DIGITAL CLOCK DISTRIBUTOR

LOCAL PRIMARY REFERENCE

FUNCTIONAL DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section provides functional descriptions and specifications for Symmetricom's Digital Clock Distributor - Local Primary Reference (DCD-LPR) System.

1.02 This section was reissued for the following reasons. Additions and changes are marked by change bars.

- Removed references to analog capability for the GTI-18 card.
- Revised information on SSM in paragraph 2-20.
- Added Table B, Signal Output for GTI-17 and -18.
- Removed hex code information from E1 System Quality Levels and T1 System Quality Levels in Table C.

1.03 All product names, service marks, trademarks, and registered trademarks used in this document are the property of their respective owners.

1.04 The DCD-LPR may be used in conjunction with a DCD-ST2 or DCD-419 System, or any DCD-500 Series System equipped with appropriate oscillators.

Note: The DCD-LPR is not compatible with Rev. C or earlier revisions of the DCD-419.

1.05 The following abbreviations are used in this document:

ACO	alarm cut-off
BITS	Building Integrated Timing Supply
CI	Clock Input
DCD	Digital Clock Distributor
GPS	Global Positioning System
GRI	group repetition intervals
GTI	GPS Timing Interface
GTR	GPS Timing Antenna/Receiver
LORAN-C	Long Range Navigation-Version C
LOU	LPR Oscillator Unit
LPR	Local Primary Reference
LTI	LORAN-C Timing Interface

MIS	Maintenance Interface, System
NTP	network time protocol
PRC	Primary Reference Clock
PRS	primary reference source
pps	pulses per second
RU	rack unit
SSM	Synchronization Status Messaging
SSU	Synchronization Supply Utility
ST2	Stratum-2 Clock
ST2E	Enhanced Stratum-2 Clock
ST3E	Enhanced Stratum-3 Clock
TI	timing interface card or slot
TNC	Transit Node Clock
TOD	Time-of-Day
USNO	United States Naval Observatory
UTC	Universal Coordinated Time
WAN	wide area networks

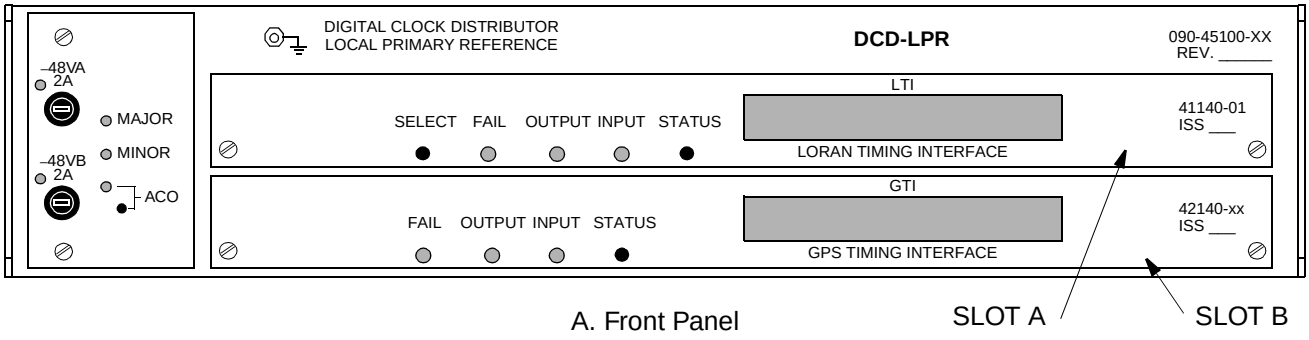
Notes:

1. Where information is common to the TNC-E, ST2, and ST2E cards, these cards are collectively referred to as rubidium clock cards. The TNC-E and ST2E clock cards are identical in specifications, functions, controls and indicators, and acceptance test procedures. The TNC-E name uses ITU standard terminology; the ST2E name uses ANSI standard terminology. The TNC-E and ST2E are interchangeable.

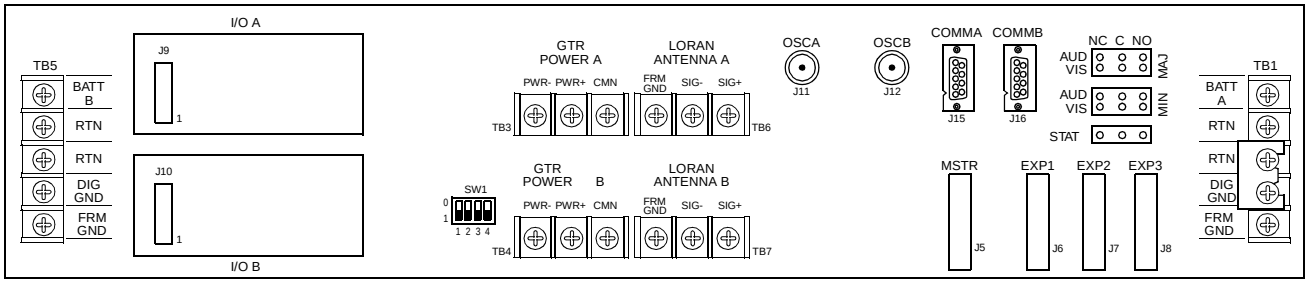
2. Where information is common to the TNC and ST3E cards, these cards are collectively referred to as quartz clock cards.

2. SYSTEM DESCRIPTION

2.01 The DCD-LPR (Figure 1) provides Stratum-1 quality reference signals when used with the DCD-ST2, DCD-419, and DCD-500 Series Systems.



A. Front Panel



B. Backplane

Figure 1. DCD-LPR Shelf

2.02 Cards which may be included in the DCD-LPR System are listed in Table A.

Table A. DCD-LPR Cards

CARD	NAME USED IN THIS SECTION	PART NUMBER	REVISION	FEATURES
ANSI-STANDARD CARDS				
GTI^{V5}	GTI-17	090-42140-17	–	Input: 5 MHz or 10 MHz, from quartz, rubidium, or better quality clocks, any combination of two quartz, rubidium, or better quality clocks, or LOU card Output: 1.544 Mb/s (T1) Framing format: ESF or D4 Time-of-Day SSM capable
GTI	GTI-15	090-42140-15	A	Input: 5 MHz or 10 MHz, from quartz, rubidium, or better quality clocks, any combination of two quartz, rubidium, or better quality clocks, or LOU card Output: 1.544 Mb/s (T1) Framing format: ESF or D4 Time-of-Day
GTI^{V5}	GTI-15	090-42140-15	B or later	
GTI	GTI-13 (Note 4)	090-42140-13	D or earlier	Input: 5 MHz or 10 MHz, from quartz, rubidium, or better quality clocks, any combination of two quartz, rubidium, or better quality clocks, or LOU card Output: 1.544 Mb/s (T1) Framing format: ESF or D4
GTI^{V5}	GTI-13 (Note 4)	090-42140-13	E or later	
GTI	GTI-11 (Note 4)	090-42140-11	–	Input: 5 MHz or 10 MHz, from rubidium or better quality clocks, ST2E or ST2 cards only Output: 1.544 Mb/s (T1) Framing format: ESF or D4
LTI	LTI	090-41140-01	–	Input: 5 MHz from rubidium or better quality clocks, ST2E or ST2 cards only Output: 1.544 Mb/s (T1) Framing format: ESF or D4
ITU-STANDARD CARDS				
GTI^{V5}	GTI-18	090-42140-18	–	Input: 5 MHz or 10 MHz, from quartz, rubidium, or better quality clocks, any combination of two quartz, rubidium, or better quality clocks, or LOU card Output: 2.048 Mb/s (E1) Framing format: CCS/CAS with or without CRC-4 Time-of-Day SSM capable

