DIGITAL CLOCK DISTRIBUTOR

DCD-400, DCD-ST2, AND DCD-CIM

GENERAL DESCRIPTION AND SPECIFICATIONS

CONTENTS PAGE

Figures

Tables Page

1. GENERAL

1.01 This practice provides descriptions, specifications, and typical applications for the Digital Clock Distributor (DCD) family of products.

1.02 This practice has been reissued due to editorial changes. No change bars are used.

1.03 Information common to the DCD-ST2 and DCD-400 Systems is referenced as “DCD”. The DCD-ST2 is referred to as the “ST2” System, and the DCD-400 as the “400” System. Information unique to the DCD-CIM System is referenced as “CIM”. Unless otherwise specified by direct reference, other information is common to all systems.

1.04 The Synchronization Monitor System (SMS) may be installed in the DCD Systems to implement DS1 performance monitoring. For details regarding the installation and operation of the SMS option, including the Communications Unit (CMU) and Synchronization Monitor Unit (SMU) cards, refer to TMSL 097-40000-11, and TMSL 097-40000-12.

1.05 The optional Maintenance Interface (MI) card provides an enhanced local and remote monitoring

interface. The MI card works in conjunction with an Alarm Interface Adapter (AIA) card to connect alarm inputs from the expansion shelves and clock status leads from the DCD shelf to the MI card. The AIA also provides an RS-232 communications port. Refer to TMSL 097-40000-26 for details regarding the installation and operation of the MI and AIA cards.

1.06 The optional SCIU Alarm and Monitoring (SAM) card provides a monitoring function to alert office personnel of removed SCIU cards that may affect customer service.

1.07 The following abbreviations are used in this document:

ACO	Alarm cutoff
ACI	Analog Clock Input card
AI	Alarm Interface card
AIS	Alarm Indication Signal
APS	Automatic protection switching
B8ZS	Bipolar with 8 Zero Substitution
BITS	Building Integrated Timing Supply
CC	Composite Clock card
CI	Clock Input card
CIM	Clock Insertion and Monitor System
CMU	Communications Unit
COFA	Change of Frame Alignment
CPE	Customer Premises Equipment
D4	DS1 Superframe format
DCD	Digital Clock Distributor
DCS	Digital Cross-connect System
DDS	Digital Data System
DS1	Digital Signal, level 1 (1.544 Mb/s)
DSX-1	Digital Cross-connect level 1
ESF	Extended Superframe format
FA	Fuse and Alarm card
FDM	Frequency division multiplex
HS	Hot spare card
LOS	Loss of signal
LPR-L3	Local Primary Reference-Loran 3
MCA	Matrix Controller Automatic card
MCA-2	Matrix Controller Automatic-2 card
MI	Maintenance Interface card
MTIE	Maximum Time Interval Error
NE	Network Element
OOF	Out of frame
PBX	Private Branch Exchange
RTZ	Return-to-zero
SCIU	Synchronous Clock Insertion Unit card
SMS	Synchronization Monitor System
SMU	Synchronization Monitor Unit
SONET	Synchronous Optical Network
ST2	Stratum-2 clock
ST2E	Enhanced Stratum-2 clock
ST3	Stratum-3 clock
ST3E	Enhanced Stratum-3 clock
TIE	Time Interval Error
TOxA	Timing Output card
TOAA	Timing Output Analog Automatic card
TOCA	Timing Output Composite Clock Automatic card
TOLA	Timing Output Logic Level Automatic card
TOTA	Timing Output DS1 Automatic card
TSG	Timing Signal Generator

2. INTRODUCTION

2.01 The Digital Clock Distributor (DCD) system provides a means of implementing the Building Integrated Timing Supply (BITS) concept within a building containing telecommunications digital equipment connected to the telecommunications digital network. The BITS concept advocates the establishment of a single master timing supply per administrative building, which provides a common clock source for frequency and phase synchronization to network elements (NE) necessary for digital cross-connectivity and transport.

2.02 The BITS has the highest quality clock within a building. It is directly referenced from a Stratum-1 local primary reference (LPR) or an upstream Stratum-1 via the interoffice synchronization distribution network. The BITS distributes all timing (frequency and phase) required by other clocks within that building.

2.03 The stratum clock cards within the DCD master shelf provide long-term averaging of the input reference to the DCD. If the input is disrupted or is out of tolerance, the DCD clock cards provide the necessary bridge in timing (holdover) and allows the network to continue to operate slip-free for several hours or days depending on the stratum quality of the clock cards installed.

2.04 The DCD regenerates a clocking signal from its input reference and buffers the short term timing variations, and generates a variety of output signals required by the NEs, e.g., framed all-ones DS1, 64 kb/s composite clock (CC), various analog frequencies, and various RS-422/RS-423/RS-232 frequencies. NEs timed from the DCD system permits unrestricted DS0 cross-connection between NEs.

2.05 The output cards of the DCD system provide distribution of timing signals for channel banks, digital switches, digital loop carrier (DLC), digital cross-connect systems (DCS), SONET OC-n terminals, ISDN equipment, digital radio, FDM carrier, PBX systems and other devices that interconnect with the telecommunications digital network.

2.06 The DCD system when equipped with Stratum-2 clock cards can accept input references from Telecom Solutions DCD-LPR (Local Primary Reference) system equipped with a GPS (Global Positioning System) and/or LORAN-C receivers traceable to Universal Coordinated Time (UTC). The combination of the DCD and DCD-LPR provide a local Stratum-1 source.

3. DESCRIPTION

3.01 The DCD system consists of the DCD-ST2, DCD-400 and DCD-CIM shelves and various input, clock, output, output protection switching and alarms cards. The shelves may be installed as a master shelf or as expansion shelves. A full system of a master and three expansion shelves has either 34 (DCD-ST2 master) or 40 output card slots capable of up to 340 (DCD-ST2 master) or 400 timing output signals. The system is modular design and permits incremental growth of a shelf and/or an output card at a time.

A. Master Shelf

3.02 All DCD systems must have a master shelf equipped with an output panel. The master shelf accepts input references, contains the clock cards, and provides clocking to the expansion shelves. It also contains timing outputs, output protection switching, and alarm and maintenance interfaces.

3.03 If unprotected outputs are desired, or if the shelf is to be equipped with only synchronous clock insertion (SCIU) cards, then output protection cards (hot standby cards and MCA/MCA-2) should not be installed. All TOx (x = 1 to 10), HS TOC and HS TOT card slots can be cabled as unprotected output slots.

B. Input Reference Signals

3.04 Input signals are arranged in pairs and designated A (primary) and B (secondary). Input reference signals can be:

- DS1 from an upstream Stratum-1 reference or LPR-L3
- Composite clock (CC) from an existing office clock
- 16.384-MHz composite clock from a #4ESS digital switch
- 2.048 MHz from a DACS II

3.05 For ST2 or ST2E clocks, the incoming DS1 reference *must* be of Stratum-2 or better quality. For ST-3 or ST-3E clocks, the reference *must* be of Stratum-3 or better quality, as defined in ANSI-T1-101.

3.06 DS1 or CC input reference signals can be accepted by the CI card.

3.07 Input reference signals from the DSX-1 to the DCD can be terminated in 100 ohms (–20 dB signals) or bridged (0 dB signals) by the built-in bridging repeater in the CI card. This allows the system to be located up to 655 feet from the DSX-1. CC input reference signals to the DCD are terminated in 133 ohms.

C. DCD-ST2 and DCD-400

3.08 The ST2 operates at Stratum-2, Stratum-2E, Stratum-3, or Stratum-3E stability, and the 400 at Stratum-3 or Stratum-3E stability. In freerun or holdover modes, either unit can act as the office clock in a BITS environment or as a free-running clock source.

3.09 Up to three expansion shelves can be installed in the ST2 or 400; the 400 can be used as an expansion shelf for the 400 and the ST2 master shelves; the ST2 cannot be used as an expansion shelf.

System Components

3.10 The ST2 and 400 Systems consist of a master shelf with any combination of the following cards:

- AI card for the ST2, or FA card for the 400
- Two CI or ACI cards
- Two stratum clock cards (ST2E, ST2, ST3E, or ST3 for the DCD-ST2; ST3E or ST3 for the DCD-400).
- Output cards, including:
  - Timing Output cards (TOAA, TOCA TOLA, TOTA)
  - Synchronous Clock Insertion card (SCIU)
  - Synchronization Monitor card (SMU)

Output Protection cards:

- Hot Standby cards (TOAA, TOCA, TOLA, TOTA)
- Matrix Controller card (MCA, MCA-2)

Timing Output Signals

3.11 The number and types of timing output signals are determined by the number and types of TOxA cards installed. TOxA cards may be used with all DCD Systems in any combination of the following:

- TOCA: Composite Clock (CC)
- TOTA: DS1 (framed all-ones)
- TOAA: Analog (sine wave)
- TOLA: RS-422/RS-232/RS-423 (TTL)

3.12 For retiming DS1 systems, SCIU cards may be used with the DCD System. In the DCD System, SCIU cards are installed in the TO card slots.

Input and Output Protection

3.13 Redundant clock input (CI or ACI) cards and ST cards provide synchronization input protection by giving the TOxA cards a choice of four prioritized timing references from which to automatically select.

