Symmetricom

097-55401-15
Issue 3: Mar 03

55400A

SYNCHRONIZATION SUPPLY UNIT

SYSTEM MANUAL

This manual describes a Symmetricom synchronization system for a telecommunications network. This system includes source clocks, receiver clocks, and network management software.

This manual is the primary document for the 55400A synchronization supply unit (SSU) and 55409A mini-SSU hardware. The other elements of the synchronization system are described here to a lesser degree. The SSU, the mini-SSU, the 55300A GPS telecom reference source, and the 5071A primary frequency source receive the most coverage.

This manual applies to the 55400A SSU system you have received unless update information is included with the equipment.

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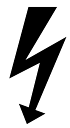
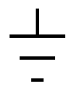
Warning Symbols That May Be Used In This Book

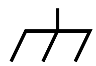
Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicates hazardous voltages.



Indicates earth (ground) terminal.



or

Indicates terminal is connected to chassis when such connection is not apparent.

Indicates Alternating current.

Indicates Direct current.

Contents

In This Manual

A1 System Overview

In This Manual

This part of the system manual helps you identify system tasks and indicates where to go for more information. It includes information on the organization, tasks, and abbreviations used in this manual.

Although most of this system manual supports the 55400A synchronization system, it also describes the installation, configuration, and some initial troubleshooting information for two Symmetricom source clocks:

- 5071A primary frequency standard
- 55300A GPS telecom primary reference source

References to the manuals supplied with these products are made where more detailed information is available. Where this occurs, specific document titles are included.

Finding information fast

To quickly locate a topic, turn to one of the following areas:

Table of contents

Find it at the front of this manual. It is a listing of all the topics covered in this manual. Use it to examine the overall content of this manual.

System manual organization

It starts on the next page. The information here describes the structure of the system manual. Find the topic you want and go to the location in the document for more information about it.

List of tasks

This list comes after the manual organization pages. Some major objectives, such as putting an SSU into service, are divided into the individual tasks necessary to accomplish each objective.

Index

Use the index at the back of this manual when you need information about a specific topic.

55400A System Manual Organization

This manual is organized into six major sections. Each chapter expands on the major topic of the section.

Section A—Learn the System

Information on what it is and how it works.

Chapter A1 System Overview—Provides an overview of the Symmetricom synchronization system.

Chapter A2 System Description—Describes the SSU in more detail.

Chapter A3 System Specifications—Presents the technical specifications for the system.

Chapter A4 Event/Alarm System—Describes the event and alarm system for the SSU that provides status about the system.

Chapter A5 Local/Remote Management—Tells what communication alternatives are supported for the 55400A SSU, 55409A mini-SSU, 55300A GPS, and 5071A frequency standard.

Section B—Prepare for the System

Information on preparing the site and the tools required.

Chapter B1 Tools and Equipment—Lists the tools and equipment needed to install the system.

Chapter B2 Equipment Rack—Describes a rack cabinet, equipment placement, and cable routing.

Chapter B3 Equipment Requirements—Specifies the dimensions and power requirements for the system equipment.

Section C—Install the System

Information on how to install the SSU, GPS primary reference source, and primary frequency standard.

Chapter C1 Installation Guidelines—Presents guidelines for the installation.

Chapter C2 Install the 55400A SSU—How to install the 55400A SSU master subrack.

Chapter C3 Install Expansion Subracks—How to install the 55400A SSU expansion subrack.

Chapter C4 Install the 55300A Primary Reference—How to install the 55300A GPS.

Chapter C5 Install the 5071A Frequency Standard—How to install the 5071A cesium clock.

Chapter C6 Install the 55409A Mini-SSU—How to install the 55409A mini-SSU subrack.

Section D—Configure the SSU

Describes the plug-in cards for the SSU: theory of operation, switch settings, and basic operation.

Chapter D1 Configure ITH Clock Cards—Understand and configure the ITH cards.

Chapter D2 Configure Output Cards—Understand and configure the output cards.

Chapter D3 Configure Communication Cards—Understand and configure the AIC/IMC/NIMC cards.

Section E—Qualify the System

Ensure the system is ready to be put into service.

Chapter E1 Qualification Procedures—Perform qualification procedures on the SSU, GPS, and cesium clock.

Chapter E2 Equipment Tests—Perform equipment tests on the SSU, GPS, and cesium clock.

Section F—Repair the System

Determine cause of problems and return the system to service.

Chapter F1 Troubleshoot the System—Troubleshoot problems with the system.

Chapter F2 Troubleshoot the SSU—Repair the SSU.

Chapter F3 Replacement Parts—Replace parts in the SSU.

Objective — Put SSU master subrack into service

Tasks	Topics	Description	See Chapter
Prepare site for equipment	Summary of tools needed.	a list of tools used to install SSU	B1
	Information about racking equipment	see recommended positioning in rack	B2
	Size and power requirements	Dimensions and current usage	B3
Install master subrack	Unpack and inspect	guidelines	C1
	Subrack	install into rack	C2
	Power connections	how to fabricate and run cables	C2
	Alarm connection	relay information and connector pinout	C2
	Remote connection	user information and connector pinout	C2
	Inputs	types of connectors	C2
	Outputs	types of connectors	C2
	Local connection	user information and connector pinout	C2
Configure cards	ITH cards	set parameter switches	D1
	Output cards	set parameter switches	D2
	Communication card	set parameter switches	D3
Install cards	ITH cards	installation steps	C2
	Output cards	installation steps	C2
	Communication card	installation steps	C2
Qualify for operation	Initial settings	verify configuration, set date, time, and ID	E1
	Configure for network operation	set network parameters for LAN, TP4, or X.25 interface using 55450A local craft terminal software	See Chapter 10 in TL1 Reference Manual for parameter descriptions
Test	Final checks	check alarms and outputs	E2
The SSU is ready to operate			

Objective — Put SSU expansion subrack into service

Tasks	Topics	Description	See Chapter
Prepare site for equipment	Summary of tools needed.	a list of tools used to install SSU	B1
	Information about racking equipment	see recommended positioning in rack	B2
	Size and power requirements	Dimensions and current usage	B3
Install expansion subrack	Unpack and inspect	guidelines	C1
	Subrack	install into rack	C2
	Power connections	how to fabricate and run cables	C2
	Outputs	types of connectors	C2
	Subrack cabling	cabling requirements between subracks	C3
Configure cards	Expansion synchronization cards	set parameter switches	C3
	Expansion communications card	set parameter switches	C3
	Output cards	set parameter switches	D2
Connect subrack cables and install cards	Add first expansion subrack	installation steps	C3
	Add additional expansion subrack	installation steps	C3
	Replace expansion subrack	removal steps	C3
Qualify for operation	Communication	verify communication between subracks	C3
Test	Final checks	check outputs	E2
The SSU is ready to operate			

Objective — Put mini-SSU subrack into service

Tasks	Topics	Description	See Chapter
Prepare site for equipment	Summary of tools needed.	a list of tools used to install mini-SSU	B1
	Information about racking equipment	see recommended positioning in rack	B2
	Size and power requirements	Dimensions and current usage	B3
Install subrack	Unpack and inspect	guidelines	C1
	Subrack	install into rack	C2
	Power connections	how to fabricate and run cables	C2
	Alarm connection	relay information and connector pinout	C2
	Remote connection	user information and connector pinout	C2
	Inputs	types of connectors	C6
	Outputs	types of connectors	C6
	Local connection	user information and connector pinout	C2
Configure cards	ITH cards	set parameter switches	D1
	Output cards	set parameter switches	D2
	Communication card	set parameter switches	D3
Install cards	ITH cards	installation steps	C2
	Output cards	installation steps	C2
	Communication card	installation steps	C2
Qualify for operation	Initial settings	verify configuration, set date, time, and ID	E1
	Configure for network operation	set network parameters for LAN, TP4, or X.25 interface using 55450A local craft terminal software	See Chapter 10 in TL1 Reference Manual for parameter descriptions
Test	Final checks	check alarms and outputs	E2
The mini-SSU is ready to operate			

Objective — Put 55300A GPS Reference Source into service

Tasks	Topics	Description	See Chapter
Prepare site for equipment	Summary of tools needed.	a list of tools used to install GPS unit	B1
	Information about racking equipment	see recommended positioning in rack	B2
	Size and power requirements	Dimensions and current usage	B3
Install GPS reference source	Unpack and inspect	guidelines	C1
	Rack mount shelf	install into rack	C4
	GPS module	install into shelf	C4
	Power connections	how to fabricate and run cables	C4
	Port 1 connection	user information and connector pinout	C4
	Alarm connection	relay information and connector pinout	See Chapter 3 in User's Guide for GPS reference source
	Time of Day connection	user information and connector pinout	See above
	Remote Access Port connection	user information and connector pinout	See above
	Signal connectors	description	C4
Qualify for operation	SatStat application	install and run to verify general health of the GPS reference source	See Chapter 1 in User's Guide for GPS reference source
	Initial settings	set local time and verify holdover actions	E1
Test	Final checks	check outputs	E2
The GPS reference source is ready to operate			

Objective — Put 5071A Frequency Standard into service

Tasks	Topics	Description	See Chapter
Prepare site for equipment	Summary of tools needed.	a list of tools used to install GPS unit	B1
	Information about racking equipment	see recommended positioning in rack	B2
	Size and power requirements	Dimensions and current usage	B3
Install frequency standard	Unpack and inspect	guidelines	C1
	Rack mount unit	install into rack	C5
	Power connections	how to fabricate and run cables	C5
	Signal connectors	description	C5
Qualify for operation	Initial settings	set continuous operation, output ports, and local time	E1
Test	Final checks	check outputs	E2
The frequency standard is ready to operate			

Abbreviations used in this manual

The terms listed here are used throughout this system manual.

Table 1. List of Terms

Term	Definition
ACO	Alarm cutoff
AIC	Alarm interface card
AIS	Alarm indication signal
AMI	Alternate mark inversion
CAS	Channel associated signaling
CCS	Common channel signaling
CRC4	Cyclic redundancy check
DCE	Data communications equipment
DDFS	Direct digital frequency synthesis
DTE	Data terminal equipment
E1	European signal, 2048 kbps
EEPROM	Electrically erasable programmable read only memory
EIA	Electronics Industries Association
ETSI	European Telecommunications Standards Institute
FFOFF	Fractional frequency offset
GPS	Global positioning system
HDB3	High-density bipolar 3
IMC	Information management card
ITH	Input track and hold card
LED	Light emitting diode
LMRTIE	Latest maximum relative time interval error
LOS	Loss of signal
MRTIE	Maximum relative time interval error
NC	Normally closed
NIMC	Network information management card
NO	Normally open
NVRAM	Non-volatile random access memory
OOF	Out of frame
OSMF	Open synchronization management framework
PRC	Primary reference clock

Table 1. List of Terms (cont'd)

Term	Definition
SDH	Synchronous digital hierarchy
SSM	Synchronization status message
SSU	Synchronization supply unit
SWDL	Software download mode
TDEV	Time deviation
TL1	Transaction language 1
TRSC	Traffic re-synchronization card

D1

Configure ITH Clock Cards

Configure, operate, and support

In This Chapter

This chapter describes the Input Track and Hold (ITH) cards for use in the 55401 series of master subracks. The topics include the following:

- Functions/features
- Clock card description
- Overview of performance measurements
- Overview of jitter and wander
- Front panel LEDs
- Mixing oscillator types
- Operating with a single ITH card
- Configuring switches on the card
- Backdating

NOTE Although firmware versions are backwards-compatible, it is recommended to always have the same version of firmware in both ITH cards.

NOTE The information in this chapter also applies to the 55409A mini-SSU.

ITH Card Functions/Features

Heart of the system

The Input Track and Hold card is the central element in the SSU. It is the heart of the synchronization tasks provided by the SSU. The main function of the ITH is to track and filter the input reference. The card also provides a holdover capability using a local oscillator. The ITH card monitors each of the reference inputs. A standard card supports five inputs consisting of one PRC and four 2048 kbps or MHz. They are monitored for errors and performance thresholds. If all signals are judged good, they are all qualified for use.

How the tracked signal is selected

The input signals become available for tracking when they are qualified. There is only one input that is tracked at any time. The one selected depends on the priority that has been assigned to it.

Assigning priority is a way of imposing a preference to the order in which the input signals will be selected. If a tracked input is lost for some reason, the ITH card will select another from the qualified inputs based on the priority settings.

ITH cards monitor each other

ITH cards work in a pair relationship. The input signals are internally connected to both cards. Each of the ITH cards works independently of the other qualifying and making judgements as to the quality of the input signals. The ITH cards continuously compare these findings to ensure that there is a backup card in agreement with the active card as to the quality of the input references.

If all input signals fail

The ITH card provides a holdover performance based upon the model of ITH card used in the system. An ITH card goes into Holdover mode whenever all inputs are disqualified, provided an input has been tracked for at least ten minutes. It is only after ten minutes of tracking a qualified input that the ITH card will have acquired enough information to go into holdover. If all inputs are disqualified before the ITH card has been tracking an input for ten minutes, the ITH card will enter Freerun mode.

If the ITH card uses a double-oven quartz oscillator (55411 or 55415), it will “learn” the local oscillator’s aging and temperature effects while tracking the active reference input. After tracking an input for 32 hours, the ITH card will go into Symmetricom SmartClock holdover if all inputs are disqualified. This mode provides a superior output quality as compared to the normal holdover performance. The highest qualify Symmetricom SmartClock holdover is available after 72 hours of tracking a reference input.

ITH Card Description

The ITH card is essentially a slave clock; it tracks an input reference and it tests the quality of the input signal. If an input signal meets all the tests for qualification, it can be selected for use as the system reference. When for any reason no input signals are judged suitable for use as a reference, the local oscillator on the active ITH card becomes the system reference. Over time, the ITH card “learns” how the local oscillator behaves and uses this information to discipline the oscillator when it is operating without a reference. The 55400A provides a number of ITH cards with different oscillator performance to meet different network requirements.

As described in greater detail in chapter A2, the cards will qualify the input signals by checking for proper formatting, signal level, and stability, as well as making performance measurements of signal quality. Then based on an automatic or user-imposed order of assigned input preference, the ITH card will select the most appropriate signal to use as the reference.

The different ITH cards differ only in the quality of the local oscillator that becomes the system reference only when all input signals are judged unavailable. A description of oscillator types and specifications can be found in chapter A3, “System Specifications.”

Option 001

The Option 001 to the ITH cards provides an additional input card to the ITH assembly increasing by four the number of input signals that can be accepted by the ITH card. A standard ITH card will handle a PRC and four 2048 kbps or kHz input signals.

Theory of operation

Each master subrack typically includes two ITH cards: one is always operating as the active card, while the other waits in standby mode to take over should the active card ever fail. Refer to the block diagram while reading this text.

Power

Each ITH card is powered by a –48 Vdc power supply and produces +5 Vdc and ±12 Vdc using a dc-to-dc converter on the card. The reference input signals are routed to both of the ITH cards from the backplane of the subrack. Output signals from one ITH card are sent to the other ITH card for monitoring.

Input Paths

The input signals pass through a differential amplifier. The resulting signal is split into two paths: a MHz path and a Mbps path. The Mbps path includes a clock recovery circuit and a framer that monitor the 2048 kbps input signals for certain conditions and failures and generates a 2048 kHz signal from them.

The input signal passes into a monitoring circuit which produces digital phase and time values. These values are read by the ITH microprocessor. They are the basis for all jitter measurements and frequency calculations.

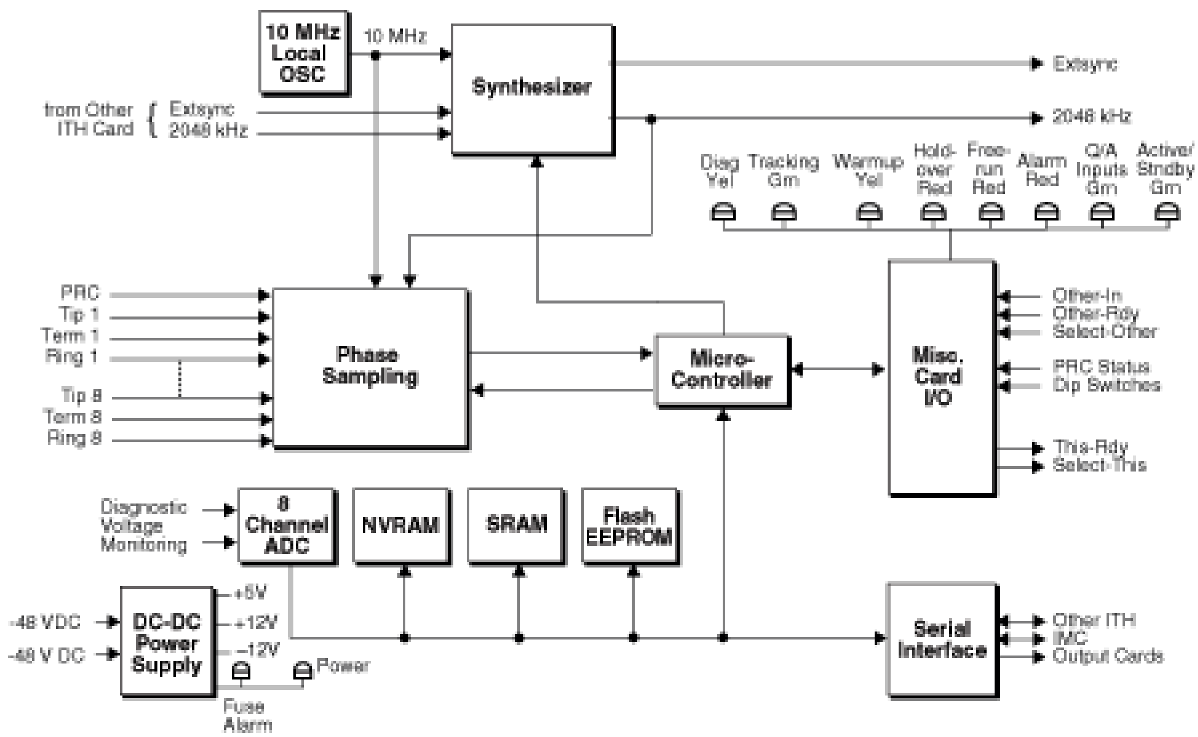


Figure D1-1. ITH card block diagram

Frequency control

The microprocessor controls the synthesizer to produce an output frequency that is the same as the tracked reference input. Since the phase sampler and synthesizer are both referenced from the same local oscillator, any error in the local oscillator frequency produces a frequency correction factor that is applied to the synthesizer.

The ITH card uses a tracking mechanism that consists of a digital feed-forward frequency-lock-loop. This synthesizer consists of a numerical accumulator and a filter. The local oscillator is compared with the reference input. The digital phase difference is filtered and differentiated to produce a frequency correction digital word that is directly proportional to the frequency it should produce. The data word is used (fed forward) to modify the ratio of the synthesizer to produce an output that tracks the reference input. The filter reduces synthesizer phase noise before the signal is passed on to the backplane.

Phase control

The local oscillator is also phase compared with all other references and the ITH card produces frequency correction terms for each reference. Whenever it becomes necessary to substitute one reference for another, the appropriate correction term is employed thereby causing no loop transients. In addition, since it is a frequency correction and not a phase correction, there is no phase change.

A phase detector phase-locks the standby ITH card output to that of the active ITH to avoid phase hits in the event the standby card has to take over for the active card. The phase detector monitors both its own output and the output of the other ITH card. It provides the fine adjustment required to maintain phase lock. The phase detector and synthesizer accommodate a frequency tolerance (pull-in, pull-out range) of approximately ±300 parts per million. If that tolerance is exceeded, the standby card will not track the reference, and a sync error is reported.

Alarms, detection, and control lines

There are two ITH card alarm lines that encode four alarm states connected to the communication card: no alarm, minor alarm, major alarm, and failure.

The ITH card has a read register that monitors the presence and status of the other ITH card, the PRC status line, alarm signals, and acknowledge pulses from the output cards. The write register can squelch the ITH output or assert the card’s output select line. Squelching the ITH backplane output clock is required to ensure that output cards will not try to track the output of a bad ITH card.

Performance measurements to evaluate quality of input signals

When the input reference is behaving normally (that is, the reference is traceable to stratum-1), the measurements on the other input channels can be used to generate alarms using thresholds or to reject the input signals. The next several sections describe how this works.