Table A. DCD-LPR Cards (Cont'd)

CARD	NAME USED IN THIS SECTION	PART NUMBER	REVISION	FEATURES
ITU-STANDARD CARDS (Cont'd)				
GTI^{V5}	GTI-16	090-42140-16	–	Input: 5 MHz or 10 MHz, from quartz, rubidium, or better quality clocks, any combination of two quartz, rubidium, or better quality clocks, or LOU card Output: 2.048 Mb/s (E1) Framing format: CCS/CAS with or without CRC-4 Time-of-Day
GTI	GTI-14 (Note 4)	090-42140-14	D or earlier	Input: 5 MHz or 10 MHz, from quartz, rubidium, or better quality clocks, any combination of two quartz, rubidium, or better quality clocks, or LOU card Output: 2.048 Mb/s (E1) Framing format: CCS/CAS with or without CRC-4
GTI^{V5}	GTI-14 (Note 4)	090-42140-14	E or later	
GTI	GTI-12 (Note 4)	090-42140-12	–	Input: 5 MHz or 10 MHz, from rubidium or better quality clocks, TNC-E cards only Output: 2.048 Mb/s (E1) Framing format: CCS/CAS with or without CRC-4
ANSI-STANDARD AND ITU-STANDARD CARDS				
LOU	LOU-1	090-42145-01	–	Source: one oven-controlled crystal oscillator with two parallel outputs
LOU	LOU-2	090-42145-02	–	Source: two independent oven-controlled crystal oscillators, each with one output

Notes:
1. The ^{V5} indicates that this is a Version 5 card.
2. Where information is common to all GTI cards, these cards are collectively referred to as GTI cards.
3. Where information is common to both LOU cards, these cards are collectively referred to as LOU cards.
4. Manufacture discontinued.

2.03 The DCD-LPR equipped with LOU and GTI cards provides office PRS timing as specified by industry standards.

2.04 The DCD-LPR accepts up to two GTI or LTI plug-in cards in any combination.

2.05 The DCD-LPR, when used in conjunction with the DCD Shelf and its clocks (rubidium or better quality), is a network (PRS), as specified by industry standards. Using GPS and/or LORAN-C radio navigation services, the DCD-LPR System can provide independent and diverse timing sources for both network or office primary reference clock applications.

2.06 Both the GTI and LTI cards employ sophisticated ensembling to ensure the highest levels of reliability, comply with tightening PRS performance masks, and mitigate known performance degradation effects of GPS and LORAN-C signals.

2.07 Ensemble averaging is a mathematical treatment of network synchronization. As a process, it treats a group of timing sources and their relative time errors simultaneously to produce an output signal that achieves a greater overall accuracy and stability than any single source. In a timing ensemble arrangement, each timing reference is adjusted by the time error between itself and a weighted average of the group.

2.08 The advantages of ensemble averaging for precise time scale determination is a significantly reduced sensitivity to internal and external noise, and elimination of a master clock dependency. These facts provide survivability and greater stability for the group as a whole. This is because the ensemble averaging output provides the best performance of the best sources in the ensemble.

2.09 The GTI is used to extract the UTC traceable clock and mitigate the effects of GPS signal instabilities. This is accomplished in two stages:

1. Simultaneously ensemble averaging six satellites in the GTR's field of view; a maximum of eight satellites will be processed in a round-robin method, if visible.

2. Ensemble averaging the uncorrected oscillator sources from the clocks in the DCD Shelf.

   Note: If LOU cards are used, the GTI takes the ensemble averaged GTR signal information, but does not ensemble average the uncorrected oscillator input from the LOU card.

2.10 It is the combination of the six-satellite ensemble and the short-term stability of the uncorrected oscillator sources that removes the instabilities, and provides PRS timing.

2.11 The LTI ensemble averages all of the stations within the two nearest Group Repetition Intervals (GRIs), such that reliable performance is not dependent on a single station. For LORAN-C, one of the primary concerns for reliable performance is the effects of electrical storms between the LORAN-C receiving antenna and the LORAN-C transmit station. Ensemble averaging multiple stations can eliminate adverse effects of electrical storms.

2.12 The LTI also uses the short-term stability of the uncorrected oscillator sources from the DCD Shelf clocks to output a signal fully compliant with the performance masks for a PRS.

2.13 Both the GTI and the LTI perform self-management and autonomous error checking. The DCD-LPR constantly monitors all stages of the PRS output signal generation. If a problem occurs that cannot be resolved by the GTI or LTI, an alarm is raised and a message is displayed on the LCD display of each timing input card. Additional information may be obtained via the rear RS-232 port for debugging purposes only when necessary.

A. Output Signals

2.14 The timing interface (TI) cards convert the timing signals provided by the (associated) antenna(s) into two primary rate T1 or E1 timing references, and passes them to the DCD Shelf.

B. Input Reference Signals

2.15 The DCD-LPR can accept two radio navigational frequency references (GPS and LORAN-C).

2.16 The two uncorrected oscillator sources are also used as timing reference sources to the timing interface cards. The sources can be from the from the DCD Shelves, from a Symmetricom cesium clock source, or from the LOU card. The DCD Shelf clocks are an integral component of the DCD-LPR. These clocks provide true short-term stability to the GTI or LTI card needed for PRS timing.

2.17 If the clock card installed in the ST A or TNC A slot (the primary source) of the DCD Shelf is removed, the TI card will automatically switch reference to the clock card installed in the ST B or TNC B slot. When the clock card is plugged back into the ST A or TNC A slot, the TI card will not immediately switch reference back to the ST A or TNC A. The switch occurs 5 minutes after the ST A or TNC A card is active and providing clock output.

2.18 Prior to switching reference, the TI card will output a 600 ns transient pulse to cause the clock cards to perform a phase buildout to prevent the timing output from moving. Occasionally, this may cause the clock card to momentarily display DRIFT/ INP TOL alarms. The ST A or TNC A card will then go into freerun. This non-service affecting condition remains for approximately 1 minute, after which the condition clears.

C. SSM

2.19 The DCD-LPR can deliver Synchronization Status Messaging (SSM) messages to network elements and BITS/SSU equipment which require SSM input signals. The GTI card delivers the appropriate SSM message, depending on the status of the GPS system.

2.20 When the system is in a normal condition, and locked to the GPS satellites, the GTI card generates a

PRC/PRS SSM message, indicating that the signal can be used as a primary reference signal. If the timing signal from the GTR degrades, or is invalid, the output of the GTI signal will change its SSM message. See Table B.

