

Introduction

One appropriately equipped SuperLink system can accommodate point-to-point audio transmission or large-scale network systems.

1. Overview

The SuperLink is an audio gateway that can be configured as a multi-channel high-fidelity bi-directional audio codec or a gateway for streaming audio over the internet. SuperLink offers full compatibility with all existing G.722 and MPEG based codecs, but adds additional state-of-the-art compression algorithms. SuperLink even allows you to send nearly *uncompressed* audio over E1 networks. With a total of five algorithms and seven connection options, SuperLink is the most flexible audio gateway available *anywhere*.

SuperLink is based around a flexible, 2U high chassis that contains an exceedingly friendly user interface, a power supply, a control processor and three slots to equip your SuperLink as you like. You are no longer bound to 'make do' with what is available... *you* equip your SuperLink with just the features you need. Need more than two bi-directional audio channels? Need to send audio in only one direction? Need to connect directly to T1 or E1? Need to stream audio? With SuperLink, all this and more is *NO PROBLEM!*

SuperLink's flexibility arises from the three slots on the back panel that can hold any of the seven plug-in modules available. Choose from two different audio modules and five different connection modules. Available audio modules include a stereo encoder and a stereo decoder. A full bi-directional stereo codec module will be available in the future. Network modules include a three BRI ISDN module, T1,

E1, V.35, and X.21/RS422. In addition, Ethernet connectivity for monitor and control, as well as updating software, is standard, and does not require a plug-in module.

SuperLink's audio coding features are unparalleled as well. Five different algorithms not only allow connections to almost all current codecs on the market, but also allow *near-uncompressed* audio over E1 links. SuperLink's algorithms include:

You can tailor the audio to your applications with five different audio compression algorithms and two linear (non-compressed) algorithms. The ability to send audio to multiple locations, insert and drop audio programs and establish cross-connections are all standard features of the SuperLink codec.

1.1 Basic Features

SuperLink is housed in an attractive 19" all-steel chassis that can be used as a table-top unit or can be rack mounted using the provided mounting brackets. SuperLink is cooled using two fans specially designed for quiet operation. SuperLink contains an international power supply that does not require jumper or switch setting adjustments for voltage or frequency changes. The power switch is located on the rear panel to prevent accidental shutoff.

SuperLink has a large, 20 character by four-line backlit alphanumeric LCD display for viewing and changing system settings, and reviewing system status. The display contrast can be adjusted over a wide range for ease of viewing from any angle and features a "soft" menu structure. The SuperLink can be configured and used from the large, built in keypad with tactile and (user selectable) audible feedback. In addition to the alphanumeric dialing keypad, there are "soft" menu navigation keys for direct function access, easy-access speed-dial and directory maintenance keys, and our unique intelligent VU meter and headphone select keys.

- ? A single Control Processor is used to control and monitor all functions of the SuperLink codec and all plug-in modules. The Control Processor allows connections to a terminal or computer through RS232 interfaces, or may be connected to a network through its Ethernet port. With two user definable alarms, four optically-isolated inputs and four relay outputs,

you can create local or remote 'events' for control of peripheral equipment. The included Ethernet port allows for high speed updating of the SuperLink's firmware via a telnet connection. The Ethernet port may also be used for connection to a Windows®-based media server to allow easy streaming of MPEG Layer 3 audio.

1.2 Audio Features

Each encoder and decoder module is capable of two-channel operation. Up to two encoder or decoder modules can be installed in a SuperLink codec yielding up to 4 audio channels.

Analog audio input and output is available with adjustable input sensitivity and output levels, variable impedance, balanced or unbalanced. Both AES/EBU and S/PDIF digital audio I/O is available, with automatic sample rate adaptation and internal, line, or external synchronization.

Many algorithms are supported to provide audio quality suited to any application. Since multiple encoder and decoder modules are supported, multiple algorithms can be used simultaneously.

Supported algorithms are listed below;

G.722 : This early PCM-based algorithm yields 7.5 kHz commentary grade mono audio ideally suited for voice applications, such as news, sports, etc. With low delay, talk-back is possible without cumbersome delay compensation schemes. G.722 as implemented in SuperLink supports a bit rate of 64 kb/s.

CCS MUSICAM® / ISO/MPEG Layer 2: ISO/MPEG Layer 2 (known as MUSICAM in Europe) is ideally suited for high fidelity music applications. With bit rates as low as 64 kb/s, MPEG Layer 2 can deliver moderate fidelity monaural audio with moderate delay. Full fidelity (20 Hz to 20 kHz) transparent monaural audio at bit rates of 128 kb/s, and full fidelity stereo audio at 256 kb/s (20 Hz to 20 kHz) is possible. Using higher bit rates allows for multiple encode/decode cycles without audible degradation.

MUSCIAM USA has spent thousands of hours and conducted dozens of listening tests to fine-tune MPEG Layer 2 to yield even better performance. Fully compatible CCS MUSICAM enhanced Layer 2 can deliver near-transparent, full fidelity joint stereo audio using as little as 128 kb/s, and true stereo at 192 kb/s. CCS MUSICAM enhanced Layer 2 encoding is fully compatible with all Layer 2 decoders and makes any decoder sound better.

SuperLink supports MPEG Layer 2 bit rates from 64 kb/s up to 384 kb/s per channel. The decoder will automatically determine the sample rate of the incoming audio.

ISO/MPEG Layer 3: Optimized for 64 kb/s per channel, Layer 3 becomes the ideal choice when high fidelity is required but transmission capacity is limited. Near transparent, full fidelity, true stereo audio is delivered using as little as 128 kb/s. The disadvantages of Layer 3 are longer delay, poor cascading, and poor post-processing.

Bit rates from 64 to 320 kb/s are supported. As with Layer 2, the decoder will automatically determine the sample rate of the incoming audio.

J.41: This algorithm can deliver master-quality (contribution grade) mono audio using 384 kb/s per channel. With only 2:1 compression, very low delay and very high immunity to cascading and post processing effects is achieved. J.41 is noted for providing audio indistinguishable from the source even after many tandem codings. The audio sample rate is fixed at 32 kHz.

J.57: Sampled at 48 kHz, with minimal audio compression and near zero delay, there is minimal degradation, even after multiple passes. J.57 requires the full capacity of the E1 link for a stereo program.

PCM: SuperLink can deliver uncompressed, near zero delay audio over either a T1 or E1 circuit with its available Linear PCM

modes. Ancillary data is available at certain bit rates and additional time slots can be available for additional data.

1.3 Multiplexer Features

SuperLink's powerful multiplexer combines a significant number of features in a single plug-in module. Each module can connect to one or two T1 or E1 circuits without changing any hardware configurations. In addition, multiple SuperLink units can be used in a daisy-chain configuration through the Drop/Insert ports to connect even more locations or expand the capacity of the *SuperLink's*. Operation is the same, regardless of which interface is used, T1 or E1.

The basic multiplexing functions; i.e., sending and receiving multiple channels of audio are enhanced with many features, including Drop/Insert and cross connect functions. These features can be combined to make your SuperLink system the backbone of a star network topology.

It is not necessary for all audio channels to use the same bit rate, sample rate or algorithm.

1.4 Control

Monitoring and control of all functions and settings is through one of two remote control ports on the front panel of the Control Processor via a terminal application, or through the Ethernet port via a telnet session.

1.5 Ancillary Data

When using any MPEG compatible algorithm, and some of the available linear PCM modes, each individual encoder/decoder pair allows one channel of ancillary data to be multiplexed into the audio bit stream and subsequently demultiplexed. This RS232 data path supports multiple baud rates and can be used for many different user applications.

Two additional ancillary data paths are available on the Control Processor module for use with other algorithms.

1.6 Streaming Audio

SuperLink may be used, along with a server, to stream MPEG Layer 3 audio over the Internet. SuperLink allows the audio to be from a local source or from anywhere in the world! Please note that software revision 1.7.7 or higher is required, and the *SuperLink* must contain a Control Processor Module equipped with an Ethernet port.

Control Processor

A single microprocessor-based module controls all functions of the SuperLink system.

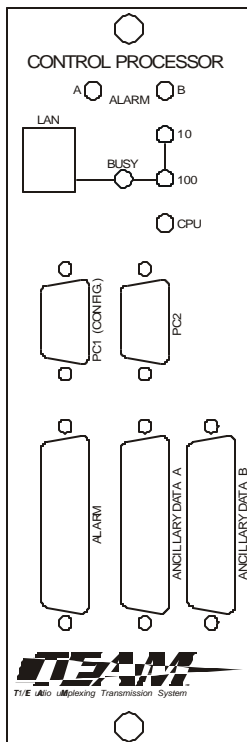
2. Overview

The heart of the SuperLink is the Control Processor. This MPC860 Power-PC communications controller-based module handles all maintenance, alarm and control functions for the SuperLink. In addition to these basic functions, the Control Processor also provides two bi-directional ancillary data ports, and a 10/100 Ethernet port that allows streaming audio through a Windows®-based Media Server. The Control Processor is required for SuperLink operation, and is factory installed in the lower-left slot, which labeled “CP Slot”. This is the only slot that will support the Control Processor. Since the SuperLink will not operate without a control processor, this module is not hot swappable, and power must be switched off if this module needs to be replaced.

The Control Processor functions are organized into three functional groups: System Administration (SA), supporting initialization, configuration, event notification, statistics gathering and software installation. System Operation (SO) supports features associated with Management and Control (M&C), including audio and data interface administration. The System Maintenance (SM) function supports troubleshooting.

2.1 Rear panel Connectors

All control, monitoring, and alarm functions for the SuperLink system are accessed from the rear panel of the Control Processor module.



2.1.1 Remote Control Command Structure

The structure of all remote control commands is a three-letter command followed by parameters. Not all commands have associated parameters, but if they do, parameters are separated from each other by a space.

All commands fall into one of six categories, with the initial letter of the command defining the category. All commands common to the full SuperLink system begin with the letter 'C'. Encoder and Decoder commands begin with the letter 'E' and 'D', respectively. Network commands begin with an 'N', and maintenance commands begin with an 'M'

On-line help is always available by typing

nQQ

Where *n* = the command category, C, E, D, N, or M. This returns a list of all commands within the category. Then, type

HELP cmd

For the command summary and syntax.

2.1.2 RS232C Maintenance and Control Port

The remote control port PC1 (CONFIG) is on the front of the Control Processor module. An RS-232C port allows the connection of a PC or terminal and is used to control all functions of the SuperLink system. This port, configured as a DCE device, allows the connection of a standard VT-100 style monitor or emulator. This connector is wired to allow a straight-through cable to be used between the PC or monitor and the SuperLink system as shown in the following table:

RS232 Maintenance and Control Connector		
Pin Number	Name	Description
1	DCD (O)	Data carrier detect
2	TD (O)	Transmit data
3	RD (I)	Receive data
4	DTR (I)	Data terminal ready
5	GND	Signal ground

RS232 Maintenance and Control Connector		
Pin Number	Name	Description
6	DSR (O)	Data set ready
7	RTS (I)	Request to send
8	CTS (O)	Clear to send
9	—	Not used

Table 2-1 — RS232C M&C Port Pin Connections

The RS232C port supports rates of 1200, 2400, 4800, 9600 or 38,400 baud, no parity, 8 data bits, 1 stop bit. The baud rate is selected using the **CRB** command:

```

CRB rate
    rate = 1200, 2400,
          4800, 9600 or
          38400

```

The factory default baud rate is 38,400. When configuring the RS232C port for the first time, you must have your terminal set for the factory default settings.

If a terminal or emulator does not support full duplex, you can set the Command Echo to 'ON' using the **CRE** command:

```

CRE state
    state = ON or OFF

```

2.1.3 Ancillary Data Ports

The two 25-pin RS232 ancillary data ports on the Control Processor are wired as DCE devices as shown in Table 2-2. Flow control is not supported on either port. These uni-directional ports provide ancillary data paths that are in addition to, and independent from, the ancillary data paths of the T1/E1 module. Rather, these ports can be considered as supplements to the data ports on the Encoder or Decoder modules. Since each port can be connected (mapped) to an Encoder or Decoder module, only one direction of data is supported.

The ancillary data ports allow locally connected devices to communicate with remote devices via included data bits within the audio bitstreams. The Command Processor provides the interface between these two ports and the Encoder or Decoder plug-in modules.

The data stream is asynchronous and can support rates up to 38,400 bps.

RS232 Ancillary Data Connectors		
Pin Number	Name	Description
1	FGND	Frame ground
2	RD (I)	Receive data
3	TD (O)	Transmit data
4	RTS (I)	Request to send
5	CTS (O)	Clear to send
6	DSR (O)	Data set ready
7	GND	Ground
8	DCD (O)	Data carrier detect
9 — 19	—	Not used
20	DTR (I)	Data terminal ready
21 — 25	—	Not used

Table 2-2 — RS-232 Ancillary Data Port Pin Connections

Data rates for the ancillary data ports on the Command Processor can range from 1200 to 38,400 baud and are selected using the `CDR` command:

```
CDR port baud
port = A or B
baud = 1200, 2400, 4800,
      9600, 19200 or 38400
```

When setting the speed of the ancillary data port on the Command Processor, you must also set the speed of the linked Encoder or Decoder data using the `EDR` or `DDR` commands. This step is necessary since the `EDR` and `DDR` commands not only set the speed of the encoder or decoder data port, but also set the speed of the data itself.

The uni-directional link, or path, between a CP data port and Encoder or Decoder module is selected using the `CAP` command:

CAP *srcport destport*

srcrport = Source slot/port,
slot = 0,...,7, (0 = CP)
port = A or B
destport = Source slot/port,
slot = 0,...,7, (0 = CP)
port = A or B

When configuring the Encoder or Decoder module using the **CAP** command, the internal port (looking towards the CP) is 'Port A' and the local port is 'Port B'.

Bi-directional Ancillary Data can be achieved if each SuperLink system is equipped as a codec (both Encoder and Decoder modules) with the transmit and receive Ancillary Data signals routed to allow bi-directional communications.

As an example, data from a local PC needs to be sent to another computer at the far-end site, as pictured in Figure 2-2:

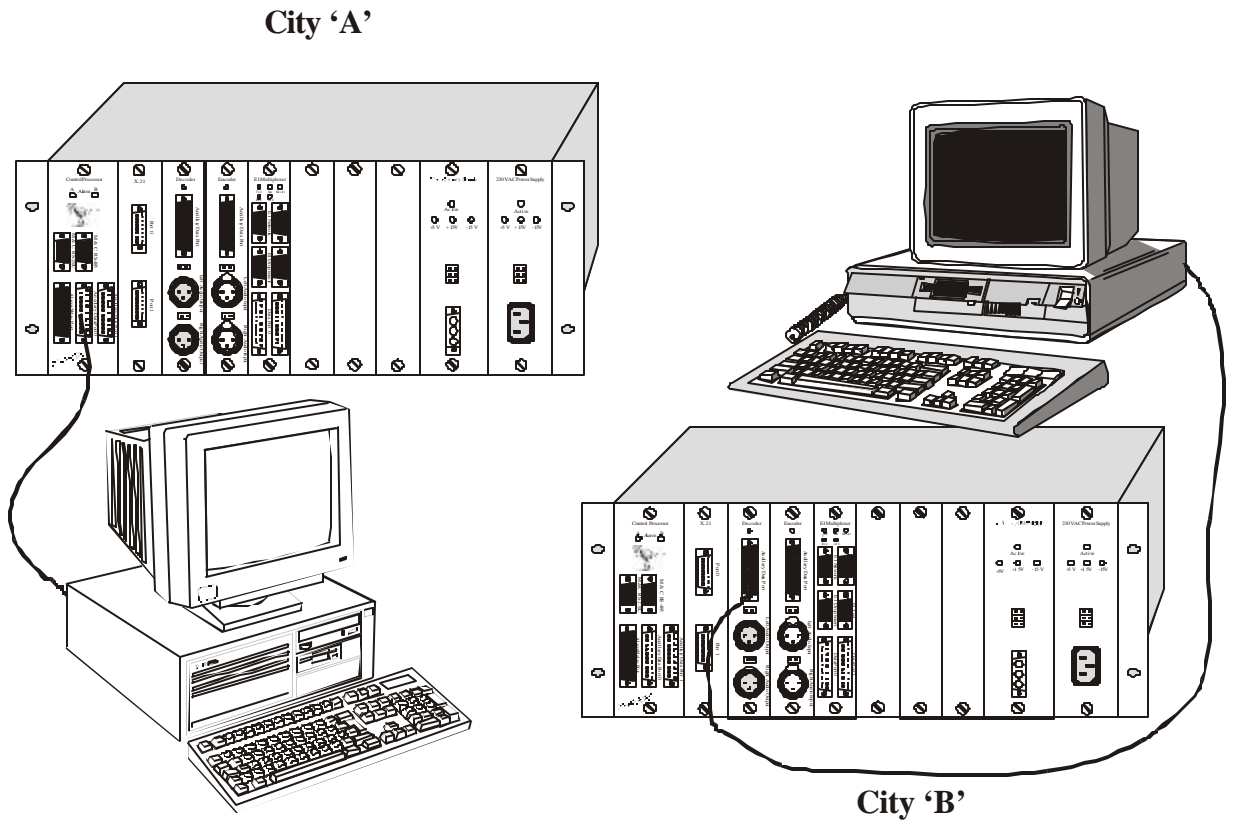


Figure 2-2 Ancillary Data Example

In this example, a computer in City 'B' is sending data to another computer in City 'A'. The computer in City 'B' is connected to the Encoder module in Slot 2 of the SuperLink system. The **CAP** command is used to set up this configuration:

CAP 2B 2A

This sets up the Encoder Module in slot 2 to receive Ancillary Data from its local port.

In City 'A', Ancillary Data from the Decoder in slot 3 is routed to Port A on the CP module with the command:

CAP 3A 0A

The **CRP** command is used to remove a uni-directional connection between the specified Data Port and the specified Encoder or Decoder module:

```

CRP srcport destport
srcrport = source slot/port,
            slot = 0,...,7, (0 = CP)
            port = A or B
destport = destination slot/port,
            slot = 0,...,7, (0 = CP)
            port = A or B

```

The CP supports three modes of Ancillary Data, BYPASS, NOMUX and OFF. In the BYPASS mode, the CP ancillary data ports are connected directly to the Encoder or Decoder without any processing delay. In the NOMUX mode, the ancillary data is processed by the CP before being routed to or from the Encoder or Decoder.

The CP Ancillary Data ports support the transfer modes as follows:

Transfer Mode	Port A	Port B
NOMUX Mode	Yes	Yes
BYPASS Mode	No	Yes

Table 2-3 Supported Ancillary Data Modes

Port mode is selected using the **CAN** command:

```

CAN port mode
port = A or B
mode = OFF, BYPASS or NOMUX

```

2.1.4 Alarm / Relay Port

The SuperLink's alarm/relay port is designed to provide both alarm and external control capabilities.

Six alarm relays are provided; Alarm A, Alarm B, RL0 through RL3, the functions of which may be user defined. The A and B alarms contain both normally open and normally closed contacts. RL0 through RL3 are dry-contact type relays. The status of the A and B alarms can also be monitored via two front panel LEDs.

The Control Processor contains four optically isolated inputs. These user programmable inputs allow the user to input control signals that are monitored by the CP. The CP software detects when these inputs

change state, and this information can be used locally to trigger certain events.

Four sets of SPST dry contact relay outputs are also provided. These outputs are intended to control external devices and signal status conditions of the SuperLink. The CP controls the state of these relays based on various system events, discussed in section 2.4.1. Further, these relays can be toggled using the **XRL** command:

```
XRL relay
      rela = A, B, RL0, ..., RL3
      y
```

Alarm/Relay Connectors		
Pin Number	Name	Description
1	OPA+	Optical input A (+)
2	OPB+	Optical input B (+)
3	OPC+	Optical input C (+)
4	OPD+	Optical input D (+)
5	OUTA1	Relay output A1 (RL0)
6	OUTB1	Relay output B1 (RL1)
7	OUTC1	Relay output C1 (RL2)
8	OUTD1	Relay output D1 (RL3)
9	COMA	Alarm relay A common
10	NORMA	Alarm relay A NC
11	ALARMB	Alarm relay B NO
12	GND	Ground
13	+5 VDC	+5 VDC (fused, 1 Amp)
14	OPA—	Optical input A (—)
15	OPB—	Optical input B (—)
16	OPC—	Optical input C (—)

Alarm/Relay Connectors		
Pin Number	Name	Description
17	OPD—	Optical input D (—)
18	OUTA2	Relay output A2 (RL0)
19	OUTB2	Relay output B2 (RL1)
20	OUTC2	Relay output C2 (RL2)
21	OUTD2	Relay output D2 (RL3)
22	ALARMA	Alarm relay A NO
23	COM B	Alarm relay B common
24	NORM B	Alarm relay B NC
25	GND	Ground

Table 2-4 — Alarm/Relay Connector Pin Connections

2.1.5 LAN Connection

A multi-speed LAN connection is provided on the Control Processor's front panel. Capable of direct connections to Local Area Networks, this port is used for streaming MPEG Layer 3 audio to the Internet and for network remote control, status monitoring and program code download.

2.2 System Administration

The Control Processor's System Administration functions include system initialization, configuration, event/alarm notification, statistics gathering and software installation.

2.2.1 System Initialization

When the SuperLink is first powered up it executes a boot sequence. During the boot sequence, the system status will be reported as well as any modules that have been found. The time stamped status includes module type (encoder, decoder, T1/E1 multiplexer, and X.21), the slot number in which the module is installed, and the hardware revision level of the module.

At first, the system initialization process generates the event:

```
STATUS: System Initializing, Software Version:
        X.Y.Z
```

The software revision is also displayed. Next, the system begins the process of auto-detecting all plug-in modules. Each time one of the seven slots are polled, the system will report the status of that slot, an example shown here:

```
STATUS:ENCODER Card Detected - Slot:3, Class:0,Rev:0
```

which includes the slot, card type and hardware revision. If no module is detected, the system will report

```
STATUS:Slot 2: Unknown card type
```

with the slot number. If no module is detected in a slot previously occupied, the system will report:

```
STATUS: Card Missing
```

Once all modules have been detected, the sequence continues when the CP loads the software and configuration information each module requires, and initializes each module. Status is reported for each step:

```
STATUS:Downloading ENC_TDM Slot 3
STATUS:Loading DSPE micro boot code Slot 3
STATUS:DSP Download DSPE micro boot code complete Slot 3
```

The boot cycle is complete when the system responds:

TELECOM CODEC - SLOT STATUS				
Slot	State	Rev	Class	Type
----	-----	---	----	-----
#[1]	[EMPTY]	[0]	[0]	[NO_CARD]
#[2]	[EMPTY]	[0]	[0]	[NO_CARD]
#[3]	[READY]	[0]	[0]	[ENCODER]
#[4]	[EMPTY]	[0]	[0]	[NO_CARD]
#[5]	[READY]	[0]	[0]	[E1]
#[6]	[EMPTY]	[0]	[0]	[NO_CARD]
#[7]	[READY]	[0]	[0]	[DECODER]

Hit <ENTER> twice for prompt:

and displays the M&C prompt:

```
MC>
```

at which point the front panel CPU LED will be illuminated and the two alarm LEDs will be off. Please note that the above displays will vary depending on your configuration.

During the boot cycle, the three front panel LEDs will light, indicating what function is presently executing:

Activity	LED Status		
	CPU	A	B
CP is powered up	ON	ON	ON
CP begins boot code execution	ON	OFF	OFF
CP Boot code complete	OFF	OFF	OFF
CP begins System code execution	ON	ON	ON
CP System Ready	ON	OFF	OFF

Table 2-5 — CPU LEDs

Steady-state A and B LEDs depend on Alarm Settings; e.g., only one Power supply.

Each step of the boot cycle is recorded in a System Log, which contains time-stamped STATUS and ERROR events for all detection, initialization and software loading steps. The system log can be viewed by using the **XLG** command:

```

XLG event
      even = 0 (clear log), 1...100
      t

```

Up to 100 lines can be displayed, starting from the top of the log. The first line is the most recent event; the last line is the oldest entry. All entries are time stamped relative to system power-up.

To list the current status of all detected modules, use the **CST** command, which returns the status and class of all plug-in slots. An example of the output is shown here:

```

MC>CST
  SLOT  STATE  REV  CLASS  TYPE
    #1    READY    0      0      ENCODER
    #2    EMPTY    0      0      NO_CARD
    #3    READY    0      0      DECODER
    #4    EMPTY    0      0      NO_CARD
    #5    EMPTY    0      0      NO_CARD
    #6    EMPTY    0      0      NO_CARD
    #7    READY    0      0      E1
MC>

```

where REV is the hardware revision of the module and CLASS is either Network or Local.

2.2.2 System Configuration

The CP maintains a non-volatile database for the entire SuperLink system, maintaining a unique configuration for each of the seven slots in the mainframe chassis.

The CP will update the stored configuration parameters when a remote control command that alters parameters is entered. The CP also periodically scans the system to determine if any modules were removed or added. A new module will generate a

```
STATUS: Card Detected
```

message, that indicates what type and revision of the module and the slot that it is in, while a missing or removed module will generate an

```
ERROR: Card Missing
```

message, with the slot number type and revision of the module that was removed. In addition, if a module has been removed, any active connections to that module are disconnected.

For each module, the CP loads a stored configuration table from non-volatile RAM. If the stored configuration is valid, the system responds:

```
STATUS: Configuration Database Loaded
```

If the configuration is not valid, the system will report:

```
ERROR: Configuration Database Checksum
Failed - System Configuration Reset
```

and load a factory default configuration.

Next, the CP compares the software that was previously booted to the current version, and if the revision numbers differ, the CP resets the Configuration Database to the system default and reports an error:

```
ERROR: Current CPSYS version mismatch
- System Configuration Reset
```

Each SuperLink module requires several software 'things' to be downloaded for proper operation. The CP will report

```
STATUS: Card Downloaded
```

after each 'thing' is loaded, and

STATUS: Card Configuration

as each card configuration is updated. If an error is encountered, the CP generates an error message detailing which 'thing' failed to load.

Once the CP is done downloading/configuring all plug-in modules, the system initialization process is complete.

During normal operation, each remote control command that alters a configuration parameter forces an update of the Configuration Database and checksum stored in RAM. The non-volatile memory is updated automatically as some parameters are changed, while others are updated periodically. The **MSY** command causes an immediate update of non-volatile RAM with the current configuration parameter values:

MSY

The CP periodically auto-detects plug-in modules to determine if modules have been removed or added. If a new module is detected, the CP generates a

STATUS: Card Detected

message, and downloads/configures the card as necessary. If a module is removed, the CP generates a

STATUS: Card Missing

message.

The CP does not alter the stored Configuration Database when a module is removed. If a module is removed and a module of the same type is re-installed in the same slot, the new module will inherit the previous configuration. If a different type of module is installed, a factory default configuration will be loaded.

Use the **XPO** command to set the slot poll/detection timer:

XPO *timer sec*

time = SlotDetect (1) or
r = ConfigUpdate (2)
sec = 0 (disables), 1...254

Factory defaults for the CP module are shown here:

<i>PARAMETER</i>	<i>RANGE</i>	<i>DEFAULT</i>	<i>COMAND</i>
------------------	--------------	----------------	---------------

<i>PARAMETER</i>	<i>RANGE</i>	<i>DEFAULT</i>	<i>COMAND</i>
RS232C M&C Port Baud Rate	1200, 2400, 4800, 9600, 19,200, 38,400	38,400	CRB
RS232C M&C Port Local Echo	Yes, No	Yes	CRE
Master Timing Fallback Order	T1/E1 Network T1/E1 Drop/Ins T1/E1 Sync T1/E1 Internal	Network, Drop/Ins, Sync Int	CMT
Slot Poll Timer	0-254 sec	3 sec	XPO
Configuration Poll Timer	0-254 sec	30 sec	XPO
Network Poll Timer	0-254 sec	30 sec	XPO
Audio Poll Timer	0-254 sec	30 sec	XPO
A-Bus Select	None, 0...7	None	MCP
Ancillary Data Mode (per port)	Off/Nomux/Bypass	Off	CAN
Ancillary Data Connect Slot (per port)	1-7. None	None	CAP
Ancillary Data Rate (per port)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	9600	CDR
Event Actions: Event configuration is stored in the CP parameter table. Each event has an Action and a Slot			
Alarm Setting:			
Action	None, A, B, RL0, RL1, RL2, RL3 (optional + modifier)		CEA
Slot Alarm	OFF/ON		CES

Table 2-6 — Control Processor Defaults

Use the **CDF** command to set an individual plug-in module to its factory default configuration:

```
CDF slot
    slot = 1,...,7, ALL
```

Please refer to the appropriate chapters for the default settings of all other plug-in modules.

2.3 Backplane

All plug-in modules fall into two classes: *Network* modules and *Local* modules. SuperLink can support multiple Network modules. Only the number of available slots not used by Network modules limits the number of Local modules. The T1/E1 modules have two ports, a Network port (N) and a Drop/Insert port (D/I). The X.21/V.35 module also has two ports, A and B, whereas all other modules have only one port, port A. The Command Processor has an Ethernet port, Port A.

Module classifications and ports are shown here:

MODULE	CLASS	PORTS SUPPORTED
T1/E1 Multiplexer	Network	Network (N), Drop/Insert (D)
TM-3BRI	Network	Network (N)
X.21	Local	Port A, Port B
V.35	Local	Port A, Port B
Encoder	Local	Port A
Decoder	Local	Port A
Command Processor	—	Port A

Table 2-7 — Module Class

The SuperLink backplane has 16 *Channels*, each supporting up to thirty-two 64 kb/s *Timeslots* for E1 (two E1 time slots are reserved, leaving only 30 for user information), or 24 for T1. These timeslots are used to connect Local and Network modules. A collection of timeslots used to make a connection is referred to as a *Subchannel*. Data is *Dropped* into the backplane timeslots (Subchannel) by *Source* modules and *Lifted* from the backplane by *Destination* modules.

Each installed Network module must have a unique address, or *Network Card number*, ranging from 1 to 4. Mapping between the

Network modules and the backplane Channels is fixed, as shown below.

The Control Processor manages Subchannel IDs transparently and broadcasts the Subchannel IDs across the Backplane Channels to notify modules when to Drop or Lift data to or from timeslots. The CP assigns Subchannel IDs 1—14 to connections as they are established. Subchannel ID 15 is broadcast by the CP to the other modules to indicate an unassigned timeslot. Subchannel ID 0 is set in the modules when they have no Subchannel Connection assigned for a given direction. The maximum number of subchannel connections is 14 in the send direction (relative to the E1 card) and 13 in the receive direction, for a total of up to 27 subchannels.

