configured as a remote shelf. In this case, the corresponding 'Q' and 'E' lights are off.	None required.

Table 5-1. Clock Card Front Panel Items (Cont'd)

Name	State	Description	Action
Active	Off	This card is not the synchronization signal source for all output cards.	If the Standby lamp on this card is lit, none required. If the Standby lamp on this card is also off: 1. If the Fail lamp is lit, replace the card; if the Fail lamp is off, remove, then insert the card (see Procedure 5-1). 2. Once the Freerun lamp is lit, if the Active lamp is still off, replace the card using Procedure 5-1.
	Green	This card is the synchronization signal source for all output cards.	None required.
Standby	Off	This card is not generating an output that is phase-locked to the output of the other (active) clock card.	If the Active lamp on this card is lit, none required. If the Active lamp on this card is also off: 1. If the Fail lamp is lit, replace the card; if the Fail lamp is off, remove, then insert the card (see Procedure 5-1). 2. If the Standby lamp is still off, replace the card using Procedure 5-1.
	Green	This card is generating an output that is phase-locked to the output of the other (active) clock card.	None required.
Force Active (Pushbutton)	–	When pressed, this pushbutton forces the card to be the active card.	–

5.1.2 Output Driver Card

Output driver card front-panel items are shown in Figure 5-2. The items are described in Table 5-2.

Figure 5-2. Output Driver Card Front Panel

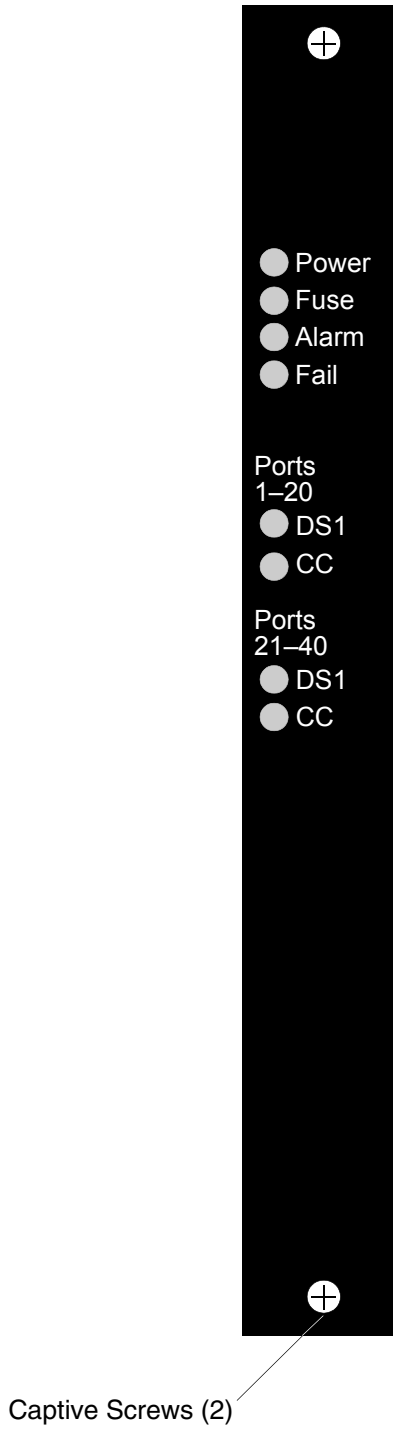


Table 5-2. Output Driver Card Front Panel Items

Name	State	Description	Action
Power	Off	Power is not present.	1. If all lamps on the system are off, apply power. 2. If all lamps on the system are off, troubleshoot the –48 V power source. 3. If all lamps on the output driver card are off, replace the card using Procedure 5-2. 4. If the Fuse lamp is lit, replace the fuse using Procedure 5-6. 5. If the replacement fuse fails, replace the card using Procedure 5-2.
	Green	Power is present.	None required.
Fuse	Off	The output driver card fuse is not open.	None required.
	Red	The output driver card fuse is open.	1. Remove the output driver card, and replace the fuse using Procedure 5-6. 2. If the replacement fuse fails, replace the card using Procedure 5-2.

Table 5-2. Output Driver Card Front Panel Items (Cont'd)

Name	State	Description	Action
Alarm	Off	There is no alarm condition.	None required.
	Red	An alarm condition exists.	If the Fail lamp is also lit, replace the card using Procedure 5-2. If not, check the output driver card lamps and other card lamps, and/or troubleshoot the error message(s) to determine the cause of the failure. Refer to the TL1 Reference for details on error messages. General reasons why Alarm LED could be uniquely lit: 1. If the card has never been initialized this LED remains lit. This could be an indication of a communication problem since the active clock card should perform the initialization. If there is no clock card in the shelf the output card would not be expected to initialize and the LED would remain lit. 2. If the output card contains FPGA version B or later the Alarm LED will light if there is a port alarm detected. For details, see "Output Port Alarms in TimeHub 5500" in the Functional Description section of Chapter 1. The FPGA version can be seen at the end of output card version information in RTRV-NETYPE-ALL response. Also, in Chapter 1, a procedure is described for attempting to clear a port alarm. See "Clearing of False Port Alarms" in "Output Driver Cards" section in Chapter 1.

