



## Technical Specifications

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This appendix provides the technical specifications relevant to the MGX 8230, its processor and service modules, and the applications and services that it provides. It contains the following sections:

- MGX 8230 Enclosure, Power, and Performance Specifications
- MGX 8230 Processor Switching Module Specifications
- AUSM/B-8T1E1 Interface Characteristics
- FRSM-2CT3 Specifications
- FRSM-2T3E3 Specifications
- FRSM-HS2 Specifications
- Counters and Statistics for FRSM-2CT3, FRSM-2T3E3, and FRSM-HS2
- FRSM-8T1 Specification
- FRSM-8E1 Specification
- Circuit Emulation Service Module for T1 Operation
- Circuit Emulation Service Module for E1 Operation
- Physical and Electrical Characteristics for Cards
- Electromagnetic Compatibility
- Conformance

### MGX 8230 Enclosure, Power, and Performance Specifications

This section describes the physical characteristics and system power requirements for the MGX 8230 feeder. The “MGX 8230 Processor Switching Module Specifications” section lists the dimensions, weight, and power consumption for each card. The appendix titled “Cabling Specifications” lists the AC power plugs for domestic and international use.

Table A-1 shows the MGX 8230 enclosure and electrical characteristics.

**Table A-1 Enclosure and Electrical Characteristics**

Item	Value
Card Slot Capacity	Supports combinations of full and single-height service modules. Two double-height slots reserved for PXMs. Up to 10 single-height slots for service modules or up to 5 double-height slots for service modules.
Enclosure Size, AC-powered system	8 Rack Units high Height: 14.00 inches (35.56 cm). Width: 17.72 ins (45.01 cm). Depth: 23.5 ins (59.69 cm) (excluding cable management)
DC-powered system	7 Rack Units high Height: 12.25 inches (63.50 cm). Width: 17.72 inches (45.01 cm). Depth: 23.5 inches (59.69 cm) (excluding cable management)
Shipping Weight for Populated Enclosure	Approximately 150 lbs.
Clearance Requirement	Minimum 30 inches front and rear; nominal 12-inch side clearance.
Power Input Voltage	AC system: Normal operating range is 100–240 VAC, 47 to 63 Hz. The maximum voltage range is 90–264 VAC. DC system: –42 to –56 VDC. Each AC supply can provide up to 1200 Watts at –48 VDC.
Current Requirements, AC System	Configuration-dependent: use Network Design Tool for exact requirements.
Current Requirements, DC System	Configuration-dependent: use Network Design Tool for exact requirements. For general planning purposes: 25 Amps at nominal –48 VDC; 29 Amps at –42 VDC maximum.
Input AC Power Connector	IEC 320 C13 input connector. The Appendix titled “Cabling Specifications” lists the AC power cords for a variety of countries and regions.
AC Power Cable	Provided with 8 feet (2.3 m) of 3-conductor wire with plug.
AC Plug at Customer end	20 A NEMA L620, 3-prong plug (domestic U.S.) 13 A 250 Vac BS1363, 3-prong fused plug (UK, Ireland) CEE 7/7 (Continental Europe) AS3112 (Australia/New Zealand) CEI23-16/VII (Italy) 125V/15A North America
DC Input Connections	Three-position terminal block for 10 AWG wire (4 square millimeters).
Operating Environment	0°–40° C (32°–104° F) normal operation (50° C or 122° F up to 72 hours). Maximum 85% relative humidity.
Shock	Withstands 10 G, 10 ms at 1/2 sine wave.
Vibration	Withstands 1/4 G, 20–500 Hz.
Heat Transfer to Environment	AC-powered: 4,800 BTUs. DC-powered: 4,100 BTUs.

**Table A-1 Enclosure and Electrical Characteristics (continued)**

Item	Value
<b>MGX 8230 Performance</b>	
Cell bus bandwidth	
Slots 3 to 5, 10 to 12:	~160 Mbps per slot, single speed ~320 Mbps per slot, double speed
Slots 6 to 7, 13 to 14	~160 Mbps per two slots, single speed ~320 Mbps per two slots, double speed
Alarm and error handling	Same as MGX 8850 and IGX 8400 series switches

## MGX 8230 Processor Switching Module Specifications

This section contains general specifications for the MGX 8230 Processor Switch Module (MGX 8230-PXM). The information in Table A-2 includes information for the two types of back cards—the PXM-UI user interface for the switch and the uplink card for trunking and CPE access.

**Table A-2 PXM Specifications**

Category	Description
Maximum switch fabric throughput	2 times OC-12.
Control access (These ports exits on the PXM-UI back card)	Control port: RJ-45 connector, EIA/TIA 232, DTE mode, asynchronous interface 19,200 baud, 1 start bit, 1 stop bit, no parity bits. Maintenance port: RJ-45 connector, EIA/TIA 232, DTE mode, asynchronous interface 9600 baud, 1 start bit, 1 stop bit, no parity bits. LAN port: RJ-45 connector, 10BASET, 802.3 Ethernet.
Uplink ports and connectors (An uplink card can have one of these number and type of connectors. The wavelength on optical lines is 1310 nm)	4 OC-3 multi-mode fiber, SC connectors 4 OC-3 single-mode fiber, intermediate reach, SC connectors 4 OC-3 single-mode fiber, long reach, SC connectors
Number of logical ports	32 across all physical ports on the uplink card (regardless of line type).

