DIGITAL CLOCK DISTRIBUTOR

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

FUNCTIONAL DESCRIPTION

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1. GENERAL

1.01 This practice provides functional descriptions for the Digital Clock Distributor (DCD) family of products. The DCD product family includes:

- DCD-Stratum-2 (ST2)
- DCD-400 (400)
- DCD-Clock Insertion and Monitor (CIM)

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

1.03 The Synchronization Monitor System (SMS) may be installed in the DCD family of systems to implement DS1 performance monitoring. For more about 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.

1.04 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.

1.05 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. Refer to TMSL 097-40015-01 for information regarding the SAM card.

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

1.07 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
BITS	Building Integrated Timing Supply
CC	Composite Clock
CI	Clock Input card
CIM	Clock Insertion and Monitor System
CMU	Communications Unit card
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
DS0	Digital Signal, level 0 (64 kb/s)
DS1	Digital Signal, level 1 (1.544 Mb/s)
DSX-1	Digital Signal cross-connect, level 1
E2A	Telemetry surveillance system
ESF	Extended Superframe format
FA	Fuse and Alarm card
HS TOxA	Hot spare card
LBO	Line build-out
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 Elements
OCXO	Oven-controlled crystal oscillator
OOF	Out of frame
PBX	Private Branch Exchange
PLL	Phase-locked loop
PLXO	Phase-locked crystal oscillator
RTZ	Return-to-zero
SCIU	Synchronous Clock Insertion Unit card
ST2	Stratum-2 clock
ST3	Stratum-3 clock
ST3E	Enhanced Stratum-3 clock
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
VCXO	Voltage-controlled crystal oscillator

2. SYSTEM FUNCTIONAL DESCRIPTION

A. System Power

2.01 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 may be used to power the systems.

B. System Diagnostics and Protection Switching

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

2.03 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 ST3E/ST3 or ST2 becomes the frequency standard for the duration of the outage.

2.04 Timing outputs are constantly monitored to ensure a stable signal. In case of a failure of an output port on a TOxA card, the system can cause a switch to an HS TOxA card.

2.05 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.

C. DCD Systems (ST2 and 400)

2.06 Both the DCD-ST2 (ST2) and the DCD-400 (400) Systems distribute timing signals to Network Elements (NE) in the digital network. Timing reference signals from an upstream source are received by the DCD Systems which continuously generate clock output signals. All output signals distributed by the DCD are locked to the reference input and are at the same stratum accuracy and stability as the input.

2.07 The DCD System (see Figure 1) consists of:

- Two clock input cards (CI A and CI B or ACI A and ACI B)
- Two stratum clock cards (ST A and ST B)
- Timing output cards (TOCA, TOTA, TOAA, TOLA) and/or SCIU cards
- Synchronization Monitor Units (SMU)
- An FA card (400) or an AI card (ST2)
- A Matrix Controller card (MCA/MCA-2) and one or two HS TOxA cards

2.08 The ST2 operates at Stratum-2 stability, and the 400 at enhanced Stratum-3 (ST3E) or Stratum-3 (ST3) stability. When both clock input cards fail, either unit can act as the office clock in a BITS environment or as a free-running clock source.

2.09 The DCD operates from either a CC input signal (from an existing office clock), analog input signals (1, 2, 10, or 16 MHz), or a DS1 input signal (bridged or terminated) and provides output timing signals depending on the number and type of TOxA cards installed.

Input Signals

2.10 For the ST2, the incoming DS1 reference *must* be of Stratum-2 or better quality. For the 400, the reference *must* be of Stratum-3 or 3E quality or better, as defined in ANSI-T1-101.

2.11 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 an LPR-L3
- Composite clock (CC) from an existing office clock

2.12 DS1 input reference signals can be terminated by 100 ohms or bridged by the built-in high impedance bridging repeater.

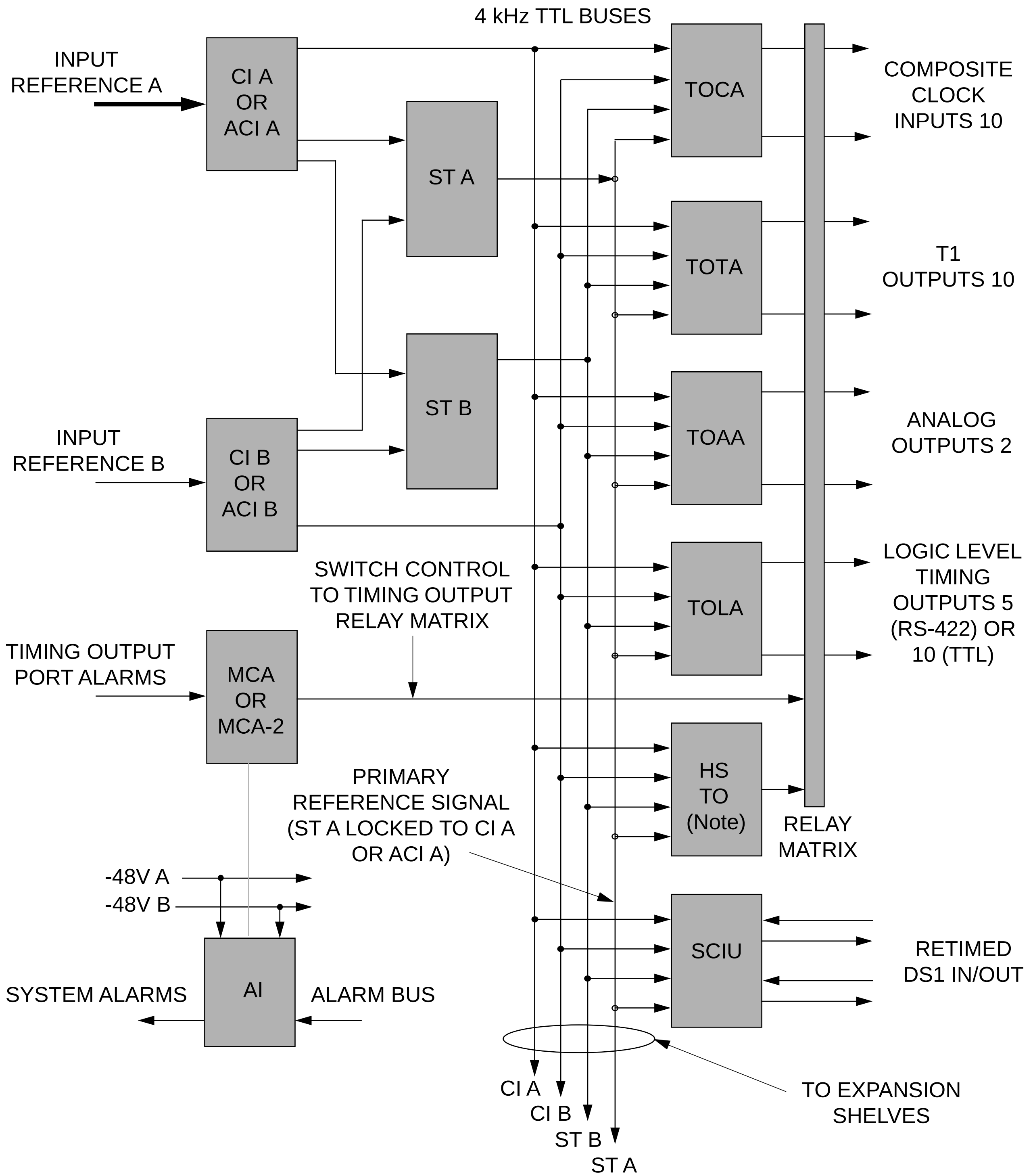
2.13 Analog input reference signals of 1, 2, 10, or 16 MHz can also be accepted if an ACI (Analog Clock Input) card is installed instead of a CI (Clock Input) card.

2.14 One input signal is applied to each CI (DS1 and CC) or ACI (analog) card which drives the ST cards. The ST cards are phase-locked to the input signal and provide outputs to the TOxA cards.

2.15 The type of TOxA card installed determines whether the output signals are Composite Clock (CC), DS1, or logic level (TTL, RS-422, RS-232). Logic on each TOxA card selects the input signal to be used to drive the output signals. Whenever the stratum (ST A or B) clock signal is present, it is the preferred driving signal over a clock input (CI or ACI) signal. Refer to Table A for input signal selection priority.

2.16 Because the system regenerates the input timing signal, rather than simply amplifying and repeating it, there is no phase delay between the input and output clock signals. Phase jitter and wander are also removed from the signal.

2.17 Both a CC timing signal and an unframed 1.544-Mb/s clock signal are provided on front panel jacks for testing. The 1.544-Mb/s clock signal is derived from the incoming reference and appears on each clock input (CI or ACI) card front panel. The CC signal (from the TOCA card) also appears on a standard 310 jack on the Matrix Controller card.



Note: Two HS TOxA cards may be installed. However, only one HS TOXA card may be placed in-service at a time.

Figure 1. DCD System – Master Shelf

Table A. Internal Timing Signal Priorities

ST TYPE	CONFIGURATION	PRIORITY
ST2	Active ST (A or B)	1
	Standby ST (B or A)	2
	CI A (or ACI A)	3
	CI B (or ACI B)	4
ST3E or ST3	ST A	1
	ST B	2
	Active clock input card (CI A or B, or ACI A or B)	3
	Standby clock input card (CI B or A, or ACI B or A)	4

2.18 Each expansion shelf has its own bus connection (via the 5 ft connectorized ribbon cables) to the master shelf, so additional clock input (CI or ACI) and ST cards are not required (Figure 2).

2.19 DCD shelves are supplied with Wire-wrap or Modular Mounting output panels to interface with network equipment. Output panels are connected to the shelf backplane with ribbon cables. The Wire-wrap panels provide wire-wrap pins for connection to the network. Modular mounting panels provide wire-wrap, BNC and D connector output kits which can be selected according to the mix of TOxA cards installed.

5 MHz Stratum Connection

2.20 The BNC connectors 5 MHz OUTPUT A and 5 MHz OUTPUT B on the DCD-ST2 shelf are for connecting to the DCD-LPR shelf. They provide the necessary 5 MHz stratum signal source for the DCD-LPR shelf. If this connection is made, a 5-MHz Isolator Assembly Kit (p/n 093-45110-04) must be ordered as a separate line item and installed.

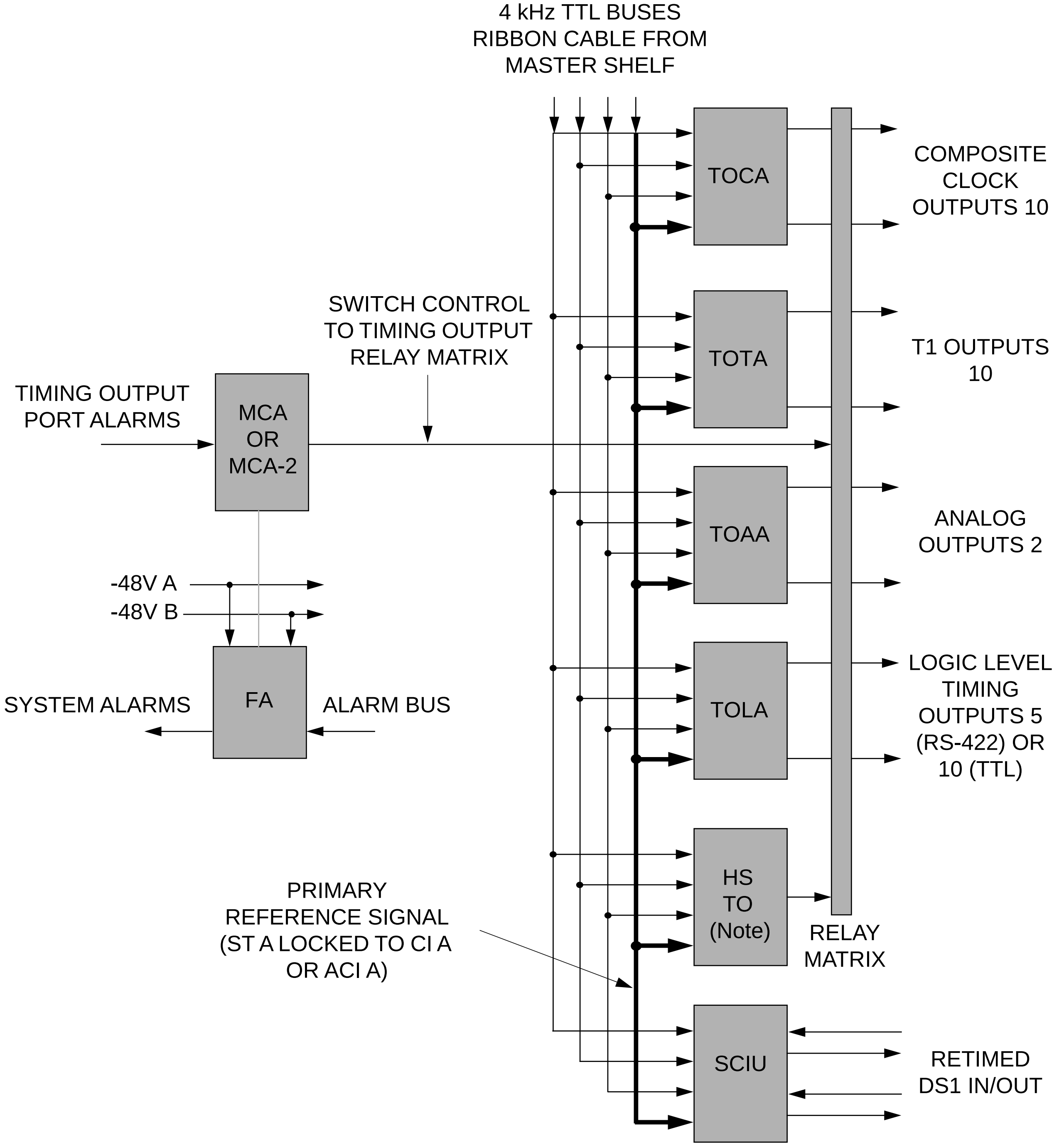
Output Protection Switching

2.21 An output protection switching matrix is located on the ST2 (Figure 3A) and 400 (Figure 3B) shelves, above the card slots. Controlled by the Matrix Controller card, the protection matrix utilizes HS TOxA cards to provide 1-for-N output protection. 1-for-N where N = the maximum number of protected output slots in a given shelf.

> ***Note:*** The MCA and the MCA-2 cards are physically and functionally compatible. Information common to the MCA and MCA-2 is referenced as Matrix Controller card. Information unique to a specific card will be prefaced by the name of the card (MCA or MCA-2). For more information about the MCA and MCA-2, refer to Part 4, Section L, Matrix Controller Card and Output Protection Matrix.