Event reports from inactive ITH card

Although both ITH cards are independently monitoring the input references for multiple behaviors and reporting any problems to the communication card, normally it is only the events reported by the active ITH card that are passed to the communication card.

This “filtering” of events from the inactive ITH card reduces traffic over the TL1 port, but it may lead to behavior that can appear confusing to anyone monitoring the SSU events. For example, if the ITH1 card were to disqualify the Input 1 signal, the access identifier included with the event message would be “ITH1-1.” This identifier refers to the signal at input channel 1 of the ITH1 card. Later, if the other ITH card becomes active and this card is able to qualify the Input 1 signal, that event would generate a message showing the clearing of the alarm with an access identifier of ITH2-1, although there is no previous message in the event log showing that an alarm occurred on the ITH2 card when the Input 1 signal was disqualified in the first place.

It is possible to modify this normal behavior and have events from both ITH cards reported. Use the RPTALL keyword described in the *55400A TL1 Programming Reference Manual*. The default value is “No” which blocks the redundant reports of ITH events from the standby ITH card.

This keyword has no effect on the event log itself. Each ITH card maintains its own log and will store all of its events for which the LOG property is set to “Y.” The RTRV-LOG command may either specify which log is to be retrieved, or if none is specified, the log from the active ITH card will be retrieved.

If you want to view all the events from the standby ITH card at any time, use the RTRV-COND or RTRV-ALM command and include an access identifier for the standby card (ITH1 or ITH2).

Disagreement between ITH cards

Normal operation may include a behavior where one ITH card qualifies an input signal and the second ITH card does not. Because the cards operate independently and come to separate conclusions about each input signal, there can be instances when the two ITH cards disagree with each other. This condition will raise an alarm.

In this case, different inputs can be active on each card. This condition should be investigated to determine the cause. One reason it may occur is because an input signal characteristic is very near a limit.

Refer to chapter F2, “Troubleshoot the SSU,” for additional information.

Active ITH card in holdover, Standby ITH card not

Should the active ITH card go into holdover while the standby card is still tracking an input, an automatic switch of active to standby and standby to active ONLY if all of the following conditions are true:

- Neither ITH card is configured as “inferior” (see Mixed oscillator operation)
- Both ITH cards are in normal operating mode (event SNOPER) indicating that the card has been operating long enough to be in tracking mode 3
- The active ITH card is not tracking an input signal
- The standby ITH card is tracking an input signal

When all these conditions become true and after approximately 60-90 seconds, the active and standby ITH cards will switch states.

The user may use the TL1 command or the front panel push button to revert to the previous arrangement, and it will not switch back. If the above conditions clear, (that is, any of the conditions become false), then if all the conditions become true again, the automatic switch would occur again.

Performance Measurements Overview

QUESTION How is it that the SSU, a slave clock, can support performance measurements on the incoming reference signals when the SSU does not have an internal reference superior to the input signal being evaluated?

ANSWER The signal used as the reference for the performance measurements is the input reference being tracked after it has been subjected to filtering for jitter and wander. It is the best available reference because at this point it has the long-term stability of the input reference and the good short-term stability of the local oscillator (LO). Since the SSU compares the output to the input in the measurement of TDEV, MRTIE, and LMRTIE, they are relative measurements.

Measurement reference background

The oscillator on the ITH card provides very good short-term stability but may have a significant offset from the nominal frequency over time. On each ITH card a digital phase detector continuously measures the phase difference between the input reference and the LO. From this data, the frequency difference at any time is continuously being produced and used as correction to the output synthesizer being driven by the LO. It is this synthesizer that generates the output frequency. As a result, the output frequency tracks a low-pass filtered version of the input reference while the LO free runs. This way the SSU nominal frequency output tracks the long-term frequency of the reference and has the short-term stability of the LO. At the same time, by monitoring these internal frequency corrections over time, it is possible to determine the short-term fluctuations of the reference and the long-term drift of the LO.

In addition, the SSU makes the same measurement of the phase difference between any other input signals not currently being tracked and the LO. An unused frequency correction word is produced continuously with time for each input signal just as if the input signal was being tracked. The only difference is that the correction word is held in reserve and is not actually used to correct the output synthesizer. In fact, the correction frequency for all references, being actively tracked or not, are simultaneously being produced by the SSU hardware and firmware. By observing these frequency corrections, the frequency difference between the LO and any reference is known at any time on a continuous basis. Using this technique, the SSU is prepared to switch to any of the input signals without any disruption in output quality, continuity, and accuracy.

Jitter and Wander Filtering

One of the tasks of the SSU is to remove jitter and wander from the input reference before distributing it to downstream equipment.

QUESTION How does the SSU filter the input reference?

ANSWER The SSU uses a tracking filter consisting of a digital phase-lock loop (PLL) on the ITH card. The PLL locks the phase of the output signal to that of the input reference. Depending on the bandwidth of the loop, any changes at the input can be spread out over a longer time at the output, thereby smoothing out any variations. When the bandwidth of a phase-lock loop is narrow, there is a longer response time to changes on the input signal, so the extent of filtering is greater. With a wide bandwidth, less filtering takes place. The loop bandwidth depends on the time constant of the phase-lock loop.

Time Constant setting controls loop bandwidth

The loop bandwidth is inversely proportional to the time constant value. The smaller the time constant number, the wider the bandwidth and the faster the system responds to changes on the reference input. So at 192 seconds, the system will react more quickly with less filtering of the input signal. With longer time constants, more filtering takes place as the system is slower to react to any changes on the input reference. A longer time constant requires a higher quality local oscillator because the oscillator will be steered less frequently.

The ITH card uses a programmable time constant to control the bandwidth of the loop. The minimum value is 192 seconds, and the maximum is 49,152 seconds. Changing the time constant allows you to change the filtering characteristics of the SSU.

EXAMPLES If the input signal is from a local cesium source, a short time constant for that input channel is appropriate (192 seconds). Little filtering is required because this signal exhibits excellent short-term and long-term stability. A local GPS reference, on the other hand, has more short-term noise than a cesium signal and as a result, a longer time constant is a better choice for the GPS signal.

Any input reference from a network usually is of less quality than a local cesium or GPS input because of the jitter and wander added by the transmission path. With a lower-quality input, more emphasis is placed on the ability of the PLL, with a longer time constant, to provide increased filtering. The better the local oscillator stability, the longer the time constant the oscillator can support.

SUMMARY The time constant value is really a setting that tries to achieve a balance between the noise characteristics of the input reference and the noise characteristics of the local oscillator. It is a matter of providing an appropriate level of filtering for the input signal based on the nature of the noise present on the input signal and the inherent stability of the local oscillator to support the filtering.

Each input channel can be assigned a different time constant value. The table below shows the recommended time constant values for different ITH card types and input references. The default value for the time constant is determined by the type of oscillator contained on the ITH card. This default value is initially assigned to all input channels.

The supported settings for each input channel are: 192, 768, 3072, 12288, and 49152 seconds.

Table D1-1. Recommended Time Constant Values (in seconds)

ITH Clock Card	Local Cesium time constant	Local GPS time constant	Network Reference time constant
55414 Enhanced Stratum 2–rubidium	192	49512	3072 (default)
55411 Stratum 2–quartz	192	3072	768 (default)
55415 Enhanced transit node	192	3072	768 (default)
55412 Transit node	192	768	192 (default)
55413 Local node	192	192	192 (default)

NOTE Unless you have studied your network enough to have a very good understanding of the absolute noise behavior of the input signals, use the recommended time constant value for the reference signals from the network. Time constant values for individual inputs can be changed using the TL1 keyword *TCONST* or the 55450A local craft terminal software.

TL1 Syntax

```
ED-SYNC::ITH-0:1:::TCONST=192;
```

Sets the PRC input to a time constant of 192 seconds.

```
RTRV-SYNC::ITH-0:1:::PARAMETER=TCONST;
```

Retrieves the loop time constant for the PRC input channel.

Tracking modes

There are three tracking modes that each ITH card will step through after start-up. Each tracking mode has more stringent operating limits for the local oscillator as it reaches its final drift rate. These modes allow for the fact that the longer the local oscillator is running, the closer the oscillator will be to reaching its final drift rate. The time constant value only applies in the final tracking mode.

The ITH card will be in Track 1 mode for 20 minutes after it comes out of warm-up. Track 2 mode lasts for 8 more hours. And finally, Track 3 mode takes over. In Track 3 mode, the PLL will operate with the time constant programmed into the circuit (192 to 49,512 seconds). You can expect the best-quality signal output from the ITH card when it is in Track 3 mode.

ITH Front Panel Indicators

An ITH card uses LEDs to indicate the current operating conditions to an observer. Much more information is available from the card itself through the TL1 interface. An explanation of the LEDs follows.

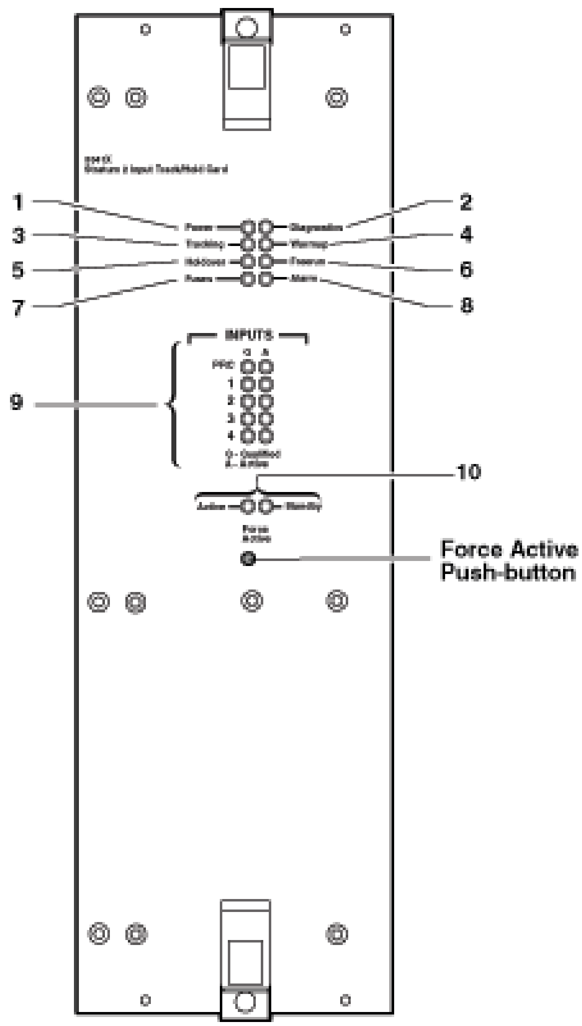


Figure D1-2. Example of ITH card front panel (without Option 001)

Table D1-2. ITH card LEDs

No.	LED	Indicates when lighted
1	Power	Power is present.
2	Diagnostics	Diagnostics are being performed or a diagnostic failure has occurred.
3	Tracking	ITH card has qualified an input and is using it as a system reference.
4	Warmup	ITH oscillator oven is warming to operating temperature and the card is not yet active.
5	Holdover	ITH oscillator, using recent tracking data from a qualified reference, is providing the output frequency. No qualified references are available.
6	Freerun	ITH oscillator is generating an output but without the use of any frequency information from a reference.
7	Fuse	ITH card fuse is open.
8	Alarm	ITH card is in the alarm state.
9	Inputs	For each input there is a Q and A where: Q = This input has been qualified for use A = This input is the active reference
10	Active	This ITH card is the synchronization source for the subrack.
10	Standby	ITH card is in the standby state generating an output that is phase-locked to the output of the other (active) ITH card and ready to take over for the active card.

ITH Card Assembly

An ITH card assembly can consist of up to three circuit boards:

- Option 001 auxiliary board
- Standard main board
- Power supply board

The Option 001 board adds the capability to accept four additional input signals in addition to the one PRC and four 2048 kbps/kHz inputs provided by the standard ITH card assembly. In the drawing below, the Option 001 board is at the top with the standard board next and the power supply board at the bottom.

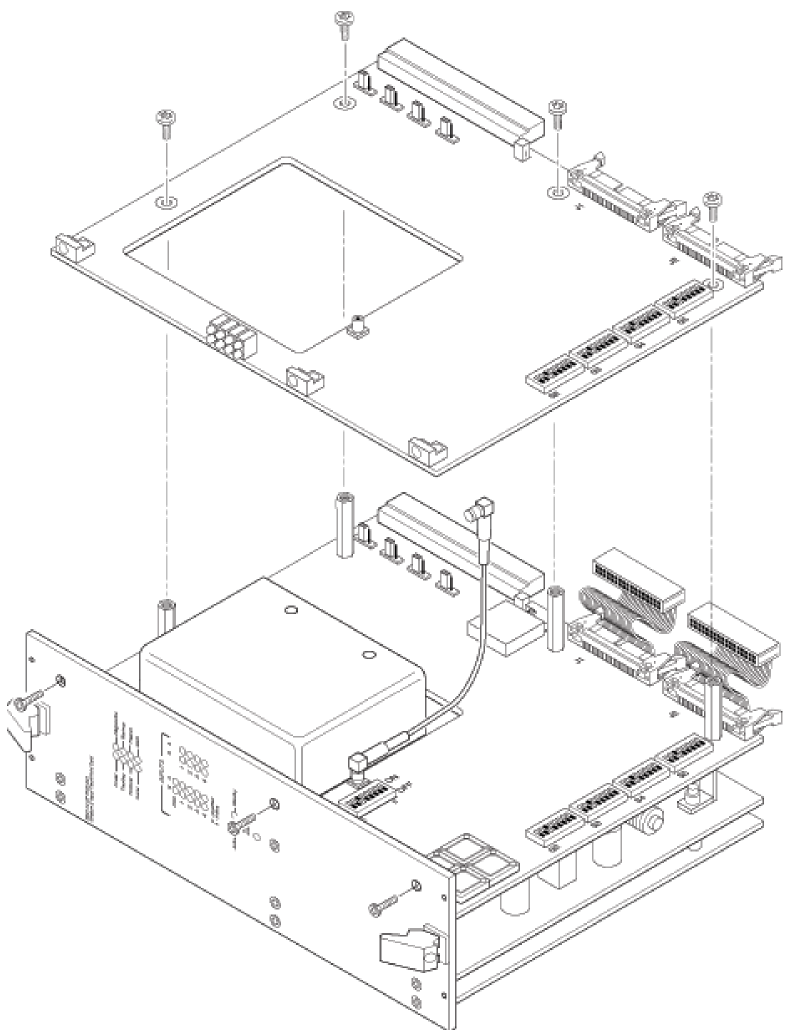


Figure D1-3. ITH card assembly with Option 001 board (top)

Configuring ITH Cards

The input track and hold card assemblies contain switches for setting parameters and jumpers for selecting bridged or terminated inputs.

The switch settings will be divided into those for the main board and the auxiliary board (the aux. board is included with Option 001 to the ITH assembly).

ITH main board switches

Switches for standard ITH card assembly. Refer to Figure D1-4 for the location of the switches.

Table D1-3. ITH main board switch settings

Switch	Bit	Parameter	Off	On
S2	1	Input 1 Type	2048 kbps	2048 kHz
	2	Input 1	Disabled	Enabled
	3	Input 1 Mode	CAS	CCS
	4	Input 1 CRC4	Enabled	Disabled
	5	Input 2 Type	2048 kbps	2048 kHz
	6	Input 2	Disabled	Enabled
	7	Input 2 Mode	CAS	CCS
	8	Input 2 CRC4	Enabled	Disabled
S3	1	Input 3 Type	2048 kbps	2048 kHz
	2	Input 3	Disabled	Enabled
	3	Input 3 Mode	CAS	CCS
	4	Input 3 CRC4	Enabled	Disabled
	5	Input 4 Type	2048 kbps	2048 kHz
	6	Input 4	Disabled	Enabled
	7	Input 4 Mode	CAS	CCS
	8	Input 4 CRC4	Enabled	Disabled
S4	1	PRC Frequency	5 MHz	10 MHz
	2	PRC Input	Disabled	Enabled
	3	Input 1 E1 Coding	AMI	HDB3
	4	Input 2 E1 Coding	AMI	HDB3
	5	Input 3 E1 Coding	AMI	HDB3

Table D1-3. ITH main board switch settings (cont'd)

Switch	Bit	Parameter	Off	On
S4	6	Input 4 E1 Coding	AMI	HDB3
	7	Mixed Oscillators	Inferior	Same/Superior
	8	Tracking Mode	Non-revertive	Revertive
S5	1–6	Reserved	—	—
	7	ITH Startup State	Switch settings overwrite memory values	Switch settings do not overwrite memory values
	8	Firmware Startup State	Force download mode	Verify firmware on startup
S6	1	Oscillator Type	See next table	See next table
	2	Oscillator Type	See next table	See next table
	3	Oscillator Type	See next table	See next table
	4–8	Reserved	—	—

Switches for local oscillator types

NOTE

These switches are set at the factory according to the type of oscillator used in the ITH assembly. ITH problems will occur if these switches are not set correctly for the particular type of oscillator card.

.

Table D1-4. ITH main board oscillator settings

Oscillator Type	S6–1	S6–2	S6–3
55411 Stratum 2	On	On	On
55412 Transit Node	On	Off	On
55413 Local Node	Off	Off	On
55414 Enhanced Stratum 2 Rubidium	Off	On	On
55415 Enhanced Transit Node	Off	On	Off
M12260&CTSxxx	Off	Off	Off

NOTE

New model ITH cards using MTI, SRS, or CTS oscillators will no longer be user configurable for oscillator settings.

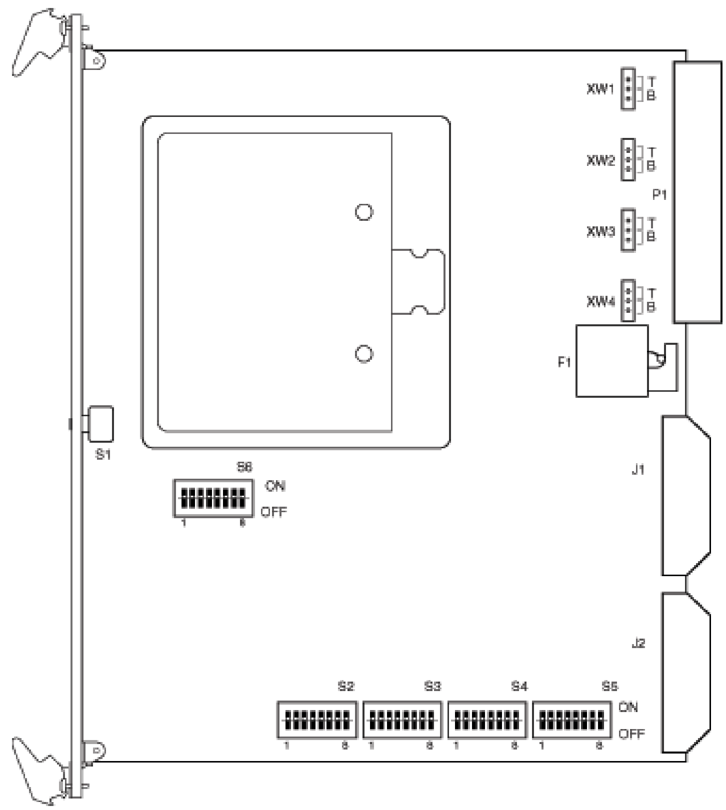


Figure D1-4. ITH main board switch locations

ITH card jumpers

The ITH card may be jumpered to provide the capability for bridging or terminating a 2048 kbps traffic-bearing signal.

Terminating

In termination mode, the traffic signal goes directly into the SSU and is terminated into 75 Ω unbalanced. This is appropriate when the SSU is the last in a series of equipment and the signal is not being used elsewhere.

NOTE

To achieve a balanced 120 Ω termination, an inline balun transformer (120 Ω balanced to 75 Ω unbalanced) is required on the subrack input connector.

Bridging

Use the bridging mode if the signal will be used for synchronization, and it also must be used somewhere else after going to the SSU, such as to a switch or digital cross-connect.

When bridging with traffic passing by the SSU, using a high-impedance, 3.3 k Ω probe will not disturb the traffic line that has a characteristic impedance of 75 Ω or 120 Ω. This in addition to the 3.3 k Ω terminating impedance of the SSU when in bridging mode provides a much higher amplitude for the input signal as opposed to using the 75 Ω termination in this situation.