Table 5-2. Output Driver Card Front Panel Items (Cont'd)

Name	State	Description	Action
Alarm (cont'd)			3. The Alarm LED will light if the output card is using the clock signal from the standby clock. While this is a perfectly good clock to use, it should normally use the clock signal from the Active clock. If this is the cause of the alarm, it could signify a problem with the Active clock, the backplane connection, or this output card. If this is the cause of the Alarm, the OSTBYCLK (Output using STandBY CLocK) will be generated. See Table M in TimeHub 5500 TL1 Reference Manual for details. Also, in Chapter 1, a procedure is described for attempting to clear a port alarm. See "Clearing of False Port Alarms" in "Output Driver Cards" in Chapter 1.

Table 5-2. Output Driver Card Front Panel Items (Cont'd)

Name	State	Description	Action
Fail	Off	No hardware or firmware failure has occurred on the output driver card.	None required.
	Red	A hardware or firmware failure has occurred on the output driver card.	General reasons why Fail LED could be uniquely lit: 1. The card has an internal hardware failure. 2. If the card has been initialized and is not currently receiving a valid clock signal on the backplane. This could be a hardware problem but would also occur if there are no clocks in the shelf (or they are still in warmup). It is easy to detect this since all output cards in the shelf would show Fail. 3. If the output card contains FPGA version A, the Fail LED will light if there is a port alarm detected. For details, see "Output Port Alarms in TimeHub 5500" in the Functional Description section of Chapter 1. The FPGA version can be seen at the end of output card version information in RTRV-NETYPE-ALL response.
Ports 1–20 DS1	Off	There is no connector card connected to ports 1 through 20, no outputs can be generated.	None required.
	Green	There is a DS1 connector card connected to ports 1 through 20.	None required.

Table 5-2. Output Driver Card Front Panel Items (Cont'd)

Name	State	Description	Action
Ports 1–20 CC	Off	There is no connector card connected to ports 1 through 20, no outputs can be generated.	None required.
	Green	There is a CC connector card connected to ports 1 through 20.	None required.
Ports 21–40 DS1	Off	There is no connector card connected to ports 21 through 40, no outputs can be generated.	None required.
	Green	There is a DS1 connector card connected to ports 21 through 40.	None required.
Ports 21–40 CC	Off	There is no connector card connected to ports 21 through 40, no outputs can be generated.	None required.
	Green	There is a CC connector card connected to ports 21 through 40.	None required.

5.1.3 Management Card

Management card front-panel items are shown in Figure 5-3. The items are described in Table 5-3.