Table A-2 PXM Specifications (continued)

Category	Description
LEDs on PXM front card (LEDs display status, but alarm history is a switch)	<p>Status for the card:</p> <ul style="list-style-type: none"> <li>• Green means active.</li> <li>• Red means failed.</li> <li>• Yellow indicates the standby card.</li> </ul> <p>LAN activity: flashing green indicates activity.</p> <p>Node alarm:</p> <ul style="list-style-type: none"> <li>• Blue indicates critical alarm</li> <li>• Red indicates major alarm.</li> <li>• Yellow indicates minor alarm.</li> </ul> <p>Node power (note that each AC power supply also has an LED):</p> <ul style="list-style-type: none"> <li>• “DC OK A” is green for okay or red for trouble.</li> <li>• “DC OK B” is green for okay or red for trouble.</li> </ul> <p>Alarm history: ACO</p> <p>Port interface (for the uplink port):</p> <ul style="list-style-type: none"> <li>• Green means active and okay.</li> <li>• Red means active and local alarm.</li> <li>• Yellow means active and remote alarm.</li> <li>• No light means inactive or not provided.</li> </ul>
LEDs on back cards	Green means active. No light means inactive or not provided.
Synchronization (These clock sources satisfy Stratum 4 requirements)	<p>8 kHz clock derived from the following sources:</p> <ul style="list-style-type: none"> <li>• Internal 8 kHz clock (10 ppm).</li> <li>• Service modules or trunk line interfaces.</li> <li>• External BITS clock port.</li> <li>• T1 clock rate 1.544 MHz <math>\pm</math> 32 ppm.</li> <li>• E1 clock rate 2.048 MHz <math>\pm</math> 50 ppm (can be either sync or data signal).</li> </ul>
BITS clock interface	<p>E1/T1 with an RJ-45 connector.</p> <p>E1 with an SMB connector.</p>
Trunk history counters	<p>Ingress, per connection:</p> <p>Number of received cells with CLP = 0.</p> <p>Number of received cells with CLP = 1.</p> <p>Egress, per connection:</p> <p>Number of received cells.</p> <p>Number of transmitted cells.</p> <p>Number of received cells with EFCI bit set.</p> <p>Number of transmitted cells with EFCI bit set.</p>

**Table A-2 PXM Specifications (continued)**

Category	Description
Connection capacities supported by PXM	Maximum number of connections: 16,000 bi-directional channels for local switching. 32,000 bi-directional channels for switching across uplink card.  Maximum aggregate bandwidth: 600 Mbps local switching (service module to service module). 1,200 Mbps switching across uplink.  Cell memory: 256K cells.
Processor clock speed and memory specifics	Clock speed: 200 MHz internal, 50 MHz external. Flash memory: 2 Mbytes. DRAM: 64 Mbytes, upgradeable to 128 Mbytes. Secondary cache: 512 Kbytes. BRAM: 128 Kbytes. Hard disk: 4 Gbytes.
Alarm indicators (audible and visual)	Central office-compatible alarm indicators and controls through a DB15 connector.
Maintenance features	Internal isolation loopback. External remote loopback. Hot-pluggable.
Card dimensions	Front card: 15.65 inches by 16.83 inches (39.75 cm by 42.75 cm) Back cards: 7.25 inches by 4.125 inches (18.42 cm by 10.48 cm)
Power	Requires -48 VDC, dissipates 150W.

## AUSM/B-8T1E1 Interface Characteristics

This section contains details for the AUSM/B-8T1E1. For physical characteristics, see Table A-3. For the T1 and E1 characteristics, see Table A-3 and Table A-5, respectively. For ATM interface characteristics, see Table A-6. For statistics and counters, see Table A-7.1

**Table A-3 Physical Characteristics of the AUSM/B-8T1E1**

Category	Description
LED Indicators Per Card	Active (green), Standby (yellow), Fail (red)
LED Indicators Per Line	One per line: Active and OK (green) Active and Local Alarm (red) Active and Remote Alarm (yellow)
Maintenance/Serviceability	Facility loopback via loop up/down per ANSI T1.408 and ATT TR 62411 (T1), CCITT G.7xx (E1) Facility Loopback via Management Console Internal Problem Isolation Loopbacks Hot pluggable

**Table A-3 Physical Characteristics of the AUSM/B-8T1E1 (continued)**

Category	Description
Card Size	Front card: 7.25" x 16.25" (18.43 cm x 41.28 cm) Back cards: 7" x 4.5" (17.78 cm x 11.43 cm)
Power	-48 VDC, 30W
Safety	EN 60950 2nd edition (including EN 41003) UL 1950 2nd edition
Compliance	T1: G.703, G.824 E1: G.703, G.823
ESD	IEC 61000-4-2

**Table A-4 T1 Interface Characteristics**

Category	Description
Line Interface	RJ-48 (100 ohms) on the LM-RJ48-8T1 back card
Line Rate	1.544 Mbps $\pm$ 50 bps (T1)
Synchronization	Transmitter can be loop-timed, receiver, or synchronized to node (normal mode)
Line Code	Bi-polar 8 Zero Substitution (B8ZS) per ANSI T1.408 (T1)
Line Framing	Extended Superframe Format (ESF 24 frame multi-frame) per ANSI T1.408
ESF Maintenance	Bit-oriented alarm and loopback messages of ESF Data Link per ANSI T1.408
Input Jitter Tolerance	Per ITU-T G.824
Output Jitter	Per ITU-T G.824 using normal mode synchronization.
Physical Layer Alarms	LOS, OOF, AIS, RAI
Physical Layer Performance Statistics	LCV, LES, LSES, CV, ES, MGX 8230, SEFS, AISS, UAS

**Table A-5 E1 Interface Characteristics**

Category	Description
Line Interface Connector	RJ-48 (120 ohms) on LM-RJ48-8E1, or SMB (75 ohms) on LM-SMB-8E1
Line Rate	2.048 Mbps $\pm$ 100 bps
Synchronization	Transmitter can be: loop timed, receiver, or synchronized to shelf (normal mode)
Line Code	HDB3 (E1)
Line Framing	16-frame multi-frame as in G.704
Input Jitter Tolerance	As specified in ITU G.823 for 2.048 Mbps
Output Jitter Generation	As specified in ITU G.823 for 2.048 Mbps

**Table A-5 E1 Interface Characteristics (continued)**

Category	Description
Physical Layer Alarms	LOS, OOF, AIS, RAI
Physical Layer Statistics	LCV, LES, LSES, CV, ES, MGX 8230, SEFS, AISS, UAS

**Table A-6 ATM Interface Characteristics**

Category	Description
Standards	ATM UNI v3.1, ITU-T G.804, per CCITT I.361.
Channel Configuration	1000 per card, across any of the T1 or E1 ports.
VPI/VCI Ranges	VPI: 0–255. VCI: 0–4096.
Traffic Classes	CBR, VBR, VBR+.
UPC Parameters	PCR, SCR (VBR), CCDV (CBR).
Congestion Control Support	ForeSight (toward Network for VBR+).
ForeSight Parameters	MIR, PIR, Rate Up, Rate Down, QIR, QIR Timeout, IBS.