NOTE Because the SSU has a fairly low disqualification threshold for 2048 kbps signals, a low signal level will usually work but may be more sensitive to changes in the input signal amplitude.

Procedure for jumper placement

There are four jumpers each on the ITH main board and auxiliary board. Refer to Figure D1-4 and Figure D1-5 for the location of the jumpers.

a. Locate the jumper on the board associated with the input channel you need to configure:

- Input 1 (main bd.) or 5 (aux bd.) = XW1
- Input 2 (main bd.) or 6 (aux bd.) = XW2
- Input 3 (main bd.) or 7 (aux bd.) = XW3
- Input 4 (main bd.) or 8 (aux bd.) = XW4

b. Set the jumper in the "T" position for 75 Ω unbalanced termination and 120 Ω termination (see the Note below).

NOTE To achieve a balanced 120 Ω termination, an inline balun transformer (75 Ω to 120 Ω) is required on the subrack input connector.

c. Set the jumper in the "B" position for 3.3 k Ω bridging.

ITH auxiliary board switches

Switches for the Option 001 auxiliary ITH board. The Option 001 board is the top board of the three boards that make up the ITH assembly. Refer to Figure D1-5 for the location of the switches.

NOTE Switches S4 and S5 on the Option 001 auxiliary board are not functional.

Table D1-5. ITH auxiliary board switch settings

Switch	Bit	Parameter	Off	On
S2	1	Input 5 Type	2048 kbps	2048 kHz
	2	Input 5	Disabled	Enabled
	3	Input 5 Mode	CAS	CCS
	4	Input 5 CRC4	Enabled	Disabled
	5	Input 6 Type	2048 kbps	2048 kHz
	6	Input 6	Disabled	Enabled
	7	Input 6 Mode	CAS	CCS
	8	Input 6 CRC4	Enabled	Disabled
S3	1	Input 7 Type	2048 kbps	2048 kHz
	2	Input 7	Disabled	Enabled
	3	Input 7 Mode	CAS	CCS
	4	Input 7 CRC4	Enabled	Disabled
	5	Input 8 Type	2048 kbps	2048 kHz
	6	Input 8	Disabled	Enabled
	7	Input 8 Mode	CAS	CCS
	8	Input 8 CRC4	Enabled	Disabled

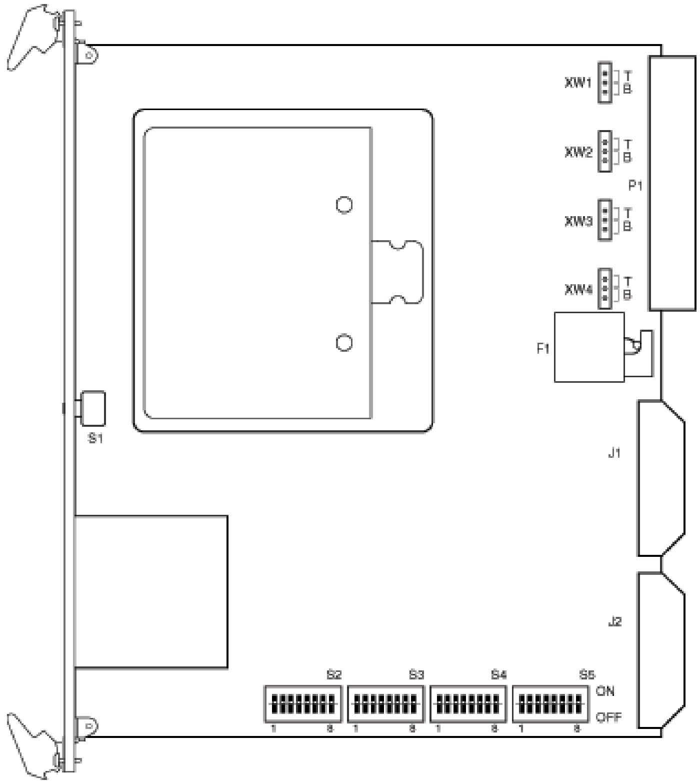


Figure D1-5. ITH Option 001 auxiliary board switch locations

Mixing Oscillator Types

Although the 55400A system normally operates with a matched pair of ITH cards, the 55401 series of subracks does support the use of mixed oscillator types, that is, different ITH cards. This arrangement may be acceptable when your network synchronization requirements are such that a lower stability holdover clock would still be acceptable in the unusual event that all input references are lost and the “superior” ITH card fails as well. Specifically, the following ITH card model numbers can be mixed. The ITH card with the better stability is listed first:

- 55414 with 55411
- 55414 with 55415
- 55411 with 55412
- 55411 with 55413
- 55415 with 55412
- 55415 with 55413

Operating differences

You need to be aware of the differences in SSU operation with mixed type oscillators. It regards the switching between ITH cards under certain conditions.

The two different oscillator types can be referred to as the “superior” and “inferior” oscillator. Normally, the superior oscillator should be the active ITH. Whenever the ITH with the inferior oscillator becomes the active ITH, a non-logged, minor alarm is generated by that card. Once the superior ITH is operating normally again, an automatic switch will take place to make the superior card active and return the inferior card to standby.

Switch setting

To support the use of a mixed ITH combination, there is a card switch setting on the ITH main board used to identify the inferior oscillator. When using a pair of equivalent ITH cards, set S4–7 to “On” for both cards.

Table D1-6. Mixed oscillator switch setting

Switch	Bit	Parameter	Off	On
S4	7	Mixed Oscillators	Inferior	Same/Superior

NOTE If you are operating the SSU with the following combinations of ITH cards: 55411 and 55415 OR 55412 and 55413 leave the mixed oscillator switch in the On position for both cards. The oscillators are of such similar performance that technically the system does not consider them different.

TL1 keywords for mixed ITH cards

When operating with a matched pair of ITH cards, there are TL1 keyword features that apply to both cards because they have equivalent performance values. These features include a setting for the tracking time constant, the pull-in range, and the holdover SSM value.

In the case where ITH cards of different types are used, there are additional keywords that only apply to the inferior oscillator of a mixed oscillator pair. Refer to the *55400A TL1 Programming Reference Manual* for details on how to use these keywords for the inferior ITH card:

- TCONSTSEC–time constant for secondary oscillator
- PIRANGESECQ–pull-in range for secondary oscillator
- HFQLEVLSEC–holdover SSM quality level for secondary oscillator

TL1 event for mixed ITH cards

To support mixed ITH card operation, there is an additional event which by default automatically generates a non-logged, minor alarm. This SECACTV event is generated by the ITH card with the inferior oscillator when that card becomes the active card.

Operating with a Single ITH Card

Although the normally recommended configuration for the SSU includes the use of two ITH cards in a master subrack, operation with only one ITH card is supported. This single ITH card configuration does sacrifice the redundancy provided by a second ITH card and can lead to a situation where a failure of the one ITH card could severely limit the ability of the SSU to provide timing signals to downstream equipment.

Operating differences

No events related to the interaction of a pair of ITH cards will occur, such as the constant comparison of the input signal quality and performance measurements.

Expansion subracks

If a master subrack operates with a single ITH card, any expansion subracks must only use one expansion sync card per subrack located in the same relative slot as the ITH card in the master subrack.

Alarms and events

There is an event to indicate that the communication card switch setting does not match the actual ITH card configuration (one card or two). The event, SGLSWMM (single/double ITH switch mismatch), indicates that either the switch is set for single ITH operation but two ITH cards are part of the master subrack, or the switch is set for dual ITH operation but there is only a single ITH card in the master subrack. The default behavior for this event is that the message is not logged and a major alarm is generated. The table below summarizes the switch setting for the communication cards.

Table D1-7. Single ITH card switch setting for communication card

Communication card	Switch	Bit	Parameter	Off	On
55431A AIC	S6	1	Single ITH	Enabled	Disabled
55441A IMC	S6	1	Single ITH	Enabled	Disabled
55442A NIMC	S8	1	Single ITH	Enabled	Disabled
55443A Exp. Comm	S6	1	Single ITH	Enabled	Disabled

Firmware upgrades

In a typical ITH configuration that includes two ITH cards, parameter settings stored in memory are shared by the two cards. During a firmware download, the active ITH card would copy the settings from its memory to the newly upgraded card. This is not possible when operating with only a single ITH card. In this case, when the firmware is upgraded, the ITH card parameter settings are restored to those specified with the card's switches since the settings in memory are erased during the firmware download process and they cannot be copied from a second ITH card.

Expansion Sync Cards

The 55419A Expansion Synchronization Card performs the function of the ITH card in the expansion subrack.

The cards and their switch settings are described in chapter C3, "Install Expansion Subracks."

Backdating

ITH Card “A” Models vs. “B”

The model “B” ITH card is considered a second generation ITH card. It has improved performance due to an upgraded microprocessor and expanded memory. The original “A” model ITH card can be used alongside a “B” card.

Single ITH Operation

Single ITH operation is supported by firmware version 3744E and later.

D2

Configure Output Cards

Theory, configuration, backdating

In This Chapter

This chapter describes the Output cards for use in the 55400A series of subracks. The topics include the following:

- Functions/features
- Generic output card description
- Front panel LEDs
- Individual card descriptions and configuration
- Backdating

Output Card Functions/Features

The output cards accept the reference signals from the ITH cards and produce a variety of signals for downstream network elements. Typically, there are sixteen outputs per card, but this can vary depending on the specific card type.

The cards are usually configured as a protected pair, so that if one card should fail, the second card takes over and continues to supply output signals.

An output card can be configured to operate without a backup card where no protection is desired. In this case, instead of having two cards side-by-side in a protected-pair configuration, a single card would be in a slot with no card installed alongside it. There is a switch setting on each card to select the protected or stand-alone mode.

Each output card uses a phase-lock-loop to handle any short interruptions that may occur on the input. This ensures a smooth continuation of output signals during short disruptions of the reference signals to the output cards that may occur, for example, when an ITH card is removed and replaced.

Output cards available at this time include the following functions:

- 2048 kbps
- 2048 kHz
- 64/8 kHz composite clock
- 1, 5, 10 MHz
- 1544 kbps
- E1 re-synchronization

Each card is described in detail in this chapter.

Output Card Description

There are a number of types of output cards for the 55400A system. This section describes the features common to all the output cards.

Theory of Operation

Each output card receives the -48 volts from the backplane. This voltage is converted by an on-board dc-to-dc converter to provide supply voltages for the output line driver circuits and card logic.

The signals to each output card are the same. They consist of the following signals:

- Control bus clock
- Control bus data lines
- EXTSYNC signals from each of the ITH cards
- ITH select line from the write register of each ITH card
- An independent verification from each ITH card that it is functioning properly
- Clock signals delivered from the backplane at 2048 kHz

Each output card performs the following functions:

- Receives the two backplane clock frequencies (one from each ITH Card)
- Makes a determination of which clock is the active one and should therefore be tracked
- Filters out jitter from the backplane clock using a phase-locked loop (PLL)
- Distributes its output to lines on the backplane which provide signals to all outputs leading from the system
- Uses transformers to drive the outputs

Common Circuit Blocks

Although differences exist between each type of output card, the following circuit blocks are present on every card

- Input clock selection.
- Control circuitry
- Phase-locked loop (PLL)
- EXTSYNC PLL
- Switch/LEDs

Clock Input Selection

The input clock is selected by circuitry operating under the guidance of a selection algorithm that determines which of the two ITH cards will be tracked

Communication Control

The output card receives serial communication signals from either ITH card over the control bus, interprets those signals, and updates registers with instruction-specific card settings—for example, to mute an output, clear an alarm, set an alarm, or provide an ACK.

The Card Status lines are used to determine which board of a protected pair is active, that is, driving the load, and which is in standby mode.

PLL

A phase-locked loop on each output card creates an output from the backplane input clock and is responsible for smoothing noise from the backplane.

EXTSYNC PLL

EXTSYNC is present on every output card but is only used by two output card types: the composite clock and 2048 kbps output cards. Its function is explained for each card below.

Switch/LEDs

Each output card type has one dual in-line package (DIP) switch. It is an eight-place ON/OFF-switch assembly that controls instrument state parameters. In addition, there is an identical set of LED indicators on every front panel.

Output Card Front Panel Indicators

All output cards contain a standard set of LEDs to indicate the current operating conditions to an observer. An explanation of the LEDs follows.

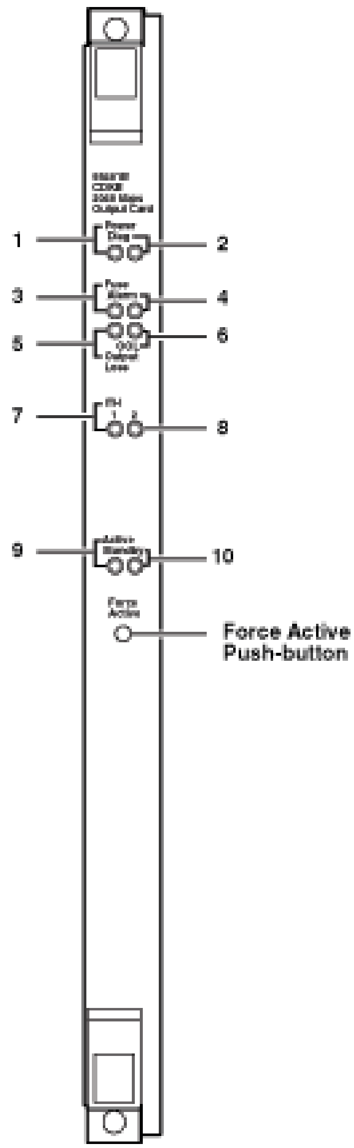


Figure D2-1. 55400A Output Card

Table D2-1. Output card LEDs

No.	LED	Indicates when lighted
1	Power	Power is present.
2	Diagnostics	N/A
3	Fuse	Card fuse is open.
4	Alarm	Card is in the alarm state.
5	Output Loss	An active output has failed.
6	OOL (Out of Lock)	Phase-locked loop on card is unlocked.
7	ITH1	Output card is tracking ITH card 1.
8	ITH2	Output card is tracking ITH card 2.
9	Active	Output card is providing outputs.
10	Standby	Output card is not providing outputs.

2048 kbps Clock Distribution Card

55481B—16 outputs

This section covers the circuitry unique to the 2048 kbps output card. Refer to Figure D2-2 for the block diagram.

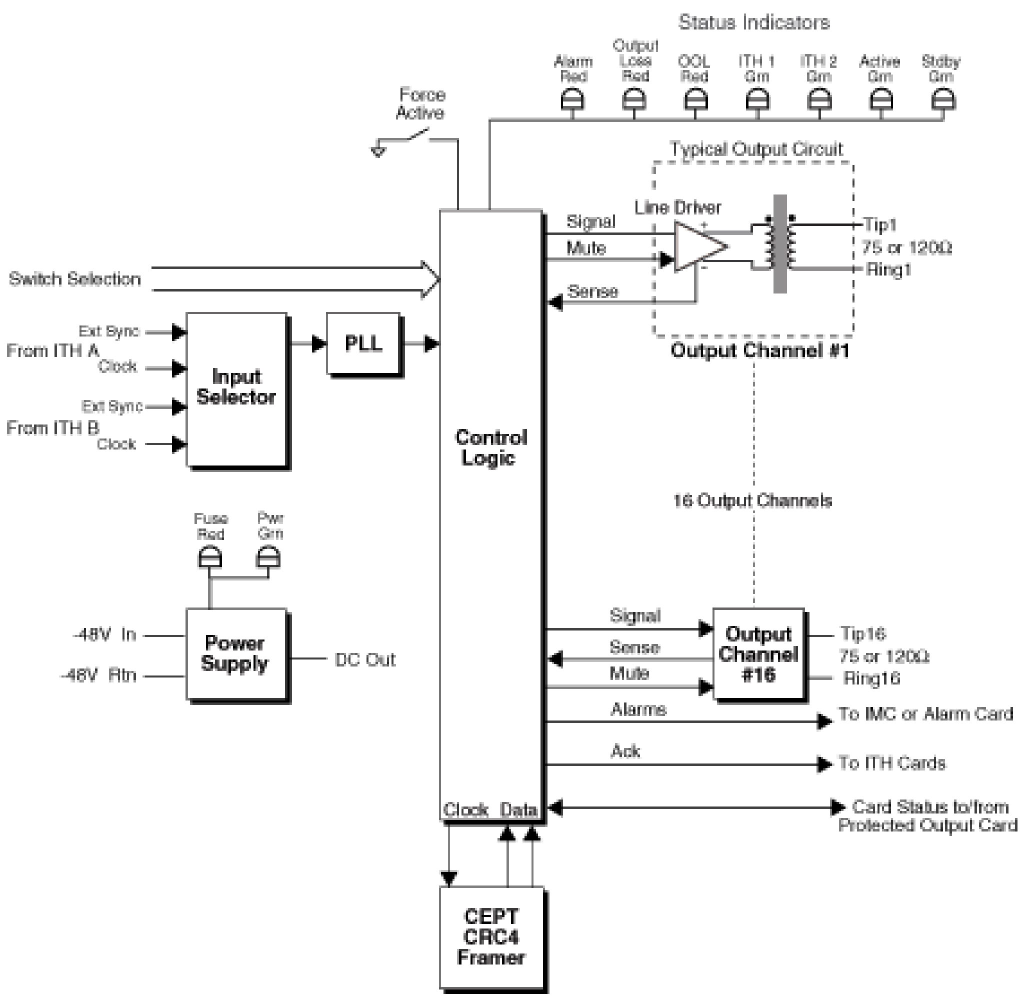


Figure D2-2. 2048 kbps Output Card Block Diagram

The EXTSYNC PLL is synchronized to the EXTSYNC input. In the event of a failure where neither ITH card is generating EXTSYNC, the output card can continue generating its own EXTSYNC.

EXTSYNC PLL output is phase-aligned on a fine and coarse scale by an output pulse, which is used by the framer IC for multi-frame and frame synchronization of outputs provided by a pair of output cards in the subrack.

In addition to a muting signal, the output line driver circuit on the card receives two drive signals from the control circuitry. In response to these inputs, the circuit generates an output signal at 2048 kbps. Two sense signals are returned from this circuit to the control circuitry to provide verification of correct circuit function. The output line driver circuit provides the power and clamping necessary to generate the correct output level and meet the pulse mask, whether the card is operated by itself or as part of a protected pair. It also protects against single circuit faults in the 1:1 protection mode.

Configuring 2048 kbps card

This output card assembly is equipped with one dual inline switch package to set the instrument-state parameters.

A programmable data pattern can be transmitted by this card during the traffic time slots. For more information, refer to the description of the *TRAFFIC* keyword in the *55400A TL1 Programming Reference Manual*.

Switch settings

Set the switches according to your system requirements.

Table D2-2. 55481B Output card switch settings

Switch	Bit	Parameter	Off	On
S1	1	Output Protection Mode	Stand-alone	Protected
	2	CCS/CAS Output	CCS	CAS
	3	Transmit CRC4	Disabled	Enabled
	4–8	Undefined	—	—

Switch location

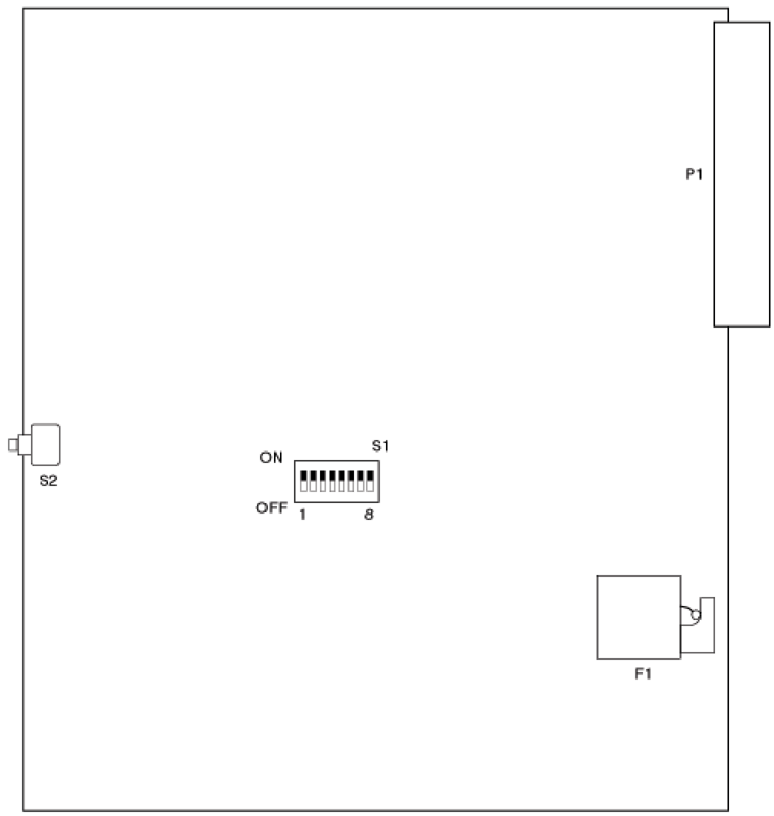


Figure D2-3. 2048 kbps Output Card Switch

2048 kHz Clock Distribution Card

55482A—16 outputs

This section covers the circuitry unique to the 2048 kHz output card. Refer to Figure D2-4 for the block diagram.