Table B. Signal Output for GTI-17 and -18

TL1 ATTRIBUTE	GTI LOCK	GPS INVALID	GTI CARD
SSME	PRC	DNU	GTI-18
SSMEC	PRC	UNK	GTI-18
SSMT	PRS	STU	GTI-17

2.21 SSM operation is enabled by TL1 command via the MIS card. For details on TL1 commands, refer to the TL1 User's Guide provided with the MIS card.

D. Fuse and Alarm

2.22 Fuse and alarm functions provide monitoring and filtering of the input power from two –48 volts dc office batteries from the office power distribution panel.

2.23 Depending on which alarms are activated in the DCD-LPR, audible and visual alarm indicator outputs are activated.

2.24 Each TI card is self-contained and provides individual alarm and status information. Minimum alarm and status information for each TI card is:

- Major alarm, form-C relay (visual and audible)
- Minor alarm, form-C relay (visual and audible)
- Status, form-C relay; reserved for future use

2.25 A front-panel ACO pushbutton, when pressed, silences the audible alarm, and lights the ACO lamp.

E. Power

2.26 The DCD-LPR Shelf is powered by two separate –48 volts dc office battery inputs. Both the redundant inputs are fused on the shelf, then bused to the cards in the shelf. If one of the battery feeds/fuses fails, a fuse alarm is indicated.

2.27 The GTI also powers the GTR via a three-conductor cable. The GTR requires power because it contains active electronics (as do all GPS antennas), and may be powered separately from the GTI.

2.28 The LTI whip antenna is passive. The preamp associated with the LTI whip antenna (to transmit the signal through the twinax cable) requires power for an FET (required as a bandpass filter).

F. GPS Timing Antenna/Receiver (GTR)

2.29 The GTR is a six-channel GPS receiver, capable of simultaneously tracking up to eight Global Positioning System (GPS) satellites, and provides timing information to the GTI. The GTR also provides Universal Coordinated Time (UTC) information to the GTI for display.

2.30 The GTR is available with Time-of-Day capabilities; a version of the GTR is available with leap second capabilities. Twice a year (end of July and December), the US Naval Observatory (USNO) decides whether or not to add a leap second. This feature notifies timed equipment that the addition of a leap second is pending, and that tracking of the leap second should be implemented.

Note: Contact Symmetricom Customer Assistance Center (CTAC) regarding availability of the GTR with leap second capabilities at one of the following numbers:

- +44 1483 510300 (U.K.)
- +1 408 428 7907 (U.S.A.)

The following toll-free number is available in some countries to access Symmetricom's Inside Sales and CTAC in the U.S.A.: +1 888 367 7966 (U.S.A.).

2.31 The GTR uses multiple satellites, and performs a majority vote on the timing information obtained from each satellite.

2.32 Majority vote is the process which validates reference sources against preset performance criteria. The algorithm measures and compares the timing information obtained from each timing source (e.g., a satellite). If, during the process of the individual comparisons, the computed value exceeds one of the preset thresholds, that source is disqualified.

2.33 The distinguishing feature of the voting algorithm is the ability to qualify a timing source against a known performance threshold when viewed with respect to at least two other sources.

2.34 Using majority vote, the GTR discards unacceptable performance data results and then ensemble averages the remaining qualified satellite information to provide a precise timing signal to the GTI card. At any one time, the GTR can ensemble average a maximum of six satellites , to derive an output timing solution.

2.35 The GTR outputs a 4 kHz clock used by the GTI to generate the disciplined timing signal for PRS accuracy, a 1 pps signal used for Time-of-Day applications (via the GTI card), and a 4 kb/s channel for transmitting GTR status information to the GTI.

2.36 These signals are Manchester-encoded, and transmitted over fiber optic cable. The fiber cable provides robust protection to the DCD-LPR System from EMI effects on this data channel link.

2.37 The GTR consists of four main sections (refer to Figure 2),

- Receiver
- Digital processor
- Phase-locked loop (PLL) subsystem
- Encoder subsystem

2.38 The receiver accepts the GPS radio navigational signals and sends the digitized GPS signal to the digital processor.

2.39 The digital processor provides the processing power required to track the satellites, position the receiver, then derive an ensemble-averaged timing correction to the phase-locked loop subsystem.

2.40 The phase-locked loop subsystem provides a time lock to GPS by locking a local oscillator to the digitally processed GPS signals.

2.41 The encoder takes the GTR information, and Manchester-encodes the clocking signals and any data messages to the GTI.

2.42 For leap second capabilities, the GTR uses an algorithm that transmits a “leap second pending” message twice a year (end of July and December) for 2 months.

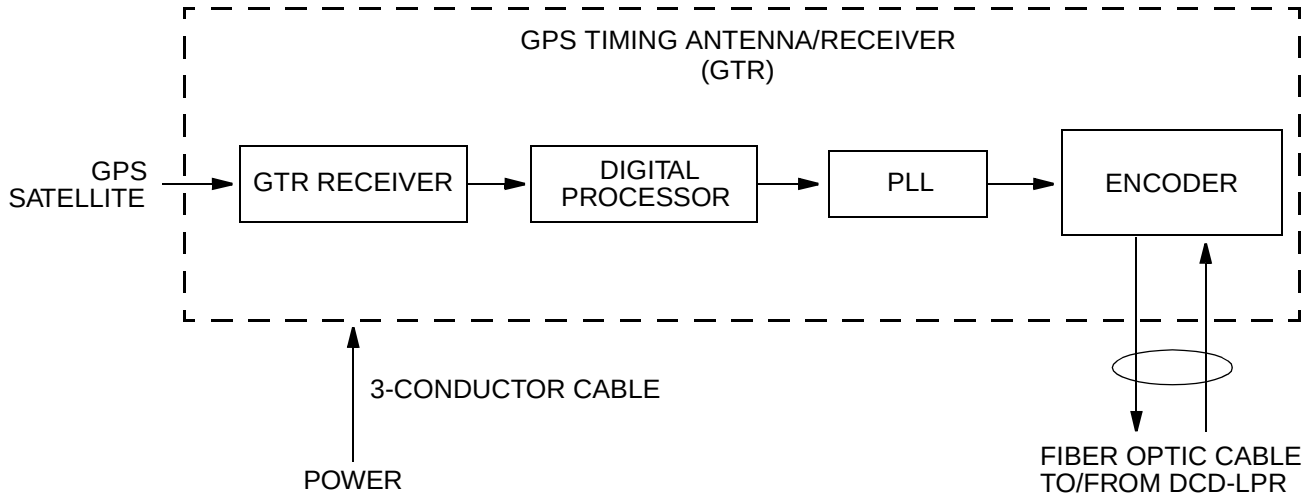


Figure 2. GTR Block Diagram

G. LORAN-C Antenna

2.43 The LORAN-C antenna is designed to work with the LTI (do not attempt to use an antenna from another source). It is a 2.4 meter (8 foot), whip (omnidirectional) antenna. The preamplifier at the base of the antenna is powered by the DCD-LPR via the twinax cable.

3. CARD DESCRIPTION

A. GTI Card

3.01 The GTI card forms the link to the roof-mounted GPS Timing Antenna/Receiver (GTR). The GTI card takes the GPS signal information from the GTR, and, using the oscillator inputs from a DCD-500 Series Shelf or DCD-Cs Shelf, performs an ensemble-averaged timed correction to provide the outputs.