3.14 Output protection is accomplished by using TOxA cards as Hot Spare (HS) cards. An HS card may be switched into service manually using the pushbuttons mounted above the master shelf or expansion shelf card cage. Both manual and automatic protection switching are under the control of the Matrix Controller Automatic (MCA or MCA-2) card.

> ***Note:*** There are two versions of the Matrix Controller Automatic card: the MCA and the MCA-2. In this document, information common to the MCA and MCA-2 is referenced as Matrix Controller card. Information unique to a specific card is referenced as the name of the card (MCA or MCA-2).

D. DCD-CIM

3.15 The CIM System uses SCIU cards to insert office synchronization on incoming or outgoing DS1 facilities. Each SCIU card retimes and retransmits a bidirectional DS1 signal at DSX-1 levels. The SCIU performs the retiming function on the A direction only. The DS1 B direction is passed through the SCIU.

3.16 By imposing office timing on a facility, the SCIU effectively isolates the office from incoming or outgoing transmission impairment, such as jitter and wander. This mitigates the effects of intervening clocks in the timing chain. Additionally, the SCIU al-

lows NEs without the capability of external synchronization to be timed within the BITS concept.

System Components

3.17 The CIM System can be configured in one of two ways:

a. Standalone (FA, 2 CI [or ACI], 2 ST3E or ST3, and up to 12 SCIU cards per shelf)

b. Expansion from an existing ST2 or 400 (FA or AI and up to 12 SCIU cards)

3.18 In the standalone configuration, the CIM System becomes the office (BITS) clock.

> ***Note:*** Using the CIM as a standalone system is not recommended; the CIM does not provide protection switching.

3.19 Up to three expansion shelves can be installed in the CIM standalone configuration, each shelf housing an FA card and up to 12 SCIUs (since SCIU cards are not protection-switchable, SCIU cards can be installed in HS slots #11 and #12).

DS1 Frame Slip Monitoring

3.20 When used for DS1 retiming, the SCIU provides frame slip and bit slip (preslip) indications in reference to the office clock. The position of the framing bit of the monitored signal is constantly compared to the position of the framing bit of the reference. A count of bit slips and frame slips is kept and displayed on the front panel lamps of the SCIU.

3.21 The SCIU can also be used in a slip-monitor-only mode. In this mode, the SCIU is bridged onto a DS1 via its high impedance interface.

DS1 Bypass Protection

3.22 Both A and B directions have bypass relays on the master shelf backplane (if specified). (If used, the Modular Mounting Panel with SCIU output will have bypass relays in the wire-wrap output kit [p/n 990-40011-10] or an SCIU wire-wrap terminal [p/n 990-40021-10]). In the event of an input reference failure, card failure, power loss, or if the SCIU is removed from the shelf, the DS1 signal is passed through unaffected. If the input is lost, an electronic bypass on the SCIU card is activated to pass the DS1 through.

E. System Expansion

3.23 The ST2, 400, and the CIM Systems are designed for modular growth. Up to three expansion shelves may be added to the master shelf, and TOxA or SCIU cards may be added as needed.

3.24 The ST2 and 400 master and expansion shelves can be connected to remote expansion systems. A remote expansion system consists of an expansion master shelf and up to three expansion shelves.

> ***Note:*** The CIM System cannot be used as a remote expansion system.

3.25 The remote expansion master shelf is equipped with two clock input cards to accept CC feeds from two different TOCA cards in the DCD master system. (ST cards are optional in the remote expansion master shelf.)

3.26 The quantity and type of cards that may be used in each shelf are listed in Table A. All cards are keyed to prevent improper installation. All types of TOxA cards and the SCIU cards can be mixed in the ST2 or 400 shelf. The CIM shelf houses only SCIU or SMU cards.

Table A. Card Quantities (Maximum)

CARD	MASTER SHELVES (Note 1)			EXPANSION SHELVES (Note 2)	
	DCD-ST2	DCD-400	DCD-CIM	DCD-400	DCD-CIM
AI Card (090-40014-02)	1				
FA Card (090-40014-01)		1	1	1	1
CI Card (090-40010-01)	2 (Note 3)	2 (Note 3)	2 (Note 4)		
ACI Card (090-40024-01)	2 (Notes 3 and 5)	2 (Notes 3 and 5)	2 (Note 4)		
ST2E Card (090-40017-02)	2 (Note 6)				
ST2 Card (090-40017-01)	2 (Note 6)				
ST3E Card (090-40019-01)	2 (Note 6)	2 (Note 6)	2 (Notes 1 & 4)		
ST3 Card (090-40013-01)	2 (Note 6)	2 (Note 6)	2 (Notes 1 & 4)		
TOxA Card(s) (Note 7)	4	10		10	
SCIU Card (090-40021-01)	4	10	12	10	12
Hot Spare TOxA Card (Note 8)	2	2		2	
MCA Card, (Note 8) 090-40015-02	1	1		1	
MCA-2 Card, (Note 8) 090-40015-03	1	1		1	

Notes:

1. Although the CIM can be used as a master shelf, it is not recommended. If used as a master shelf, the CIM does not provide protection switching.
2. Three expansion shelves are allowed per system. The DCD-400 and CIM shelves may be used as expansion shelves with any master shelf. The ST2 shelf may not be used as an expansion shelf.
3. A maximum of two (in any combination of CIs and ACIs) per master shelf.
4. CI or ACI cards and ST cards may be installed in the CIM master shelf for a standalone system configuration.
5. An ACI card is not required if an LPR-L3 is installed.
6. A maximum of two per master shelf. Must be matched sets, e.g., two ST2Es, two ST2s, two ST3Es, or two ST3s.
7. Output cards (TOxA) may be any of the following:
   TOCA Card 090-40011-02
   TOTA Card 090-40012-02
   TOAA Card 090-40022-01 or 090-40022-03
   TOLA Card 090-40023-01, -02, -03
8. The Matrix Controller card is required, along with one or two HS TOxA cards to implement manual or automatic protection switching.

3.27 Figure 1 shows the ST2 master shelf which houses common equipment (an AI card, CI or ACI cards, and ST2 cards), and up to four TOxA cards. A fully configured ST2 System (four shelves) holds up to 34 TOxA or SCIU cards, or combinations of each. The ST2 shelf cannot be used as an expansion shelf.

3.28 Figure 2 shows the 400 master shelf which houses common equipment (an FA card, CI or ACI cards, and ST3 cards), and up to 10 TOxA cards. This shelf can be used as an expansion shelf for ST2, 400, and CIM master shelves. A fully configured 400 System (4 shelves) holds up to 40 TOxA or SCIU cards, or combinations of both card types.

3.29 Figure 3 shows the CIM master shelf which houses common equipment (FA and CI or ACI cards). For standalone operation, ST3/3E cards may be added with up to 12 SCIU cards. A fully configured CIM System (four shelves) can hold up to 48 SCIU cards. The shelf can also be used as an expansion shelf for the ST2, 400, and CIM master shelves.

Note: Although the CIM can be used as a master shelf (in a standalone configuration), it is not recommended. The CIM does not provide protection switching.