When a subchannel is set up, a *Channel Group* and *Bit Rate* (Nx64, N = 1-30 for E1, 1-24 for T1) are specified that define the group of timeslots in the Channel that are connected. The Control Processor supports the Channel Group timeslot assignment defined as shown in Table 2-8A for E1 and 2-8B for T1:

Please note that International convention has numbered E1 Timeslots from 0 to 31. For E1 (0 and 16 are reserved):

Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
1	1	1, 17	1, 2, 3	1, 2, 17, 18	1, 2, 3, 4, 5	1, 2, 3, 17, 18, 19	1, 2, 3, 17, 18, 19, 4, 5, 6, 20, 21, 22	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31
2	2	2, 18	17, 18, 19	3, 4, 19, 20	17, 18, 19, 20, 21	4, 5, 6, 20, 21, 22	1, 2, 3, 17, 18, 19, 7, 8, 9, 23, 24, 25	
3	3	3, 19	4, 5, 6	5, 6, 21, 22	6, 7, 8, 9, 10	7, 8, 9, 23, 24, 25	1, 2, 3, 17, 18, 19, 10, 11, 12, 26, 27, 28	
4	17	4, 20	20, 21, 22	7, 8, 23, 24	22, 23, 24, 25, 26	10, 11, 12, 26, 27, 28	1, 2, 3, 17, 18, 19, 13, 14, 15, 29, 30, 31	
5	18	5, 21	7, 8, 9	9, 10, 25, 26	11, 12, 13, 14, 15	13, 14, 15, 29, 30, 31	4, 5, 6, 20, 21, 22, 7, 8, 9, 23, 24, 25	
6	19	6, 22	23, 24,	11, 12,	27, 28.	1, 2, 3, 4,	4, 5, 6, 20, 21, 22,	

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Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
			25	27, 28	29, 30, 31	5, 6	10, 11, 12, 26, 27, 28	
7	4	7, 23	10, 11, 12	13, 14, 29, 30	1, 3, 5, 7, 9	7, 8, 9, 10, 11, 12	4, 5, 6, 20, 21, 22, 13, 14, 15, 29, 30, 31	
8	5	8, 24	26, 27, 28	1, 2, 3, 4	2, 4, 6, 8, 10	13, 14, 15, 17, 18, 19	7, 8, 9, 23, 24, 25, 10, 11, 12, 26, 27, 28	
9	6	9, 25	13, 14, 15	5, 6, 7, 8	3, 5, 7, 9, 11	20, 21, 22, 23, 24, 25	7, 8, 9, 23, 24, 25, 13, 14, 15, 29, 30, 31	
10	20	10, 26	29, 30, 31	9, 10, 11, 12	4, 6, 8, 10, 12	26, 27, 28, 29, 30, 31	10, 11, 12, 26, 27, 28, 13, 14, 15, 29, 30, 31	
11	21	11, 27	1, 3, 5	17, 18, 19, 20	5, 7, 9, 11, 13	1, 3, 5, 7, 9, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	
12	22	12, 28	2, 4, 6	21, 22, 23, 24	6, 8, 10, 12, 14	2, 4, 6, 8, 10, 12	17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28	
13	7	13, 29	3, 5, 7	25, 26, 27, 28	7, 9, 11, 13, 15	3, 5, 7, 9, 11, 13	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23	
14	8	14, 30	4, 6, 8	1, 3, 5, 7	8, 10, 12, 14, 18	4, 6, 8, 10, 12, 14	2, 4, 6, 8, 10, 12, 14, 18, 20, 22, 24, 26	
15	9	15, 31	5, 7, 9	2, 4, 6, 8	9, 11, 13, 15, 17	5, 7, 9, 11, 13, 15	3, 5, 7, 9, 11, 13, 5, 17, 19, 21, 23, 25	
16	23	1,2	6, 8, 10	3, 5, 7, 9	10, 12, 14, 18, 20	6, 8, 10, 12, 14, 18	4, 6, 8, 10, 12, 14, 18, 20, 22, 24, 26, 28	
17	24	3,4	7, 9, 11	4, 6, 8, 10	11, 13, 15, 17, 19	7, 9, 11, 13, 15, 17	5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27	
18	25	5,6	8, 10, 12	5, 7, 9, 11	12, 14, 18, 20, 22	8, 10, 12, 14, 18, 20	6, 8, 10, 12, 14, 18, 20, 22, 24, 26, 28, 30	
19	10	7,8	9, 11, 13	6, 8, 10, 12	13, 15, 17, 19, 21	9, 11, 13, 15, 17, 19	7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29	
20	11	9,10	10, 12, 14	7, 9, 11, 13	14, 18, 20, 22, 24	10, 12, 14, 18, 20, 22	8, 10, 12, 14, 18, 20, 22, 24, 26, 28, 30, 2	
21	12	11,12	11, 13, 15	8, 10, 12, 14	15, 17, 19, 21, 23	11, 13, 15, 17, 19, 21	9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31	
22	26	13,14	12, 14, 18	9, 11, 13, 15	17, 19, 21, 23,	12, 14, 18, 20,	10, 12, 14, 18, 20, 22, 24, 26, 28, 30,	

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Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
23	27	15,17	13, 15, 17	10, 12, 14, 18	25 18, 20, 22, 24, 26	22, 24 13, 15, 17, 19, 21, 23	2, 4 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 1	
24	28	17,18	14, 18, 20	11, 13, 15, 17	19, 21, 23, 25, 27	14, 18, 20, 22, 24, 26	12, 14, 18, 20, 22, 24, 26, 28, 30, 2, 4, 6	
25	13	19, 20	15, 17, 19	12, 14, 18, 20	20, 22, 24, 26, 28	15, 17, 19, 21, 23, 25	13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 1, 3	
26	14	21, 22	17, 19, 21	13, 15, 17, 19	21, 23, 25, 27, 29	17, 19, 21, 23, 25, 27	14, 18, 20, 22, 24, 26, 28, 30, 2, 4, 6, 8	
27	15	23, 24	18, 20, 22	14, 18, 20, 22	22, 24, 26, 28, 30	18, 20, 22, 24, 26, 28	15, 17, 19, 21, 23, 25, 27, 29, 31, 1, 3, 5	
28	29	25, 26	19, 21, 23	15, 17, 19, 21	23, 25, 27, 29, 31	19, 21, 23, 25, 27, 29	17, 19, 21, 23, 25, 27, 29, 31, 1, 3, 5, 7	
29	30	27, 28	20, 22, 24	17, 19, 21, 23		20, 22, 24, 26, 28, 30	18, 20, 22, 24, 26, 28, 30, 2, 4, 6, 8, 10	
30	31	29, 30	21, 23, 25	18, 20, 22, 24		21, 23, 25, 27, 29, 31	19, 21, 23, 25, 27, 29, 31, 1, 3, 5, 7, 9	
31		31, 31	22, 24, 26	19, 21, 23, 25		17, 18, 19, 20, 21, 22	20, 22, 24, 26, 28, 30, 2, 4, 6, 8, 10, 12	
32		31, 1	23, 25, 27	20, 22, 24, 26		18, 19, 20, 21, 22, 23	21, 23, 25, 27, 29, 31, 1, 3, 5, 7, 9, 11	
33		1, 3	24, 26, 28	21, 23, 25, 27		19, 20, 21, 22, 23, 24	22, 24, 26, 28, 30, 2, 4, 6, 8, 10, 12, 14	
34		2, 4	25, 27, 29	22, 24, 26, 28		21, 22, 23, 24, 25, 26	23, 25, 27, 29, 31, 1, 3, 5, 7, 9, 11, 13	
35		3, 5	26, 28, 30	23, 25, 27, 29		22, 23, 24, 25, 26, 27	24, 26, 28, 30, 2, 4, 6, 8, 10, 12, 14, 18	
36		4, 6	27, 29, 31	24, 26, 28, 30		23, 24, 25, 26, 27, 28	25, 27, 29, 31, 1, 3, 5, 7, 9, 11, 13, 15	
37		5, 7	28, 30, 2	25, 27, 29, 31		24, 25, 26, 27, 28, 29	26, 28, 30, 2, 4, 6, 8, 10, 12, 14, 18, 20	
38		6, 8	29, 31, 1	26, 28,		25, 26,	27, 29, 31, 1, 3, 5,	

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Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
				30, 2		27, 28, 29, 30	7, 9, 11, 13, 15, 17,	
39		7, 9	30, 2, 4	27, 29, 31, 1			28, 30, 2, 4, 6, 8, 10, 12, 14, 18, 20, 22	
40		8, 10	31, 1, 3	28, 30, 2, 4			29, 31, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19	
41		9, 11	2, 3, 4	29, 31, 3, 5			30, 2, 4, 6, 8, 10, 12, 14, 18, 20, 22, 24	
42		10, 12	3, 4, 5	30, 2, 4, 6			31, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21	
43		11, 13	5, 6, 7	31, 2, 5, 7				
44		12, 14	6, 7, 8	1, 9, 17, 25				
45		13, 15	8, 9, 10	2, 10, 18, 26				
46		14, 17	9, 10, 11	3, 11, 19, 27				
47		15, 17	11, 12, 13	4, 12, 20, 28				
48		17, 19	12, 13, 14	5, 13, 21, 29				
49		18, 20	14, 15, 17	7, 14, 22, 30				
50		19, 21	15, 17, 18	9, 15, 23, 31				
51		20, 22	18, 19, 20					
52		21, 23	19, 20, 21					
53		22, 24	21, 22, 23					
54		23, 25	22, 23, 24					
55		24, 26	24, 25, 26					
56		25, 27	25, 26, 27					
57		26, 28	27, 28, 29					
58		27, 29	28, 29, 30					
59		28, 30	1, 9, 17					
60		29, 31	2, 10, 18					
61		2, 3	3, 11, 19					

Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
62		4, 5	4, 12, 20					
63		6, 7	5, 13, 21					
64		8, 9	6, 14, 22					
65		10, 11	7, 15, 23					
66		12, 13	9, 17, 24					
67		14, 15	10, 18, 25					
68		18, 19	11, 19, 26					
69		20, 21	12, 20, 27					
70		22, 23	13, 21, 28					
71		24, 25	14, 22, 29					
72		26, 27	15, 23, 30					
73		28, 29						
74		30, 31						

Table 2-8A — Timeslot Assignment for E1

Please note that T1 Timeslots are numbered from 1 to 24. For T1:

Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
1	1	1, 2	1, 2, 3	1, 2, 3, 4	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
2	2	3, 4	4, 5, 6	5, 6, 7, 8	6, 7, 8, 9, 10	7, 8, 9, 10, 11, 12	13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	
3	3	5, 6	7, 8, 9	9, 10, 11, 12	11, 12, 13, 14, 15	13, 14, 15, 16, 17, 18	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23	
4	4	7, 8	10, 11, 12	13, 14, 15, 16	17, 18, 19, 20, 21	19, 20, 21, 22, 23, 24	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24	
5	5	9, 10	13, 14, 15	17, 18, 19, 20	13, 14, 15, 16, 17	1, 3, 5, 7, 9, 11	3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 1	
6	6	11, 12	16, 17, 18	21, 22, 23, 24	18, 19, 20, 21, 22	2, 4, 6, 8, 10, 12	4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 2	

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Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
7	7	13, 14	19, 20, 21	1, 3, 5, 7	1, 3, 5, 7, 9	3, 5, 7, 9, 11, 13	5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 1, 3	
8	8	15, 16	22, 23, 24	2, 4, 6, 8	2, 4, 6, 8, 10	4, 6, 8, 10, 12, 14	6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 2, 4	
9	9	17, 18	1, 3, 5	3, 5, 7, 9	3, 5, 7, 9, 11	5, 7, 9, 11, 13, 15	7, 9, 11, 13, 15, 17, 19, 21, 23, 1, 3, 5	
10	10	19, 20	2, 4, 6	4, 6, 8, 10	4, 6, 8, 10, 12	6, 8, 10, 12, 14, 16	8, 10, 12, 14, 16, 18, 20, 22, 24, 2, 4, 6	
11	11	21, 22	3, 5, 7	5, 7, 9, 11	5, 7, 9, 11, 13	7, 9, 11, 13, 15, 17	9, 11, 13, 15, 17, 19, 21, 23, 1, 3, 5, 7	
12	12	23, 24	4, 6, 8	6, 8, 10, 12	6, 8, 10, 12, 14	8, 10, 12, 14, 16, 18	10, 12, 14, 16, 18, 20, 22, 24, 2, 4, 6, 8	
13	13	1, 3	5, 7, 9	7, 9, 11, 13	7, 9, 11, 13, 15	9, 11, 13, 15, 17, 19	11, 13, 15, 17, 19, 21, 23, 1, 3, 5, 7, 9	
14	14	2, 4	6, 8, 10	8, 10, 12, 14	8, 10, 12, 14, 16	10, 12, 14, 16, 18, 20	12, 14, 16, 18, 20, 22, 24, 2, 4, 6, 8, 10	
15	15	3, 5	7, 9, 11	9, 11, 13, 15	9, 11, 13, 15, 17	11, 13, 15, 17, 19, 21	13, 15, 17, 19, 21, 23, 1, 3, 5, 7, 9, 11	
16	16	4, 6	8, 10, 12	10, 12, 14, 16	10, 12, 14, 16, 18	12, 14, 16, 18, 20, 22	14, 16, 18, 20, 22, 24, 2, 4, 6, 8, 10, 12	
17	17	5, 7	9, 11, 13	11, 13, 15, 16	11, 13, 15, 17, 19	13, 15, 17, 19, 21, 23	15, 17, 19, 21, 23, 1, 3, 5, 7, 9, 11, 13	
18	18	6, 8	10, 12, 14	12, 14, 16, 18	12, 14, 16, 18, 20	14, 16, 18, 20, 22, 24	16, 18, 20, 22, 24, 2, 4, 6, 8, 10, 12, 14	
19	19	7, 9	11, 13, 15	13, 15, 17, 19	13, 15, 17, 19, 21	15, 17, 19, 21, 23, 1	17, 19, 21, 23, 1, 3, 5, 7, 9, 11, 13, 15	
20	20	8, 10	12, 14, 16	14, 16, 18, 20	14, 16, 18, 20, 22	16, 18, 20, 22, 24, 2	18, 20, 22, 24, 2, 4, 6, 8, 10, 12, 14, 16	
21	21	9, 11	13, 15, 17	15, 17, 19, 21	15, 17, 19, 21, 23	17, 19, 21, 23, 1, 3	19, 21, 23, 1, 3, 5, 7, 9, 11, 13, 15, 17	
22	22	10, 12	14, 16, 18	16, 18, 20, 22	16, 18, 20, 22, 24	18, 20, 22, 24, 2, 4	20, 21, 22, 2, 4, 6, 8, 10, 12, 14, 16,	

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Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
23	23	11, 13	15, 17, 19	17, 19, 21, 23	17, 19, 21, 23, 1	19, 21, 23, 1, 3, 5	18 21, 23, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19	
24	24	12, 14	16, 18, 20	18, 20, 22, 24	18, 20, 22, 24, 2	20, 22, 24, 2, 4, 6	22, 24, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20	
25		13, 15	17, 19, 21	19, 21, 23, 1	19, 21, 23, 1, 3	21, 23, 1, 3, 5, 7	23, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21	
26		14, 16	18, 20, 22	20, 22, 24, 2	20, 22, 24, 2, 4	22, 24, 2, 4, 6, 8	24, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22	
27		15, 17	19, 21, 23	21, 23, 1, 3	21, 23, 1, 3, 5	23, 1, 3, 5, 7, 9		
28		16, 18	20, 22, 24	22, 24, 2, 4	22, 24, 2, 4, 6	24, 2, 4, 6, 8, 10		
29		17, 19	21, 23, 1	23, 1, 3, 5	23, 1, 3, 5, 7	1, 5, 9, 13, 17, 21		
30		18, 20	22, 24, 2	24, 2, 4, 6	24, 2, 4, 6, 8	2, 6, 10, 14, 18, 22		
31		19, 21	23, 1, 3	1, 7, 13, 20		3, 7, 11, 15, 19, 23		
32		20, 22	24, 2, 4	2, 8, 14, 21		4, 8, 12, 16, 20, 24		
33		21, 23	2, 3, 4	3, 9, 15, 22				
34		22, 24	5, 6, 7	4, 10, 16, 23				
35		23, 1	8, 9, 10	5, 11, 17, 24				
36		24, 2	11, 12, 13	7, 12, 18, 1				
37		2, 3	14, 15, 16					
38		4, 5	17, 18, 19					
39		6, 7	20, 21, 22					
41		8, 9	23, 24, 1					
41		10, 11	3, 4, 5					
42		12, 13	6, 7, 8					
43		14, 15	9, 10, 11					
44		16, 17	12, 13, 14					

Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
45		18, 19	15, 16, 17					
46		20, 21	18, 19, 20					
47		22, 23	21, 22, 23					
48		2, 1	24, 1, 2					
49			1, 9, 17					
50			2, 10, 18					
51			3, 11, 19					
52			4, 12, 20					
53			5, 13, 21					
54			6, 14, 22					
55			7, 15, 23					
56			8, 16, 24					

Table 2-8B — Timeslot Assignment for T1

As an example, consider a *SuperLink* system equipped with a T1 multiplexer and four Encoder modules. We want to send two channels of G.722 audio at 64 kb/s each, one stereo MPEG Layer 2 program at 128 kb/s, and two stereo programs at 256 kb/s each.

There are several solutions to this requirement, one being Channel Groups 1 and 2 for the G.722 programs. This uses Timeslots 1 and 2. Selecting Channel Group 2 for the 128 kb/s program uses Timeslots 3 and 4. For the 256 kb/s programs we again select Channel Group 2, using Timeslots 5, 6, 7 and 8, and Channel Group 3, using Timeslots 9, 10, 11 and 12. Note that although we assigned Channel Group 2 more than once (three times, to be exact), we have not assigned the same timeslots more than once, which would be an error.

2.3.1 Network Module Number Assignment

Multiple Network Modules can be installed, and each requires a unique “address” number. This number maps the module to the backplane channels as described previously. The **NMC** command tells

the CP to establish new backplane connections on all 30 (or 24 for T1) Drop/Lift timeslots based on the Network Module number.

More than one network module can be installed in a SuperLink card cage, the E1, T1, or ISDN BRI module, and each is assigned an ID number. Since the SuperLink recognizes which module is installed, all commands that return a system or module status will identify the installed module.

The CP first checks to see if the selected number (address) is not in use, and if not, the new Subchannel Connection is allocated, overriding any previous connections. If the selected number is already in use, an error condition is reported.

Note: when a Network Module is assigned a new Network Module number, all Local modules formerly connected to that Network module must be reconnected. The user must either: 1) remove existing Subchannel Connections to this Network Module (using the **NRC** command) and set up new Subchannel Connections to this or another Network Module, or 2) assign the old Network Card number to a different Network Card. In this case, the Network Card will inherit the connections formerly associated with the other Network Card.

2.3.2 2.4.2 Network Module / Local Module Subchannel Connections

The **NMC** command:

```
NMC src/port dest/port rate changrp
      Src/port   = source slot/port:
                   slot = 1,...,7
                   port = A, B, N, or D
      dest/por  = destination slot/port:
      t          slot = 0,...,7 (0 = CP)
                   port = A, B, N, or D
      rate       = bitrate:
                   N x 64, N = 1,...,30
      changrp   = channel group, 1,...,74 (E1)
                   1,...,56 (T1)
```

controls the setup of connections (Subchannels) between a Network module and a Local module. The CP supports up to 14 simultaneous Subchannel connections.

When using the SuperLink's streaming audio capabilities, the Command Processor must be set as the destination (Slot 0, Port A).

As an example, suppose there is an encoder card in slot 3, an E1 multiplexer card in slot 5 and a decoder card in slot 7. I want to configure for 384 kb/s send and receive using Channel Group 2. The following commands will do this:

```
NMC 3A 5N 6 2
NMC 5N 7A 6 2
```

The CP checks if the selected cards/ports are present, and the specified Bit Rate and Channel Group is available, and no connection already exists in the specified direction. If so, a Subchannel ID is set up along with the Slot RAM so that the module can Drop/Lift data to/from the appropriate timeslots on the backplane. If all of the above conditions are not met, an error condition is reported.

A module Port can support a single Subchannel connection in each direction (Drop/Lift). Once a Subchannel is assigned to a Port for a given direction, that connection must be disconnected before setting up a different connection. However, Decoder modules support a "multiple listen" feature, this means that multiple decoders can receive the same E1/T1 channel group. Thus, if the configured Bit Rate/Channel Group is already in use, the specified decoder module is added to the existing Subchannel Connection.

The **NRC** command:

```
NRC src/port dest/port
src/port = source slot/port:
            slot = 1,...,7
            port = A, B, N, or D
dest/port = destination slot/port:
            t   slot = 0,...,7 (0 =
                CP)
            port = A, B, N, or D
```

controls the removal of connections (Subchannels) between a Network module and a Local module. The CP disconnects all timeslots associated with the Subchannel and frees up the assigned Subchannel ID.

2.3.3 Subchannel Connection Initialization

During the Control Processor boot cycle, or when a Network Card is detected, the Control Processor initializes the Subchannel Connections as follows:

T1/E1 Multiplexer Module — If there is no T1/E1 module currently installed, the CP allocates a Subchannel ID, sets up the CP Slot RAM and assigns up to 32 Drop & Lift timeslots to Backplane Channels.

If the current Network Card number is already in use, the CP logs the message:

```
ERROR: Connection Failure - Network Card
      Number unavailable, Slot # Port #.
```

and the card does not initialize. Otherwise, the CP sets the card state to READY.

When the Control Processor detects a Local Card, either during system boot or when a module is installed, the CP initializes the Subchannel Connections as follows:

Encoder module — For all encoder modules that have a Drop/Lift Subchannel ID configured, the CP checks to see if the configured Network Card is present and the configured Bit Rate/Channel Group is available. If available, a Subchannel ID is allocated, and the Slot RAM and the T1/E1 modules XPOINT are set up so that the appropriate timeslots can be Dropped or Lifted from the backplane.

If the set up of the Subchannel Connection fails, the CP logs the message:

```
ERROR: Connection Failure - Network Card
      or Timeslots unavailable, Slot # Port #.
```

and the card does not initialize. Otherwise, the CP sets the card state to READY.

Decoder module — For all decoder modules that have a Drop/Lift Subchannel ID configured, the CP checks to see if the configured Network Card is present and the configured Bit Rate/Channel Group is available. If available, a Subchannel ID is allocated, and

the Slot RAM and the T1/E1 modules XPOINT are set up so that the appropriate timeslots can be Lifted or Dropped from the backplane.

If the setup of the Subchannel Connection fails, the CP logs the message:

```
ERROR: Connection Failure - Network Card
      or Timeslots unavailable, Slot # Port #.
```

and the card does not initialize. Otherwise, the CP sets the card state to READY.

A “multiple listen” feature allows multiple decoder modules to use a Channel Group/Bit Rate already in use. Any decoder module can simply be added to the existing Subchannel Connection.

X.21/V.35 module — If a Drop or Lift Subchannel ID is configured (for each port), the CP checks to see if the configured Network Cards are present and the selected Bit Rate/Channel Groups are available (for each port). If available, a Subchannel ID is allocated (per port) and Slot RAM is set up so that each X.21/V.35 port Drops and Lifts the appropriate timeslots from the Backplane (in a full duplex manner if required). In addition, the T1/E1 module’s XPOINT is set up so that the appropriate timeslots are received from the T1/E1 Network Port and Dropped onto the Backplane, and Lifted from the Backplane and sent to the T1/E1 Network port.

If the setup of the Subchannel Connection fails, the CP logs the message:

```
ERROR: Connection Failure - Network Card
      or Timeslots unavailable, Slot # Port #.
```

and the card does not initialize. Otherwise, the CP sets the card state to READY.

2.3.4 T1/E1 Drop/Insert Port Connections

A collection of timeslots that make up a connection between the T1/E1 Network Port and the T1/E1 Drop/Insert Port is called a *Drop/Insert Connection*. One 1.5 Mbit/s (T1) or 2Mbit/s (E1) Drop/Insert

connection is supported in each direction, and the CP manages Drop/Insert connections transparently. The CP assigns a Drop/Insert Connection ID when a connection is established for a given direction, and frees up the ID when the connection is removed. The maximum number of connections that can be established between the Drop/Insert Port and the T1/E1 Network Port is 8 per direction (16 total).

The Drop/Insert Port supports the “multiple listen” feature. Thus, if a decoder card already uses the configured Channel Group/Bit Rate (in the RECEIVE direction from the Network), the Drop/Insert port is connected to the timeslots. However, the Drop/Insert port cannot transmit to the Network on a Channel group/Bit Rate already in use.

The **NMD** command controls the setup of the Drop/Insert Connections between the T1/E1 Network Port and the Drop/Insert Port.

```
NMD sslprt dsplrt br cg
      sslprt = source slot/port:
      t          slot = 1,...,7
                port = N or D
      dsplrt = destination slot/port,
      t          slot = 1,...,7
                port = N or D
      br       = Bitrate:
                Nx64, N = 1,...,30
      cg       = channel group, 0,...,31 (E1)
                1,...,24 (T1)
```

If the Drop/Insert Connection is unavailable, the CP reports an error.

The **CSS** command is used to display the currently active Drop/Insert Connections.

The **NRD** command is used to remove the Drop/Insert connections between the T1/E1 Network Port and the T1/E1 Drop/Insert Port.

```
NRD sslprt dsplrt br cg
      sslprt = source slot/port:
      t          slot = 1,...,7
                port = N or D
      dsplrt = destination slot/port,
      t          slot = 1,...,7
```

port = N or D

br = Bitrate:
 Nx64, N = 1, ..., 30

cg = channel group, 0, ..., 31 (E1)
 1, ..., 24 (T1)

2.4 Status Monitoring

There are three status LEDs on the Control Processor module. The green 'CPU' LED illuminates when the Control Processor is powered on and is ready to accept commands. The two alarm LEDs, Alarm A and Alarm B, are user definable and operate in conjunction to the two alarm relays discussed in Section 2.1.4. In addition to the two alarm LEDs/relays, four other relay actions can be mapped into user-defined events.

2.4.1 Event-To-Action Mapping

Many specific system events can be mapped into actions, including LED illumination and relay closures. There are 4 event categories: Common, Encoder, Decoder and Network events. In addition to the event-to-action mapping available, all events are time-stamped and logged to the CP system event log. The CP supports the following actions:

Action	Description
NONE	Do nothing
A	Activate LED A and Relay A
B	Activate LED B and Relay B
RL0,...,RL3	Activate Relay 0,...,3
CS0,...,CS3	Command Sequence 0,...,3

Table 2-11 System Actions

In addition, each action supports a "+" modifier which latches the action when an event occurs. The action must then be cleared manually. Without the "+" modifier, the action follows the trigger, clearing when the triggering event clears.

The CP also supports seven generic Slot Alarm events, one per system slot (C10 – C17). This enables you to assign specific Encoder, Decoder or Network events to a slot alarm, thus enabling you to determine which installed encoder, decoder or network card is in failure mode if

more than one is installed. The **CES** command turns ON or OFF Slot Alarm reporting for the specified event.

Example: **CES D01 ON**

If a Decoder card in slot 3 is missing, the CP will generate a Decoder Event "D01 Decoder Missing" and the Common Event "C12 Slot Alarm 3", thus indicating that the Decoder module in slot 3 has been removed. The CP will execute the actions associated with both events D01 and C12.

The following event-to-action mapping can be performed using the **CEA** command:

<i>EVENT</i>	<i>EVENT #</i>	<i>DESCRIPTION</i>	<i>DEFAULT ACTION</i>	<i>DEFAULT SLOT ALARM</i>
Common System Events:				
Power Supply Failure	C01	Power supply A or B failure	None	
Opto-Input 0 HIGH	C02	Opto-Input 0 transition low to high	None	
Opto-Input 1 HIGH	C03	Opto-Input 1 transition low to high	None	
Opto-Input 2 HIGH	C04	Opto-Input 2 transition low to high	None	
Opto-Input 3 HIGH	C05	Opto-Input 3 transition low to high	None	
Opto-Input 0 LOW	C06	Opto-Input 0 transition high to low	None	
Opto-Input 1 LOW	C07	Opto-Input 1 transition high to low	None	
Opto-Input 2 LOW	C08	Opto-Input 2 transition high to low	None	
Opto-Input 3 LOW	C09	Opto-Input 3 transition high to low	None	
Slot Alarm 1	C10	Event w/ Slot Alarm, Slot 1	None	
Slot Alarm 2	C11	Event w/ Slot Alarm, Slot 2	None	
Slot Alarm 3	C12	Event w/ Slot Alarm, Slot 3	None	
Slot Alarm 4	C13	Event w/ Slot Alarm, Slot 4	None	
Slot Alarm 5	C14	Event w/ Slot Alarm, Slot 5	None	
Slot Alarm 6	C15	Event w/ Slot Alarm, Slot 6	None	
Slot Alarm 7	C16	Event w/ Slot Alarm, Slot 7	None	
Encoder Events:				
Encoder Card missing	E01	Card ID Register does not indicate Encoder card	None	
Encoder Card Init Failure	E02	Failed card download or config	None	
Encoder Watchdog Failure	E03	DSPA ISR HF3 bit not toggling	None	
Encoder Overload	E04	DSP status: B0 = 1 or b1 = 1	None	
Encoder AES Lock	E05	DSP status b5 = 1	None	
Decoder Events:				

<i>EVENT</i>	<i>EVENT #</i>	<i>DESCRIPTION</i>	<i>DEFAULT ACTION</i>	<i>DEFAULT SLOT ALARM</i>
Decoder Card Missing	D01	Card ID Register does not indicate Decoder card	None	
Decoder Card Init Failure	D02	Failed card download or config	None	
Decoder Watchdog Failure	D03	DSPA ISR HF3 bit not toggling	None	
Decoder Overload	D04	DSP status2: B5 = 1 or b6 = 1	None	
Decoder AES Lock	D05	DSP status1 b4 = 1	None	
Decoder loss of frame	D06	DSP status2 b9 = 1	None	
Decoder scale factor error	D07	DSP status2 b8 = 1	None	
Decoder Frame Protect Error	D08	DSP status2 b7 = 1	None	
Decoder line error	D09	DSP status2 b17 = 1	None	
Network Events:				
E1/T1 Multiplex Card Missing	N01	Card ID Register does not indicate E1 or T1 MUX card	None	
E1/T1 Multiplex Card Init Failure	N02	Failed card download or config	None	
X.21/V.35 Card Missing	N03	Card ID Register does not indicate X.21/V.35 card	None	
X.21/V.35 Card Init Failure	N04	Failed card download or config	None	
Loss Of Sync	N05	Current Network sync source lost sync (E1MUX – ATSY)	None	
Loss Of Signal	N06	Current Network sync source lost signal (E1MUX – ATFSn, b15)	None	
X.21/V.35-A TxFIFO Error	N07	FIFO status Rec A-TRANS full or empty	None	
X.21/V.35-B TxFIFO Error	N08	FIFO status Rec B-TRANS full or empty	None	
X.21/V.35-A RxFIFO Error	N09	FIFO status Rec A-RECV full or empty	None	
X.21/V.35-B RxFIFO Error	N10	FIFO status Rec B-RECV full or empty	None	
E1/T1 AIS On	N11	AIS Alarm is active (all ones)	None	

Table 2-9 — Event-to-Action Mapping

As an example of using the **CEA** command to define an event to action, the command:

CEA N01 +B

assigns the Loss of Sync event (N01) to latch relay B. Remember that the factory default will activate, but not latch, relay B.