3.02 GTI-11, GTI-13, GTI-15, and GTI-17 cards provide a T1 output frequency of 1.544 Mb/s. GTI-12, GTI-14, and GTI-16 cards provide an E1 output frequency of 2.048 Mb/s. The GTI-18 card provides an E1 output frequency of 2.048 Mb/s, selectable via TL1 command. In addition, framing formats are switch-selectable.

3.03 Figure 3 shows a simplified block diagram of how the GTI card works with the DCD Shelf. Figure 4 shows how the GTI card works with the LOU card to provide output timing to the DCD Shelf. Communication between the GTI card and the GTR is accomplished through a fiber optic link.

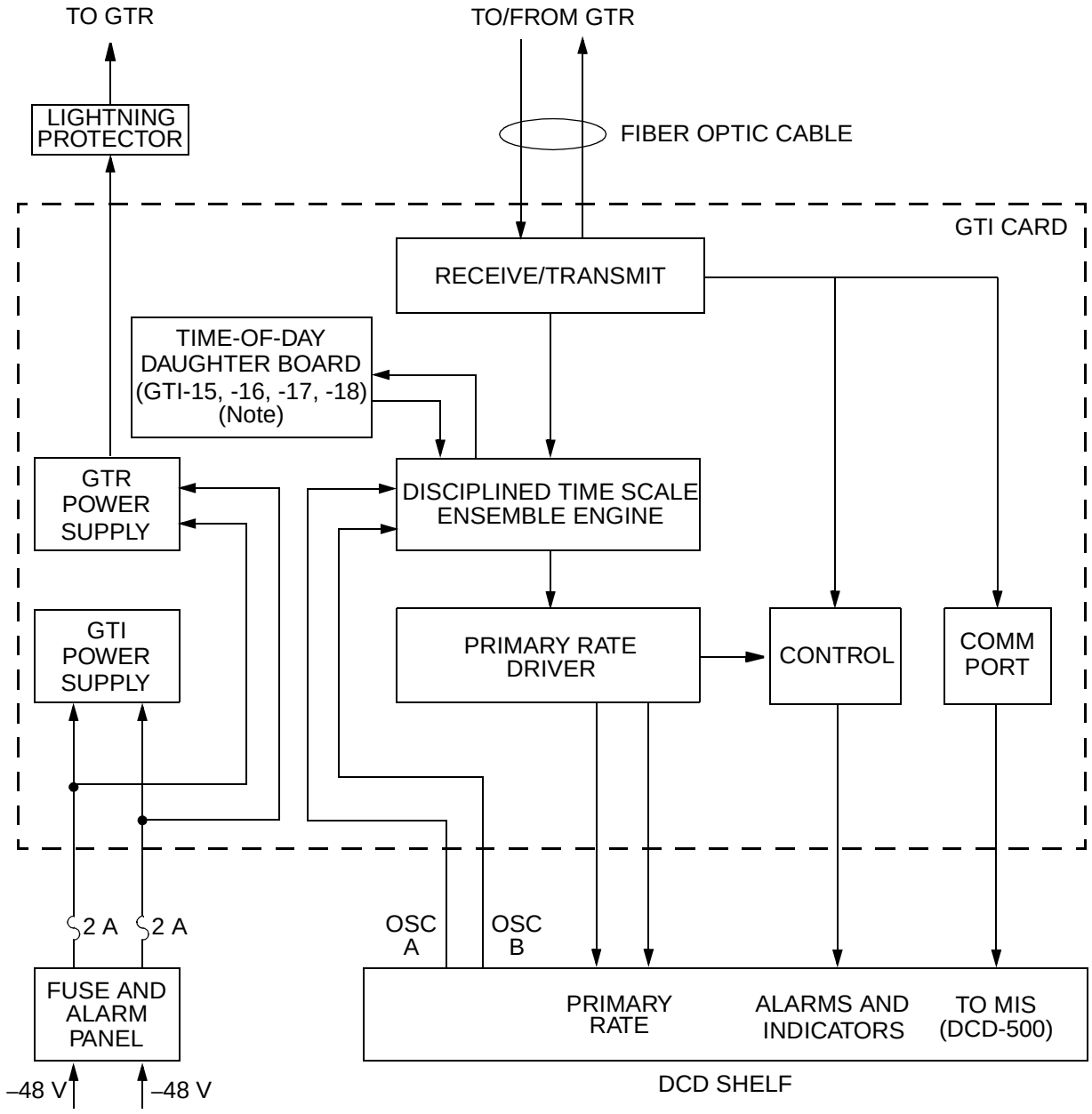
3.04 Information from the GTR is sent to a fiber optic receiver/transmitter in the GTI card. The transmitter and receiver are incorporated on the I/O module located on the DCD-LPR Shelf backplane. A lamp on the module lights green to indicate that a 4 kHz signal from the GTR is present.

3.05 The receiver accepts the GPS signal information from the GTR and sends it to an ensemble engine.

3.06 The GTI card ensemble averages the signal, using the oscillator inputs (from the DCD Shelf), or, inputs from a 10 MHz external source, and performs time correction. The corrected signal is sent to output drivers to provide the outputs to the timing output cards.

