

8 port Gigabit Ethernet/Fibre Channel TDM Multiplexer Module

Overview

8 port TDM Multiplexer Module is a part of MICROSENS 10G Transport Platform, a high performance and flexible carrier-class transmission system. The 10G Transport Platform enables increasing transport capacities in CWDM, DWDM and SDH networks. The use of wide range TDM modules permits to reduce the number of necessary wavelengths and to decrease the overall cost of the application. Ethernet over SDH modules enable using existing SONET/SDH infrastructure for IP transmission.



The general features of the system:

- 19" 2U Chassis with 5 module slots and management card
- Max. 5x single size modules f.ex. 2x double size + 1x single size module
- Hot swappable modules & power supplies
- Redundant power supplies with -48 VDC input (opt. 230 VAC)
- Exchangeable air- and filter module
- Wide range of functional xWDM and TDM modules available

The functional modules of 10G Transport Platform include:

- TDM 8x GBE or 8x GFC to 10G/OC-192/STM-64
- TDM 5x GBE or 5x 2GFC to OC-192/STM-64
- TDM 4x OC-48/STM-16 to 10G/OC-192/STM-64
- TDM 2x GBE and 2x GFC to OC-48/STM-16
- 10G transponder with 3R, XFP and fixed Laser Versions
- 10G protocol converter 10G LAN to 10G WAN (OC-192/STM-64)
- DWDM MUX/DeMUX, OADMs, EDFAs

Introduction

MICROSENS TDM Multiplexer is a bidirectional module offering the aggregation and transport of up to 8 data client ports (GbE, GFC) onto a 10 Gb/s signal. Thus it enables much more effective multiplexing and saving the optical channel capacities.

Features

- 8 x Gigabit Ethernet/Fibre Channel client port interfaces
- RMON on Gigabit Ethernet input signals
- SFP modules for client port physical interfacing
- OC-192c, STM-64c line format, reduced functionality interface
- XFP module for standard line port physical interface
- FFI module 40 and 80 km B&W or DWDM line interface
- SDH/SONET performance monitoring
- DDM (Digital Diagnostic Monitoring) information from SFP and XFP

System description

The Multiplexer Module is a bidirectional device. It therefore has different sections:

- Upstream Section: from eight GbE/GFC optical inputs to OC192c/STM-64c optical output
- Downstream Section: from OC192c/STM-64c optical input to eight GbE/GFC optical outputs
- Common sections composed of :
 - Controller block, providing interfacing to the controller board hosting the SNMP Agent.
 - Power supplies: generates different internal power supplies from the -48V of the backplane
 - Front panel LEDs indicating the status of the ports, line and the MS43062xM common functions