**Table A-7 AUSM/B-8T1E1 Statistics and Counters**

Counter Type	Description
Per Port	Number of cells received from the interface. Number of cells received with unknown VPI/VCI. Last known VPI/VCI received from the port. Number of cells discarded due to error in Cell Header. Number of cells received with non-zero GRC field. Number of cells transmitted to the interface. Number of cells transmitted for which EFCI was set. Number of egress cells discarded due to service interface physical alarm.
<b>Endpoint (channel)</b>	
Ingress	Number of cells received from port. Number of cells received from the port with CLP = 1. Number of cells received from the port with EFCI = 1. Number of cells from the port discarded due to queue exceeded QDepth. Number of cells (with CLP) set) discarded due to queue exceeded CLP threshold. Number of cells from the port for which CLP was set due to UPC violations.
<b>ATMizer Channel Counters</b>	
Ingress	Number of cells transmitted to cell bus. Number of cells to cell bus for which EFCI was set. Number of cells to cell bus discarded due to shelf alarm.

**Table A-7 AUSM/B-8T1E1 Statistics and Counters**

Counter Type	Description
Egress	Number of cells received from the cell bus. Number of cells discarded due to queue exceeded QDepth (per Egress Q). Number of cells discarded due to queue exceeded CLP threshold (per Egress Q). Number of cells received with CLP = 1.
<b>Other Counters</b>	
Ingress	Number of OAM cells discarded. Number of AIS cells received from the port. Number of RDI (FERF) cells received from the port. Number SegmentLpBk cells received from the port. Number of SegmentLpBk cells transmitted to cell bus.
Egress	Number of OAM cells discarded. Number of AIS cells transmitted to the port. Number of SegmentLpBk cells transmitted to the port. Number of SegmentLpBk cells received from the port.
Diagnostic Statistics	Peak Queue Depth (Ingress: per channel).

## FRSM-2CT3 Specifications

This section provides details for the FRSM-2CT3. Topics consist of the following:

- Transport technology standards with which the card complies (Table A-8)
- General physical attributes of the card, such as LEDs on the faceplate (Table A-9)
- Line and framer characteristics (Table A-10 and “FRSM-2CT3 Framer” section)
- Line alarms (“FRSM-2CT3 Line Alarms”)

**Table A-8 Frame Relay Interface Standards**

Interface	Standard
Frame Relay Interface	ANSI T1.618, 2-octet header
ATM Layer	CCITT I.361 and ATM UNI v3.1
AAL Layer	AAL5 per ITU-T I.363
FR-Cell Interworking	Per ITU-T I.555 and I.36x.1, as summarized in “ATM-to-Frame Relay Interoperability Implementation Agreement” v 1.0

**Table A-9 FRSM-2CT3 Front Card Physical Characteristics**

Feature	Significance or Value
Power	–48 VDC, 60W (estimated)



**Table A-9 FRSM-2CT3 Front Card Physical Characteristics (continued)**

Feature	Significance or Value
Card Status Indicator LEDs	Active (Green), Failed (Red), Standby (Yellow)
Line Status Indicator LEDs	Active & Okay (Green), Active & Local Alarm (Red), Active & Remote Alarm (Yellow)
Reliability	> 85000 hours MTBF (target)
Card Size	7.25 inches by 16.5 inches

**Table A-10 FRSM-2CT3 Line Level**

Feature	Significance or Value
Number of T3 Lines	Two
Line Interface Connector	75 ohm BNC
Line Rate	44.736 Mbps +/- 20 ppm
Line Coding	B3ZS
Transmit Timing	Normal or Loop timed
Input Jitter Tolerance	Per GR-449-CORE, ITU-T G.824
Output Jitter	0.05 UI maximum with jitter-free input clock
Output Pulse	Per T1.102.1993

## FRSM-2CT3 Framer

The FRSM-2CT3 line framer:

- Supports M13 or C-bit parity format.
- Performs required inversion of second and fourth multiplexed DS1 streams per ANSI T1.107.
- Generates loop-up code to the far-end device to loop back any of the DS1s or entire DS3 signal stream by way of the FEAC channel.
- Automatically detects the incoming loop-up codes from the far-end device as well as loop back any of the DS1s or entire DS3 signal stream back to the far-end device. The loopback occurs at the M13 framer chip.

## FRSM-2CT3 Line Alarms

For line alarms, the FRSM-2CT3 supports:

- Detection and generation of Remote Alarm Indicator (RAI) signal (also known as FERF and Yellow signal)
- Detection and generation of Alarm Indication Signal (AIS)
- Detection of Out of Frame (OOF) condition

- Detection of Loss of Frame (LOS) condition
- Automatic generation of Far End Block Error (FEBE)

## FRSM-2T3E3 Specifications

This section provides details for the FRSM-2T3E3. Where appropriate, it has separate sections for T3 and E3 technologies. Topics consist of the following:

- Transport technology standards with which the card complies (Table A-11)
- General physical attributes of the card, such as LEDs on the faceplate (Table A-12)
- Line and framer characteristics for T3 operation (Table A-13 and “T3 Framer Level”)
- Line and framer characteristics for E3 operation (Table A-14 and “E3 Framer Level”)
- Line alarms (“FRSM-2T3E3 Line Alarms”)

**Table A-11 Frame Relay Interface Standards**

Interface	Standard
Frame Relay Interface	ANSI T1.618, 2-octet header
ATM Layer	CCITT I.361 and ATM UNI v3.1
AAL Layer	AAL5 ITU-T I.363
FR-Cell Interworking	Per ITU-T I.555 and I.36x.1, as summarized in <i>ATM-to-Frame Relay Interoperability Implementation Agreement v 1.0</i>

**Table A-12 FRSM-2T3E3 Front Card Physical Characteristics**

Feature	Significance or Value
Power	–48 VDC, 60W (estimated)
Card Status Indicator LEDs	Active (Green), Failed (Red), Standby (Yellow)
Line Status Indicator LEDs	Active & Okay (Green), Active & Local Alarm (Red), Active & Remote Alarm (Yellow)
Reliability	> 85000 hours MTBF (target)
Card Size	7.25 inches by 16.5 inches

## FRSM-2T3E3 T3 Line

The T3 line characteristics appear in Table A-13.