The CP also supports seven generic Slot Alarm events, one per system slot (C10 – C17). This enables you to assign specific Encoder, Decoder

or Network events to a slot alarm, thus enabling you to determine which installed encoder, decoder or network card is in failure mode if more than one is installed. The **CES** command turns ON or OFF Slot Alarm reporting for the specified event.

Example: **CES D01 ON**

If a Decoder card in slot 3 is missing, the CP will generate a Decoder Event "D01 Decoder Missing" and the Common Event "C12 Slot Alarm 3", thus indicating that the Decoder module in slot 3 has been removed. The CP will execute the actions associated with both events D01 and C12.

Events are evaluated and actions are executed based on the poll timers for each category. The **CCE** command deactivates all currently activated events, and can also be used to display current event mapping.

2.4.2 Command Sequences

Utilizing the Event to Action Mapping feature of the *SuperLink*, it is possible to perform a list of commands upon a certain event. Maybe you would want the *SuperLink* to change to a backup Network Module when the primary network link fails. With the *SuperLink's* command sequences, the *SuperLink* can perform this function. Use the **CEC** Command to enter a Command Sequence.

The **CEC** command:

	CEC <i>sn</i>	
	CEC	
<i>CEC</i>	=	Creates a new Command sequence or Quick Card Configuration Entry
<i>CEC sn</i>	=	Edits the command sequence <i>sn</i>

The **CEC** command has two functions, either to create a Command Sequence, or to create a "Quick Card Configuration". A Quick Card Configuration is basically a blueprint for a given card's settings.

A Quick Card Configuration can also be created automatically based on a card's current settings. This is done using the **CSE Command**.

The **CSE** command:

```
CEC sl na
    sl      = Slot 1,...,7
    na      = Name or description of the
              Quick Card Configuration Entry
```

2.4.3 System Statistics

All other system status monitoring, including the status of all installed modules, is performed through either of the two remote control ports, and requires a terminal or emulator.

Slot status, the type of module, state, revision, class, and version can be displayed using the **CST** command discussed previously. There are several different information formats returned by this command. If no slot number is specified, then this command returns the slot status. If a slot number is specified, then a detailed status report for that slot is given, for example:

```
MC>cst 5

Slot 5:E1
Network Card           = 1           SubChannel ID       = 1
Sync Source           = RX NETWORK   CRC4                 = ON
AIS Alarm Generate    = OFF          TS 16 Master        = NO FRAMING
MASTER
  X21 Baud Rate        = UNDEFINED    V24 Port Connect    =
DROP/INSERT
  V24 Port Mode[0]     = INACTIVE    V24 Port Mode[1]   = INACTIVE
  V24 Handshaking[0]   = OFF          V24 Handshaking[1] = OFF
  FALC[Network]        = 18           FALC[Drop/Insert]  = a208
  FALC[Timing(TS2)]    = 8000
```

```
Receive Drop & Insert Connections:
Transmit Drop & Insert Connections:
```

```
Event Status:
```

EVENT	#	ACTION	STATE
E1 Mux Missing	N01	RL0	NOT ACTIVE
E1 Mux Init Failure	N02	NONE	NOT ACTIVE
Loss of Sync	N05	NONE	NOT ACTIVE
Loss of Signal	N06	NONE	NOT ACTIVE

but

```
MC>cst
```

```
TELECOM CODEC - SLOT STATUS
```

Slot	State	Rev	Class	Type
#[1]	[EMPTY]	[0]	[0]	[NO_CARD]
#[2]	[EMPTY]	[0]	[0]	[NO_CARD]
#[3]	[READY]	[0]	[0]	[ENCODER]
#[4]	[EMPTY]	[0]	[0]	[NO_CARD]
#[5]	[READY]	[0]	[0]	[E1]
#[6]	[EMPTY]	[0]	[0]	[NO_CARD]
#[7]	[READY]	[0]	[0]	[DECODER]

The Subchannel status for all active Subchannel connections is displayed using the **CSS** command. Displayed status includes source, destination, rate, and channel group:

- Subchannel ID (1-14)
- Source Slot (1-7), Port (A/B)
- Destination Slot (1-7), Port (A/B)
- Bit Rate (N x 64), where N = 1 to 30
- Channel Group (1-74)

A sample output is shown here:

MC>CSS

CONNECTION STATUS [2]					
<u>Source</u>	<u>Slot/Port</u>	<u>Destination</u>	<u>Slot/Port</u>	<u>Rate(kbs)</u>	<u>Chan</u>
<u>Group</u>					
[Encoder]	[3A]	-> [E1 Mux]	[5N]	[384]	[2]
[E1 Mux]	[5N]	-> [Decoder]	[7A]	[384]	[2]

Encoder

Up to six stereo Encoder modules can be used in the SuperLink system.

3. Overview

The SuperLink encoder module is a standard stereo audio encoder, with a choice of analog and/or digital (AES/EBU or S/PDIF) audio inputs and an RS232C ancillary data channel. Numerous algorithms and bit rates are supported, including 64 kb/s G.722, Nx64 kb/s MUSICAM-enhanced Layer 2 and MPEG Layer 3, J.41 (384 kb/s mono), J.57 (J.57 is not supported with T1), and several linear PCM (uncompressed, near zero delay) audio modes. If multiple encoder modules are used, different compression algorithms and bit rates can be used for different channels simultaneously.

The encoder's powerful 24-bit A/D converter insures low distortion and high signal-to-noise ratios, regardless of algorithm used. Multiple sampling rates and input levels accommodate a wide range of audio sources and bandwidths. With six installed encoder modules, it is possible to send up to twelve individual, high-fidelity monaural channels. In addition, different configurations can be used for different audio channels simultaneously.

3.1 Encoder Installation

Your SuperLink system can support up to six encoder or decoder modules. Modules can be inserted in any of the seven free slots (at least one Network Interface module is required), except the two right-most power supply and the left-most control processor slots. It is not necessary to remove system power when removing or inserting encoder

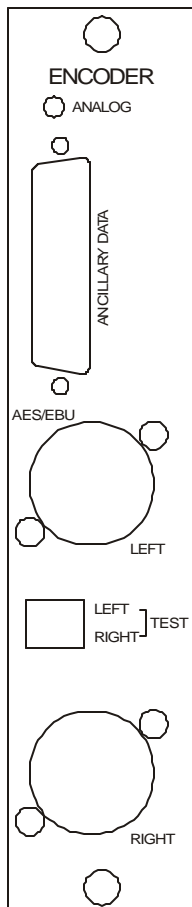


Figure 3-1 —
Encoder module

modules. The installation or removal of an encoder card is automatically detected.

3.2 MPEG Algorithm Modes

3.2.1 Full Stereo and Dual Mono

Users have expressed confusion concerning the differences between full stereo, dual mono and joint stereo algorithm modes. From a coding and compression standpoint, stereo and dual mono are identical; that is, half of the total bits are assigned to the left channel, and half of the total bits are assigned to the right channel. Left is always left, and right is always right...no blending, no sound stage manipulations.

Note!

Algorithm mode selection is available only when using MPEG algorithms. When using any other algorithm, the mode is set by default.

We should note that the original reason for the “Full Stereo” and “Dual Mono” distinction is a throwback to consumer equipment. For example, in MTS television audio, Full Stereo refers to stereo program audio, whereas Dual Mono refers to monaural audio with a secondary audio program (SAP).

3.2.2 Joint Stereo

Unlike dual mono or stereo, joint stereo employs real-time bit allocation techniques and dynamically assigns bits to the channels and frequency bands that need them the most. Bits are assigned on a frame-by-frame basis. This dynamic bit allocation results in wider bandwidths and higher signal-to-noise ratios than are possible with the fixed bit allocation of the other modes. If the bit allocation logic determines that enough capacity is available for true stereo, then stereo frames will be sent.

Unlike stereo and dual mono, joint stereo may manipulate the left-right sound stage and stereo separation at high and low frequencies. The infinite left-right sound stage is blended into seven locations at high and low frequencies should the bit allocation logic deem it necessary. However, it has been shown that any spatial blending is in frequency bands where the human auditory system would normally blend stereo signals.

After rigorous testing with trained listeners, joint stereo audio has been determined to yield higher perceived audio quality than stereo or dual mono at bit rates of 256 kb/s or lower.

The encoder algorithm mode is selected using the **EAM** command:

```
EAM slot mode
      slot      = 1, ..., 7
      mode      = M, DM, JS or FS
```

Please note that the encoder algorithm mode has meaning only for MPEG algorithms and is ignored for G.722, J.41 and J.57.

3.3 Encoder Algorithms

The SuperLink encoder module currently supports seven different algorithms that enable you to meet any audio quality requirement, from voice only to digital mastering quality. In addition, there is additional on-board memory for new algorithms to be installed as they are developed.

3.3.1 G.722

G.722 is one of the earliest audio coding algorithms to be standardized. G.722 is a relatively simple algorithm based on ADPCM (adaptive pulse code modulation) offering full duplex, commentary grade audio over a single 64 kb/s channel. Please note that the SuperLink system is full duplex only if equipped with both encoder and decoder modules.

The key advantages of G.722 are its compatibility with most other codecs and very low coding delay times. G.722 is ideal for situations where instantaneous talkback is required, such as dial-in talk shows, two-way IFB and distant interviews. The main disadvantages are its limited audio fidelity, poor signal-to-noise ratio, and poor cascading properties. G.722 is not recommended for music applications.

With sampling fixed at 16 kHz, G.722 can deliver monaural, 7.5 kHz audio over one 64 kb/s channel. Up to 12 single direction or six bi-directional channels can be supported in an appropriately equipped SuperLink system.

3.3.2 MUSICAM and ISO/MPEG Layer II

MUSICAM® is MUSICAM USA's enhancement to the ISO MPEG Layer II encoding algorithm. A psychoacoustic masking-based algorithm, MUSICAM offers the best possible combination of fidelity, low to moderate delay and excellent cascading ability at all bit rates. MUSICAM encoding is fully compatible with all MPEG Layer II decoders, and since the enhancements are only in the encoder, any

decoder will sound better when connected to a SuperLink encoder. Please note that the coding delay will vary from 60 to 400 ms, depending on the sample rate and decoder manufacturer. MUSICAM, as implemented in the SuperLink encoder, supports sampling rates of 24, 32 and 48 kHz, and bit rates of 64, 128, 192, 256, 320 and 384 kb/s. Up to 12 unidirectional or 6 bi-directional audio channels can be supported in an appropriately configured SuperLink system.

MUSICAM enhanced MPEG Layer II can deliver 10.2 kHz monaural audio on one 64 kb/s channel with 24 kHz sampling. Although a narrower audio bandwidth at 64 kb/s than MPEG Layer III, the advantages are better signal-to-noise ratio, lower delay, less noticeable artifacts and better results when cascading and post-processing.

When using 128 kb/s, the SuperLink delivers transparent 20 kHz monaural, near-transparent joint stereo, or 10.2 kHz dual mono (stereo) audio. At bit rates higher than 128 kb/s, the SuperLink delivers transparent joint stereo or stereo with immunity to degradation even after up to 15 cascades (at 384 kb/s).

Please note that the CCSO and CCSN algorithm designations are both MUSICAM-enhanced Layer II algorithms. These are included for connecting to very early CCS Audio Products and MUSICAM USA decoders manufactured before MPEG Layer II transmission protocol was standardized.

3.3.3 ISO/MPEG Layer III

Psychoacoustic masking-based ISO/MPEG Layer III can deliver full duplex, 15 kHz monaural audio using only one 64 kb/s channel. When using 128 kb/s, transparent 20 kHz monaural audio is possible, with near-transparent 20 kHz joint-stereo. In dual mono or stereo modes, near-transparent 15 kHz audio is obtained with bit rates as low as 128 kb/s.

Although at low bit rates, Layer III offers a wider bandwidth than other algorithms, this additional bandwidth does come at a price. The disadvantages of using Layer III are the long coding delay times, typically 300 to 600 ms (depending on sample rate), and poor cascading ability. In addition, audible artifacts may be noticeable when using Layer III at lower bit rates, and post-processing, especially digital post processing, may further degrade the audio.

At 128 kb/s, the only advantage to using Layer III over MUSICAM is that Layer III can deliver true stereo with 15 kHz bandwidth. Other than that, at 128 kb/s data rates, we recommend using Layer III only when communication with a Layer III-only decoder is required or when using SuperLinks streaming audio capabilities. Even at 128 kb/s, digital artifacts may be noticeable, and the delay, cascading and post-processing limitations are still present.

At bit rates higher than 128 kb/s, there is no advantage to using Layer III over MUSICAM. Layer III bit rates up to 320 kb/s are included only for compatibility. Your SuperLink encoder supports Layer III bit rates of 64, 128, 192, 256 and 320 kb/s, and sample rates of 24, 32 and 48 kHz. Up to 12 one way or six bi-directional audio channels can be supported in an appropriately configured SuperLink system.

3.3.4 J.41

The industry standard J.41 algorithm produces transparent, digital mastering quality 15 kHz monaural audio using a single 384 kb/s channel. This non-psychoacoustic-based algorithm, with compression ratios as low as 2:1, is noted for very low delay, excellent transparency, and immunity to digital post-processing and cascading effects.

Sampling rate is fixed at 32 kHz, and the bit rate is fixed at 384 kb/s per channel. Each encoder module can be used to send two monaural channels (one stereo program). Pre-emphasis is available and is activated using the **EEP** command:

```
EEP slot emph
slot      = 1, ..., 7
emph     = NO or J.17
```

3.3.5 J.57

Unlike the MPEG based algorithms available in the SuperLink system, J.57 does not depend on redundancy reduction, but rather on companding (compression / expansion) and multiplexing. This results in minimal data loss and allows conversion to a format suitable for transmission directly over E1. Since very little compression is employed, there is no lost audio and the audio data is theoretically capable of unlimited encoding cycles without degradation. Since the audio is nearly uncompressed, one stereo signal uses the full capacity of an E1. J.57 is an ITU-T standard intended expressly for sending audio over E1, and as such, is not supported for T1 SuperLink systems.

3.3.6 PCM

SuperLink offers several linear PCM (uncompressed) audio modes. Depending on conversion rates, bit rates, and sample rates, up to a full T1 (1536 kbps), or up to 27 time slots (E1 module only) can be used to send uncompressed, near zero delay stereo audio.

By sending 24 bit digital audio sampled at 32kHz, over a full T1 circuit (1536kbps), the best audio quality is achieved, however there is no room for ancillary data. By sending 18 bit digital audio sampled at 32kHz, ancillary data of up to 38400 baud is possible. By sending 18 bit digital audio sampled at 48kHz, additional T1 time slots are still available to the user.

SuperLink can deliver linear PCM stereo audio over an E1 circuit, 18 bit digital audio sampled at 48kHz using 27 time slots (1728kbps) while still leaving additional time slots available to the user.

All modes deliver near zero delay stereo audio (less than 1ms using 48kHz sampling).

3.4 Encoder Configuration

If an encoder module is installed in a previously unpopulated slot, or a slot that previously held another type of module, a factory default encoder configuration is automatically loaded. If an encoder module is installed in a slot previously used by an encoder card, the previous configuration is loaded.

3.4.1 Algorithm Selection

The encoder algorithm mode is selected using the **EAL** command:

```
EAL slot algo
      slot      = 1,...,7
      algo      = G.722, MPEGL2,
                  MPEGL3, J.41 J.57,
                  or PCM
```

Please note that when J.41 is selected, the encoder sample rate must be set at 48 kHz. Although the J.41 standard defines the sample rate at 32 kHz, the signal is internally re-sampled and filtered.

Factory default = MPEGL2.

3.4.2 Encoder Line Format

Three line formats are available, Single Line, Independent Mono, and Combined Line. Independent Mono is used only with monaural-only algorithms J.41 and G.722 when stereo or independent mono operation is desired, for example, stereo J.41 (dual mono). Independent Mono line mode insures that both monaural channels have uniform delay.

All other algorithms and modes not using ISDN BRI should use the single-line format. Combined Line Mode is used over ISDN BRI modules when more than 1 B-Channel is required to make the connection. The **ELI** command is used to set the encoder line format:

```
ELI slot line
      slot      = 1,...,7
      line      = S or I
```

Factory default = Single Line.

3.4.3 Encoder Bit Rate

MPEG algorithms allow a wide selection of bit rates enabling you to adjust the transmission bit rate to your application. The **NMC** command is used to select the number of subchannels used, thus determining the bit rate. Refer to Section 7.5.3 for information on the **NMC** command.

Bit rate selection is valid only when using any of the MPEG-based algorithms. When using non-MPEG algorithms, the bit rate is set by the algorithm specifications.

Factory default = 384 kb/s.

3.4.4 Encoder Sample Rate

When using any MPEG algorithm, the sample rate (in kilohertz) can be selected using the **ESR** command:

```
ESR slot rate
      slot      = 1,...,7
      rate      = 16, 24, 32 or 48
```

For non-MPEG algorithms, the sample rate is fixed and determined by the algorithm specifications. The sample rate for G.722 is fixed at 16 kHz. J.41 and J.57 use 48 kHz sampling.

Please note that due to the maximum 1.99:1 ratio of the rate converters, certain encoder sample rates are not valid when using digital audio inputs.

Audio sample rate	Valid encoder sample rates
32 kHz	24, 32 48 kHz
44.1 kHz	24, 32 48 kHz
48 kHz	32, 48 kHz

Table 3-1 – Audio sample rate vs. Encoder sample rate

Please do not confuse the digital audio sample rate with the encoder sample rate.

Factory default = 48 kHz for MPEG algorithms, J.41 and J.57; 16 kHz for G.722.

3.4.5 PCM Mode

When using the PCM algorithm, several modes can be selected using the **EPM** command:

```
EPM slot mode
      slot      = 1, ..., 7
      mode      = 16/48K/24, 24/32K/24,
                  18/32K/18, 18/48K/27
```

Two new connection Bit Rates have been added to the E1 which can only be used with the PCM algorithm. These are 1152 kbps (N=18) and 1728 kbps (N=27). Only one Channel Group (CG 1) is available for these rates.

When using 1728 kbps bit rate in linear PCM (18 bits at 48 kHz sampling rate) the E1 capacity is not fully consumed leaving three free timeslots being available for other use.

The PCM Mode for 18/32K/24 (18 bits at 32 kHz at 1536 kbps) also supports transmission of ancillary data up to 38400 baud. The ancillary data port is set up as normal using CAP to enable the port and EDR to set the baud rate. Ancillary data is transmitted transparently without any protocol.

3.4.6 Channel Swap and Mono Mix-down

It may sometimes be necessary to exchange left and right channel audio. For example, when in a monaural mode, only the audio input to

the left channel is encoded. Using the channel swap feature allows right channel audio to be encoded. You can therefore switch audio sources at any time. This is accomplished using the **ECS** command:

```
ECS slot mode
      slot      = 1,...,7
      mode      = NORMAL or SWAP
```

Mono mix-down allows you to mix the left and right channel signals to monaural for encoding. It is not necessary to use external audio mixing to mix a stereo program to mono. There are three mix-down modes available, L+R (M0), L+R - 3 dB (M3) and L+R - 6 dB (M6). Mono mix has no effect when any stereo encoding mode is selected.

```
EMM slot mode
      slot      = 1,...,7
      mode      = OFF, M0, M3 or M6
```

Factory default, channel swap = NORMAL.

Factory default, mono mix = OFF.

3.4.7 Ancillary Data

In addition to the ancillary data ports on the CP module, each encoder card has one ancillary data port that can be used to send RS-232 data to a far-end decoder when using any MPEG algorithm. This DB25 connector allows RS-232 data to be sent directly to the encoder DSP and combined with the MPEG audio data. The far-end decoder then separates the ancillary data from the audio data. A true three-wire data path is provided; flow control is not provided. Data rates from 300 to 38,400 bits/sec are supported and selected with the **EDR** command:

```
EDR slot rate
      slot      = 1,...,7
      rate      = 1200, 2400, 4800,
                  9600, 19200 or
                  38400
```

Also note that when present, ancillary data uses bits normally assigned to audio data. Under most circumstances, this will not noticeably degrade the audio performance; however, the use of high data rates with low transmission bit rates should be avoided.

In addition to the connector on the encoder, SuperLink allows you to encode ancillary data from the ancillary data connector on the

Command Processor module. This requires setting the ancillary data rate on the CP port using the **CDR** command as well as setting the encoder ancillary data rate.

MPEG algorithms support several ancillary data formats for compatibility with other codecs and satellite systems. CCS Standard (CSTD) can be used to send or receive ancillary data from any CCS Audio Products or MUSICAM USA codec; CCS Generic (CGEN) can be used only with MUSICAM USA's **CDQPrima**, **Prima LT**, **RoadRunner**, SuperLink or SuperLink codecs. The IRTDAB format supports features used with DAB systems, and ADR is a special case of the DAB format.

Use the **EAF** command to select the appropriate format:

```
EAF slot format
      slot      = 1,...,7
      format    = CSTD, CGEN, IRTDAB
                  or ADR
```

Since each encoder module is capable of supporting two audio channels (stereo) and it is also possible to configure each channel independently (independent mono), it is possible to route the ancillary data to either or both channels using the **EAS** command:

```
EAS slot channel
      slot      = 1,...,7
      channel   = LEFT, RIGHT or BOTH
```

G.722, as implemented in the *SuperLink*, does not support ancillary data. J.41 supports ancillary data through the two data ports on E1 module.

Factory default, baud rate = 9600.

Factory default, format = CGEN.

Factory default, channel = BOTH

3.4.8 MPEG Layer II Scale Factor Protection (Error Concealment)

Another MUSICAM USA exclusive feature available with MUSICAM-Enhanced MPEG Layer 2 is Advanced Concealment of Errors (ACE). ACE is based on CRC (Cyclic Redundancy Code) protection of the ISO/MPEG Layer 2 scale factor.

Encoder Scale Factor Protection is controlled by the **ESP** command:

```
ESP slot mode
      slot      = 1,...,7
```

mode = NO or YES

Factory default = NO

In general, it is better to use scale factor protection if the data channel is noisy (high BER). Scale factor protection (**ESP**) is used for all ISO/MPEG Layer 2 types of bitstreams. Scale factor is the level of the digital audio signal within a sub-band. There are 32 sub-bands and the scale factors change the level over a 120 dB range. An error on any scale factor will cause a perceptible impairment in the audio. To prevent this, scale factor protection can be inserted at the encoder and if the decoder is capable of recognizing it, then the decoder can perform a concealment operation to repair the damaged scale factor. If the decoder does not know about scale factor protection, the audio is decoded and any damaged scale factors cause impairments.

!note:

If ESP has enabled scale factor protection, the far end decoder must enable scale factor correction with the DSP command. If only one end has scale factor protection enabled, audio may be muted. The SuperLink's Scale factor protection is not compatible with other manufacturer's codecs. Scale factor protection is compatible with MUSICAM USA's CDQ2001, **CDQPrima**, **Prima LT** and SuperLink codecs.

3.4.9 Sine Wave Detection

Sine wave detection should be used only when using test tones for audio analysis with test equipment, and should be OFF for normal operation. Sine wave detection is available only when using any MPEG Layer 2 algorithm, and is selected using the **ESD** command:

```
ESD slot mode
slot      = 1, ..., 7
mode     = ON or OFF
```

Factory default = OFF.

3.4.10 Encoder Header and Decoder Status Bits

When using an ISO/MPEG Layer 2 compatible audio compression algorithm, there are certain flags that may be set in the header. These five user defined flag bits can be used by the decoder or can be used as additional signaling paths.

The Emphasis bit is set using the **EEP** command:

```

EEP slot mode
  slot      = 1,...,7
  mode      = NO, 50 or J.17

```

The Original bit is set using the **EOR** command:

```

EOR slot mode
  slot      = 1,...,7
  mode      = YES or NO

```

The Copyright bit is set using the **ECR** command:

```

ECR slot mode
  slot      = 1,...,7
  mode      = YES or NO

```

The Private bit is set using the **EPI** command:

```

EPI slot mode
  slot      = 1,...,7
  mode      = ON or OFF

```

The Protection bit is set using the **EPR** command:

```

EOR slot mode
  slot      = 1,...,7
  mode      = YES or NO

```

3.4.11 Input Selection

The encoder modules available for use in your SuperLink system are capable of two different audio input modes: digital audio or analog audio input.

For modules equipped with both analog and digital audio inputs, jumpers are used to select which input source is active. (Refer to Figure 3-2.) Jumpers J3 and J4 select digital audio inputs when in position 2-3 and select analog audio inputs when in position 1-2.

Jumpers are also used to select the digital audio input format, either AES/EBU or S/PDIF. Jumper J7, when in position 1-2 sets AES/EBU

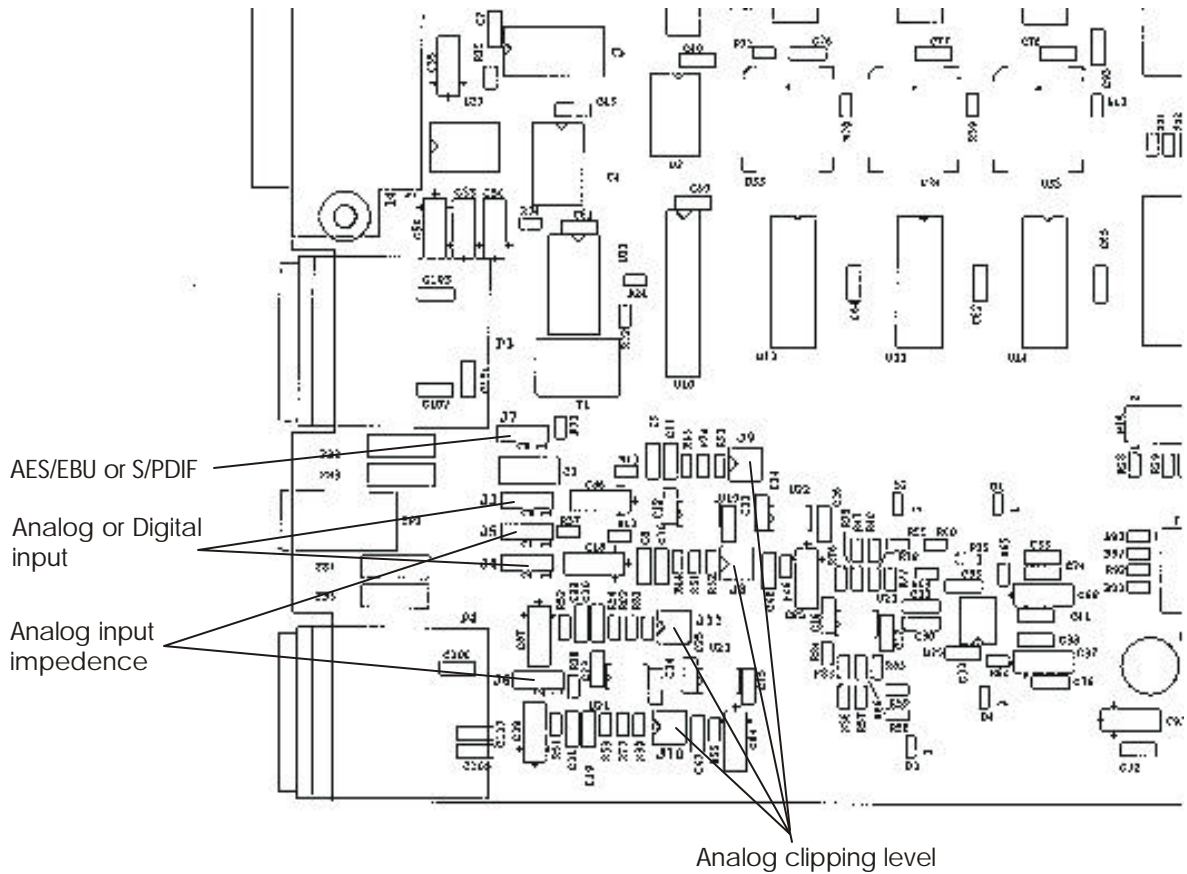


Figure 3-2 Encoder Jumper Layout

input, and when in position 2-3 sets S/PDIF inputs. All industry standard digital sample rates, 32, 44.1 and 48 kHz, are supported.

	J7
AES/EBU	1-2
S/PDIF	2-3

Table 3-2 Digital Input Jumper Settings

Please note that digital audio I/O is not supported when using G.722.

3.4.12 AES/EBU or S/PDIF Timing Considerations

Timing for the encoder DSPs is provided by the AES/EBU or S/PDIF audio itself, and therefore, no external timing source is required. The SuperLink encoder contains very high quality rate converters, and supports 32, 44.1 and 48 kHz digital audio sampling rates.

3.4.13 Analog Input Level Adjustment

The analog input clipping level is variable, in three steps. The nominal clipping level of +18 dBu can be changed to either +15 dBu or +24 dBu with jumpers J8, J9, J10 and J11 on the encoder module (all levels are ± 1 dB). The jumpers affect both channels simultaneously. Refer to the table below for the proper settings of these jumpers.

J8, J9, J10, J11	+24 dBu	+18 dBu	+15 dBu
Positions 1-2	On	On	Off
Positions 3-4	On	Off	Off

Table 3-3 Attenuation Jumper Settings

Note that position indicators for jumpers J8, J9, J10 and J11 may not be marked on the Encoder board. With the board lying on the table in front of you, pins 1 & 2 are the *lower (closer to you)* two pins. Pins 3 & 4 are the *upper* two pins.

3.4.14 Analog Input Impedance

To make your encoder module compatible with a variety of professional and consumer analog audio equipment, two input impedance levels are supported. Jumpers J5 and J6 are used to change input impedance from 600 Ω (position 1-2) to >12k Ω (position 2-3).

	J5	J6
600W	1-2	1-2
>12kW	2-3	2-3

Table 3-4 Impedance Jumper Settings

3.5 Default Configuration

A factory default configuration is loaded whenever an encoder module is installed in a slot not previously occupied by an encoder. The factory default configuration can also be loaded at any time using the **CDF** command:

```
CDF slot
    slot = 1, ..., 7
```

Factory defaults for the encoder are shown here:

PARAMETER	RANGE	DEFAULT	COMMAND
Network Module	1	1	NMC/NRC
Channel Group	1 -32	1	NMC/NRC
Bit Rate	Nx64, N=1-32	6x64	NMC
Drop Subchannel ID	0-14	0	NMC/NRC
Lift Subchannel ID	0-14	14	NMC/NRC
Audio Input Source	Analog, Digital	Analog	EAI
Sample Rate	16, 24, 32, 48	48 kHz	ESR
Audio Channel Swap	Normal, Swap	Normal	ECS
Mono Mix	Off, 0dB, -3dB, -6 dB	Off	EMM
Sine Wave Detector	No, Yes	No	ESD
Scale Factor Protection	No, Yes	No	ESP
Algorithm	MPEGL2, CCSO, CCSN, J.41, J.57	MPEGL2	EAL
Algorithm Mode	Mono, Joint Stereo, Stereo, Dual Mono	Joint Stereo	EAM
J.42 Application	Off, On	Off	EJ2
Line Format	Single Line, Independent Mono	Single Line	ELI
Emphases Bit	No, 50, J.17	No	EEP
Original Bit	No, Yes	No	EOR
Copyright Bit	No, Yes	No	ECR
Private Bit	No, Yes	No	EPI
Protection Bit	No, Yes	Yes	EPR
Ancillary Data Format	CCS Standard, CCS Generic, CCS Sync, IRT DAB Sync, ADR	CCS Generic	EAF
Ancillary Data Rate	300, 1200, 2400, 4800, 9600, 38400	9600	EDR
Ancillary Data Channel	Left, Right, Both	Both	EAS

Table 3-5 Encoder Defaults

3.6 Audio and Status Monitoring

Located between the two analog audio inputs is an audio monitoring point. The audio output from this single-ended test point is 20 dB down from the audio input to the encoder. These test points are disabled when using digital audio inputs.