Figure 5-3. Management Card Front Panel

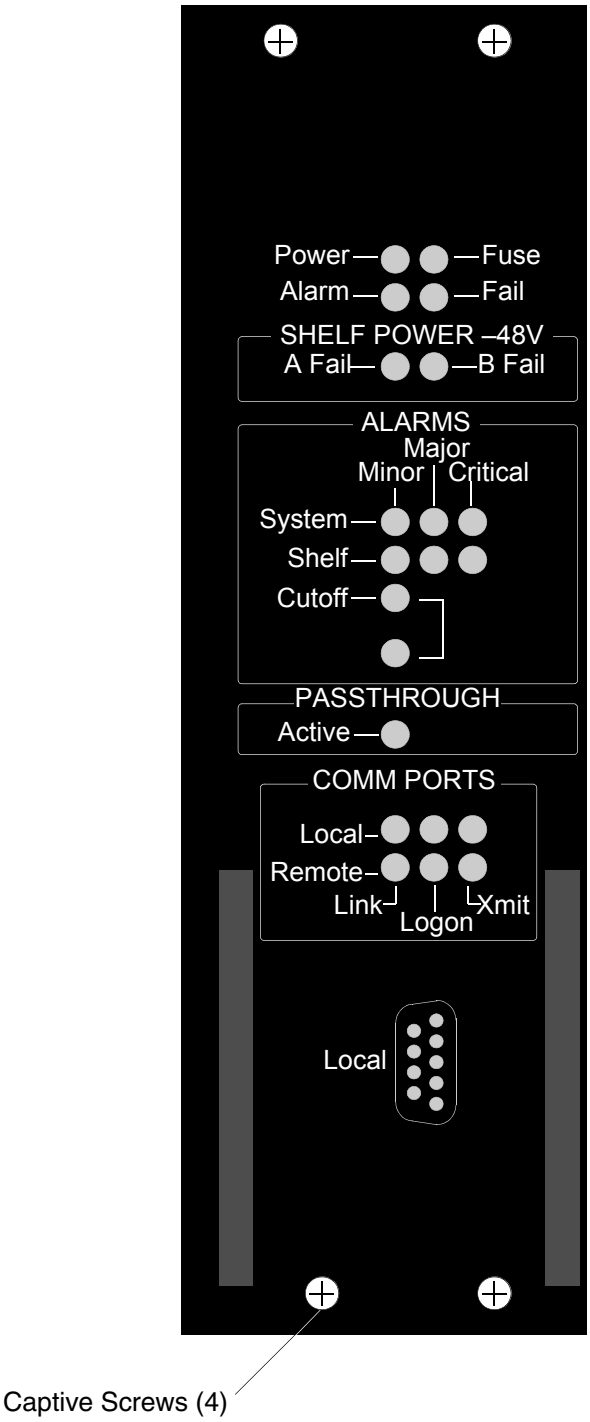


Table 5-3. Management Card Front Panel Items

Name	State	Description	Action
Power	Off	Power is not present.	1. If all lamps on the system are off, apply power. 2. If all lamps on the system are off, troubleshoot the –48 V power source. 3. If all lamps on the management card are off, replace the card using Procedure 5-3. 4. If the Fuse lamp is lit, replace the fuse using Procedure 5-7. 5. If the replacement fuse fails, replace the card using Procedure 5-3.
	Green	Power is present.	None required.
Fuse	Off	The management card fuse is not open.	None required.
	Red	The management card fuse is open.	1. Remove the management card, and replace the fuse using Procedure 5-7. 2. If the replacement fuse fails, replace the card using Procedure 5-3.
Alarm	Off	There is no alarm condition.	None required.
	Red	An alarm condition exists.	If the Fail lamp is also lit, replace the card using Procedure 5-3. If not, check the management card lamps and other card lamps, and/or troubleshoot the error message(s) to determine the cause of the failure. Refer to the TL1 Reference (see RTRV-ALM) for details on error messages.

Table 5-3. Management Card Front Panel Items (Cont'd)

Name	State	Description	Action
Fail	Off	No hardware or firmware failure has occurred on the management card.	None required.
	Red	A hardware or firmware failure has occurred on the management card.	Replace the card using Procedure 5-3.
SHELF POWER – 48V A Fail	Off	The –48V A input is at the normal voltage level.	None required.
	Red	The –48V A input is below the normal voltage level.	Troubleshoot and repair the A – 48 V battery input.
SHELF POWER – 48V B Fail	Off	The –48V B input is at the normal voltage level.	None required.
	Red	The –48V B input is below the normal voltage level.	Troubleshoot and repair the B – 48 V battery input.
ALARMS System Minor	Off	There is no minor alarm outside the shelf.	None required.
	Red	A minor alarm condition exists outside the shelf.	Refer to the TL1 Reference (see RTRV-ALM) to determine which minor alarm occurred and the recommended action.
ALARMS System Major	Off	There is no major alarm outside the shelf.	None required.
	Red	A major alarm condition exists outside the shelf.	Refer to the TL1 Reference (see RTRV-ALM) to determine which major alarm occurred and the recommended action. If there is also a minor system alarm, it will not be shown on the front panel because only the highest severity alarm of a group (system or shelf) is illuminated. If there is a minor system alarm and the major system alarm ends, the minor system alarm LED will then light.

Table 5-3. Management Card Front Panel Items (Cont'd)

Name	State	Description	Action
ALARMS System Critical	Off	There is no critical alarm outside the shelf.	None required.
	Red	A critical alarm condition exists outside the shelf.	Refer to the TL1 Reference (see RTRV-ALM) to determine which critical alarm occurred and the recommended action. If there is also a major and/or minor system alarm, it will not be shown on the front panel because only the highest severity alarm of a group (system or shelf) is illuminated. If there is a minor or major system alarm and the critical system alarm ends, the LED associated with the highest-severity remaining system alarm LED will then light.
ALARMS Shelf Minor	Off	There is no minor alarm within the shelf.	None required.
	Red	A minor alarm condition exists in the shelf.	Refer to the TL1 Reference (see RTRV-ALM) to determine which minor alarm occurred and the recommended action.
ALARMS Shelf Major	Off	There is no major alarm within the shelf.	None required.
	Red	A major alarm condition exists in the shelf.	Refer to the TL1 Reference (see RTRV-ALM) to determine which major alarm occurred and the recommended action. If there is also a minor shelf alarm, it will not be shown on the front panel because only the highest severity alarm of a group (system or shelf) is illuminated. If there is a minor shelf alarm and the major shelf alarm ends, the minor shelf alarm LED will then light.

Table 5-3. Management Card Front Panel Items (Cont'd)

Name	State	Description	Action
ALARMS Shelf Critical	Off	There is no critical alarm within the shelf.	None required.
	Red	A critical alarm condition exists in the shelf.	Refer to the TL1 Reference (see RTRV-ALM) to determine which critical alarm occurred and the recommended action. If there is also a major and/or minor shelf alarm, it will not be shown on the front panel because only the highest severity alarm of a group (system or shelf) is illuminated. If there is a minor or major shelf alarm and the critical shelf alarm ends, the LED associated with the highest-severity remaining shelf alarm LED will then light.
AUDIBLE ALARMS Cutoff (Lamp)	Off	The alarm cutoff function has not been activated.	None required. Press the ALARMS Cutoff pushbutton to silence all audible alarms.
	Red	An audible or visible alarm was present. The audible alarm has been silenced, but the alarm condition still exists.	None required.
AUDIBLE ALARMS Cutoff (Pushbutton)	–	Silences all audible alarms when pressed.	None required.
PASS THROUGH Active	Off	The management card is not supplying the output frequency to the clock cards.	None required.
	Red	Both clock cards are malfunctioning, and the management card is supplying the output frequency.	Troubleshoot the clock cards.