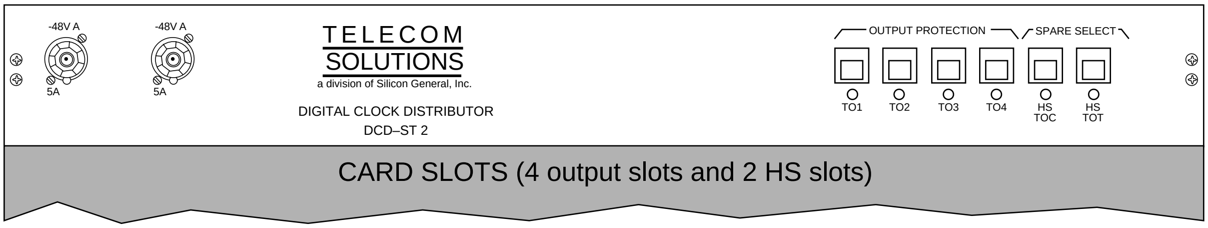
2.22 If a port fails on an in-service TOxA card or a card fails for which a like HS TOxA is installed, the Matrix Controller card and the protection matrix automatically place the HS TOxA card in service and switch the failed card out of service. The failed card can be replaced without disrupting service if it has been manually or automatically switched to the HS TOxA.

> ***Note:*** Only one TOxA card may be on HS switching at any given time. The second HS slot is provided to permit HS protection for two different types of TOxA cards within a shelf.

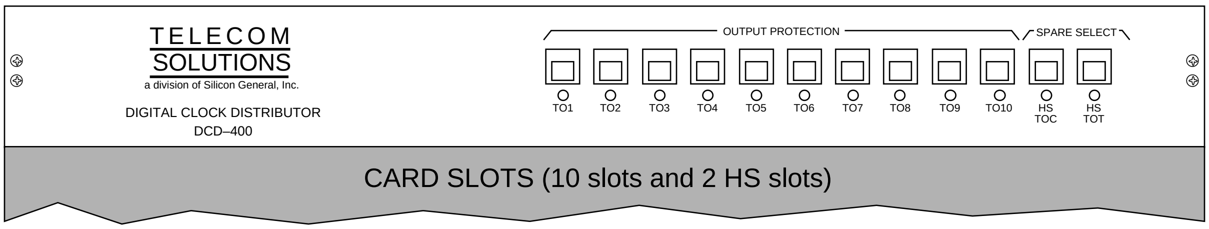


Note: Two HS TOxA cards may be installed. However, only one HS TOxA card may be placed in-service at a time.

Figure 2. DCD System – Expansion Shelf



A. DCD-ST2



B. DCD-400

Figure 3. Output Protection Matrix

D. CIM System

2.23 The CIM System uses Synchronous Clock Insertion Unit (SCIU) cards to insert office synchronization on incoming or outgoing DS1 facilities; each card supports one bidirectional DS1 circuit. This allows the SCIU to isolate the office from incoming or outgoing impairments, such as jitter and wander.

2.24 The CIM may be equipped with enhanced Stratum-3 (ST3E) or Stratum-3 (ST3) clock cards, or an ST2 if used as an expansion to an ST2 shelf. The CIM can be configured to run as a standalone system or as an expansion from an existing ST2 or 400.

> ***Note:*** The use of the CIM as a master shelf is not recommended; the CIM does not provide protection switching.

2.25 As shown in Figure 4 (the standalone, or master system), the CIM System consists of:

- Two clock input cards (CI or ACI)
- One or two ST3E/ST3 cards
- Up to 12 SCIU cards

2.26 Three expansion shelves may be added to a master shelf, each holding up to 12 SCIU cards for a total system capacity of 48 bidirectional DS1s.

2.27 Logic on each SCIU card selects the input signal to be used to drive the outputs. (Refer to Table A for the priority of input selections.) Since the SCIU can receive a variety of framing protocols, a switch can be set to allow the SCIU to be transparent to out-of-frame conditions (see Figure 5).

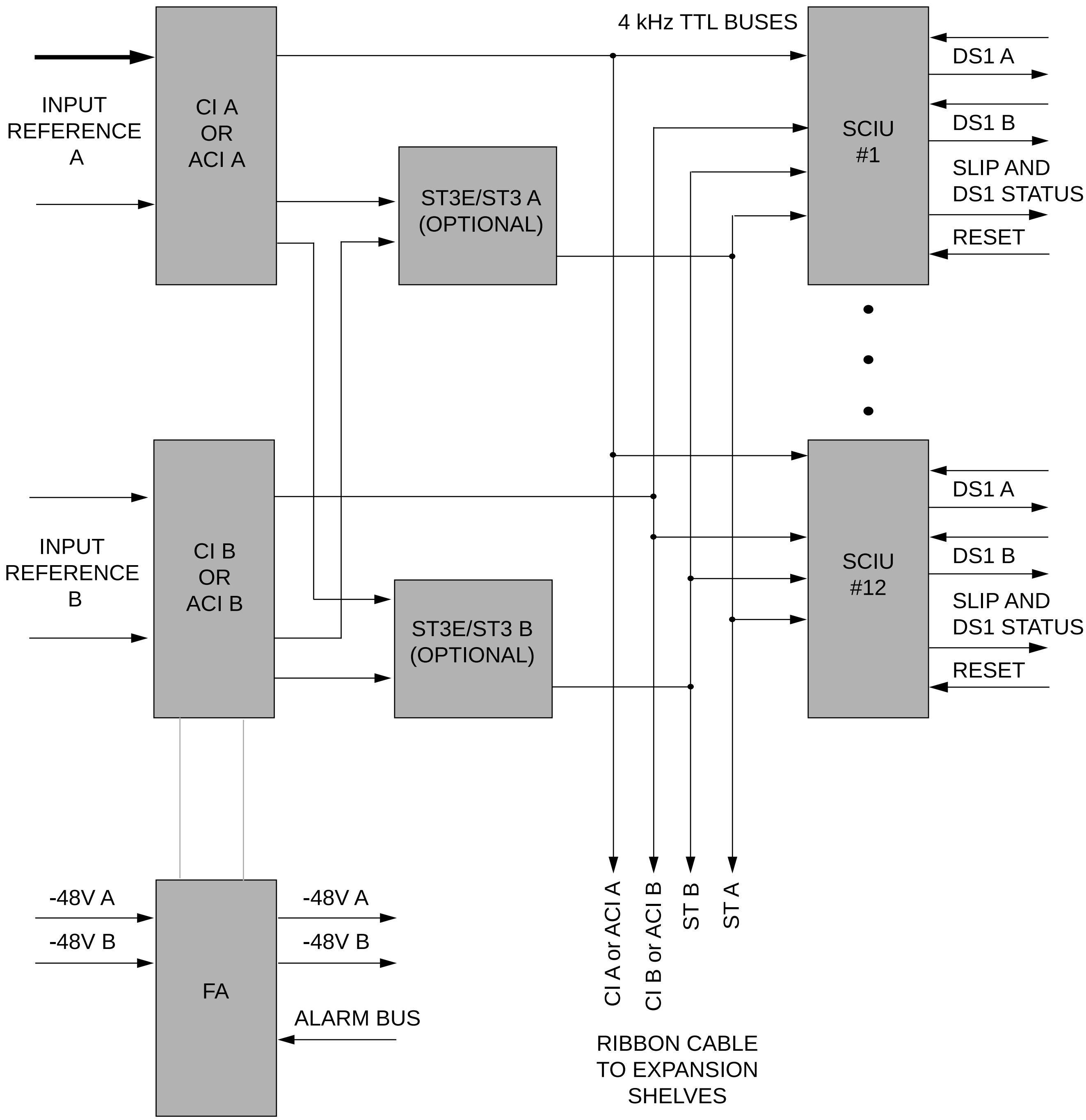
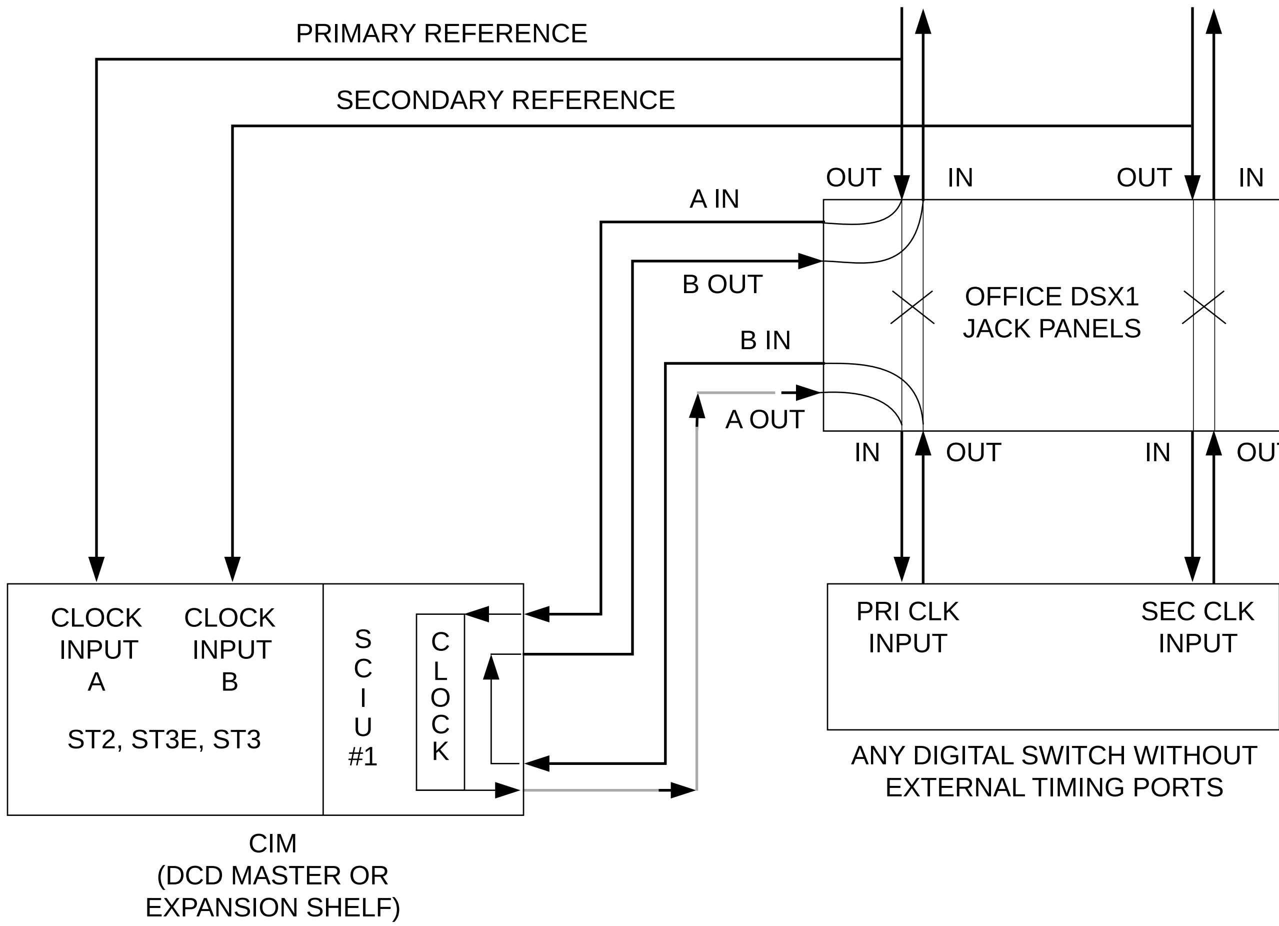


Figure 4. CIM System - Master Shelf



Notes:
1.The PRI side is shown for drawing clarity only.
2. ——► Indicates DCD-controlled clocking directions (WEST OUT or A OUT).
3.SCIUs may or may not be installed on same spans as clock input A and B.
4. ╳ This cross-connect is removed after installation of the SCIU.
5.Do not take DCD reference (clock input A and B) from "A OUT" side.

Figure 5. SCIU Card Interface to CIM

Input Signals

2.28 The reference for the CIM *must* be of Stratum-3 or 3E quality or better, as defined in ANSI-T1-101.

2.29 Input signals are arranged in pairs and designated A (primary) and B (secondary). The CIM input reference may be DS1, analog, CC, or DCD expansion bus signals. One input signal is applied to each CI (or ACI) card, which drives the ST3E/ST3 and SCIU cards. The ST3E/ST3 cards are phase-locked to the input signal and provide their own outputs to the SCIU cards.

2.30 Timing inputs to the standalone CIM may be either DS1 or CC signals of Stratum-3 or better quality, as defined in ANSI-T1-101.

2.31 DS1 input reference signals can be terminated by 100 ohms or bridged by the built-in high impedance bridging repeater. CC signals can be accepted from an existing office clock.

2.32 Analog input reference signals of 1, 2, 10, or 16 MHz can also be accepted if an ACI (Analog Clock Input) card is installed instead of a CI (Clock Input) card. This applies only in the CIM master shelf for a standalone system configuration.

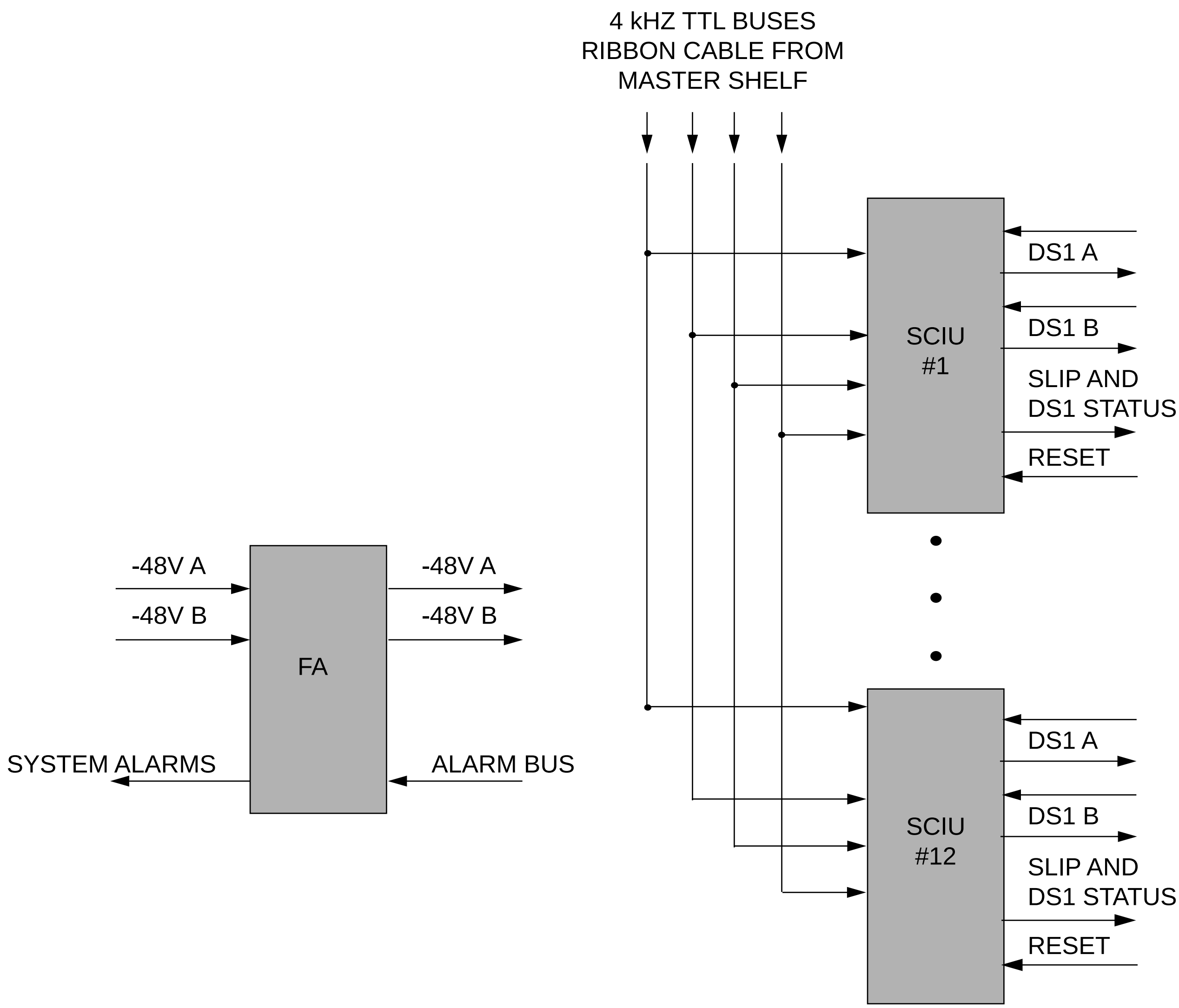


Figure 6. CIM System - Expansion Shelf

2.33 If the input reference to the clock input card (CI or ACI) fails, the ST3E/ST3 goes into holdover mode and continues to provide reference to the SCIU cards. In holdover mode, the CIM System continues to operate at Stratum-3E or Stratum-3 stability.