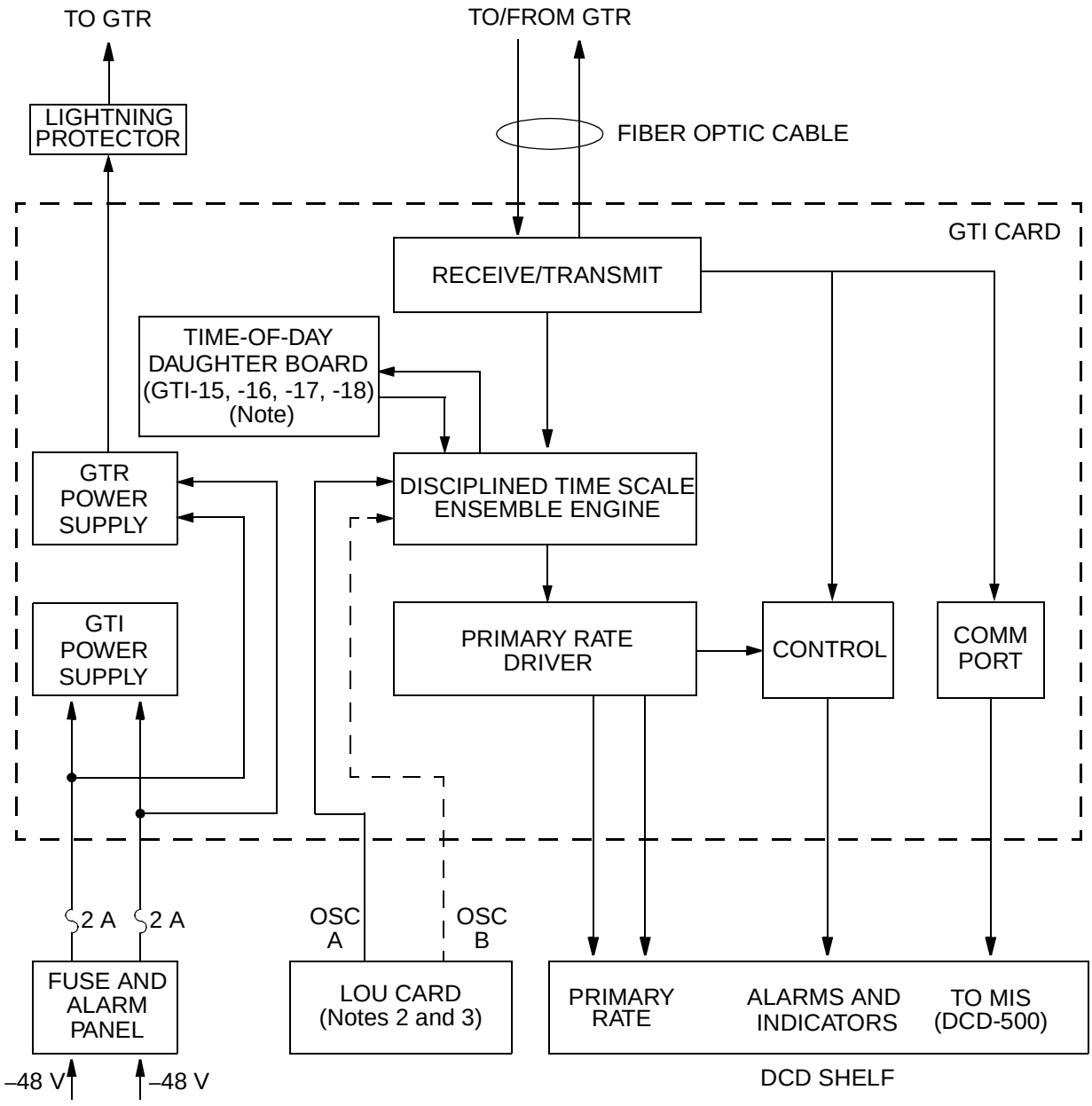
3.07 On power-up, the GTI card output is AIS or squelched (user selectable). This condition persists until the GTI card has qualified all the GPS inputs, correlated its position, and is ready for PRS operation. At this point, the GTI card will have entered "GTI LOCK" and now outputs a valid DS1 or E1 output synchronization signal.

3.08 Typically, the GTI card sends an AIS signal or squelches the output (user selectable) when a major alarm is raised, e.g., loss of all inputs—both oscillators, and the GTR signal. All alarm and status messages are displayed in the LCD display, and the status pushbutton on the front panel is used to step through the LCD display screens to display time and status information.



Note: See Figure 5 for a diagram of the TOD system.

Figure 3. GTI Card Block Diagram (without LOU Card)



Notes:

1. See Figure 5 for a diagram of the TOD system.
2. In the LOU-1 card, there is only one oscillator, but provides 2 parallel outputs.
3. In the LOU-2 card, both oscillators are active, but only one oscillator at a time provides timing; oscillator A is the primary source; oscillato rB provides timing only when A has failed.

Figure 4. GTI Card Block Diagram (with LOU Card)

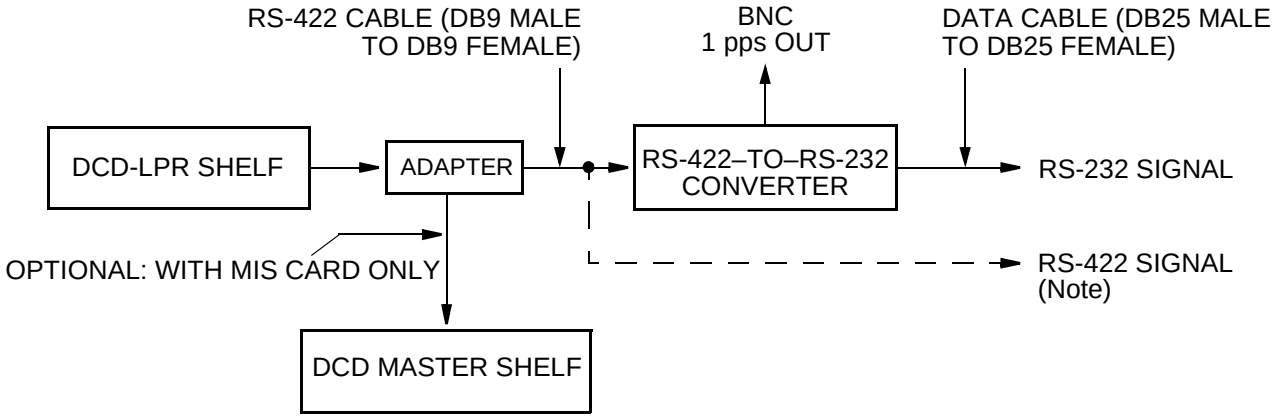
Time-of-Day

3.09 The GTI-15, GTI-16, GTI-17, and GTI-18 cards include the Time-of-Day (TOD) feature. These cards are similar to the GTI-13 and GTI-14 cards, with the following exceptions:

- An additional set of configuration switches on the GTI card daughter board are provided to set alarm integration for TOD alarms, baud rate, and TOD message formatting

3.10 The TOD engine and accompanying software produce a TOD output stream on the TOD ribbon cable connectors which are routed to the adapter. There are two RS-422 outputs from the adapter: one for GTI-1 and the other for GTI-2. If required, an RS-422–to–RS-232 converter can be added to provide an RS-232 signal (Figure 5).

3.11 The TOD engine uses the synchronization input signals from the GTR as a reference from which the output signal is generated. The synthesizer inputs provide a stable reference which is not phase-locked to the GTR in the short term. The GTR signal gives the approximate position of the 1 second mark in time. Using these signals, the phase measurement circuitry in the TOD engine, and the GTI phase measurements, the TOD engine can control the output phase to track the long-term average of the GTR signal.



Note: RS-422–to–RS-232 converter not required for RS-422 signal.

Figure 5. Time-of-Day System

3.12 The TOD output at the adapter is user selectable as either a Cisco Systems proprietary TOD signal, or an NTP Type 4 signal (see Table C for signal specifications).

SSM

3.13 GTI-17 and GTI-18 cards are SSM capable. SSM messages are transmitted continuously until there is a state change determined by the GTI card. Also, the user can assign output messages by TL1 command. For details on TL1 commands, refer to the TL1 User's Guide provided with the MIS card.

B. LTI Card

3.14 The LTI card forms the link to the roof-mounted LORAN-C antenna. The LTI card takes the LORAN-C signal information, and, using the DCD oscillator (rubidium only) inputs from the DCD-ST2,

DCD-419, or DCD-500 Series Shelf, performs an ensemble-averaged timed correction to provide the outputs.

LTI Card Outputs

3.15 The LTI card outputs two primary rate T1 timing references of 1.544 Mb/s which are passed to the inputs of DCD-ST2, DCD-419, or DCD-500 Series Shelf. In addition, framing formats are switch-selectable.

3.16 On power-up, the LTI card outputs either an AIS signal, or the output is squelched, depending on the user-configured setting. This condition persists until the LTI card has qualified all the LORAN-C inputs, correlated its position, and is ready for PRS operation. At this point, the LTI card will have entered "LTI LOCK" and outputs a valid framed all-ones output signal.