**Table A-13 T3 Line Level**

Feature	Significance or Value
Number of T3 Lines	Two

**Table A-13 T3 Line Level (continued)**

Feature	Significance or Value
Line Interface Connector	75 ohm BNC
Line Rate	44.736 Mbps +/- 20 ppm
Line Coding	B3ZS
Transmit Timing	Normal or Loop timed
Input Jitter Tolerance	Per GR-499-CORE, ITU-T G.824
Output Jitter	0.05 UI maximum with jitter-free input clock
Output Pulse	Per ANSI T1.102

## T3 Framing Level

For the framing characteristics of T3 operation, the FRSM-2T3E3:

- Supports C-bit parity and M13 DS3 format.
- Frames to a DS3 signal with a maximum average reframe time that meets the requirements set by TR-TSY-000009 and GR-499-CORE.
- Detects the alarm indication signal (AIS) in milliseconds in the presence of a  $10^{-3}$  bit error rate.
- When in-frame, indicates M-bit or F-bit framing errors as well as P-bit errors. In C-bit parity mode, it also indicates both C-bit parity errors and far end block errors.

## FRSM-2T3E3 E3 Line

For characteristics of the line on an FRSM-2T3E3 with an E3 back card see figure A14:

**Table A-14 E3 Line Level**

Feature	Significance or Value
Number of E3 Lines	Two
Line Interface Connector	75 ohm BNC
Line Rate	34.368 Mbps +/- 20 ppm
Line Coding	HDB3
Transmit Timing	Normal or Loop timed
Input Jitter Tolerance	Per ITU-T G.823
Output Jitter	0.05 UI maximum with jitter-free input clock per AT&T TR54014
Output Pulse	Per ITU-T G.703

## E3 Framing Level

For line framing, the E3 operation of the FRSM-2T3E3 complies with ITU-T G.751.

## FRSM-2T3E3 Line Alarms

For line alarms, the FRSM-2T3E3 supports:

- Detection and generation of Remote Alarm Indicator (RAI) signal (also known as FERF and Yellow signal)
- Detection and generation of Alarm Indication Signal (AIS)
- Detection of Out of Frame (OOF) condition
- Detection of Loss of Frame (LOS) condition
- Automatic generation of Far End Block Error (FEBE)

## Statistics and Counter Specifications

See the section titled “Counters and Statistics for FRSM-2CT3, FRSM-2T3E3, and FRSM-HS2” for lists of applicable statistics and counters.

## FRSM-HS2 Specifications

The FRSM-HS2 is the Frame Relay module with two HSSI ports. The topics in this section are:

- Transport technology standards with which the card complies (Table A-15)
- General physical attributes of the card, such as LEDs on the faceplate (Table A-16)
- Line and framer characteristics (Table A-17)

For lists of the counters and statistics that are available on the FRSM-VHS series of cards, see the section titled “Counters and Statistics for FRSM-2CT3, FRSM-2T3E3, and FRSM-HS2.”

**Table A-15** *Frame Relay Interface Standards*

Interface	Standard
Frame Relay Interface	ANSI T1.618, 2-octet header
ATM Layer	CCITT I.361 and ATM UNI v3.1
AAL Layer	AAL5 per ITU-T I.363
FR-Cell Interworking	Per ITU-T I.555 and I.36x.1, as summarized in <i>ATM-to-Frame Relay Interoperability Implementation Agreement v 1.0</i>

**Table A-16** *FRSM-HS2 Physical Characteristics*

Feature	Significance or Value
Power	–48V, 75W (estimated) The SCSI2-2HSSI back card consumes 5 watts at 5 VDC and 6 watts at –5 VDC.
Card Status Indicator LEDs	Active (Green), Failed (Red), Standby (Yellow)

**Table A-16 FRSM-HS2 Physical Characteristics (continued)**

Feature	Significance or Value
Line Status Indicator LEDs	Active & Okay (Green), Active & Local Alarm (Red), Active & Remote Alarm (Yellow)
Reliability	> 85000 hours MTBF (target)
Card Size	Front card: 7.25" x 16.25" (18.43 cm x 41.28 cm) Back card: 7" x 4.5" (17.78 cm x 11.43 cm)

**Table A-17 FRSM-HS2 Line Characteristics**

Feature	Significance or Value
Number of HSSI Lines	Two
Connector Type	SCSI-2
Signaling Rate	52 Mbps max
Line Alarms	<ul style="list-style-type: none"> <li>Control lead is inactive</li> <li>Recovered clock does not match configured line rate</li> </ul>
Synchronization	Transmitter may be either loop-timed to Receiver (DTE mode) or synchronized to shelf (DCE mode)
Electrical Interchange Characteristics	ITU-T V.12

## Counters and Statistics for FRSM-2CT3, FRSM-2T3E3, and FRSM-HS2

This section lists counters and statistics that apply to most types of cards in the FRSM-VHS group.

**Table A-18 Counters per Line**

Counter
Received frames lost due to aborts
Received frames lost due to illegal header (EA bit)
Received frames lost due to CRC errors
Received frames with bit alignment errors
Received frames with unknown DLCI
Received frames with illegal frame length
Received good frame
Transmit frames lost due to under-run/Abort count
Transmit good frame

**Table A-18 Counters per Line (continued)**

<b>Counter</b>
LMI status inquiry request count
LMI signaling protocol (keep-alive time-out count)
LMI sequence number error count
LMI status transmit count (in response to request)
LMI update status transmit count (in response to configuration changes)
Frames with FECN set count
Frames with BECN set count
DE frames discarded count
Number of frames reassembled but discarded due to service interface physical layer alarm