3.30 Figure 4 shows a system configured with the maximum four shelves.

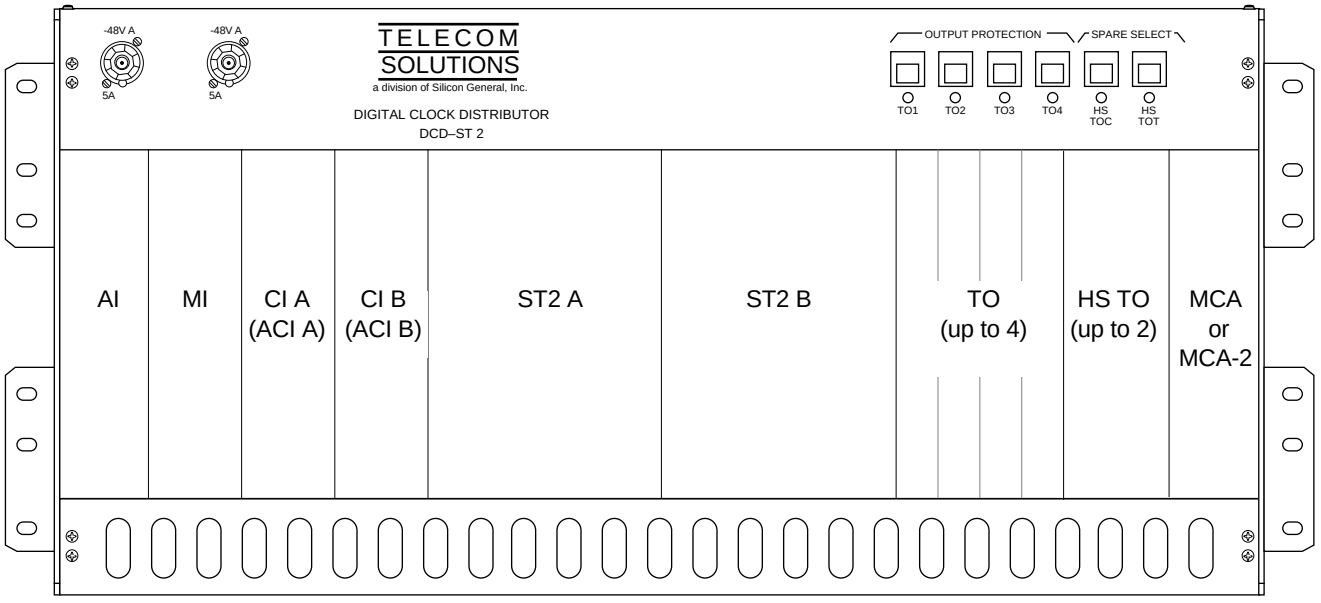


Figure 1. DCD-ST2 Master Shelf

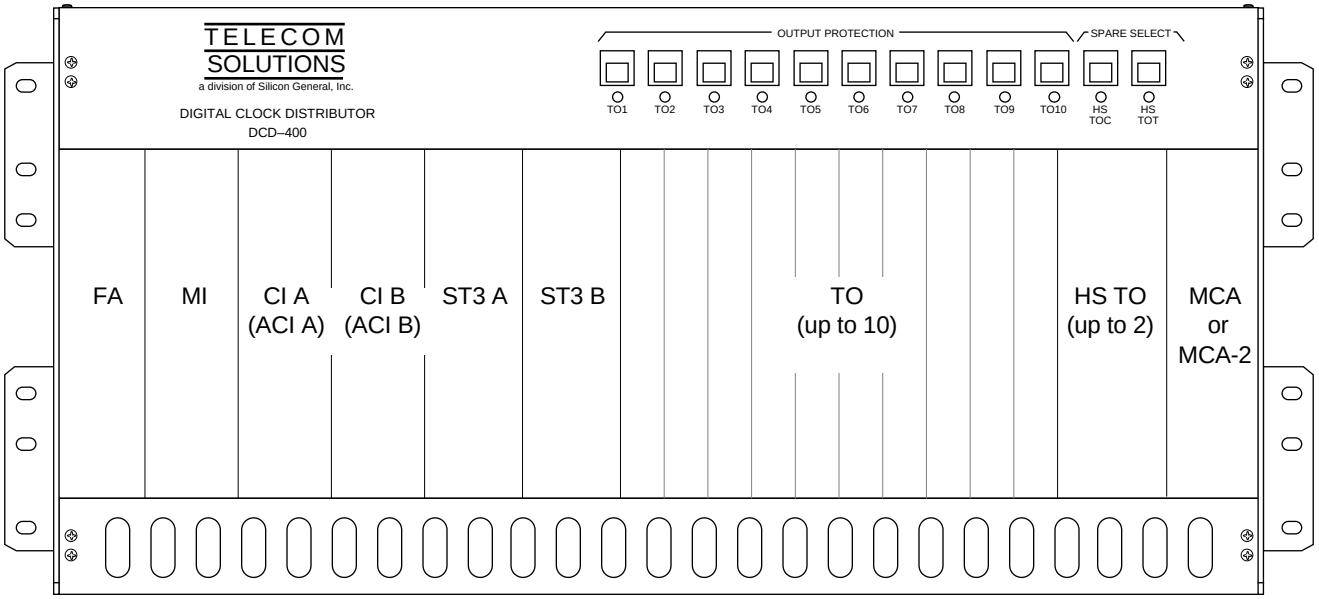
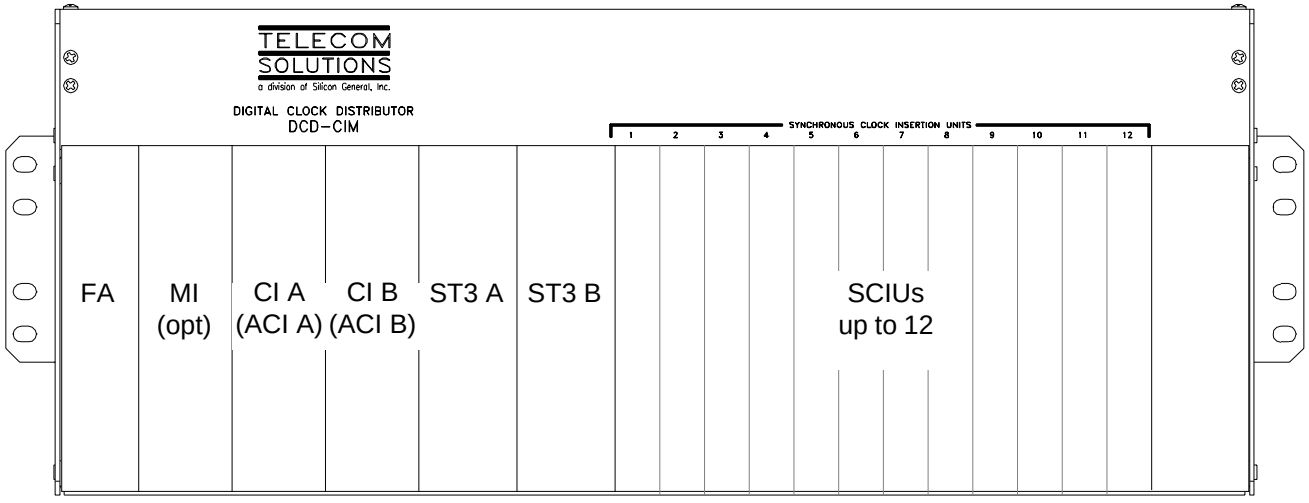
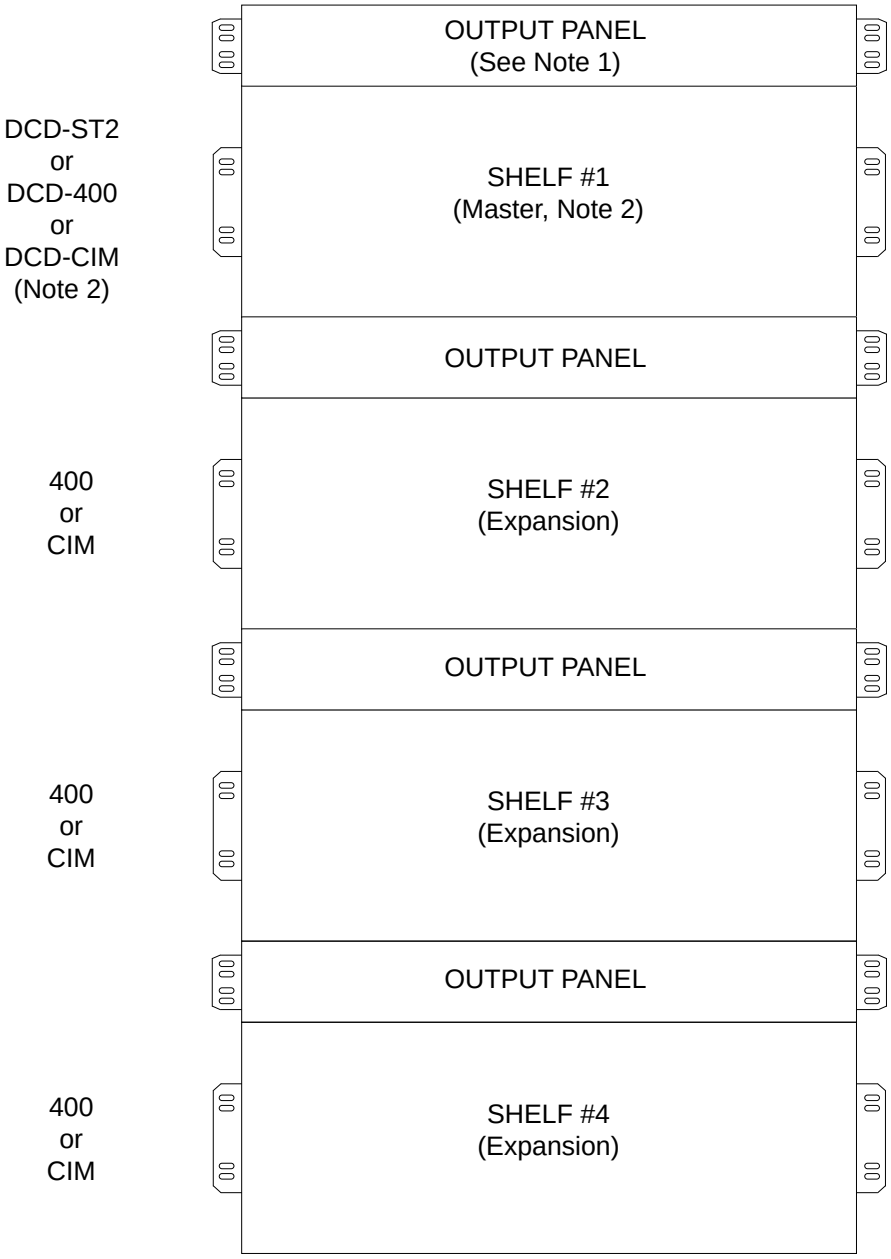


Figure 2. DCD-400 Master Shelf



Note: Although the CIM can be used as a master shelf (in a standalone configuration), it is not recommended. The CIM does not provide protection switching.