Table 5-3. Management Card Front Panel Items (Cont'd)

Name	State	Description	Action
COMM PORTS Local Link	Off	The local communication port is disabled.	If no physical connection exists, none required. If a physical connection exists, troubleshoot the cable connection.
	Green	The local communication port is enabled.	None required.
COMM PORTS Local Logon	Off	A user is not logged on the local port.	None required.
	Green	A user is logged on the local port.	None required.
COMM PORTS Local Xmit	Off	Data is not being transferred on the local port.	None required.
	Green	Data is being transferred on the local port.	None required.
COMM PORTS Remote Link	Off	The network connection is disabled.	If no physical connection exists, none required. If a physical connection exists, troubleshoot the cable connection.
	Green	The network connection is enabled.	None required.
COMM PORTS Remote Logon	Off	A user is not logged on the network.	None required.
	Green	A user is logged on the network.	None required.
COMM PORTS Remote Xmit	Off	Data is not being transferred on the network.	None required.
	Green	Data is being transferred on the network.	None required.

5.1.4 EC Card

EC card front-panel items are shown in Figure 5-4. The items are described in Table 5-4.

Figure 5-4. EC Card Front Panel

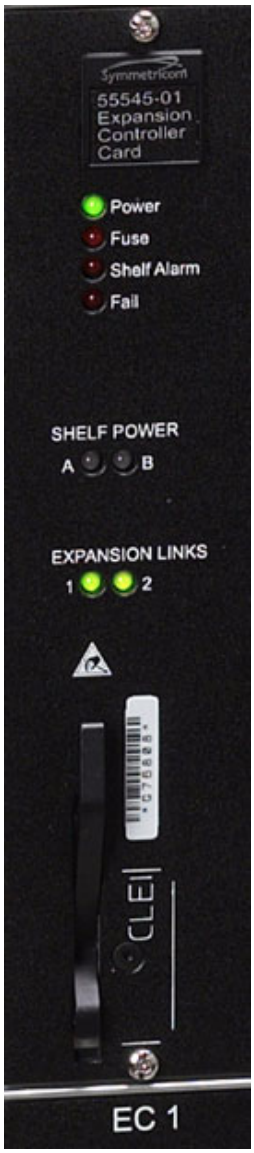


Table 5-4. EC Card Front Panel Items

Name	State	Description	Action
Power	Off	Power is not present.	1. If all lamps on the system are off, apply power. 2. If all lamps on the system are off, troubleshoot the –48 V power source. 3. If all lamps on the EC card are off, replace the card using Procedure 5-4. 4. If the Fuse lamp is lit, replace the fuse using Procedure 5-8. 5. If the replacement fuse fails, replace the card using Procedure 5-4.
	Green	Power is present.	None required.
Fuse	Off	The EC card fuse is not open.	None required.
	Red	The EC card fuse is open.	1. Remove the EC card, and replace the fuse using Procedure 5-8. 2. If the replacement fuse fails, replace the card using Procedure 5-4.
Shelf Alarm	Off	There is no alarm condition.	None required.
	Red	An alarm condition exists.	If the Fail lamp is also lit, replace the card using Procedure . If not, check the EC card lamps and other card lamps, and/or troubleshoot the error message(s) to determine the cause of the failure. Refer to the TL1 Reference for details on error messages.
Fail	Off	No hardware or firmware failure has occurred on the EC card.	None required.
	Red	A hardware or firmware failure has occurred on the EC card.	Replace the card using Procedure 5-4.

Table 5-4. EC Card Front Panel Items (Cont'd)

Name	State	Description	Action
SHELF POWER –48V A Fail	Green	The –48V A input is at the normal voltage level.	None required.
	Red	The –48V A input is below the normal voltage level.	Troubleshoot and repair the A –48 V battery input.
SHELF POWER –48V B Fail	Green	The –48V B input is at the normal voltage level.	None required.
	Red	The –48V B input is below the normal voltage level.	Troubleshoot and repair the B –48 V battery input.
Expansion Link 1	Off	The link 1 cable is not connected.	Connect the link 1 cable.
	Red	The link 1 cable is attached, but there is a problem receiving either clock timing, clock framing, or communication from the master shelf.	Check clock timing, clock framing, and communication on master shelf.
	Green	EC card is receiving proper timing, framing,and communication from the master shelf.	None required.
Expansion Link 2	Off	The link 2 cable is not connected.	Connect the link 2 cable.
	Red	The link 2 cable is attached, but there is a problem receiving either clock timing, clock framing, or communication from the master shelf.	Check clock timing, clock framing, and communication on master shelf.
	Green	EC card is receiving proper timing, framing,and communication from the master shelf.	None required.

5.2 Card Replacement

5.2.1 Clock Card

WARNING: Before replacing the clock card, make sure that the system has at least one clock active and is NOT operating in Passthrough mode by checking the light on the Management Card.

If this is not the case and you are inserting a clock card that does not have the most recent configuration for that specific shelf, you have to reprogram the new clock card in another shelf to match the desired shelf configuration. Failure to do so will change the configuration to the one stored in the new card. This may affect the output signals.

To replace the clock card, follow the steps in Procedure 5-1, and refer to Figure 5-1.

Procedure 5-1. Clock Card Replacement

Step	Action
1	Put on a properly grounded ESD wrist strap.
2	Ensure that the card being replaced is in Standby.
3	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
4	Remove the card from the shelf.
5	Insert the replacement card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
6	Remove the replacement card just enough so that it slides away from the backplane connector (to clear the alarm).
7	Carefully re-insert the replacement card into the shelf: again, ensure that the card is aligned properly and is fully seated.
8	Wait for the Warmup lamp to turn off on the replacement card (approximately 2 minutes to 20 minutes) and the Tracking lamp to light.
9	Press the Cutoff pushbutton on the management card several times.
10	Verify that any alarm conditions are cleared.