**Table A-19 Service-Related Statistics**

<b>Service Statistic</b>
Number of received frames
Number of bytes received
Number of frames received with DE=1
Number of frames received but discarded
Number of received bytes discarded
Number of frames received but discarded due to <ul style="list-style-type: none"> <li>• CRC error</li> <li>• Illegal frame length</li> <li>• Alignment error</li> <li>• Abort</li> </ul>
Number of frames reassembled and transmitted
Number of frames reassembled and transmitted with DE=1
Number of frames discarded due to reassembly errors
Number of frames transmitted
Number of bytes transmitted
Number of frames transmitted with DE set
Number of frames transmitted during LMI logical port alarm
Frames FECN set count
Frames BECN set count
Number of transmit frames discarded
Number of transmit bytes discarded

**Table A-19 Service-Related Statistics (continued)**

<b>Service Statistic</b>
Number of transmit frames discarded due to: <ul style="list-style-type: none"> <li>• CRC error</li> <li>• Illegal frame length</li> <li>• Alignment error</li> <li>• Abort</li> <li>• DE egress queue threshold exceeded</li> <li>• Physical link failure</li> </ul>

**Table A-20 ATM Cell-Related Statistics**

<b>ATM Cell Statistic</b>
Number of cells transmitted to PXM
Number of cells discarded due to intershelf link alarm
Number of cells transmitted with CLP bit set
Number of AIS cells transmitted
Number of FERF cells transmitted
Number of BCM cells transmitted
Number of end-to-end loop back cells transmitted
Number of segment loop back cells transmitted
Number of cells received from PXM
Number of cells received with CLP bit set
Number of AIS cells received
Number of FERF cells received
Number of BCM cells received
Number of end-to-end loopback cells received
Number of segment loopback cells received
Number of OAM cells discarded due to CRC-10 error

**Table A-21 Diagnostic-Related Statistics**

<b>Diagnostic Statistic</b>
Header of last cell with unknown LCN
Header of last received frame with unknown DLCI
ECN current queue depth

**Table A-22 Troubleshooting Statistics**

Troubleshooting Statistic
ECN current queue depth, per channel

## FRSM-8T1 Specification

This section provides information on the T1 operation of the FRSM-8T1E1 card set. Topics are

- General physical information about the card set (Table A-23)
- Information about the Frame Relay service (Table A-24)
- System-level interface (Table A-25)
- Statistics and counters (Table A-26)

**Table A-23 General Card Specifications**

Category	Description
Indicators per card	Active (Green), Standby (Yellow), Fail (Red)
Indicators per line	Active & Okay (Green) Active & Local Alarm (Red) Active & Remote Alarm (Yellow)
Line Interface connector	RJ-48 when used with RJ48-8T1 back card
Line Rate	1.544 Mbps $\pm$ 50 bps
Line Framing	ESF per ATT TR 54016
Maintenance/Serviceability Features	Internal Problem Isolation Loopbacks Hot-pluggable cards
Reliability, MTBF	> 65000 hours
Card Size	FRSM-8T1: 7.25" x 16.25" LM-DB15-8T1: 7.0" x 4.5" Power: -48 VDC, 30W with 8 active T1 lines

**Table A-24 Frame Relay Service With T1 Lines**

Category	Description
Synchronization	Transmitter may be either loop-timed to receiver or synchronized to shelf (called normal mode)
Input Jitter Tolerance	Per ITU-T G.824
Output Jitter Generation	Per ITU-T G.824 using normal mode synchronization
Physical Layer Alarms	LOS, OOF, AIS, RAI
Number of Frame Relay Ports	One—a single Frame Relay stream occupying <i>N</i> consecutive time slots



Table A-24 Frame Relay Service With T1 Lines (continued)

Category	Description
Frame Relay Interface Rates	<p>Either of the following:</p> <ul style="list-style-type: none"> <li>• 56 Kbps</li> <li>• <math>N \times 64</math> Kbps (where <math>N</math> is the number of consecutive time slots)</li> </ul>
Frame Relay Interface	Per ANSI T1.618, 2-octet header
Frame Relay Performance Counters (per Port; $N \times DS0$ )	<p>Received frames discarded due to Aborts</p> <p>Received frames discarded due to illegal header (EA bit)(s)</p> <p>Received frames discarded due to CRC errors (s)</p> <p>Received frames discarded due to alignment errors (s)</p> <p>Received frames discarded due to unknown DLCI (s)</p> <p>Received frames discarded due to illegal frame length (s)</p> <p>Received frames discarded due to DE threshold exceeded</p> <p>Received frames with DE already set</p> <p>Received frames with FECN already set</p> <p>Received frames with BECN already set</p> <p>Received frames tagged FECN</p> <p>Received frames (s)</p> <p>Received bytes (s)</p> <p>Transmit frames discarded due to underrun</p> <p>Transmit frames discarded due to Abort</p> <p>Transmit frames discarded due to egress Q-depth exceeded (s)</p> <p>Transmit bytes discarded due to egress Q-depth exceeded (s)</p> <p>Transmit frames discarded due to egress DE threshold exceeded Transmit frames (s)</p>
	<p>Transmit bytes(s)</p> <p>Transmit Frames with FECN set (s)</p> <p>Transmit Frames with BECN set (s)</p>
	<p>LMI receive status inquiry request count (s)</p> <p>LMI transmit status inquiry request count</p> <p>LMI invalid receive status count (s)</p> <p>LMI signaling protocol (keep alive time-out count) (s)</p> <p>LMI sequence number error count (s)</p> <p>LMI receive status transmit count (in response to request)</p> <p>LMI transmit status transmit count (in response to request)</p> <p>Transmit frames during LMI alarm (s)</p> <p>Transmit bytes during LMI alarm (s)</p> <p>LMI update status transmit count (in response to configuration changes)</p>
Diagnostics (per port)	Last unknown DLCI received

**Table A-25 System Interface**

Category	Description
ATM Layer	Per ITU-T I.361 and ATM UNI v3.1
AAL Layer	AAL5 per ITU-T I.363
FR-Cell Interworking	Per ITU-T I.555 and I.36x.1, as summarized in <i>Frame Relay Forum, FR/ATM PVC Interworking Implementation Agreement FRF.5</i>