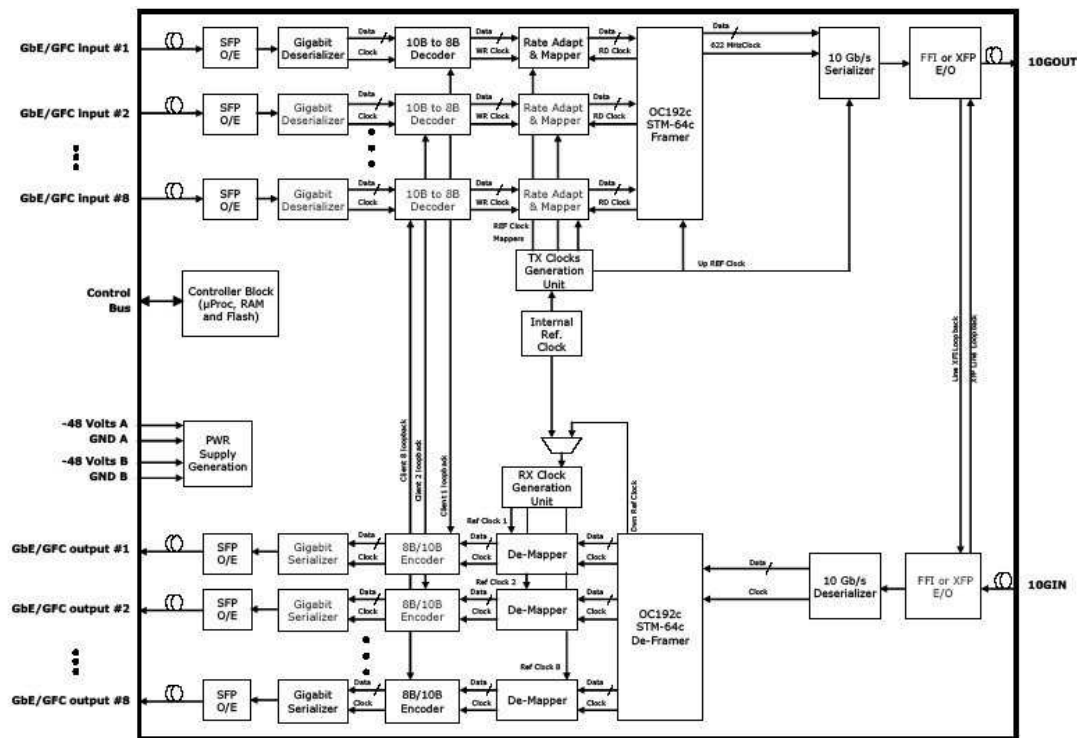


Figure 1: Block diagram of 8 port TDM Multiplexer.

Upstream section

Input Ports interfacing and 10/8B decoder

The upstream section has eight configurable Gigabit Ethernet (1.25 Gb/s) / Fiber Channel (1.0625Gb/s) inputs. Client physical interfacing is done through standard SFP modules, therefore allowing providing also GbE/GFC optical or electrical interfacing. Each upstream client port is 10B to 8B decoded prior to be adapted by the rate adaptation and mapping function. Incoming 10B characters which are not recognized being valid are replaced by a K30.7 during the decoding process.

The port configuration information (GbE, GFC protocol) is provided by the controller block on a per port basis.

The following information is provided to the controller on a per port basis:

- SFP absence
- Loss of optical input signal
- Loss of word synchronization from the 10B to 8B decoder
- Counting of incoming decoding violations (Separate counters for running disparity and received illegal 10B words)
- DDM information

Running Disparity error definition:

3 conditions:

- disparity of a received 10B word is different from 0 (5 ones, five zeros), +2 (6 ones, 4 zeros) or -2 (4 ones, 6 zeros)
- running disparity at the beginning of a 10B word is negative and disparity of the received 10B word is -2
- running disparity at the beginning of a 10B word is positive and disparity of the received 10B word is +2 each time one of these three cases is encountered, RD errors counter is incremented by one.

Decoding violations definition

If during the decoding process, a 10B word is not found in the decoding table column given by the current running disparity, it is considered as a decoding violation error (even if it exists in the other column).

Decoding violation counter is incremented each time such a case is encountered.

RMON (Remote Network Monitoring, GbE clients only, optional)

Remote Network Monitoring functionality is provided on the GbE incoming client ports to the MS43062xM.

The following statistics are made available on a per port basis:

- Bytes counter:
total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including FCS octets).
- Packet counters:
total number of packets (including bad packets, broadcast packets, and multicast packets) received.
- CRC errors counter
total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).
- Multicast packet counter
total number of good packets received that were directed to a multicast address (LSB of most significant byte of the destination MAC address equal to 1). Note that this number does not include packets directed to the broadcast address.
- Broadcast packet counter
total number of good packets received that were directed to the broadcast address (MAC address equal to FF:FF:FF:FF:FF:FF). Note that this does not include multicast packets.

In the previous counters definitions:

Good packets are error-free packets that have a valid frame length. For example, on Ethernet, good packets are error-free packets that are between 64 octets long and 1518 octets long. They follow the form defined in IEEE 802.3 section 3.2.all.

Bad packets are packets that have proper framing and are therefore recognized as packets, but contain errors within the packet or have an invalid length. For example, on Ethernet, bad packets have a valid preamble and SFD, but have a bad CRC, or are either shorter than 64 octets or longer than 1518 octets.

Mapper

Incoming signals must be synchronized together and are mapped in a proprietary frame prior of being multiplexed together for framing in an OC-192c/STM-64c signal. The organization of mapped client signals into the OC-192c/STM-64c is described on Figure 3.

Rate adaptation process of each incoming GbE/GFC signal aligns each incoming frequency to the local system frequency.

For GbE signals, rate adaptation is performed by:

- Adding or removing IDLES after at least 3 have been received

- Adding or removing /C1/C2/ in continuous stream of /C1/C2/ (after at least three have been received)

For GFC signals, rate adaptation is performed by:

- Adding or removing IDLES after at least 2 have been received

This includes the case for which the structure of Inter Frame Gap is:

IDLE-IDLE-PRIMITIVE SIGNAL-IDLE-IDLE.