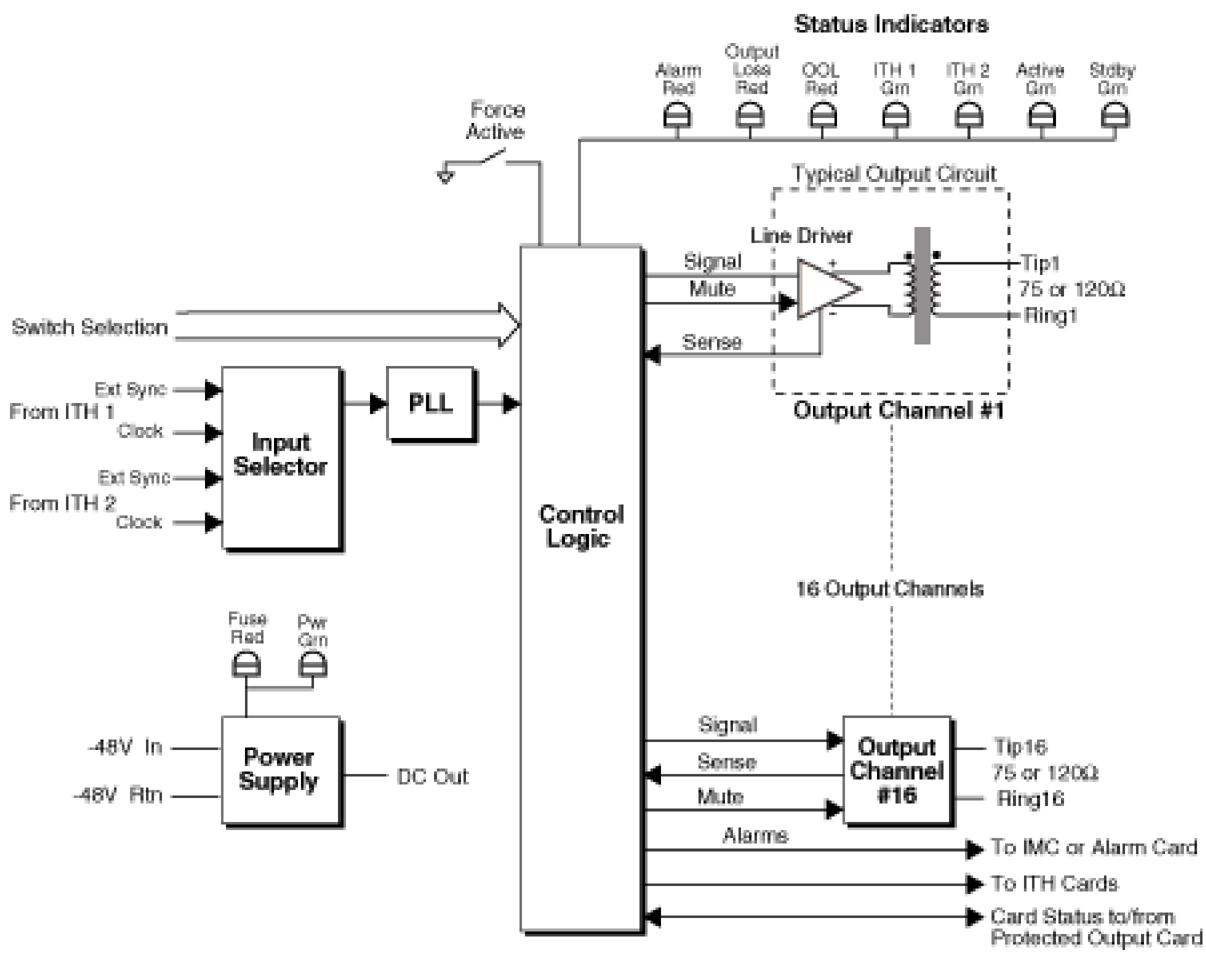


Figure D2-4. 2048 kHz Output Card Block Diagram

The EXTSYNC PLL is synchronized to the EXTSYNC input. In the event of a failure where neither ITH card is generating EXTSYNC, the output card can continue generating its own EXTSYNC.

In addition to a muting signal, the output line driver circuit receives two drive signals from the control circuitry. In response to these inputs, the circuit generates an output signal at 2048 kHz. Two sense signals are returned from this circuit to the control circuitry to provide verification of correct circuit function. The output line driver circuit provides the power and clamping necessary to generate the correct output level and meet the pulse mask, whether the card is operated by itself or as part of a protected pair. It also protects against single circuit faults in the 1:1 protection mode.

Configuring 2048 kHz card

This output card assembly is equipped with one dual inline switch package to set the instrument-state parameters.

Switch settings

Set the switches according to your system requirements.

Table D2-3. 55482A Output card switch settings

Switch	Bit	Parameter	Off	On
S1	1	Output Protection Mode	Stand-alone	Protected
	2–8	Undefined	—	—

Switch location

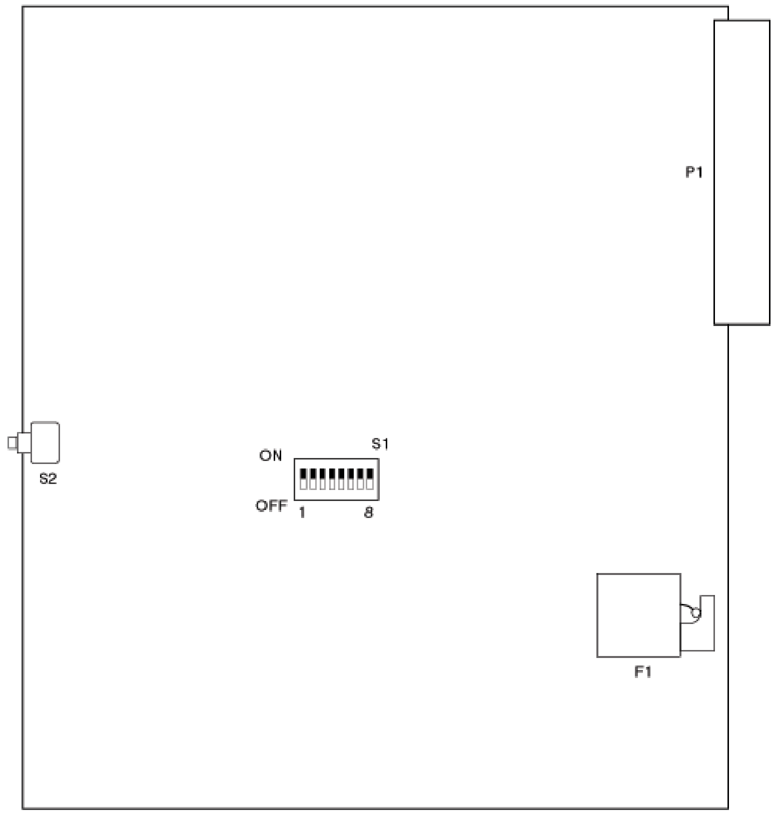


Figure D2-5. 2048 kHz Output Card Switch

64/8 kHz Composite Clock Distribution Card

55483A—16 outputs

This section covers the circuitry unique to the 64/8 kHz output card. Refer to Figure D2-6 for the block diagram.

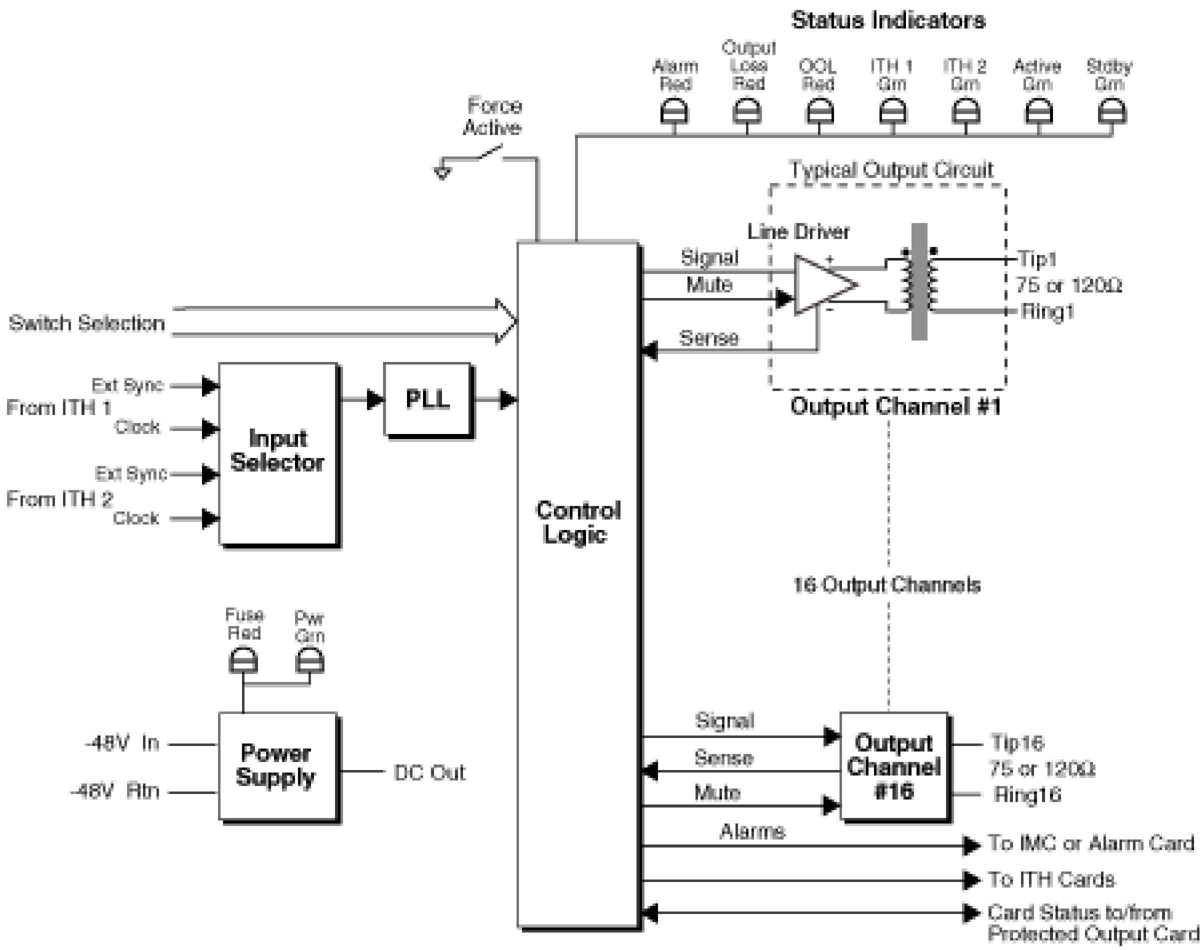


Figure D2-6. 64/8 kHz Composite Clock Card Block Diagram

The EXTSYNC PLL is synchronized to the EXTSYNC input. In the event of a failure where neither ITH card is generating EXTSYNC, the output card can continue generating its own EXTSYNC.

In addition to a muting signal, the output line driver circuit on the composite clock card receives two drive signals from the control circuitry. In response to these inputs, the circuit generates the composite clock outputs. Two sense signals are returned from this circuit to the control circuitry to provide verification of correct circuit function. The output line driver circuit provides the required power to drive a 133 Ω load within the pulse mask limits.

EXTSYNC PLL output is phase-aligned on a fine and coarse scale. The two output signals are pulses that alternate between the two signals. The rate of the double pulses corresponds to the bipolar violations of the composite clock output to be generated. The use of the EXTSYNC PLL circuit to generate these drive signals guarantees that composite clocks produced by a pair of cards within the same subrack are in phase alignment.

Patch Panel for Balanced Outputs

The 55483A Clock Card together with a patch panel provides 16 balanced outputs at 64/8 kHz with an electrical waveform that meets the requirements of the interface at 64 kbit/s as specified in ITU-T Recommendation G.703.1.

The patch panel is required because the 55401D subrack has grounded outputs that cannot provide balanced output signals. Center-tapped transformers in the patch panel convert the single-ended 75 Ω signals from the 55400A to balanced 120 Ω outputs. The Option 002 patch panel provides Siemens 1.5/5.6 input and RJ-45 output connectors. The Option 003 patch panel supplies BNC input and RJ-45 output connectors.

This section provides circuit and parts information for the patch panel. The information includes a circuit diagram and pin designations for the connectors.

Parts Included with Patch Panel

- Rack Mount Flanges—ETSI and EIA
- Screws for rack mount flanges

The figures below show a circuit diagram of the patch panel and the pinout for the RJ-45 connectors.

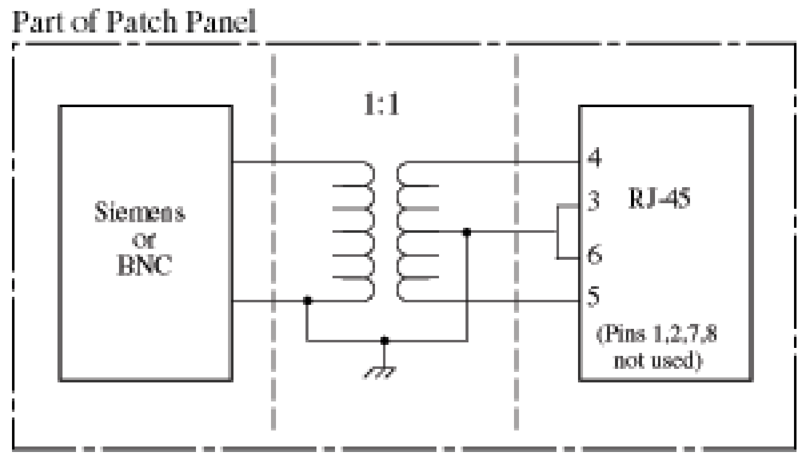


Figure D2-7. Patch Panel Circuit Diagram

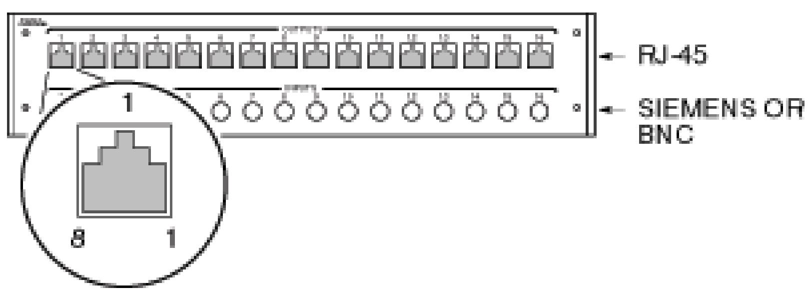


Figure D2-8. Patch Panel Front View

NOTE

The patch panel must be used with the 55483A in order to meet the requirements of ITU-T G.703.1 for balanced outputs.

Configuring 64/8 kHz card

This output card assembly is equipped with one dual inline switch package to set the instrument-state parameters.

Switch settings

Set the switches according to your system requirements.

Table D2-4. 55483A Output card switch settings

Switch	Bit	Parameter	Off	On
S1	1	Output Protection Mode	Stand-alone	Protected
	2–8	Undefined	—	—

Switch location

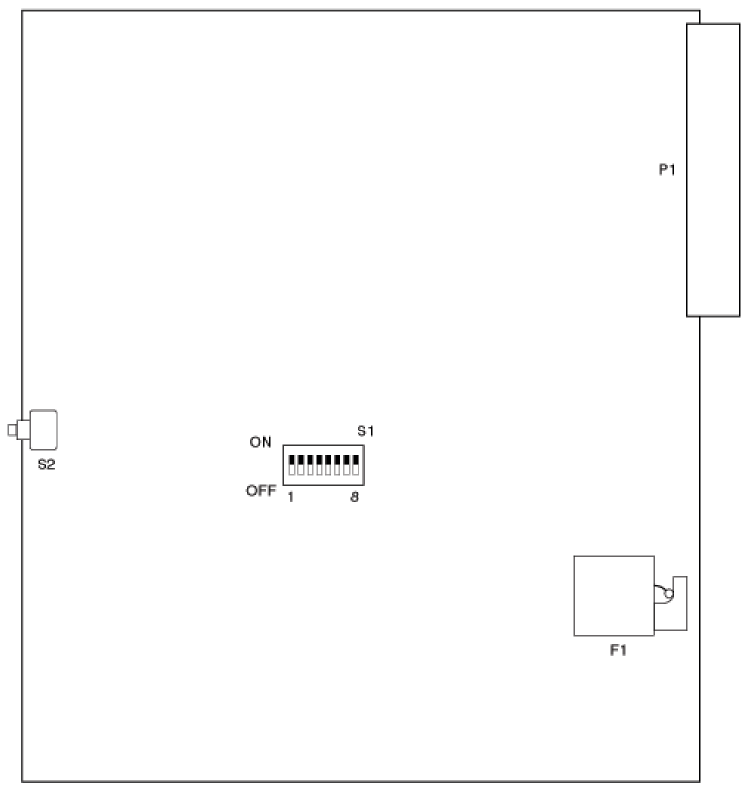


Figure D2-9. Composite Clock Output Card Switch

1/5/10 MHz Clock Distribution Card

55484A—8 outputs

This section covers the circuitry unique to the 1/5/10 MHz output card. Refer to Figure D2-10 for the block diagram.

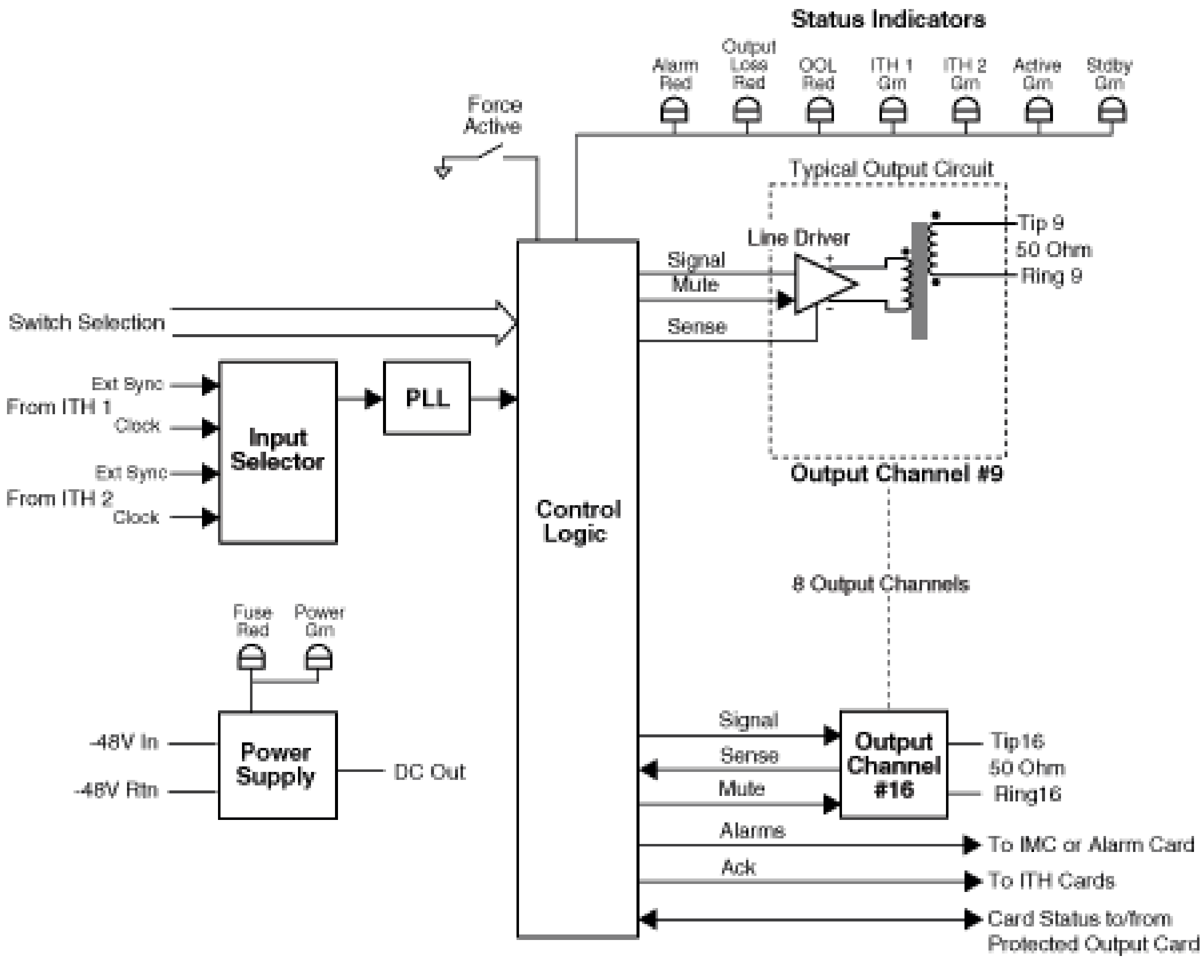


Figure D2-10. 1/5/10 MHz Output Card Block Diagram

This card is capable of producing one of three output frequencies for each output port. The different frequencies (1 MHz, 5 MHz, or 10 MHz) are selected using dual in-line switch assemblies. In addition, there is a switch to select the output protection mode.