Procedure 5-1. Clock Card Replacement (Cont'd)

Step	Action
11	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

5.2.2 Output Driver Card

To replace the output driver card, follow the steps in Procedure 5-2, and refer to Figure 5-2.

Procedure 5-2. Output Driver Card Replacement

Step	Action
1	Put on a properly grounded ESD wrist strap.
2	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
3	Remove the card from the shelf.
4	Insert the replacement card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
5	Wait for the Power lamp to light, the DS1 and/or CC lamps to light according to the output connector cards installed, and the Fail and Alarm lamps to turn off.
6	Press the Cutoff pushbutton on the management card several times.
7	Verify that any alarm conditions are cleared.
8	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

5.2.3 Management Card

To replace the management card, follow the steps in Procedure 5-3, and refer to Figure 5-3.

Procedure 5-3. Management Card Replacement

Step	Action
1	If applicable, remove the cable connected to the management card.
2	Put on a properly grounded ESD wrist strap.
3	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
4	Remove the card from the shelf.
5	Set switch S1 on the replacement card the same as the card being replaced.
6	Insert the replacement card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
7	Wait 5 seconds.
8	Remove the replacement card just enough so that it slides away from the backplane connector (to clear the alarm).
9	Carefully re-insert the replacement card into the shelf: again, ensure that the card is aligned properly and is fully seated.
10	If using an LAN connection, connect a nine-pin male-to-female RS-232 interface cable from the communication port on a computer with communications software to the Local port on the TimeHub 5500. If not, skip to Step 12.
11	Configure the network parameters (refer to the Test chapter for details).
12	Wait approximately 2 minutes.
13	Press the Cutoff pushbutton several times.
14	Verify that any alarm conditions are cleared.
15	If applicable, re-connect the cable that was connected to the management card that was replaced.
16	Verify the Power lamp is lit.
17	If using a local communication connection, verity the Local lamp is lit. If using an LAN connection, verify the Link lamp is lit.
18	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

5.2.4 EC Card

To replace the EC card, follow the steps in Procedure 5-4, and refer to Figure 5-4.

Procedure 5-4. EC Card Replacement

Step	Action
1	Put on a properly grounded ESD wrist strap.
2	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
3	Remove the card from the shelf.
4	Insert the replacement card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
5	Wait for the Power lamp to light, the Shelf Power and Expansion Links lamps to light, and the Fail and Alarm lamps to turn off.
6	Press the Cutoff pushbutton on the management card several times.
7	Verify that any alarm conditions are cleared.
8	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

5.3 Fuse Replacement

5.3.1 Clock Card

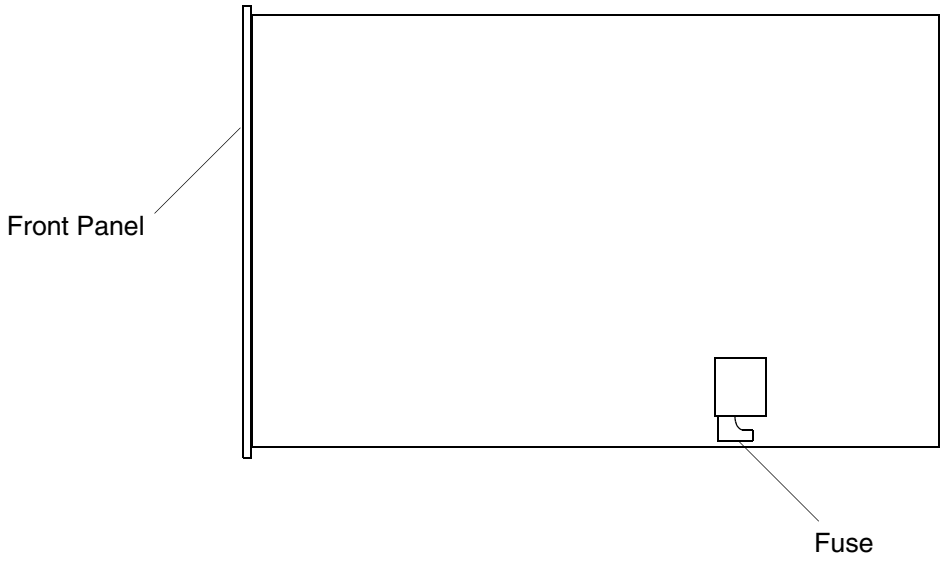
To replace the fuse on the clock card, follow the steps in Procedure 5-5, and refer to Figures 5-1 and 5-5.