**Table A-26 List of Counters**

Category	Description
Channels (endpoints) per card	256, which you can allocate across any of the interfaces
Service Counters  Note that an (s) at the end of the description means the data in the counter is usable as a statistic.	Number of frames received (s) Number of bytes received (s) Number of frames received with DE already set (s) Number of bytes received with DE already set (s) Number of frames received with unknown DLCI Number of frames received but discarded (s) Number of received bytes discarded (s) Number of received bytes discarded due to exceeded Q-depth (s) Number of frames received and discarded due to: intershelf alarm exceeded DE threshold (s) exceeded Q depth (s) Number of frames received with FECN set Number of frames received with BECN set Number of frames received tagged FECN Number of frames received tagged BECN
	Number of frames transmitted (s) Number of bytes transmitted (s)

**Table A-26 List of Counters (continued)**

Category	Description
	Number of frames transmitted with DE set (s) Number of frames discarded due to reassembly errors (s) Number of frames transmitted during LMI logical port alarm(s) Number of frames transmitted with FECN set (s) Number of frames transmitted with BECN set (s) Number of transmit frames discarded (s) Number of transmit bytes discarded Number of transmit frames discarded due to: CRC error (s) egress Q depth exceeded (s) egress DE threshold exceeded source abort physical link failure (T1) ATM cells: Number of cells transmitted to PXM Number of cells transmitted with CLP bit set Number of OAM AIS cells transmitted (s) Number of OAM FERF cells transmitted (s) Number of BCM cells transmitted Number of OAM end-to-end loopback cells transmitted (s) Number of OAM segment loopback cells transmitted Number of cells received from PXM Number of cells received with CLP bit set Number of OAM AIS cells received (s) Number of OAM FERF cells received (s) Number of BCM cells received Number of OAM end-to-end loopback cells received (s) Number of OAM segment loopback cells received Number of OAM cells discarded due to CRC-10 error (s)
Statistics	If any of the counters in the preceding category of Service Counters includes an "(s)," you can configure it for statistics usage
Diagnostics	Last unknown LCN received Number of cells with unknown LCN

## FRSM-8E1 Specification

This section provides information on the E1 operation of the FRSM-8T1E1 card set. Topics are:

- General physical information about the card set (Table A-27)
- Information about the Frame Relay service (Table A-28)
- System-level interface (Table A-29)
- Statistics and counters (Table A-30)

**Table A-27 General Card Specifications**

Category	Description
Line Interface connector	RJ-48 when used with RJ-48-8E1 line module. SMB when used with SMB-8E1 line module
Line Rate	2.048 Mbps $\pm$ 100 bps

**Table A-27 General Card Specifications (continued)**

Category	Description
Synchronization	Transmitter may be either loop-timed to receiver or synchronized to shelf ( <i>normal mode</i> )
Input Jitter Tolerance	Per ITU-T G.823
Output Jitter Generation	Per ITU-T G.823
Physical Layer Alarms	LOS, OOF, AIS, RAI
Indicators per card	Active (Green), Standby (Yellow), Fail (Red)
Indicators per line	Active & Okay (Green) Active & Local Alarm (Red) Active & Remote Alarm (Yellow)
Maintenance/Serviceability Features	Internal Problem Isolation Loopbacks Hot-pluggable cards
Reliability, MTBF	> 65000 hours
Card Size	FRSM-8E1: 7.25" x 16.25" (18.43 cm x 41.28 cm) RJ48-8E1: 7.0" x 4.5" (17.78 cm x 11.43 cm) SMB-8E1: 7.0" x 4.5" (17.78 cm x 11.43 cm)
Power	-48 VDC, 30W with 8 active E1 lines

**Table A-28 Frame Relay Service With E1 Lines**

Category	Description
Number of Frame Interfaces	1–31 occupying N, where $1 < N < 31$ . Sum of all < 31 for CCS or 1–30 for CAS.
Frame Relay Interface Rates	Either 56 Kbps or $N \times 64$ Kbps, where N is the same as defined in the preceding item the preceding item “Number of Frame Interfaces.”
Ingress	8000-cell buffer shared between virtual channels/paths standard usage parameter control (UPC) Selective Cell Discard Virtual Circuit Queuing EFCI setting per VC
Egress	8000-cell storage capacity shared between four ports Up to 12 user-selectable egress queues per port Selective Cell Discard EFCI setting per Queue
Frame Relay Interface	Per ANSI T1.618, 2-octet header

**Table A-28 Frame Relay Service With E1 Lines (continued)**

Category	Description
Frame Relay Performance Counters (per Port; N x DS0):	Received frames discarded due to Aborts Received frames discarded due to illegal header (EA bit)(s) Received frames discarded due to CRC errors (s) Received frames discarded due to alignment errors (s) Received frames discarded due to unknown DLCI (s) Received frames discarded due to illegal frame length (s) Received frames discarded due to DE threshold exceeded Received frames with DE already set Received frames with FECN already set Received frames with BECN already set Received frames tagged FECN Received frames (s) Received bytes (s)
	Transmit frames discarded due to underrun Transmit frames discarded due to Abort Transmit frames discarded due to egress Q-depth exceeded (s) Transmit bytes discarded due to egress Q-depth exceeded (s) Transmit frames discarded due to egress DE threshold exceeded Transmit frames (s) Transmit bytes(s) Transmit Frames with FECN set (s) Transmit Frames with BECN set (s) LMI receive status inquiry request count (s) LMI transmit status inquiry request count LMI invalid receive status count (s) LMI signaling protocol (keep alive time-out count) (s) LMI sequence number error count (s) LMI receive status transmit count (in response to request) LMI transmit status transmit count (in response to request) Transmit frames during LMI alarm (s) Transmit bytes during LMI alarm (s) LMI update status transmit count (in response to configuration changes)
Diagnostics (per port):	Last unknown DLCI that arrived

**Table A-29 System Interface**

Category	Description
ATM Layer	Per ITU-T I.361 and ATM UNI v3.1
AAL Layer	AAL5 per ITU-T I.363
FR-Cell Interworking	Per ITU-T I.555 and I.36x.1, as summarized in <i>Frame Relay Forum, FR/ATM PVC Interworking Implementation Agreement FERF.5</i>