- Adding or removing Primitive sequences on continuous streams of primitive sequences (after at least three received)

Incoming GbE or GFC signals frequency have a tolerance of ± 100 ppm. Local system clock has a tolerance of ± 20 ppm. Rate adaptation process therefore ensures that the clock tolerance of the GbE and GFC data stream restored at the far end will be ± 20 ppm.

For ensuring the rate adaptation process is performed properly, incoming signal shall have the following characteristics:

- Inter frame gap of incoming GbE frames shall contain at least 4 IDLE ordered set.
- Inter frame gap of incoming GFC frames shall contain at least 3 IDLE primitive signals (/K28.5/D21.5/D21.5/D21.5/).

This previous conditions ensures that clock tolerances up to ± 120 ppm on incoming signals can be compensated for.

Synchronized GbE or GFC incoming signals are mapped in a proprietary frame. This frame transports the following information in addition to the data (per client port):

- Client Signal Fail indication: a bit in the mapping frame is set in case one of the following conditions are present on the incoming signal (see Figure 2)
 - SFP not present
 - Loss of incoming signal
 - Loss of 10B/8B decoder synchronization
 - Rate adaptation buffer overflow

All these contributors to client signal fail are configurable through the SNMP agent of the system.

- A client BIP-8 parity (CBIP) is computed over each mapped client signal and inserted in the corresponding mapping frame. The client BIP parity covers one line for each client signal (see Figure 3 for the organization of client signals in the outgoing SONET/SDH frame), which means the total number of bytes covered is 2080 bytes per mapped client signal (including the CBIP byte itself).

The following information is provided to the controller on a per port basis:

- Client Signal Fail asserted
- Rate adaptation buffer overload

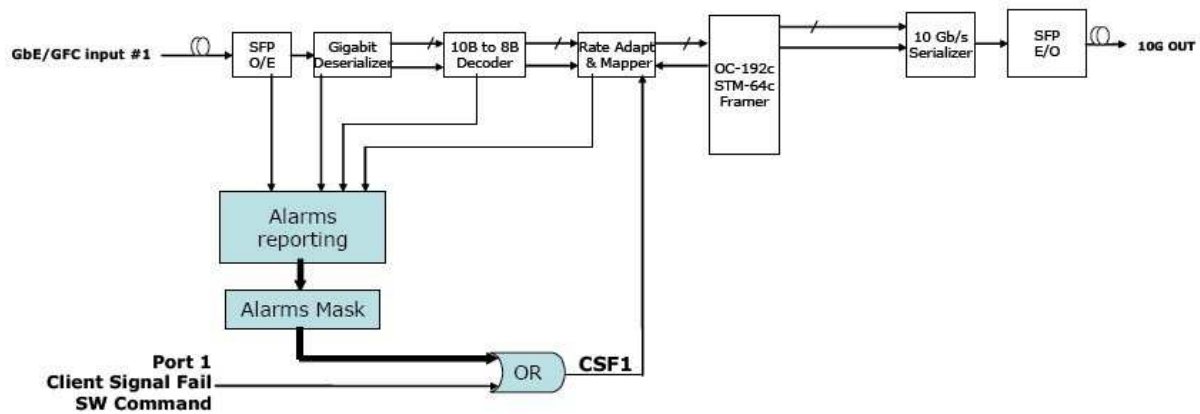


Figure 2: Upstream Client Signal Fail assertion principle.

Framer

The eight mapped GbE/GFC client signals are then interleaved in a STS-192c payload in SONET mode and in an AU4-64c payload in SDH mode. The pointer value is set to 522 decimal.

The payload is framed into an OC-192c/STM-64c output signal.

B1 is calculated and inserted in its corresponding locations in the outgoing signal.

The following information is provided to the controller on a per port basis:

- MS-AIS inserted (test purposes)
- MS-RDI inserted

J0 insertion (optional)

With this option (J0 insertion and extraction), J0 is inserted according one of the 4 following configurable modes:

- Single byte mode (SDH standard)
- 16 bytes modes with CRC7 (SDH standard)
- 64 bytes mode with CRC7 (extended SDH standard)
- 64 bytes mode with CR and LF special characters (SONET standard)

Line Optical Interfacing

Depending on the MS43062xM version, line optical interfacing can be performed through either an XFP module, either an FFI module.