Procedure 5-5. Clock Card Fuse Replacement

Step	Action
1	Put on a properly grounded ESD wrist strap.
2	Ensure that the card being removed is in Standby.
3	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
4	Remove the card from the shelf.
5	Using a GMT fuse puller, remove the fuse from the fuseholder labeled XF1.
6	Replace the fuse with a 3 amp GMT fuse: when inserting the fuse, do not force; the fuse should easily snap-fit into the fuseholder.
7	Insert the card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
8	Remove the card just enough so that it slides away from the backplane connector (to clear the alarm).
9	Carefully re-insert the card into the shelf: again, ensure that the card is aligned properly and is fully seated.
10	Wait for the Warmup lamp to turn off on the card (approximately 2 minutes to 20 minutes) and the Tracking lamp to light.
11	Press the Cutoff pushbutton on the management card several times.
12	Verify that any alarm conditions are cleared.
13	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

Figure 5-5. Clock Card Fuse XF1



5.3.2 Output Driver Card

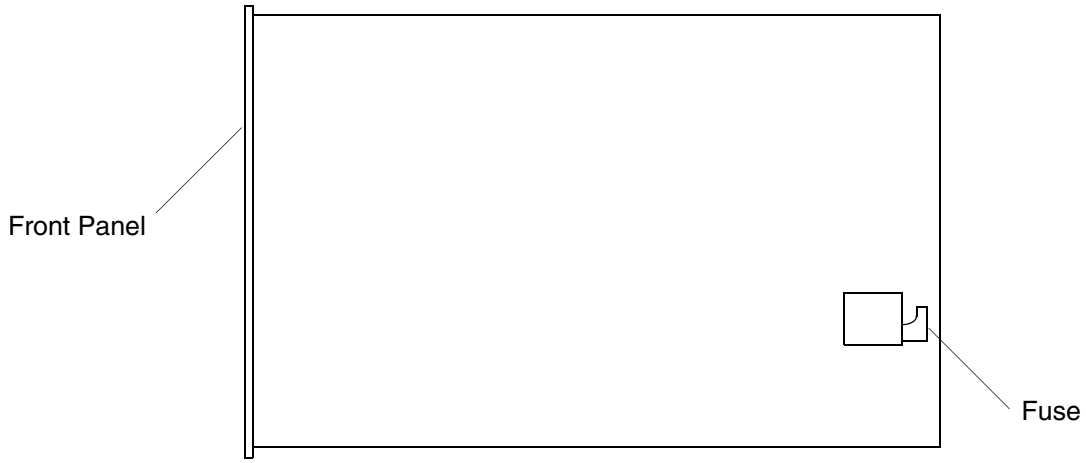
To replace the fuse on the output driver card, follow the steps in Procedure 5-6, and refer to Figures 5-2 and 5-6.

Procedure 5-6. Output Driver Card Fuse Replacement

Step	Action
1	Put on a properly grounded ESD wrist strap.
2	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
3	Remove the card from the shelf.
4	Using a GMT fuse puller, remove the fuse from the fuseholder labeled F1.
5	Replace the fuse with a 1 amp GMT fuse: when inserting the fuse, do not force; the fuse should easily snap-fit into the fuseholder.
6	Insert the card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
7	Wait for the Power lamp to light, the DS1 and/or CC lamps to light according to the output connector cards installed, and the Fail and Alarm lamps to turn off.
8	Press the Cutoff pushbutton on the management card several times.
9	Verify that any alarm conditions are cleared.
10	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

Figure 5-6. Output Driver Card and Management Card Fuse F1



5.3.3 Management Card

To replace the fuse on the management card, follow the steps in Procedure 5-7, and refer to Figures 5-3 and 5-6.

Procedure 5-7. Management Card Fuse Replacement

Step	Action
1	If applicable, remove the cable connected to the management card.
2	Put on a properly grounded ESD wrist strap.
3	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
4	Remove the card from the shelf.
5	Using a GMT fuse puller, remove the fuse from the fuseholder labeled F1.
6	Replace the fuse with a 1 amp GMT fuse: when inserting the fuse, do not force; the fuse should easily snap-fit into the fuseholder.
7	Insert the card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
8	Wait 5 seconds.
9	Remove the card just enough so that it slides away from the backplane connector (to clear the alarm).
10	Carefully re-insert the card into the shelf: again, ensure that the card is aligned properly and is fully seated.
11	Press the Cutoff pushbutton several times.
12	Verify that any alarm conditions are cleared.
13	If applicable, re-connect the cable that was connected to the card.
14	Verify the Power lamp is lit.
15	If using a local communication connection, verify the Local lamp is lit. If using an LAN connection, verify the Link lamp is lit.
16	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

5.3.4 EC Card

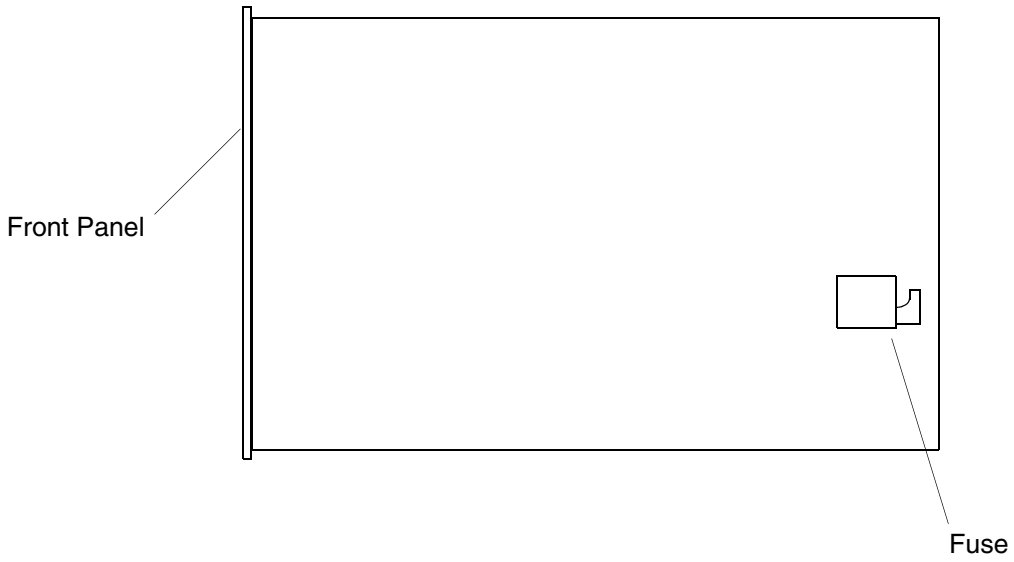
To replace the fuse on the EC card, follow the steps in Procedure 5-8, and refer to Figures 5-4 and 5-7.