The output card provides up to eight output signals on outputs 9 through 16. Each output can be configured to one of these four states:

- 1 MHz
- 5 MHz
- 10 MHz
- Off

NOTE As with all output cards, those used as a protected pair must have identical switch settings or an output card mismatch event will occur.

The PLL on the card is synchronized to the clock input. The EXTSYNC input aligns the phase of the output clock across a pair of output boards. A pair of switches is used to set the frequency of individual outputs.

In addition to a muting signal, the output line driver circuit receives two drive signals from the control circuitry. In response to these inputs, the circuit generates an output signal at the selected frequency. Two sense signals are returned from this circuit to the control circuitry to provide verification of correct circuit function. The output line driver circuit provides the power and clamping necessary to generate the correct output level, whether the card is operated by itself or as part of a protected pair. It also protects against single circuit faults in the 1:1 protection mode.

Configuring 1/5/10 MHz card

This output card assembly is equipped with five dual inline switch packages to set the instrument-state parameters.

Switch settings

Set the switches according to your system requirements.

Table D2-5. 55484A Output card protection setting

Switch	Bit	Parameter	Off	On
S1	1	Output Protection Mode	Stand-alone	Protected
	2–4	Undefined	—	—

Table D2-6. 55484A Output card frequency setting

Output Port	Output Frequency	Switch Setting	Switch Setting
9	1 MHz	S5-1/On	S5-2/On
	5 MHz	S5-1/Off	S5-2/On
	10 MHz	S5-1/On	S5-2/Off
	No output	S5-1/Off	S5-2/Off
10	1 MHz	S5-3/On	S5-4/On
	5 MHz	S5-3/Off	S5-4/On
	10 MHz	S5-3/On	S5-4/Off
	No output	S5-3/Off	S5-4/Off
11	1 MHz	S5-5/On	S5-6/On
	5 MHz	S5-5/Off	S5-6/On
	10 MHz	S5-5/On	S5-6/Off
	No output	S5-5/Off	S5-6/Off
12	1 MHz	S5-7/On	S5-8/On
	5 MHz	S5-7/Off	S5-8/On
	10 MHz	S5-7/On	S5-8/Off
	No output	S5-7/Off	S5-8/Off
13	1 MHz	S6-1/On	S6-2/On
	5 MHz	S6-1/Off	S6-2/On
	10 MHz	S6-1/On	S6-2/Off
	No output	S6-1/Off	S6-2/Off
14	1 MHz	S6-3/On	S6-4/On
	5 MHz	S6-3/Off	S6-4/On
	10 MHz	S6-3/On	S6-4/Off
	No output	S6-3/Off	S6-4/Off
15	1 MHz	S6-5/On	S6-6/On
	5 MHz	S6-5/Off	S6-6/On
	10 MHz	S6-5/On	S6-6/Off
	No output	S6-5/Off	S6-6/Off
16	1 MHz	S6-7/On	S6-8/On
	5 MHz	S6-7/Off	S6-8/On
	10 MHz	S6-7/On	S6-8/Off
	No output	S6-7/Off	S6-8/Off

Switch locations

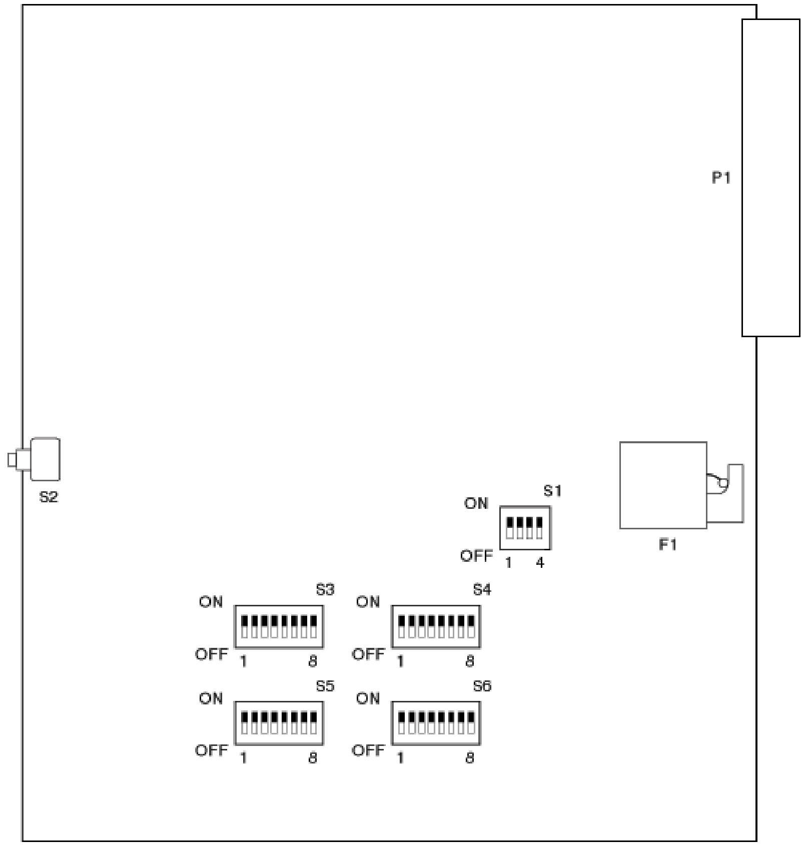


Figure D2-11. 1/5/10 MHz Clock Distribution Output Card Switches

1544 kbps Clock Distribution Card

55485B—16 outputs

This section covers the circuitry unique to the 2048 kbps output card. Refer to Figure D2-12 for the block diagram.

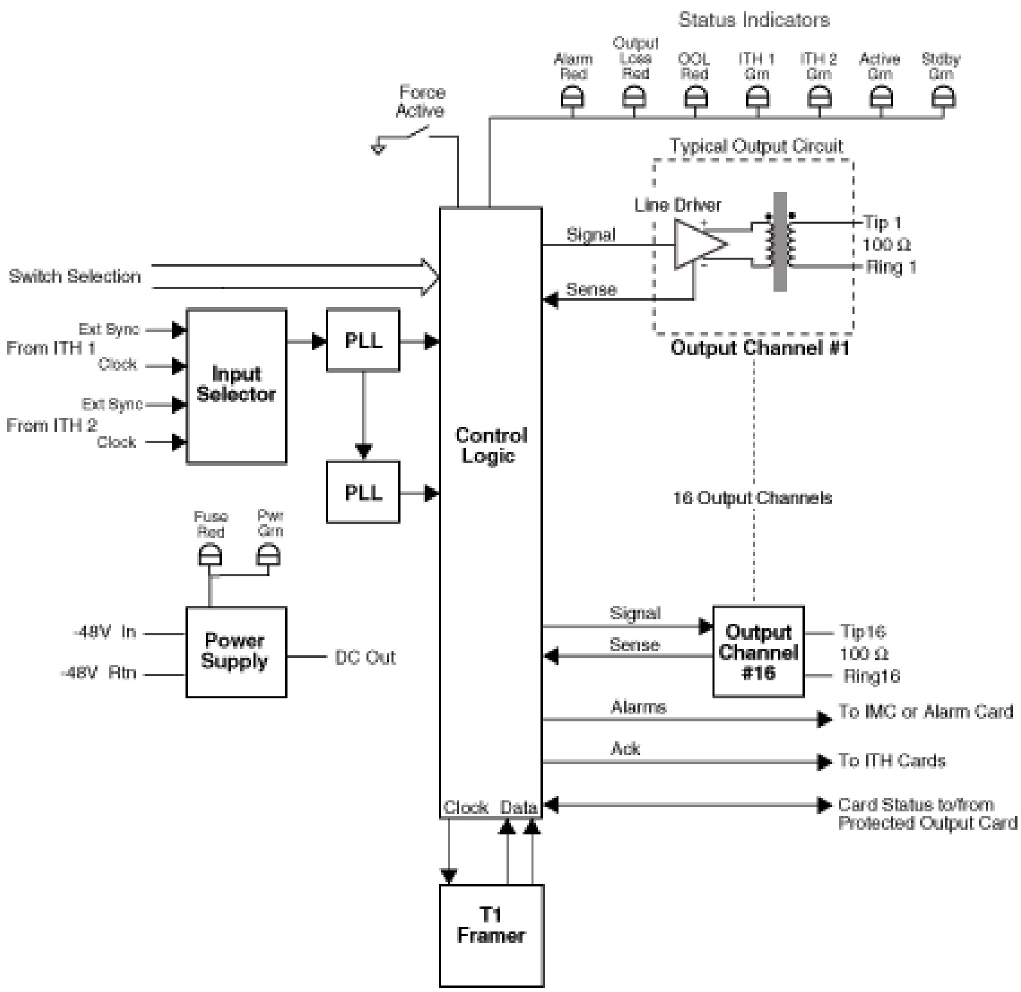


Figure D2-12. 1544 kbps Clock Distribution Card Block Diagram

The EXTSYNC PLL is synchronized to the EXTSYNC input. In the event of a failure where neither ITH card is generating EXTSYNC, the output card can continue generating its own EXTSYNC.

The EXTSYNC PLL output is phase-aligned on a fine and coarse scale by an output pulse, which is used by the framer IC for multi-frame and frame synchronization of 1544 kbps output cards in the subrack.

In addition to a muting signal, the output line driver circuit on the card receives two drive signals from the control circuitry. In response to these inputs, the circuit generates an output signal at 1544 kbps. Two sense signals are returned from this circuit to the control circuitry to provide verification of correct circuit function. The output line driver circuit provides the power and clamping necessary to generate the correct output level and meet the pulse mask, whether the card is operated by itself or as part of a protected pair. It also protects against single circuit faults in the 1:1 protection mode.

Configuring 1544 kbps card

This output card assembly is equipped with one dual inline switch package to set the instrument-state parameters.

Switch settings

Set the switches according to your system requirements. Switch S3 selects the data pattern transmitted during the 1544 kbps traffic time slots. The default setting is with all bits set to 1 (On). This causes a data value of 0xFF to be transmitted.

Table D2-7. 55485B Output card switch settings

Switch	Bit	Parameter	Off	On
S2	1	Output Protection Mode	Stand-alone	Protected
	2	D4/ESF Format Mode	D4	ESF
	3	Undefined	—	—
	4	Undefined	—	—
S3	1	First bit (MSB)	0	1
	2		0	1
	3		0	1
	4		0	1
	5		0	1
	6		0	1
	7		0	1
	8	Last bit (LSB)	0	1

Switch locations

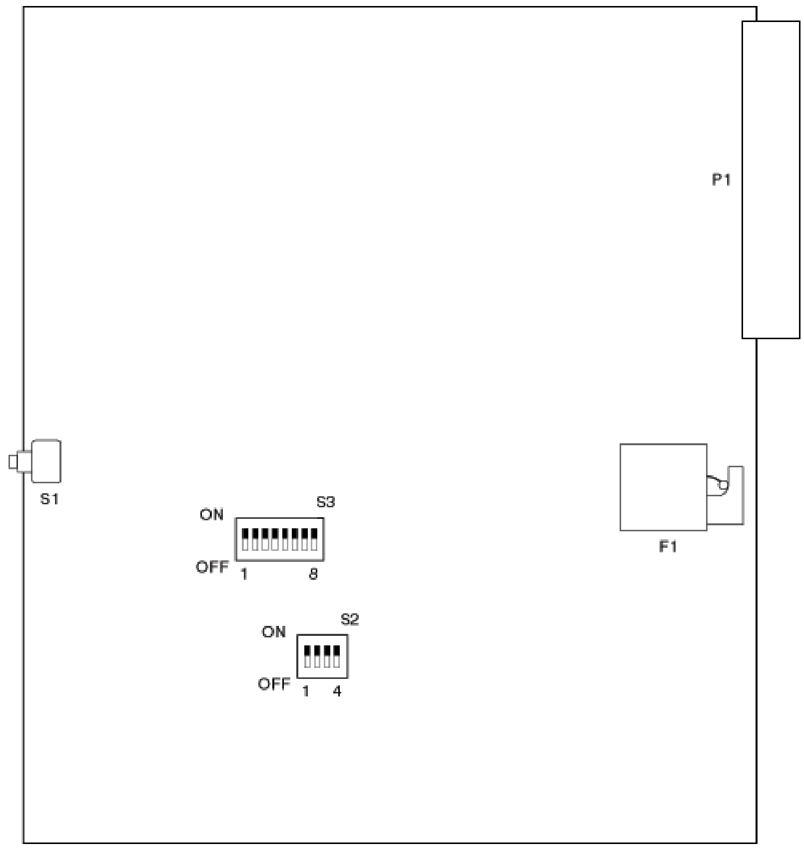


Figure D2-13. 1544 kbps Output Card Switch Locations

2048 kHz/2048 kbps Clock Distribution Card

55488A—16 outputs

This card supplies both 2048 kHz and 2048 kbps output signals. Subrack outputs 1 through 8 provide 2048 kHz and outputs 9 through 16 provide 2048 kbps.

Since this card combines the functions of the 55482A and 55481B output cards, please refer to the documentation for those cards for a description of the circuitry.

Configuring 2048 kHz/2048 kbps card

This output card assembly is equipped with one dual inline switch package to set the instrument-state parameters.

A programmable data pattern can be transmitted on the 2048 kbps outputs during the traffic time slots, as is the case for the 55481B. For more information, refer to the description of the *TRAFFIC* keyword in the *55400A TL1 Programming Reference Manual*.

Switch settings

Set the switches according to your system requirements.

Table D2-8. 55488A Output card switch settings

Switch	Bit	Parameter	Off	On
S1	1	Output Protection Mode	Stand-alone	Protected
	2	CCS/CAS Output	CCS	CAS
	3	Transmit CRC4	Disabled	Enabled
	4–8	Undefined	—	—

NOTE Set S1–2 and S1–3 as desired for the 2048 kbps outputs (ports 9 through 16). These settings have no effect on the 2048 kHz outputs.

Switch location

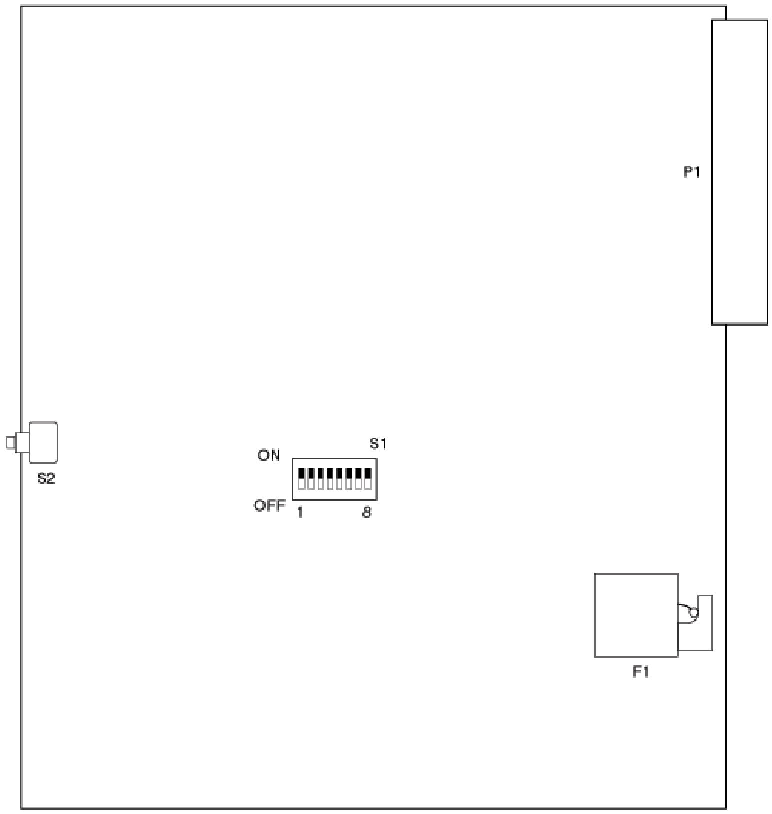


Figure D2-14. 2048 kHz/2048 kbps Output Card Switch

Traffic Re-synchronization Card

55471A—8 inputs/8 outputs

SUMMARY The 55471A Traffic Re-synchronization Card (TRSC) provides eight channels for E1 signals. Four of these channels will re-time the input signals and four will only buffer the input signals. (Firmware revision 3744E, or later, is required in the IMC or NIMC, and the ITH cards to support TRSC operation.)

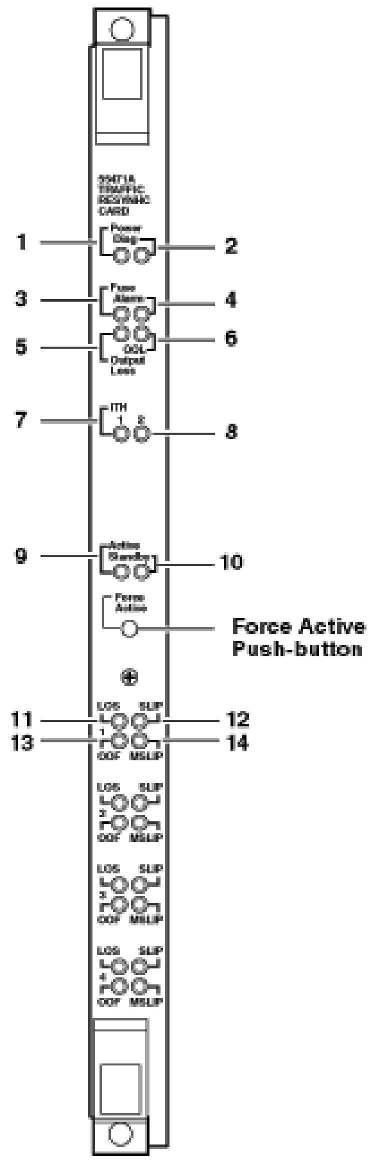


Figure D2-15. 55471A Traffic Re-sync Card

TRSC Front Panel LEDs

Besides the standard LEDs, there are additional LEDs on this card to indicate conditions related to the input and processing of the signals by this card. The descriptions here are referenced to the drawing on the previous page.

1 Power: –48 Volts is present.

2 Diag: Board diagnostics are being performed or a diagnostics failure has occurred.

3 Fuse: The –48 Volt fuse is open.

4 Alarm: Card is in alarm condition (refer to the Alarm section below for details)

5 Output Loss: Each of the eight outputs is constantly monitored for valid output. If an output does not match the expected value, then all outputs are squelched. The board will switch to Standby. The Alarm LED will also light. This event indicates a hardware failure.

6 OOL: On-card phase-lock loop is unlocked. The Alarm LED will also light.

7 ITH1: TRSC is tracking ITH card 1

8 ITH2: TRSC is tracking ITH card 2

9 Active: Outputs of card are active.

10 Standby: Outputs of card are squelched.

Force Active push button: Forces card to become the active card in a 2-card protected pair. The redundant card is forced into Standby mode.