FFI modules are MICROSENS designed optical interfaces which present the same optical connector, as well as same management information as an XFP.

FFI module provides 40/80 km black and white or DWDM interface.

As opposed to XFP, FFI units are integrated in the MS430624M and therefore can not be removed separately.

The following alarms can be read from the Line Optical Interface:

- XFP absent
- Transmitter fault
- Transmitter CDR not locked
- Transmitter not ready
- DDM information

The following controls can be sent to the XFP/FFI:

- Shut down optical transmitter
- XFI loop-back (if implemented in XFP)
- XFP Line loop-back (if implemented in XFP)

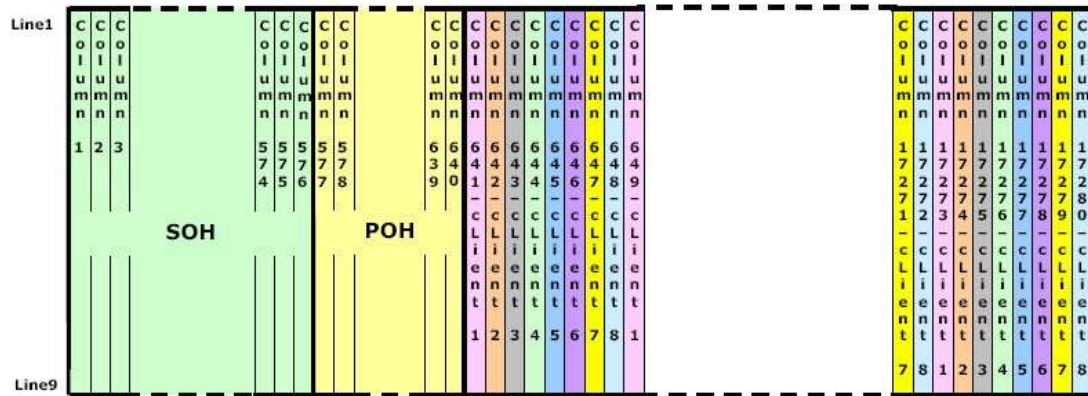


Figure 3: Organization of the mapped 8 client signals in STM-64c/OC-192c frame.

DownStream Section
Line Optical Interfacing

Depending on the MS43062xM version, line optical interfacing can be performed through either an XFP module, either an FFI module.

FFI modules are MICROSENS designed optical interfaces which present the same optical connector, as well as same management information as an XFP.

FFI module provides 40 and 80 km B&W and DWDM interface.

As opposed to XFP, FFI units are not hot pluggable into the MS430624M.

The following alarms can be read from the Line Optical Interface:

- XFP absent
- Loss of input signal
- Receiver CDR not locked
- Receiver not ready
- DDM information

De-Framer

OC-192c/STM64c frame alignment is performed and B1 parity calculation is computed.

No pointer processing is performed on the received signals.

The following information is provided to the controller for the OC-192c/STM-64c incoming signal:

- Loss of Frame on incoming signal
- MS-AIS received
- MS-RDI received
- B1 errors counting

The performance of the de-framer is:

- OOF to In Frame transition
In Frame state is declared upon reception of two consecutive frames containing the framing pattern searched.
Framing pattern searched is a 20 bit pattern overlapping the A1-A2 transition.
- In Frame to OOF transition
OOF state is declared upon reception of five consecutive frames not containing the framing pattern searched.
Framing pattern searched is a 8 bit pattern overlapping the A1-A2 transition.

The previous criteria for declaring IF and OOF lead to the following performance of the framer:

- Probability for False Recovery per 250 μ s time interval with random unframed signal while in OOF state:
 $1,13 \times 10^{-6}$
- Time between two false OOF for BER = 10^{-3} while in In Frame state:
 $3,815 \times 10^6$ (~44 days)

LOF is declared upon 3 consecutive msec of OOF state.

LOF is reset upon 3 consecutive msec of In Frame state.

J0 extraction (optional)

The Section Trace Identifier (J0 byte) is captured and confirmed on three frames.