Procedure 5-8. EC Card Fuse Replacement

Step	Action
1	Put on a properly grounded ESD wrist strap.
2	Using a #2 Phillips-head or Pozidrive screwdriver, loosen the captive screws at the top and bottom of the card front panel.
3	Remove the card from the shelf.
4	Using a GMT fuse puller, remove the fuse from the fuseholder labeled F1.
5	Replace the fuse with a 1 amp GMT fuse: when inserting the fuse, do not force; the fuse should easily snap-fit into the fuseholder.
6	Insert the card into the shelf: ensure that the card aligns properly with its mating backplane connector; push the card into place until it is fully seated into the backplane connectors.
7	Wait for the Power lamp to light, the Shelf Power and Expansion Links lamps to light, and the Fail and Alarm lamps to turn off.
8	Press the Cutoff pushbutton on the management card several times.
9	Verify that any alarm conditions are cleared.
10	Tighten the captive screws at the top and bottom of the card front panel.

End of Procedure

Figure 5-7. EC Card Fuse F1



5.4 Repair and Return

When returning defective equipment for factory repair, obtain the following information prior to calling Symmetricom:

- A complete description of the trouble (alarms, equipment behavior, etc.), part number, serial number, issue/revision level, and warranty expiration date.
- If the warranty has expired, a purchase order with “bill to” information.
- A customer field technical contact including address, phone number and FAX number.
- Return shipping information.

To return defective or damaged equipment, use Procedure 5-9.

Procedure 5-9. Equipment Return

Step	Action
1	Call your local Symmetricom distributor or Symmetricom’s Inside Sales (refer to the Sales subsection), and obtain a Return Material Authorization (RMA) number and shipping address. *Note:* Retain the RMA number for future reference. The RMA number is used by Symmetricom for internal tracking of the unit. Reference the RMA number in all communications with Symmetricom regarding the unit.
2	Pack the defective equipment, including a list containing all the information obtained above, in the original packing material. If the original packing material is not available, inform Symmetricom, and the appropriate shipping material will be provided. *Note:* Equipment must be returned in the original packaging, or approved replacement packaging for the warranty to be honored.
3	Mark the RMA number and the equipment serial number on the outside of the shipping carton.

Procedure 5-9. Equipment Return (Cont'd)

Step	Action
4	Ship the equipment prepaid and insured to one of the addresses below, as directed by the Customer Assistance Center: Symmetricom Attn: Customer Service 2300 Orchard Parkway San Jose, CA 95131 or Symmetricom Attn: Repair and Return P.O. Box 5219 La Montaña Industrial Park Aguadilla, Puerto Rico 00603 *Note:* Repaired equipment is typically shipped within 30 days of receipt by Symmetricom, or per contract terms. Shipping costs to Symmetricom are paid by the customer; shipping costs back to the customer are paid by Symmetricom.

End of Procedure

5.5 Technical Assistance

For technical assistance, contact the following:

Symmetricom, Inc.
2300 Orchard Parkway
San Jose, CA 95131-1017

U.S.A. Call Center:
888-367-7966 (from inside U.S.A. only – toll-free)
408-428-7907
Fax: 408-428-7998

Europe, Middle East, and Africa (EMEA) Call Center:
+44 (0) 1189 699 799
Fax: +44 (0) 1189 277 520

E-mail: cac@symmetricom.com

Internet: http://www.symmetricom.com

5.6 Sales

For sales assistance, contact the following:

Symmetricom, Inc.
2300 Orchard Parkway
San Jose, CA 95131-1017

U.S.A. Call Center:
888-367-7966 (from inside U.S.A. only – toll-free)
408-428-7907

Europe, Middle East, and Africa (EMEA) Call Center:
+44 (0) 1189 699 799

Fax: 408-428-7998

E-mail: info@symmetricom.com

Internet: http://www.symmetricom.com

5.7 Manual Updates

From time to time, this manual may be updated. The updated version of the manual will be available for downloading in electronic form via the Internet. After downloading, the manual can be viewed on a computer or printed out.

Manual updates are available at:

http://www.symmetricom.com/support/login/login.php

NOTE: If you are downloading a manual for the first time, you will need to register with Symmetricom. If you are currently registered, login and download the manual update.

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Chapter 6

Specifications

This chapter includes:

6.1 Overview

The TimeHub 5500 equipment specifications are listed as follows.