Figure 3. DCD-CIM Master Shelf



Notes:

1. Output panels may be either Wire-wrap Panels with wire-wrap connections to the network or Modular Mounting Panels that provide a network interface via connectorized Output Kits.
2. Although the CIM can be used as a master shelf, it is not recommended. If used as a master shelf, the CIM does not provide protection switching.

Figure 4. DCD System Configuration

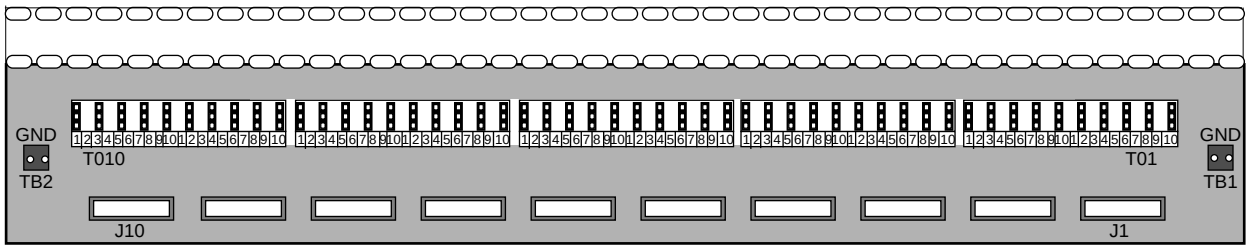
F. Output Panels

3.31 An output panel (Modular Mounting or Wire-wrap) is mounted above each shelf to provide output connections to the network. The Wire-wrap panel is used if a connectorized network interface is not desired (Figure 5).

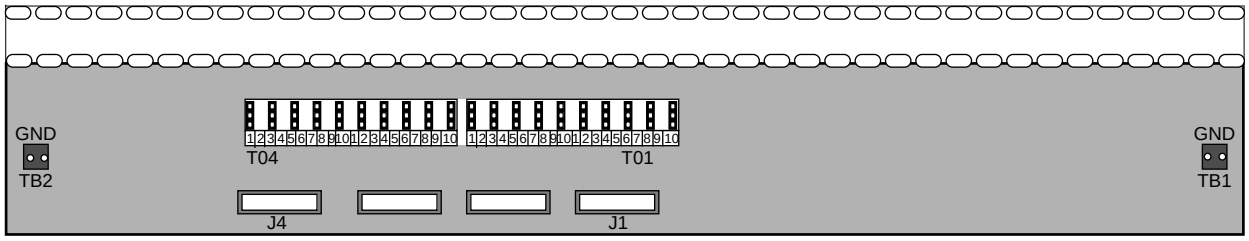
3.32 A Modular Mounting panel (Figure 20) can be equipped with up to 10 output kits (wire-wrap terminals, DB9 connectors, or BNC connectors) as required for each TOxA or SCIU card installed. Refer to Table D and Figure 21 for descriptions of the output kits.

3.33 The output from each slot in the shelf is wired to the output panel with ribbon cables so that future expansion only requires adding TOxA or SCIU cards.

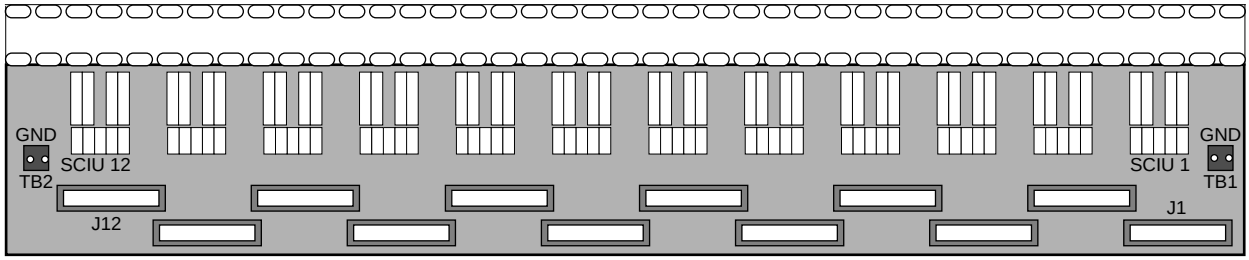
Note: The wire-wrap output panels illustrated in Figure 5B and Figure 5C can be added to the output panel shown in Figure 5A later in an existing arrangement.



A. Wire-wrap Output Panel for DCD-400

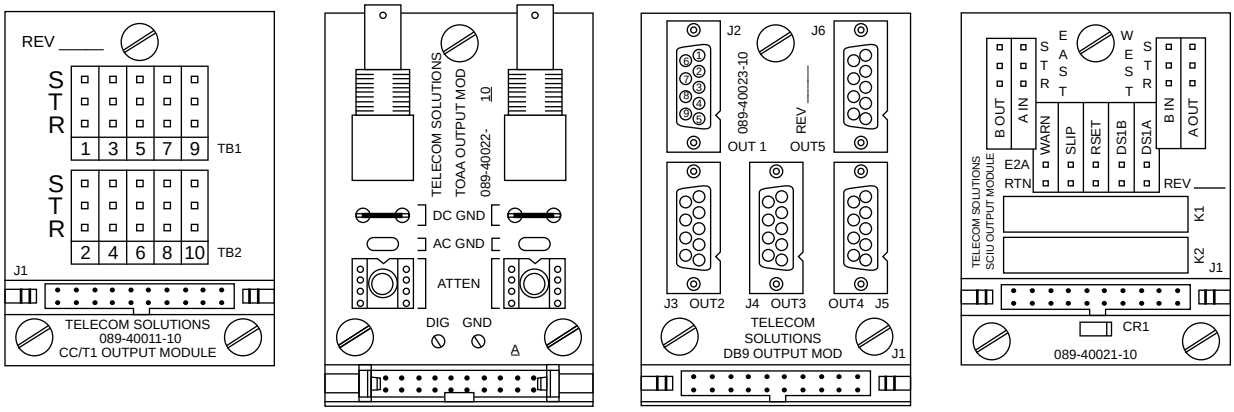


B. Wire-wrap Output Panel for DCD-ST2



C. SCIU Wire-wrap Output Panel for DCD-CIM

Figure 5. Wire-wrap Output Panels



Wire-wrap Output Kit | BNC Output Kit | DB9 Output Kit | SCIU I/O Wire-wrap Kit

Figure 7. Modular Mounting Panel Output Kits

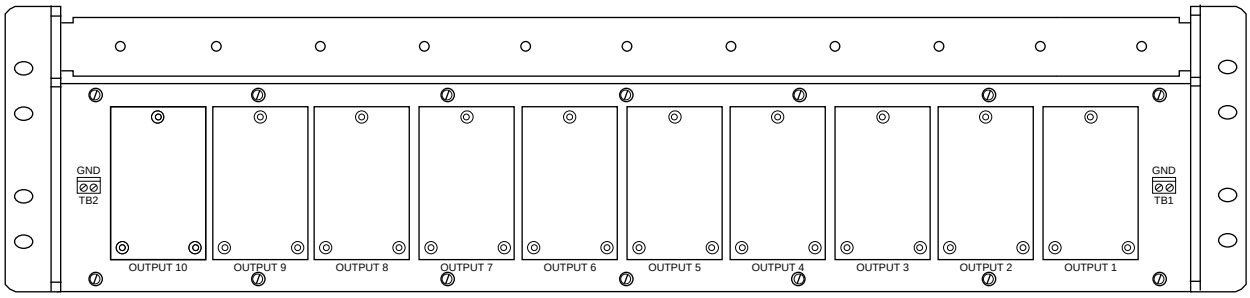


Figure 6. Modular Mounting Panel

Table B. Modular Mounting Panel Output Kits

DESCRIPTION	PART #	USED WITH	COMMENTS
Modular Mounting Panel*	090-40002-31	DCD-400, CIM, and ST2	Accommodates 10 output kits (listed below)
Wire-Wrap Output Kit	990-40011-10	TOCA, TOTA, TOLA Cards	10 wire-wrap output ports
BNC Output Kit	990-40022-10	TOAA Card	2 BNC connectors and attenuator kit
DB9 Output Kit	990-40023-10	TOLA Card (also can be used with TOCA and TOTA)	5 DB9 female connectors for RS-422 and TTL outputs
SCIU I/O Wire-Wrap Kit	990-40021-10	SCIU Card	I/O for one SCIU with wire-wrap pins

* Modular Mounting Panel may be ordered separately for addition of TOAA, TOLA or SCIU cards to the standard DCD assemblies. The DCD shelves can be ordered with the Modular Mounting Panel by specifying p/n 990-40000-08 (400), 990-40000-09 (ST2), or 990-40000-28 (CIM).

G. System Power

3.34 The DCD and CIM Systems are powered by two separate -48V dc office battery inputs. Both -48V dc inputs are fused on the shelf, then bused to the rest of the cards in the shelf. Each card contains a dc-to-dc converter to provide its own dc supply voltages. Unfiltered -48V dc can be used to power the systems.

3.35 Redundant power sources ensure operation if a single source fails or a single fuse opens. The office BITS clock should be considered as a critical service element.

H. System Diagnostics and Protection Switching

3.36 Both the DCD and CIM Systems use sophisticated diagnostics to measure frequency offset, error rates, phase change, and other input and output signal parameters.