The MS43062xM may be configured to support one of the four following modes:

- Single byte mode (SDH standard)
- 16 bytes modes with CRC7 (SDH standard)
- 64 bytes mode with CRC7 (extended SDH standard)
- 64 bytes mode with CR and LF special characters (SONET standard)

The following information is provided to the controller on a per port basis:

- Trace Identifier Mismatch
- Trace Identifier Instable
- CRC error detected alarm

Signal Degrade and Signal Fail generation (optional)

The Signal Fail alarm is asserted on:

- Loss Of Signal detection
- Loss Of Frame detection
- MS-AIS detection
- B1 error rate higher than a defined threshold.

The Signal Degrade alarm is asserted on:

- B1 error rate higher than a defined threshold.

The following information is provided to the controller on a per port basis:

- Signal Fail alarm,
- Signal Degrade alarm.

The following information is received from the controller on a per port basis:

- Signal Degrade threshold (10^{-6} to 10^{-9}),
- Signal Fail threshold (10^{-3} to 10^{-6}),
- Restore default thresholds (10^{-9} for SD and 10^{-6} for SF),
- Signal Fail and Signal Degrade alarms reset.

Performance Monitoring (optional)

The Performance Monitoring is performed and based on the B1 error detection according to the SONET/SDH standard. The following parameters are available:

- Coding Violation (CV)
- Errored Seconds (ES)
- Severely Errored Seconds (SES)
- Severely Errored Framing Seconds (SEFS)

The following information is provided to the controller on a per port and per parameter basis:

- a 15-minutes current counter
- a 15-minutes previous register
- 31 recent 15-minutes history counters
- two 15-minutes TCA (Threshold Crossing Alert) alarms (low and high)
- a 24-hours current counter
- a 24-hours previous register
- a 24-hours TCA (Threshold Crossing Alert) alarm

The following information is received from the controller:

- a 15-minutes current counter reset, defined for all parameters on a per port basis,
- a 15-minutes high threshold, defined on a per port and per parameter basis,
- a 15-minutes low threshold, defined on a per port and per parameter basis,
- a 24-hours current counter reset, defined for all parameters on a per port basis,
- a 24-hours threshold, defined on a per port and per parameter basis,
- Synchronization, common to all parameters and all ports.

De-Mapper

The de-mapper extracts GbE or GFC data from the proprietary mapping frame. Client Signal Fail information is also extracted and reported to the controller block. BIP-8 parity (CBIP) is computed over each individual received channel and compared to the received BIP-8. Error counting is performed and the result is reported to the controller block. Data passed to the 8B/10B encoder. Under failure conditions, an output client AIS (CAIS) signal is inserted on the outgoing client port.

The alarms leading to assertion of client AIS are:

- Loss of optical input signal
- Loss of Frame on OC-192c/STM-64c input.
- L-AIS/MS-AIS received on the OC-192c/STM-64c input.
- Incoming CSF detected on individual channel
- De-mapper buffer overflow on individual channels

The client AIS signal is configurable to be one of the two following:

- Permanent K30.7 in GbE
- Permanent Illegal 10B neutral disparity code group: 0011110001 (RD-) or 1100001110 (RD+) in GFC
- Client optical output port shut down.

The CAIS mechanism is described in Figure 5.

The following information is received from the application processor on a per port basis:

- GbE, GFC configuration

The following information is provided to the application processor on a per port basis:

