Chapter 3

Functional Description

This chapter provides functional descriptions of the MUX100 system and its modules. The chapter also discusses the intended applications for the MUX100, as well as controls and indicators for each module.

3.1 Overview

The MUX100 performs digital processing, switching, and signaling conversion between analog voice circuits and digital trunk facilities, such as E1 and T1 trunk lines. The supported analog voice circuit conversions are two-wire Foreign Exchange Subscriber (FXS), two-wire Foreign Exchange Office (FXO), four-wire voice only, and four-wire E&M. The supported data circuit interface is four-wire RS232C and, optionally, ITU V.28.

The Digital Signal Processor card (DSP module) converts the analog voice circuits into a digital format suitable for digital processing and switching. This stored operating program also provides signaling bit and tone conversion for voice channels. The DSP module also performs signaling tone detection and generation.
You configure trunk and channel parameters via a non-intelligent ASCII-compatible control console or PC. Control console access is via a serial communications port mounted on the rear panel of the MUX100.

The MUX100 supports the following standard digital trunk interfaces:

- Balanced T1, 100 ohms
- Balanced E1, 120 ohms
- Unbalanced E1, 75 ohms

A trunk connects to the MUX100 via the rear mounted connector (balanced or unbalanced). The digital signal is routed to the Aggregate card (AGC module) for clock extraction and frame synchronization.

The AGC module provides the timing recovery and framing functions required to access a CEPT E1 or T1 digital trunk. The AGC formats and multiplexes the PCM signals for each voice channel into timeslots on the digital trunk.

The CPU module controls the MUX100 system. A Motorola 68000 microprocessor executes the stored program code, which performs the A-bit to line signaling conversions, and the CPU manages the system configuration. A serial interface from the CPU module provides control console access. Bus transceivers are also equipped to access the other modules in the system through the backplane.

The Telco Panel provides termination, conditioning, and relay switching circuitry for interfacing 30 channels (DS0s) to the MUX100.

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**Note:** The Telco Panel is the standard rear module for the MUX100. Also available are a Voice/Data Interface Panel and individual Line Interface Modules (LIMs). Please see your Encore Networks sales representative for information on rear modules other than those discussed in this document.

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The stored program is contained in flash memory (EPROM), allowing factory default configuration settings to be permanently retained. User-defined configuration settings are stored in on-board battery-protected random-access memory (RAM). Additional components for timer and real-time clock functions are also present. The program is expandable for future function requirements.
After the signaling is determined, the PCM bus from the AGC module is extended to the voice channel modules. Each voice channel module contains digital components for access and control from the CPU. The other components on the card consist of codec and analog access circuitry.

Each voice channel module supports five individual voice circuits. Thus, five timeslots on the PCM bus are converted to separate analog channels. For an E1 trunk, six voice channel modules (30 channels) are required to use the entire trunk capacity. For T1, five voice channel modules (24 channels) are required. Each voice channel consists of a codec and associated analog interface components. The CPU is capable of accessing and controlling each codec separately.

The codec is capable of switching from μ-law (mu-law) coding to A-law PCM coding under program control. The transmit and receive analog signal levels are also adjustable via the control console. This feature eliminates manual level adjustments and test equipment connections.

The control console port is a standard ASCII port, enabling you to use a simple non-intelligent terminal for control access. Alternatively, you can use a PC-based computer with a serial port, and a compatible communications program.

You can add redundant capability as necessary to the MUX100 by installing additional common components—the power supply (PSU), the CPU module (CPU), and the Aggregate module (AGC).

### 3.2 System Application

The MUX100 can be configured for multiple interfaces, and additional links not shown can be supported. Brief descriptions of the common interfaces are provided in the following subsections.

#### 3.2.1 Four-Wire Voice

Voice analog lines typically interface with four wires—two wires for transmit and two wires for receive. The four-wire interface is a balanced 600-ohm connection. The MUX100 uses channel cards to interface with these lines. The Four-Wire Voice Channel card, for example, supports five separate ports or channels based on the above interface.

#### 3.2.2 E&M Leads

Many systems require call initiation and release functions to be handled via separate control leads. These functions are normally referred to as E&M
signaling or E&M leads. Each E&M card must correspond with an associated four-wire voice card. When placing calls over voice circuits without in-band signaling tones, these leads are used to indicate a call attempt, answer, dial pulses, release, and other network required signals (such as metering pulses).