2.34 The SCIU may be optioned to automatically transmit a framed all-ones signal to the downstream devices. When its DS1 input circuit fails (LOS), this all-ones signal continues to provide traceable Stratum-2 or -3 timing from the DCD System. The SCIU may be optioned to be transparent and pass the LOS through to its output.

2.35 The CI (and ACI) cards reclock the input timing signals, rather than simply amplifying and repeating them. This removes any unwanted phase jitter and attenuates wander so it is not transferred to the outgoing DS1 facilities.

2.36 When used as an expansion shelf (Figure 6), the CIM shelf backplane is connected directly to the DCD master shelf via a ribbon cable; additional CI (or ACI) cards or ST3 cards are not required.

Slip Monitoring

2.37 Each SCIU performs bit and frame slip monitoring. The incoming DS1 is compared to the input reference, and the frame position in the elastic buffer within the SCIU is monitored. A change of one bit in the relative position of framing bits between the two signals causes a slip warning to be generated. As the count of bit slips is incremented, the SCIU sequentially lights its front panel slip counter lamps (0, 64, 128).

2.38 At 192-bit slips, a frame slip indication is given by lighting the SLIP lamp. After counting eight frame slips, the HI SLIP lamp is lit. The front panel RESET switch resets the SLIP and HI SLIP counters to zero and turns off the corresponding lamps, but does not affect the current values of the bit slip counters or lamps.

2.39 Status indicator outputs for E2A telemetry systems are provided on the shelf backplane. Major and minor or no office alarms are switch-selectable for each level of slip indication and for DS1 LOS.

DS1 Bypass Switching

2.40 Each SCIU card has two modes of protection:

a. An electronic bypass on the SCIU card is activated when the reference to the SCIU is not present or when manual bypass is activated.

b. A relay bypass on the shelf is activated when an SCIU card fails, is removed from the shelf, or shelf power is lost.

3. ST2 AND 400 MODES OF OPERATION

A. Power-Up

3.01 The oscillator of the ST3E/ST2 card takes up to one hour to warm-up. If there is no reference input available, the FREE RUN lamp flashes during the warm-up period, then lights steady. The ST3 card take up to 10 minutes for warm-up; a lamp indication is not available until input is detected. At this time, the REF A or REF B lamp lights.

3.02 If there is an input, the FREE RUN lamp flashes until the phase difference between the input and output of the ST3E/ST2 is within tolerance, then goes off. The REF A lamp lights if the signal from the CI A (or ACI A) card is being used; the REF B lamp lights if the signal from the CI B (or ACI B) card is being used.

3.03 The ST3E/ST2 card monitors the outputs of both clock input (CI or ACI) cards, and constantly compares the frequencies of the two cards. If the difference between the two is too great, the INP UNLKD lamp lights, and a minor alarm is generated.

3.04 Like the ST3E/ST2 cards, the ST3 monitors the outputs of both clock input (CI or ACI) cards, but instead checks for CI (or ACI) card failure, or whether the outputs are more than ±15 ppm out of lock range. If either condition is detected, the LOCK lamp lights.

3.05 The microprocessor and the power supply of the ST3E/ST2/ST3 card are constantly monitored. If either fails, the FAIL lamp lights.

B. Convergence

3.06 The output frequency of the synthesizer is adjusted to reduce the difference between it and the input frequency to the ST3E/ST2. The LOCKED lamp is lit when the phase difference between the input and output of the card is within the specified range.

3.07 While the output is converging on the input, the ACTIVE lamp is off. The ACTIVE lamp lights when the frequency difference between input and output is within range. Because only one ST3E/ST2 can be active (supplying the TOxA cards) at a time, the ACTIVE lamp lights only on the first ST3E/ST2 to converge.

C. Tracking

3.08 During normal operation, the output of the ST3E, ST2, and ST3 cards track its input signal. The frequency difference between input and output generates a correction signal which shifts the output frequency of the synthesizer in a direction to make the difference tend toward zero and acts as an "electronic flywheel" to buffer phase and frequency changes on the input.

D. Holdover

ST3E and ST2

3.09 The input frequency is sampled, and the samples are averaged over 24 hours and stored. The synthesizer uses this stored frequency to determine its output frequency when the input varies too far from center frequency and the ST3E/ST2 goes into holdover. The HOLD OV lamp lights until the input returns within range of the center frequency when the ST3E/ST2 comes out of holdover and the HOLD OV lamp goes off.

3.10 A switch on the ST2 shelf backplane can be set to generate either a major or minor alarm when both ST clocks are in holdover. If the input is too far from center frequency, the INP TOL lamp lights, and goes out when the input returns within range.

ST3

3.11 The ST3 card is based on a PLL operating at 3.089 MHz. The PLL output is compared to a voltage-compensated oscillator (VXCO), and an offset is generated to phase-lock to the input clock (CI A or B or ACI A or B). If an input source is unavailable or has failed, the circuit goes into clock holdover mode, at the frequency of the last valid input.

E. Timing Input Transfer

3.12 The ST3E, ST2, and ST3 cards monitor the 4-kHz output of both clock input (CI or ACI) cards. If both outputs are within tolerance, ST A will lock to clock input A and ST B will lock to clock input B. In the event one of the clock input cards fail or goes out of tolerance, the ST3E/ST2/ST3 automatically switches to the other clock input. The REF A or REF B lamp lights to show which clock input card is the reference. Manual transfers can also be made remotely by grounding a pin on the shelf backplane.

F. Output Transfer

> ***Note:*** The following explanation applies only to the ST3E/ST2 cards; there is no XFR switch on the ST3.

3.13 Manual output transfers are made by pressing the XFR button on the front panel of the ST card.

> ***Note:*** This is not recommended; pressing the XFR button on the front panel may cause hits on the output each time it is pressed.

G. TOxA Card Inputs

3.14 The TOxA cards automatically select the timing signal input of the highest priority. An ST card output will be used if available. If no ST is available, the TOxA will use the output of a clock input (CI or ACI) card. (For a list of input signal selection priorities, refer again to Table A.)

4. CARD FUNCTIONAL DESCRIPTIONS

A. AI Card (ST2 Master Shelf Only)

4.01 The Alarm Interface (AI) card (Figure 7) monitors input power from two -48V dc office batteries. Front panel jacks allow testing of A and B supplies at the input to the shelf. The -48V is passed to the CI (or ACI), ST2, TOxA, SCIU, and Matrix Controller cards, each of which contains a dc-to-dc converter to provide its own regulated dc voltages.

4.02 Output Alarms from the TOxA cards, input reference alarms from the clock input (CI or ACI) cards, and fail alarms from all cards in the shelf are bused to the AI card by the shelf alarm bus. Status indications including clock loss and port alarms are also monitored by the AI card. Depending on which alarms are received, the AI activates audible and visual alarm and status indicator (SI) outputs. An additional set of alarm status leads on the backplane enables either a major or minor alarm in the event of a battery failure or a blown fuse.

4.03 Major and minor alarm leads have both normally-open (NO) and normally-closed (NC) dry relay contacts. Major and Minor Status Indicators have normally open relay contacts only. All other status indicators are open-collector outputs between the SI lead and its return (SIR). No voltage potential exists on the SI leads, and they can be used to interface external systems with negative voltages such as -48V dc and -24V dc.

4.04 Alarm battery supply (ABS) is not required for the system. When dc power is lost to the shelf, the normally open relays close, initiating an office alarm.

4.05 A front panel alarm cutoff (ACO) pushbutton, when pressed, silences the office audible alarm and lights the ACO lamp. The ACO pushbuttons on all shelves in the system have the same effect. An external lead on the shelf backplane is provided for remote ACO operation.

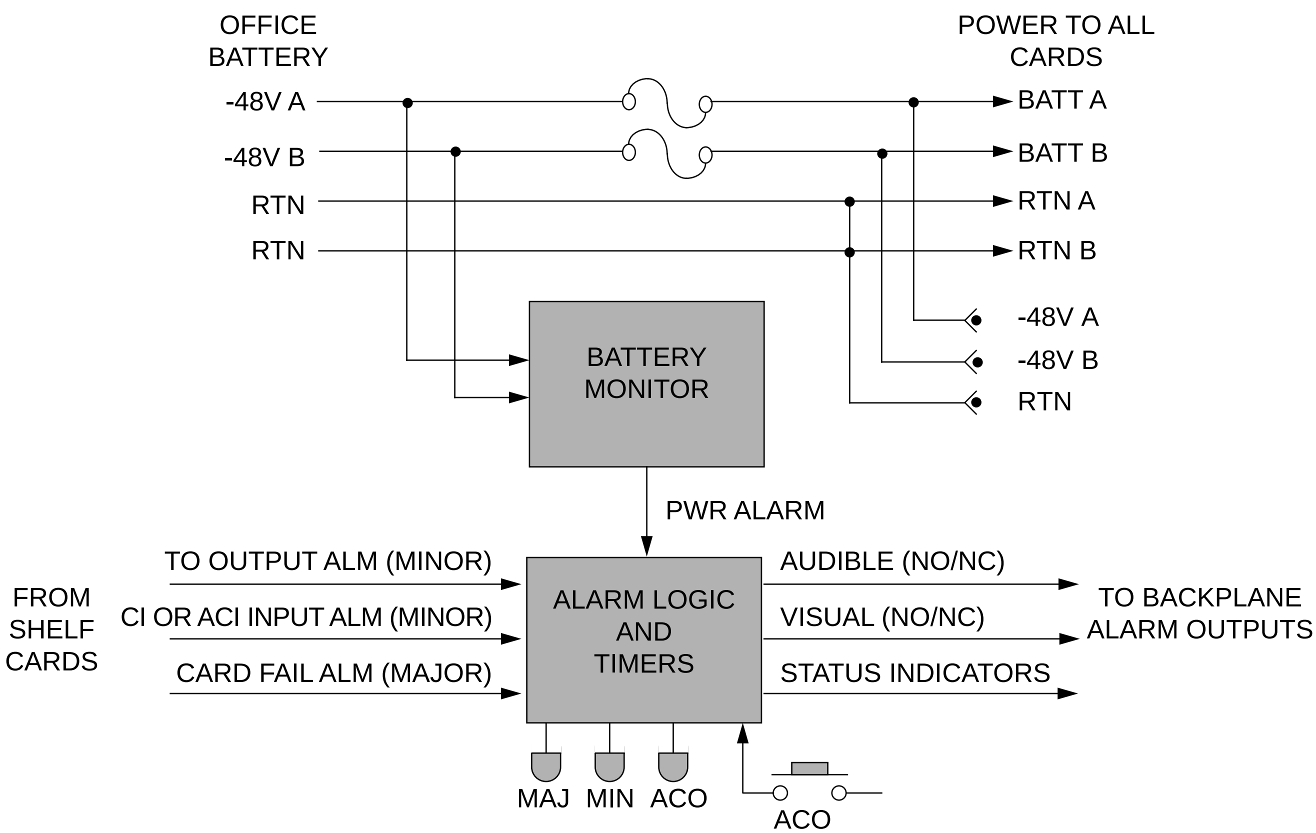


Figure 7. AI Card Block Diagram

B. FA Card (400 and CIM)

4.06 The Fuse and Alarm (FA) card (Figure 8) filters and provides fuse protection for two office batteries (-48V dc) from the office power distribution panel. Front panel jacks allow testing of the A and B supplies at the input to the shelf. The -48V is passed to the clock input (CI or ACI), ST3, TOxA, SCIU, and Matrix Controller cards, each of which contains a small dc-to-dc converter to provide its own regulated dc voltages.

4.07 Bypass fuses are provided on the backplane. If the FA card is removed, bypass relays automatically cut in the fuses to power the shelf. The FA card can be removed without interrupting service.

> ***Note:*** When the FA card is removed, alarm functions are not operational.

4.08 All other operations of the FA card are identical to the AI card, including alarms, alarm cutoff (ACO), and front panel lamps.