A single indicator lamp on the front of the encoder module indicates audio input source selection. The lamp is illuminated when analog audio is selected through software using the **EAI** command:

```
EAI slot source
```

Where *slot* = 1...7, *source* = A or D.

Please remember that the digital audio indicator lamp follows the software setting, not the jumper setting. To change audio sources, you must change both the software setting and the jumpers.

The status of all other encoder parameters, including algorithm, bit rate, sample rate, mode, audio source, framed state, and other parameters can be monitored through the Command Processor using the **CST** command:

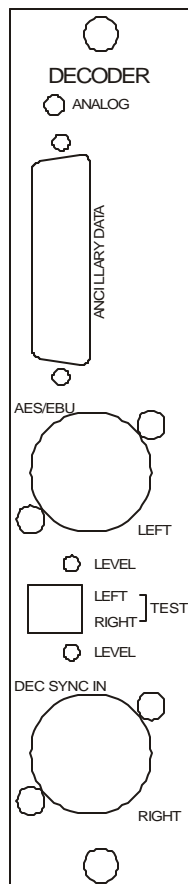
```
CST slot
```

Where *slot* = 1 to 7

Decoder

Up to six stereo Decoder modules can be used in the SuperLink system.

4. Overview



The SuperLink decoder module is a standard stereo audio decoder, with a choice of analog and/or digital (AES/EBU or S/PDIF) audio outputs and an RS-232 ancillary data channel. Numerous algorithms and bit rates are supported, including 64 kb/s G.722, Nx64 kb/s MUSICAM-enhanced Layer 2 and MPEG Layer 3, J.41 (384 kb/s mono), J.57 (companded and multiplexed) and several linear PCM (uncompressed, near zero delay) audio modes. If multiple encoder and decoder modules are used, different compression algorithms can be used for different channels simultaneously.

The decoder's powerful 24-bit D/A converter insures low distortion and high signal-to-noise ratios regardless of algorithm used. Multiple sampling rates and output levels accommodate a wide range of devices and bandwidths. With six installed decoder modules, it is possible to receive up to twelve individual, high-fidelity monaural channels per unit. Several SuperLink units can be daisy-chained for up to thirty audio channels. In addition, different configurations can be used for different channels simultaneously.

4.1 Decoder Installation

Your SuperLink system can support up to six encoder, decoder or X.21/V.35 modules. Modules can be inserted in any free slot except the two right-most power supply and the left-most control processor slots. It is not necessary to remove system power when removing or inserting

Figure 4-1 —
Decoder module

decoder modules. The installation or removal of a decoder card is automatically detected.

4.2 Decoder Configuration

If a decoder module is installed in a previously unpopulated slot or a slot that previously held another type of module, a factory default decoder configuration is loaded. If a decoder module is installed in a slot that previously held a decoder module, then the previous configuration is loaded.

4.2.1 Algorithm Selection

The SuperLink decoder module can decode any of the different algorithms supported to enable you to meet any audio quality requirement, from voice only to digital mastering quality. In addition, there is extra on-board memory for new algorithms to be installed as they are developed. Refer to Section 3.3 (Encoder Algorithms) for a description of all available algorithms.

The decoder algorithm is selected using the **DAL** command:

```
DAL slot algo
      slot      = 1,...,7
      algo      = G.722, MPEGL2,
                  MPEGL3, J.41, J.57
                  or PCM
```

Factory default = MPEGL2.

4.2.2 Decoder Algorithm Modes

The SuperLink decoder automatically senses the algorithm mode of the incoming audio data, thus making algorithm mode selection unnecessary. When monaural modes are used, the same audio can be sent to both left and right channels.

4.2.3 Decoder Line Format

Two line formats are available, Single Line and Independent Mono. Independent Mono is used only with monaural-only algorithms (G.722 and J.41) when stereo or independent mono operation is desired, for example, dual G.722 and stereo J.41 (dual mono). All other algorithms and modes should use the single line format. The decoder algorithm mode **must** match algorithm mode of the connected encoder for audio to pass from encoder to decoder. The **DLI** command is used to set the decoder line format:

DLI slot line

slot = 1, ..., 7

line = S or I

Factory default = Single line.

4.2.4 Decoder Bit Rate

MPEG algorithms allow a wide selection of bit rates enabling you to select the best transmission bit rate for your application. The **NMC** command is used to select the bit rate. Refer to Section 7.5.3 for information on the **NMC** command.

When using non-MPEG algorithms, the bit rate is set by the algorithm specifications.

Factory default = 384 kb/s.

4.2.5 Decoder Sample Rate

MPEG algorithms allow a range of encoder/decoder sample rates. Under normal conditions, the decoder sample rate is slaved to the incoming bit stream, set by the encoder, and is not adjustable. However, upon power-up with MPEG Layer 3 at 32 kHz sampling, it may be necessary to issue a **DDO** command to set the decoder sample rate. This may be necessary since the sample rate must be set to 48 kHz to boot the decoder.

Do not confuse encoder/decoder sample rates with digital audio sample rates, discussed later.

4.2.6 PCM Mode

When using the PCM algorithm, several modes can be selected using the **DPM** command:

DPM slot mode

slot = 1, ..., 7

mode = 16/48K/24, 24/32K/24,
18/32K/18, 18/48K/27

Two new connection Bit Rates have been added to the E1 which can only be used with the PCM algorithm. These are 1152 kbps (N=18) and 1728 kbps (N=27). Only one Channel Group (CG 1) is available for these rates.

When using 1728 kbps bit rate in linear PCM (18 bits at 48 kHz sampling rate) the E1 capacity is not fully consumed leaving three free timeslots being available for other use.

The PCM Mode for 18/32K/24 (18 bits at 32 kHz at 1536 kbps) also supports receiving ancillary data up to 38400 baud. The ancillary data port is set up as normal using CAP to enable the port and DDR to set the baud rate.

4.2.7 Channel Copy/Swap and Output Muting

It may be desirable to swap the left and right channel audio outputs or to copy one channel to the other output. The **DCS** command is used for this:

```
DCS slot mode
    slot      = 1,...,7
    mode      = NORM, CLTOR, CRTOL
               or SWAP
```

The **DMU** command is used to mute one or both output channels:

```
DMU slot mode
    slot      = 1,...,7
    mode      = NONE, LEFT, RIGHT
               or BOTH
```

Factory default, copy/swap = NORM.

Factory default, decoder mute = NONE.

4.2.8 J.41/J17 Emphasis

If J.41 emphasis is used in encoding (turned on with the **EEP** command) you must set the decoder to recognize the emphasis using the **DEP** command.

Syntax: **DEP** slot emphasis

4.2.9 Ancillary Data

Each decoder card has one ancillary data port that can be used to receive RS232 data from a far-end encoder when using any MPEG algorithm. This DB25 connector provides RS232 data de-multiplexed from the audio data. A true three-wire data path is provided; flow control is not provided. Data rates from 300 to 38,400 bits/sec are supported and selected with the **DDR** command:

```
DDR slot rate
    slot      = 1,...,7
    rate      = 300, 1200, 2400,
               4800 ,9600 or 38400
```

In addition to the connector on the decoder, SuperLink allows you to route decoded ancillary data to the ancillary data connector on the Command Processor module. This requires setting the ancillary data rate on the CP port using the **CDR** command as well as setting the decoder ancillary data rate.

When present, ancillary data uses bits normally assigned to audio data. Under most circumstances, this will not noticeably degrade the audio performance; however, the use of high data rates with low transmission bit rates should be avoided.

MPEG supports several ancillary data formats for compatibility with other codecs and satellite systems. Refer to Section 7.2.1 for a description of the different formats. The decoder ancillary data format must be the same as the connected encoder format. Use the **DAF** command to select the appropriate format:

```

DAF slot format
      slot      = 1,...,7
      format   = CSTD, CGEN, IRTDAB
                  or ADR

```

Since each decoder module is capable of supporting two audio channels (stereo), it is necessary to route the ancillary data to either channel when using monaural modes using the **DAS** command:

```

DAS slot channel
      slot      = 1,...,7
      channel   = LEFT or RIGHT

```

G.722, as implemented in the *SuperLink*, does not support ancillary data. J.41 supports ancillary data through the two data ports on E1 module, and J.57 supports AES/EBU ancillary data only.

Factory default, baud rate = 9600 kb/s.

Factory default, format = CCS Generic.

Factory default, channel = RIGHT.

4.2.10 MPEG Layer II Scale Factor Protection (Error Concealment)

Another MUSICAM USA exclusive feature available with MUSICAM-Enhanced Layer 2 is Advanced Concealment of Errors (ACE). ACE is based on CRC (Cyclic Redundancy Code) protection of the ISO/MPEG Layer 2 scale factor.

Decoder Scale Factor Protection is controlled by the **DSP** command:

```
DSP slot mode
Slot      = 1, ..., 7
Mode      = YES or NO
```

In general, it is better to use scale factor protection if the data channel is noisy (high BER). Scale factor protection (**DSP**) is used for all ISO/MPEG Layer 2 types of bitstreams. Scale factor is the level of the digital audio signal within a sub-band. There are 32 sub-bands and the scale factors change the level over a 120 dB range. An error on any scale factor will cause a perceptible impairment in the audio. To prevent this, scale factor protection can be inserted at the encoder and if the decoder is capable of recognizing it, then the decoder can perform a concealment operation to repair the damaged scale factor. If the decoder does not know about scale factor protection, the audio is decoded and any damaged scale factors cause impairments.

!note:

If the decoder has enabled scale factor correction, the far end encoder must enable scale factor protection with the **ESP command. If only one end has scale factor protection enabled, audio may be muted.** The SuperLink's Scale factor protection is not compatible with other manufacturer's codecs. Scale factor protection is compatible with MUSICAM USA's CDQ2001, **Prima LT**, **CDQPrima**, and SuperLink codecs.

When Scale Factor Protection is activated, only ancillary data modes CCS Standard and CCS Generic are supported.

Factory default = NO.

4.2.11 MPEG Layer II Decoding Mode

Two MPEG Layer 2 decoding modes are available for compatibility with CCS Audio Products codecs manufactured before ISO/MPEG standardization. Under normal operation, ISOCCS mode should be used, unless an older CCS codec is used at the far end. Use the DCO command to change formats:

DCO slot fmt

```
Slot      = 1, ..., 7
Fmt       = CCS or ISOCCS
```

Factory default = ISOCCS.

4.2.12 Output Selection

All decoder modules are equipped with both analog and digital outputs. To change output type, use the **DAO** command:

```

DAO slot output
      slot      = 1,...,7
      output    = ANALOG or DIGITAL

```

You must also use jumpers to select which output is active. Jumpers J3, J4, J14 and J15 are used to select the audio output, analog or digital. When all of these jumpers are in position 1-2, analog output is selected. When these jumpers are in position 2-3, digital output is selected.

Jumpers are also used to select the digital audio output format, AES/EBU or S/PDIF. Jumpers J2 and J5, when in position 1-2 select AES/EBU, and when in position 2-3 select S/PDIF. Please note that digital audio I/O is not supported when using G.722.

Digital audio output sample rate, not to be confused with the encoder/decoder sample rate, is selected using the **DDO** command:

```

DDO slot rate
      slot      = 1,...,7
      rate      = 32 or 48

```

44.1 kHz output sampling is possible when an external sync source is used.

Output	J3	J4	J14	J15
Analog	1-2	1-2	1-2	1-2
Digital	2-3	2-3	2-3	2-3
Output Format	J2		J5	
AES/EBU	2-3		2-3	
S/PDIF	1-2		1-2	

Table 4-1 Digital Audio Output Jumpers

Factory default, output select = ANALOG.

4.2.13 Analog Output Level Adjustment

(See Figure 4-2) The analog output level is variable, in three steps. The nominal output level of +18 dBu (0 dB gain relative to maximum input level of +18 dBu) can be set at either +15 dBu or +24 dBu (-3 or +9 dBu) with jumpers J16 and J17 on the decoder module (all levels are ± 1 dB). When these jumpers are in position 1-4, the output fixed at 0 dB boost/cut, when the jumpers are removed, the output is attenuated by 3 dB.

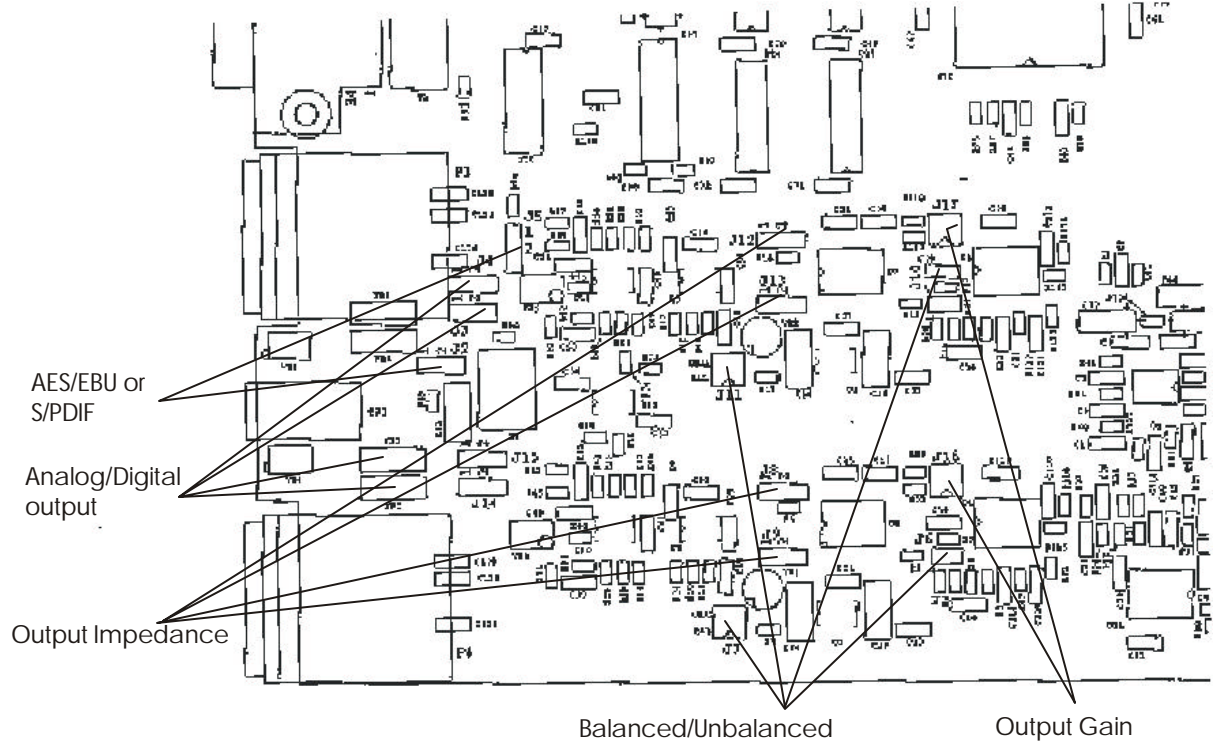


Figure 4-2 Decoder Jumper Layout

In addition to this course level adjustment, it is also possible to adjust the level of each channel individually over a range of approximately ± 2 dB using the trim-pots that can be accessed through holes in the front panel.

Clip Level	J16	J17	Gain
+24 dBu	2-3	2-3	+6 dB
+18 dBu	1-4	1-4	0 dB
+15 dBu	open	open	-3 dB

Table 4-2 Attenuation Jumper Settings

4.2.14 Output Impedance Adjustment

Jumpers J8, J9, J12 and J13, when in position 1-2, set the analog output impedance at 20 Ω . When these jumpers are in position 2-3, the output impedance is set at 600 Ω .

Balanced audio output is selected when Jumpers J6 and J10 are open, and jumpers J7 and J11 are in positions 1-4. For unbalanced output, jumpers J6 and J10 are in, and jumpers J7 and J11 are in positions 2-3.

Output Impedance	J8	J9	J12	J13
20 W	1-2	1-2	1-2	1-2
600 W	2-3	2-3	2-3	2-3
Output Select	J6	J7	J10	J11
Balanced	Open	1-4	Open	1-4
Unbalanced	Short	2-3	Short	2-3

Table 4-3 Decoder Output Jumper Settings

4.3 Default Configuration

A factory default configuration is loaded whenever a decoder card is installed in a slot not previously occupied by a decoder module. The factory default configuration can also be loaded at any time using the **CDF** command:

```
CDF slot
slot = 1,...,7
```

Factory defaults for the decoder are shown here:

PARAMETER	RANGE	DEFAULT	COMMAND
Network Module	1-4	1	NMC/NRC
Channel Group	1-32	1	NMC/NRC
Bit Rate	Nx64, N=1-32	6	NMC
Digital Audio Sample Rate	32, 48	48	DDO
Audio Channel Copy/Swap	Normal, Swap, CLtoR, CRtoL	Normal	DCS
Scale Factor Protection	No, Yes	No	DSP
Algorithm	MPEGL2, CCSO, CCSN, J.41, J.57	MPEGL2	DAL
Output Mute	None, Both, Left, Right	None	DMU
Line Format	Single Line, Independent Mono	Single Line	DLI
Emphasis Bit in	No, 50, J.17	No	DEP

PARAMETER	RANGE	DEFAULT	COMMAND
Header			
Decoding Mode	ISO, ISOCCS	ISOCCS	DCO
J.42 Application	Off, On	Off	DJ2
Ancillary Data Format	CCS Standard CCS Generic CCS Sync IRT DAB Sync	CCS Generic	DAF
Ancillary Data Rate	300, 1200, 2400, 4800, 9600, 38400	9600	DDR
Ancillary Data Channel	Both, Left, Right	Both	DAS

Table 4-4 Decoder Default Settings

4.4 Audio and Status Monitoring

Located between the analog channel audio outputs is an audio monitoring point. The audio present at these single-ended test points is 20 dB down from the analog audio output of the decoder. These test points are disabled for digital audio outputs.

A single indicator lamp on the front of the decoder module indicates analog audio output is selected. The status of all other decoder parameters, including algorithm, bit rate, sample rate, mode, audio output, framed state and other parameters can be monitored through the Command Processor using the **CST** command:

```
CST slot
      slot = 1,...,7
```

E1 Multiplexer

The E1 multiplexer is used for non-North American operation. Chapter 6 discusses the T1 multiplexer for North American operation.

5. Overview

This plug-in module is designed to provide all of the multiplexing and interface functions required to connect the SuperLink system to the E1 digital network. E1 is the 2.048 Mb/s standard used everywhere except North America (E1 may be available in some areas of North America).

This module provides access to up to three E1 circuits: timing E1, a drop/insert E1 and a main channel E1. The two user data ports can be configured for X.21 or V.24 protocols.

5.1 E1 Multiplexer Installation

The E1 multiplexer module can be installed in any free slot except the left-most control processor and the two right-most power supply slots. Multiple E1 modules can be installed, and it is not necessary to turn the SuperLink system off to remove or install an E1 module.

5.2 Front Panel Connectors

Three network connectors; a test connector and two user data ports are located on the E1 module front panel.

5.2.1 E1

The three E1 ports, Main (E1), Drop/Insert, and Timing (E1 Clock) are all wired identically. Each connection uses the standard 120Ω symmetrical interface.

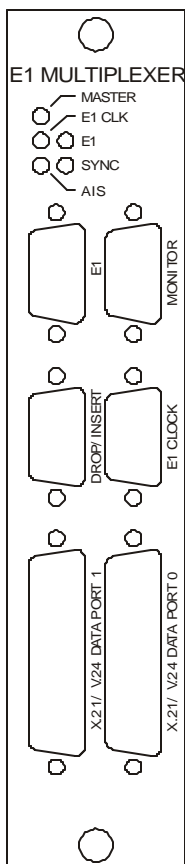


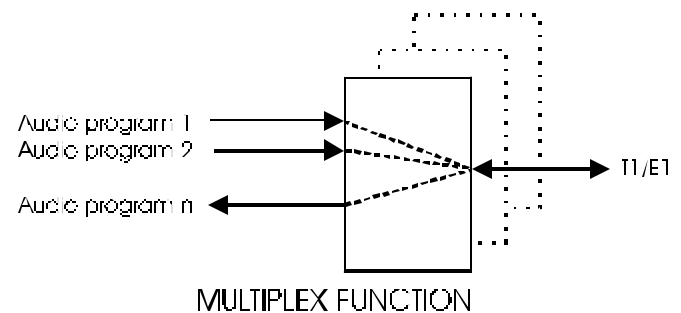
Figure 5-1 — E1 Interface / Multiplexer

The E1 timing interface allows connections to the network, but unlike the other two interfaces, this interface is used only to derive network timing. This includes both bit clock and frame sync information. This is a receive-only interface. Connections are as shown:

E1 Port		
Pin Number	Name	Description
1	RCV +	Incoming E1 (+) or D/I
2	GND	Ground/shield
3	XMT +	Outgoing E1 (+) or D/I
4	—	
5	—	
6	RCV -	Incoming E1 (-) or D/I
7	GND	Ground/shield
8	XMT -	Outgoing E1 (-) or D/I
9	—	

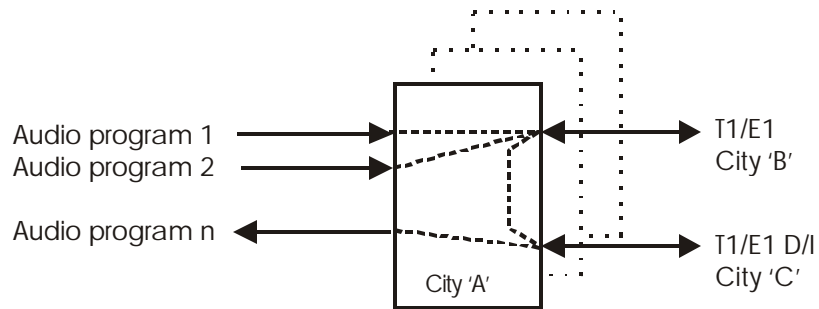
Table 5-1 – E1 Port Pin Connections

The primary network interface port is the bi-directional 'Main' E1 port. Audio data from the SuperLink encoders is multiplexed with data from the Drop/Insert (D/I) port and the two user data ports and is



output through the Main E1 port. Conversely, data coming into this port is demultiplexed and sent to the appropriate location, decoders, Drop/Insert port, or the user data interfaces. In the example shown here, n audio channels are multiplexed into one E1 interface. The maximum number of (single direction) audio channels depends on the bit rates of each channel, and the number of encoder/decoder modules installed. E1 has thirty-two channels, each 64 kb/s. 30 channels are available for audio(2 channels overhead). For example, if using 384 kb/s audio channels, five is the maximum number of channels with E1.

Another key function of the E1 module is the capability to drop and insert data traffic to and from the primary network interface. Data to and from the bi-directional D/I interface is multiplexed/demultiplexed with other audio and ancillary data internally in this module.



DROP / INSERT FUNCTION

As an example, in a three-location setup, location 'A', the central location, is connected to location 'B' (Main E1 port) and to location 'C' through to the D/I port as shown here. There is no direct link between locations 'B' and 'C'. Location 'C' sends several channels of audio to location 'B' through location 'A'. One audio channel from 'C' is dropped and decoded at location 'A', and two audio channels for location 'B' are inserted.

While the D/I port's primary function is to accept drop/insert data, it is electrically identical to the main E1 port. Therefore, it can be used as a second primary E1 interface, allowing the transmission of the same audio to two locations for each interface module installed.

SuperLinkSuperLinkAll connections between the Drop/Insert Port and the Main E1 Port are controlled using the **NMD** for establishing the connections and the **NRD** command for removing the connection:

```
NMD source dest rate changrp
      source      = Source slot, port
                   slot = 1,...,7
                   port = N or D
      dest        = destination slot, port
                   slot = 1,...,7
                   port = N or D
      rate        = Bit rate, N x 64
                   N = 1,...,30
```

changgrp = Channel group, 1, ..., 74

NRD *source dest*

source = Source slot, port
 slot = 1, ..., 7
 port = N or D

dest = destination slot, port
 slot = 1, ..., 7
 port = N or D

Connections between the Drop/Insert Port and the *SuperLink* Encoder, Decoder, X.21, or Control Processor modules are also possible, and are controlled using the **NMC** command to establish, and the **NRC** command to remove these connections, with the D port value specified for the Drop/Insert Port. Selecting the Command Processor port 'A' as a destination enables SuperLinks streaming audio capabilities, discussed in later chapters.

NMC *srcport destport rate changgrp*

srcport = source slot/port,
 slot = 1, ..., 7, port = A,
 B, N or D

destport = destination slot/port,
 slot = 0, ..., 7 (0 = CP)
 port = A, B, N or D

rate = bitrate *N*, (*N* X 64), *N* = 1, ..., 30

changgrp = channel group, 1, ..., 74

NRC *srcport destport*

srcport = source slot/port,
 slot = 1, ..., 7, port = A,
 B, N or D

Destport = destination slot/port,
 slot = 0, ..., 7, (0 = CP)
 port = A, B, N or D

5.2.2 E1 Channel Group and Time Slot Assignments

Table 5a-2 shows the Timeslot assignments for the T1 interface. Refer to Chapter 2 for further explanation of timeslots and channel groups. Please note that International convention has numbered E1 Timeslots from 0 to 31. For E1 (0 and 16 are reserved):

Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
1	1	1, 17	1, 2, 3	1, 2, 17, 18	1, 2, 3, 4, 5	1, 2, 3, 17, 18, 19	1, 2, 3, 17, 18, 19, 4, 5, 6, 20, 21, 22	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31
2	2	2, 18	17, 18, 19	3, 4, 19, 20	17, 18, 19, 20, 21	4, 5, 6, 20, 21, 22	1, 2, 3, 17, 18, 19, 7, 8, 9, 23, 24, 25	
3	3	3, 19	4, 5, 6	5, 6, 21, 22	6, 7, 8, 9, 10	7, 8, 9, 23, 24, 25	1, 2, 3, 17, 18, 19, 13, 14, 15, 29, 30, 31	
4	17	4, 20	20, 21, 22	7, 8, 23, 24	22, 23, 24, 25, 26	10, 11, 12, 26, 27, 28	1, 2, 3, 17, 18, 19, 10, 11, 12, 26, 27, 28	
5	18	5, 21	7, 8, 9	9, 10, 25, 26	11, 12, 13, 14, 15	13, 14, 15, 29, 30, 31	4, 5, 6, 20, 21, 22, 7, 8, 9, 23, 24, 25	
6	19	6, 22	23, 24, 25	11, 12, 27, 28	27, 28, 29, 30, 31	1, 2, 3, 4, 5, 6	4, 5, 6, 20, 21, 22, 10, 11, 12, 26, 27, 28	
7	4	7, 23	10, 11, 12	13, 14, 29, 30	1, 3, 5, 7, 9	7, 8, 9, 10, 11, 12	4, 5, 6, 20, 21, 22, 13, 14, 15, 29, 30, 31	
8	5	8, 24	26, 27, 28	1, 2, 3, 4	2, 4, 6, 8, 10	13, 14, 15, 17, 18, 19	7, 8, 9, 23, 24, 25, 10, 11, 12, 26, 27, 28	
9	6	9, 25	13, 14, 15	5, 6, 7, 8	3, 5, 7, 9, 11	20, 21, 22, 23, 24, 25	7, 8, 9, 23, 24, 25, 13, 14, 15, 29, 30, 31	
10	20	10, 26	29, 30, 31	9, 10, 11, 12	4, 6, 8, 10, 12	26, 27, 28, 29, 30, 31	10, 11, 12, 26, 27, 28, 13, 14, 15, 29, 30, 31	
11	21	11, 27	1, 3, 5	17, 18, 19, 20	5, 7, 9, 11, 13	1, 3, 5, 7, 9, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	
12	22	12, 28	2, 4, 6	21, 22, 23, 24	6, 8, 10, 12, 14	2, 4, 6, 8, 10, 12	17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28	

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Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
13	7	13, 29	3, 5, 7	25, 26, 27, 28	7, 9, 11, 13, 15	3, 5, 7, 9, 11, 13	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23	
14	8	14, 30	4, 6, 8	1, 3, 5, 7	8, 10, 12, 14, 18	4, 6, 8, 10, 12, 14	2, 4, 6, 8, 10, 12, 14, 18, 20, 22, 24, 26	
15	9	15, 31	5, 7, 9	2, 4, 6, 8	9, 11, 13, 15, 17	5, 7, 9, 11, 13, 15	3, 5, 7, 9, 11, 13, 5, 17, 19, 21, 23, 25	
16	23	1,2	6, 8, 10	3, 5, 7, 9	10, 12, 14, 18, 20	6, 8, 10, 12, 14, 18	4, 6, 8, 10, 12, 14, 18, 20, 22, 24, 26, 28	
17	24	3,4	7, 9, 11	4, 6, 8, 10	11, 13, 15, 17, 19	7, 9, 11, 13, 15, 17	5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27	
18	25	5,6	8, 10, 12	5, 7, 9, 11	12, 14, 18, 20, 22	8, 10, 12, 14, 18, 20	6, 8, 10, 12, 14, 18, 20, 22, 24, 26, 28, 30	
19	10	7,8	9, 11, 13	6, 8, 10, 12	13, 15, 17, 19, 21	9, 11, 13, 15, 17, 19	7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29	
20	11	9,10	10, 12, 14	7, 9, 11, 13	14, 18, 20, 22, 24	10, 12, 14, 18, 20, 22	8, 10, 12, 14, 18, 20, 22, 24, 26, 28, 30, 2	
21	12	11,12	11, 13, 15	8, 10, 12, 14	15, 17, 19, 21, 23	11, 13, 15, 17, 19, 21	9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31	
22	26	13,14	12, 14, 18	9, 11, 13, 15	17, 19, 21, 23, 25	12, 14, 18, 20, 22, 24	10, 12, 14, 18, 20, 22, 24, 26, 28, 30, 2, 4	
23	27	15,17	13, 15, 17	10, 12, 14, 18	18, 20, 22, 24, 26	13, 15, 17, 19, 21, 23	11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 1	
24	28	17,18	14, 18, 20	11, 13, 15, 17	19, 21, 23, 25, 27	14, 18, 20, 22, 24, 26	12, 14, 18, 20, 22, 24, 26, 28, 30, 2, 4, 6	
25	13	19, 20	15, 17, 19	12, 14, 18, 20	20, 22, 24, 26, 28	15, 17, 19, 21, 23, 25	13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 1, 3	
26	14	21, 22	17, 19, 21	13, 15, 17, 19	21, 23, 25, 27, 29	17, 19, 21, 23, 25, 27	14, 18, 20, 22, 24, 26, 28, 30, 2, 4, 6, 8	
27	15	23, 24	18, 20, 22	14, 18, 20, 22	22, 24, 26, 28, 30	18, 20, 22, 24, 26, 28	15, 17, 19, 21, 23, 25, 27, 29, 31, 1, 3, 5	
28	29	25, 26	19, 21, 23	15, 17, 19, 21	23, 25, 27, 29, 31	19, 21, 23, 25, 27, 29	17, 19, 21, 23, 25, 27, 29, 31, 1, 3, 5, 7	