Telephone networks employ several types of electrical interfaces to connect to E&M leads. These methods are typically referred to as Types I–V E&M signaling. The types indicate a specific electrical interface.

The MUX100 uses the E&M Line card to support E&M lead requirements. This card supports five separate ports or channels independently. Interface components are configured to support the specified Types I–V and virtually any DC electrical signaling requirement.

3.2.3 **Two-Wire FXS**

The FXS Voice Channel card supports five ports (channels) and provides the loop interface functions required for subscriber lines or extensions, including secondary protection facilities. Ringing of the line is supported through a Ring Generator card in the chassis or through an external ring generator. Either generator can drive more than one line. (Different software packages are required for use of the Ring Generator card or external ring generator.)

FXS functions supported are on/off hook loop closures and reverse battery signaling loops.

3.2.4 **Two-Wire FXO**

The FXO Voice Channel card is designed for applications that require extending subscriber loops from central offices to remote locations. This card supports five ports (channels) where loop battery/current and ringing are provided from a central office. This module functions as a remote subscriber instrument emulating on/off hook functions, loop reversals, ring detection, and dialing provision.

3.2.5 **Signaling**

The MUX100 can support conversion for both line signaling and register signaling, when required. Specific configuration of the hardware and software are driven by the signaling standards required for each application.
3.3 **Hardware Description**

The following sections contain descriptions of the MUX100 chassis, common modules, and signaling cards. Component illustrations, functional block diagrams, pinouts, and slot assignments are included.

### 3.3.1 Chassis Assembly

The chassis assembly (Figure 3-1) is a Eurocard 3U, 19-inch rackmountable metal enclosure that houses the MUX100 circuit card modules. The chassis contains card slot guides and a central backplane to which circuit card modules are inserted from the front and rear of the chassis. Except for the DC/DC Converter cards, all modules and the backplane have non-keyed, mating DIN-type connectors. Twenty card slots are provided in the front and rear of the chassis. Mounting brackets are provided on the front of the chassis so that it can be bolted to mounting strips in equipment rack posts.

![Figure 3-1. Chassis Assembly](image)

### 3.3.2 Modules

The MUX100 can hold several modules that support various network protocols, signaling, and input power requirements. Module types are slot-dependent—they must be installed in the appropriate slots to ensure that the MUX100 operates properly.

Except for the power supply and the CPU, modules are hot-swappable. You can insert or remove a hot-swappable module from the chassis while the
MUX100 is powered up, without damaging the module or the chassis. For power supply or connection modules, however, you must turn off the associated circuit breaker before inserting or removing the module from the chassis. For more details on replacing modules, refer to the MUX100 Channel Bank Multiplexer Installation and Maintenance Guide.

### 3.3.2.1 Front Panel Modules

The chassis holds the processing modules for the MUX100. Each module contains at least one circuit card and a faceplate. The faceplate of each front panel module has at least two captive mounting screws, a card extractor, a nameplate, and usually one or more LED indicators. The indicators facilitate system operation, troubleshooting, and monitoring. Figure 3-2 shows the full complement of front panel modules, and Table 3-1 defines their designated slot assignments.

![Figure 3-2. MUX100 Front Panel Fully Equipped for E&M Operation](image)

**Table 3-1. Front Panel Slot Assignments for Standard (Voice Channel) MUX100**

<table>
<thead>
<tr>
<th>Slot</th>
<th>Module</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>DC Converter Card</td>
<td>Primary PSU</td>
</tr>
<tr>
<td>A2</td>
<td>Digital Signal Processor(^1)</td>
<td>DSP #1</td>
</tr>
<tr>
<td>A3</td>
<td>Digital Signal Processor(^1)</td>
<td>DSP #2</td>
</tr>
<tr>
<td>A4</td>
<td>Central Processor CPU</td>
<td>Primary CPU</td>
</tr>
<tr>
<td>A5</td>
<td>Central Processor CPU</td>
<td>Secondary CPU</td>
</tr>
</tbody>
</table>

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Table 3-1. Front Panel Slot Assignments for Standard (Voice Channel) MUX100 (2 of 4)