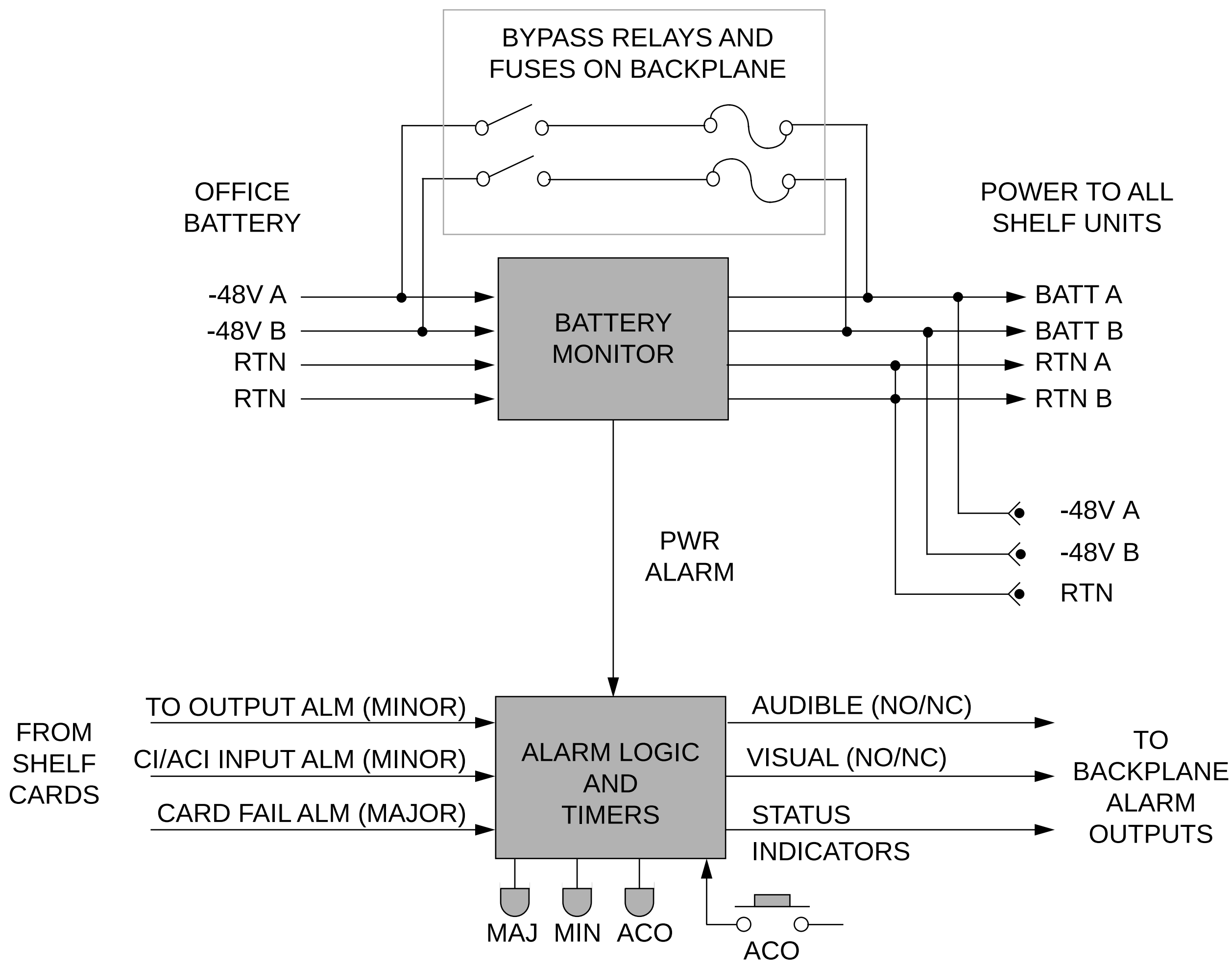


Figure 8. FA Card Block Diagram

C. CI Card

4.09 Two CI cards provide input signal redundancy. Each CI card uses one CC or DS1 input as its timing reference, as shown in Figure 9. A switch on the CI card selects the type of input and the framing format (if DS1) of the input timing signal. Front panel lamps (CC and DS1) show which type of input is selected.

> ***Note:*** The CC input from an existing office clock is used for Stratum-3 applications only.

4.10 The DS1 input can be either a terminated signal or a high-impedance signal via the built-in bridging repeater. Refer to Section 2, Installation, of this practice for recommended bridging connections.

4.11 For ST2 systems, under normal operating conditions, CI A drives ST A, and CI B drives ST B. Both input reference signals are simultaneously monitored, and if an input fails, the ST automatically switches to the other CI card, which then supplies both ST clock cards until the failed reference is restored. The SOURCE ACTIVE lamp on the front panel indicates which CI card is on-line.

> ***Note:*** Both CI cards are active if the system contains redundant ST2 cards. Only one CI card is active in systems with a single ST2 or with ST3E/ST3 cards.

4.12 Pressing the front panel transfer (XFR) pushbutton switches between the CI cards. The switch function is also brought out to an external lead on the backplane for remote control.

4.13 The CI card also contains a source control circuit which causes the card to switch to the redundant CI card if the primary card (defined as the card currently in operation) fails. Excessive bipolar violations (BPV) also cause the system to switch between CI cards.

4.14 Switching activity between CI A and CI B will not cause the timing outputs to transmit phase hits, as the phase information of the active signal is transferred to the redundant CI card before switching. A phase-locked crystal oscillator (PLXO) keeps the CI output stable while the transfer takes place. The PLXO also removes any phase jitter from the incoming signal before it passes the reference to the ST, TOxA, or SCIU cards.

4.15 If both CI cards fail, the ST2 or ST3E/ST3 cards go into holdover mode, and the system automatically uses the active stratum clock.

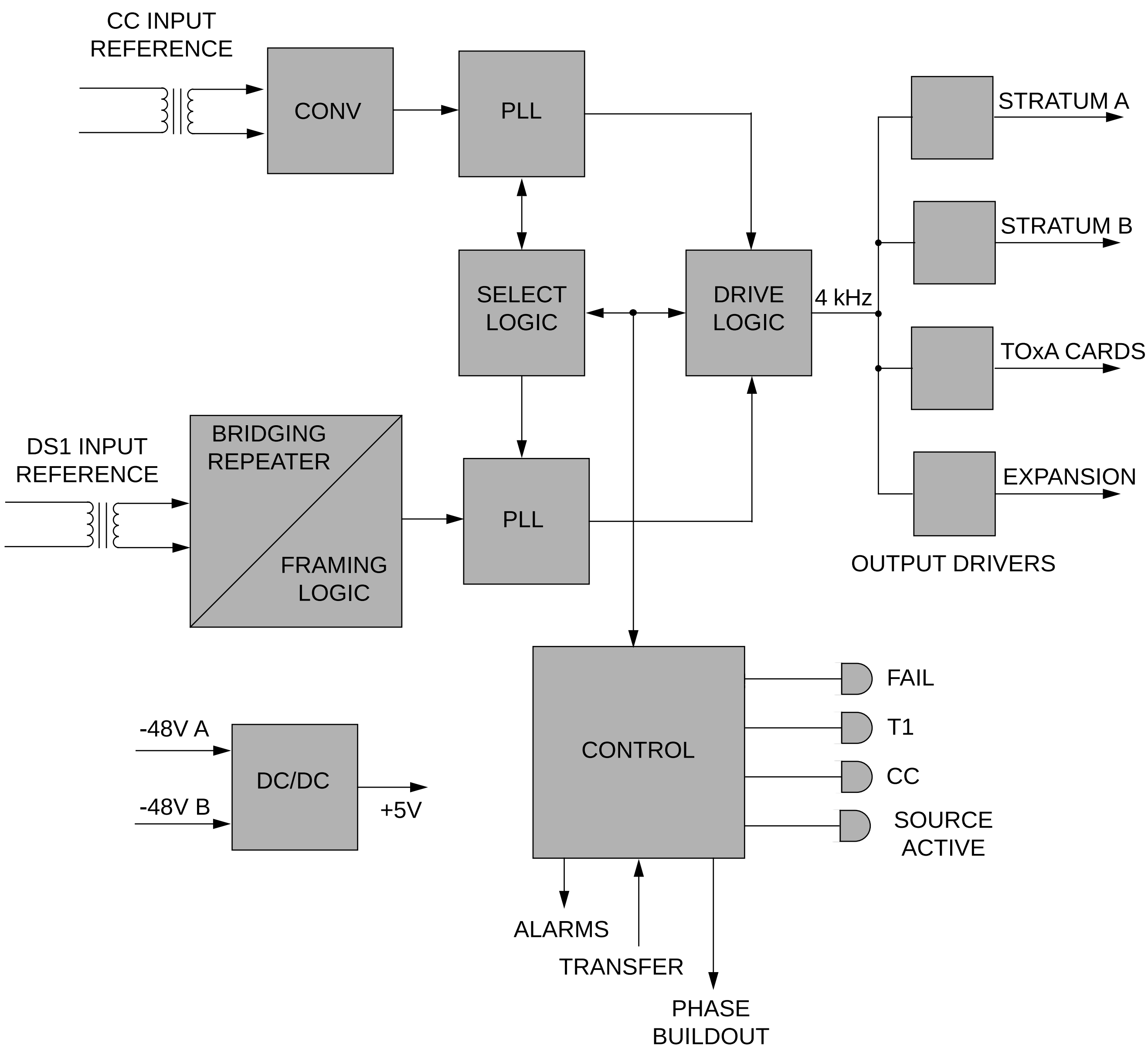


Figure 9. CI Card Block Diagram

D. ACI Card

4.16 The Analog Clock Input (ACI) card performs the same functions as the CI card, except its input reference signal is analog instead of digital. The ACI card (Figure 10) can accept inputs of 1, 2, 10, or 16 MHz, selected by the front panel frequency-select switches. The appropriate front panel lamp (1, 2, 10, or 16 MHz) lights to indicate the input frequency.

4.17 The analog input to the ACI card is converted to digital levels and sent to the clock recovery circuit. The output of the PLXO goes to the output drivers which send timing signals to the ST2 or ST3E/ST3 cards, the TOxA cards, and expansion shelves.

4.18 A monitor circuit checks the incoming signal, the locked status of the PLXO, and the +5V dc supply. If the incoming signal is degraded for 2 seconds, the source fail (SRC FL) lamp lights, and the PLXO maintains the previous frequency and phase. If the problem continues for more than two seconds, the FL lamp also lights. The FL lamp also lights if unlock occurs or if the +5 volt output of the dc-to-dc converter fails.

4.19 If input signal problems continue, the ACI initiates a transfer to the other ACI card, if installed. The SRC ACT lamp lights on the active ACI card. If the other ACI card also cannot supply timing, the active ACI goes into holdover.

4.20 A transfer between ACI cards can be manually initiated by pressing the front panel XFR switch. A remote transfer can be activated by placing a resistance of less than 1,000 ohms across the remote transfer pins on the rear of the shelf.

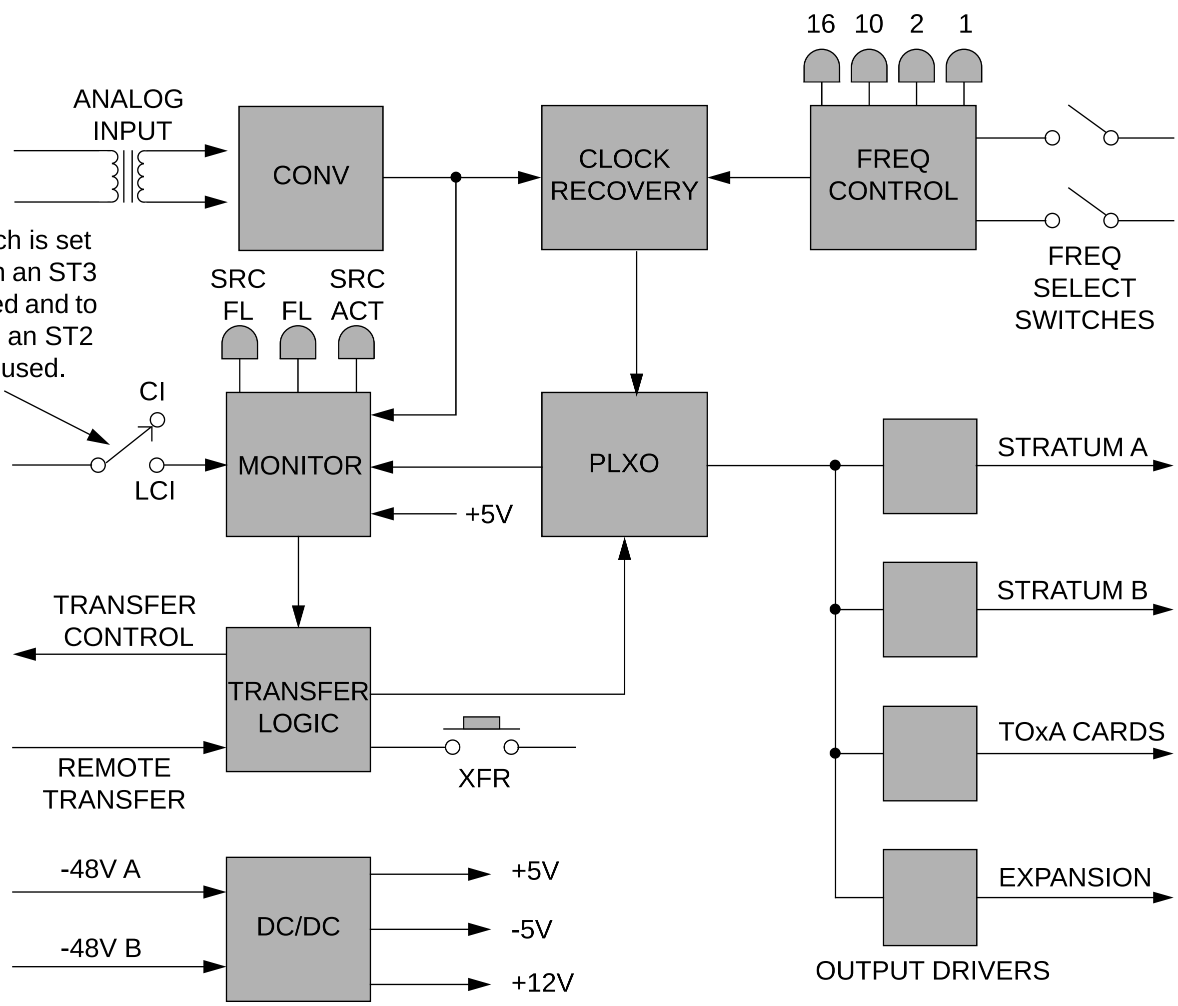


Figure 10. ACI Card Block Diagram

E. ST2E Card

4.21 The Enhanced Stratum-2 clock card (ST2E) (Figure 8) is almost identical to the ST2 clock card. Like the ST2 card, the ST2E provides a stable reference to drive the Timing Output (TOxA) cards. ST2E cards are normally configured to function as a pair and are used in the master shelf only.

4.22 The enhancements over the ST2 card include: extensive fault tolerants, and improved diagnostic capabilities. The ST2E also has the capability to interwork with Telecom Solutions' DCD-LPR System to provide PRS performance.

4.23 During normal operation, each ST2E is locked to its respective clock input card (i.e., CI A or CI B). A 4-kHz reference signal generated by the clock input cards is sampled for 5 minutes and averaged. At the end of the 5-minute period, a new averaged value is given to the synthesizer. This 5-minute value is combined with the 12 previous 5-minute samples and adjusted for the current temperature. Network wander filtering is achieved by this process in combination with microprocessor filtering.

4.24 The output of the ST2E is controlled by a 17-bit frequency synthesizer. Any frequency difference between the ST2E and the reference generates a change in the synthesizer frequency that moves the output towards a frequency difference of zero. If all reference outputs are precisely 4-kHz, no correction is given to the synthesizer.

4.25 The essential element of the ST2E is a rubidium atomic oscillator with a 24-hour holdover stability of that far exceeds ANSI and Bellcore required specifications. The oscillator is calibrated over a wide temperature range to provide additional stability during ambient temperature variations.