- CSF received
- BIP-8 errors counting
- CAIS asserted

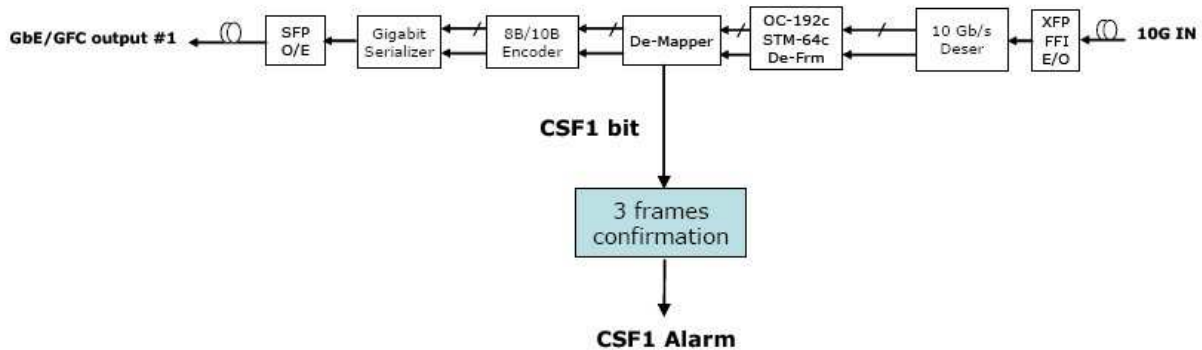


Figure 4: Downstream CSF detection mechanism

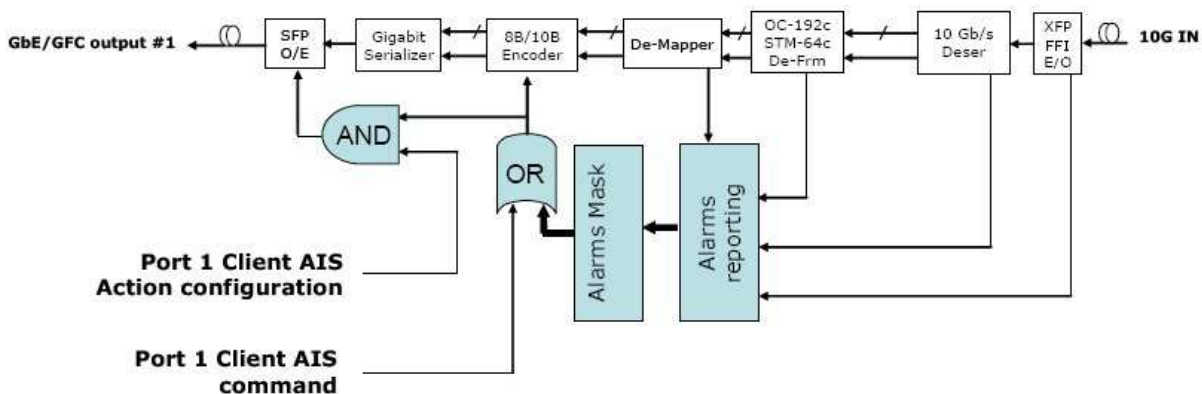


Figure 5: Downstream CAIS mechanism.

8B/10B encoder and output port interfacing

The data to be 8B/10B encoded consist of the data itself to be encoded as well a signalling line indicating whether the data being presented to the encoder is a data word or a control word.

Errors which can have happened on the transmission line may lead to words which are not recognized by the encoder. Under such condition, unrecognized incoming characters are encoded with the following 10B neutral disparity code group:

0011110001 (RD-) or 1100001110 (RD+) in GFC/2GFC or K30.7 in GbE.

The following information is provided to the application processor on a per port basis:

- Optical transmitter failure
- DDM information

The following configuration information is received from the application processor on a per port basis:

- Optical output shut-down
- GbE/GFC configuration

Each channel is serialized and converted to an optical signal by SFP modules.

Maintenance Loop backs**Client loop back**

As a test feature, an individual client loop back can be performed for maintenance operations. The client signal received on an input port is looped back on the corresponding outgoing client port. The description of the data path in case of client loop back is found on Figure 6.

XFI loop back

As a test feature, an XFI loop back can be performed for maintenance operations, allowing looping back the transmitted 10Gb/s signal on the downstream section. The description of the data path in case of XFI loop back is found on Figure 7.

XFP Line loop back

As a test feature, a line loop back can be performed for maintenance operation, allowing looping back the received 10 Gb/s signal on the upstream section. The clock and data path in case of XFP line loop back is described on Figure 8.