<table>
<thead>
<tr>
<th>Slot</th>
<th>Module</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6</td>
<td>Aggregate Card</td>
<td>Primary AGC for single-trunk configuration, or non-redundant AGC for digital trunk #1 of dual-trunk configuration</td>
</tr>
<tr>
<td>A7</td>
<td>Aggregate Card</td>
<td>Secondary AGC for single-trunk configuration, or non-redundant AGC for digital trunk #2 of dual-trunk configuration</td>
</tr>
<tr>
<td>A8</td>
<td>One of the following: FXO Voice Channel Card, FXS Voice Channel Card, Four-Wire Voice Channel Card</td>
<td>One of the following: FXO channels 1 through 5, FXS channels 1 through 5, Four-Wire voice channels 1 through 5</td>
</tr>
<tr>
<td>A9</td>
<td>One of the following: FXO Voice Channel Card, FXS Voice Channel Card, Four-Wire Voice Channel Card</td>
<td>One of the following: FXO channels 6 through 10, FXS channels 6 through 10, Four-Wire voice channels 6 through 10</td>
</tr>
<tr>
<td>A10</td>
<td>One of the following: FXO Voice Channel Card, FXS Voice Channel Card, Four-Wire Voice Channel Card</td>
<td>One of the following: FXO channels 11 through 15, FXS channels 11 through 15, Four-Wire voice channels 11 through 15</td>
</tr>
<tr>
<td>A11</td>
<td>One of the following: FXO Voice Channel Card, FXS Voice Channel Card, Four-Wire Voice Channel Card</td>
<td>One of the following: FXO channels 16 through 20, FXS channels 16 through 20, Four-Wire voice channels 16 through 20</td>
</tr>
</tbody>
</table>
### Table 3-1. Front Panel Slot Assignments for Standard (Voice Channel) MUX100 (3 of 4)

<table>
<thead>
<tr>
<th>Slot</th>
<th>Module</th>
<th>Assignment</th>
</tr>
</thead>
</table>
| A12  | One of the following:  
  - FXO Voice Channel Card  
  - FXS Voice Channel Card  
  - Four-Wire Voice Channel Card | One of the following:  
  - FXO channels 21 through 26  
  - FXS channels 21 through 26  
  - Four-Wire voice channels 21 through 26 |
| A13  | One of the following:  
  - FXO Voice Channel Card  
  - FXS Voice Channel Card  
  - Four-Wire Voice Channel Card | One of the following:  
  - FXO channels 26 through 30  
  - FXS channels 26 through 30  
  - Four-Wire voice channels 26 through 30 |
| A14  | One of the following:  
  - FXO Voice Channel Card  
  - Four-Wire Voice Channel Card  
  - E&M Line Card<sup>2</sup> | One of the following:  
  - FXO channels 31 through 35  
  - Four-Wire voice channels 31 through 35  
  - Signaling for Four-Wire voice channels 1 through 5 |
| A15  | One of the following:  
  - FXO Voice Channel Card  
  - Four-Wire Voice Channel Card  
  - E&M Line Card<sup>2</sup> | One of the following:  
  - FXO channels 36 through 40  
  - Four-Wire voice channels 36 through 40  
  - Signaling for Four-Wire voice channels 6 through 10 |
| A16  | One of the following:  
  - FXO Voice Channel Card  
  - Four-Wire Voice Channel Card  
  - E&M Line Card<sup>2</sup>  
  - Ring Generator Card<sup>3</sup> | One of the following:  
  - FXO channels 41 through 45  
  - Four-Wire voice channels 41 through 15  
  - Signaling for Four-Wire voice channels 11 through 15  
  - Ring generation for FXS cards |
### Table 3-1. Front Panel Slot Assignments for Standard (Voice Channel) MUX100 (4 of 4)

<table>
<thead>
<tr>
<th>Slot</th>
<th>Module</th>
<th>Assignment</th>
</tr>
</thead>
</table>
| A17  | One of the following:  
- FXO Voice Channel Card  
- Four-Wire Voice Channel Card  
- E&M Line Card$^2$  
- Ring Generator Card$^3$ | One of the following:  
- FXO channels 46 through 50  
- Four-Wire voice channels 46 through 50  
- Signaling for Four-Wire voice channels 16 through 20  
- Ring generation for FXS cards |
| A18  | One of the following:  
- FXO Voice Channel Card  
- Four-Wire Voice Channel Card  
- E&M Line Card$^2$  
- Ring Generator Card$^3$ | One of the following:  
- FXO channels 51 through 55  
- Four-Wire voice channels 51 through 25  
- Signaling for Four-Wire voice channels 21 through 25  
- Ring generation for FXS cards |
| A19  | One of the following:  
- FXO Voice Channel Card  
- Four-Wire Voice Channel Card  
- E&M Line Card$^2$  
- Ring Generator Card$^3$ | One of the following:  
- FXO channels 56 through 60  
- Four-Wire voice channels 56 through 60  
- Signaling for Four-Wire voice channels 26 through 30  
- Ring generation for FXS cards |
| A20  | DC Connector Card | Secondary PSU |