4.26 Each ST2E card monitors the frequency of the other ST2E card's 4-kHz signal and compares it to the clock input signals. If an out of range level is detected, the ST2E cards initiate an "inputs unlocked" status. This merely means that the respective input signals to each ST2E have drifted apart from one another. This is not a service affecting phenomenon. Note however, the ST2E remains active and tracks the respective input. If a problem is detected on the output, the SRC A or B lamps, depending on which card has the problem, will illuminate as per the following:

- If the ST2E is tracking the output of clock input card, the lamp will light green.
- If the reference from the clock input card is disqualified, the lamp will light red.
- If the reference from the clock input card is missing, the lamp goes off.
- If the input reference from the clock input card is drifting, the lamp flashes green.

4.27 All transfers, clock input and ST2E cards, are performed without hits on the internal 4-kHz reference bus by transferring the phase information to the backup card. If an input reference signal fails to meet ST2E input tolerance requirements, the secondary source will be selected. This action will result in a phase movement at the output, according to ANSI and Bellcore specifications. Finally, if all available reference signal inputs are not within the Stratum-2 pull-in range, the ST2E enters into holdover.

4.28 When the ST2E enters holdover, the 36 previous 1-hour averages are retrieved from a history file in RAM. The most recent 12 are discarded and the remaining 24 are averaged with the current temperature value to establish a holdover center frequency value for the synthesizer.

4.29 If, for any reason, the processor detects that maintenance is required on the ST2E card, the OSC lamp flashes red if the oscillator has failed, which disables the ST2E card output; flashes green if the card requires factory maintenance (flashes for approximately two weeks).

4.30 None of the frequency and phase comparisons or transfers are made with only one ST2E card. The "inputs unlocked" lamp is inoperative. The transfer switch, in this case, transfers the clock input reference rather than the active ST2E when operating as a pair.

4.31 All status lamps on the ST2E front panel are duplicated as ALARM status leads on the shelf backplane. A switch option on the DCD backplane is provided to enable either major or minor alarm status when both ST2E clocks are in holdover mode.

4.32 With both input cards installed, each ST2E indicates an active status. However, only one ST2E will indicate that it is using one of the two possible inputs by lighting the SRC A or SRC B lamp. The output cards select the ST2E in the STA slot as the preferred clock. The ST2E in STB slot becomes the preferred clock only if one of the following conditions occur:

a. The ST2E in the STA slot fails.

b. The DSBL pushbutton switch on the ST2E faceplate in clock slot A is pressed (this switch is pressed only if the card is going to be removed - once the switch is pressed, the output will be disabled for up to 20 minutes).

Note: The DSBL pushbutton on the ST2E card installed in clock slot B does not function (ST2E B cannot be disabled).

4.33 The outputs from both ST2E cards and both clock input cards, are available to the timing output cards for selection based on preset priorities (refer to Table A for priorities).

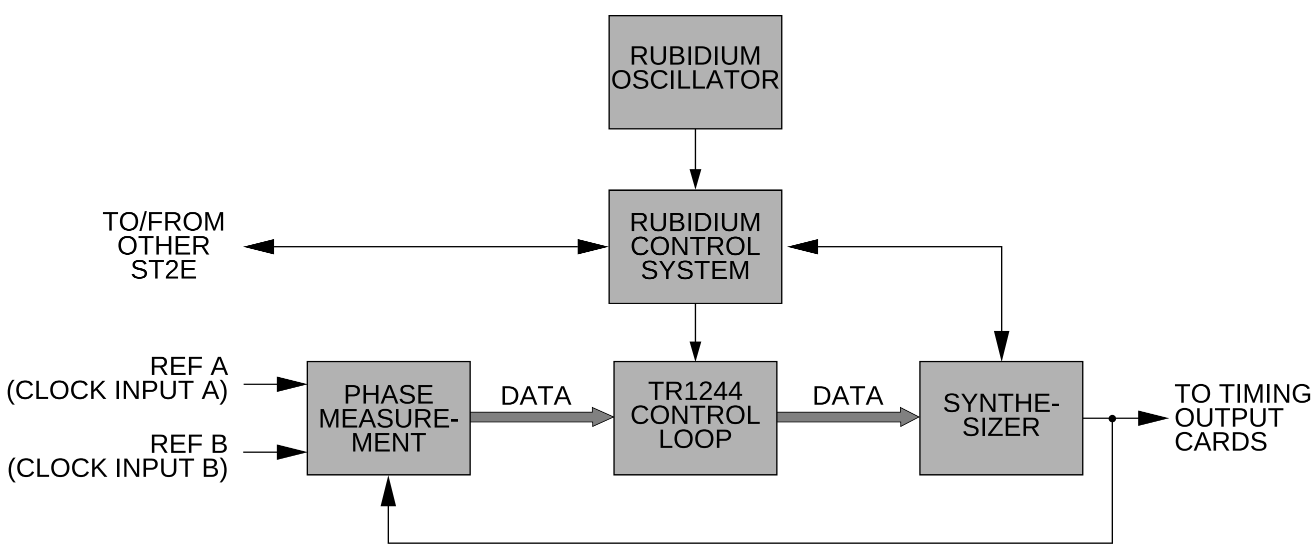


Figure 11. ST2E Card Block Diagram

F. ST2 Card

4.34 The ST2 clock card (Figure 11) provides a stabilized reference to drive the TOxA cards. ST2 cards are normally configured to function as a pair. ST2 A receives its reference from CI A (or ACI A) and ST2 B receives its reference from CI B (or ACI B).

4.35 During normal operation, each ST2 is frequency-locked to its respective CI (or ACI) card. The 4-kHz reference from the clock input (CI or ACI) cards are sampled for 5 minutes and the samples are averaged. At the end of the 5-minute period, the new averaged value is given to the synthesizer. This 5-minute value is combined with the 12 previous 5-minute samples and adjusted for the current temperature.

4.36 The output of the ST2 is controlled by a 17-bit frequency synthesizer. Any frequency difference between the ST2 card and the reference generates a change in the synthesizer frequency in steps of 1×10^{-12} Hz which moves the output towards a frequency difference of zero.

4.37 The heart of the ST2 card is a rubidium atomic oscillator with a 24-hour stability of 4×10^{-11} which operates at near Stratum-1 accuracy (1×10^{-11}). Temperature compensation is provided for each oscillator to ensure a stable output. The frequency synthesizer can accommodate temperature and aging variations over the expected life of the ST2.

4.38 The active ST2 card compares its 17-bit synthesizer value to the 17-bit synthesizer value of the other ST2. Each ST2 card also monitors the frequency of the other ST's 4-kHz signal and compares it to the clock input (CI or ACI) cards. If a frequency difference of greater than $\pm 1.0 \times 10^{-9}$ is detected, the ST2 cards initiate an "inputs unlocked" status, but continue to be active and track the input.

4.39 The input and output of the ST2 is separated by a microprocessor, the DCD-ST2 is able to filter out unwanted wander from the incoming reference.

4.40 If problems are detected in the ST2 card or in the input reference signals (other than out-of-tolerance, $\pm 1.6 \times 10^{-8}$), the ST2 initiates a transfer to remove the bad card/signal from the system. All transfers, CI (or ACI) and ST2s, are performed without hits on the internal 4-kHz reference bus by transferring the phase information to the backup card. In addition, if a single input is out of the Stratum-2 window ($\pm 1.6 \times 10^{-8}$), the corresponding ST2 will go into holdover.

4.41 If the ST2 cannot lock to its respective clock input reference (CI or ACI), it switches to the other clock input card. ST2 A and ST2 B both lock to clock input B when clock input A fails. If both clock input references fail or are out of Stratum-2 tolerance, the ST2 clocks go into holdover mode. When this occurs, the previous 36 1-hour averages are retrieved from a history file in RAM. The last 12 are discarded and the remaining 24 are averaged with the current temperature to give a holdover value for the synthesizer. As the ST2 cards go into or out of holdover, or switch to the output of the other clock input (CI or ACI) card, the active ST2 remains active.

4.42 If, for any reason, the processor detects that maintenance is required on the ST2 card, the REF lamp flashes (depending upon which the ST2 is locked to, REF A or REF B). A minor alarm is issued. The alarm may be retired by pressing the XFR front panel pushbutton. The REF lamp will continue to flash, indicating that maintenance is required and that the card *must be replaced within 180 days*.

4.43 While the maintenance (REF) lamp is flashing, the ST2 clock continues to operate normally. However, after 180 days or more, the ST2 may go into a failure mode, in which it is taken off-line, the FAIL lamp lights, and a major alarm is generated. The active status transfers to the other clock in the system.

4.44 None of the frequency and phase comparisons or transfers are made with only one ST2 card. The "inputs unlocked" lamp is inoperative. The transfer switch, in this case, transfers the clock input (CI or ACI) reference rather than the active ST2 when operating as a pair.

4.45 During normal operation, after an initial 1-hour stabilization period, the ST2 maintains a maximum time interval error (MTIE) of less than 10 ns. All status lamps on the ST2 front panel are duplicated as E2A status leads on the shelf backplane. A switch option on the DCD-ST2 backplane is provided to enable either major or minor alarm status when both ST2 clocks are in holdover mode.

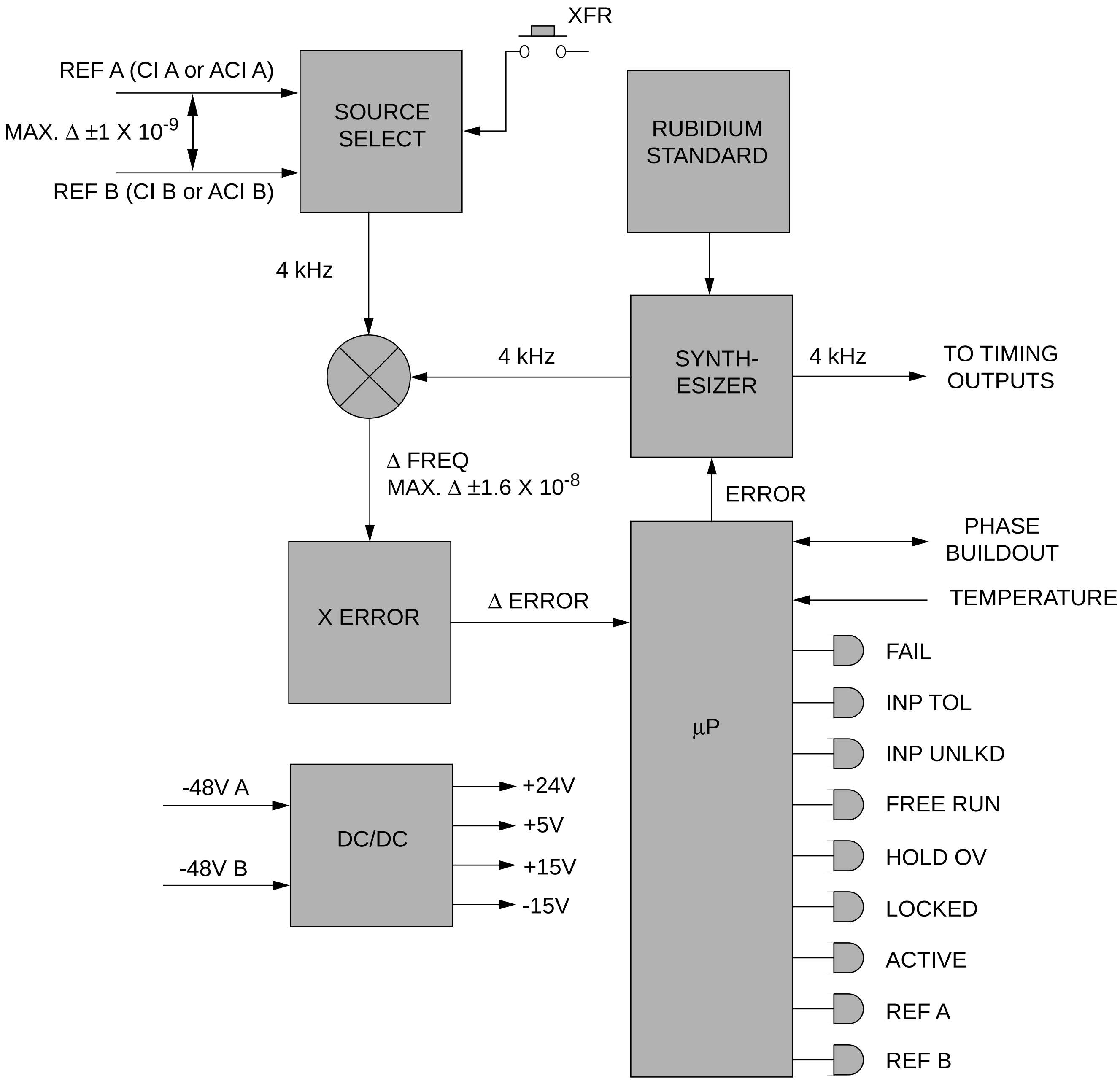


Figure 12. ST2 Card Block Diagram

G. ST3E Card

4.46 The ST3E card is very similar to the ST3 card, but provides a greater degree of accuracy and filtering. Both cards use the same slots of the same shelves, but the two card types cannot be mixed in the same shelf.

4.47 As shown in Figure 12, two 4-kHz signals from the reference clock input (CI or ACI) cards enter the source sample circuit. The frequency of these signal samples are compared with the 4-kHz signal output of the synthesizer. The frequency difference is sent to the microprocessor.

4.48 The main input to the synthesizer is the output of an oven-controlled crystal oscillator (OCXO) with a 24-hour stability near Stratum-2 quality. A switch on the ST3E card selects the pull-in range. The two possible ranges are: $\pm 5.6 \times 10^{-6}$ or $\pm 2 \times 10^{-6}$.

4.49 The other input to the synthesizer is a correction signal once per second from the microprocessor. This signal changes the synthesizer output frequency in a direction to cause the difference frequency out of the comparator to be zero. Changes to the synthesizer are in frequency steps of 5×10^{-10} Hz which allows the synthesizer to act as an "electronic flywheel" and buffer phase and frequency changes on the input.

4.50 The output of the synthesizer becomes the 4-kHz timing output of the ST3E card. The synthesizer has enough range to accommodate aging variations over the life of the card.