3.37 If one or more input parameters are not within tolerance, the system switches to an alternate input. If the alternate input is not in tolerance, the system goes into holdover mode, and the internal ST2/ST3E/ST3 becomes the frequency standard for the duration of the outage.

3.38 Timing outputs are constantly monitored to ensure a stable signal. In case of an output port failure on a TOxA card, the system supports switching to an HS card. A TOxA card failure also is supported by HS switching.

3.39 Optional HS output protection is implemented by installing one or two TOxA cards in the HS slots. These can be activated manually using the pushbuttons on the master front panel or automatically by the MCA (or MCA-2) card.

Note: No output protection is available for SCIU or SMU cards in any shelf. However, the SCIU card includes DS1 bypass capabilities to pass the DS1 through unaffected in the event of a system failure.

3.40 The modular design of both the DCD and CIM Systems simplifies system expansion, troubleshooting, and repair. Front panel lamps provide clock driver status, input signal status, error alarms, and failure status.

4. APPLICATIONS

A. DCD Applications

4.01 The BITS concept advocates the establishment of a single master timing supply for each administrative building. A BITS contains the BITS clock: the lowest-numbered stratum, highest-accuracy clock within a building that is directly synchronized by the interbuilding synchronization network. The BITS also distributes all timing required by other clocks within that building.

4.02 A BITS may receive its reference signal(s) from either a Stratum-1 clock, an Interexchange Carrier timing interface (reference connection), or a BITS in another building. The reference signals must be generated from a clock of equal or greater accuracy (lower numbered stratum) than the BITS that uses the reference. Under normal operating conditions, all clock signals are traceable to a Stratum-1 primary reference.

4.03 The DCD provides system-wide synchronization via CC, DS1, analog or TTL/RS-422/RS-232 timing signals. The DCD regenerates a clocking signal from its input reference and buffers phase (byte or frame) variations. Phase variation problems are alleviated by introducing an adjustable phase delay so that signals can be supplied to DS0-rate interconnecting equipment located up to 3000 feet from the DCD source.

4.04 The DS1 timing signal is a non-service-carrying signal which uses a framed, all-ones, bipolar return-to-zero (RTZ), 50-percent duty cycle line format. The analog output can be used for digital switches, radio, and FDM carrier switches. The TTL/RS-422/RS-232 signals are used for data equipment, PBX, small remote switching modules, and T1 multiplexers.

4.05 Figure 22 illustrates typical DCD applications. The DCD can interface to additional timing signal generators (TSG) and to existing equipment that requires network timing such as digital switches, digital cross-connects, channel banks, SONET terminals, test systems, and digital data system (DDS) equipment.

4.06 An additional, although rare, application, may be a digital island network with no internetwork connectivity which may be timed with a DCD equipped with stratum clocks in freerun mode.

B. SCIU Applications

4.07 The SCIU cards in a CIM shelf system provide a method of distributing the BITS clock to network equipment that does not allow for external timing inputs, such as some digital switches. In this case, without the SCIU, two DS1 lines would ordinarily be "nailed up" to provide timing to the switch. This method reduces the productivity of the switch. By using the SCIU cards on the two DS1 lines (Figure 23A), the switch can now process traffic on the DS1 lines while the SCIU provides traceable and backup timing. Preferably, the SCIUs in this application will be timed by a Stratum-2 BITS clock such as the DCD-ST2.

4.08 The DS1 signal at the output of the SCIU towards the switch is a retimed version of the incoming trunk. Coding and framing are left intact to allow the switch to continue to monitor end-to-end transmission performance.

4.09 Often when a digital switch is transmitting synchronization downstream to another office or independent telco, the switch's output has a certain amount of wander, due in part to the switch "breathing" and its processor routines. The receiving switch must be able to recover the frequency component and apply it to its clock. The SCIU can be deployed at the output of the switch (Figure 23B) to isolate the switch timing from the office timing and provide a stable downstream clock without jitter or wander. This mitigates the effects of intervening clocks.

4.10 Figure 23C illustrates a typical SCIU Hi-Cap application. To provide external timing, a through DCS circuit needs to be allocated for timing purposes, effectively removing two expensive DCS ports from revenue service. Because the SCIU can inject network synchronization on any DS1 facility, it provides a solution to the problem which does not deplete traffic carrying circuits.

4.11 While the SCIU effectively isolates the office from incoming or external network timing, it also eliminates the problems associated with multiple office clocks and network timing chains developing phase walk and frequency offsets.

4.12 Two SCIUs can be connected to send the DS1 signal in two directions (Figure 23D). The DS1 output signals of both SCIUs (towards the switch) are reclocked versions of the incoming signals.

4.13 When used as a slip monitor (Figure 23E), the SCIU provides a measure of incoming versus office clock timing which can be used to monitor the integrity of the synchronization network or timing back from a downstream office.