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Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
29	30	27, 28	20, 22, 24	17, 19, 21, 23		20, 22, 24, 26, 28, 30	18, 20, 22, 24, 26, 28, 30, 2, 4, 6, 8, 10	
30	31	29, 30	21, 23, 25	18, 20, 22, 24		21, 23, 25, 27, 29, 31	19, 21, 23, 25, 27, 29, 31, 1, 3, 5, 7, 9	
31		31, 31	22, 24, 26	19, 21, 23, 25		17, 18, 19, 20, 21, 22	20, 22, 24, 26, 28, 30, 2, 4, 6, 8, 10, 12	
32		31, 1	23, 25, 27	20, 22, 24, 26		18, 19, 20, 21, 22, 23	21, 23, 25, 27, 29, 31, 1, 3, 5, 7, 9, 11	
33		1, 3	24, 26, 28	21, 23, 25, 27		19, 20, 21, 22, 23, 24	22, 24, 26, 28, 30, 2, 4, 6, 8, 10, 12, 14	
34		2, 4	25, 27, 29	22, 24, 26, 28		21, 22, 23, 24, 25, 26	23, 25, 27, 29, 31, 1, 3, 5, 7, 9, 11, 13	
35		3, 5	26, 28, 30	23, 25, 27, 29		22, 23, 24, 25, 26, 27	24, 26, 28, 30, 2, 4, 6, 8, 10, 12, 14, 18	
36		4, 6	27, 29, 31	24, 26, 28, 30		23, 24, 25, 26, 27, 28	25, 27, 29, 31, 1, 3, 5, 7, 9, 11, 13, 15	
37		5, 7	28, 30, 2	25, 27, 29, 31		24, 25, 26, 27, 28, 29	26, 28, 30, 2, 4, 6, 8, 10, 12, 14, 18, 20	
38		6, 8	29, 31, 1	26, 28, 30, 2		25, 26, 27, 28, 29, 30	27, 29, 31, 1, 3, 5, 7, 9, 11, 13, 15, 17,	
39		7, 9	30, 2, 4	27, 29, 31, 1			28, 30, 2, 4, 6, 8, 10, 12, 14, 18, 20, 22	
40		8, 10	31, 1, 3	28, 30, 2, 4			29, 31, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19	
41		9, 11	2, 3, 4	29, 31, 3, 5			30, 2, 4, 6, 8, 10, 12, 14, 18, 20, 22, 24	
42		10, 12	3, 4, 5	30, 2, 4, 6			31, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21	
43		11, 13	5, 6, 7	31, 2, 5, 7				
44		12, 14	6, 7, 8	1, 9, 17, 25				
45		13, 15	8, 9, 10	2, 10, 18, 26				
46		14, 17	9, 10, 11	3, 11, 19,				

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Channel Group	E1 Timeslots (0 & 16 Reserved)							
	64K	128K	192K	256K	320K	384K	768K	1920K
				27				
47		15, 17	11, 12, 13	4, 12, 20, 28				
48		17, 19	12, 13, 14	5, 13, 21, 29				
49		18, 20	14, 15, 17	7, 14, 22, 30				
50		19, 21	15, 17, 18	9, 15, 23, 31				
51		20, 22	18, 19, 20					
52		21, 23	19, 20, 21					
53		22, 24	21, 22, 23					
54		23, 25	22, 23, 24					
55		24, 26	24, 25, 26					
56		25, 27	25, 26, 27					
57		26, 28	27, 28, 29					
58		27, 29	28, 29, 30					
59		28, 30	1, 9, 17					
60		29, 31	2, 10, 18					
61		2, 3	3, 11, 19					
62		4, 5	4, 12, 20					
63		6, 7	5, 13, 21					
64		8, 9	6, 14, 22					
65		10, 11	7, 15, 23					
66		12, 13	9, 17, 24					
67		14, 15	10, 18, 25					
68		18, 19	11, 19, 26					
69		20, 21	12, 20, 27					
70		22, 23	13, 21, 28					
71		24, 25	14, 22, 29					
72		26, 27	15, 23, 30					
73		28, 29						
74		30, 31						

Table 5-2 — Timeslot Assignment for E1

5.2.3 E1 Cable Requirements

There is no recommended manufacturer or type of cable that must be used for E1 connections. The only limitation on cable selection is that the cable attenuation should not exceed 6dB at 2 MHz, end-to-end. Therefore, maximum cable length depends entirely on the specifications of the cable selected.

5.2.4 Test Port

In addition to the three E1 network interface ports, there is also an E1 test connector (Monitor) that provides access to both the primary and D/I interface. Buffered access to the E1 ports for monitoring with test equipment is provided.

E1 Test Port (Monitor Port)		
Pin Number	Name	Description
1	DS2RCV +	Incoming E1 (+)
2	DS2XMT+	Outgoing E1 (+)
3	DIRCV+	Incoming D/I (+)
4	DIXMT+	Outgoing D/I (+)
5	GND	Ground/shield
6	DS2RCV -	Incoming E1 (-)
7	DS2XMT-	Outgoing E1 (-)
8	DIRCV-	Incoming D/I (-)
9	DIXMT-	Outgoing D/I (-)

Table 5-2 E1 Monitor Port Pin Connections

5.2.5 User (Ancillary) Data Ports

The two User Data ports, wired identically, are configured for V.24 asynchronous bi-directional data. The pins used determine the interface used. These ports are independent of the SuperLink's audio encoder/decoder functions.

Port data is retrieved or inserted from/to time slots on the SuperLink backplane. Since these data ports are configured as DCE devices in

operation, they are always considered as the clock master, and will not accept an input clock from an external device.

The asynchronous V.24 ports, electrically equivalent to RS232, are limited to data rates of 9600 kb/s or less. The data rate adaptation is automatic.

Unlike X.21 data, which can be inserted in any available time slot, the V.24 data is inserted into time slot 16 only. This is the limiting factor as to data speed.

User Data Ports			
Pin Number	Name	Description	Interface
1	FGND	Frame ground A	V.24/X.21
2	RD (I)	Receive data	V.24
3	TD (O)	Transmit data	V.24
4	RTS (I)	Request to send	V.24
5	CTS (O)	Clear to send	V.24
6	DSR (O)	Data set ready	V.24
7	GND	Signal ground	V.24/X.21
8	DCD (O)	Data carrier detect	V.24
9	TDA (O)	Transmit data A	X.21
10	CA (O)	Control element A	X.21
11	RDA (I)	Receive data A	X.21
12	IA (I)	Indicator element A	X.21
13	SA (I)	Timing element A	X.21
14	—		
15	—		
16	—		
17	BA (I)	Byte timing A	X.21
18	BB (I)	Byte timing B	X.21
19	—		
20	DTR (I)	Data terminal ready	V.24
21	TDB (O)	Transmit data B	X.21

User Data Ports			
22	CB (O)	Control element B	X.21
23	RDB (I)	Receive data B	X.21
24	IB (I)	Indicator element B	X.21
25	SB (I)	Timing element B	X.21

Table 5-3 User Data Port Pin Connections

The ancillary data ports can be configured for asynchronous V.24 data. X.21 support will be added in the future.

There are 5 possible V.24 modes, selected with the **NVM** command:

```

NVM slot port mode
      slot    = 1,...,7
      port    = 0 or 1
      mode    = INACTIVE, TX, TXRX,
              TS16RXTX or
              TS16TXONES

```

When not used, the port mode should be set to Inactive. The TX mode is used to send V.24 data to the E1 transmit only. The TxRx mode sets up for bi-directional data from the E1 transmit and receive. In addition to receiving the V.24 data, the TS16RXTX mode will forward V.24 data from the E1 receive to the E1 transmit. The TS16TXONES mode is the same as the TX16RXTX mode except that all '1's are forwarded to the E1 transmitter.

The ancillary data can be routed to a far-end SuperLink or SuperLink system through either the main Network E1 interface or the Drop/Insert E1 interface. The **NVC** command is used to select the E1 interface:

```

NVC slot port
      slot    = 1,...,7
      port    = NETWORK or DROPINSERT

```

V.24 handshaking is set using the **NVS** command:

```

NVS slot port mode
      slot    = 1,...,7
      port    = 0 or 1

```

mode = ON, OFF, DTR, or
RTS

5.3 Sync (Timing) Source

There are four possible timing sources that can be used as a master clock for the SuperLink system. Internal timing uses an internal crystal for synchronization. Timing can also be derived from the Main E1 port, the Drop/Insert E1 port or the Timing E1 port. The **NSS** command is used to select the active timing (sync) source:

```
NSS slot sync
      slot = 1,...,7
      sync = INT, RXTIMING,
            RXNETWORK or RXDROPINSERT
```

If several SuperLink units are working in a daisy-chain configuration, it is important that every unit is synchronized to a single master clock. This can be the internal, E1, Drop/Insert or an external clock. If daisy-chaining the clock, be sure not to make a ring, or circle, configuration. One SuperLink cannot receive the timing from two E1 sources; e.g., you cannot output audio coming in through E1 and Drop/Insert ports simultaneously unless the unit feeding the Drop/Insert port has the exact same timing as the receiving unit.

5.4 Time-Slot 16 Master Framing

Time slot 16 is used for the transmission of ancillary data when the J.41 algorithm is used. Ancillary data from the two ports on the E1 module uses the capacity of this time slot for transmission to the far-end data ports

Master framing of this signal is controlled using the **NTM** command:

```
NTM slot frame
      slot = 1,...,7
      frame = ON or OFF
```

5.5 CRC4

CRC4 error protection, optionally selectable, uses a single bit in alternate frames of the E1 bit stream to form a CRC calculation of a multiframe structure. This yields additional protection against errors in the frame alignment signal.

```
NCR slot CRC
      slot = 1,...,7
```

sync = ON or OFF

5.6 Default Configuration

A factory default configuration is loaded whenever a multiplexer module is installed in a slot not previously occupied with a multiplexer module. A factory default configuration can be loaded at any time using the **CDF** command:

CDF *slot*

slot = 1,...,7

Note: Any previously established module connections will be cleared with this command.

Factory defaults for the E1 multiplexer are shown here:

PARAMETER	RANGE	DEFAULT	COMMAND
Network Module	1-4	1	NNC
Drop Subchannel ID	0-14	0	—
Lift Subchannel ID	0-14	0	—
Drop/Insert Rx Conn ID	0-8	0	NMD
Drop/Insert Tx Conn ID	0-8	0	NMD
Drop/Insert Channel Group	1-74	1	NMD
Drop/Insert Bit Rate	Nx64, N=1-30	6	NMD
Sync Source	Internal CLK RX Timing I/F RX Network I/F RX Drop/Ins	RX Network I/F	NSS
CRC4	Off, On	On	NCR
TS16 Master Framing	Off, On	Off	NTM
AIS Alarm	Off, On	Off	NAS
V.24 Mode	Inactive Tx Only Tx/Rx TS16->TX	Inactive	NVM

PARAMETER	RANGE	DEFAULT	COMMAND
V.24 Port Connect	Tx Ones TS16 Network, Drop/Insert	Network	NVC
V.24 Handshake	Off, On, DTR, RTS	Off	NVS

Table 5-4 – E1 Multiplexer Factory Defaults

5.7 Status Monitoring

There are five status LEDs on the E1 module:

- The **Master** LED illuminates when the E1 module is used for system timing
- The **E1 Clk** and **E1** LEDs:
 - Illuminate GREEN when there is a signal at the interface AND the module can synchronize to that signal AND the interface is selected as the sync source AND the module is selected as clock master for the system
 - Illuminate RED when there is NO signal at the interface (Loss Of Signal) OR (the interface is selected as the sync source AND the board cannot synchronize to the signal)
 - Are OFF if there is no signal at the interface (LOS) AND (the interface is not selected as the sync source OR the board is not selected as clock master for the system)
- The AIS LED illuminates when an all 'ones' signal is received from the E1 network
- The SYNC LED illuminates when the E1 module is unable to achieve synchronization from the selected source

The status of all other module functions, including used and free time slots, add/drop, multiplex and alarm functions is obtained through the Control Processor module.

T1 Multiplexer

The T1 multiplexer is used for North American operation. Chapter 5 discusses the E1 multiplexer for operation in the rest of the World.

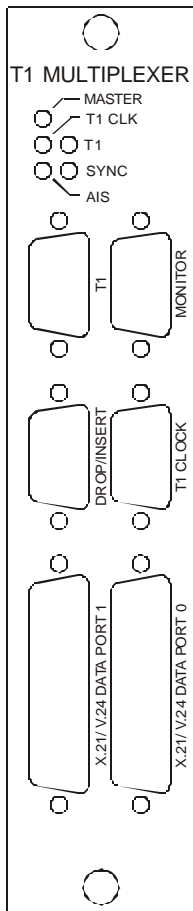


Figure 6-1 — T1 Interface / Multiplexer

6. Overview

This plug-in module is designed to provide all of the multiplexing and interface functions required to connect the SuperLink system to the T1 digital network. T1 is the 1.544 Mb/s standard used in North America, whereas E1 is the 2.048 Mb/s standard used everywhere except North America. For connection to the E1 digital network, an E1 Multiplexer card is required.

This module provides access for up to three T1 circuits: timing T1, a drop/insert T1 and a main channel T1. The two user data ports can be configured for X.21 or V.24 protocols; however, V.24 is not available with this software revision.

6.1 Multiplexer Installation

The T1 multiplexer module can be installed in any free slot except the left-most control processor and the two right-most power supply slots. Multiple T1 modules can be installed, and it is not necessary to turn the SuperLink system off to remove or install a T1 module.

6.2 Front Panel Connectors

Three network connectors; a test connector and two user data ports are located on the T1 module front panel.

6.2.1 T1

The three T1 ports, Main (T1), Drop/Insert, and Timing (T1 Clock) are all wired identically. Each connection uses the standard 120Ω symmetrical interface.

Connector pinouts are shown in Table 6-1A. A built-in CSU allows the T1 multiplexer to be connected directly to the network without an external CSU/DSU.

T1 port connectors		
DB-9 Pin Number	Name	Description
1	RCV +	Incoming T1 (+) or D/I
2	GND	Ground/shield
3	XMT +	Outgoing T1 (+) or D/I
6	RCV -	Incoming T1 (-) or D/I
7	GND	Ground/shield
8	XMT -	Outgoing T1 (-) or D/I
4, 5, 9	-	Not used

Table 6-1A – T1 Main, D/I, and Timing Port Pin Connections

For connections to a T1 network using RJ-45 connectors, a DB-9 to RJ-45 adapter can be made using the pinouts shown in Table 6-1B.

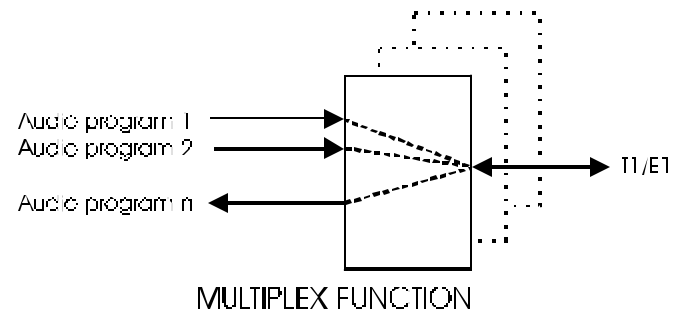
T1 RJ-45 to DB-9 Adapter	
RJ-45F Pin	DB-9F Pin
1	1
2	6
4	3
5	8

Table 6-1B RJ-45 to DB-9 Adapter

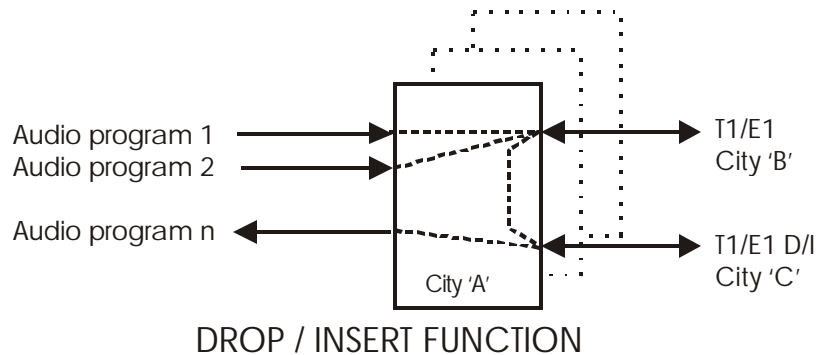
Please note that the RJ-45 pins are numbered pin 8 left, pin 1 right.

The T1 timing interface allows connections to the network, but unlike the other two interfaces, this interface is used only to derive network timing. This includes both bit clock and frame sync information. This is a receive-only interface and does not have a built-in CSU/DSU. The DS1 external clock signal goes to the Drop/Insert port and has internal CSU/DSU support. If the Drop/Insert function is required in addition to external DS1 clock, two SuperLink units can be used with the external clock driving the first unit and the timing of the second unit derived from its Drop/Insert port.

The primary network interface port is the bi-directional 'Main' T1 port. Audio data from the SuperLink encoders is multiplexed with data from the Drop/Insert (D/I) port and the two user data ports and is output through the Main T1 port. Conversely, data coming into this port is demultiplexed and sent to the appropriate location, decoders, Drop/Insert port, or the user data interfaces. In the example shown here, n audio channels are multiplexed into one T1 interface. The maximum number of (single direction) audio channels depends on the bit rates of each channel, and the number of encoder/decoder modules installed. T1 has a maximum capacity of twenty-four 64 kb/s channels. For example, if using 384 kb/s audio channels, four is the maximum number of channels with T1.



Another key function of the T1 module is the capability to drop and insert data traffic to and from the primary network interface. Data to and from the bi-directional D/I interface is multiplexed/demultiplexed with other audio and ancillary data internally in this module.



As an example, in a three-location setup, location 'A', the central location, is connected to location 'B' (Main T1 port) and to location 'C' through to the D/I port as shown here. There is no direct link between locations 'B' and 'C'. Location 'C' sends several channels of audio to location 'B' through location 'A'. One audio channel from 'C' is dropped and decoded at location 'A', and two audio channels for location 'B' are inserted.

While the D/I port's primary function is to accept drop/insert data, it is electrically identical to the main T1 port. Therefore, it can be used as a second primary T1 interface, allowing the transmission of the same audio to two locations for each interface module installed.

In addition to the multiplexing and drop/insert functions, a cross connect function is also provided. It is possible to use one centrally located *SuperLink* unit as the hub of a star-configured network. As an example, shown here, one central *SuperLink* unit is connected to six remote locations. The cross connect function allows any remote location to send audio to any other remote location without the need to decode and encode at the central location.

All connections between the Drop/Insert Port and the Main T1 Port are controlled using the **NMD** for establishing the connections and the **NRD** command for removing the connection:

NMD *source dest rate changrp*

source = Source slot, port
 slot = 1, ..., 7
 port = N or D
dest = destination slot, port
 slot = 1, ..., 7
 port = N or D
rate = Bit rate, N x 64
 N = 1, ..., 24
changrp = Channel group, 1, ..., 24

NRD *source dest*

source = Source slot, port
 slot = 1, ..., 7
 port = N or D
dest = destination slot, port
 slot = 1, ..., 7
 port = N or D

Connections between the Drop/Insert Port and the *SuperLink* Encoder, Decoder or X.21 modules are also possible, and are controlled using the **NMC** command to establish, and the **NRC** command to remove these connections, with the D port value specified for the Drop/Insert Port:

NMC *srcport destport rate changrp*

srcport = source slot/port,
 slot = 1, ..., 7, port =
 A, B, N or D
destport = destination slot/port,
 slot = 1, ..., 7, port =
 A, B, N or D
rate = bitrate N, (N X 64), N =
 1, ..., 24
changrp = channel group, 1, ..., 56

NRC *srcport destport*

srcport = source slot/port,
 slot = 1, ..., 7, port =
 A, B, N or D
Destport = destination slot/port,
 slot = 1, ..., 7, port =

A, B, N or D

6.2.2 T1 Channel Group and Time Slot Assignments

Table 6b-2 shows the Timeslot assignments for the T1 interface. Refer to Chapter 2 for further explanation of timeslots and channel groups.

Please note that T1 Timeslots are numbered from 1 to 24. For T1:

Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
1	1	1, 2	1, 2, 3	1, 2, 3, 4	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
2	2	3, 4	4, 5, 6	5, 6, 7, 8	6, 7, 8, 9, 10	7, 8, 9, 10, 11, 12	13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	
3	3	5, 6	7, 8, 9	9, 10, 11, 12	11, 12, 13, 14, 15	13, 14, 15, 16, 17, 18	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23	
4	4	7, 8	10, 11, 12	13, 14, 15, 16	17, 18, 19, 20, 21	19, 20, 21, 22, 23, 24	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24	
5	5	9, 10	13, 14, 15	17, 18, 19, 20	13, 14, 15, 16, 17	1, 3, 5, 7, 9, 11	3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 1	
6	6	11, 12	16, 17, 18	21, 22, 23, 24	18, 19, 20, 21, 22	2, 4, 6, 8, 10, 12	4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 2	
7	7	13, 14	19, 20, 21	1, 3, 5, 7	1, 3, 5, 7, 9	3, 5, 7, 9, 11, 13	5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 1, 3	
8	8	15, 16	22, 23, 24	2, 4, 6, 8	2, 4, 6, 8, 10	4, 6, 8, 10, 12, 14	6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 2, 4	
9	9	17, 18	1, 3, 5	3, 5, 7, 9	3, 5, 7, 9, 11	5, 7, 9, 11, 13, 15	7, 9, 11, 13, 15, 17, 19, 21, 23, 1, 3, 5	
10	10	19, 20	2, 4, 6	4, 6, 8, 10	4, 6, 8, 10, 12	6, 8, 10, 12, 14, 16	8, 10, 12, 14, 16, 18, 20, 22, 24, 2, 4, 6	
11	11	21, 22	3, 5, 7	5, 7, 9, 11	5, 7, 9, 11, 13	7, 9, 11, 13, 15, 17	9, 11, 13, 15, 17, 19, 21, 23, 1, 3, 5, 7	

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Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
12	12	23, 24	4, 6, 8	6, 8, 10, 12	6, 8, 10, 12, 14	8, 10, 12, 14, 16, 18	10, 12, 14, 16, 18, 20, 22, 24, 2, 4, 6, 8	
13	13	1, 3	5, 7, 9	7, 9, 11, 13	7, 9, 11, 13, 15	9, 11, 13, 15, 17, 19	11, 13, 15, 17, 19, 21, 23, 1, 3, 5, 7, 9	
14	14	2, 4	6, 8, 10	8, 10, 12, 14	8, 10, 12, 14, 16	10, 12, 14, 16, 18, 20	12, 14, 16, 18, 20, 22, 24, 2, 4, 6, 8, 10	
15	15	3, 5	7, 9, 11	9, 11, 13, 15	9, 11, 13, 15, 17	11, 13, 15, 17, 19, 21	13, 15, 17, 19, 21, 23, 1, 3, 5, 7, 9, 11	
16	16	4, 6	8, 10, 12	10, 12, 14, 16	10, 12, 14, 16, 18	12, 14, 16, 18, 20, 22	14, 16, 18, 20, 22, 24, 2, 4, 6, 8, 10, 12	
17	17	5, 7	9, 11, 13	11, 13, 15, 16	11, 13, 15, 17, 19	13, 15, 17, 19, 21, 23	15, 17, 19, 21, 23, 1, 3, 5, 7, 9, 11, 13	
18	18	6, 8	10, 12, 14	12, 14, 16, 18	12, 14, 16, 18, 20	14, 16, 18, 20, 22, 24	16, 18, 20, 22, 24, 2, 4, 6, 8, 10, 12, 14	
19	19	7, 9	11, 13, 15	13, 15, 17, 19	13, 15, 17, 19, 21	15, 17, 19, 21, 23, 1	17, 19, 21, 23, 1, 3, 5, 7, 9, 11, 13, 15	
20	20	8, 10	12, 14, 16	14, 16, 18, 20	14, 16, 18, 20, 22	16, 18, 20, 22, 24, 2	18, 20, 22, 24, 2, 4, 6, 8, 10, 12, 14, 16	
21	21	9, 11	13, 15, 17	15, 17, 19, 21	15, 17, 19, 21, 23	17, 19, 21, 23, 1, 3	19, 21, 23, 1, 3, 5, 7, 9, 11, 13, 15, 17	
22	22	10, 12	14, 16, 18	16, 18, 20, 22	16, 18, 20, 22, 24	18, 20, 22, 24, 2, 4	20, 21, 22, 2, 4, 6, 8, 10, 12, 14, 16, 18	
23	23	11, 13	15, 17, 19	17, 19, 21, 23	17, 19, 21, 23, 1	19, 21, 23, 1, 3, 5	21, 23, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19	
24	24	12, 14	16, 18, 20	18, 20, 22, 24	18, 20, 22, 24, 2	20, 22, 24, 2, 4, 6	22, 24, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20	
25		13, 15	17, 19, 21	19, 21, 23, 1	19, 21, 23, 1, 3	21, 23, 1, 3, 5, 7	23, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21	
26		14, 16	18, 20, 22	20, 22, 24, 2	20, 22, 24, 2, 4	22, 24, 2, 4, 6, 8	24, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22	
27		15, 17	19, 21, 23	21, 23, 1, 3	21, 23, 1, 3, 5	23, 1, 3, 5, 7, 9		

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Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
28		16, 18	20, 22, 24	22, 24, 2, 4	22, 24, 2, 4, 6	24, 2, 4, 6, 8, 10		
29		17, 19	21, 23, 1	23, 1, 3, 5	23, 1, 3, 5, 7	1, 5, 9, 13, 17, 21		
30		18, 20	22, 24, 2	24, 2, 4, 6	24, 2, 4, 6, 8	2, 6, 10, 14, 18, 22		
31		19, 21	23, 1, 3	1, 7, 13, 20		3, 7, 11, 15, 19, 23		
32		20, 22	24, 2, 4	2, 8, 14, 21		4, 8, 12, 16, 20, 24		
33		21, 23	2, 3, 4	3, 9, 15, 22				
34		22, 24	5, 6, 7	4, 10, 16, 23				
35		23, 1	8, 9, 10	5, 11, 17, 24				
36		24, 2	11, 12, 13	7, 12, 18, 1				
37		2, 3	14, 15, 16					
38		4, 5	17, 18, 19					
39		6, 7	20, 21, 22					
41		8, 9	23, 24, 1					
41		10, 11	3, 4, 5					
42		12, 13	6, 7, 8					
43		14, 15	9, 10, 11					
44		16, 17	12, 13, 14					
45		18, 19	15, 16, 17					
46		20, 21	18, 19, 20					
47		22, 23	21, 22, 23					
48		2, 1	24, 1, 2					
49			1, 9, 17					
50			2, 10, 18					
51			3, 11, 19					
52			4, 12, 20					
53			5, 13,					

Channel Group	T1 Timeslots							
	64K	128K	192K	256K	320K	384K	768K	1536K
54			21 6, 14, 22					
55			7, 15, 23					
56			8, 16, 24					

Table 6-2 — Timeslot Assignment for T1

6.2.3 T1 Cable Requirements

There is no recommended manufacturer or type of cable that must be used for T1 connections. The only limitation on cable selection is that the cable attenuation should not exceed 6dB at 2 MHz, end-to-end. **In order to properly configure the internal CSU, you need to know the approximate cable length.**

6.2.4 Monitor Port

In addition to the three T1 network interface ports, there is also a T1 test connector (Monitor) that provides access to both the primary and D/I interface. Buffered access to the T1 ports for monitoring with test equipment is provided.

T1 Test Port (Monitor Port)		
Pin Number	Name	Description
1	RX T1 (ring)	Incoming T1 (+)
2	TX T1 (ring)	Outgoing T1 (+)
3	RX D/I (ring)	Incoming D/I (+)
4	TX D/I (ring)	Outgoing D/I (+)
5	GND	Ground/shield
6	RX T1 (tip)	Incoming T1 (-)
7	TX T1 (tip)	Outgoing T1 (-)
8	RX D/I (tip)	Incoming D/I (-)
9	TX D/I (tip)	Outgoing D/I (-)

Table 6-3 T1 Monitor Port Pin Connections

6.2.5 User Data Ports

The two User Data ports, wired identically, are configured for either X.21 synchronous or V.24 asynchronous bi-directional data. The same connector is used for both V.24 (electrically equivalent to RS232) and X.21. The pins used determine the interface used. These ports are independent of the SuperLink's audio encoder/decoder functions.

V.24 support is currently not available but will be activated in a future release

Port data is retrieved or inserted from/to time slots on the SuperLink backplane. Since these data ports are configured as DCE devices in operation, they are always considered as the clock master, and will not accept an input clock from an external device.

The asynchronous V.24 ports, electrically equivalent to RS232, are limited to data rates of 9600 kb/s or less. The data rate adaptation is automatic.

Unlike X.21 data, which can be inserted in any available time slot, the V.24 data is inserted into time slot 16 only. This is the limiting factor as to data speed.

User Data Ports			
Pin Number	Name	Description	Interface
1	FGND	Frame ground A	V.24/X.21
2	RD (I)	Receive data	V.24
3	TD (O)	Transmit data	V.24
4	RTS (I)	Request to send	V.24
5	CTS (O)	Clear to send	V.24
6	DSR (O)	Data set ready	V.24
7	GND	Signal ground	V.24/X.21
8	DCD (O)	Data carrier detect	V.24
9	TDA (O)	Transmit data A	X.21
10	CA (O)	Control element A	X.21
11	RDA (I)	Receive data A	X.21
12	IA (I)	Indicator element A	X.21
13	SA (I)	Timing element A	X.21
14	—		

User Data Ports			
15	—		
16	—		
17	BA (I)	Byte timing A	X.21
18	BB (I)	Byte timing B	X.21
19	—		
20	DTR (I)	Data terminal ready	V.24
21	TDB (O)	Transmit data B	X.21
22	CB (O)	Control element B	X.21
23	RDB (I)	Receive data B	X.21
24	IB (I)	Indicator element B	X.21
25	SB (I)	Timing element B	X.21

Table 6-4 User Data Port Pin Connections

6.3 Sync (Timing) Source

There are four possible timing sources that can be used as a master clock for the SuperLink system. Internal timing uses an internal crystal for synchronization. Timing can also be derived from the Main T1 port, the Drop/Insert T1 port or the Timing T1 port. The **NSS** command is used to select the active timing (sync) source:

```
NSS slot sync
      slot = 1,...,7
      sync = INT, RXTIMING,
            RXNETWORK or RXDROPINSERT
```

If several SuperLink units are working in a daisy-chain configuration, it is important that every unit is synchronized to a single master clock. This can be the internal, T1, Drop/Insert or an external clock. If daisy-chaining the clock, be sure not to make a ring, or circle, configuration. One SuperLink cannot receive the timing from two T1 sources, e.g., you cannot output audio coming in through the main and Drop/Insert ports simultaneously unless the unit feeding the Drop/Insert port has the exact same timing as the receiving unit.