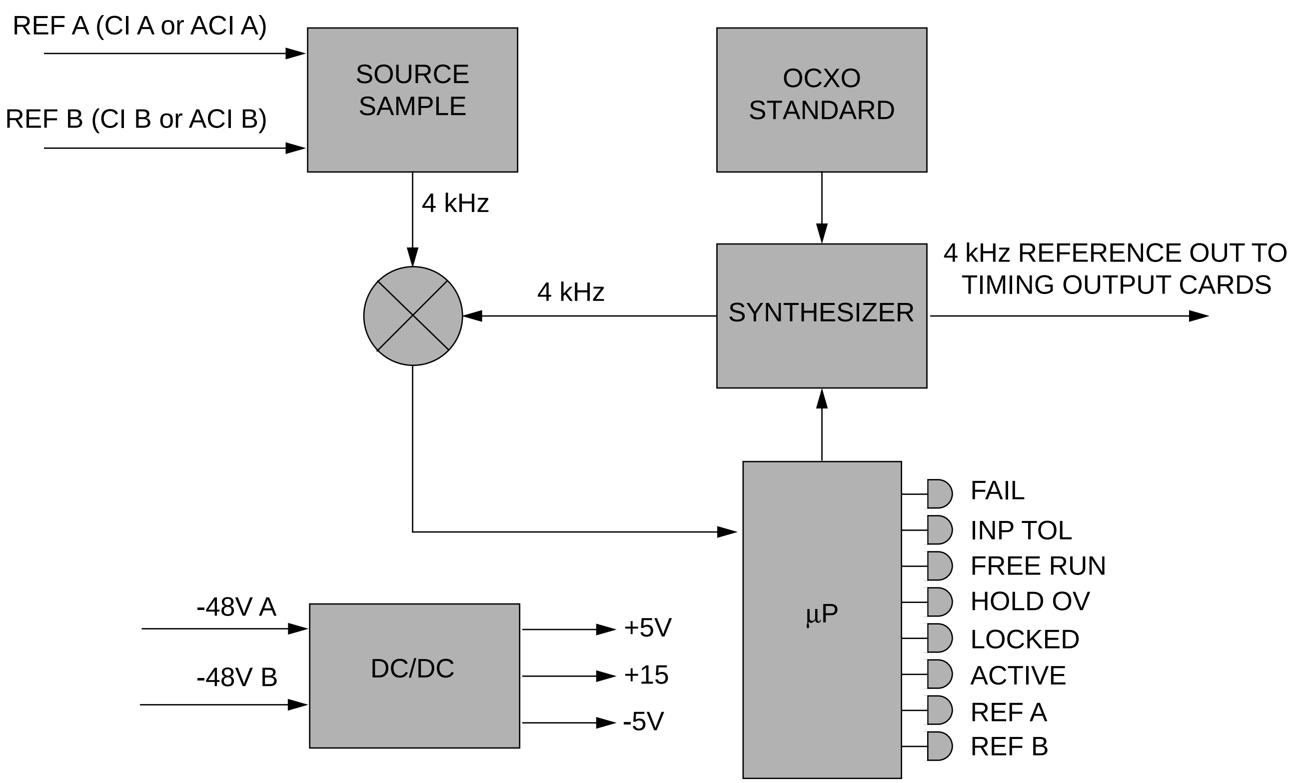


Figure 13. ST3E Card Block Diagram

H. ST3 Card

4.51 The Stratum-3 (ST3) clock card (Figure 13) provides timing signals at Stratum-3 accuracy on the main bus to drive the TOxA cards. Select logic on each TOxA and SCIU card automatically chooses the input timing signal of the highest priority (refer to Table A).

4.52 The ST3 card is based on a PLL operating at 3.089 MHz. The PLL output is compared to a voltage-compensated oscillator (VXCO), and an offset is generated to phase-lock to the input clock (CI A or B or ACI A or B).

4.53 If an input source is unavailable or has failed, the circuit goes into clock holdover mode, at the frequency of the last valid input. The ST3 then provides clock to the TOxA cards at an accuracy of ±0.15 ppm, for a minimum of 24 hours. If the DCD System is started without an input reference, the ST3 maintains ±0.5 ppm accuracy.

4.54 The output timing signal is placed on a common bus for use by all TOxA and SCIU cards in the system. If both ST3 cards fail, a major system alarm is issued and the TOxA cards use the output of the clock input (CI or ACI) cards.

4.55 A phase buildout circuit between the two clock input (CI or ACI) cards and each ST3 clock prevents transients from being transmitted to the TOxA cards when there is a transfer between the two ST3s.

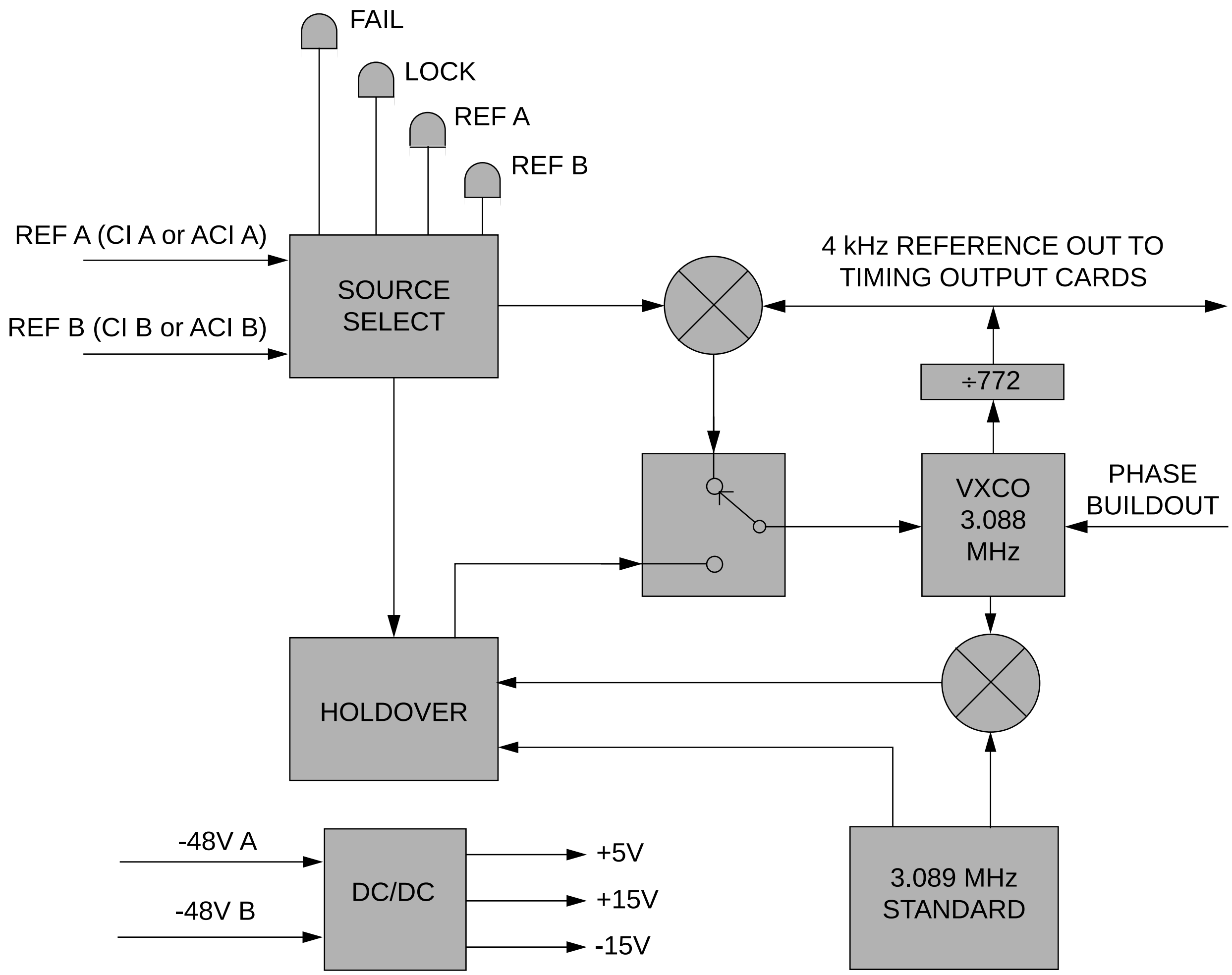


Figure 14. ST3 Card Block Diagram

I. TOCA Card

4.56 Figure 14 is a block diagram of a Timing Output Composite Clock (CC) Automatic card (TOCA). The card provides 10 composite clock timing outputs.

4.57 The TOCA's output timing signal generator is always enabled. Individual ports can be placed in high-impedance state (turned off) by inserting a shorting plug in the appropriate front panel jack. This feature is used primarily during in-service testing.

4.58 A bus selector circuit obtains the timing signal from either the ST A, ST B, CI A, or CI B cards (or ACI A or ACI B) according to the priority as shown in Table A. If no input timing signals are present on the buses, the TOCA card turns off both its ST and INPUT lamps, lights the FAIL lamp, and mutes the outputs.

4.59 A phase-delay circuit, controlled by the cable compensation switches, reconstitutes the internal timing signal with an additional delay applied to its output signal. The delay is one frame width plus a negative phase delay to compensate for cable runs of 0 to 1,500 feet, in 500-foot increments. Thus, the output timing signal can drive external timed devices located at cable distances of up to 3000 feet from the DCD.

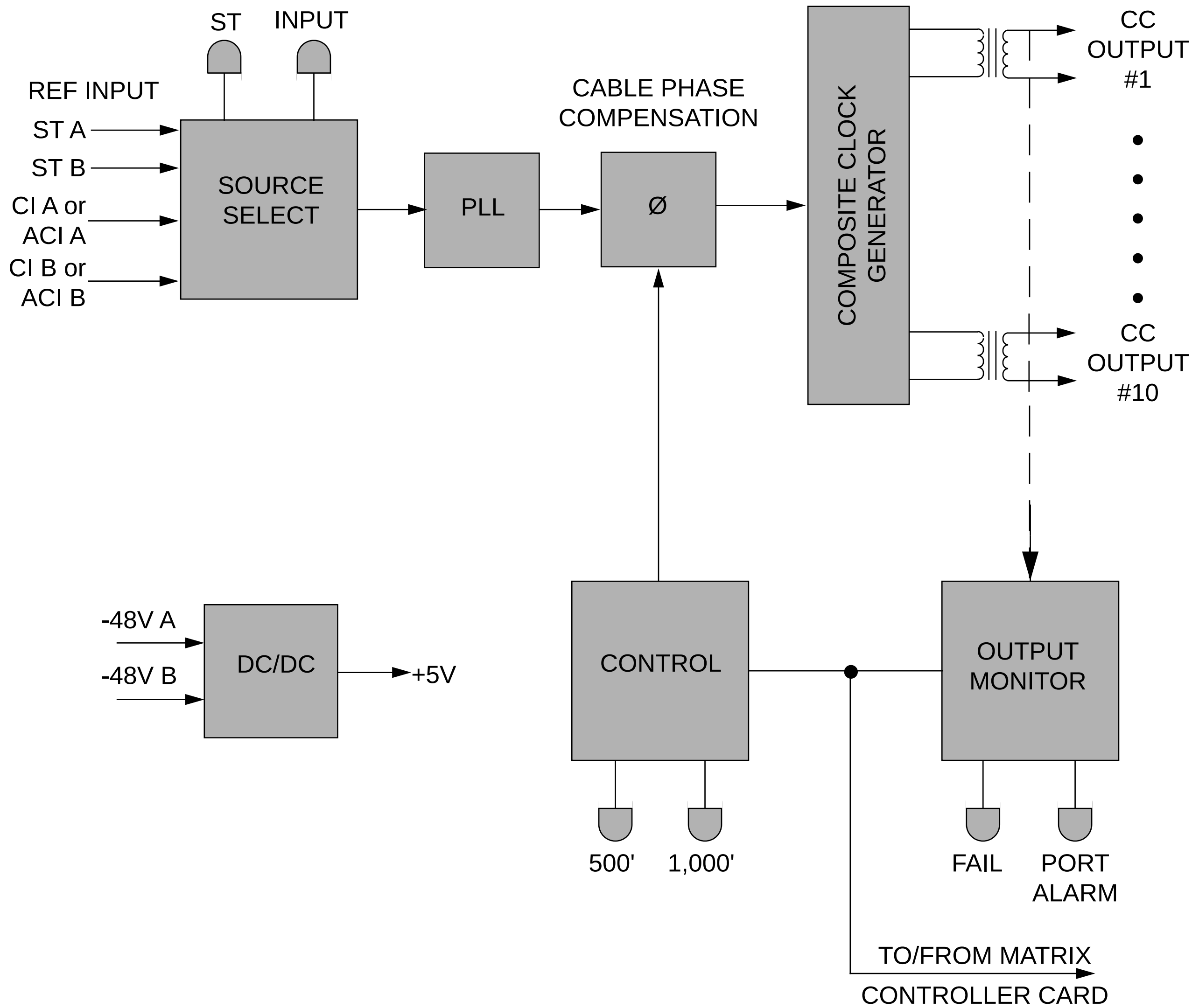
4.60 The reconstituted and delayed CC timing signal is then applied to each port driver through an impedance-matching transformer. A CC output port can drive up to six external devices.

4.61 An activity monitor determines if any of the output ports have failed, lights the front panel PORT ALM lamp and generates a minor alarm. The TOCA outputs are switched automatically by the Matrix Controller card to an HS card of the same type, if equipped. If all 10 ports lack an output signal, the output monitor lights the FAIL lamp and issues a major alarm.

4.62 If there has been a switch to an HS card, pressing the TO pushbutton switch (above the card whose PORT ALM lamp is lit) identifies the failed port on the Matrix Controller card front panel lamps. If the port alarm transfers to the HS card and the failure is external to the TOCA card, the outputs switch back to the original TOCA. The outputs of that card are locked from further switching unless a new alarm occurs.

4.63 When a switch occurs, the cable compensation switch settings are also automatically transferred to the HS card and are indicated on its front panel lamps. Switching can be performed manually by using the switches on the protection matrix.

4.64 When option switch SW1-2 (of the TOCA card) is in the LOCAL (ON) position, the TOCA/Matrix Controller card combination disables the output signal, registers a port alarm, and initiates an HS switch if a disabling pin is inserted into one of the disable jacks on the front panel of the TOCA card. If in the OFF position, the output signal is disabled, but an HS switch will not occur if a disabling pin is inserted into one of the jacks.



Note: TOCA and TOTA clock leads that are installed but unterminated, may cause false alarms in the DCD shelf. All cabled clock leads must be attached to equipment or to a 100 - 135 ohm resistor. It is not necessary to terminate the unused ports to any TOCA or TOTA card at the DCD wire-wrap panel.