1. The DSP modules are not redundant. Each provides tones for up to 15 voice channels.
2. Complementary card for designated Four-Wire Voice Channel card when E&M signaling is used. E&M line cards in slots A14, A15, A16, A17, A18, and A19 complement Four-Wire Voice Channel cards in slots A8, A9, A10, A11, A12, and A13, respectively.
3. The Ring Generator card spans two slots: slots 16 and 17 or slots 18 and 19.
3.3.2.1.1 **DC/DC Converter Card**

The DC/DC Converter card, or PSU module (Figure 3-3), converts DC input power to regulated, overcurrent-protected ±5 VDC supply voltages for all circuit card modules in the MUX100. There are two variations of this module—one for applications where the MUX100 is AC-powered and another for applications where the MUX100 is DC-powered. For AC-powered applications, the unit receives input power from a designated Power Supply Input card on the rear panel of the MUX100. For DC-powered applications, the input power (-48 VDC) is received from a designated DC Input Unit Interface on the rear panel of the MUX100.

![Figure 3-3. PSU Module Faceplate](image)

The MUX100 can contain two PSU modules for redundancy. The DC outputs from the redundant PSU modules are diode-isolated and connected in parallel to supply uninterrupted power if one PSU module fails or is removed. When the MUX100 is equipped with only one PSU module, this PSU module must be installed in the A1 slot (primary PSU).

**Warning:** Failure to disengage power from the PSU when removing it from the chassis will result in damage to installed MUX100 modules.

*Table 3-2* describes all indicators on the PSU module faceplate.
3.3.2.1.2 Central Processor Unit Card

The Central Processor Unit card, or CPU module (Figure 3-4), controls all other modules in the MUX100. The CPU also supports RS-232-C serial communications with a control console, allowing you to configure and monitor the MUX100.

Table 3-2. PSU Module LED Indicators

<table>
<thead>
<tr>
<th>Name</th>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>48V IN</td>
<td>green</td>
<td>When lit, indicates that -48 VDC input voltage to the PSU module is present.</td>
</tr>
<tr>
<td>+5V OUT</td>
<td>green</td>
<td>When lit, indicates that +5 VDC output voltage from the PSU module is present.</td>
</tr>
<tr>
<td>-5V OUT</td>
<td>green</td>
<td>When lit, indicates that -5 VDC output voltage from the PSU module is present.</td>
</tr>
</tbody>
</table>

Figure 3-4. CPU Module Faceplate

The CPU features a 16-MHz Motorola 68000 microprocessor with 512 kb EPROM (flash memory) and 256 kb CMOS static RAM. The EPROMs provide nonvolatile storage of the system program. The CMOS static RAM provides volatile storage of all system configuration parameters. A lithium battery contained on the CPU module protects CMOS static RAM against data loss due to power interruption.
The MUX100 can contain two CPU modules for redundancy. You must manually perform replication of memory contents; however, once you ensure that the software and configuration are identical in each CPU, system operation remains unchanged following a CPU switchover.

Table 3-3 describes all indicators on the CPU module faceplate.

**Table 3-3. CPU Module LED Indicators**

<table>
<thead>
<tr>
<th>Name</th>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS</td>
<td>green</td>
<td>When lit, indicates that the CPU module is in service (on line). This indicator should not be lit on a CPU module that is operating in standby mode (off line).</td>
</tr>
</tbody>
</table>

**3.3.2.1.3 Digital Signal Processor Card**

The Digital Signal Processor card, or DSP module (Figure 3-5), performs signaling tone detection and generation, as well as protocol conversion for 15 voice channels (timeslots) on the digital trunk. The DSP module can also perform A-law or μ-law (mu-law) conversion of PCM-encoded voice signals for the channels. The DSP module provides the MUX100 with full control over register signaling for both the analog and digital trunks. Register signaling provides calling and/or called number information necessary for routing.
The MUX100 can contain two DSP modules to support up to 30 two-wire or four-wire voice channels. DSP modules are non-redundant; one DSP supports voice channels 1–15, and the other DSP supports voice channels 16–30.