Master framing of this signal is controlled using the **NTM** command:

```
NTM slot frame
```

```

slot    = 1,...,7
frame   = ON or OFF

```

6.4 X.21

X.21 allows a wide selection of ancillary data rates, from 56 to 384 kb/s. Baud rate is selected using the **NXB** command:

```

NXB slot port rate
      slot    = 1,...,7
      port    = 0 or 1
      rate    = 56, 64, 112, 128,
                168, 192, 224, 256,
                280, 320, 336, or
                384

```

X.21 handshaking is set using the **NXH** command:

```

NXH slot port mode
      slot    = 1,...,7
      port    = 0 or 1
      mode    = ON or OFF

```

6.5 CRC6

CRC6 error protection, optionally selectable, uses a single bit in alternate frames of the T1 bit stream to form a CRC calculation of a multiframe structure. This yields additional protection against errors in the frame alignment signal.

```

NCR slot CRC
      slot    = 1,...,7
      CRC     = ON or OFF

```

6.6 Default Configuration

A Factory default configuration is loaded whenever a multiplexer module is installed in a slot not previously occupied with a

multiplexer module. A factory default configuration can be loaded at any time using the **CDF** command:

```
CDF slot
slot = 1,...,7
```

Note: Any previously established module connections will be cleared with this command.

Factory defaults for the T1 multiplexer are shown here:

PARAMETER	RANGE	DEFAULT	COMMAND
Network Module	1-4	1	NNC
Drop Subchannel ID	0-14	0	—
Lift Subchannel ID	0-14	0	—
Drop/Insert Rx Conn ID	0-8	0	NMD
Drop/Insert Tx Conn ID	0-8	0	NMD
Drop/Insert Channel Group	1-56	1	NMD
Drop/Insert Bit Rate	Nx64, N=1-24	6	NMD
Sync Source	Internal CLK RX Timing I/F RX Network I/F RX Drop/Ins	RX Network I/F	NSS
CRC6	Off, On	On	NCR
AIS Alarm	Off, On	Off	NAS

Table 6-5 – T1 Multiplexer Factory Defaults

6.7 Status Monitoring

There are five status LEDs on the T1 module:

- The **Master** LED illuminates when the T1 module is used for system timing
- The **T1 Clk** and **T1** LEDs:
 - Illuminate GREEN when there is a signal at the interface AND the module can synchronize to that signal AND the interface is selected as the sync source AND the module is selected as clock master for the system

- Illuminates RED when there is NO signal at the interface (Loss Of Signal) OR (the interface is selected as the sync source AND the board cannot synchronize to the signal)
- OFF if there is no signal at the interface (LOS) AND (the interface is not selected as the sync source OR the board is not selected as clock master for the system)
- The AIS LED illuminates when an all 'ones' signal is received from the T1 network
- The SYNC LED illuminates when the T1 module is unable to achieve synchronization from the selected source

The status of all other module functions, including used and free time slots, add/drop, multiplex and alarm functions is obtained through the Control Processor module.

6.8 T1 Interface and CSU Commands

Although integrated into the T1 module, the CSU functions are separate from the multiplex functions. In addition, *some* T1 multiplex configurations commands are local to this module.

6.8.1 Current Settings And Factory Defaults

To view the current settings of the T1 interface card (including the CSU), use the CST command, specifying the slot of the T1 interface.

```
CST slot report detailed information for module in
      slot slot
      slot = 1,...,7
```

6.8.2 Timing/Synchronization Source Select

There are four possible timing sources that can be used as a master clock for the SuperLink system. Internal timing uses an internal crystal for synchronization. Timing can also be derived from the Main T1 port, the Drop/Insert T1 port or the Timing T1 port. The NSS command is used to select the active timing (sync) source:

```
NSS slot sync
      slot = 1,...,7
      sync = ?, INT, RXTIMING,
            RXNETWORK or RXDROPINSERT
```

You can also use this command to display the current setting.

If several SuperLink units are working in a daisy-chain configuration, it is important that every unit is synchronized to a single master clock. This can be the internal, T1, Drop/Insert or an external clock. If daisy-chaining the clock, be sure not to make a ring, or circle, configuration. One SuperLink cannot receive the timing from two T1 sources; e.g., you cannot output audio coming in through T1 and Drop/Insert ports simultaneously unless the unit feeding the Drop/Insert port has the exact same timing as the receiving unit.

Default: Receive signal Network interface

6.8.3 CRC Error Checking

CRC6 error protection, optionally selectable, uses a single bit in alternate frames of the E1 bit stream to form a CRC calculation of a multiframe structure. This yields additional protection against errors in the frame alignment signal.

```
NCR slot CRC
    slot = 1,...,7
    sync = ON or OFF
```

Default: ON

6.8.4 AIS Alarm Generation

If activated, an AIS alarm will be generated when certain standard 'keep-alive' signals are received.

```
NAS slot ?          print current value for slot
NAS slot ais
    slot = 1,...,7
    ais = ON or OFF
```

Default: On

6.8.5 Set Line Coding

In North America, two 'standards' for T1 are used: B8ZS (Bipolar 8-Zero's Substitution) and AMI (Alternate Mark Inverse). This command is used to match the interface to your T1 circuit.

```
NLC slot ?          print current value for slot
NLC slot int code
    slot = 1,...,7
    int = N or D
    code = AMI or B8ZS
```

6.8.6 Set Framing

In addition to the two 'standard' line codings mentioned above, there are several 'standard' T1 framing formats used as well: 'Super-Frame' and two versions of 'Extended Super-Frame'. This command is used to match the interface to the appropriate framing structure of your T1 circuit.

```
NFR slot ?          print current value for slot
NFR slot int frame
```

```

slot      = 1,...,7
int       = N or D
frame     = ANSI, ATT or D4

```

Factory default: ANSI ESF

Default: ANSI ESF

6.8.7 T1 Loopback

Loopback testing is useful for system troubleshooting. Three loopback states are possible for the entire T1 module: OFF, Line and Payload. Use the **NLB command** to put the T1 module into loopback mode.

```

Syntax:  NLB slot ?           print current value for slot
         NLB slot lb ts
         slot      = 1..7
         lb        = OFF, LINE or PAYLOAD
         ts        = 1..24

```

Default: Off

6.8.8 T1 Time Slot Loopback

Sometimes it may be useful to put only individual time slots of the T1 into a loopback state for testing. Use the **NTL command** to put individual time slots of the T1 into loopback mode.

```

Syntax:  NTL slot ?           print current value for slot
         NTL slot lb
         slot      = 1..7
         lb        = OFF, LINE or PAYLOAD

```

Default: Off

6.8.9 Line Build-out Options

As with any high-speed data circuit, wire length must be compensated for in order to insure proper operation. For T1, wire length is considered to be 'Short Haul' or 'Long Haul'. Since the wire from the telephone central office is compensated only to the POP, the T1 interface must compensate for the wire between the SuperLink and the POP.

```

NLO slot ?           print current value for slot
NLO slot int build

```

```

slot      = 1..7
int       = N or D
build     = 1..8 (as above)

```

6.8.10 Display Local Network Port Statistics

The *SuperLink* displays the statistics for the local network port in an understandable and meaningful format. Error counters are cleared every second, therefore, the data shown represents only errors that occurred during the previous second. An ASSI T1.403-formatted performance report is sent to the far-end chassis once per second with statistics information from the previous four seconds. Refer to Table 6-5 for an explanation of the output.

NLS *slot state* Display ANSI stats from local network port

```

slot      = 1,...,7
int       = ON or OFF

```

This command updates the display every 5 seconds until turned off

6.8.11 Display Remote Network Port Statistics

Use this command to display the statistics from the remote network port. The **NRS** (Remote Statistics) command displays performance statistics accumulated at the local chassis based on PRMs received from the chassis at the far end via the Facility Data Link (FDL). If an error counter's maximum value is reached, the value is frozen i.e., the counter does not roll over.

NRS *slot state* Display ANSI stats from local network port

```

slot      = 1,...,7
int       = ON or OFF

```

This command updates the display every 5 seconds until turned off

Error counters for both the **NLS** and **NRS** commands are 8-bits, allowing a maximum value of 255.

Following is a description of each of the error counters.

CRC

Shows range of CRC errors.

Severely Errored Frame Seconds (Sev Erd Frm Sec)

Incremented every second in which one or more framing errors or more than 319 CRC errors occurred.

Unavailable Seconds (Unav Sec)

Not updated.

Controlled Slip Seconds (Slip Sec)

Incremented every second in which one or more controlled slips occurred.

Pulse Code Violation Seconds (PCV Sec)

Accumulates number of CRC errors that occurred each second.

Line Errored Seconds (Lin Erd Sec)

Incremented every second in which one or more line code violations occurred. Same as Line Code Violation Seconds.

Bursty Errored Seconds (Burst Erd Sec)

Incremented every second in which a framing error did not occur, but between 1 and 319 (inclusive) CRC errors occurred.

Degraded Minutes (Degd Min)

Not updated.

Line Code Violation Seconds (LCV Sec)

Incremented every second one or more line code violations occurred. Same as Line Errored Seconds.

The output is shown here:

Octet Structure Bit Number								
Octet Number	8	7	6	5	4	3	2	1
5	G3	LV	G4	U1	U2	G5	SL	G6
6	FE	SE	LB	G1	R	G2	Nm	NI
7	G3	LV	G4	U1	U2	G5	SL	G6
8	FE	SE	LB	G1	R	G2	Nm	NI
9	G3	LV	G4	U1	U2	G5	SL	G6
10	FE	SE	LB	G1	R	G2	Nm	NI
11	G3	LV	G4	U1	U2	G5	SL	G6
12	FE	SE	LB	G1	R	G2	Nm	NI

Octet no.	Octet contents	Interpretation
5, 6	Variable	Data for latest second (T_0)
7, 8	Variable	Data for previous second (T_{0-1})
9, 10	Variable	Data for earlier second (T_{0-2})
11, 12	Variable	Data for earlier second (T_{0-3})

Bit Value	Interpretation
G1 = 1	CRC error event = 1
G2 = 1	1 < CRC error event = 5
G3 = 1	5 < CRC error event = 10
G4 = 1	10 < CRC error event = 100
G5 = 1	100 < CRC error event = 319
G6 = 1	CRC error event = 320
SE = 1	Severely errored frame event = 1 (FE shall = 0)
FE = 1	Frame sync bit error event = 1 (SE shall = 0)
LV = 1	Line code violation event = 1
SL = 1	Slip event = 1
LB = 1	Payload loopback activated
U1, U2	0, 0 — May be modified by SPRM
R	0 — May be modified by SPRM
NmNI	00, 01, 10, 11 — one second report modulo 4 counter

NOTE – The rightmost bit (bit 1, lsb) is transmitted first for all fields except for the two bytes of the FCS that are transmitted leftmost bit (bit 8, msb) first. **CAUTION:** for the FCS bytes only, the bit numbering is different from that of Q.921 standards.

Table 6-6 Network Port Statistics

6.8.12 Display Local Performance Report

Use this command to display the raw, local ANSI performance report.

NLP Display raw local ANSI performance report message

6.8.13 Display Remote Performance Report

Use this command to display the raw, remote ANSI performance report.

NRP Display raw local ANSI performance report message

ISDN Terminal Adapter

TM - 3BRI - x

Connect your SuperLink system to external codecs and other devices through ISDN U or S/T interface ports.

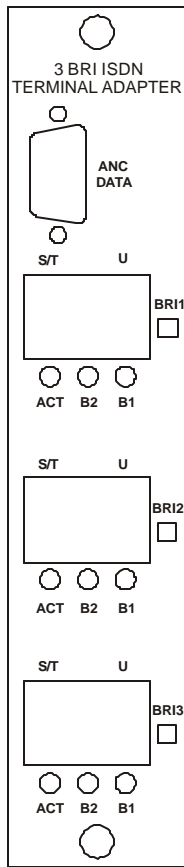


Figure 7-1 TM-3BRI ISDN Terminal Adapter

7. Overview

The TM-3BRIx ISDN Terminal Adapter supports up to 3 ISDN BRIs for multiple audio connections. Supporting both S/T and U interfaces, the TM-3BRIx can be used anywhere in the world that ISDN is available.

7.1 Installation

The TM-3BRIx module can be installed in any available slot, and is automatically recognized by SuperLink. There are no user settable jumpers. The TM-3BRIx can be purchased with one (TM-3BRI-1), two (TM-3BRI-2) or three (TM-3BRI-3) BRI connections installed. At least one BRI must be initially installed, and additional BRIs can be installed in the field, with the addition of daughter boards.

7.1.1 ISDN Cable Requirements

Both the S/T and U interfaces have RJ-45 connectors. Standard ISDN wiring practices should be observed, bearing in mind that multi-conductor phone wire is required for connections to the S/T interface. The U interface requires only two-conductor cable as only the center conductors of the RJ-45 connector are used.

Sometimes, the telephone company may provide only a four-wire RJ-11 connector for the U interface. If you don't have an RJ-11 to RJ-45 adapter cord, a standard RJ-11 plug will fit into the RJ-45 jack on the TM-3BRI.

Note!

Proper ISDN Circuit wiring is critical for dependable operation

Although, depending on wire quality, your SuperLink can be located thousands of feet from the Telco termination; you should attempt to keep line lengths as short as possible.

Unlike standard phone circuits, extension lines are not permitted with ISDN. You cannot have an ISDN line service to two rooms. Splices should be avoided as well. MUSICAM USA strongly recommends that existing building phone wiring not be used for ISDN since in most cases you cannot tell if there are splices or extensions, especially in older buildings.

The **TM-3BRI** must be configured before it can be used. Since each BRI is configured independently, they can each be configured for different locations or different countries, using the appropriate BRI for the current location.

7.2 Configuration for use in North America

Each BRI within the TM-3BRI-x ISDN interface module must be configured for use in a particular country and identified (to the telephone Central Office) before it can be used. If the TM-3BRI interface module is equipped with more than one BRI, each BRI can be configured for a different country, making the SuperLink true 'plug-and-play'.

Each BRI provides both S/T and U interfaces. For North America, the 'U' interface is used, with a built-in NT-1 (required for North American operation).

Probably the most confusing aspect of ISDN codecs is configuring the Terminal Adapter for the ISDN in your area. This is especially true in North America, where there are several local 'flavors' of ISDN that are all provisioned differently. Elsewhere, configuration of the terminal adapter may be as simple as insuring the proper country is selected.

In North America, the ISDN service provider must supply the following information to allow you to correctly configure the Terminal Adapter:

ISDN 'Flavor', e.g., National ISDN or Custom.

Service Provider Identification Numbers (SPID numbers). National ISDN (NI1) always requires SPID numbers; some locations using Custom ISDN may not require SPID numbers. If SPID numbers are required, most areas use two, but some implementations require only one.

7.2.1 Switch Type:

It is necessary to tell the TA what type of switch protocol is being used at the Telco central office. The ISDN service provider will give this information to you. You need to set the switch type only once for each BRI, a maximum of three, since it is impossible to have different switch types for the individual "B" channels in an ISDN line. Set the appropriate switch type, either National or AT&T Custom using the CSW Command from a terminal.

Set '5ESS CUST' only for AT&T custom point-to-point or point-to-multipoint ISDN service available in a limited number of areas in the United States. For all other ISDN service, including AT&T National ISDN, select 'NI1'.

Use the **CSW command** to set the Switch Type for any or all of the BRIs.

CSW *slot BRI Type*

slot = 1...7

BRI = BRI1, BRI2, BRI3, ALL

Switch Type = NI12, AT&T

7.2.2 Service Provider ID (SPID) Number:

After the switch type is entered, you will then be prompted to enter two SPID numbers for each BRI installed, up to a maximum of six.

For most areas in North American, the TA must be told the SPID number of the calling ISDN line, that is, the line to which the SuperLink is connected; i.e., your ISDN line. The ISDN service provider in your area provides this number to you. **It is important to remember that every time the SuperLink is moved, or whenever there is a change in the ISDN**

line, or even Area Code changes, the SPID and ID number, switch type and possibly other parameters for the TA setup must be updated.

Use the **CSI command** to set the SPID numbers for both 'B' channels.

CSI slot Dig.Interface SPID

Note: Dig. Interface refers to successive ISDN "B" channels

Slot = 1...7

Digital Interface = 1...6

SPID Number = SPID Number(Max. 20 digits) or *(no SPID)

Please note that some implementations of AT&T Custom ISDN may require only one SPID number or may not use SPID numbers at all.

If SPIDs are not used in your area, line 2 may answer the first incoming call and line 1 will answer the second.

Once both SPID numbers are entered you will be prompted to enter Identification (ID) numbers.

7.2.3 Identification (ID) Number:

If you are required to use two SPID numbers per BRI, then you must use ID numbers as well. For North American operation, the ID number is just the seven-digit ISDN line number connected to the TM-3BRI. Use the **CLD command** to set the SPID numbers for both 'B' channels.

CLD slot Dig. Interface ID

Note: Dig. Interface refers to successive ISDN "B" channels

Slot = 1...7

Digital Interface = 1...6

ID Number = ID Number(Max. 20 digits) or *(no ID)

7.2.4 Low-Layer Control (LLC):

The **CLL Command** is used to set the Low Layer Control protocol used by ISDN. This may be a trial-and-error setting in your area. Usually, LLC should be set to ON, but if you have trouble making or receiving some calls, try setting LLC to OFF.

CLL slot Dig. Interface State

Note: Dig. Interface refers to successive ISDN "B" channels

Slot	=	1...7
Digital Interface	=	1...6 or ALL
State	=	ON or OFF

7.2.5 Reset:

After the above parameters have been set, it is necessary to reset the terminal adapter. The **CTR Command** is used to reset the internal terminal adapter. The Terminal Adapter currently returns no information after a reset. Please note that a complete reset takes about 25 seconds, and you should not attempt to dial before the reset is complete.

CTR slot

Slot	=	1...7
------	---	-------

7.3 Configuration for International Operation

Each BRI within the TM-3BRI ISDN interface module must be configured for use in a particular country and identified (to the telephone Central Office) before it can be used. If the TM-3BRI interface module is equipped with more than one BRI, each BRI can be configured for a different country, making the SuperLink true 'plug-and-play'.

Each BRI provides both S/T and U interfaces. For North America, the 'U' interface is used; however, everywhere else, the 'S/T' interface is used.

Probably the most confusing aspect of ISDN codecs is configuring the Terminal Adapter for the ISDN in your area. Even in the same country or region, there may be several local 'flavors' of ISDN that are all provisioned differently. Elsewhere, configuration of the terminal adapter may be as simple as insuring the proper country is selected.

7.3.1 Switch Type:

It is necessary to tell the TA what type of switch protocol is being used at the Telco central office. DSS1 is most commonly used in European countries, and JATE is used in Japan and other Pacific-Rim countries. You need to set the switch type only once for each BRI, a maximum of three, since it is impossible to have different switch types for the individual "B" channels in an ISDN line.

Use the **CSW command** to set the Switch Type for any or all of the BRI's.

CSW *slot BRI Type*

slot = 1...7

BRI = BRI1, BRI2, BRI3, ALL

Type = DSS1, 1TR6, or JATE

If using the TM-3BRI in Germany, it may be necessary to select 1TR6 as the switch protocol. The ISDN service provider will give this information to you.

7.3.2 LDN / MSN Number:

The MSN (Multiple Subscriber Number) allows you to connect several codecs (terminal adapters) to one ISDN bus, if the DSS1 Euro-ISDN protocol is used. Each BRI requires two MSN numbers, one for each 64 kb/s channel. You do not need to enter the whole MSN, you just have to enter the last different digits. For example, if your MSN for line 1 is 8115517571 and for line 2 is 8115517581, then you need to enter only '71' and '81' for the MSNs. Use the **CLD Command** to set the LDN/MSN number from a terminal.

CLD *slot Dig.Interface LDN*

Slot	=	1...7
Digital Interface	=	1...6
LDN/MSN	=	LDN/MSN or *(no LDN/MSN)

7.3.3 Sub-Address:

Sub-addresses are required when using the German 1TR6 switch protocol. Like the MSN used with DSS1, the sub-address enables you to connect several codecs (terminal adapters) to the same ISDN bus. For every terminal adapter, you need two sub-addresses (EAZ numbers), one for each 64 kb/s channel, numbers between 1 and 8. Use the **CSA command** set the sub address from a terminal.

CSA *slot Dig.Interface Sub-address*

Slot	=	1...7
Digital Interface	=	1...6 or ALL
Sub-address	=	1...8 or *(no Sub-Address)

7.3.4 LLC (Low Level Command) State:

(UK Only) It is only necessary to set the LLC state in the United Kingdom. Different areas in the UK require different settings. If you cannot dial properly with the default setting, toggle the setting. Remember that you must set each B channel individually to the proper state. The **CLL Command** is used to set the LLC protocol.

CLL slot Dig.Interface State

Slot	=	1...7
Digital Interface	=	1...6 or ALL
State	=	ON or OFF

7.3.5 Reset:

After the above parameters have been set, it is necessary to reset the terminal adapter. The **CTR Command** is used to reset the internal terminal adapter. The Terminal Adapter currently returns no information after a reset.

CTR slot

Slot	=	1...7
------	---	-------

Please note that a complete reset takes about 25 seconds, and you should not attempt to dial before the reset is complete.

7.4 Making internal connections to and from TM-3BRI

Connections between the TM-3BRI and the *SuperLink* Encoder, Decoder, or Control Processor modules are also possible, and are controlled using the **NMC command** to establish, and the **NRC command** to remove these connections. Selecting the Control Processor port 'A' as a destination enables SuperLinks streaming audio capabilities, discussed in later chapters.

```

NMC srcport destport rate changrp
  Srcport   = source slot/port,
              slot = 1,...,7, port = A,
              B, or N
  Destport  = destination slot/port,
              slot = 0,...,7 (0 = CP)

```

$port = A, B, \text{ or } N$
Rate = bitrate N , ($N \times 64$), $N = 1 \text{ or } 2$
Changgrp = channel group, 1...6

NRC *srcport destport*

Srcport = source slot/port,
 $slot = 1, \dots, 7, port = A, B, \text{ or } N$
destport = Destination slot/port,
 $slot = 0, \dots, 7, (0 = CP)$
 $port = A, B, \text{ or } N$

7.5 ISDN Channel Groups/ B-Channel Assignments

Table 7-4 shows the B-Channel assignments for the 3BRI interface.

Channel Group	ISDN B-Channels	
	64K	128K
1	1	1 & 2
2	2	3 & 4
3	3	5 & 6
4	4	n/a
5	5	n/a
6	6	n/a
13	n/a	1 & 3
14	n/a	2 & 4
15	n/a	3 & 5
16	n/a	4 & 6
37	n/a	2 & 3
38	n/a	4 & 5

Table 7-4 ISDN Channel Groups

Note!

The green ACT LED *MUST* be illuminated for ISDN operation.

7.6 Status Monitoring

Each of the three BRIs has indicator LEDs to signal activity. The 'B1' and 'B2' LEDs are connection indicators for each of the two 'B' channels, and will illuminate steadily when connected. The green 'ACT' (Activated) LED will illuminate if the corresponding BRI is installed.

X.21 and V.35 Interfaces

Connect your SuperLink system to external codecs and other devices through industry standard X.21 or V.35 interface ports.

8. Overview

These plug-in modules provide an industry standard interface to other devices and systems. Providing access to the SuperLink's TDM backplane bus, the X.21 or V.35 Interface allows external devices, such as processing and coding equipment, to be connected to the E1 or T1 interface.

The X.21 or V.35 interface module can be installed in any free slot except the left-most control processor and the two right-most power supply slots. Multiple X.21 and/or V.35 modules may be installed, and it is not necessary to turn the SuperLink system off to remove or install an X.21 or V.35 module.

8.1 Front Panel Connectors

The module has two ports, with each a DB-15 connector. The X.21 module is wired as shown:

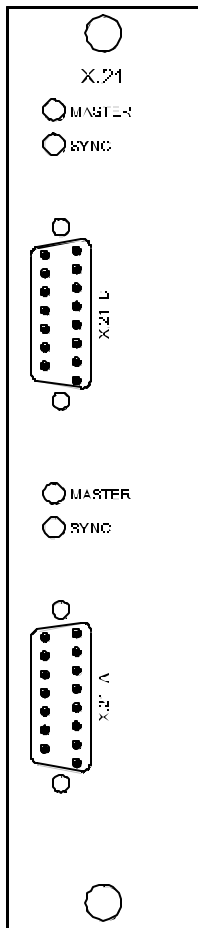


Figure 8-1 – X.21 Module

X.21 Port		
Pin Number	Name	Description
1	FGND	Frame ground A
2	TDA (O)	Transmit data A
3	CA (O)	Control element A
4	RDA (I)	Receive data A
5	IA (I)	Indicator element A
6	SA (I)	Timing element A

X.21 Port		
7	BA (I)	Byte timing A
8	GND	Signal ground
9	TDB (O)	Transmit data B
10	CB (O)	Control element B
11	RDB (I)	Receive data B
12	IB (I)	Indicator element A
13	SB (I)	Timing element B
14	BB (I)	Byte timing B
15	—	Not used

Table 8-1 X.21 Port Pin Connections

The V.35 module is wired as shown:

V.35 Port		
Pin Number	Name	Description
1	FGND	Frame ground A
2	TDA (O)	Transmit data A
3	RTS (O)	Request to send
4	RDA (I)	Receive data A
5	N/C	Not used
6	RETA	Receive timing A
7	TETA	Transmit timing A
8	GND	Signal ground
9	TDB (O)	Transmit data B
10	DTR	Data terminal ready
11	RDB (I)	Receive data B
12	RLSD	Receive line signal detect
13	RETB	Receive timing B
14	TETB	Transmit timing B
15	CTS	Clear to send

Table 8-2 V.35 Port Pin Connections

The SuperLink may be equipped with X.21 and/or V.35 interface modules for ISDN, leased circuits, and other transmission media. In addition, since the RS422 interface is electrically compatible with industry standard RS449 equipment, the SuperLink's X.21/RS422 adapter

can be used with RS449 equipment with the addition of an adapter cable. Each of these digital interfaces requires clock and data to be exchanged between the SuperLink and the terminal equipment. **The SuperLink always expects the clock to be provided by the terminal equipment; therefore, only terminal equipment that provides clock data can be used.** The encoder section outputs data synchronized with the clock and the decoder expects the data to be synchronized with the clock.

The data and clock lines are differential, and require a pair of wires for each signal. The control lines in the V.35 interface are single-ended and require only one wire for each signal. The X.21 control lines are differential. The RS422 interface does not support any control lines. Any RS422 input control lines defined are ignored by the SuperLink and any output control lines defined are held at constant values.

When using X.21, RS422 or V.35 interfaces, the **TEAM** is configured as a DTE device

8.2 X.21 and V.35 Configuration

Since an X.21 or V.35 module can be configured as a Local module, the **NMC/NRC** command(s) must be used to assign a type and address to the module. These same commands also define the X.21 or V.35 module's Channel Group, bit rate, Lift and Drop Subchannel ID. Each X.21 or V.35 module has two ports, which are individually configurable.

8.2.1 X.21 and V.35 Default Configuration

A factory default configuration is loaded whenever an X.21 or V.35 module is installed in a slot not previously occupied by an X.21 or V.35 module. The factory default configuration can also be loaded at any time using the **CDF** command:

```
CDF slot
      where slot = 1...7      or ALL
```

Factory defaults for the X.21 and V.35 modules are shown here:

PARAMETER	RANGE	DEFAULT	COMMAND
Network Card (per port)	1-4	1	NMC / NRC
Channel Group (per port)	1-74	1	NMC / NRC
Bit Rate (per port)	Nx64, N = 1-32	6	NMC
Drop Subchannel ID (per port)	0-14	0	NMC / NRC
Lift Subchannel ID (per port)	0-14	0	NMC / NRC

Table 8-3 X.21 and V.35 Factory Defaults

Remote Control Commands

Simple three-letter commands are used for all functions and settings.

9. Overview

You can perform all functions, including configuration, monitoring, and maintenance using a computer or terminal connected to the SuperLink system M&C ports.

In addition, the Telnet server is now enabled in the CP code, allowing Ethernet control of the CP as well as high-speed downloads of the software. Any Telnet client can be used to communicate with the CP through the Ethernet port, but note that not all Telnet clients support file transfer. The address for Telnet communications is the CP's IP address with a port number of 2000. A tested Telnet application for the CP control and software download is HyperTerminal.

This feature can also enable multiple SuperLink units to be controlled by a single PC terminal using multiple instances of HyperTerminal. Alternately, a single *SuperLink* unit can be controlled from multiple sites via the Ethernet.

The following commands are valid for software revision 2.0.7 and later, unless otherwise noted. Some commands are not applicable when using the T1 multiplexer module and these are noted. On-line help is available for all commands by simply typing:

HELP *cmd*

cmd = command name

9.1 Common Commands

9.1.1 CAN Set Ancillary Data Mode

Definition: This command is used to control the transfer mode for the two ancillary data ports on the Control Processor module. There are two ports on the module and each port supports three (port 0) or four (port 1) modes. A full description of the available modes can be found in Section 2.2.4.

Syntax: **CAN ?** display current setting
 CAN *port mode*
 port = A or B
 mode = OFF, BYPASS or NOMUX

Factory default: OFF

9.1.2 CAP Set Ancillary Port Connection

Definition: This command is used to set up a uni-directional connection between a CP ancillary data port and another slot/port, such as those on an encoder or decoder module.

Syntax: **CAP ?** display current setting
 CAP *sslprt dslprt*
 sslprt = source data slot/port
 dslprt = destination data slot/port
 slot = 0, ..., 7, 0 = CP
 port = A or B

Factory default: none (0)

9.1.3 CCE Clear Event Action

Definition: This command is used to clear all currently activated (+) events.

Syntax: **CCE ?** display all currently
 activated events
 CCE *EcEn*
 event = event class/number or ALL

Where: $E_c = C$ (Common events), D (Decoder events), E (Encoder events), or N (Network events)
 $E_n = 1 \dots 64$

Example: **CCE C01** clears power supply failure event

9.1.4 CDF Set Default Parameters

Definition: This command is used to set the module in a specific slot, or all installed modules, to the factory default values.

Note: Factory default configurations for the different module types can be found in the chapters discussing those modules.

Syntax: **CDF** *slot*
slot = 0, ..., 7 or ALL, 0 = CP

9.1.5 CDR Set Ancillary Data Port Data Rate

Definition: This command is used to set baud rate for the two ancillary data ports located on the Control Processor Module.

Syntax: **CDR ?** display current settings
CDR *port rate*
port = A or B
rate = 1200, 2400, 4800, 9600, 19200, 38400

Factory default: 9600

9.1.6 CEA Set Event-To-Action Logic

Definition: This command assigns an action to a specified event. The actions taken are “edge triggered” when a particular event occurs, and can be latched if preceded with a ‘+’ modifier.