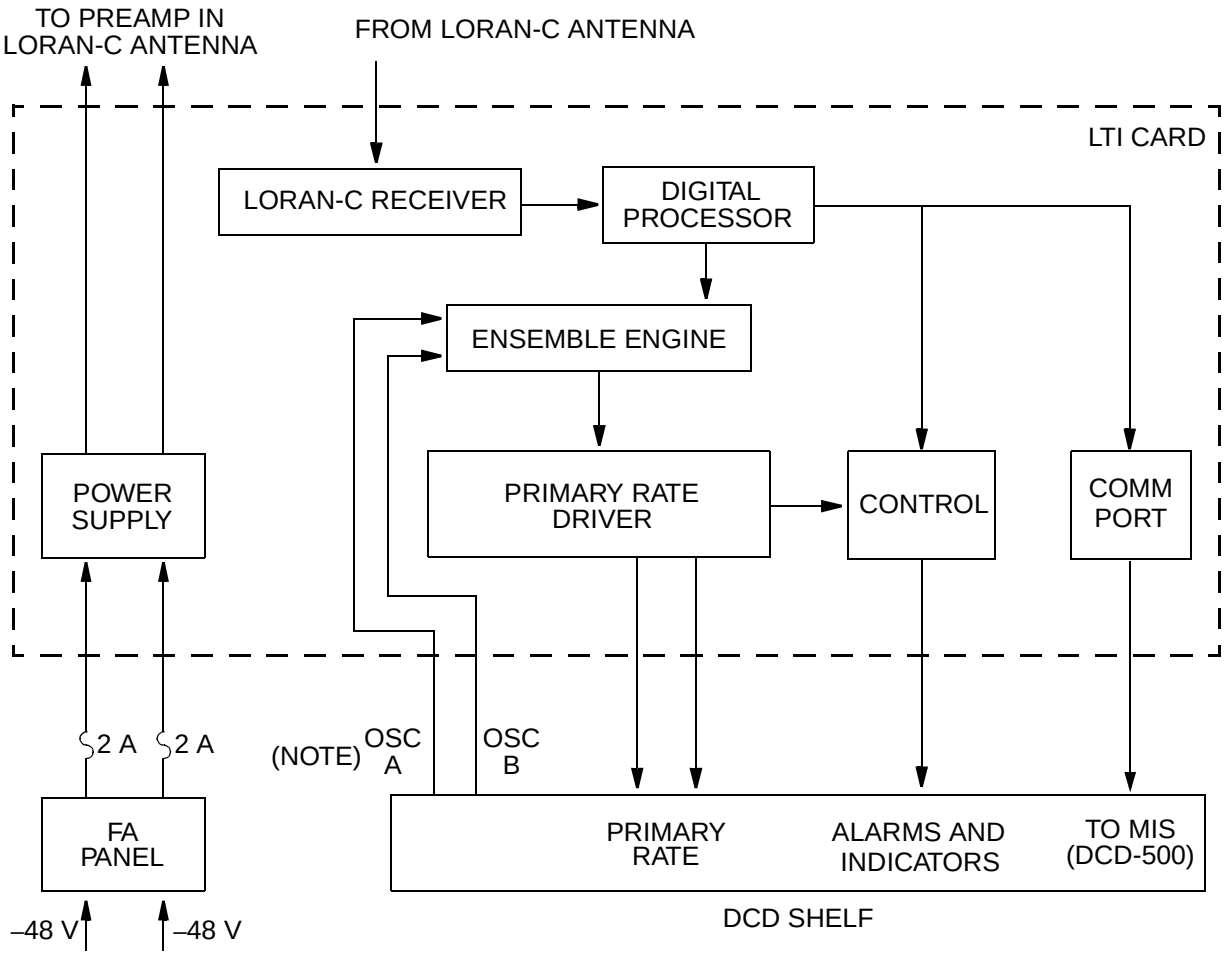
3.17 The LTI card will only output AIS or squelch the output when a major alarm is raised, e.g., loss of all inputs—both DCD oscillators.

3.18 Figure 6 shows a simplified block diagram of how the LTI card works. Communication between the LTI card and LORAN antenna is accomplished through a twinax cable.

3.19 The receiver provides filtering and amplification of the LORAN-C signal to the digital processor.

3.20 The digital processor provides the processing power required to lock to a station, and sends the frequency and phase information to a phase-locked loop subsystem in the ensemble engine.

3.21 All alarm and status messages are displayed in the LCD display, and the pushbuttons on the front panel are used to step through the LCD display screens to display time and status information.



NOTE: From rubidium or better quality oscillators only.

Figure 6. LTI Card Block Diagram

C. LOU Card

3.22 The LOU card is typically used in applications requiring an upgrade to the existing system (e.g., upgrading a DCD Shelf equipped with an ST3 or TNC to PRS level), or if connecting to a BITS from a manufacturer other than Symmetricom. When used with a DCD Shelf, the LOU card can be used as timing reference sources to the GTI card to provide office PRS timing, as specified by the Telcordia document GR2830.

3.23 The GTI card takes the GPS signal information from the GTR and the uncorrected oscillator input from the LOU card, and sends the signal to an output driver to provide the outputs to the timing output cards.

3.24 Two LOU cards are available: LOU-1 and LOU-2 (Figure 7 and Figure 8). The LOU-1 card contains one oscillator with two parallel outputs, and the LOU-2 card contains two active oscillators, but only one oscillator at a time provides timing.

3.25 If using the LOU-2 card, oscillator A is the preferred clock. Oscillator B becomes the preferred clock only if oscillator A fails.