### 3.3.2.1.4 Aggregate Card

The Aggregate card, or AGC module (Figure 3-6), provides the timing recovery and framing functions required to access a CEPT E1 or T1 digital trunk. The AGC module formats and multiplexes the PCM signals for each voice channel into respective timeslots on the digital trunk. Transmit timing for the digital trunk can be derived from the received digital trunk data or generated internally. The AGC module detects internal alarm conditions on the digital trunk and reports findings to the CPU module. The alarms include out-of-frame (Red), remote failure (Yellow), all ones (AIS), and loss of signal (Red). You can configure your choice of trunk type, framing, timing source, and other parameters. For more details on configuring the digital trunk, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.
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For single-trunk configurations, the MUX100 can be equipped with two AGC modules for redundancy. For dual-trunk configurations, the MUX100 must be equipped with two AGC modules, one for each digital trunk. Table 3-4 describes the indicators on the AGC module faceplate.

Table 3-4. AGC Module LED Indicators (1 of 2)

<table>
<thead>
<tr>
<th>Name</th>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td>red</td>
<td>When lit, indicates that an out-of-frame condition (loss of synchronization) has existed for more than 2.5 seconds. An out-of-frame condition is declared when the AGC module detects an error in framing bits or absence of the digital trunk signal. The RED alarm clears (becomes unlit) when the out-of-frame condition is not detected for 2.5 seconds. This indicator should be lit when the AGC module is operating in standby mode.</td>
</tr>
</tbody>
</table>

Figure 3-6. AGC Module Faceplate
The FXO Voice Channel card, or FXO module (Figure 3-7), provides the interface for up to five Foreign Exchange Office (FXO) two-wire voice circuits to the MUX100. The FXO module contains digital circuitry that supports each analog two-wire voice circuit with loop battery/current and ringing provided from a central office. It can also support off-hook detection, ring voltage, programmable loop detect threshold, and level range adjustment depending on the specific application. Loop-start applications are fully supported.
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You can configure level adjustments in 0.1 dB increments on a per-channel basis via a control console. For more details on configuring FXO channels, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.

The MUX100 can contain a maximum of 12 FXO modules, to support 60 two-wire FXO channels. FXO modules are designated specific voice channels based on slot numbers, as defined in Table 3-1. The FXO modules are non-redundant.

3.3.2.1.6 FXS Voice Channel Card

The FXS Voice Channel card, or FXS module (Figure 3-8), provides the interface for up to five Foreign Exchange Subscriber (FXS) two-wire voice circuits. The FXS module contains interface components that provide off-hook detection, programmable loop detect threshold, and level adjustment for each voice circuit. Loop-start applications are supported.
Ring voltage (105 VAC 20 Hz) can be applied to each FXS module by means of an external ring generator connected to the MUX100 rear panel. Or, with software version 15356 and above, you can use a Ring Generator card, residing in the MUX100, to generate ring voltage for the FXS module.

**Warning:** The MUX100 cannot use both a Ring Generator card and an external ring generator; otherwise, contention will result.

You can configure level adjustments in 0.1 dB increments on a per-channel basis via a control console. For more details on configuring FXS channels, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.

The MUX100 can contain a maximum of six FXS modules, to support 30 two-wire FXS channels. FXS modules control specific voice channels based on slot numbers, as defined in Table 3-1. The FXS modules are non-redundant.

### 3.3.2.1.7 Four-Wire Voice Channel Card

The Four-Wire Voice Channel card, commonly called the Four-Wire module (Figure 3-9), provides the interface for up to 5 four-wire analog voice circuits to the MUX100. The Four-Wire module filters, samples, compresses, and
performs analog-to-digital (A/D) conversion on each analog signal passing into a serial stream of pulse-code modulation (PCM) samples suitable for digital processing and switching. The voice channels are multiplexed into the digital trunk for transmitting via the AGC module. The reverse process is performed in the receive direction. The transmit and receive voice frequency (VF) paths are balanced 600-ohm impedance.

![Figure 3-9. Four-Wire Module Faceplate](image)

You can configure individual voice channels. Level adjustments are in increments of 0.1 dB. For more details on configuring four-wire channels, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.

The Four-Wire module used in applications as either voice-only or as a four-wire E&M configuration requires a complementary E&M Line card to support associated line signaling functions.