There are four classes of events: Common, Encoder, Decoder and Network. Common events include power supply failure and opto-input activation. Network events include loss of signal and loss of sync.

The **T1 multiplexer** does not support the **CDR** command.

The factory default event-to-action mapping is shown here:

<i>EVENT</i>	<i>EVENT #</i>	<i>DESCRIPTION</i>	<i>DEFAULT ACTION</i>	<i>DEFAULT SLOT ALARM</i>
Common System Events:				
Power Supply Failure	C01	Power supply A or B failure	None	
Opto-Input 0 HIGH	C02	Opto-Input 0 transition low to high	None	
Opto-Input 1 HIGH	C03	Opto-Input 1 transition low to high	None	
Opto-Input 2 HIGH	C04	Opto-Input 2 transition low to high	None	
Opto-Input 3 HIGH	C05	Opto-Input 3 transition low to high	None	
Opto-Input 0 LOW	C06	Opto-Input 0 transition high to low	None	
Opto-Input 1 LOW	C07	Opto-Input 1 transition high to low	None	
Opto-Input 2 LOW	C08	Opto-Input 2 transition high to low	None	
Opto-Input 3 LOW	C09	Opto-Input 3 transition high to low	None	
Slot Alarm 1	C10	Event w/ Slot Alarm, Slot 1	None	
Slot Alarm 2	C11	Event w/ Slot Alarm, Slot 2	None	
Slot Alarm 3	C12	Event w/ Slot Alarm, Slot 3	None	
Slot Alarm 4	C13	Event w/ Slot Alarm, Slot 4	None	
Slot Alarm 5	C14	Event w/ Slot Alarm, Slot 5	None	
Slot Alarm 6	C15	Event w/ Slot Alarm, Slot 6	None	
Slot Alarm 7	C16	Event w/ Slot Alarm, Slot 7	None	
Encoder Events:				
Encoder Card missing	E01	Card ID Register does not indicate Encoder card	None	
Encoder Card Init Failure	E02	Failed card download or config	None	
Encoder Watchdog Failure	E03	DSPA ISR HF3 bit not toggling	None	
Encoder Overload	E04	DSP status: B0 = 1 or b1 = 1	None	
Encoder AES Lock	E05	DSP status b5 = 1	None	
Decoder Events:				
Decoder Card Missing	D01	Card ID Register does not indicate Decoder card	None	
Decoder Card Init Failure	D02	Failed card download or config	None	
Decoder Watchdog Failure	D03	DSPA ISR HF3 bit not toggling	None	
Decoder Overload	D04	DSP status2: B5 = 1 or b6 = 1	None	
Decoder AES Lock	D05	DSP status1 b4 = 1	None	
Decoder loss of frame	D06	DSP status2 b9 = 1	None	
Decoder scale factor error	D07	DSP status2 b8 = 1	None	
Decoder Frame Protect Error	D08	DSP status2 b7 = 1	None	
Decoder line error	D09	DSP status2 b17 = 1	None	
Network Events:				

9.1.7 CES Set Event Slot Alarm Reporting

Definition: This command is used to assign specific Encoder, Decoder or Network events to a slot alarm, thus enabling you to determine which installed encoder, decoder or network card is in failure mode if more than one is installed. There are seven slot alarms.

Syntax: **CES ?** display current settings
CES event report
event = event category and number
category = D, E, or N
number = 1,...,64
action = ON or OFF

Example: **CES D01 ON**

If a Decoder card in slot 3, for example, is missing, the CP will generate a Decoder Event "D01 Decoder Missing" and the Common Event "C12 Slot Alarm 3", thus indicating that the Decoder module in slot 3 has been removed. The CP will execute the actions associated with both events D01 and C12.

9.1.8 CLD Set ISDN ID Number (North America Only)

Definition: This command is used to set or view the ISDN ID Number for a given ISDN B-Channel. The ID number is the 7-digit ISDN telephone number for each B-Channel.

Syntax: **CLD slot Dig.Interface LDN**

Slot = 1...7

Digital Interface = 1...6

LDN/MSN = LDN/MSN or *(no LDN/MSN)

9.1.9 CLL Set ISDN LLC (Low-Level Command) State

Definition: This command is used to set the LLC state for a given B-Channel.

Syntax: **CLL** *slot Dig.Interface State*

Slot = 1...7

Digital Interface = 1...6 or ALL

State = ON or OFF

9.1.10 CMS Set ISDN MSN/LDN Number

Definition: This command is used to set or view the MSN/LDN ID Number for a given ISDN B-Channel. The LDN (Local Directory Number) is the 7-digit ISDN telephone number for each B-Channel.

Syntax: **CLD** *slot Dig.Interface LDN*

Slot = 1...7

Digital Interface = 1...6

LDN/MSN = LDN/MSN or *(no LDN/MSN)

9.1.11 CMT Set Master Fallback Timing Order

Definition: All timing for the SuperLink system is derived from one of four sources. Internal timing is derived from a high precision timing source in the Control Processor. External timing can be from the T1 or E1 Network interface, the T1/E1 Drop/Insert interface or the T1/E1 Sync interface. If any timing source should fail or become unstable, SuperLink will automatically fall back to the next available source.

The factory default sequence is N, D, S I, but this can be changed using the **CMT** command. If the current sync source is lost, the SuperLink system will switch to the next port in the hierarchy. If a higher priority sync source is restored, the SuperLink system will revert back to that source automatically.

Note: The red SYNC LED on the T1 or E1 module will light when a valid sync source is not found or when the internal source is selected.

Syntax: **CMT ?** display current fallback order
CMT slot level port
slot = 1, ..., 7
Level = 1, ..., 4
port = N, D, S or I

9.1.12 CQQ Print Common Command Summaries

Definition: This *help* command prints a summary of all "C" commands.

Syntax: **CQQ** print command summary

9.1.13 CRB Set RS-232 Remote Control Port Baud Rate

Definition: This command is used to set the RS-232 remote control interface baud rate. The baud rate can be 1200, 2400, 4800, 9600 or 38400 baud.

Syntax: **CRB ?** print RS232 port baud rate
CRB rate set remote control baud rate to *rate*
rate = 1200, 2400, 4800,
9600 or 38400

Factory default: 38,400

9.1.14 CRE Set RS-232 Remote Control Port Command Echo

Definition: This command is used to set the RS-232 remote control interface command echo. If using a terminal or emulation package that does not support full duplex, set the echo to 'ON'. When downloading new software in flash, it is advisable to turn off (set to 'OFF') command echo to speed the download process.

Syntax: **CRE** ? print current command echo state
 CRE *echo* set remote control command echo to
 echo = ON or OFF

Factory default: ON

9.1.15 CRP Remove Ancillary Port Connection

Definition: This command is used to remove an ancillary data connection (path) between a specific data port and a specific Encoder or Decoder module.

Syntax: **CRP** *srcport destport*
 srcrport = source slot/port,
 slot = 0,...,7, (0 = CP)
 port = A or B
 Destport = destination slot/port,
 slot = 0,...,7, (0 = CP)
 port = A or B

9.1.16 CSA Set ISDN Sub-Address (International Use Only)

Definition: This command is used to set the ISDN Sub-address for a given B-Channel.

Syntax: **CSA** *slot Dig.Interface Sub-address*
 Slot = 1...7
 Digital = 1...6 or ALL
 Interface
 Sub-address = 1..8 or *(no Sub-Address)

9.1.17 CSI Set ISDN SPID Number (North America Only)

Definition: This command is used to set or view the ISDN SPID Number for a given ISDN B-Channel.

Syntax: **CSI** *slot Dig.Interface SPID*

Slot = 1...7

Digital Interface = 1...6

SPID Number = SPID Number(Max. 20 digits) or *(no SPID)

9.1.18 CSS Report System Connection (Subchannel) Status

Definition: The Subchannel status for all active Subchannel connections is displayed using the **CSS** command. Displayed status includes source, destination, rate, and channel group:

Source Slot (1-7), Port (A/B)
 Destination Slot (1-7), Port (A/B)
 Bit Rate (N x 64), where N = 1 to 30
 Channel group

A sample output is shown here:

```
MC>CSS
                                CONNECTION STATUS [ 2 ]

Source  Slot/Port Destination Slot/Port Rate(Kbs)  Chan
Group
-----
-----
-----
-----
-----
[ENCODER] [3A] -> [E1 MUX ]    [5N]          [384 ]      [5
]
[E1 MUX ] [5N] -> [DECODER]    [7A]          [384 ]      [5
]
-----
```

Syntax: **CSS** Report subchannel status

9.1.19 CST Report Codec Status

Definition: To list the current status of all detected plug-in modules, use the **CST** command, which returns the status and class of all plug-in slots.

A sample output is shown here:

```
MC>CST
SLOT  STATE  REV  CLASS  TYPE
#1    READY   0    0     ENCODER
#2    EMPTY   0    0     NO_CARD
#3    READY   0    0     DECODER
#4    EMPTY   0    0     NO_CARD
#5    EMPTY   0    0     NO_CARD
#6    EMPTY   0    0     NO_CARD
#7    READY   0    0     E1
MC>
```

The same command, with parameters, is used to display detailed information of individual plug-in modules.

```
MC>CST 1

Slot 1:ENCODER
  Algorithm                = J.41          Algorithm Mode      =
MONO
  Audio Input Source       = ANALOG        Input Channel Swap =
NORMAL
  Sample Rate              = 48kHz         Line Format         = SINGLE
LINE
  Mono Mix                 = OFF           Mono Mix Type      =
INVALID
  Scale Factor Protect     = NO           Sine Wave Detector = OFF
  Protection Bit           = NO           Private Bit        = OFF
  Original Home            = NO           Copyright          = NO
  J41 Pre-Emphasis        = OFF           Emphasis          = NO
EMPHASIS
  J42 Application         = OFF           Anc data rate      =
9600
  Anc Data Channel        = RIGHT        Anc Data Format    = CCS
GENERIC

  Network Card            = 1           Channel Group      = 1
  Drop SubChannel ID     = 0           Lift SubChannel ID = 0
  Bit Rate (Kbs)         = 384        Network Line Port  = 0
```

Syntax: **CST** report codec status (general)
CST slot report detailed information for module in slot *slot*
slot = 0, ..., 7

9.1.20 CSW Set ISDN Switch Type

Definition: This command is used to set or view the ISDN Switch Type for a given BRI Interface.

Syntax: **CSW** *sl br si*

sl = Slot = 1...7

br =BRI = BRI1, BRI2, BRI3, ALL

si= = NI12, AT&T, DSS1, 1TR6, & JATE
Switch
Type

9.1.21 CVN Report Software Version Number

Definition: This command is used to print the software version number for a selected software module in FLASH RAM. All modules do not necessarily have the same version number.

Syntax: **CVN** *tx* print version and verify checksum of program *tx*

<u><i>tx</i></u>	=	DSPD	decoder DSP program 1
		DSPDX	decoder DSP program 2
		DSPDXX	decoder DSP program 3
		DSPV	VU meter DSP program
		DSPE	encoder DSP program 1
		DSPEX	encoder DSP program 2
		DSPR	Reed-Solomon DSP program
		G722D	G.722 decoder program
		G722E	G.722 encoder program
		CPSYS	command processor program
		CPBOOT	command processor boot program
		E1_TDM	E1 - backplane

	interface program
DEC_TDM	Decoder / backplane interface program
ENC_TDM	Encoder / backplane interface program
CP_TDM	Control processor / backplane interface program

9.2 Decoder Commands

9.2.1 DAF Set Decoder Layer 2 Ancillary Data Format

Definition: This command is used to set the decoder ancillary data format for ISO/MPEG Layer II. The ancillary data ports on the decoder module can only be made active when using any MPEG algorithm.

MPEG algorithms support several ancillary data formats for compatibility with other codecs and satellite systems. CCS Standard (CSTD) can be used to send or receive ancillary data from any CCS Audio Products or MUSICAM USA codec, CCS Generic (CGEN) can be used only with MUSICAM USA's ***CDQPrima, Prima LT*** or SuperLink codecs. The IRTDAB format supports features used with DAB systems and ADR is a special case of the DAB format.

Syntax:

```

DAF slot ?           print current value for slot
DAF slot format
           slot      = 1,...,7
           format    = CSTD, CGEN, IRTDAB,
                       or ADR

```

Factory default: CGEN

9.2.2 DAL Set Decoder Algorithm

Definition: This command is used to set the decoder algorithm, which must match the algorithm of the connected encoder. For decoding CCSO and CCSN algorithms, select MPEGL2.

Syntax: **DAL** *slot* ? print current value for *slot*

```

DAL slot algo
           slot      = 1,...,7
           algo      = G.722, MPEGL2,
                       MPEGL3, J.41 or J.57

```

Factory default: J.41

9.2.3 DAO Select Decoder Audio Output

Definition: This command is used to select the decoder output format, analog or digital. Simultaneous analog and digital output is not supported and selection is necessary since the connectors are shared.

Note: In addition to selecting the decoder output in software, you must also change jumper settings on the Decoder card.

```

Syntax:  DAO slot ?                print current value for slot
             DAO slot output
                slot      = 1,...,7
                output    = (A)nalog or (D)igital

```

Factory default: Analog

9.2.4 DAS Set Ancillary Data Channel For MPEG Layer 2 Mono

Definition: This command is used to select which channel, left or right, should be used to accept ancillary data when using the independent mono MPEG Layer 2 configuration.

```

Syntax:  DAS slot ?                print current value for slot
             DAS slot chan
                slot      = 1,...,7
                chan      = LEFT or RIGHT

```

Factory default: RIGHT

9.2.5 DCO Set Decoder MPEG Layer 2 Decoding Mode

Definition: This command is used to control decoding of audio bit streams. If ISO is selected, then only ISO layer 2 bit streams are decoded. If ISOCCS is selected, then ISO layer 2 and older CCS bit streams are decoded. This command is for compatibility checking of bit streams. For normal operation, set to ISOCCS (default). Selecting ISO will

make the decoder incompatible with older CCS Audio Products CDQ1000 and CDQ2000 codecs.

Syntax: **DCO** *slot* ? print current value for *slot*
 DCO *slot mode*
 slot = 1, ..., 7
 mode = ISO or ISOCCS

Factory default: ISOCCS

9.2.6 DCS Set Decoder Channel Copy/Swap Mode

Definition: This command is used to control the audio output. It allows the left channel to be copied over the right channel (CLTOR), the right channel to overwrite the left channel (CRTOL) or the left and right channels to be swapped (SWAP). If **cs** is set to NORM, then the output of the decoder is the same as received, i.e. left channel to left channel and right channel to right channel.

Syntax: **DCS** *slot* ? print current value for *slot*
 DCS *slot cs*
 slot = 1, ..., 7
 cs = NORMAL, SWAP, CLTOR
 or CRTOL

Factory default: NORM

9.2.7 DDO Set Digital Audio Output Sampling Rate

Definition: Digital audio is output from the decoder at the sampling rate specified in the header. This digital audio output, sampled at the selected rate, can be used directly, or can then be converted to other rates via an external sample rate converter.

The internal sample rate converter is capable of sampling rate changes between 0.51 and 1.99. For example, if the decoder received a bit stream that indicated that the encoder sampling rate was 24 kHz, then the output sampling rate could be set to 32 or 44.1 kHz but not 48 kHz since 48 kHz would be a sampling rate conversion of 2.0 to 1. This is out of the range of the sampling rate converter.

command can be used to independently set the Decoder audio sampling rate to either 48kHz or 32 kHz. This sampling rate is also stored in NVRAM. During transmission it is overridden by the received sampling rate. The automatic resetting of audio sampling rate does not apply to other compression algorithms (which feature fixed audio sampling rates at 16kHz, 32kHz and 48kHz for G.722, J.41 and J.57 respectively)

9.2.8 DDR Set Decoder Ancillary Data Port Data Rate

Definition: This command is used to set the data rate for the decoder Ancillary data port.

Syntax:

```

DDR slot ?           print current value for slot
DDR slot rate
           slot         = 1, ..., 7
           rate         = 1200, 2400, 4800,
                           9600, 19200 or 38400

```

Factory default: 9600

9.2.9 DEP Set Decoder Emphasis

Definition: Decoder emphasis can be set when using the J.41 algorithm.

Syntax:

```

DEP slot ?           print current value for slot
DEP slot emph
           slot         = 1, ..., 7
           emph         = NO or YES

```

Factory default: NO

9.2.10 DES Enable Decoder AES Sync Timing

Definition: This command is used to enable/disable the use of the decoder AES/EBU sync signal. Normally, the AES/EBU sync signal for the decoder is used to determine the rate of the output of the AES/EBU decoder output. The AES/EBU decoder sync input can be ignored by setting **es** to NOTREQ.

If there is no signal present at the decoder sync input, or **DES** is set to DISABLE, then the D/A converter and the AES/EBU transmitter in the decoder derives its timing

from the network clock. The exact value of the clock is phase locked to the network clock at a rate given by information in the received ISO/MPEG data stream.

If there is a sync signal present at the decoder sync input, then the signal going to the decoder D/A converter and to the AES/EBU transmitter is rate adapted to the frequency of the received sync input. This insures that the AES output is in sync with the external digital audio equipment.

Syntax: **DES** *slot* ? print current value for *slot*
 DES *slot es*
 slot = 1,...,7
 es = REQ or NOTREQ

Factory default: NOTREQ

9.2.11 DLI Set Decoder Line Format

Definition: This command is used to set the line format for those algorithms that support both single line or independent mono operation. Single line format (S) is standard for all algorithms and allows a decoder to receive either stereo or mono frames from a single encoder. Independent mono (I) allows a single decoder to receive two independent monaural programs from two different locations. Currently, only G.722 and J.41 supports independent mono operation.

Syntax: **DLI** *slot* ? print current value for *slot*
 DLI *slot format*
 slot = 1,...,7
 format = S or I

Factory default: Single line

9.2.12 DMU Mute Decoder Output Channels

Definition: This command is used to mute one or both audio output channels.

Syntax: **DMU** *slot* ? print current value for *slot*
 DMU *slot* *mute*
 slot = 1, ..., 7
 mute = NONE, BOTH, LEFT or
 RIGHT

Factory default: NONE

9.2.13 DQQ Print Decoder Command Summaries

Definition: This *help* command prints a summary of all Decoder commands.

Syntax: **DQQ** print command summary.

9.2.14 DSP Decoder Scale Factor Protection

Definition: This command is used to enable or disable the use of scale factor protection. If scale factor protection checking is disabled, a bit error can have a much greater effect on the audio output than if scale factor protection is used. If scale factor protection is used by the decoder, the linked encoder must also have scale factor protection enabled. Scale factor protection may not be compatible with other codecs. See Section 4.4 in the [***CDQPrima** Technical Reference Manual*](#) for details.

When Scale Factor Protection is used, only CCS Standard or CCS Generic Ancillary Data formats should be used.

Syntax: **DSP** *slot* ? print current value for *slot*
 DSP *slot* *prot*
 slot = 1, ..., 7
 prot = YES or NO

Factory default: NO

9.3 Encoder Commands

9.3.1 EAC Set Encoder Custom Ancillary Data Mode For T1

Definition: The **EAC** command is used for a custom mode of ancillary data. This mode, called “McCurdy Mode” is compatible with **Prima** series codecs at the receiving end. This mode

is supported only when using MPEG Layer 2 audio coding.

The McCurdy mode is a custom mode for ancillary data transmission. It enables the transmission of multiplexed relay switch information coded in the special McCurdy protocol and presented as an RS-232 data stream. McCurdy formatted contact closure input data is fed to the ancillary data port of the Encoder module. After processing by the Encoder, the data is transmitted in the embedded ancillary data channel of the encoded audio. At the receiver, a specialized decoder extracts the relay switch data from the ancillary data stream and then drives the output relay switches. The *SuperLink* unit allows each Encoder module to send a separate McCurdy data stream so multiple streams can be carried using a single *SuperLink* unit.

Syntax: **EAC** *slot* ? print current value for *slot*
 EAC *slot state*
 slot = 1, ..., 7
 state = ON or OFF

Factory default: OFF

9.3.2 EAF Set Encoder Layer 2 Ancillary Data Format

Definition: This command is used to set the encoder ancillary data format. The CCS Standard (CSTD) format is compatible with the CDQ codec family including the CDQ2000, 2001 and **Prima** models as well as the SuperLink decoder. The CCS Generic format (CGEN) is incompatible with the older CCS format used in the CDQ2000 and 2001. The DAB and ADR formats include scale factor protection and are the formats specified by the IRT.

Syntax: **EAF** *slot* ? print current value for *slot*
 EAF *slot format*
 slot = 1, ..., 7
 format = CSTD, CGEN, IRTDAB,
 or ADR

Factory default: CGEN

9.3.3 EAI Select Encoder Audio Input Source

Definition: This command is used to toggle between analog and digital audio inputs on those encoder cards that are equipped with both inputs.

Note: In addition to selecting the encoder input in software, you must also change jumper settings on the Encoder card.

Syntax: **EAI** *slot* ? print current value for *slot*
EAI *slot* *source*
 slot = 1,...,7
 source = (A)nalog or (D)igital

Factory default: Analog

9.3.4 EAL Set Encoder Algorithm

Definition: This command is used to select the encoding algorithm. Seven algorithms are available, with a full discussion of each found in Chapter 3.

CCSO, CCSN and MPEGL2 are all MUSICAM USA enhanced MPEG Layer 2 algorithms. MPEGL2 should be used when connecting to all CCS Audio Products except the oldest CDQ1000 and CDQ2000 MPEG Layer 2 decoders.

Syntax: **EAL** *slot* ? print current value for *slot*
EAL *slot* *algo*
 slot = 1,...,7
 algo = MPEGL2, CCSO, CCSN,
 MPEGL3, G.722, J.41,
 or J.57

Factory default: J.41

9.3.5 EAM Set Encoder Algorithm Mode

Definition: This command is used to set the encoding algorithm mode when using any MPEG algorithm. Other algorithms define the algorithm mode, and selection is not necessary. Available modes are monaural (M), Joint Stereo (JS), Full Stereo (FS), and Dual Mono (DM). Refer to Chapter 3 for a description of each mode.

Syntax: **EAM** *slot* ? print current value for *slot*
 EAM *slot mode*
 slot = 1, ..., 7
 mode = M, JS, FS, or DM

Factory default: Mono

9.3.6 EAS Set Encoder Ancillary Data Channel For Mono

Definition: With MPEG Layer 2 Independent Mono operation, it is possible to send ancillary data to one or both connected decoders. This command is used to associate the ancillary data with an audio channel.

Syntax: **EAS** *slot* ? print current value for *slot*
 EAS *slot chan*
 slot = 1, ..., 7
 chan = BOTH, LEFT, or RIGHT

Factory default: BOTH

9.3.7 ECR Set Encoder Copyright Bit In Header

Definition: This command is used to enable or disable the Copyright bit in the ISO MPEG header.

Syntax: **ECR** *slot* ? print current value for *slot*
 ECR *slot copyr*
 slot = 1, ..., 7
 copyr = YES or NO

Factory default: NO

9.3.8 ECS Set Encoder Audio Input Channel Swap Mode

Definition: This command is used to control the encoder audio input. If **swap** is set to SWAP, then the left and right audio channels are swapped before input to the compression algorithm. If **swap** is set to NORM, then the input audio is passed unchanged to the encoder.

This command is useful for controlling the action of the encoder in the presence of mono audio signals as well as correcting input cabling mistakes. When in the mono mode, the SuperLink encoder uses audio only from the left

input. The swap mode will force the SuperLink encoder to encode the audio from the right input. You can also use the channel swap mode to switch between two mono sources.

Syntax: **ECS** *slot* ? print current value for slot
 ECS *slot swap*
 slot = 1, ..., 7
 swap = NORM or SWAP

Factory default: NORM

9.3.9 EDR Set Encoder Ancillary Data Port Rate

Definition: This command is used to set the Encoders ancillary data port baud rate for use with MPEG algorithms.

Syntax: **EDR** *slot* ? print current value for slot
 EDR *slot rate*
 slot = 1, ..., 7
 rate = 1200, 2400, 4800,
 9600, 19200, or 38400

Factory default: 9600

9.3.10 EEP Set Encoder Emphasis Bit in Header

Definition: Encoder emphasis can be set when using the J.41 algorithm. Two different emphasis values are available: J.17 and 50 microseconds.

Syntax: **EEP** *slot* ? print current value for slot
 EEP *slot emph*
 slot = 1, ..., 7
 emph = NO, 50 or J.17

Factory default: NO

9.3.11 ELI Set Encoder Line Format

Definition: This command is used to set the line format for those algorithms that support both single line and independent mono operation. Single line format (S) is standard for all algorithms and allows a decoder to receive either stereo or mono frames from a single encoder. Independent

mono (I) allows a single encoder to send two independent monaural programs to two different locations. Currently, only G.722 and J.41 supports independent mono operation.

Syntax: **ELI** *slot* ? print current value for *slot*
 ELI *slot format*
 slot = 1, ..., 7
 format = S or I

Factory default: Single line

9.3.12 EMM Set Encoder Mono Mix

Definition: This command enables or disables the mono mix feature. If mono mix is enabled, the left and right audio inputs are summed to mono and the result is input to the left and right channel of the encoder. The algorithm mode must be set to mono (**EAM MONO**). Mono mix works only when using MPEG algorithms. Mono mix is used when stereo source material must be mixed to mono for transmission.

The values for the mono mix can be M0, M3, or M6, or OFF, representing the following:

0dB = L + R
 -3dB = (L + R) - 3dB
 -6dB = (L + R) - 6dB
 OFF = stereo

where L and R are the left and right channel signals respectively

Syntax: **EMM** *slot* ? print current value for slot
 EMM *slot mix*
 slot = 1, ..., 7
 mix = OFF, 0dB, -3DB, -6DB

Factory default: OFF

9.3.13 EOR Set Encoder Original Bit In Header

Definition: This command is used to enable or disable the Original Bit in the ISO MPEG header.

Syntax: **EOR** *slot* ? print current value for slot

```

EOR slot orig
           slot      = 1,...,7
           orig      = YES or NO

```

Factory default: NO

9.3.14 EPI Set Private Bit In Header

Definition: This command is used to enable or disable the Private Bit in the ISO MPEG header.

```

Syntax:  EPI slot ?           print current value for slot
            EPI slot priv
              slot      = 1,...,7
              priv      = YES or NO

```

Factory default: NO

9.3.15 EPR Set Protection Bit In Header

Definition: This command is used to enable or disable the Protection Bit in the ISO MPEG header.

```

Syntax:  EPR slot ?           print current value for slot
            EPR slot prot
              slot      = 1,...,7
              prot      = YES or NO

```

Factory default: YES

9.3.16 EQQ Print Encoder Command Summaries

Definition: This *help* command prints a summary of all Encoder commands.

```

Syntax:  EQQ           print command summary.

```

9.3.17 ESD Set Encoder Sine Wave Detector

Definition: This command enables or disables the encoder sine wave detector. If the sine wave detector is enabled, then typical objective measurements such as THD will show the quality of the analog circuitry and not the effects of MPEG compression.

Sometimes the sine wave detector can be activated by rare passages of music, which may result in a slight distortion

of the passage. Turning the sine wave detector off prevents false sine wave detection. However, turning off the sine wave detector may cause poorer objective measurements when using test signals.

Note: Turning the sine wave detector off, in no way, harms the MPEG audio compression algorithm and may improve subjective audio quality. The sine wave detector should be turned OFF for normal operation.

Syntax: **ESD** *slot* ? print current value for slot
 ESD *slot* *sinedet*
 slot = 1,...,7
 sinedet = OFF or ON

Factory default: OFF

9.3.18 **ESP** Set Encoder Scale Factor Protection

Definition: This command is used to enable or disable the use of scale factor protection for error concealment when using MPEG Layer 2 algorithms. If scale factor protection checking is disabled, bit errors can have a much greater effect on the audio output than if scale factor protection is used. If scale factor protection is enabled at the encoder, the decoder must also have scale factor protection enabled. Scale factor protection is not compatible with other manufacturer's codecs, and is backward compatible only with the CDQ2001 codec.

When Scale Factor Protection is used, only CCS Standard or CCS Generic Ancillary Data formats should be used.

Syntax: **ESP** *slot* ? print current value for slot
 ESP *slot* *prot*
 slot = 1,...,7
 prot = YES or NO

Factory default: NO

9.3.19 **ESR** Set Encoder Sampling Rate

Definition: The ESR command is used to select the encoder sampling rate when using any MPEG algorithm. For other non-

MPEG algorithms, the encoder sample rate is fixed and cannot be changed.

Please do not confuse the encoder sample rate with the digital audio sample rate.

Syntax: **ESR** *slot* ? print current value for slot
 ESR *slot rate*
 slot = 1, ..., 7
 rate = 16, 24, 32, or 48

Factory default: 48 kHz

9.4 Maintenance Commands

9.4.1 MCE Download Flash Code

Definition: The **MCE** command is used to download FLASH code to the T1 or E1 MUX processor through the ancillary data port A of the CP module. Note that the Ancillary data format must be set to NOMUX using the **CAN** command and the data rate must be set to 9600 baud using the **CDR** command. MUSICAM USA strongly suggests that this command be used only with factory guidance.

9.4.2 MCP Set Connect Port

Definition: This command is used to connect the current remote port to a backplane A-Bus. This allows a direct RS-232 connection from the remote port to the A-Bus and all devices attached to that bus. This allows manual control of the connected bus.

Syntax: **MCP** *abus* connect to A-Bus Control port *abus*
 abus = NONE, 0...7

9.4.3 MQQ Print Command Summary For All Maintenance Commands

Definition: This *help* command prints a summary of all Maintenance commands.

Syntax: **MQQ** print command summary.

9.4.4 MSY Synchronize Ram and BBM

Definition: This command is used to write any unwritten bytes to nonvolatile memory. Many of the variables that are kept

ENC_TDM	Encoder / backplane interface program
CP_TDM	Control processor / backplane interface program

9.5 Network Commands

9.5.1 NAS Set T1/E1 AIS Alarm Support

Description: This command is used to turn on the T1 or E1 modules reporting of AIS alarms (all 'ones' alarm) to the command processor. The function must be ON to write the alarm incident to the status log supported by the command processor.

Syntax: **NAS** *slot* ? print current value for slot
 NAS *slot* *ais*
 slot = 1, ..., 7
 ais = ON or OFF

9.5.2 NCR Set E1 CRC4 or T1 CRC6 Support

Description: This command is used to turn on the E1/T1 modules reporting of CRC4/CRC6 alarms to the command processor. The function must be ON to write the alarm incident to the status log supported by the command processor.

Syntax: **NCR** *slot* ? print current value for slot
 NCR *slot* *CRC*
 slot = 1, ..., 7
 CRC = ON or OFF

9.5.3 NFR Set T1 Framing Format

Description: In addition to the two standard T1 line coding formats, there are multiple framing formats supported by T1 as well: 'Super-Frame', known as 'D4 Superframe', and two versions of 'Extended Super-Frame', ANSI and AT&T. This command is used to match the interface to the appropriate framing structure of your T1 circuit.

The E1 multiplexer does not support the **NFR** command.