Figure 15. TOCA Card Block Diagram

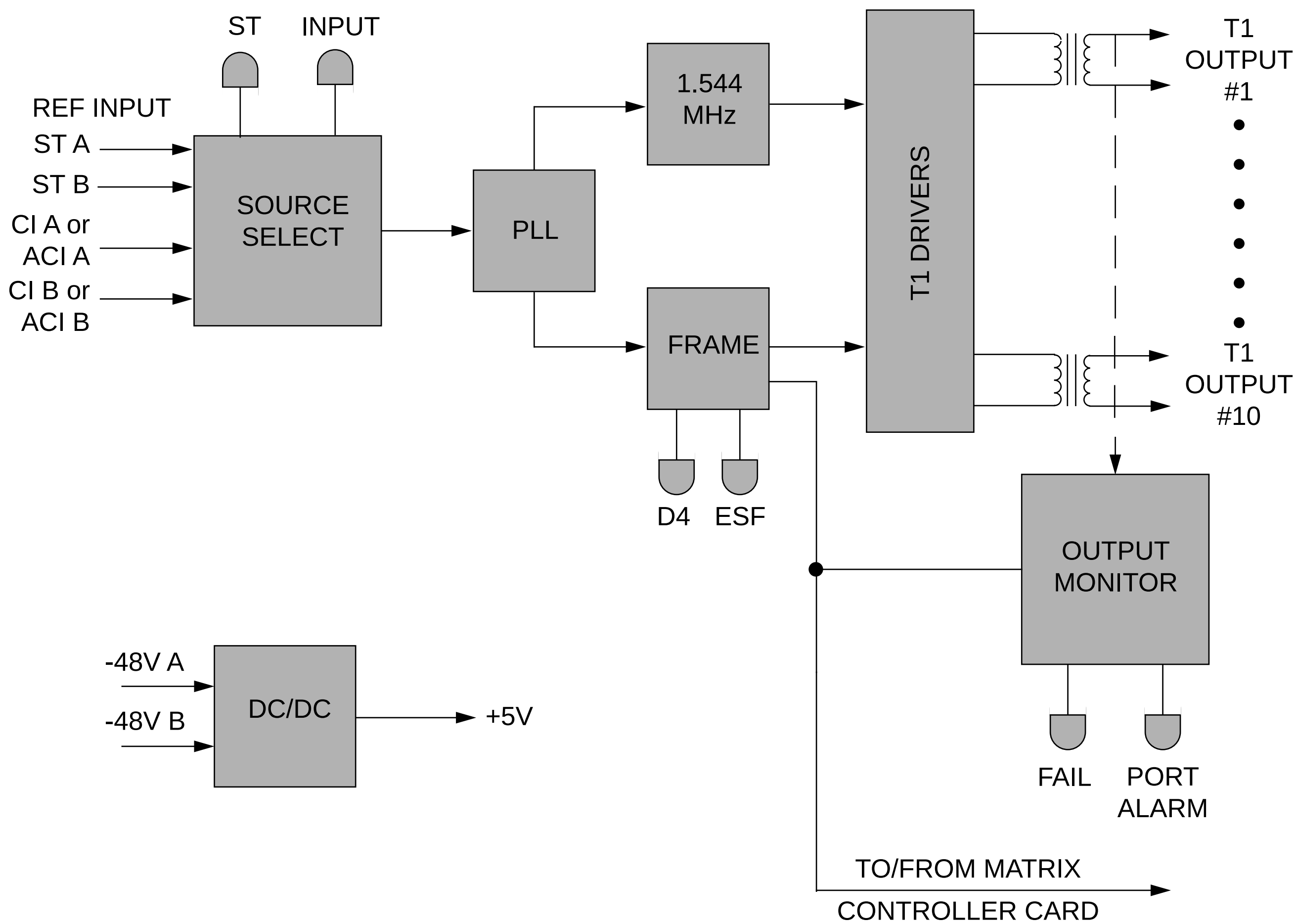
J. TOTA Card

4.65 The Timing Output DS1 Automatic (TOTA) cards (Figure 15) provide 10 T1 timing outputs (1.544-MHz). The TOTA is similar to the TOCA, in that it uses the same reference inputs. The TOTA differs from the TOCA cards in the following respects:

a. TOTA cards have no cable compensation capabilities; external devices must be located within 655 cable feet of the output port. A DS1 output port can drive up to two external devices.

b. TOTA cards contain an option switch which selects the output signal framing format (D4 or ESF). The framing format settings are also transferred to the HS TOTA card upon switching.

c. The TOTA output timing signals are framed all-ones (DS1).



Note: TOCA and TOTA clock leads that are installed but unterminated, may cause false alarms in the DCD shelf. All cabled clock leads must be attached to equipment or to a 100 - 135 ohm resistor. It is not necessary to terminate the unused ports to any TOCA or TOTA card at the DCD wire-wrap panel.

Figure 16. TOTA Card Block Diagram

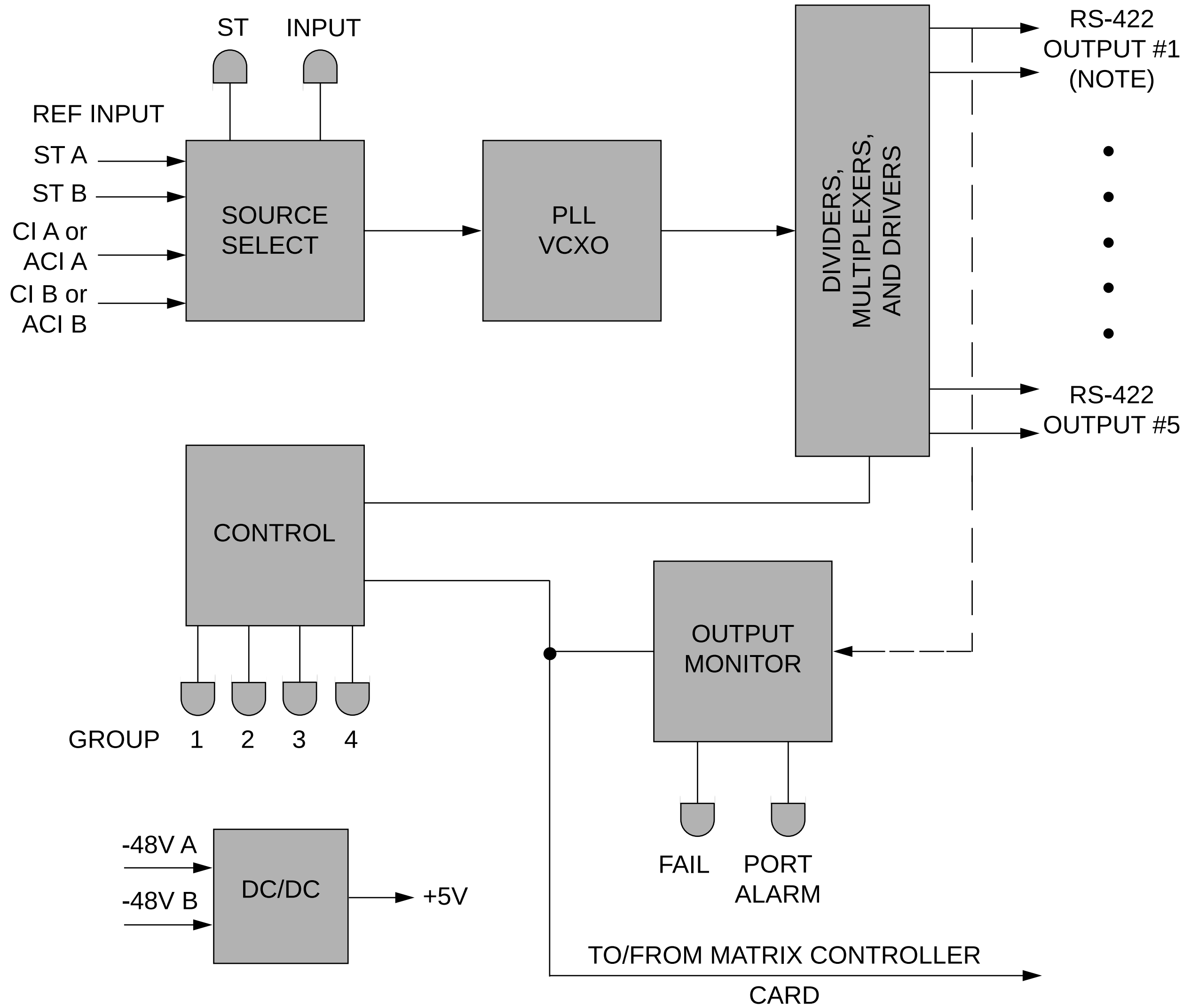
K. TOLA Card

4.66 The Timing Output Logic Level Automatic (TOLA) card comes in four models (-01, -02, -03, and -04). Each model provides five timing outputs whose frequencies are switch-selectable from one of four groups. The output frequencies in each group for the four card models are shown in Table B. Front panel lamps indicate which group has been selected.

4.67 The timing outputs for the -01, -02, and the -04 models are RS-422. By connecting between one side of the RS-422 output and ground, up to 10 TTL (RS-423) outputs are supported. The outputs of the -03 card are RS-232 only and cannot be configured as TTL outputs.

4.68 Refer to Figure 16. A bus selector circuit obtains the 4-kHz timing reference signal from the highest priority input as shown in Table A. If no input timing signals are present on the buses, the TOLA card turns off both its ST and INPUT lamps, lights the FAIL lamp and mutes the timing outputs. The 4-kHz reference is fed into a phase-locked loop (PLL) and VCXO circuit, and then to a group of dividers and multiplexers which drive the outputs. If the TOLA fails, the APS function transfers its switch settings to an HS TOLA, if equipped, and the relay matrix connects the outputs to the HS card. A PLXO helps to stabilize the timing outputs while switching activities occur.

4.69 The RS-422 and RS-232 outputs are fed to the modular mounting panel, which should be equipped with one DB9 output kit (5 connectors) for each TOLA card installed. For access to network equipment requiring logic level (RS-423) timing, the wire-wrap panel is used.



Note: The -03 model provides RS-232 only. For TTL outputs (-01 and -02 only), use one side of the RS-422 driver and ground for each of TTL outputs 1 - 10.

Figure 17. TOLA Card Block Diagram

L. TOAA Card

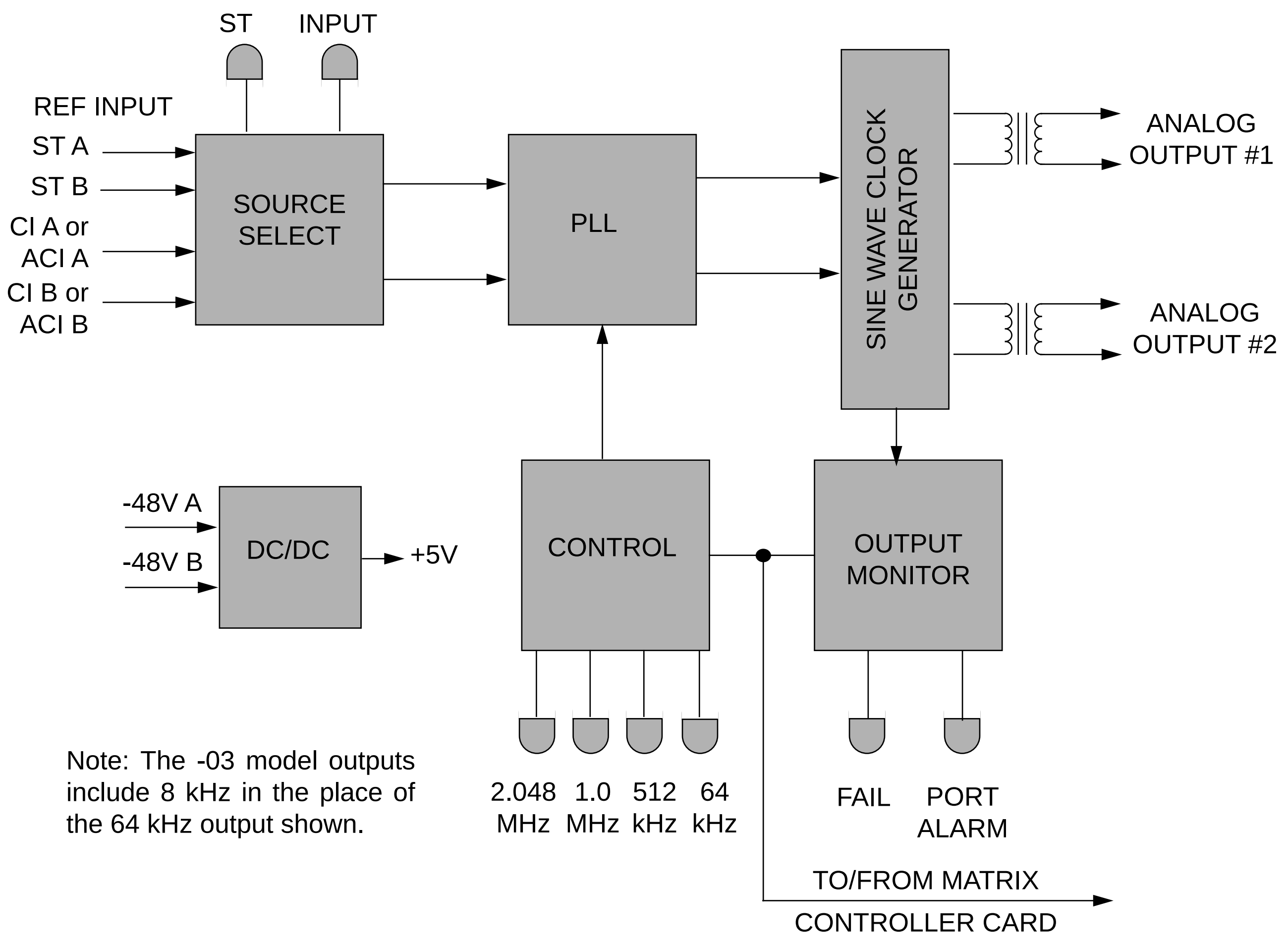
4.70 Figure 17 is a block diagram of the Timing Output Analog Automatic (TOAA) card. Two 1V rms sine wave outputs have selectable frequencies of 2.048 MHz, 1.0 MHz, 512 kHz, or 64 kHz. Three different TOAA models are available (-01, -02, -03). The -01 and -02 models differ only in output impedance, with the -01 card at 75 ohms, and the -02 card at 50 ohms. The -03 model provides an 8-kHz signal in place of the 64-kHz output shown, with a 75-ohm output impedance.

4.71 A bus selector circuit obtains the 4-kHz timing reference signal from either the ST or the CI cards according to the selection priority shown in Table A. If no input timing signals are present on the buses, the TOAA card turns off its ST and INPUT lamps, lights the FAIL lamp and mutes the timing outputs.

4.72 The 4-kHz reference is fed into a phase-locked loop (PLL). Switch settings select the sine wave generator output frequency from one of four available frequencies. Front panel lamps indicate the selected frequency.

4.73 The TOAA outputs are fed to the Modular Mounting panel which should be equipped with a BNC output kit for each TOAA installed. A selection of plug-in, level-coordinating attenuators (0, 3, 30, and 60 dB) are provided with the BNC output kit. Ideally, the level should be attenuated at the terminating end of the cable.

4.74 If the TOAA fails, its switch settings are transferred to an HS TOAA, if equipped, and the Matrix Controller card causes the relay matrix to connect the HS card to the outputs.



Note: The -03 model outputs include 8 kHz in the place of the 64 kHz output shown.

Figure 18. TOAA Card Block Diagram

M. Matrix Controller Cards and Output Protection Matrix

4.75 Output protection for the DCD Systems may be either automatic or manual. Both methods require a Matrix Controller Automatic (MCA or MCA-2) card (Figure 18), and HS TOxA cards. Each DCD shelf contains slots for two HS cards.

4.76 Although the DCD shelves are equipped with two HS positions, only one HS TOxA can be switched in service at a time. There are four different TOxA card types and two HS slots per shelf.