The MUX100 can contain a maximum of 12 Four-Wire modules, to support 60 four-wire voice channels. For four-wire applications using E&M signaling, up to 6 Four-Wire modules can be installed. The Four-Wire modules are designated specific voice channels based on slot numbers, as defined in Table 3-1. The Four-Wire modules are non-redundant.

### 3.3.2.1.8 E&M Line Card

The E&M Line card, or E&M module (Figure 3-10), processes associated signaling leads for up to 5 four-wire circuits that use E&M signaling. The

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E&M module processes the on-hook/off-hook status, ring trip, and dialed digit information for each connected four-wire voice channel. The E&M module multiplexes signaling information for all voice channels into one bitstream for transmission over the digital trunk line.

The E&M module contains interface components that are configured to support E&M signaling Types I to V. You can use DIP switches to configure the signaling type individually for each channel. For more details on setting E&M signaling DIP switches, refer to the *MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide*.

The MUX100 can contain a maximum of six E&M modules to support 30 four-wire voice channels using E&M signaling. E&M modules control specific voice channels based on their slot numbers and complement the four-wire modules, as defined in Table 3-1. The E&M modules are non-redundant. The state of the indicators on the E&M module faceplate depend on the specific application.

### 3.3.2.1.9 Ring Generator Card

In MUX100 software package 15356 and above, the Ring Generator card (RNG101, commonly called the RNG module) provides the ring voltage for one to six FXS cards. This feature is currently available for the R2-to-DTMF application.

*Figure 3-11* shows the Ring Generator Card.
Table 3-5 describes the LED indicators on the RNG module faceplate.

**Table 3-5. RNG Module LED Indicators**

<table>
<thead>
<tr>
<th>Name</th>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS</td>
<td>green</td>
<td>When lit, indicates the RNG module is in service (on line) and functioning properly.</td>
</tr>
<tr>
<td>FAIL</td>
<td>red</td>
<td>When lit, indicates a RNG module failure.</td>
</tr>
</tbody>
</table>

The Ring Generator card generates a pulsed 76-volt rms, 16-Hz ring signal rated at 30 watts. The ring voltage is supplied to the FXS cards. Output voltage protection automatically shuts the RNG module down when the ring signal output exceeds the safe operating range. Ring signal frequency and voltage are factory-set and do not require adjustment by an operator.

Figure 3-12 provides a functional block diagram of the RNG module.
The Ring Generator card eliminates the need for an external ring generator, and, to provide redundancy, the MUX100 can hold two RNG modules. Each Ring Generator card takes up two card slots. One Ring Generator card goes into front slots 16 and 17; if a second (redundant) Ring Generator card is used, it goes into front slots 18 and 19. It is recommended that two power supplies be used when using one or two Ring Generator cards.

When the MUX holds a Ring Generator card, slots 16 through 19 cannot be used for voice cards—i.e. FXS, FXO, four-wire, or E&M cards—even if some of those slots are empty.

Warning: The MUX100 cannot use both a Ring Generator card and an external ring generator. If both are active, there will be contention.

3.3.2.2 Rear Panel Modules

The rear panel contains the interface modules for the MUX100. Each module contains at least one circuit card and a faceplate. The faceplate of each rear panel module has at least two captive mounting screws and usually one or more ports. The ports support connection of external equipment to the MUX100.

For voice channel connections, the MUX100 uses a Telco Panel. The Telco Panel supports connection of channel cables that have 50-pin telco connectors. Figure 3-13 shows the full complement of rear panel modules for a Telco Panel-equipped MUX100; Table 3-6 defines the designated slot assignments.
Figure 3-13. Rear Panel Arrangement, Equipped with Telco Panel

Table 3-6. Rear Panel Slot Assignments, MUX100 Telco Panel (1 of 2)

<table>
<thead>
<tr>
<th>Slot</th>
<th>Module</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>One of the following:</td>
<td>Respectively:</td>
</tr>
<tr>
<td></td>
<td>• DC Input Unit Interface card</td>
<td>• Primary DCI</td>
</tr>
<tr>
<td></td>
<td>• Power Supply Interface card</td>
<td>• Primary PSI</td>
</tr>
<tr>
<td>A2</td>
<td>Blank panel</td>
<td>None</td>
</tr>
<tr>
<td>A3</td>
<td>Blank panel</td>
<td>None</td>
</tr>
<tr>
<td>A4 and A5</td>
<td>Computer Console Interface</td>
<td>CCI</td>
</tr>
<tr>
<td>A6 or A6/7 only¹</td>
<td>Digital Trunk Interface</td>
<td>DTI</td>
</tr>
<tr>
<td>A7, or A6/A7 only¹</td>
<td>Digital Trunk Interface</td>
<td>DTI</td>
</tr>
<tr>
<td>A8–A18</td>
<td>Telco Panel</td>
<td>Channels 1–60, external ring generator connection</td>
</tr>
<tr>
<td>A19</td>
<td>Blank panel</td>
<td>None</td>
</tr>
</tbody>
</table>