11 LOS 1–4: Indicates loss of signal for the identified channel transmitting re-timed traffic. The output will squelch or transmit AIS, depending on the switch setting. Alarm LED will also light.

12 SLIP 1–4: Indicates a frame slip detection for the identified channel transmitting re-timed traffic. A slip indication occurs when there is an underflow or overflow of the on-card two-frame storage buffer. The underflow condition (buffer is empty) results in transmission of a repeated frame of data. The overflow condition causes the loss of one frame of data.

13 OOF 1–4: Indicates out of frame detection for the identified channel transmitting re-timed traffic or a mismatch between the switch settings for the channel and the input signal type.

14 MSLIP 1–4: Indicates multiple slips detected for the identified channel transmitting re-timed traffic at a rate equal to, or greater than, the frequency offset specified with the HSLIMIT keyword.

Alarm Conditions

These are the conditions that cause the Alarm LED to light:

- Signal loss (LOS) on input of any enabled channel.
- Signal loss on output of any enabled channel.
- Card out of lock (OOL).
- A card used in stand-alone mode has its switch set to protected (a pair of cards expected).
- Card has a power supply value out of range.
- Both reference clocks to the card have failed.
- One of the four re-timed inputs has detected a framing error.
- A multiple slip condition has occurred on one of the four re-timed inputs.
- A hardware failure has occurred.

Theory of Operation

Refer to the block diagram while reading this description. A TRSC has eight channels, four of which are re-timed and four which are only buffered. The input section of all eight channels is similar and is fed from the input connectors on the subrack to the backplane connector of the TRSC.

NOTE All TRSC inputs must use an external 75 Ω feed-thru termination because of internal backplane requirements.

The input signal to the TRSC is a 2048 kbps E1 signal which uses a bipolar format with a peak-to-peak amplitude of approximately 4.8 V. The bipolar 2048 kHz signals are input to a receiver chip through a 1:2 step-up transformer. The receiver can compensate for line losses and uses peak detection and a variable threshold to improve the signal-to-noise ratio. The recovery process splits the data and clock information on the input signal and processes them separately. The receiver then increases the signals to a TTL level and synchronizes the data and clock signals. The output from the receiver is three separate signals that correspond to positive and negative pulses occurring on the incoming Tip and Ring inputs, and the recovered clock.

The eight E1 output signals from the TRSC have the same multiframe structures as their respective inputs, either CCS (PCM31) or CAS (PCM30), with or without CRC-4 multiframe. The TRSC also supports the use of the spare CRC-4 bits for the Synchronization Status Message (SSM). The SSM bits can be set by the TRSC, or the card can just pass through the value from the incoming data.

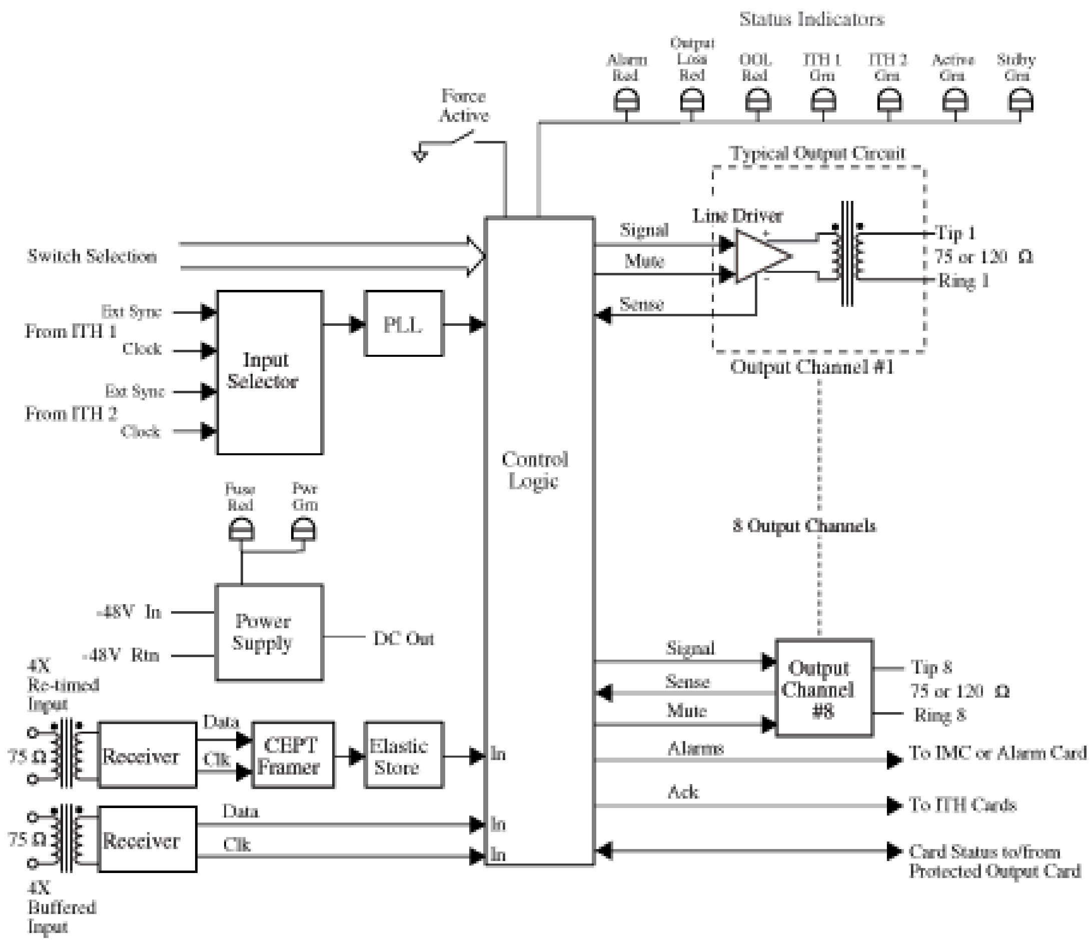


Figure D2-16. Traffic Re-synchronization Card Block Diagram

The four re-timed channels of the TRSC provide precision timing for network equipment that cannot receive external clock timing. These channels accept E1 (2048 kHz) traffic-bearing signals, remove jitter and wander from the signals, and then supply these re-synchronized signals for use by downstream network equipment. When any network element (NE) derives its timing from these signals, the NE is synchronized to the network.

In addition, the TRSC accepts up to four other signals that it can buffer, performing a repeater function. These input signals are recovered with the resulting output signals being restored to the correct nominal amplitude levels. These four buffered channels do not re-time the input signals nor do they filter any wander and jitter. All eight channels can function independently, for the most part. The exceptions are noted in the section on operation behaviors.

Re-timed Channels (1, 2, 3, 4)

The re-timed channels use the LOS detector from the receiver to give both a front panel LED indication and to force the output to AIS or squelch. The recovered signals from the receiver are fed to the receive side of their corresponding framer device. Here the differential signal is converted into a single-ended signal and, depending on the input type selected, frame sync is established and the multi-frame sync signal is generated.

Next the single-ended signal and the recovered clock are input to the elastic storage buffer where the re-timing function takes place. The buffer depth varies to compensate for jitter and wander between the input clock and the reference clock. The nominal delay, or depth, is one frame, the maximum is two frames and the minimum is zero frames.

Whenever the buffer depth reaches either two frames or zero frames, a slip has occurred and the TRSC will assert the SLIP output event. The elastic storage buffer then automatically re-centers the data pointer in the buffer. If the depth was two frames when the align signal was asserted, then a frame is deleted. If the depth is zero frames, a frame is repeated.

The slip-compensated multiframe alignment signal is fed to the framer to establish the transmit side multiframe timing. The framer formats the data as required and the data is output as differential signals and processed for the output stage. This same circuitry allows modification or pass-through of the SSM bits in the CRC-4 multiframe payload.

Buffered Channels (5, 6, 7, 8)

The four buffered channels are not re-timed and so the data in equals the data out, including any jitter or wander in the timing. The input signals are recovered, though, so if the input is attenuated, the output will be restored to the proper nominal amplitude levels. This action makes the TRSC useful as a repeater for these four channels.

If the Loss of Signal detector is asserted for any of the channels, then that particular output will go to AIS (unframed all ones) or squelch, depending on the switch settings described later in this section. The LOS LED on the TRSC front panel only indicates this condition for the four re-timed channels, so although there is no visual LOS indicator for the buffered channels, there is a TL1 event that is reported when a buffered channel experiences an LOS condition.

The recovered clocks and data signals are used by the TRSC to produce a signal compatible with the output stage to reproduce the original bipolar format. The output stages are transformer-coupled and direct the signals to the appropriate connector on the subrack.

TRSC Port Assignments

Output cards, normally used in protected pairs, occupy the plug-in module area in the subrack designated with letters A to E. These same letters are used on the subrack connector panel to designate the rows of outputs from the corresponding output cards. For example, the outputs cards located in the “A” slots supply signals to the row of connectors labeled with “A.”

Normally, each row of the subrack’s connectors are outputs only. However, in the case of the TRSC, the row of connectors corresponding to the location of the TRSC are made up of both inputs and outputs, as specified in the table below.

Table D2-9. Traffic Re-synchronization Card Port Assignments

Retimed Channels	Subrack Input Port	Subrack Output Port	Buffered Channels	Subrack Input Port	Subrack Output Port
Channel 1	1	2	Channel 5	3	4
Channel 2	5	6	Channel 6	7	8
Channel 3	9	10	Channel 7	11	12
Channel 4	13	14	Channel 8	15	16

75 Ω Termination

All TRSC inputs must be externally terminated with a 75 Ω termination:

> Connect a feed-thru 75 Ω termination between the input signal cable and the TRSC input port.

These are available from Symmetricom. Refer to chapter F3, “Replacement Parts.”

NOTE If using the TRSC in the mini-SSU subrack, the output modules have on-board 75 Ω terminations that can be selected with jumpers to eliminate the need for external terminators on the TRSC inputs. See chapter C6.

Operation Behaviors

This section describes details of the TRSC operation that can be useful for helping to understand how the card works. IT IS RECOMMENDED THAT YOU READ THIS SECTION BEFORE USING THE TRSC.

Configuration

- Firmware revision 3744E, or later, is required in the IMC or NIMC, and in the ITH cards to support TRSC operation.
- The input signal types (CAS/CCS/CRC-4) and the LOS Action can only be configured using the card's switches.
- SSM operation is only supported with a CRC-4 multiframe structure. When SSM modification is enabled (using TL1 keyword, TRSCSSM=INSERT), CRC-4 must be enabled on the TRSC via a switch setting to force recalculation of the CRC-4 bits.

Inputs

- Each input must be externally terminated with a 75 Ω termination to properly match the input impedance of the subracks.
- The HDB3 signal format is supported for the TRSC but not the AMI format.

Outputs

- Bit Transparency—The TRSC attempts to maintain maximum data transparency. The exceptions are:

  –1. Bits 2-8 of an alignment frame are always overwritten with the frame alignment signal (0011011).

  –2. Bits 2 and 3 (remote alarm indication bit) of a non-alignment frame are always output as “1” and “0”, respectively.

- A CRC-4 error on the output signal will be generated if the Remote Alarm bit is set on a CRC-4 input signal. This is because the Remote Alarm bit is always cleared by the TRSC, but the CRC-4 is not always regenerated. To prevent this problem, use the TRSCSSM=INSERT keyword to force the CRC-4 to be regenerated.

- The re-timed outputs may have a single bipolar error when the standby TRSC is switched to the active mode.
- Common Associated Signaling (CAS) employs a bit-oriented signaling technique utilizing time slot 16. The CAS multiframe alignment signal is contained in time slot 16 of frame 0. The first four bit locations contain the bit sequence: 0000. The remaining four bits are used as spare and alarm bits. In the other 15 frames, time slot 16 is reserved for channel signaling data. It is NOT recommended to use the bit sequence “0000” for the ABCD signaling bits because this will emulate the multiframe alignment word and cause loss of synchronization in downstream equipment.

Alarms and Events

- The Alarm LED will remain lighted until signals are connected to all input channels (re-timed and buffer) that are enabled. The default condition for the TRSC is to have all channels enabled. Disable unused channels using the TL1 command, SQUELCH. This is described in this document under, To Enable or Disable TRSC Channels.
- Buffered Channels (channels 5-8) are monitored only for loss of signal. The TRCBLOS (Traffic Re-sync Card Buffer Loss of Signal) event will be generated when a loss of signal occurs on one of the buffered (not re-timed) channels.
- Loss of signal, out of frame, slip, and multiple slip conditions will create alarm conditions on the TRSC and generate TL1 events, but these conditions will not generate alarms on the IMC/NIMC cards.
- The OOF (Out Of Frame) LED will stay continuously lit if the input signal type does not match the card’s switch setting for that input channel.
- HSLIMIT settings above 10,000 ppb combined with high slip rates (one or more slips every 12 seconds) will periodically cause the MSLIP LED to incorrectly extinguish and an “Ended TRSC Input High Slip” event to incorrectly occur. This happens because of the relatively slow rate at which the TRSC slip alarm is polled.

Card Configuration

Configuring a TRSC is a bit more difficult than with other cards because this card has inputs as well as outputs. Switches are used to set the following parameters:

- Signaling mode
- CRC-4 Yes or No

- Output protection mode
- LOS action

The rest of this section describes the switch settings, where the switches can be found on the card, and the command to enable or disable channels on the card.

Switch Settings

The table below shows the parameters set via the TRSC switches. Refer to Figure D2-17 for the location of the switches on the 55471A card. Switch 1 is used to set the output format for the four re-timed channels. Switch 3 sets the protection mode and the action the card will take when a loss of signal condition is detected.

Table D2-10. TRSC switch settings

Switch	Bit	Parameter	Off	On
S1	1	Channel 1 Signaling Mode	CCS	CAS
	2	Channel 1 CRC-4 Mode	Non-CRC-4	CRC-4
	3	Channel 2 Signaling Mode	CCS	CAS
	4	Channel 2 CRC-4 Mode	Non-CRC-4	CRC-4
	5	Channel 3 Signaling Mode	CCS	CAS
	6	Channel 3 CRC-4 Mode	Non-CRC-4	CRC-4
	7	Channel 4 Signaling Mode	CCS	CAS
	8	Channel 4 CRC-4 Mode	Non-CRC-4	CRC-4
S3	1	Output Protection Mode	Stand-alone	Protected
	2	LOS Action	AIS	Squelch
	3	Reserved	—	—
	4	Reserved	—	—

NOTE

Switches S1 and S3 are not oriented in the same direction. Carefully observe the On and Off positions.

TRSC Switch Locations

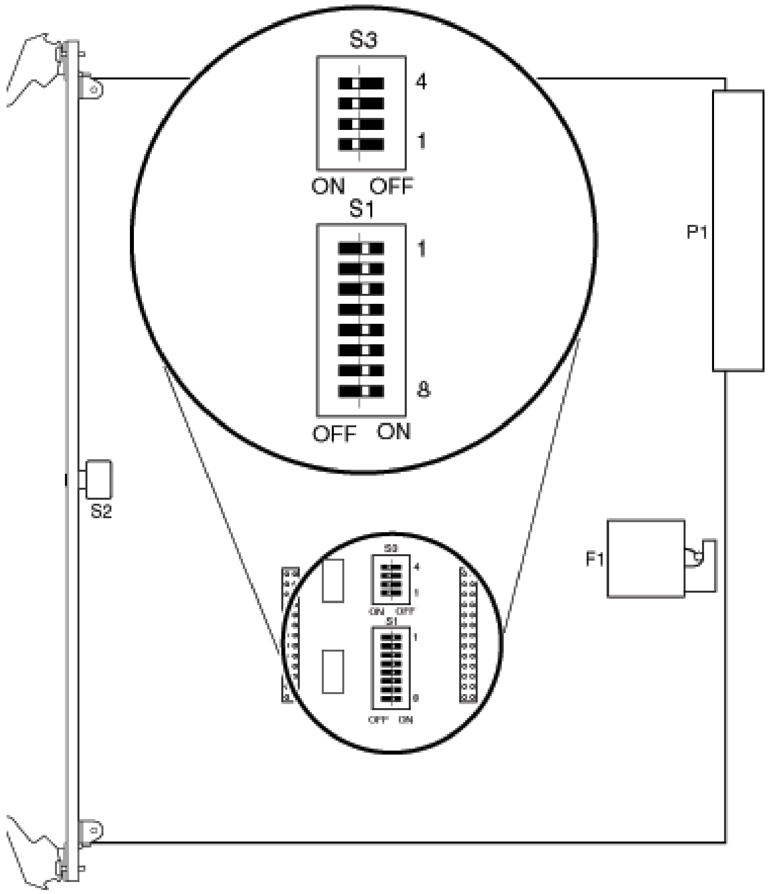


Figure D2-17. Traffic Re-synchronization Card Assembly Switches

NOTE Switches S1 and S3 are positioned differently. Verify proper orientation for the On and Off settings when making switch selections.

To Enable or Disable TRSC Channels

The TRSC provides eight channels. Four channels will re-time input signals and four will only buffer the input signals. Use the following TL1 command information to specify the channels that should or should not be used. The default condition is all channels enabled.

Table D2-11. Traffic Re-synchronization Card Port Assignments

Retimed Channels	Subrack Input Port	Subrack Output Port	Buffered Channels	Subrack Input Port	Subrack Output Port
Channel 1	1	2	Channel 5	3	4
Channel 2	5	6	Channel 6	7	8
Channel 3	9	10	Channel 7	11	12
Channel 4	13	14	Channel 8	15	16

NOTE For the TRSC, the SQUELCH command acts on the channel number, not the output port number as with other output cards. For example, to squelch Output Port 10, you would squelch Channel 3.

Syntax Examples

```
ed-sync::sn-outx-y:1:::squelch=y;
```

Syntax Explanation: Where n=number of the subrack (0-4), x=letter of the slot where the output card is located (A-E), and y=the channel number (1-8). “1” is an example of a Correlation Tag. This is a user-defined string of up to six alphanumeric characters. Any responses or acknowledgments will include the Correlation Tag. This is useful when more than one person is sending commands at the same time. The Correlation Tag can be used to identify the person to which the commands and responses belong.

1 To disable all channels of subrack number 1 (first expansion subrack) with the TRSC in slot B, send the following command:

```
ed-sync::s1-outb-1&2&3&4&5&6&7&8:1:::squelch=y;
```

2 To enable the four re-timed channels, send the following command:

```
ed-sync::s1-outb-1&2&3&4:1:::squelch=n;
```

3 To query the status of TRSC buffered Channel 5 in a master subrack, slot C, send the following query:

```
rtrv-sync::s0-outc-5:1:::parameter=squelch;
```

TRSC Keyword Functions

There are two TL1 Keywords to support the functions of the TRSC. Refer to the *55400A TL1 Programming Reference Manual* for more information about TL1 keywords and commands. The TRSC keywords deal with setting an alarm threshold for the occurrence of multiple slips within the TRSC and with specifying whether an SSM should be simply passed through or modified according to conditions in the SSU.

- HSLIMIT
- TRSCSSM

HSLIMIT Keyword

Sets a detection threshold for the slip rate. When the threshold is met or exceeded, a multiple slip (MSLIP) alarm event is triggered and the MSLIP LED lights.

SSM Insertion

The Synchronization Status Message (SSM) is a four-bit code that indicates the current synchronization quality level to downstream equipment. The TRSC supports the ability to pass through SSM information or insert an SSM value based on the quality of the reference timing source being used by the TRSC. During normal operation, the TRSC inserts onto its output the SSM quality level of the reference signal being tracked by the SSU. In Holdover mode, the value set with the keyword, HFQLEVL, will be inserted on the transmitted re-timed signal. Once the SSU leaves Holdover mode and returns to tracking an input reference signal, the TRSC will end transmitting the holdover synchronization status and return to sending the synchronization status of the tracked reference.

Backdating

55481A clock distribution card—2048 kbps

This card can carry a traffic pattern, but it is limited to all ONES (0xFF). The 55481B card can carry a traffic value that contains 1 ZERO.

Behavior when mixing "A" and "B" cards

When installing "A" and "B" 2048 kbps cards in a protected pair, be aware that the system behavior will depend on the firmware version that the system is running.

Before Firmware Version 3744H

If a 55481A is paired with a 55481B, both cards will automatically have the traffic pattern value set to 255 (all ONES).