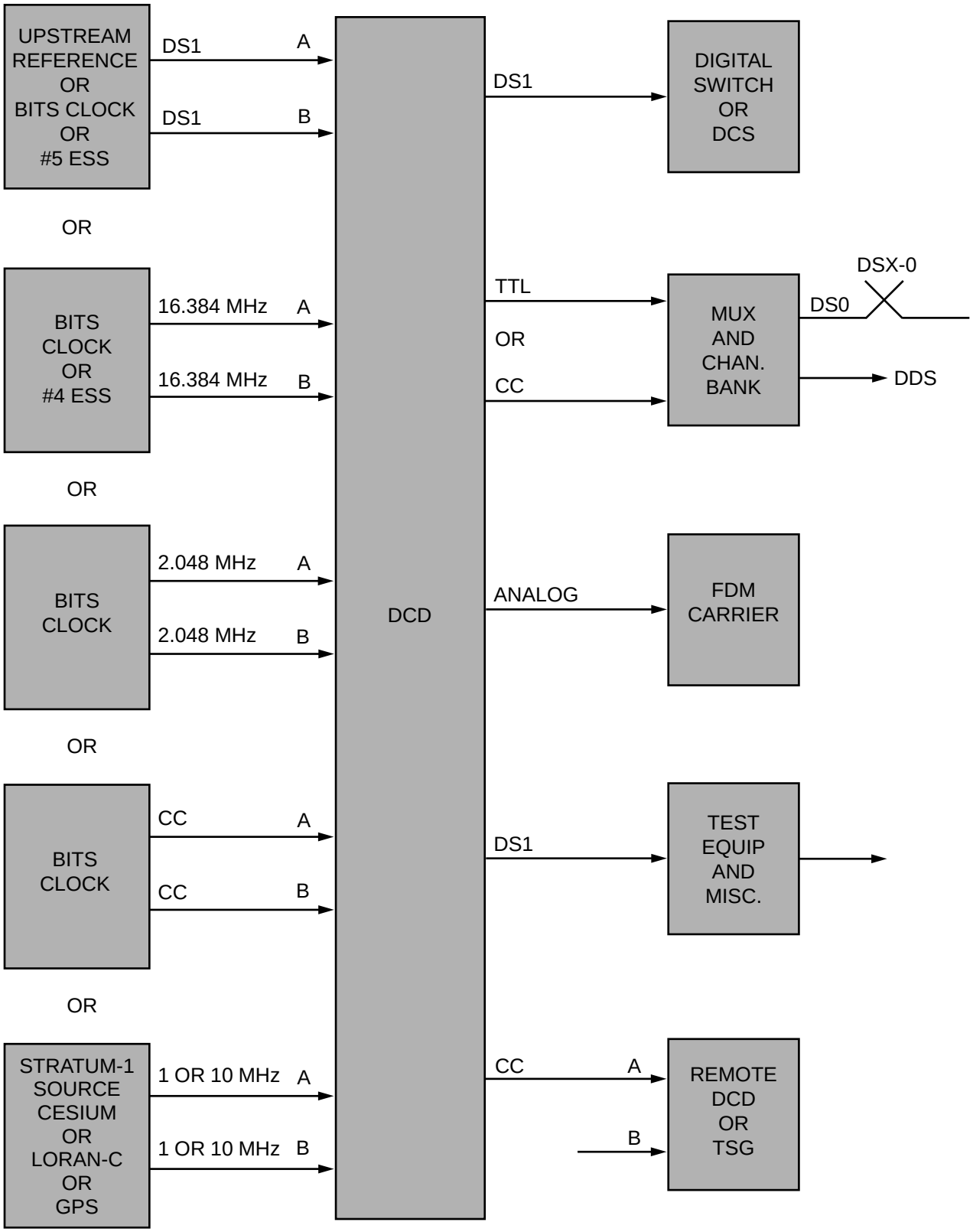


Figure 8. Typical DCD Applications

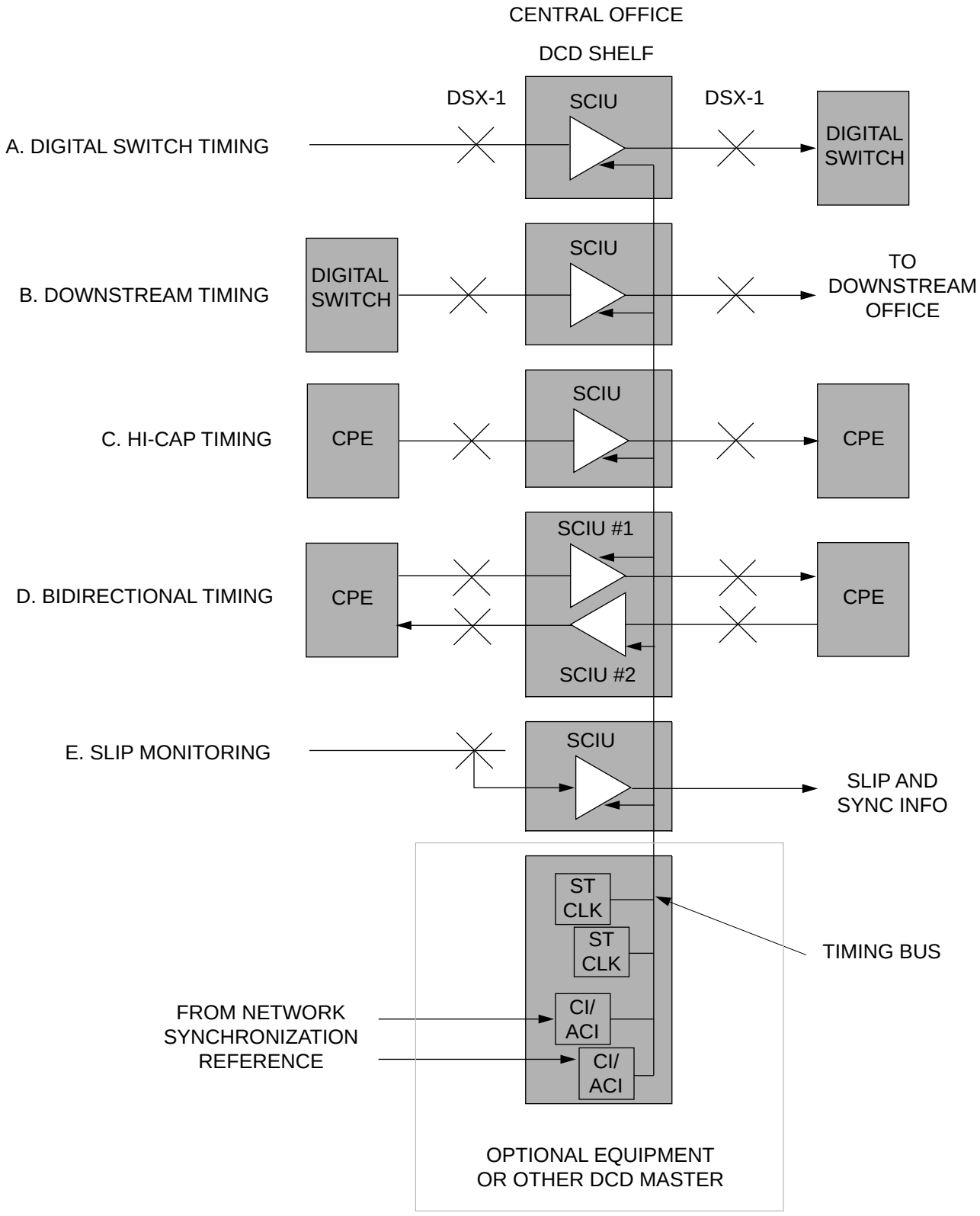


Figure 9. SCIU Applications

5. SPECIFICATIONS

5.01 The ST2, 400, and CIM System specifications are listed in Table E. Specifications for the individual cards are listed in Table F.

Table C. System Specifications

ITEM	DCD-ST2	DCD-400	DCD-CIM
GENERAL			
Input Reference	DS1 (D4, ESF, B8ZS), Type II (Stratum-2 or better per ANSI T1-101)	Dual DS1 (D4, ESF, B8ZS), dual CC, or DCD expansion bus	Dual DS1 (D4, ESF, B8ZS), dual CC, or DCD expansion bus
TOxA Cards Per Shelf (max.)	4 (master) 10 (expansion)	10 (master) 10 (expansion)	
TOxA Cards Per System (max.)	34	40	
SCIU Cards Per Shelf (max.)	4 (master)	10	12
SCIU Cards Per System (max.)	34	40	48
Output Connectors	Wire-wrap terminals or Modular Mounting Panel with Output Kits	Wire-wrap terminals or Modular Mounting Panel with Output Kits	Modular Mounting Panel with SCIU wire-wrap Output Kit
Internal Clock	Stratum-2, rubidium atomic oscillator (Stratum-3 or enhanced Stratum-3 crystal oscillator)	Stratum-3 or enhanced Stratum-3 crystal oscillator	(Optional Stratum-3 or enhanced Stratum-3 crystal oscillator)
Warm-up Time	60 minutes	5 min./30 min. ST3E	5 minutes
POWER			
Voltage	-48V dc ±10%	-48V dc ±10%	-48V dc ±10%
Current, Master Shelf (Note 1)	1.5A (Note 2)	1.3A	1.5A
Current, Expansion Shelf	1.3A	1.3A	1.3A
Recommended Fusing for Master Shelf	8A	3A	3A
Recommended Fusing for Expansion Shelf	3A	3A	3A
Notes: 1. Current specifications for fully loaded shelves. 2. For the first 30 minutes, the ST2 needs 4A.			

Table C. System Specifications (Contd)

ITEM	DCD-ST2	DCD-400	DCD-CIM
PHYSICAL			
Master Shelf Dimensions (W x D x H) (w/output panel)	23" x 14" x 12"	23" x 12.25" x 12"	23" x 12.25" x 12"
Expansion Shelf	23" x 12.25" x 12"	23" x 12.25" x 12"	23" x 12.25" x 12"
Weight (fully loaded)	25 pounds (approx)	25 pounds (approx)	25 pounds (approx)
Operating Temperature	0 - 45°C	0 - 50°C	0 - 50°C
Humidity	0 - 95%, noncondensing	0 - 95%, noncondensing	0 - 95%, noncondensing
ALARM AND STATUS OUTPUTS			
Relay Contact Ratings	2A, resistive load	2A, resistive load	A, resistive load
Audible and Visual Alarms (major and minor)	Normally open and normally closed contacts	Normally open and normally closed contacts	Normally open and normally closed contacts
Alarm Status Indication (major and minor)	Normally open contacts	Normally open contacts	Normally open contacts
Status Leads (5-7 Ω ground on return lead)	All ST2 SI, clock loss and port alarm are open collector Naps, 120V, 50 mA nominal, 500 mA maximum	Open collector PNP, 120V, 50 mA nominal, 500 mA maximum	Open collector PNP, 120V, 50 mA nominal, 500 mA maximum

Table D. Card Specifications

ITEM	SPECIFICATION
CI CARD	
DS1 Input Signal Monitor	Loss of signal (LOS) or AIS, OOF, and COFA
Input Error Threshold	Error rate of 10^{-6} (based on BPV)
Framing Protocols	D4 /ESF
Input Signal Level, Terminated	1.0 to 3.5 V base-to-peak, -10 dB up to 655 ft. from DSX
Input Signal Level, Bridged	0.1 to 0.35 V base-to-peak, up to 655 ft. from DSX
Input Signal Impedance	Bridging or terminated, 100 Ω resistive
Input Signal Jitter Tolerance	10-unit intervals, peak-to-peak, 0-310 Hz; 0.3-unit intervals, 10 kHz to 50 kHz (per Pub TA-TSY-000378)
Composite Clock Input Format	64 kb/s all-ones, RTZ, 62.5% duty cycle, up to 1500 ft. from source
Composite Clock Input Level	1.5 to 4.0 V base-to-peak
Composite Clock Input Impedance	135 Ω resistive
Dimensions (HxWxD)	6.0 in. x 1.625 in. x 9.625 in. + 0.25 in. (for latch)
ACI CARD	
Input Signal Type	Analog 2.048 MHz (CCITT G.703, Table 10), 1.0, 5.0, and 10.0 MHz sine wave
Input Signal Level	0.3 V to 1.5 V rms
Input Impedance	75 Ω ±5%
Input Frequency	Switch-selectable: 10 MHz sine wave, 5.0 MHz sine wave, 2.048 MHz sine wave, 1 MHz sine wave
Clock Holdover	2 seconds with zero phase shift
Transfer Time	2 seconds
Dimensions (HxWxD)	6.0 in. x 1.625 in. x 9.625 in. + 0.25 in. (for latch)
ST2E CARD	
Accuracy	$\pm 1 \times 10^{-9}$
Holdover Stability 0 to 24 hrs at 25°C 0 to 24 hrs from 0 to 45°C 30 days	 $\pm 2 \times 10^{-11}$ $\pm 5 \times 10^{-11}$ $\pm 1 \times 10^{-10}$
Input Tolerance	$\pm 1.6 \times 10^{-8}$
Pull-in Range	$\pm 1.6 \times 10^{-8}$
Lock Range	$\pm 1 \times 10^{-9}$
Convergence Time	≤1 hour