¹ DTI

MUX100™ Series Channel Bank Multiplexer Hardware Reference Guide
3.3.2.2.1 DC Input Unit Interface Card

The DC Input Unit Interface card, or DCI module (Figure 3-14), provides termination, EMI filtering, and relay switching circuitry for interfacing DC input power to the MUX100. This module contains no active components (i.e., it is passive only). The power connector, chassis grounding screw, and circuit breaker supports application and overcurrent protection of -48 VDC power to a designated PSU module. One DCI module is required for each PSU module in the MUX100. DCI modules are non-redundant. DCI modules are designated specific PSU modules based on slot number, as shown in Table 3-7.

Note: The Telco Panel is the standard rear module for the MUX100. Also available are individual Line Interface Modules (LIMs) and a Voice/Data Interface Panel. For information on modules other than those discussed in this manual, contact your Encore Networks, Inc., sales representative.

### Table 3-6. Rear Panel Slot Assignments, MUX100 Telco Panel (2 of 2)

<table>
<thead>
<tr>
<th>Slot</th>
<th>Module</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A20</td>
<td>One of the following:</td>
<td>Respectively:</td>
</tr>
<tr>
<td></td>
<td>• DC Input Unit Interface card</td>
<td>• Secondary DCI</td>
</tr>
<tr>
<td></td>
<td>• Power Supply Interface card</td>
<td>• Secondary PSI</td>
</tr>
</tbody>
</table>

1. A double-width DTI module is used for single digital trunk applications; a single-width DTI module is used for dual digital trunk applications.
When the MUX100 contains only one power supply, the DCI is installed in the primary DCI slot (rear slot 1). The power connector on the DCI module is a standard three-pronged DC power connector, such as the Power-Combicon (part number PC4/3-ST-7,62) manufactured by Phoenix Contact Ltd. (Encore Networks, Inc., recommends use of this connector for use with the DCI.) For details on interface cabling requirements, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.

### Table 3-7. DCI–PSU Module Assignment

<table>
<thead>
<tr>
<th>DCI Module</th>
<th>Designated PSU Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear slot 1</td>
<td>Front slot 1</td>
</tr>
<tr>
<td>Rear slot 20</td>
<td>Front slot 20</td>
</tr>
</tbody>
</table>

When the MUX100 contains only one power supply, the DCI is installed in the primary DCI slot (rear slot 1). The power connector on the DCI module is a standard three-pronged DC power connector, such as the Power-Combicon (part number PC4/3-ST-7,62) manufactured by Phoenix Contact Ltd. (Encore Networks, Inc., recommends use of this connector for use with the DCI.) For details on interface cabling requirements, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.

#### 3.3.2.2 Power Supply Input Card

The Power Supply Input card, or PSI module (Figure 3-15), provides termination, EMI filtering, and relay switching circuitry for interfacing 110/220 VAC, 50/60 Hz input power to the MUX100. In addition, the PSI module converts the 110 VAC or 220 VAC input to a regulated 300 V DC output. The power connector, chassis grounding screw, and switch (circuit breaker) support application and overcurrent protection of input power to a designated PSU module. One PSI module is required for each PSU module.
in the MUX100. PSI modules are non-redundant. PSI modules are designated specific PSU modules based on slot number, as shown in Table 3-8.

![Figure 3-15. PSI Module Faceplate](image)

**Table 3-8. PSI–PSU Module Assignment**

<table>
<thead>
<tr>
<th>PSI Module</th>
<th>Designated PSU Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear slot 1</td>
<td>Front slot 1</td>
</tr>
<tr>
<td>Rear slot 20</td>
<td>Front slot 20</td>
</tr>
</tbody>
</table>

When the MUX100 contains only one power supply, the PSI is installed in the primary PSI slot (rear slot 1). The power receptacle is an IEC 320 connector. For details on interface cabling requirements, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.