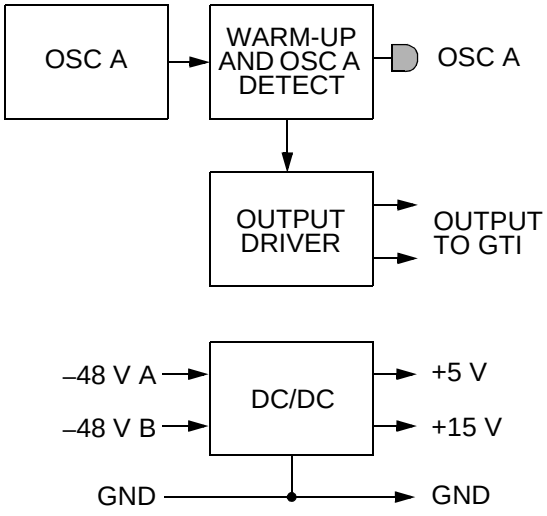


Figure 7. LOU-1 Block Diagram

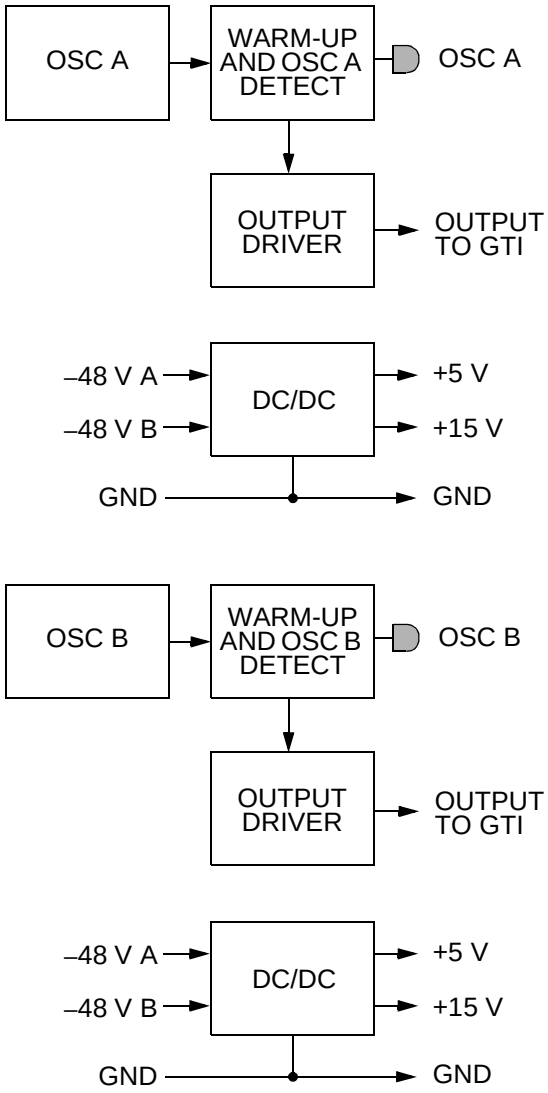


Figure 8. LOU-2 Block Diagram

3.26 If the oscillator fails in the LOU-1 card, a lamp lights to indicate failure. If one of the oscillators fails in the LOU-2 card, the other oscillator provides timing. Fault tolerance is achieved by using the redundant oscillators. If both oscillators fail in the LOU-2 card, or the oscillator in LOU-1 card fails, the DCD-LPR will defer to a degraded mask output, as specified by the Telcordia document GR2830.

4. SPECIFICATIONS

4.01 The DCD-LPR System specifications are listed in Table C.

Table C. DCD-LPR System Specifications

<table>
<tr><th>ITEM</th><th>SPECIFICATION</th></tr>
<tr><td colspan="2">DCD-LPR SYSTEM</td></tr>
<tr><td>Sensitivity</td><td>Locks with signal-to-atmospheric noise level of –10 dB or better</td></tr>
<tr><td>Performance</td><td>
<table>
<tr><th rowspan="2">Observation Time MTIE (sec.)</th><th colspan="2">MTIE</th></tr>
<tr><th>TNC-E, ST2, ST2E @ 25 °C (72 °F)</th><th>ST3E, TNC, LNC, LOU-1, LOU-2 @ 25 °C (72 °F)</th></tr>
<tr><td>1</td><td>8 ns</td><td>8 ns</td></tr>
<tr><td>10</td><td>10 ns</td><td>10 ns</td></tr>
<tr><td>100</td><td>10 ns</td><td>10 ns</td></tr>
<tr><td>1000</td><td>30 ns</td><td>60 ns</td></tr>
<tr><td>10000</td><td>100 ns</td><td>200 ns</td></tr>
<tr><td>100000</td><td>100 ns</td><td>600 ns</td></tr>
</table>
</td></tr>
<tr><td>Inputs</td><td>The GTI-11 card accepts 5 MHz or 10 MHz from rubidium or better quality clock cards, from ST2E or ST2 clock cards; the GTI-12 accepts 5 MHz or 10 MHz rubidium or better quality clock cards, from TNC-E clock cards; the GTI-13, GTI-14, GTI-15, GTI-16, GTI-17, and GTI-18 cards accept 5 MHz or 10 MHz inputs from quartz, rubidium, or better quality clock cards, or combinations of the two clock types, or LOU card; the LTI card accepts 5 MHz from rubidium clocks, from ST2E or ST2 clock cards only.</td></tr>
<tr><td>Outputs</td><td>The GTI-13, -15, and -17 provide 2 outputs: 1.544 Mb/s DS1, framed all-ones, Superframe (D4) format or ESF
The GTI-12, -14, -16, and -18 provide 2 outputs: 2.048 Mb/s E1, framed all-ones CCS/CAS</td></tr>
</table>

Table C. DCD-LPR System Specifications (Cont'd)

ITEM	SPECIFICATION
DCD-LPR SHELF	
Alarm Output Audible and Visible	
Major	Activates if power is lost on GTI/LTI card or if any major alarm condition exists on the GTI/LTI card (e.g., loss of all inputs, or GTI/LTI card has failed)
Minor	Activates if any minor alarm condition exists on the GTI/LTI card (e.g., a single blown fuse or loss of a single input)
Status (VIS only)	Not used
Type	Dry contact
Format	Normally open and normally closed
Contact Rating	1.0 A @ 56 V dc, 0.6 A @ 125 V ac
Power	
Voltage	–40 V dc to –56 V dc
Current	Minimum 1 A
Shelf Fuses	2 A
Power Source Fuses	3 A
Environmental	
Operating Temperature	0 °C to +45 °C
Operating Humidity	0 % to 95%, noncondensing
Dimensions (HxWxD)	13.3 cm (5.25 in.) (3 RU) x 48.3 cm (19.0 in.) x 27.9 cm (11.0 in.) overall
Note: If mounting above equipment that produces heat, leave an additional 1 RU (4.4 cm [1.75 in.]) beneath the shelf for air flow.	

Table C. DCD-LPR System Specifications (Cont'd)

ITEM	SPECIFICATION
GTI-11, GTI-12, GTI-13, GTI-14, GTI-15, GTI-16 CARDS	
Input Type	GTI-11 accepts rubidium or better quality, ST2E or ST2 cards only GTI-12 accepts rubidium or better quality, TNC-E cards only GTI-13, GTI-14, GTI-15, and GTI-16 accept 5 MHz or 10 MHz inputs from quartz, rubidium, or better quality clocks, or combinations of the two clock types, or LOU card
Output Frequency	GTI-11, GTI-13, and GTI-15: 1.544 Mb/s (DS1), framed all-ones GTI-12, GTI-14, and GTI-16: 2.048 Mb/s (E1), framed all-ones
Framing Format - Switch-selectable	GTI-11, GTI-13, and GTI-15: ESF or D4 (SF) GTI-12, GTI-14, and GTI-16: CCS/CAS, with or without CCS4
Environmental Operating Temp Operating Humidity	 0 °C to +45 °C 0 to 95%, noncondensing
Dimensions (HxWxD)	4.92 cm (1.9375 in.) x 35.08 cm (13.8125 in.) x 19.37 cm (7.625 in.)
SSM Capable	No
GTI-17, GTI-18 CARDS	
Input Type	Accept 5 MHz or 10 MHz inputs from quartz, rubidium, or better quality clocks, or combinations of the two clock types, or LOU card
Output Frequency	GTI-17: 1.544 Mb/s (DS1), framed all-ones GTI-18: 2.048 Mb/s (E1), framed all-ones
Framing Format - Switch-selectable	GTI-17: ESF or D4 GTI-18: CCS/CAS, with or without CCS4
Environmental Operating Temp Operating Humidity	 0 °C to +45 °C 0 to 95%, noncondensing
Dimensions (HxWxD)	4.92 cm (1.9375 in.) x 35.08 cm (13.8125 in.) x 19.37 cm (7.625 in.)
SSM Capable	Yes
Note: For details on TL1 commands, refer to the TL1 User's Guide provided with the MIS card.	
LTI CARD	
Input Type	LTI accepts 5 MHz inputs from ST2E or ST2 cards only
Environmental Operating Temp Operating Humidity	 0 °C to +45 °C 0 to 95%, noncondensing
Dimensions (HxWxD)	4.92 cm (1.9375 in.) x 35.08 cm (13.8125 in.) x 19.37 cm (7.625 in.)
SSM Capable	No