Firmware Version 3744H and later

If a 55481A is paired with a 55481B that is operating with a traffic pattern other than 255, the 55481A card will be taken off-line and an alarm will be issued. The 55481B card will generate the specified legal traffic pattern. If a pattern with more than one zero is set for the slot where the 55481B is located, the card will be programmed to 0xFF (255).

Refer to the Traffic keyword description in the *55400A TL1 Programming Reference Manual* for the keyword syntax.

55485A clock distribution card—1544 kbps

8 outputs (9 through 16 on subrack)

NOTE This card is not compatible with the 55485B card, which provides 16 outputs. Do not install "A" and "B" 55485 cards in a protected pair.

D3

Configure Communication Cards

Theory, configuration, backdating

In This Chapter

This chapter describes the Communication cards for use in the 55401 and 55409 series of subracks. The topics include the following:

- Functions/features
- Individual card descriptions and configuration
- Backdating

Communication Card Functions/Features

The purpose of the communication card is to provide the following functions:

- Alarm management and reporting
- Interface to the external world for system status and management

Different Cards for Different Applications

The different models of communication cards provide different capabilities depending on the needs of the SSU system.

Alarm management and local/remote communication

55441A Information Management Card (IMC) contains:

- Functions of the AIC
- Local communication port for accessing internal status information and configuring system parameters
- Remote port supports the same communication functions over a modem
- Support for expansion subracks

Alarm management and local/network communication

55442A Network Information Management Card (NIMC) contains:

- Functions of the AIC
- Local port communication
- Networking capability
- Support for expansion subracks

NOTE The communication card is not a redundant element of the SSU and it is not required for SSU operation. The SSU can still accept, process, and distribute timing signals should the communication card fail.

Each card is described in detail in this chapter.

Information Management Card

The Information Management Card (IMC) provides local and remote communication and alarm functions for the 55400A system. The card's front panel is shown in Figure D3-1. Figure D3-2 illustrates the card's circuitry. Table D3-1 defines the LEDs on the front panel.

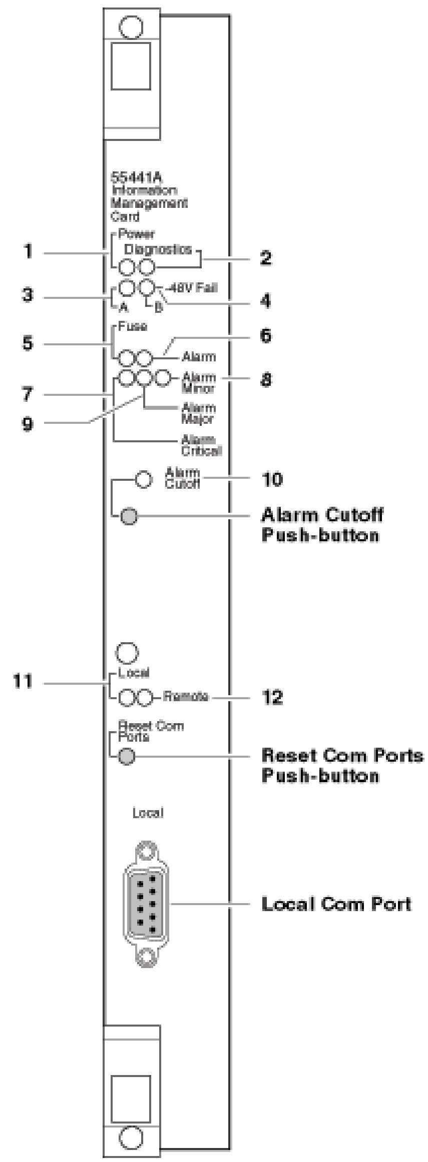


Figure D3-1. 55441A Information Management Card

Table D3-1. Information Management Card LEDs

No.	LED	Indicates when lighted
1	Power	Power is present.
2	Diagnostics	Diagnostics are being performed.
3	–48 V Fail A	–48 Vdc (A) input is outside normal voltage range.
4	–48 V Fail B	–48 Vdc (B) input is outside normal voltage range.
5	Fuse	AIC card fuse is open.
6	Alarm	Card is in the alarm state.
7	Alarm Critical	Critical alarm exists in master subrack.
8	Alarm Minor	Minor alarm exists in master subrack.
9	Alarm Major	Major alarm exists in master subrack.
10	Alarm Cutoff	Audible or visual alarm was present: audible has been silenced: alarm state continues.
11	Local	Local port is busy. Indicates that a user is logged on.
12	Remote	Remote port is busy. Indicates that a user is logged on.

IMC Description

The power supply on the IMC receives –48 volts from the backplane and converts it to an output voltage using its on-board dc-to-dc converter.

The IMC accepts status signals from each ITH card, status lines from each pair of output cards, and the Alarm Cutoff and Reset Com Ports lines from push-buttons at the IMC front panel.

Alarm generation circuits continually monitor status lines from the ITH cards and the output cards. Data from these circuits are interpreted by a hardware state machine for a possible alarm condition. Whenever an alarm condition is detected, the alarm generation circuitry determines the alarm severity. Appropriate IMC alarm relays are then switched.

Alarm Cutoff push button

When the Alarm Cutoff push button on the IMC front panel is pressed, the Alarm Cutoff LED on the IMC front panel lights up and the audible alarm relay contacts return to the non-alarmed state. The cutoff LED will remain lit until the alarm condition is over. Once the Alarm Cutoff button has been pressed and the alarm condition is no longer present, the alarm function resets automatically.

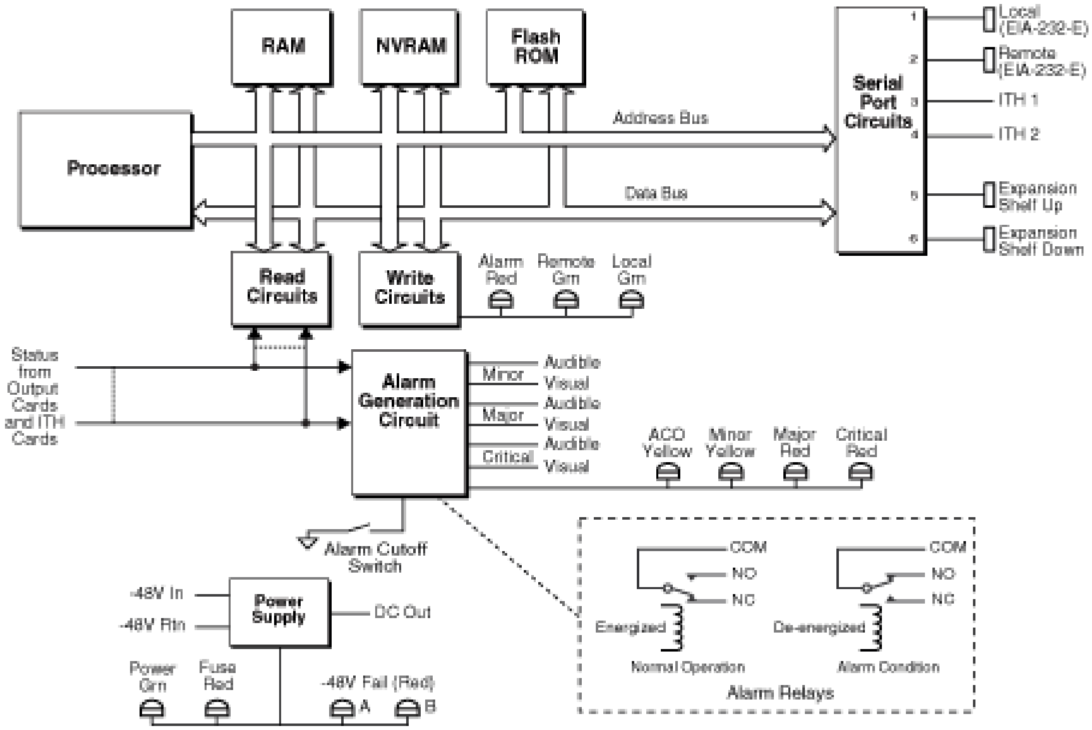


Figure D3-2. Information Management Card Block Diagram

Drive lines from the alarm generation circuitry activate visual and audible alarms. There are three alarm relays for office visual and audible alarms: critical, major, and minor, for a total of six relays in all. The LED array at the IMC front panel is activated by the alarm generation circuitry.

Control Circuitry

The control circuitry consists of RAM, NVRAM, flash EEPROMs, read ports, a write port, a central processor, and address decoding logic. All input status lines and lines from the alarm generation circuitry are fed into the read ports. The data bus is connected to all RAM, NVRAM, flash EEPROMs, and the write port for communication with the central processor. An address bus from the central processor feeds the address decoding logic and the serial port circuits. Chip select lines from the address decoding logic are provided to the three serial port circuits and the I/O ports.

Three serial port circuits give the IMC the ability to communicate with the outside world. They provide local and remote terminal communications, communications with the two ITH cards, and communications with any expansion subrack. The serial port circuits connect the IMC with remote or local terminals which can configure the system, download firmware, receive event and alarm messages, set input priority tables, and set alarm thresholds.

Reset Com Ports

Pressing the Reset Com Ports push-button switch on the IMC front panel causes the IMC to read the communication switch settings on the card into memory. For example, if TL1 commands had been used to change the baud rate or flow control values from those specified by the switch settings, this push-button resets the values to the switch values. Also, after making any changes to the switch settings, re-install the card and press this push button to force the card to read the new values into memory.

TL1 commands can be used for communications between the IMC and a local or remote terminal. The IMC reports alarms automatically to the terminal in real time. The IMC card provides a log of the most recent TL1 automatic responses.

Local Port on IMC

The Local Port supports connection to a local terminal. A user can send TL1 commands to configure the system, retrieve event and alarm messages, set input priority tables, download firmware, and set alarm thresholds. These same tasks can be performed using a graphical user-interface application, such as the 5450A local craft terminal software.

Table D3-2. Local connector pinout

Pin Number	Description
1	DCD (Data carrier detect)
2	RxD (Received data)
3	TxD (Transmitted data)
4	DTR (Data terminal ready)
5	GND (Signal ground)
6	DSR (Data set ready)
7	RTS (Request to send)
8	CTS (Clear to send)
9	RI (Ring indicator)

Configuring IMC card

This IMC card assembly is equipped with four dual inline switches to set the instrument-state parameters for the card.

Switch settings

Set the switches according to your system requirements. All switches are set to On at the factory except for S4–1. The default setting for Security is Off.

Table D3-3. 55441A IMC card switch settings

Switch	Bit	Parameter	Off	On
S3	1–2	Local Port Baud Rate	See Table D3-6 for details	
	3	Local Port Flow Control	Enabled	Disabled
	4–5	Remote Port Baud Rate	See Table D3-7 for details	
	6	Remote Port Flow Control	Enabled	Disabled
	7	Local Port Echo	Disabled	Enabled
	8	Remote Port Echo	Disabled	Enabled
S4	1	Security	Disabled	Enabled
	2	IMC Startup State	Switch settings override memory values.	Use memory values.
	3	Force Enable Local Port	Local port is enabled even if previously disabled by TL1 command	Normal operation where TL1 command can disable local port.
	4	Modem Control	Enabled	Disabled
	5–8	Reserved	—	—
S5	1	Firmware Mode	Force download mode.	Verify firmware code.
	2	Reserved	—	—
	3	Combine Critical/Major Alarms	Enabled	Disabled
	4–8	Reserved	—	—
S6	1	Single ITH Operation	Enabled	Disabled
	2–4	Reserved	—	—

NOTE

If S5–3 is set to Off, Critical and Major alarms are combined as Major alarms. The Critical alarm relay will indicate if the ACO push button has been pressed.

Set the switches according to you system requirements.

Table D3-4. 55441A Local Port Baud settings

Baud Rate	Switch S3–1	Switch S3–2
1200	ON	OFF
2400	OFF	ON
9600	ON	ON
19.2 k	OFF	OFF

Set the switches according to you system requirements.

Table D3-5. 55441A Remote Port Baud settings

Baud Rate	Switch S3–4	Switch S3–5
1200	ON	OFF
2400	OFF	ON
9600	ON	ON
19.2 k	OFF	OFF

NOTE

Whenever the local/remote baud rate or flow control switch settings are modified, re-install the card and press the Reset Comm Ports push button to force the card to read the new values into memory.

Switch location

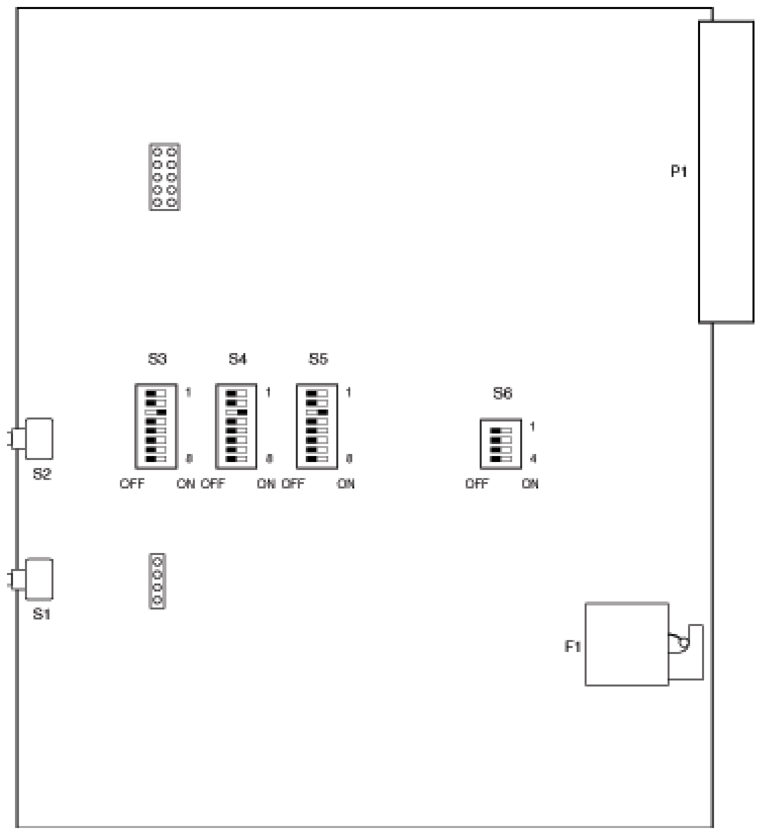


Figure D3-3. IMC Card Switch

Network Information Management Card

The Network IMC makes it possible to install the SSU on a network and manage it from a remote location. A LAN, X.25 (Option 002), or TP4 (Option 003) interface is available. The card's front panel is shown in Figure D3-4. The network version of the IMC also adds a rack alarm port described below. The LED indicators on the network card are described in Table D3-6.

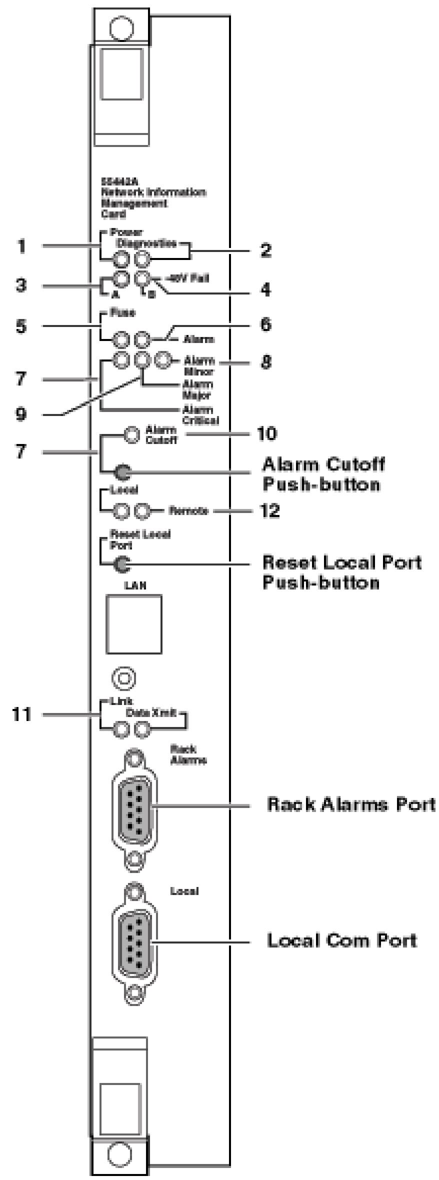


Figure D3-4. 55442A Network Management Card

Table D3-6. Network Information Management Card LEDs

No.	LED	Indicates when lighted
1	Power	Power is present.
2	Diagnostics	Diagnostics are being performed.
3	–48 V Fail A	–48 Vdc (A) input is outside normal voltage range.
4	–48 V Fail B	–48 Vdc (B) input is outside normal voltage range.
5	Fuse	AIC card fuse is open.
6	Alarm	Card is in the alarm state.
7	Alarm Critical	Critical alarm exists in master subrack.
8	Alarm Minor	Minor alarm exists in master subrack or external rack.
9	Alarm Major	Major alarm exists in master subrack or external rack.
10	Alarm Cutoff	Audible or visual alarm was present: audible has been silenced: alarm state continues.
11	Link/Data Xmit	Link shows that network connection is active. Xmit shows data transfer.
12	Local/Remote	Local or Remote port is busy. Indicates that a user is logged on.

NIMC Description

Because the circuitry of the NIMC is similar to that of the IMC, please refer to the description for the IMC to understand the operation of this card. This section will concentrate on what is different about this card.

Network IMC Port Assignments

Depending on the type of NIMC you have, the communication ports will be assigned differently.

Table D3-7. Network Card Port Assignments

Network IMC Card	Network Type	Port Usage
55442A standard	TCP/IP	Uses LAN port on NIMC, Remote port not functional.
55442A Option 002	X.25	Uses Remote port on subrack, LAN port not functional.
55442A Option 003	TP4	Uses LAN port on NIMC, Remote port not functional.

Rack Alarms Connector

The 55442A Network Information Management Card includes a rack alarm input connector. Alarm signals from other equipment in the rack can be connected to the 55400A. This way the SSU can pass these external alarms over the network to the Network Manager. These alarm inputs can be used for alarms that indicate faults in the rack power supply and in other equipment installed in the rack. Table D3-8 describes the alarm connector pinout and the assigned alarm severity.

NOTE The word “External” in Table D3-8 means outside of the 55400A subrack.

Table D3-8. 55442A Rack Alarms Connector Pinout

Pin Number	Description
1	Ground
2	External Rack Power Alarm (Major)
3	External Cesium 2 Alarm (Major)
4	External GPS Reports Critical Alarm (Major)

Table D3-8. 55442A Rack Alarms Connector Pinout (continued)

Pin Number	Description
5	External GPS Reports Major Alarm (Major)
6	External Rack Alarm 5 (Major)
7	External Rack Alarm 6 (Major)
8	External Rack Alarm 7 (Major)
9	External Rack Alarm 8 (Minor)

The Rack Alarms connector provides ground on pin 1 and a TTL High level on pins 2 through 9. An open indicates a non-alarm condition. Any grounding of pins 2 through 9 indicates an alarm condition. For example, Pin 2 could be used to monitor the power to the rack, and Pin 3 could support an alarm for a second 5071A Primary Frequency Standard in the rack. Pins 4 and 5 can be used for the GPS equipment in the rack. Pins 6 through 9 can be used as needed. The one Minor alarm (pin 9) will not be promoted to Major by the Network IMC. Any promotion is the responsibility of the equipment generating the alarm. The SSU simply forwards these rack alarms to the Network Manager.

Here are examples of the Rack Alarm reports sent to the Network Manager:

```
SSU 97-08-19  14:54:31
**0005 REPT ALM TSG
"IMC:MJ,RCKALM1,NSA,08-19,14:54:31:\"Ext. Rack Power
Alarm"\
;


SSU 97-08-19  14:54:31
**0005 REPT ALM TSG
"IMC:MJ,RCKALM2,NSA,08-19,14:54:31:\"Ext. Cesium 2
Alarm"\
;
```

Example of Wiring Diagram for Rack Alarms Connector

The drawing in Table D3-5 shows how a relay in a GPS device in the equipment rack could be connected to the Rack Alarms Port. When the relay went into the alarm condition, the Network IMC would send a Major alarm message to the Network Manager. The operation would be similar for the other alarm lines.