Syntax: **NFR** *slot* ? print current value for slot
 NFR *slot int frame*
 slot = 1,...,7
 int = N or D
 frame = ANSI, ATT or D4

Factory default: ANSI ESF

9.5.4 NLB Set T1 Loopback State

Definition: Loopback testing is useful for system troubleshooting. Three loopback states are possible: OFF, Line and Payload.

Syntax: **NLB** *slot* ? print current value for slot
 NLB *slot int lb*
 slot = 1,...,7
 int = N or D
 frame = OFF, LINE or PAYLOAD

Factory default: OFF

9.5.5 NLC Set T1 Line Coding

Definition: In North America, two line code 'standards' for T1 are used: B8ZS (Bipolar 8-Zero's Substitution) and AMI (Alternate Mark Inverse). This command is used to match the interface to your T1 circuit.

Syntax: **NLC** *slot* ? print current value for slot
 NLC *slot int code*
 slot = 1,...,7
 int = N or D
 code = AMI or B8ZS

Factory default: ANSI B8ZS

9.5.6 NLO T1 Line Build-out Options

Definition: As with any high-speed data circuit, wire length must be compensated for in order to insure proper operation. For T1, wire length is considered to be 'Short Haul' or 'Long Haul'. Since the wire from the telephone central office is compensated only to the POP, the T1 interface must compensate for the wire between the SuperLink and the POP.

The E1 multiplexer does not support the **NLB** command.

The E1 multiplexer does not support the **NLC** command.

The E1 multiplexer does not support the **NLO** command.

Syntax: **NLO** *slot* ? print current value for slot

NLO *slot int build*

slot = 1, ..., 7

int = N or D

build = 0, ..., 8

0: Short haul, 0 – 133 ft.

1: Short haul, 133 – 266 ft.

2: Short haul, 266 – 399 ft.

3: Short haul, 399 – 533 ft.

4: Short haul, 533 – 655 ft.

5: Long haul, 0dB

6: Long haul, -7.5dB

7: Long haul, -15dB

8: Long haul, -22.5dB

Factory default: 0

9.5.7 NLP Display Local Performance Report

Definition: This command is used to display a summary of collected T1 performance data from the local CSU in ANSI format. A full description of the output screen begins on page 5B-13

Syntax: **NLP** *slot* print accumulated statistics for T1 MUX in slot

slot = 1, ..., 7

The E1 multiplexer does not support the **NLP** command.

9.5.8 NLS Display Local Network Port Statistics

Definition: This command is very similar to the **NLP** command except that the output is refreshed every five seconds, resulting in a continuous error report.

Syntax: **NLS** *slot state* Toggle statistics printing for T1 card in slot

slot = 1, ..., 7

state = ON or OFF

The E1 multiplexer does not support the **NLS** command.

9.5.9 NMC Setup Backplane Subchannel Connection

Description: The **NMC** command controls the setup of connections (Subchannels) between a Network module and a Local module. The CP supports up to 14 simultaneous Subchannel connections.

A module Port can support a single Subchannel connection in each direction (Drop/Lift). Once a Subchannel is assigned to a Port for a given direction, that connection must be removed before setting up a different connection.

Syntax: **NMC** *srcport destport rate changrp*
srcport = source slot/port,
 slot = 1,...,7, *port* = A,
 B, N or D
destport = destination slot/port,
 slot = 1,...,7, *port* = A,
 B, N or D
rate = bitrate *N*, (*N* X 64), *N* = 1,...,30
changrp = channel group, 1,...,56

9.5.10 NMD Setup Drop/Insert Connection

Definition: This command is used to set up drop and/or insert connections between T1 or E1 ports.

Syntax: **NMD** *srcport destport rate changrp*
srcport = source slot/port,
 slot = 1,...,7, *port* = N
 or D
destport = destination slot/port,
 slot = 1,...,7, *port* = N
 or D
rate = bitrate *N*, (*N* X 64), *N* = 1,...,30
changrp = channel group, 1,...,56

9.5.11 NNC Set Network Card Number

Description: Up to four Network type modules are allowed in each SuperLink system. The **NNC** command is used to assign each Network module a unique number, or 'address'.

Syntax: **NNC** *slot ?* print current value for slot
NNC *slot cardnum*
 slot = 1,...,7
 cardnum = 1,...,4

9.5.12 NQQ Print Network Command Summary

Definition: This *help* command prints a summary of all Network commands.

Syntax: **NQQ** print command summary.

9.5.13 NRC Remove Backplane Subchannel Connection

Description: This command is used to remove an established backplane Subchannel connection. Connections must be removed before a new connection can be established.

Syntax: **NRC** *srcport destport*
srcport = source slot/port,
slot = 1,...,7, *port* = A,
 B, N or D
destport = destination slot/port,
slot = 1,...,7, *port* = A,
 B, N or D

9.5.14 NRD Remove Drop/Insert Connection

Description: This command is used to terminate a connection between a T1 or E1 Network port and Drop/Insert port.

Syntax: **NRD** *srcport destport*
srcport = source slot/port,
slot = 1,...,7, *port* = N
 or D
destport = destination slot/port,
slot = 1,...,7, *port* = N
 or D

9.5.15 NSS Set T1/E1 Sync Source

Description: The SuperLink system requires a timing source for operation. Timing can be derived from any of the three T1/E1 ports or internally. This command is used to select not only the timing source but the active T1 or E1 module as well.

Syntax: **NSS** *slot ?* print current value for slot
NSS *slot sync*
slot = 1,...,7
sync = INT, TXTIMING,
 RXNETWORK or
 RXDROPINSERT

9.5.16 NRP Display Remote Performance Report

Definition: This command is used to display a summary of collected T1 performance data from the *far-end* CSU in ANSI format.

The E1 multiplexer does not support the NLP command.

For a full description of the output screen begins on page 5B-13

Syntax: **NRP** *slot* print accumulated statistics for the far-end T1 MUX

The E1 multiplexer does not support the **NLS** command.

9.5.17 NRS Display Remote Network Port Statistics
 Definition: This command is very similar to the **NLP** command except that the output is refreshed every five seconds, resulting in a continuous error report.

Syntax: **NRS** *slot* **ON** or **OFF** print current statistics for the far-end T1 MUX

9.5.18 NTM Set Time Slot 16 Master Timing
 Definition: This command is used to set the E1 card to act as the master timing for establishing TS16 framing.

Syntax: **NTM** *slot* ? print current value for slot
NTM *slot* *timing*
slot = 1,...,7
timing = ON or OFF

9.5.19 NVC Set E1 Card V.24
 Definition: This command is used to connect the V.24 port on the E1 card to the selected E1 port.

The T1 multiplexer does not support the **NVC** command.

Syntax: **NVC** *slot* ? print current value for slot
NVC *slot* *port*
slot = 1,...,7
port = NETWORK or DROPINSERT

9.5.20 NVM Set E1 V.24 Mode
 Definition: This command is used to configure the E1 cards V.24 ports operating mode.

The T1 multiplexer does not support the **NVM** command.

Syntax: **NVM** *slot* *port* ? print current value for slot
NVM *slot* *port*
slot = 1,...,7
port = 0 or 1
mode = INACTIVE, TX, TXRX, TS16RXTX, or TS16TXONES

9.5.21 NVS Set E1 V.24 Signal Handshaking

The T1 multiplexer does not support the NVS command.

Definition: This command is used to configure the handshaking for the V.24 port on the E1 module. The options set the CTS, DCD and DSR to be always ON, always OFF or to follow the DTR or RTS leads.

Syntax:

```

NVC slot port ?      print current value for slot
NVC slot port hndshk
           slot         = 1,...,7
           port          = 0 or 1
           hndshk       = ON, OFF, DTR or RTS

```

Operation Overview

One appropriately equipped SuperLink system can accommodate point-to-point audio transmission or large-scale network systems.

10. Configuration

This chapter will show how to program and use the SuperLink system. Written in a tutorial format, this chapter shows how to program the modules and connections for bi-directional audio and ancillary data over a T1 or E1 network.

All examples in this chapter will be relative to a SuperLink system consisting of two Encoder cards, one Decoder card, an E1 multiplexer with a E1 line and a Drop/Insert line, an X.21 card and a Control Processor.

10.1 Send Audio Configuration

In this example, we will be using the Encoder card in Slot 2 to send MPEG Layer 2 stereo audio at 384 kb/s. We will also be sending independent mono (stereo) G.722 audio to the same location from the Encoder card in slot 3.

First, we need to configure the Encoder in slot 2 for our configuration. We must enter the selected algorithm, mode, sample rate and line format:

EAL 2 MPEGL2	set algorithm
EAM 2 JS	set mode
ELI 2 S	set line format
ESR 2 48	set sample rate

Next, we must map the Encoder through the backplane to the E1 multiplexer. In this example, we will be using a bit rate of 384 kb/s, 6 x 64), Channel Group 5.

NMC 2A 5N 6 5	map encoder (slot 2) to the network port of the E1 module in slot 5 using six 64 kb/s channels, and assign to channel group 5.
----------------------	--

Next, we'll program the Encoder in slot 3 for dual G.722, since G.722 only supports 16 kHz sampling, we do not have to set this parameter:

EAL 3 G.722	set algorithm
EAM 3 M	set mode
ELI 3 I	set line format

Next, we must map the Encoder through the backplane to the E1 multiplexer. In this example, we will be using a bit rate of 128 kb/s, (2 x 64), Channel Group 6.

NMC 3A 5N 2 6	map encoder (slot 3) to the network port of the E1 module in slot 5 using two 64 kb/s channels, and assign to channel group 6.
----------------------	--

10.2 Receive Audio Configuration

Continuing with the above example, we will now configure the Decoder card in slot 7 to receive MPEG Layer 2 at 384 kb/s using channel group 5:

DAL 7 MPEGL2	set algorithm
DLI 7 S	set line format

Note that the Decoder mode and sample rate need not be set since these are slaved to the incoming audio.

Next, we must map the Decoder through the backplane to the E1 multiplexer. In this example, we will be using a bit rate of 384 kb/s, (6 x 64), Channel Group 5.

NMC 5N 7A 6 5

map the Network port of the E1 multiplexer in slot 5 to the Decoder module in slot 7 using six 64 kb/s channels, and assign to channel group 5.

You can now check the configurations using the CSS command:

MC>css

CONNECTION STATUS [3]

Source	Slot/Port	Destination	Slot/Port	Rate (Kbs)	Chan Group
[ENCODER]	[2A]	-> [E1 MUX]	[5N]	[384]	[5]
[ENCODER]	[3A]	-> [E1 MUX]	[5N]	[128]	[6]
[E1 MUX]	[5N]	-> [DECODER]	[7A]	[384]	[5]

MC>

10.3 Ancillary Data Setup

In addition to the bi-directional audio, we also want bi-directional RS232 ancillary data. Since G.722 does not support ancillary data, we will be using the MPEG Layer 2 channels for this.

In this case, we will be sending data at 9600 baud, using the ancillary data connector in the front of the Encoder module in slot 2. For return data, we will be using the first port on the Control processor module.

First, we set the baud rates:

EDR 2 9600

Set the Encoder ancillary data baud rate

CAN A NOMUX

Enable CP port A

CDR A 9600

Set the CP port A baud rate to 9600

Now, map the ancillary data ports:

CAP 7A 0A

Map the decoder ancillary data to the CP ancillary data port A

CAP 0A 2A

Map the Encoder ancillary data to its local port

10.4 E1 Drop/Insert Configuration

In this example, we will set up a bi-directional 768 kb/s channel that passes through the E1 multiplexer Network port to the Drop/Insert port.

NMD 5N 5D 12 7

Set up connection Network port to Drop/Insert port

NMD 5D 5N 12 7

Set up connection Drop/Insert port to Network port

10.5 X.21 Configuration

For our last configuration example, we want to configure an X21 port for 64 kb/s output from Channel Group 1 of the main Network E1. The X.21 card has been installed in slot 6, and we want to configure port 'A' of this card.

NMC 5N 6A 1 1

Had there been a V.35 module instead of the X.21 module, the configuration steps would have been identical

10.6 Software Installation and Upgrade

All system functions, including audio compression algorithms, can be easily updated as new features or functions become available. The CP supports system upgrades through the RS232 M&C port using any asynchronous communications package with an "upload" feature. Two examples of acceptable packages are Procomm Plus® and Hyperterminal® (Microsoft Windows). Port baud rates up to 38,400 are supported.

There are four categories of software used in the SuperLink codec: CPBOOT (Boot software), CPSYS (system software), DSP software (Encoder and Decoder) and FPGA Logic (multiplexing functions). There may be many individual software modules (referred to as "THINGS") in each software category.

In all cases, when new software is required, installation instructions will be packaged with the software.

Streaming Audio

With a connection to a Windows NT or 2000 server, SuperLink becomes the backbone for multi-channel MPEG Layer 3 streaming audio

11. Overview

The SuperLink system can be the backbone of a multi-channel MPEG Layer 3 audio server. All Layer 3 bit rates between 64 and 320 kb/s are supported, as is 32 or 48 kHz sampling. Only the number of encoder modules limits the number of audio channels. A fully loaded SuperLink can therefore support twelve audio channels, and multiple SuperLink mainframes can be stacked to support many more streams. Each encoder module can operate at a different bit or sample rate. Equip the SuperLink with decoder modules as well, and you can even stream audio received from anywhere in the world!

11.1 Listener Requirements

For the listener, there are no special requirements other than Windows Media Player version 7.0 or later (and a processor capable of supporting this) and access to a network at a rate faster than the streaming bit rate. For example, for streaming audio at 64 kb/s, a dial-up modem connection is not acceptable, even at 56 kb/s.

11.2 The Server

Connect the 10 base-T network port on the *SuperLink's* Control Processor module to a network interface port on a Windows NT or 2000 server using a straight-through CAT-5 cable. Do not use 'crossover' cables. In almost all instances, this connection would be made through a hub or router. If no router or hub is used, at least two NICs are required in the

server. As with all network connections, care must be used with respect to wire, connector quality and cable lengths.

The minimum server requirements are:

Processor	Pentium class
Processor speed	= 233 MHz
Memory	= 64 K
Operating system	Windows NT, = SP5 (SP6 recommended), Windows 2000

Table 11-1 Server System Requirements

Currently, the maximum number of connections supported is 16.

The software required for the Format Server can be obtained from MUSICAM USA. Install the three files using our self-extracting installer. Once installed, there are three files associated with the server:

- FormatServe.exe – This executable retrieves streams of audio from a SuperLink and makes it available to the Windows Media Server/Player. It can be configured to accept audio from any SuperLink unit visible on the network and make this audio available on any port number, to which the Media Server must connect. It is this program with which the user interacts.
- FormatServer.hlp – This is an on-line help file
- StreamChan.exe – This is an executable utility, and this file must be in the same directory (folder) as FromatServe.exe. The act of starting and stopping an audio stream starts and stops this process.

An additional Windows media Format encoder file, WMFDist.exe, is needed for the NT or 2000 server, and is available at no cost from www.tucows.com or MUSICAM USA.

11.3 SuperLink Setup

The SuperLink, in addition to having a network card (T1, E1, or 3-BRI ISDN) installed, must be given an IP address as well. If not already set at the factory, you can set the IP Address using the **XIA Command**.

XIA n.n.n.n:sn

n.n.n.n = IP address wher n=any decimal number from 0-255

Sn=Subnet Mask = Sunnet mask entered in Hex format

XIA ? - Show current internet address

Sample: Set IP address to 155.155.155.1 with a Subnet Mask of 255.255.255.0

XIA 155.155.155.1:ffffff00

Note:

The TEAM must be re-booted following any change to the IP address

The IP address can also be set manually, as follows:

- Turn on the SuperLink unit or re-boot if already on.
- When the display says "Press any key to stop auto-boot..." stop the boot by hitting any key on the console attached to the SuperLink. At that point, the following prompt should appear:

CP BOOT>

- Use the 'c' command to single-step through the boot parameters. After typing 'c' and hitting the return key, each additional press of the return key will step through the next boot parameter. Pressing the '-' key, and then Return, will bring you to the previous parameter, and pressing the '.' (period) key and Return clears the current field.
- Change the value of inet on ethernet (e) to an appropriate IP address and subnet mask.

For instance, to assign the IP address 192.168.0.10 and subnet mask 255.255.255.0 to your SuperLink, you would do the following:

CP BOOT> c *↵*

Make sure all the following parameters are set as shown. Parameters not shown here are left as is:

```
boot device      : cpm
processor number : 0
inet on ethernet (e) : 192.168.0.10:fffff00
flags (f)       : 0x0
target name (tn) : MusicamCP
other (o)        : CPSYS
```

Continue pressing the return key until you get the **CP BOOT** prompt. Check all parameters by entering the 'p' command at this prompt:

CP BOOT> p *↵*

The display will now look similar to this (note that some values may be different):

```
boot device      : cpm
unit number     : 0
processor number : 0
host name       : e=205.197.242.120
file name       : fffff00
inet on ethernet (e) : 192.168.0.10
gateway inet (g)  : 205.197.242.129
flags (f)       : 0x0
target name (tn) : MusicamCP
other (o)       : CPSYS
```

CP BOOT>

At this point, if your SuperLink CP software is version 1.8.1 or later, you can re-boot the SuperLink. If the CP software is earlier than this, please contact MUSICAM USA.

11.4 Enabling Streaming Audio

In order to enable the output stream, a sub-channel connection from some source port (any network card) to any port of the CP card in slot 0 must be established. (For this example we use port 'A') When properly configured, the streaming software will check the command and machine state for validity and begin the flow of data out through the

Ethernet port. Please note that slot 0, ports A through P are the only valid destinations. Follow these steps:

- Set the SuperLink IP address (as above)
- Set the algorithm to MPEGL3
- Set the sample rate to 32 or 48 (kHz)
- Use the **NMC** command to map the encoder to the Network module. In the following example, the encoder is in slot 2 and the network module is in slot 4. The bit rate is 128 kb/s therefore the number of time slots used is 2, and for this example, we're selecting channel group 1.

NMC 2a 4n 2 1

- Use the NMC command to map the Network module to the Control Processor:

NMC 4n 0a 2 1

Additional audio channels from additional encoders can be added similarly, selecting a different channel group and a different Control Processor port.

11.5 Configuring the Format Server

When the output stream is enabled, a Format Server configured with the SuperLink's IP address can stream the audio data from the SuperLink.

Upon running the format server program for the first time, you must configure the server to recognize any SuperLink units connected to it. Since multiple SuperLinks can be supported, you can use the format server main screen, shown in Figure 10-1, to manage the available units for streaming:

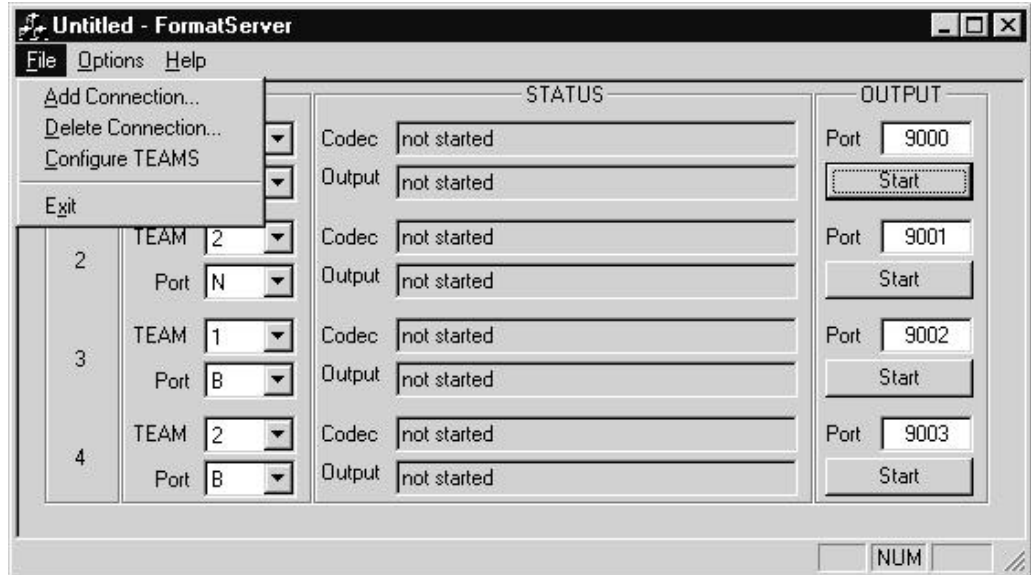


Figure 11-1 Format Server Main Screen

From the **File** menu, choose **Configure SuperLinks**. To add a SuperLink, click the **ADD** button from the **Configure SuperLinks** window, shown in Figure 10-2, and enter the IP address of the SuperLink in the **Add IP** dialog that appears, shown in Figure 10-3.

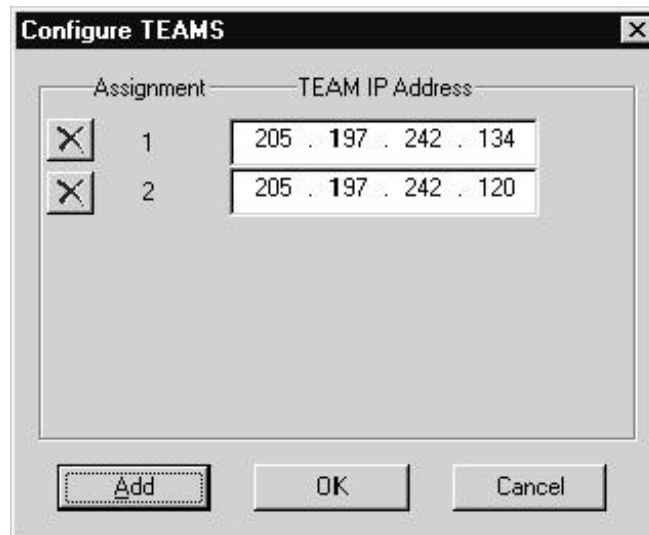


Figure 11-2 Configure SuperLinks Window



Figure 11-3 Add IP Address Window

Click the **OK** button to save the SuperLink IP address and return to the **Configure SuperLinkS** dialog box. At this point, click the **OK** button to save the configuration or the **ADD** button to add additional SuperLink units before saving. The number under the 'Assignment' column is the SuperLinks ID number, and is used to make connections to it.

To remove a SuperLink from the set, click the **X** button to the left of the ID number in the **Configure SuperLinkS** dialog box.

When finished, click **OK** in the 'Configure SuperLinkS' dialog to save all changes.

11.6 Making Connections

A connection is an association between a port on the Control Processor card of a particular SuperLink and a TCP port on the Format Server host. You can choose which output port number you would like of use, and this value becomes part of the URL of the audio stream.

As an example, if you make a connection and set the output port to 9000 on a machine called StreamHost, the URL for that stream will be:

<http://StreamHost:9000>

To make a connection, select File and Add Connection (refer to Figure 1). When you do, a new connection will appear with a unique channel number and some default values. To configure the connection, you need to:

- Supply the source SuperLink number. This is the number that is assigned to the SuperLink when you configure it.
- Supply the input port value. This is the port on the Control Processor card of the SuperLink to which the SuperLink is sending the

data you wish to stream. For instance, to stream the data in the SuperLink that's on a connection from the network card to port 0A, you would choose 'A' as the input port for this connection.

- Supply the output port value. This is the TCP port number from which the data will be available for streaming on the host running the format server, and is appended to the host named after a colon in the URL.

Once you have configured all these values, you are ready to start the flow of data. Clicking the start button in the output column will cause the Format Server to synchronize with the SuperLink and begin streaming the data. When the Output Status reads "Streaming Audio" the data is available on the output port.

When you start a connection, you cannot change any of its configuration values until you stop it again.

If you remove or change the associated connection on the SuperLink, it is recommended you also stop and start the connection in the Format Server.

All connections made will be remembered and restored when restarting the Format Server. If the AutoStart option is set, they will also start to stream if they were started when the Format Server was last shut down.

11.7 Deleting Connections

When a connection is no longer needed, you can remove it permanently from the Format Server configuration by choosing **File** and then **Delete Connection**. A window will appear asking you for the channel number of the connection you wish to delete. This number is listed in the left-hand column of the main Format Server window. Simply select the channel and click "Delete" to remove it. The channel numbers of other connections will not change.

You can select multiple channels at once by shift- or control-clicking them. When you click "Delete", all selected channels will be removed.

Deleted channels will not appear the next time the Format Server is started.

12. Specifications & Installation Notes

12.1 Encoder

Each encoder module supports analog or digital inputs for dual mono or stereo feeds with a variety of audio coding standards, including J.57 2 MB audio. An additional RS232 data signal can be transmitted. A-to-D converters are 24-bit for superb audio quality, low noise and low distortion.

Audio Connectors:	Gold plated Neutrik® XLR Female
A/D Converter:	24 bit delta-sigma
Sample Frequency:	16, 24, 32 & 48 kHz
Input Impedance:	600 ohms or >12K ohm, selectable
Clipping Level:	+15, +18, +21, +/-1 dBu, selectable
THD+N:	<-0.005% at 1 kHz
SNR:	>95 dB
Crosstalk:	<-90 dB
L/R Phase Difference:	<0.5°
Algorithms:	CCS MUSICAM® Old CCS MUSICAM® New ISO/MPEG Layer II ISO/MPEG Layer III G.722 J.41 J.57 (for use at 2MB only)
Digital Input:	AES/EBU or S/PDIF
Lock Range:	+/- 200ppm
Rate Adaption:	Automatic
Ancillary Data Connector:	DB25 Female
Ancillary Data Bit Rates:	300, 1200, 2400, 9600 & 38,400 bps
Ancillary Data Mode:	8 data bits, 1 stop bit

12.2 Decoder

Each Decoder module supports analog or digital outputs for dual mono or stereo, plus RS232 ancillary data. D-to-A converters are 24-bit.

Connectors:	Gold plated Neutrik® XLR Male
D/A Converter:	24 bit delta-sigma
Sample Frequency:	16, 24, 32 & 48 kHz
Output Impedance:	600 ohms or <20 ohm, selectable
Clipping Level:	+15, +18, +21, +/-1 dBu, selectable
THD+N:	<-0.005% at 1 kHz
SNR:	>95 dB
Crosstalk:	<-90 dB
L/R Phase Difference:	<0.5°
Algorithms:	CCS MUSICAM® Old CCS MUSICAM® New ISO/MPEG Layer II ISO/MPEG Layer III G.722 J.41 J.57 (for use at 2MB only)
Digital Output:	AES/EBU or S/PDIF
Lock Range:	+/- 200ppm
Rate Adaption:	Automatic
Digital Audio Sync Input	
Ancillary Data Connector:	DB25 Female
Ancillary Data Bit Rates:	300, 1200, 2400, 9600 & 38,400 bps
Ancillary Data Mode:	8 data bits, 1 stop bit

12.3 X.21 Module

Each X.21 module supports I/O of synchronous data signal with bit rates of n x 64 kb/s. Each module provides two separate X.21 ports. Free time slots within the total time frame may be allocated for each port.

12.4 V.35 Module

Each V.35 module supports I/O of synchronous data signal with bit rates of n x 64 kb/s. Each module provides two separate V.35 ports. Free time slots within the total time frame may be allocated for each port.

12.5 TM-3BRI ISDN Terminal Adapter

Each TM-3bri module allows ISDN connections with bit rates of 64 kb/s per B-Channel. Each module provides either an S/T or a U Interface for connection to the ISDN line. All industry standard ISDN Switch types

and protocols are supported including National ISDN- 1 or 2 and AT&T custom which are used in North America, and DSS1, 1TR6, and JATE which are used internationally.

12.6 E1 Multiplexer

Line Interface, Jitter:	Meets or exceeds ITU-T I.431 and G.703 specifications
LOS Indication:	Programmable thresholds meeting ITU-T G.775 specifications
Frame Aligner:	2048 kb/s alignment/synthesis according to ITU-T G.704 specifications
Error Checking:	Via CRC4 procedures according to ITU-T G.706. CRC4 to bit-CRC4 Interworking of ITU-T G.706, Annex B
Signaling Controller:	Multiframe synchronization and synthesis ITU-T G.732
LOS Detection:	All methods stated in ITU-T G.775 and ETSI 300233 specifications
Jitter Attenuator:	Meets or exceeds jitter transfer requirements of recommendation I.431, and G.745/736. Also meets or exceeds requirements of ETSI TBR12/13. Output jitter limit with 15 UI input at 20 Hz will start jitter attenuation at nearly 2 Hz.
Jitter Tolerance:	Complies with ITU specifications for CEPT application.
Clock Generation/Modes:	Meets or exceeds recommendations of ITU-T G.735, G.824 and I.431 in case of input jitter tolerance, jitter transfer and output jitter
Receive Signal Controller:	The receive signaling controller can be programmed to operate in various signaling

modes. The SuperLink E1 Module will perform the following signaling and data link methods:

- Message Oriented Signaling, also called Common Channel Signaling (CCS)
- Channel Associated Signaling (CAS)

The signaling information is carried in time slot 16 (TS16). The signaling controller samples the bit stream that is output on pin RDO. In case of channel associated signaling, data is sampled on the receive line side clocked with the extracted receive route clock and stored in registers RS1-16. The signaling procedure will be performed as described in ITU-T G.704 and G.732

General Signaling:

Sa bits in accordance with ITU-T G.704 and ETS 300233. E bits in accordance with ITU-T G.704 and ETS 300233

CAS-CC:

For Channel Associated Signaling the use of time slot 16 is recommended. The autonomous CAS multiframe structure is not related to a double frame or a CRC-multiframe structure (refer to ITU-T G.704). The FALC54 internal driver supports CAS multiframe synchronization and synthesis. E1mux: This is used for transmitting async serial data (ZI1, ZI2 ports) sampled at 21kHz

Safety:

ETSI ETS 300 -46-3

12.7 General

Physical

Dimensions:

19" W x 7" H x 9.8" D / 48.3 x 17.8 x 24.9 cm

Weight:

20 lbs / 9 kg

Power Requirements

Universal AC Supply:

90-255 VAC, 48-65 Hz

60 VDC Supply:

42-75 VDC

Environmental

Temperature: 41° F to 113° F / +5° C to +45° C
 Humidity: 20% to 80%, non-condensing

12.8 Delay Measurements

The following delay measurements are taken analog input to analog output, with the E1 signal looped directly at the network connector. All measurements are $\pm 20\%$.

Algorithm	Algorithm Mode	Sample Rate (KHz)	Bit Rate (Kbps)	Delay (ms)
J.57	FS	48	1920	5.84
MPEGL2	JS	48	128	73.7
	JS	48	256	67.2
	JS	48	384	66.5
MPEGL3	JS	32	128	287
J.41	M	48	384	9.70
G.722	M	16	64	37.5

12.9 Installation Notes

It is recommended that the SuperLink be placed in a rack with spacing of at least 2U on top and bottom of the unit. In a rack with multiple units, a solid piece of non-flammable baffle (e.g.; metal shelf) must be placed on top and bottom with separation of at least 2U from the unit. If the unit is to be installed in an enclosed environment, additional cooling may be required.

There are no special requirements for removing power prior to the power supply. The power cord is the main disconnect device.

For full compliance with all emissions requirements, it is recommended that a shielded power cord be used with SuperLink unit.



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