6.1.1 Local Communication Port

Connector Type:	9-pin, female D connector
Connector Label:	Local
Connector Location:	Management card (front) Rear of shelf
Electrical Interface:	RS-232
Baud Rate:	1200 bps 2400 bps 9600 bps 19.2 kbps
Data Bits:	8
Parity Bit:	None
Stop Bits:	1
Flow Control:	None

6.1.2 LAN Communication Port

Connector Type:	RJ-45 (10 Base-T)
Connector Label:	LAN
Connector Location:	Rear of shelf

6.1.3 Remote Communication Port

Reserved for future use.

6.1.4 GPS Input

Reserved for future use.

6.1.5 Expansion Link 1 Input

Used to connect to the expansion shelf.

6.1.6 Expansion Link 2 Input

Used to connect to the expansion shelf.

6.1.7 DS1 Inputs

Connector Type:	Wire-wrap pins
Connector Label:	DS1 REF (T, R, S) DS1 MON (T, R, S)
Connector Location:	Input/Alarm Connector module (rear of shelf)
Number of Inputs:	4 reference inputs and/or monitoring 4 additional inputs for monitoring only (Clocks 090-55512-02 or 090-55514-02 required)
Bit Rate:	1.544 Mb/s
Impedance:	100 Ω
Format:	DS1 (Telcordia GR-499-CORE; ANSI T1.101)
Framing:	D4 or ESF (selectable)
Line Code:	B8ZS
SSM State:	Enable Disable
Cable Attenuation:	7.0 dB maximum
LOS Threshold:	–14 dB to –10 dB (terminated) relative to nominal 3 V amplitude –34 dB to –30 dB (bridged) relative to nominal 3 V amplitude

6.1.8 PRS Reference Input

Connector Type:	BNC
Connector Label:	5/10 MHz IN
Connector Location:	Input/Alarm Connector card (rear of shelf)
Number of Inputs:	1
Frequency:	5 MHz or 10 MHz
Impedance:	50 Ω
Format:	Sine or square wave
Amplitude:	0.5 V p-p

6.1.9 Composite Clock Inputs (Remote Shelf Only)

Connector Type:	Wire-wrap pins
Connector Label:	CC IN (T, R, S)
Connector Location:	Input/Alarm Connector card (rear of shelf)
Number of Inputs:	2
Bit Rate:	64 kb/s
Impedance:	133 Ω
Format:	Bipolar RTZ

6.1.10 DS1 Outputs

Connector Type:	Wire-wrap pins
Connector Label:	1–10 (S, T, R)
Connector Location:	Wire-wrap panel
Number of Outputs:	Up to 40 protected or non-protected outputs per card Maximum of 140 per system
Bit Rate:	1.544 Mb/s
Impedance:	100 Ω balanced
Format:	DS1
Framing:	D4 or ESF (selectable)
SSM:	Enable, Disable
Line Code:	B8ZS
Amplitude:	2.4 V to 3.6 V terminated with 100 w

6.1.11 Composite Clock Outputs

Connector Type:	Wire-wrap pins
Connector Label:	1–10 (S, T, R)
Connector Location:	Wire-wrap panel
Number of Outputs:	Up to 40 protected or non-protected outputs per card Maximum of 140 per system
Bit Rate:	64 kb/s
Impedance:	133 Ω balanced
Line Code:	Bipolar RTZ

6.1.12 Output Alarms

Connector Type:	Wire-wrap pins
Connector Label:	OFFICE ALARMS (NC, C, NO)
Connector Location:	Input/Alarm Connector card (rear)
Contact Type:	Dry contact
Severity:	Critical (audible and visible) Major (audible and visible) Minor (audible and visible)
State:	Normally open and normally closed

6.1.13 Input Alarms

Connector Type:	Wire-wrap pins
Connector Label:	EXT ALARM INPUTS (+, –)
Connector Location:	Input/Alarm Connector card (rear)
Number of Inputs:	10 (4 universal, 6 contact closure only)
Contact Type:	Relay closure monitoring
Severity:	Fixed
State:	Normally open

6.1.14 Power

Connector Type:	Terminal block
Connector Labels:	Return/–48V (A) Return/–48V (B)
Connector Location:	Rear panel
Voltage:	–42 V dc to –60 V dc (each connector)
Current:	Master/Remote Shelf: 180 W Expansion Shelf: 100 W
Recommended Battery Feed Fuse:	10 A

6.1.15 Shelf Mechanical

Mounting:	NEBS 19 in. rack NEBS 23 in. rack
Rack Mounting Position:	Flush 2 in. offset 5 in. offset
Width:	16.6 in.
Height:	10.5 in.
Depth:	11.6 in.
Weight:	14 lb empty 40 lb fully loaded

6.1.16 Wirewrap Panel Mechanical

Mounting:	19 in. rack or 23 in. rack (with supplied mounting ears)
Rack Mounting Position:	Flush
	5 in. offset
Width:	16.6 in.
Height:	5.25 in.: wire-wrap module type 3.5 in.: built-in wire-wrap pin type
Depth:	4.6 in.

6.1.17 Shelf and Wirewrap Panel Environmental

Operating Temperature:	0 °C to +45 °C
Operating Humidity:	5% to 95%
Electromagnetic Compliance:	FCC Part 15, Sub Part B, Class A

6.1.18 Certification

NEBS Level 3 compliant

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