**3.3.2.2.3 Computer Console Interface Card**

The Computer Console Interface card, or CCI module (Figure 3-16), provides termination and switching circuitry for interfacing external supervisory and alarm monitoring equipment to the MUX100. The Supervisory port supports transport of RS-232-C serial communication signals between the online CPU module and a control console, modem, communications server, or other compatible communications device. The Alarm port supports connection of dry contact signals to remote alarm
monitoring equipment. The alarm signals interfaced to the CCI module from
the CPU supply information to the dry contacts.

The serial interface is a DB-25 female connector, and the alarm interface is a
DB-9 female connector. For details on interface cabling requirements, refer
to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance
Guide.

![Figure 3-16. CCI Module Faceplate](image)

### 3.3.2.2.4 Digital Trunk Interface Card

The Digital Trunk Interface card, or DTI module (Figure 3-17), provides
termination, conditioning, and relay switching circuitry for interfacing the
digital trunk to the MUX100. This module also contains line protection fuses
and T1/E1 trunk-selection jumper connections. The DTI module is available
in three versions:

- Balanced T1, 100 ohms
- Balanced E1, 120 ohms
- Unbalanced E1, 75 ohms

For balanced T1 and E1 configurations, the trunk line terminates to a DB-15
connector. Figure 3-17 shows a rear view of the balanced DTI interface. For
unbalanced E1 configurations, the trunk line terminates to separate transmit
and receive BNC connectors. For details on interface cabling requirements,
refer to the MUX100 Channel Bank Multiplexer Installation and Maintenance Guide.

![DTI Module Faceplate, DB-15 Interface](image)

**Figure 3-17. DTI Module Faceplate, DB-15 Interface**

### 3.3.2.2.5 Telco Panel

The Telco Interface Module (Figure 3-18) provides termination, conditioning, and relay switching circuitry for interfacing all voice and data lines to the MUX100. This panel contains eight 50-pin female telco connectors (J1 through J8), and one 4-position ring voltage input connector.

The individual voice circuits are routed to the backplane via a ribbon cable to their appropriate channel modules. All channel interfaces are 600 ohm, balanced. For details on interface cabling requirements, refer to the MUX100 Series Channel Bank Multiplexer Installation and Maintenance Guide.
3.3.3 External Ring Generator

The use of an external ring generator and power supply are options for MUX100 applications that require a ring voltage source for operation of the two-wire FXS voice circuits. For these applications, an external ring generator provides the ring voltage (nominally 96 VAC, 20/30Hz). The ring generator and associated power supply are mounted externally on the MUX100 chassis.

The ring generator signaling output is switch-selectable for 20/30Hz, continuous or pulsed ringing. The ring generator is capable of ringing up to 10 high-impedance telephone ringers simultaneously. The ring generator’s power supply operates from a 110 VAC power source.

With software version 15356 and above, the MUX100 can use a Ring Generator card instead of an external ring generator. (See Section 3.3.2.1.9, Ring Generator Card.)

Warning: The MUX100 cannot use both a Ring Generator card and an external ring generator. If both are active, there will be contention.

3.4 System Software

System software is the stored program the CPU module executes to perform system management tasks. System software resides in nonvolatile memory.
(flash) on the CPU module. You interact with the system software via a command-line interface (CLI) at a control console. Using the software command set, you can configure and monitor the MUX100 and download (install) system software. Once the MUX100 is placed in service, operator intervention is necessary only for configuration changes (such as adjustment of signal reference levels or protocol timers) or system monitoring.

The MUX100 is shipped from the factory fully assembled and tested, with pre-installed software using factory default parameters. The factory default parameters are suitable for typical network operations; however, you can modify these parameters as necessary for specific network requirements.

Upon power-up or following a system reset, the CPU module begins an initialization sequence. This sequence determines which modules are installed and which interfaces exist (such as T1 or E1, two-wire FXS, two-wire FXO, four-wire E&M, 64-Kbps data, etc.).

Once the hardware configuration is determined, the stored program continues initialization by loading the system configuration parameters from CMOS static RAM to the respective modules. These parameters are the user-defined configuration or, if no user-defined configuration exists, the factory default parameters.

An initialization sequence on the analog and digital trunks frame-aligns and clock-synchronizes the trunks. The initialization establishes internal connectivity paths that allows system operation to begin automatically.

A state machine implemented in the stored program processes all call connections following system initialization.