> ***Note:*** The Hot Spare function does not operate with the SCIU card.

4.77 The output protection switch matrix is located just above the DCD shelf card slots, and is controlled by the Matrix Controller card. The switch matrix contains the HS signal bus, pushbutton switches to select the TOxA and HS card outputs, and a lamp for each TOxA and HS slot.

4.78 For manual activation of output protection, the pushbutton for the failed TOxA card and its HS card must be pressed simultaneously and held down until both lamps light (about 2 seconds). To manually return a TOxA card to service, the TOxA and HS TOxA pushbuttons must be pressed simultaneously and held until both lamps turn off.

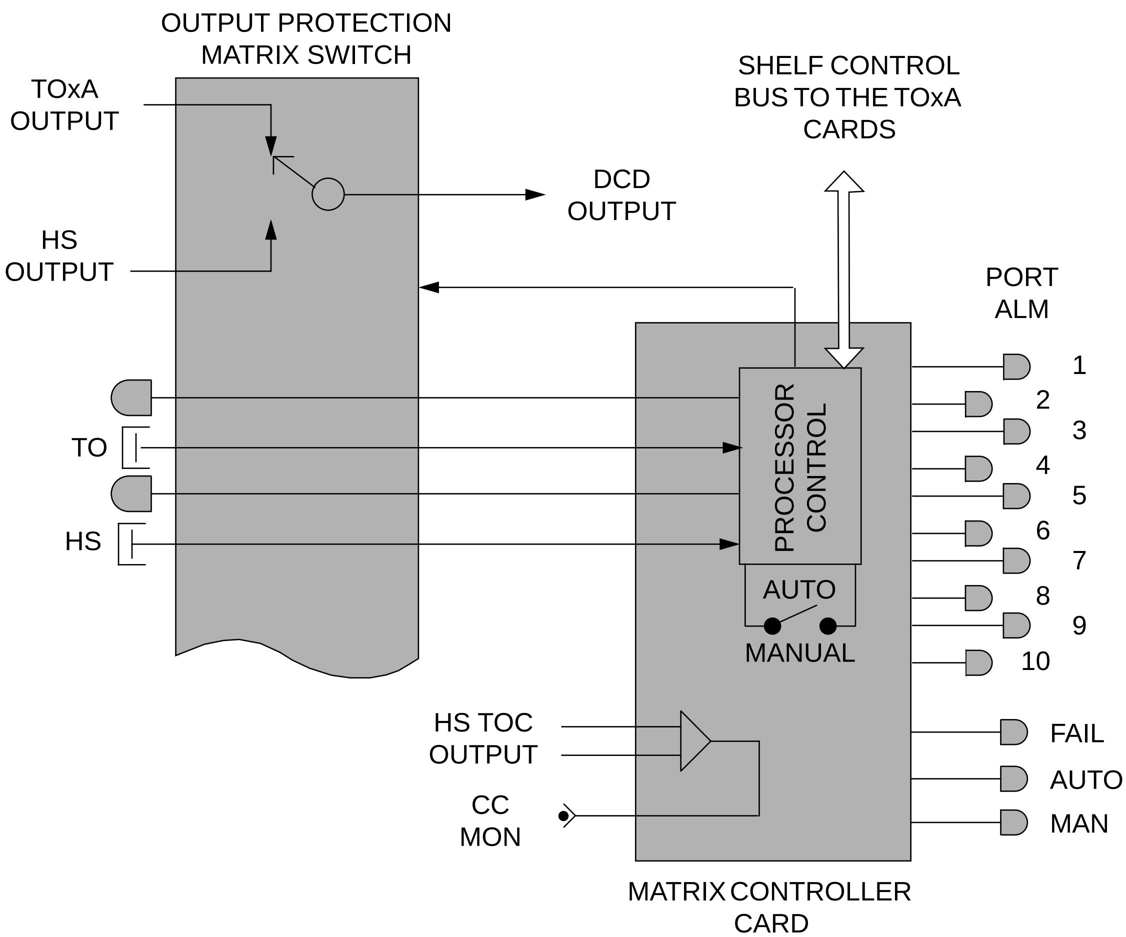


Figure 19. MCA and MCA-2 Card and Output Protection Matrix

4.79 The Matrix Controller card monitors the protection matrix pushbuttons for activation, and the TOxA cards for port alarms. When an active TOxA fails, is removed, or the proper sequence of buttons is pressed, the Matrix Controller card activates the relays and lamps in the protection matrix and switches in the appropriate HS card, if equipped. The AUTO and MAN lamps on the Matrix Controller card front panel indicate whether switching was initiated automatically or manually.

4.80 After switching has taken place, individual port alarms can be identified by pressing the pushbutton above the failed card. This action lights the corresponding PORT ALM lamp (from 1 to 10) on the Matrix Controller card front panel.

4.81 An HS card cannot accidentally be placed inservice, and an active TOxA card cannot accidentally be taken out of service. Activating the HS card requires that the Matrix Controller card detect a TOxA failure or that the front panel pushbuttons be pressed in the correct sequence.

4.82 Whenever manual or automatic protection switching takes place, the TOxA cards automatically transfer their option switch settings and port alarms to the HS TOxA card.

4.83 The Matrix Controller switches the failed port to the HS TOxA. If the failed condition persists, the Matrix Controller switches back to the original port. (This is an indication of an external short.)

4.84 The Matrix Controller card provides an isolated CC output at the front panel jack for monitoring and testing. This signal is output #1 of the HS TOCA card, if installed. The front panel CC output is still available when the HS TOCA is used as a spare.

4.85 Though physically and functionally similar, three features distinguish the MCA-2 from the MCA:

a. If theMCA-2 card experiences a communications loss or intermittent communication with all the cards within the shelf, all 10 port alarm lamps will light. At this point, a major alarm will be initiated and automatic switching inhibited. Manual switching is activated to allow switching out of cards to find the malfunctioning card. This condition remains until the fault is corrected.

b. If the card fails, a major alarm is generated, and the FAIL lamp on the MCA-2 card lights. If this occurs, the card will have to be replaced.

c. The MCA-2 card provides priority protection switching. Priority protection switching sets levels of failure and determines switching priority by these levels. The failure levels are as follows:

   - A single port alarm is the lowest level.
   - Card failure is the highest level. Card failure is defined as 6 or more port alarms, circuitry failure, or loss of communication to an output card.
   - Failure levels between the lowest and highest levels are determined by the number of port alarms on a card (2, 3, 4, or 5 port alarms).

   Protection switching is provided in the following manner:

   - If multiple cards report port alarms or card failures, protection will be provided to the output card with the highest failure level.
   - If protection switching has occurred on one card, and another card (with a lower failure level) reports an alarm, protection will remain with the card with the higher failure level.
   - If two cards report the same failure level, protection will be provided to the card which reported the alarm first.
   - As alarms are cleared, protection will be switched to the card with the highest failure level.

N. SCIU Card

4.86 The Synchronous Clock Insertion Unit (SCIU) card (Figure 19) is an elastic buffer that synchronizes an incoming or outgoing DS1 facility with an external timing source. The SCIU isolates the synchronization of a DS1 circuit while inserting office timing. The SCIU card interfaces a bidirectional DS1 signal and provides retiming in the A direction while passing the DS1 through in the B direction.

4.87 A source select circuit in the SCIU selects the timing reference according to the priorities shown in Table A. With a valid reference, the SYNC lamp is lit green. If a reference is not present, the SYNC lamp is lit red. The 4-kHz reference is then fed to a phase-locked loop with an output frequency of 1.544-MHz. This signal is used to clock the elastic buffer output, and the transmit line driver

4.88 In the DS1 A direction, the DS1 signal is applied to the line interface and clock recovery circuit. The signal is converted to a unipolar format which passes all coding and logic errors through the SCIU intact. The input signal is also applied to an off-line framer where framing is monitored. Front panel lamps indicate LOS, OOF, and slips that cause excessive reframe conditions. A set of status leads also provides a framing status output.

4.89 The output from the clock recovery circuit clocks the signal into the elastic buffer which is a bank of six 64-bit FIFO (first in, first out) storage devices. The FIFO bank holds two DS1 frames. The DS1 bit stream is clocked into the center of the buffer by the write clock and is clocked by the read clock out of the buffer to the output line driver and line buildout (LBO) circuitry.

4.90 If the read and write clocks are at the same rate, the data stays at the center of the buffer. However, if the write clock is either faster or slower than the stable read clock, the FIFO begins to fill to the left or right. As the FIFO devices fill or empty to 128 bits, a lamp is lit, and the slip warning status lead is activated.

4.91 When the last FIFO device is full (192 bits or one DS1 frame), a frame slip indication is set and a count started that triggers the excessive slip indication after eight slips. During the count, the frame slip lamp stays lit, but the 64- and 128-bit slip lamps are reset. The slip also activates the SLIP status lamp for 5 seconds.

Slip Monitoring

4.92 The SCIU provides bit slip (preslip) and frame slip indications via front panel lamps and status data to local and remote monitoring systems. DS1 failure (LOS), system reference, and bypass indications are also given.

4.93 At the frame slip point when the buffer is filled, an uncontrolled slip occurs. However, no zeros are transmitted downstream; thus, only a COFA (change of frame alignment) may be detected by the downstream device if the frame bit moves out from the buffer in the receiving equipment.

4.94 If the on-line framer detects an LOS or OOF condition in the DS1 input, the SCIU transmits (if optioned to do so) a framed all-ones signal at the reference rate to allow the downstream device to continue to recover timing. An LOS or OOF condition also resets the slip lamps and counter. The framer may be disabled by an option switch. Disabling the framer allows unframed DS1 signals to be passed by the SCIU.

4.95 In the DS1 B direction, the signal enters the SCIU and is applied to the line interface and clock recovery circuit. The data and recovered clock are then fed directly to the line driver and line buildout. No signal processing occurs other than detecting the LOS conditions, which are indicated with a status point and the bicolored DS1 B lamp. Jitter is attenuated in the B direction.

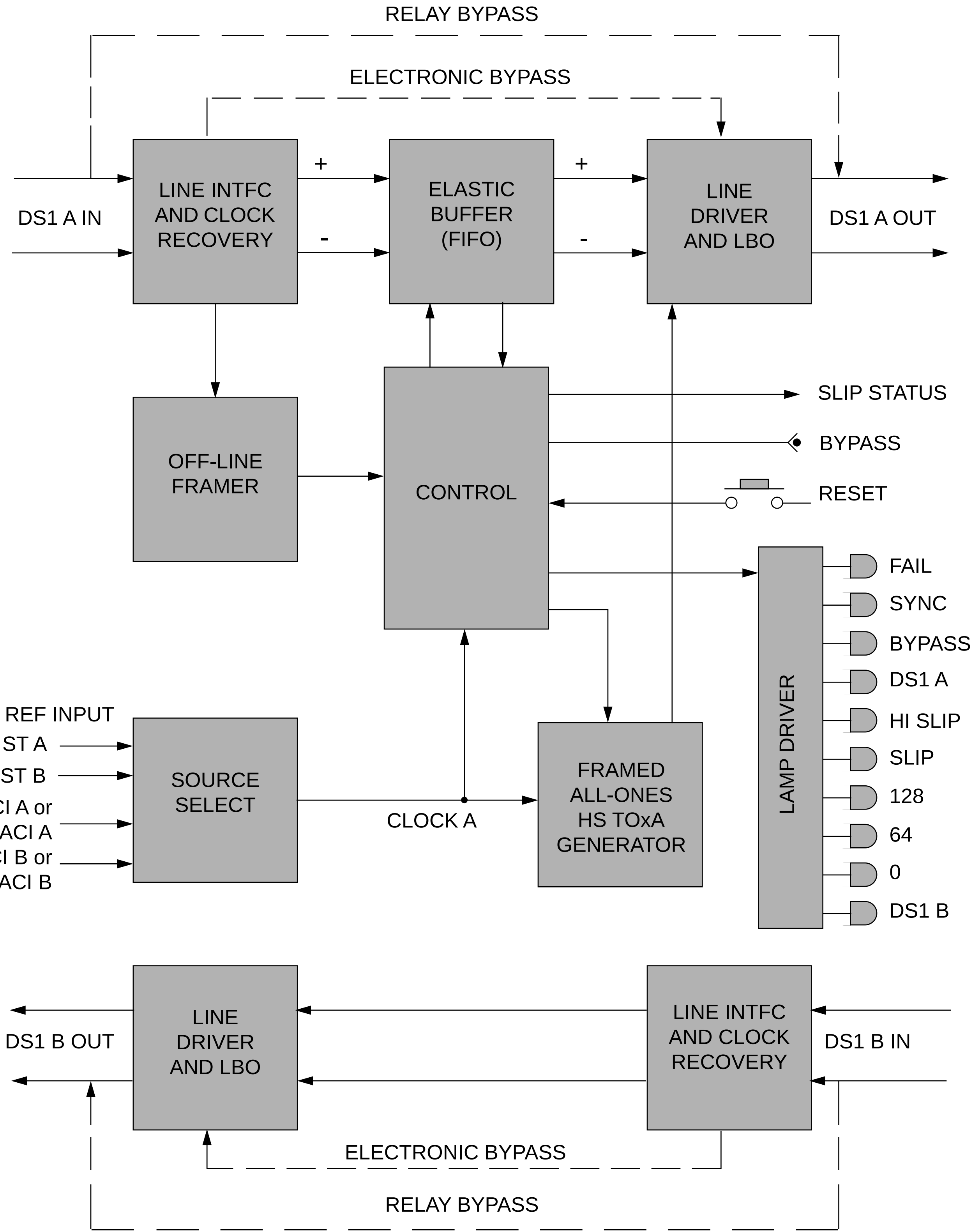


Figure 20. SCIU Card Block Diagram

DS1 Bypass

4.96 Both A and B directions have bypass relays in the event of a reference failure, card failure, power loss, or if the SCIU is removed from the shelf.

4.97 Two types of bypass are provided for the SCIU. If the input reference is lost, an electronic bypass on the SCIU card is activated. This allows the SCIU to provide DSX-1 compatible signals by utilizing the LBO functions. A front panel jack is provided to allow manual activation of the electronic bypass. A lit BYPASS lamp indicates the electronic bypass is active.

4.98 An alarm is set when the electronic bypass is active; this is the same as is set for DS1 A (major, minor, or no alarm).

4.99 A relay bypass on the shelf is activated if the SCIU card fails, if dc power is lost, or if the SCIU is removed from the shelf. The bypass relays are part of the CIM wire-wrap terminal panel or modular mounting panel.

Slip Monitor Mode

4.100 The SCIU can also be used in a slip monitor-only mode. In the monitor mode, the DS1 A line interface acts as an office bridging repeater. The connection to the DS1 to be monitored must be made through a pair of 432-ohm bridging resistors or the DSX-1 monitor jack. The DS1 A input is applied to the FIFO, and slip information is obtained and displayed in reference to the SCIU reference, as above. In the slip monitor mode, the DS1 B lamp is off.