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
Warm-up Time	≤30 minutes
Operating Temperature	0°C to +45°C
Storage Temperature	-40°C to +70°C
Dimensions (HxWxD)	152.4 mm x 38.1 mm x 244.34 mm + 6.35 mm (for latch) (occupies 2 slots in DCD shelf)
ST2 CARD	
Source	Rubidium atomic oscillator
Clock Holdover Stability: 0-24 hours, 0-25°C 0-24 hours, 0-45°C 30 days	 $\pm 4.0 \times 10^{-11}$ $\pm 1.0 \times 10^{-10}$ $\pm 1.5 \times 10^{-10}$
Accuracy (20 years)	1.0×10^{-9}
Input Tolerance	$\pm 1.6 \times 10^{-8}$
Pull-in Range	$\pm 1.6 \times 10^{-8}$
Lock Range	$\pm 2.0 \times 10^{-9}$
Convergence Time	≤2 hours
Warm-up Time	1 hour
Operating Temperature	0-45°C
Dimensions (HxWxD)	6.0 in. x 4.0 in. x 9.625 in. + 0.25 in. (for latch)
ST3E CARD	
Source	Oven-controlled crystal oscillator
Accuracy (20 years)	1.0×10^{-6}
Clock Holdover Stability: 0-24 hours, 25°C 0-24 hours, 0-50°C 30 days	 $\pm 3.0 \times 10^{-10}$ $\pm 1.0 \times 10^{-8}$ $\pm 1.0 \times 10^{-8}$
Input Tolerance (switch-selectable)	$\pm 5.0 \times 10^{-6}$ $\pm 2.0 \times 10^{-6}$
Pull-in Range (switch-selectable)	$\pm 5.0 \times 10^{-6}$ $\pm 2.0 \times 10^{-6}$
Lock Range	$\pm 1.0 \times 10^{-7}$
Convergence Time	≤1 hour
Warm-up Time	30 minutes
Operating Temperature	0-50°C
Dimensions (HxWxD)	6.0 in. x 1.625 in. x 9.625 in. + 0.25 in. (for latch)

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
Input Tolerance (switch-selectable)	$\pm 5.0 \times 10^{-6}$ $\pm 2.0 \times 10^{-6}$
ST3 CARD	
Source	Temperature-controlled crystal oscillator
Clock Holdover Stability: 0-24 hours, 25°C 0-24 hours, 0-50°C 30 days	 $\pm 3.0 \times 10^{-9}$ $\pm 1.0 \times 10^{-7}$ $\pm 1.0 \times 10^{-7}$
Accuracy (20 years)	1.0×10^{-5}
Input Tolerance	$\pm 15.0 \times 10^{-6}$
Pull-in Range	$\pm 15.0 \times 10^{-6}$
Lock Range	$\pm 15.0 \times 10^{-6}$
Convergence Time	≤30 sec.
Warm-up Time	Not Applicable
Operating Temperature	0-50°C
Dimensions (HxWxD)	6.0 in. x 1.625 in. x 9.625 in. + 0.25 in. (for latch)
TOCA CARD	
Output Type	Composite clock (digital 64/8 kb/s)
Waveform	2.7 to 5.5 V peak, 3 V nominal; bipolar RTZ; all-ones with BPV every eighth pulse
Wave Shape	Rectangular, rise time <500 ns, pulse width 9.8 µs ±5%, pulse interval 15.6 µs ±5%
Impedance	133 Ω, ±5%; resistive; can drive up to 6 downstream devices
Duty Cycle	62.5%
Drive Capability	0 to 3,000 ft of twisted-pair, 22 AWG cable in the following lengths: 0-1500, 1501-2000, 2001-2500, and 2501-3000 ft
Number of Ports	10
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOTA CARD	
Output Type	DS1
Waveform	2.4 to 3.6 V peak, 3.5 V nominal; bipolar return to zero, all-ones; ESF or D4 format, per Pub 43801
Wave Shape	Rectangular, rise time <100 ns, pulse width 325 ns ±30 ns, pulse interval 648 ns ±64 ns, per CB-119
Impedance	100 Ω ±5%; resistive; can drive up to 2 downstream devices

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
Overshoot	≤10% of peak-to-base amplitude
Duty Cycle	50%
Output Drive Capability	0 to 655 ft of twisted-pair, 22 AWG ABAM cable
Number of Ports	10
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOLA -01 CARD	
Output Type	Logic level; RS-422 or RS-423 (TTL)
Wave Amplitude	2 to 6 V pp for RS-422 (balanced) into 100 Ω >3 V for RS-423 (unbalanced) into 450 Ω
Wave Shape	Square wave
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates: • RS-422 • Wire-wrap Panel • Frequency groups 0–3 selectable by switch on card	Group / Out 1 / Out 3 / Out 5 / Out 7 / Out 9 0 / 4 kb/s / 8 kb/s / 64 kb/s / 1.544 Mb/s / 1.544 Mb/s 1 / 256 kb/s / 512 kb/s / 2.048 Mb/s / 1.544 Mb/s / 1.544 Mb/s 2 / 384 kb/s / 768 kb/s / 1.536 Mb/s / 1.544 Mb/s / 1.544 Mb/s 3 / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s
Data Rates: • RS-423 • Wire-wrap Panel • Frequency groups 0–3 selectable by switch on card	Group / Out 1 & 2 / Out 3 & 4 / Out 5 & 6 / Out 7 & 8 / Out 9 & 10 0 / 4 kb/s / 8 kb/s / 64 kb/s / 1.544 Mb/s / 1.544 Mb/s 1 / 256 kb/s / 512 kb/s / 2.048 Mb/s / 1.544 Mb/s / 1.544 Mb/s 2 / 384 kb/s / 768 kb/s / 1.536 Mb/s / 1.544 Mb/s / 1.544 Mb/s 3 / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s
Data Rates: • RS-422 • DB9 Connector • Frequency groups 0–3 selectable by switch on card	Group / Out 1 / Out 2 / Out 3 / Out 4 / Out 5 0 / 1.544 Mb/s / 1.544 Mb/s / 64 kb/s / 8 kb/s / 4 kb/s 1 / 1.544 Mb/s / 1.544 Mb/s / 2.048 Mb/s / 512 kb/s / 256 kb/s 2 / 1.544 Mb/s / 1.544 Mb/s / 1.536 Mb/s / 768 kb/s / 384 kb/s 3 / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s
Cable Lengths • RS-422 • 24 AWG Twisted Pair	Data Rate / Distance / Data Rate / Distance 4, 8, 64 kb/s / 3275 ft / 768 kb/s / 400 ft 256 kb/s / 1300 ft / 1.536 Mb/s / 225 ft 384 kb/s / 825 ft / 1.544 Mb/s / 225 ft 512 kb/s / 650 ft / 2.048 Mb/s / 150 ft
Cable Lengths • RS-423 (TTL) • 24 AWG Twisted Pair	Data Rate / Distance 4 kb/s / 825 ft 8 kb/s / 325 ft 64 kb/s / 50 ft ≥100 kb/s / Not recommended
Number of Ports	5 RS-422 or 10 RS-423 (TTL)
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
TOLA -02 CARD	
Output Type	Logic level; RS-422 or RS-423 (TTL)
Wave Amplitude	2 to 6 V pp for RS-422 (balanced) into 100 Ω >3 V for RS-423 (unbalanced) into 450 Ω
Wave Shape	Square wave
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates (four frequency groups) - From wire-wrap panel	Group / Out 1 / Out 2 / Out 3 / Out 4 / Out 5 0 / 8 kb/s / 8 kb/s / 8 kb/s / 8 kb/s / 8 kb/s 1 / 256 kb/s / 512 kb/s / 2.048 Mb/s / 1.544 Mb/s / 1.544 Mb/s 2 / 384 kb/s / 768 kb/s / 1.536 Mb/s / 1.544 Mb/s / 1.544 Mb/s 3 / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s
Data Rates (four frequency groups) - From DB9 connector	Group / Out 1 / Out 2 / Out 3 / Out 4 / Out 5 0 / 8 kb/s / 8 kb/s / 8 kb/s / 8 kb/s / 8 kb/s 1 / 1.544 Mb/s / 1.544 Mb/s / 2.048 Mb/s / 512 kb/s / 256 kb/s 2 / 1.544 Mb/s / 1.544 Mb/s / 1.536 Mb/s / 768 kb/s / 384 kb/s 3 / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s / 1.544 Mb/s
RS-422 24 AWG Twisted Pair (Maximum Distance)	Data Rate / Distance / Data Rate / Distance 8 kb/s / 3275 ft / 768 kb/s / 400 ft 256 kb/s / 1300 ft / 1.536 Mb/s / 225 ft 384 kb/s / 825 ft / 1.544 Mb/s / 225 ft 512 kb/s / 650 ft / 2.048 Mb/s / 150 ft
RS-423 (TTL) 24 AWG Twisted Pair (Maximum Distance)	Data Rate / Distance 8 kb/s / 325 ft ≥100 kb/s / Not recommended
Number of Ports	5 RS-422 or 10 RS-423 (TTL)
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOLA -03 CARD	
Output Type	RS-232
Wave Amplitude	>+3 V from GND and >-3 V from GND for RS-232 into 3 to 7 kΩ
Wave Shape	Square wave
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates (four frequency groups) - From wire-wrap panel	Group / Out 1 / Out 2 / Out 3 / Out 4 / Out 5 0 / 4.8 kb/s / 4.8 kb/s / 4.8 kb/s / 4.8 kb/s / 4.8 kb/s 1 / 9.6 kb/s / 9.6 kb/s / 9.6 kb/s / 9.6 kb/s / 9.6 kb/s 2 / 19.2 kb/s / 19.2 kb/s / 19.2 kb/s / 19.2 kb/s / 19.2 kb/s 3 / 56 kb/s / 56 kb/s / 56 kb/s / 56 kb/s / 56 kb/s