**Table A-30 List of Counters**

<b>Category</b>	<b>Description</b>
Channels (Endpoints)	256 per card—can be allocated across any of the Frame Relay interfaces
Counters	<p>Service Counters: Number of frames received (s)            Number of bytes received (s)            Number of frames received with DE already set (s)            Number of bytes received with DE already set (s)            Number of frames received with unknown DLCI            Number of frames received but discarded (s)            Number of received bytes discarded (s)            Number of received bytes discarded due to exceeded Q-Depth (s)            Number of frames received and discarded due to</p> <ul style="list-style-type: none"> <li>• intershelf alarm</li> <li>• exceeded DE threshold (s)</li> <li>• exceeded Q depth (s)</li> </ul> <p>Number of frames received with FECN set            Number of frames received with BECN set</p> <hr/> <p>Number of frames received tagged FECN            Number of frames received tagged BECN            Number of frames transmitted (s)            Number of bytes transmitted (s)            Number of frames transmitted with DE set (s)            Number of frames discarded due to reassembly errors (s)            Number of frames transmitted during LMI logical port alarm(s)            Number of frames transmitted with FECN set (s)            Number of frames transmitted with BECN set (s)            Number of transmit frames discarded (s)            Number of transmit bytes discarded            Number of transmit frames discarded due to: CRC error (s)            egress Q depth exceeded (s)            egress DE threshold exceeded source abort physical link failure (T1)</p>

Table A-30 List of Counters (continued)

Category	Description
	ATM cells: Number of cells transmitted to PXM Number of cells transmitted with CLP bit set Number of OAM AIS cells transmitted (s) Number of OAM FERF cells transmitted (s) Number of BCM cells transmitted Number of OAM end-to-end loopback cells transmitted (s) Number of OAM segment loopback cells transmitted Number of cells received from PXM Number of cells received with CLP bit set Number of OAM AIS cells received (s) Number of OAM FERF cells received (s) Number of BCM cells received Number of OAM end-to-end loopback cells received (s) Number of OAM segment loopback cells received Number of OAM cells discarded due to CRC-10 error (s) Statistics: All of the above counters followed by an (s) can be configured as statistics. Diagnostics: Last unknown LCN received Cells with unknown LCN count Card General

## Circuit Emulation Service Module for T1 Operation

This section contains operational details for the CESM 8T1E1 with the RJ48-8T1 back card.

Table A-31 CESM 8T1 Card Information

Category	Description
Back Card	RJ48-8T1
Line Rate	T1: 1.544 Mbps $\pm$ 50 bps
Transmit Clocking	Normal clock or SRTS generated
Line Coding	B8ZS
Frame mode	ESF
Line alarms	Loss or Signal (LOS) Loss of Frame (LOF) Loss of multiframe (LOMF) Remote loss of signal or frame (RAI) All ones received (AIS) Bi-polar violation
Alarm indication times	Near end alarm up-count Near end alarm down-count Near end alarm maximum count Far end alarm up-count Far end alarm down-count Far end alarm maximum count

**Table A-31 CESM 8T1 Card Information (continued)**

Category	Description
Supported OAM cells	AIS FERF End-to-end loopback Segment loopback RTD loopback BCM
Physical Layer Performance Statistics	N/A
LED Indicators Per Card	Active (green), Failed (red), Standby (yellow)
BERT	Active (green), Errors (yellow)
1:N Redundancy	Active (green)
Indicator for each T1	Active (green)
Reliability, MTBF	
Card Size	Front card: 7.25" x 16.25" (18.43 cm x 41.28 cm) Back card: 7" x 4.5" (17.78 cm x 11.43 cm)
Power	48 VDC, 30W
Loopbacks	On or Off

## Circuit Emulation Service Module for E1 Operation

This section contains operational details for the CESM-8T1E1 with an E1 back card.

**Table A-32 CESM 8E1 Card Set Details**

Category	Description
Back Card	RJ48-8E or SMB-8E1
Line Rate	E1: 2.048 Mbps $\pm$ 100 bps (50 ppm)
Transmit Clocking	Normal clock or SRTS generated
Line Coding	HDB3
Frame mode	single-frame multi-frame
Line alarms	Loss or Signal (LOS) Loss of Frame (LOF) Loss of multi-frame (LOMF) Remote loss of signal or frame (RAI) All ones received (AIS) Bi-polar violation



**Table A-32 CESM 8E1 Card Set Details (continued)**

Category	Description
Alarm indication times	Near end alarm up-count Near end alarm down-count Near end alarm maximum count Far end alarm up-count Far end alarm down-count Far end alarm maximum count
Supported OAM cells	AIS FERF End-to-end loopback Segment loopback RTD loopback BCM
Physical Layer Performance Statistics	N/A
Indicators	
Card-level	Active (green), Failed (red), Standby (yellow)
BERT	Active (green), Errors (yellow)
1:N Redundancy	Active (green)
Indicator for each T1	Active (green)
Reliability, MTBF	
Card Size	Front card: 7.25" x 16.25" (18.43 cm x 41.28 cm) Back card: 7" x 4.5" (17.78 cm x 11.43 cm)
Power	-48VDC, 30 W
Loopbacks	On or Off

## Physical and Electrical Characteristics for Cards

For quick reference, Table A-33 shows physical dimensions and power consumption for each card. Detailed information for each card appears in the section of this appendix for a specific card.