Table C. DCD-LPR System Specifications (Cont'd)

ITEM	SPECIFICATION	
	SSM	
E1 System Quality Levels	Quality Level	Meaning
	PRC	Primary Reference Clock
	DNU	Do not use or idle code (no SSM message)
	UNK	Unknown
T1 System Quality Levels	Quality Level	Meaning
	PRS	Primary Reference Source
	STU	Synchronized – Traceability Unknown

Table C. DCD-LPR System Specifications (Cont'd)

ITEM	SPECIFICATION
TIME-OF-DAY (Optional)	
Data Signal	
Baud Rate	9600 b/s
Format	8 data bits, no parity, 1 start/stop bit
Physical/Electrical	Output of Adapter: Physical: DB9, female Electrical: RS-422 Output of Converter (optional): Physical: DB25, female Electrical: RS-232
Data Format	Cisco Systems: Time format: Year/month/day, hour:minute:second Alarm fields: Alarm severity, source, and cause where the TOD alarm codes are defined as follows: Alarm severity: NR = non-reporting MN = minor alarm MJ = major alarm Alarm source: TOD = TOD output card GTI = GTI CK1 = Clock 1 CK2 = Clock 2 PW1 = primary power feed PW2 = secondary power feed GTR = GTR GPS = GPS satellites Alarm cause: ACQ = acquiring UNL = unlocked FLT = fault LOS = loss NTP Type 4: Time format: Year Julian-date hour:minute:second:millisecond Alarm fields: First character, sp = insync, ? = out of sync
1 pps Signal	
Pulse Width	800 µs
Valid Edge	Rising
Accuracy	<1 µs compared to UTC
Physical/Electrical	Output of Adapter: Physical: DB9, female Electrical: RS-422 Output of Converter (optional), DB25: Physical: DB25, female Electrical: RS-232 Output of Converter (optional), BNC: Physical: BNC Electrical: TTL

Table C. DCD-LPR System Specifications (Cont'd)

ITEM	SPECIFICATION
LOU CARDS (LOU-1, LOU-2)	
Source	LOU-1, one oven-controlled crystal oscillator; LOU-2, two oven-controlled crystal oscillators
Accuracy 24 hours 20 years	 3.0×10^{-10} 1.0×10^{-6}
Warm-up Time	30 min
Environmental Operating Temp Operating Humidity	 0 °C to +45 °C 0 to 95%, noncondensing
Dimensions (HxWxD)	4.92 cm (1.9375 in.) x 35.08 cm (13.8125 in.) x 19.37 cm (7.625 in.)
BLANK PANEL	
Dimensions (HxWxD)	4.92 cm (1.9375 in.) x 35.08 cm (13.8125 in.) x 7.93 cm (3.125 in.)
ANTENNA/RECEIVER (GTR)	
Type	Stable phase centered active patch
Power	16 to 32 V dc at 6.5 W
Fiber cable wave length	850 nm
Power cable between GTR and power source	Minimum 242.7 m (minimum 1,200 ft) with GTI card providing power Minimum 242.7 m (minimum 1,200 ft) with an external power source
Cable types	For single lightning protector installations: one shielded 3-conductor cable, 1.47 mm (16 AWG) with a 1.47 mm (16 AWG) built-in drain wire and one shielded 3-conductor cable, 1.47 mm (16 AWG) For dual lightning protectors: two shielded 3-conductor cables, 1.47 mm (16 AWG), with a 1.47 mm (16 AWG) built-in drain wire; and one shielded 3-conductor cable, 1.47 mm (16 AWG) 200 µ multimode fiber optic cables to connect the GTR to the DCD-LPR Shelf.
Environmental (GTR) Operating Temp Storage Temp Relative Humidity	 Operating: –40 °C to +70 °C (cannot be started at temperatures below –20 °C) Storage: –50 °C to +100 °C Up to 100%
Dimensions	29.8 cm (11.75 in.) diameter; 16.5 cm (6.5 in.) total height

Table C. DCD-LPR System Specifications (Cont'd)

ITEM	SPECIFICATION
LORAN-C ANTENNA	
Type	Active whip
Preamp	FET type, bandpass filter, powered from receiver
Cable types	Type 1 Lightning Protectors For single lightning protector: two twinax cables, RG-108A (or equivalent) as plenum-rated cables are required. One cable must have TROMPETER TWINAX BNC connector plugs #PL30-55 (or equivalent) on both ends; one cable must have a TROMPETER TWINAX BNC connector plug #PL30-55 (or equivalent) on one end, and a spade lug connector to fit 1.02 mm (18 AWG) wire, 6.35 mm (0.25 in.) wide, and fit to a #6 stud on the other end. For dual lightning protectors: three twinax cables, RG-108A (or equivalent) as plenum-rated cables are required. Two cables must have TROMPETER TWINAX BNC connector plugs #PL30-55 (or equivalent) on both ends; one cable must have a TROMPETER TWINAX BNC connector plug #PL30-55 (or equivalent) on one end, and a spade lug connector to fit 1.02 mm (18 AWG) wire, 6.35 mm (0.25 in.) wide, and fit to a #6 stud on the other end.
	Type 2 Lightning Protectors For single lightning protector: two twinax cables, RG-108A (or equivalent) as plenum-rated cables are required. One cable must have a TROMPETER TWINAX BNC connector plug #PL30-55 (or equivalent) on one end, and a spade lug connector to fit 1.02 mm (18 AWG) wire, 6.35 mm (0.25 in.) wide, and fit to a #6 stud on the other end; one cable must have a spade lug connector to fit 1.02 mm (18 AWG) wire, 6.35 mm (0.25 in.) wide, and fit to a #6 stud on both ends. For dual lightning protectors: three twinax cables, RG-108A (or equivalent) as plenum-rated cables are required. One cable must have a TROMPETER TWINAX BNC connector plug #PL30-55 (or equivalent) on one end, and a spade lug connector to fit 1.02 mm (18 AWG) wire, 6.35 mm (0.25 in.) wide, and fit to a #6 stud on the other end; two cables must have a spade lug connector to fit 1.02 mm (18 AWG) wire, 6.35 mm (0.25 in.) wide, and fit to a #6 stud on both ends.
Distance between antenna and LTI	Minimum 1,219 m (minimum 4,000 ft)
Environmental Operating Temp Storage Temp Relative Humidity	 –40 °C to +70 °C (cannot be started at temperatures below -25 °C) –50 °C to +100 °C Up to 100%
Dimensions (Height)	3.3 m (10.5 ft) overall (2.4 m [8 ft] antenna, 178 mm [7 in.] conduit-T, 0.6 m [2 ft] pipe section)

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