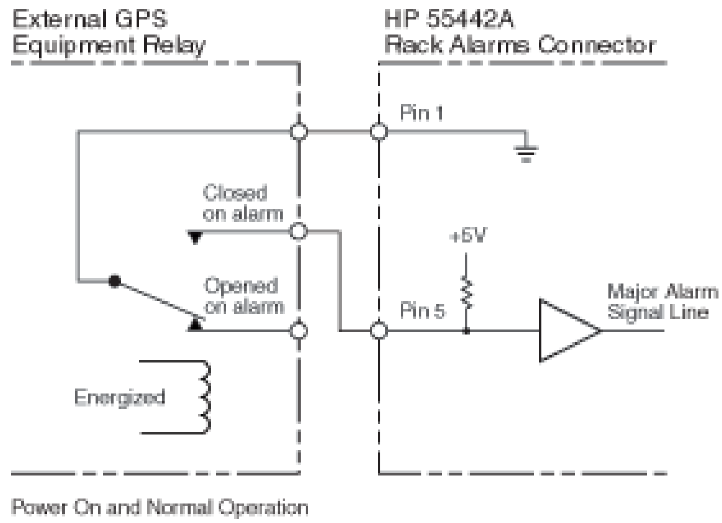


Figure D3-5. Example of Relay to Rack Alarms Connection

LAN Port on NIMC

The LAN port uses an 8-pin modular RJ-45 connector for terminating 10Base-T cabling.

Local Port on NIMC

The Local Port supports connection to a local terminal. A user can send TL1 commands to configure the system, retrieve event and alarm messages, set input priority tables, download firmware, and set alarm thresholds. These same tasks can be performed using a graphical user-interface application, such as the 55450A local craft terminal software.

Table D3-9. Local connector pinout

Pin Number	Description
1	DCD (Data carrier detect)
2	RxD (Received data)
3	TxD (Transmitted data)
4	DTR (Data terminal ready)
5	GND (Signal ground)
6	DSR (Data set ready)
7	RTS (Request to send)
8	CTS (Clear to send)
9	RI (Ring indicator)

Remote Comm Port on master subrack

The Remote Port is located on the SSU subrack itself. It is the X.25 interface connector for the Option 002 55442A Network IMC. This port is not operational with the LAN or TP4 version of the 55442A. Remote management of the SSU can be accomplished using the TL1 command syntax or by using a graphical user-interface application for network management, such as the 55452A open synchronization management framework for HP-UX.

Table D3-10. Remote connector pinout for X.25

Pin Number	Description	Signal Direction
1	No connection	—
2	TxD (Transmitted data)	Out
3	RxD (Received data)	In
4	RTS (Request to send)	Out
5	CTS (Clear to send)	In
6	DSR (Data set ready)	In
7	GND (Signal ground)	—
8	DCD (Data carrier detect)	In
9–14	No connection	—

Table D3-10. Remote connector pinout for X.25 (continued)

Pin Number	Description	Signal Direction
15	Tx clk (Transmitted clock)	In
16	No connection	—
17	Rx clk (Received clock)	In
18–19	No connection	—
20	DTR (Data terminal ready)	Out
21–25	No connection	—

NOTE

The remote port can only be used for an X.25 network connection. The RTS and DTR signals are always asserted (active). The handshake signals: CTS, DSR, and DCD are not used by the SSU. The X.25 network connection for the 55400A requires the use of a leased-line synchronous modem, not a dial-up type.

Alarm Cutoff push button

When the Alarm Cutoff push-button is pressed, the Alarm Cutoff LED lights up and the audible alarm relay contacts return to the non-alarmed state. The LED will remain lit until the alarm condition no longer exists. After the button has been pressed and the alarm condition no longer exists, the alarm function resets automatically.

Reset Local Port push button

Pressing the Reset Com Ports push-button switch on the IMC front panel causes the IMC to read the communication switch settings on the card into memory. For example, if TL1 commands had been used to change the baud rate or flow control values from those specified by the switch settings, this push-button resets the values to the switch values. Also, after making any changes to the switch settings, re-install the card and press this push button to force the card to read the new values into memory.

Option 004 Expanded Memory

The expanded memory option makes it possible to record up to 24 hours of consecutive, filtered time interval error measurements (CTIE). For information about how to use this feature, see chapter 8 of the *55400A TL1 Programming Reference Manual*.

Configuring NIMC card

This NIMC card assembly is equipped with five dual inline switches to set the instrument-state parameters for the card.

Switch settings

Set the switches according to your system requirements. All switches are set to On at the factory except for S4–1. The default setting for Security is Off.

Table D3-11. 55442A NIMC card switch settings

Switch	Bit	Parameter	Off	On
S3	1–2	Local Port Baud Rate	See Table D3-14 for details	
	3	Local Port Flow Control	Enabled	Disabled
	4–6	Reserved	—	—
	7	Local Port Echo	Disabled	Enabled
	8	Reserved	—	—
S4	1	Security	Disabled	Enabled
	2	NIMC Startup State	Switch settings override memory values.	Use memory values.
	3	Force Enable Local Port	Local port is enabled even if previously disabled by TL1 command	Normal operation where TL1 command can disable local port.
	4–8	Reserved	—	—
S5	1	Firmware Mode	Force download mode.	Verify firmware code.
	2	Reserved	—	—
	3	Combine Critical/Major Alarms	Enabled	Disabled
	4–8	Reserved	—	—
S6	1–4	Reserved	Must be Off.	Do not use.
	5–7	Reserved	—	—
	8	Enforce IP Match (see next page)	Disabled	Enabled
S8	1	Single ITH Operation	Enabled	Disabled
	2–4	Reserved	—	—

Set the switches according to you system requirements.

Table D3-12. 55442A Local Port Baud settings

Baud Rate	Switch S3–1	Switch S3–2
1200	ON	OFF
2400	OFF	ON
9600	ON	ON
19.2 k	OFF	OFF

NOTE Whenever the local baud rate or flow control switch settings are modified, re-install the card and press the Reset Local Port push button to force the card to read the new values into memory.

Enforce IP Match

When switch S6–8 is set to On (enabled), only communication from the addresses of the primary and alternate element managers (EM1 and EM2) will be accepted. Communication from all other network addresses will be ignored. When this switch is set to Off, communication from any network address will be accepted.

NOTE In the case of the TCP/IP LAN version of the NIMC, the IP match function will also include the addresses of the primary and alternate local managers (LM1 and LM2).

Switch location

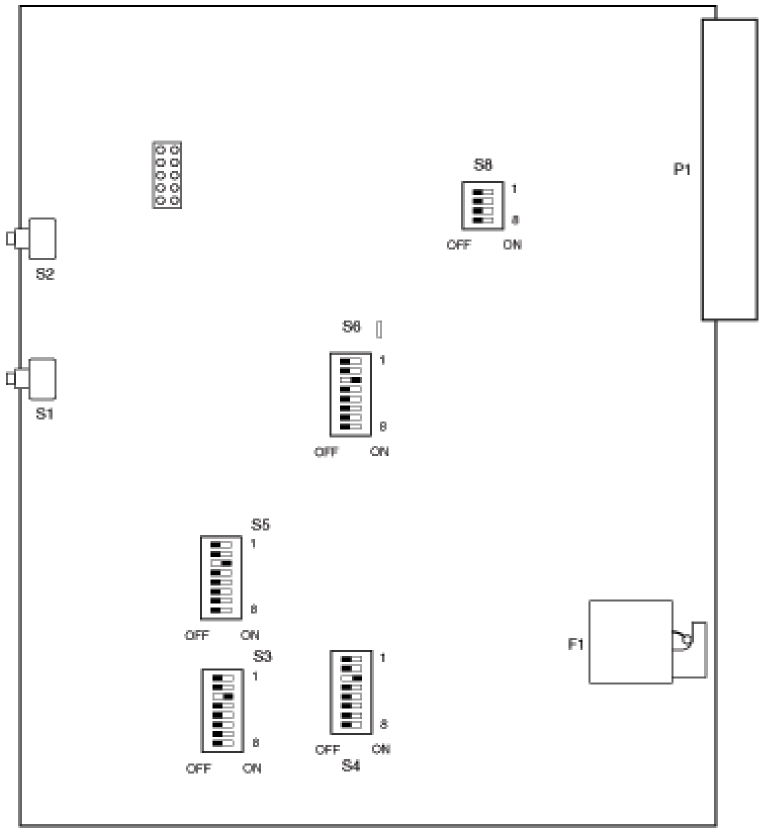


Figure D3-6. NIMC Card Switch

NOTE

When the S5–3 switch is set to Off, Critical and Major alarms are combined as Major alarms. The Critical alarm relay will indicate if the ACO push button has been pressed.

Preparing the NIMC for Network Use

The most important step in preparing an NIMC for use on a network is configuring the network parameters on the card. Before the SSU can be used on a network, there is an extensive list of network parameters that must be set correctly for each of the network interfaces.

The procedure for preparing an NIMC for use on a network is described in chapter E1, "Qualification Procedures."

NOTE Only an overview to the different network parameters is presented here. Refer to chapter 10, "Network Parameters," in the *55400A TL1 Programming Reference Manual* for detailed instructions on configuring the NIMC for network operation.

Saving Network Parameters into Memory

All network parameters that require address settings or port numbers are stored in two separate regions of Network IMC memory. The two areas of memory are called: Working Memory (WKG) and Auxiliary Memory (AUX). The WKG memory contains the parameter settings being used by the network, while the AUX memory holds a backup copy of these parameters. The WKG memory parameters cannot be directly set. Any parameter modifications are first set in the AUX memory and then when you are sure the settings are correct, the CPY-MEM-SECU command is used to transfer the AUX memory to WKG memory.

55442A Network IMC

The 55442A Network IMC supports a 10Base-T LAN connection. Before testing the LAN port or installing the SSU on a network, the following network parameters must be set via the SSU Local Port (the TL1 keywords are shown in parentheses):

- IP address of network element/SSU (IPNEX)
- IP subnetwork mask (IPSUBNETX)
- IP address of default gateway (IPGATEX)
- IP address of element manager (IPEM1X)
- IP address of local manager (IPLM1X)
- Command port number (PORTCMDSX)
- Automatic event output port number (PORTAOX)

55442A Option 002 Network IMC

The 55442A Option 002 Network IMC supports an X.25 network connection. Before testing the X.25 port or installing the SSU on a network, the following network parameters must be set via the SSU Local Port (the TL1 keywords are shown in parentheses).

Always set the following parameters:

- X.25 address of network element/SSU (X25NEX)
- X.25 address of element manager (X25EM1X)
- Logical channel starting number (X25SRTSVCX)
- Logical channel ending number (X25ENDSVCX)

Set the following parameters only if necessary. Default values are typically acceptable:

- Level 3 packet size (X25L3PKSZ)
- Level 3 window size (X25L3WX)
- Level 2 window size (X25L2KX)
- Retransmission timer (X25T1X)
- Acknowledgment timer (X25T2X)
- Idle timer (X25T3X)
- Retransmission count (X25N2X)
- Frame size (X25N1X)

55442A Option 003 Network IMC

The 55442A Option 003 Network IMC supports a 10Base-T connection. Before using the TP4 interface or installing the SSU on a network, the following network parameters must be set via the SSU Local Port (the TL1 keywords are shown in parentheses):

- NSAP address of network element/SSU (NSAPNEX)
- NSAP address of element manager (NSAPEM1X/NSAPEM2X)
- TSAP for command port (TSAPCMDSX)
- TSAP for automatic output port (TSAPAOX)
- Low-level encryption of communications (SCRAMBLEX)

Expansion Communication Card

The 55443A Expansion Communications Card performs the function of the communication card in the expansion subrack.

This card is described in chapter C3, "Install Expansion Subracks."

Backdating

This section contains information about products that are no longer current.

55431A Alarm Interface Card (AIC)

The AIC collects alarm information from every other card located in the subrack and determines whether any combination of alarms is a critical, major, or minor alarm state. The appropriate alarm relays are activated and the lights the corresponding critical, major, or minor LED indicator on the front panel.

Table D3-13. 55431A Alarm Interface Card Relays

Description	Specification
Alarm Relay Contact Ratings	
Switching Power	60 W, 62.5 VA
Switching Voltage	60 Vdc, 30 Vac
Switching Current	1A maximum
Critical, Major, & Minor Alarm Relays, with or without alarm cutoff	Open and closed contacts
ACO (alarm cutoff) Switch—front panel	Push button, when pressed silences the audible alarm and lights the ACO LED.

Alarm management only

55431A Alarm Interface Card (AIC) provides:

- Alarm signals from the SSU and nothing more.
- Alarm Information Card—the only way this card communicates with the outside world is with the LED indicators on its front panel indicating status and alarms. No type of local or remote communication is supported.

More detailed information about the AIC is included below.

Alarm Interface Card

The Alarm Interface Card (AIC) only provides alarm functions. The card's front panel is shown in Figure D3-7. Figure D3-8 illustrates the card's circuitry. Table D3-14 defines the LEDs on the front panel.

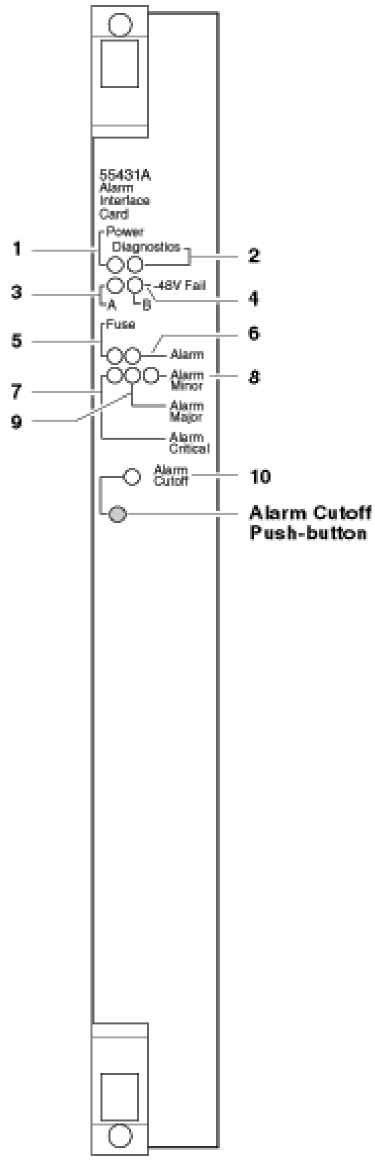


Figure D3-7. 55431A Alarm Interface Card

Table D3-14. Alarm Interface Card LEDs

No.	LED	Indicates when lighted
1	Power	Power is present.
2	Diagnostics	N/A
3	–48 V Fail A	–48 Vdc (A) input is outside normal voltage range.
4	–48 V Fail B	–48 Vdc (B) input is outside normal voltage range.
5	Fuse	AIC card fuse is open.
6	Alarm	Card is in the alarm state.
7	Alarm Critical	Critical alarm exists in master subrack.
8	Alarm Minor	Minor alarm exists in master subrack.
9	Alarm Major	Major alarm exists in master subrack.
10	Alarm Cutoff	Audible or visual alarm was present: audible has been silenced: alarm state continues.

AIC Description

The power supply on the AIC receives –48 volts from the backplane and converts it to an output voltage using its on-board dc-to-dc converter.

The AIC accepts status signals from both ITH cards, status lines from each pair of output cards, and the Alarm Cutoff line from the push-button at the AIC front panel.

Alarm generation circuits continually monitor status lines from the ITH cards and the output cards. Data from these circuits are interpreted by a hardware state machine for a possible alarm condition. Whenever an alarm condition is detected, the alarm generation circuitry determines the alarm severity. Appropriate AIC alarm relays are then switched. When the Alarm Cutoff push-button on the AIC front panel is pressed, the Alarm Cutoff LED on the AIC front panel lights up and the audible alarm relay contacts return to the non-alarmed state. The cutoff LED will remain active until the alarm condition is over. Once the Alarm Cutoff button has been pressed and the alarm condition is no longer present, the alarm function resets automatically.

Drive lines from the alarm generation circuitry activate visual and audible alarms. There are three alarm relays for office visual and audible alarms: critical, major, and minor. The LED array at the AIC front panel is activated by the alarm generation circuitry.

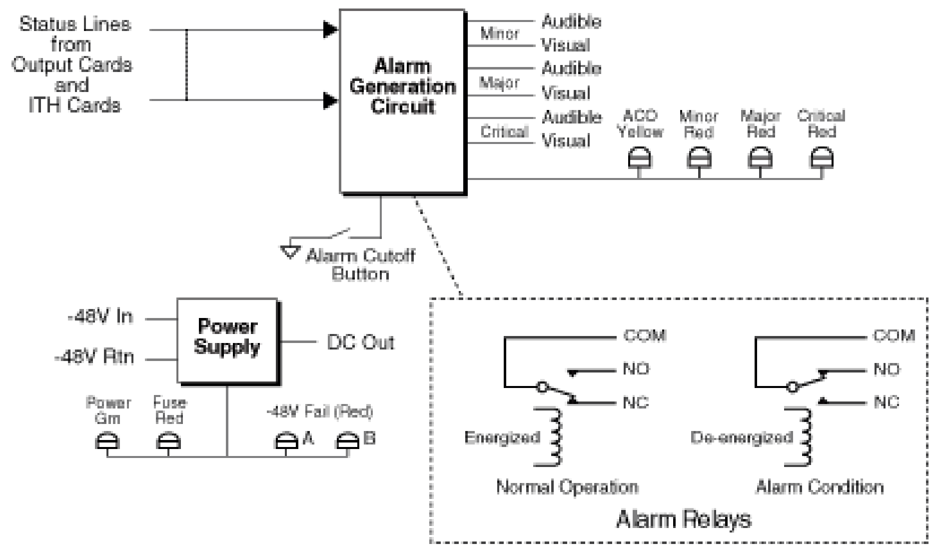


Figure D3-8. Alarm Interface Card Block Diagram

Configuring AIC card

This AIC card assembly is equipped with two dual inline switches to set the instrument-state parameters for the card.

Switch settings

Set the switches according to you system requirements. The switch locations are shown in Figure D3-9

Table D3-15. 55431A AIC card switch settings

Switch	Bit	Parameter	Off	On
S5	1–2	Reserved	—	—
	3	Combine Critical/Major Alarms	Enabled	Disabled
	4–8	Reserved	—	—
S6	1	Single ITH Operation	Enabled	Disabled
	2–4	Reserved	—	—

Switch location

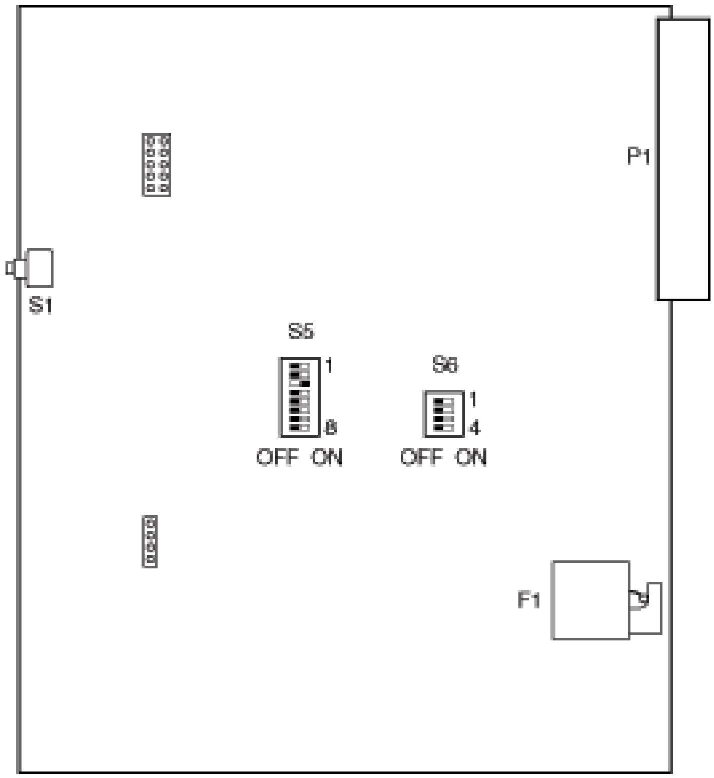


Figure D3-9. AIC Card Switch

NOTE

When the S5–3 switch is set to Off, Critical and Major alarms are combined as Major alarms. The Critical alarm relay will indicate if the ACO push button has been pressed.

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