**Table A-33 Physical Characteristics and Power Consumption by Card**

Module	Back Cards	Front Card Dimensions (inches)	Back Card Dimensions (inches)	Weight (front and back card)	Power Consumption
FRSM-8T1 FRSM-8E1 FRSM-8T1c FRSM-8E1c	8 T1, 8 E1	7.25 x 16.25	7.00 x 4.50	1.74 lbs/ 0.76 lbs	30 Watts
FRSM-2CT3	2 T3	7.25 x 16.25	7.00 x 4.50	1.74 lbs/ 0.76 lbs	60 Watts

Table A-33 Physical Characteristics and Power Consumption by Card (continued)

Module	Back Cards	Front Card Dimensions (inches)	Back Card Dimensions (inches)	Weight (front and back card)	Power Consumption
FRSM-2T3E3	2 T3, 2 E3	7.25 x 16.25	7.00 x 4.50	1.74 lbs/ 0.76 lbs	60 Watts
FRSM-HS2	2 HSSI	7.25 x 16.25	7.00 x 4.50	1.74 lbs/ 0.6 lbs	75 Watts
CESM-8T1E1	8 T1, 8 E1	7.25 x 16.25	7.00 x 4.50	1.74 lbs 0.76 lbs	30 Watts
AUSM/B-8T1E1	8-T1, 8-E1	7.25 x 16.25	7.00 x 4.50	1.74 lbs 0.76 lbs	30 Watts
PXM1	OC-3c/STM-1	15.65 x 15.83	7.00 x 4.5	4.80 lbs	100 Watts

## Electromagnetic Compatibility

This section lists the national and international standards for electromagnetic compatibility to which the MGX 8230 complies. It consists of a list of reference documents, a table (Table A-34) that indicates applicability of the standards, and the test levels for CE mark immunity.

The applicable standards for electromagnetic compatibility are

- NEBS Systems Requirements (GR-1089-CORE)
- EN 55022/08.94
- EN 50081-1/01.92 and EN 50082-1/01.92 (Generic Immunity Requirements), International Electromechanical Commission (IEC 61000-4-2 through IEC 61000-4-5) European Norm designation EN 61000-4-2 through EN 61000-4-5

Details on how each standard applies in this Cisco product appear in Table A-34.

Table A-34 Electromagnetic Compatibility and Immunity

Category	AC-Powered (110/220 VAC)	DC-Powered (-48V)
U.S.A EMC	FCC Part 15, Class A	not applicable
Japan EMC	Austel 3548 Class A	not applicable
Australia EMC	VCCI Class A	not applicable
CE mark	EMC: EN 55022 Class A	not applicable
Immunity	<ul style="list-style-type: none"> <li>• EN 50082-1 (generic immunity)</li> <li>• EN 61000-4-2 through -5</li> </ul>	

**Table A-34 Electromagnetic Compatibility and Immunity (continued)**

Category	AC-Powered (110/220 VAC)	DC-Powered (-48V)
NEBS (EMC)	not applicable	EMC: GR-1089-CORE Class A (radiated and magnetic fields) and line conductance. GR-1089-CORE ESD (8 KV contact) RS (10 V/meter) CS (clause 3.3.3) European Telecom Standards (ETSI) for Surge: ETSI 300 386-1, DC power leads only (200 VAC–1000 VAC)

The levels for the mandatory CE mark immunity tests are

- For IEC 61000-4-2 (ESD), the test level is 4.
- For IEC 61000-4-3 (RS), the test level is 3.
- For IEC 61000-4-4 (EFT), the test level is 4.
- For IEC 61000-4-5 (Surge), the test level is 3.

## Conformance

This section contains standards compliance information for features on the MGX 8230.

### ATM UNI

The ATM specifications for the User-Network Interface to which the MGX 8850 complies are

- ATM Forum–ATM UNI, V3.1, 1995.
- ITU Recommendation I.361–B-ISDN ATM Layer Specification, March 1993.
- ITU Recommendation I.371–Traffic Control and Congestion Control in B-ISDN, March 1993.
- ITU Recommendation I.432–B-ISDN User Network Interface—Physical Interface Specification, March 1993.
- ITU Recommendation I.610–B-ISDN Operation and Maintenance Principles and Functions, Specification, November 1995.
- ANSI T1E1.2/94-002R1, Draft–B-ISDN and DS1/ATM User Network Interfaces: Physical Layer Specification.
- ANSI T1E1.2/94-020, Draft–B-ISDN Customer Installation Interfaces, Physical Media Dependent Specification.

## SONET/SDH

The standards and responsible organizations with which MGX 8850 SONET technology complies are as follows:

- Bell Communications Research–SONET Transport Systems: Common Generic Criteria, GR-253-CORE, Issue 2, 1995.
- Bell Communications Research–Broadband Switching System Generic Requirements, GR-1110-CORE, Issue 1, Sept. 1994.
- Bell Communications Research–ATM and ATM AAL Protocols, GR-1113-CORE, Issue 1, July 1994.
- Bell Communications Research–Generic Requirements for Operations of Broadband Switching Systems, GR-1248-CORE, Issue 2, Rev 1.
- ITU-T G.707–Network Node Interface for the Synchronous Digital Hierarchy.
- ITU Recommendation G.782–Types and General Characteristics of Synchronous Digital Hierarchy (SDH) Equipment, January 1994.
- ITU Recommendation G.783–Characteristics of Synchronous Digital Hierarchy (SDH) Equipment Functional Blocks, January 1994.
- ITU Recommendation G.832–Transport of SDH Elements on PDH Networks: Frame and Multiplexing Structures, November 1993.
- ITU Recommendation G.958–Digital Line Systems based on the Synchronous Digital Hierarchy for use on Optical Fibre Cables, November 1994.
- ANSI T1.105–Digital Hierarchy–Optical Interface Rates and Formats Specifications (SONET), 1991.
- ANSI T1.231–Digital Hierarchy–Layer 1 In-Service Digital Transmission Performance Monitoring (SONET), 1993.

## Frame Relay

The standards and responsible organizations with which MGX 8230 Frame Relay technology complies are as follows:

- FRF.1.1
- FRF.2.1
- FRF.3.1
- FRF.5
- FRF.6
- FRF.8

## Circuit Emulations Service

ATM Forum CES 2.0.

## Safety

The MGX 8230 enclosure meets all applicable regulatory agency Product Safety requirements.

- UL 1950, Third Edition (Standard for Safety, Information Technology Equipment, Including Electrical Business Equipment).
- CSA C22.2-#950- M95, (Standard for Safety, Information Technology Equipment, Including Electrical Business Equipment).
- EN 60 950 (Safety of Information Technology Equipment, Including Electrical Business Equipment).
- TS001 Austel-Safety Requirements for Customer Equipment. (Including AS3260, Safety of Information Technology Equipment)-Australia.
- EN 41003 (European Product Safety Standard for Telecommunications Equipment).

## Environmental

The MGX 8230 adheres to the Bellcore GR-63-CORE environmental standard.