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
Data Rates (four frequency groups) -From DB9 connector	Group: 0 — Out 1: 4.8 kb/s; Out 2: 4.8 kb/s; Out 3: 4.8 kb/s; Out 4: 4.8 kb/s; Out 5: 4.8 kb/s 1 — 9.6 kb/s; 9.6 kb/s; 9.6 kb/s; 9.6 kb/s; 9.6 kb/s 2 — 19.2 kb/s; 19.2 kb/s; 19.2 kb/s; 19.2 kb/s; 19.2 kb/s 3 — 56 kb/s; 56 kb/s; 56 kb/s; 56 kb/s; 56 kb/s
RS-232 24 AWG Twisted Pair (Maximum Distance)	Data Rate — Distance 4.8 kb/s — 50 ft 9.6 kb/s — 50 ft 19.2 kb/s — 50 ft 56 kb/s — Not recommended
Number of Ports	5
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOLA -04 CARD	
Output Type	Logic level; RS-422 (RS-423 (TTL) not recommended)
Wave Amplitude	2 to 6 V pp for RS-422 (balanced) into 100 Ω
Wave Shape	Square wave
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates	All data rates are 2.048 Mb/s
Cable Lengths (max. in meters; RS-422) 24 AWG Twisted Pair (Maximum Distance)	Data Rate — Distance 2.048 Mb/s — 160 ft
Number of Ports	5 RS-422 or 10 RS-423 (TTL)
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOLA -05 CARD	
Output Type	Logic level; RS-422 or RS-423 (TTL)
Wave Amplitude	2 to 6 V pp for RS-422 (balanced) into 100 Ω >3 V for RS-423 (unbalanced) into 450 Ω
Wave Shape	Square wave
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates (four frequency groups) - From wire-wrap panel	Group: 0 — Out 1: 1.544 Mb/s; Out 2: 64 kb/s; Out 3: 128 kb/s; Out 4: 192 kb/s; Out 5: 1.024 Mb/s 1 — 1.544 Mb/s; 64 kb/s; 128 kb/s; 192 kb/s; 1.024 Mb/s 2 — 1.544 Mb/s; 64 kb/s; 128 kb/s; 192 kb/s; 1.024 Mb/s 3 — 1.544 Mb/s; 64 kb/s; 128 kb/s; 192 kb/s; 1.024 Mb/s

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
Data Rates (four frequency groups) - From DB9 connector	Group 0: Out 1 1.024 Mb/s; Out 2 192 kb/s; Out 3 128 kb/s; Out 4 64 kb/s; Out 5 1.544 Mb/s Group 1: Out 1 1.024 Mb/s; Out 2 192 kb/s; Out 3 128 kb/s; Out 4 64 kb/s; Out 5 1.544 Mb/s Group 2: Out 1 1.024 Mb/s; Out 2 192 kb/s; Out 3 128 kb/s; Out 4 64 kb/s; Out 5 1.544 Mb/s Group 3: Out 1 1.024 Mb/s; Out 2 192 kb/s; Out 3 128 kb/s; Out 4 64 kb/s; Out 5 1.544 Mb/s
RS-422 24 AWG Twisted Pair (Maximum Distance)	Data Rate / Distance: 64 kb/s / 3275 ft; 128 kb/s / 2600 ft; 192 kb/s / 1650 ft; 1.024 Mb/s / 300 ft; 1.544 Mb/s / 225 ft
RS-423 (TTL) 24 AWG Twisted Pair (Maximum Distance)	Data Rate / Distance: 64 kb/s / 50 ft; ≥100 kb/s / Not recommended
Number of Ports	5 RS-422 or 10 RS-423 (TTL)
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOLA -06 CARD	
Output Type	Logic level; RS-422 or RS-423 (TTL)
Wave Amplitude	2 to 6 V pp for RS-422 (balanced) into 100 Ω >3 V for RS-423 (unbalanced) into 450 Ω
Wave Shape	Square wave
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates (four frequency groups) - From both wire-wrap panel and DB9 connector	Group 0: Out 1 4.8 kb/s; Out 2 4.8 kb/s; Out 3 4.8 kb/s; Out 4 4.8 kb/s; Out 5 4.8 kb/s Group 1: Out 1 9.6 kb/s; Out 2 9.6 kb/s; Out 3 9.6 kb/s; Out 4 9.6 kb/s; Out 5 9.6 kb/s Group 2: Out 1 19.2 kb/s; Out 2 19.2 kb/s; Out 3 19.2 kb/s; Out 4 19.2 kb/s; Out 5 19.2 kb/s Group 3: Out 1 56 kb/s; Out 2 56 kb/s; Out 3 56 kb/s; Out 4 56 kb/s; Out 5 56 kb/s
RS-422 24 AWG Twisted Pair (Maximum Distance)	Data Rate / Distance: 4.8 thru 56 kb/s / 3275 ft
RS-423 (TTL) 24 AWG Twisted Pair (Maximum Distance)	Data Rate / Distance: 4.8 kb/s / 825 ft; 9.6 kb/s / 325 ft; 19.2 kb/s / 150 ft; 56 kb/s / 50 ft
Number of Ports	5 RS-422 or 10 RS-423 (TTL)
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOLA -07 CARD	
Output Type	Logic level; RS-422 (RS-423 (TTL) not recommended)
Wave Amplitude	2 to 6 V pp for RS-422 (balanced) into 100 Ω
Wave Shape	Square wave

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
Impedance	100 Ω resistive, balanced; 450 Ω resistive, unbalanced
Data Rates (four frequency groups) - From both wire-wrap panel and DB9 connector	Group 0: Out 1 2.048 Mb/s, Out 2 2.048 Mb/s, Out 3 2.048 Mb/s, Out 4 2.048 Mb/s, Out 5 2.048 Mb/s Group 1: Out 1 1.024 Mb/s, Out 2 1.024 Mb/s, Out 3 1.024 Mb/s, Out 4 1.024 Mb/s, Out 5 1.024 Mb/s Group 2: Out 1 512 kb/s, Out 2 512 kb/s, Out 3 512 kb/s, Out 4 512 kb/s, Out 5 512 kb/s Group 3: Out 1 256 kb/s, Out 2 256 kb/s, Out 3 256 kb/s, Out 4 256 kb/s, Out 5 256 kb/s
RS-422 24 AWG Twisted Pair (Maximum Distance)	Data Rate 256 kb/s — Distance 1300 ft Data Rate 512 kb/s — Distance 650 ft Data Rate 1.024 Mb/s — Distance 300 ft Data Rate 2.048 Mb/s — Distance 150 ft
Number of Ports	5 RS-422 or 10 RS-423 (TTL)
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
TOAA CARD (-01, -02, -03, and -05)	
Output Type	Analog
Waveform	1 V rms
Wave Shape	Sine wave
Impedance	75 ohms ±5%, resistive, unbalanced for -01, -03, and -05 50 ohms ±5%, resistive, unbalanced for -02
Output Frequency	Switch-selectable (-01, -02): 2.048 MHz, 1.0 MHz, 512 kHz, or 64 kHz (-03): 2.048 MHz, 1.0 MHz, 512 kHz, or 8 kHz (-05): 5 MHz
Level Attenuators	0, 3, 30, 60 dB
Number of Ports	2
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)
SCIU CARD	
Input	Bidirectional DS1
DS1 Input, A and B	Message DS1 1.544 Mb/s (framed or unframed)
Input Monitor	LOS or AIS, OOF
Input Error Threshold	2 out of 4 OOF, 32 consecutive zeroes
Framing Protocols	D4, ESF; with or without B8ZS or AMI
Input Signal Level, Terminated	DSX-1, 1.5 to 4.5 V base-to-peak, up to 655 ft from DSX-1
Input Signal Level, Bridging	0.15 to 0.45 V base-to-peak, up to 655 ft from DSX-1
Input Signal Level, Impedance	Bridging, or terminated in 100 Ω
Input Signal Level, Jitter Tolerance	10 UI p-p, 0.31-10 kHz; 0.3 UI p-p, 10-100 kHz (per T1.102)
DS1 Output, Levels A and B	3 V base-to-peak nominal before line build-out pre-emphasis (per ANSI T1.102-1988)

Table D. Card Specifications (Contd)

ITEM	SPECIFICATION
DS1 Output Impedance	100 Ω
Residual Jitter Output, DS1 A	0.025 UI with Stratum-2 source; 0.1 UI with ST3E source, 0.05 to 100 kHz
DS1 A Buffer Size	±192 bits, ± DS1 frame
DS1 A Buffer Hysteresis	64 bits, approximately 40 µs
DS1 A Through Delay	Nominal 125 µs; 250 µs maximum
DS1 B Through Delay	Nominal 2.6 µs; 5.2 µs maximum
Dimensions (HxWxD)	6.0 in. x 0.75 in. x 9.625 in. + 0.25 in. (for latch)