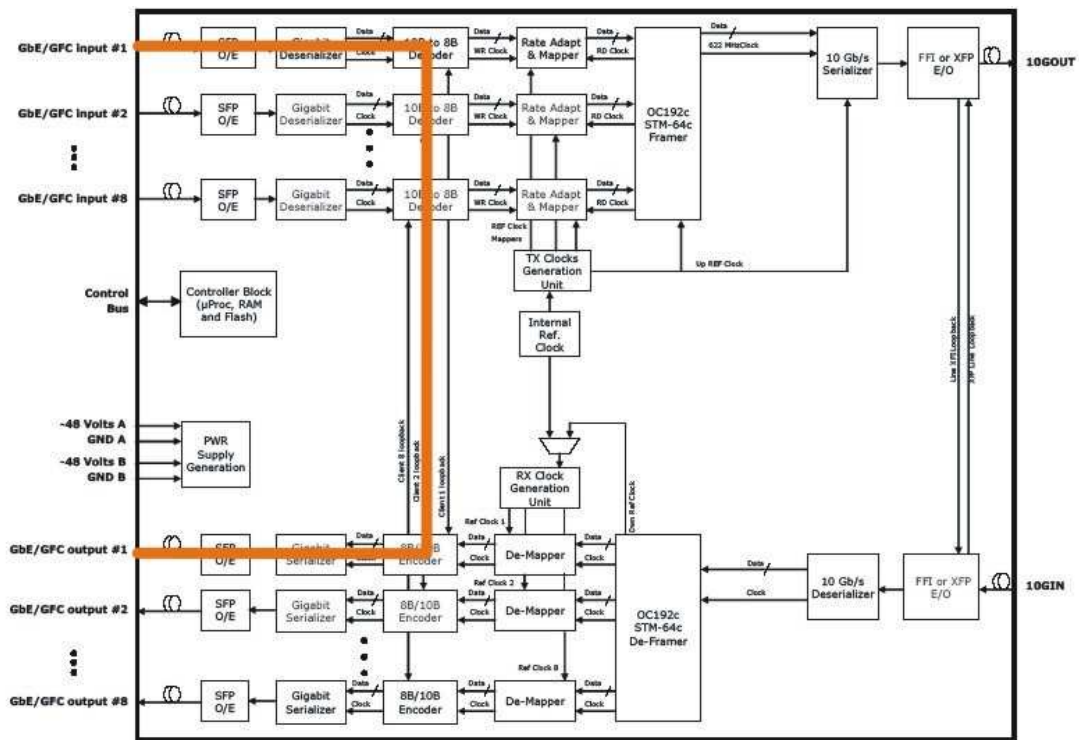


Figure 6: Signal data path in client loop-back operation.

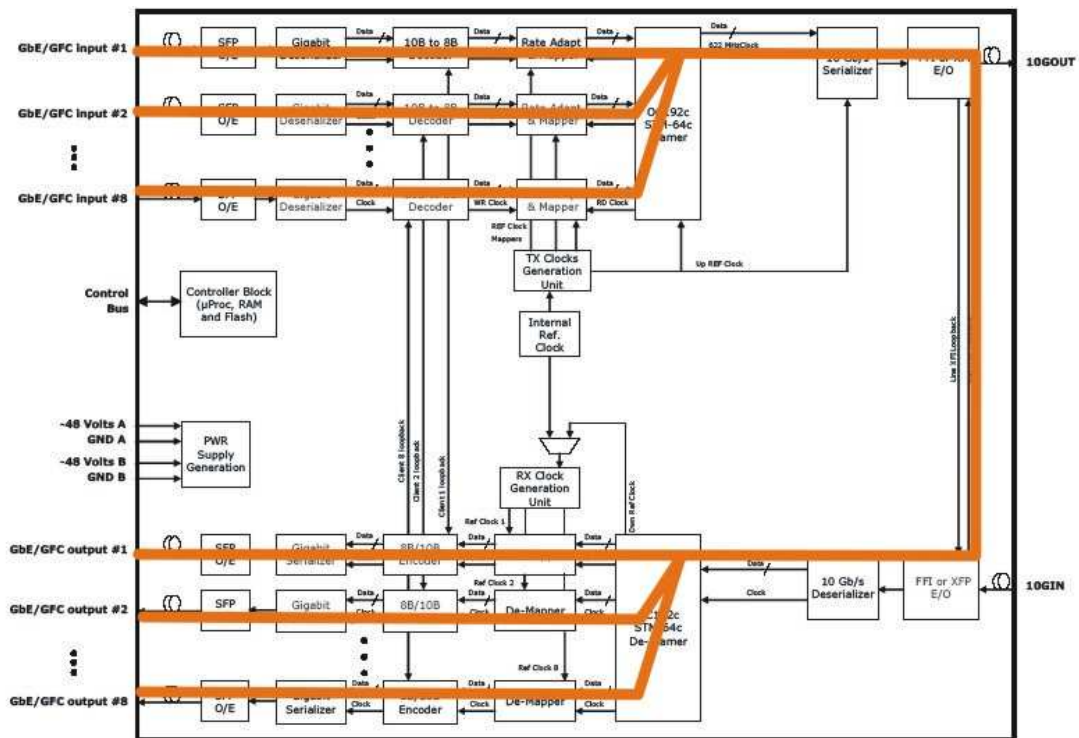


Figure 7: Signal data path in XFI loop-back operation.

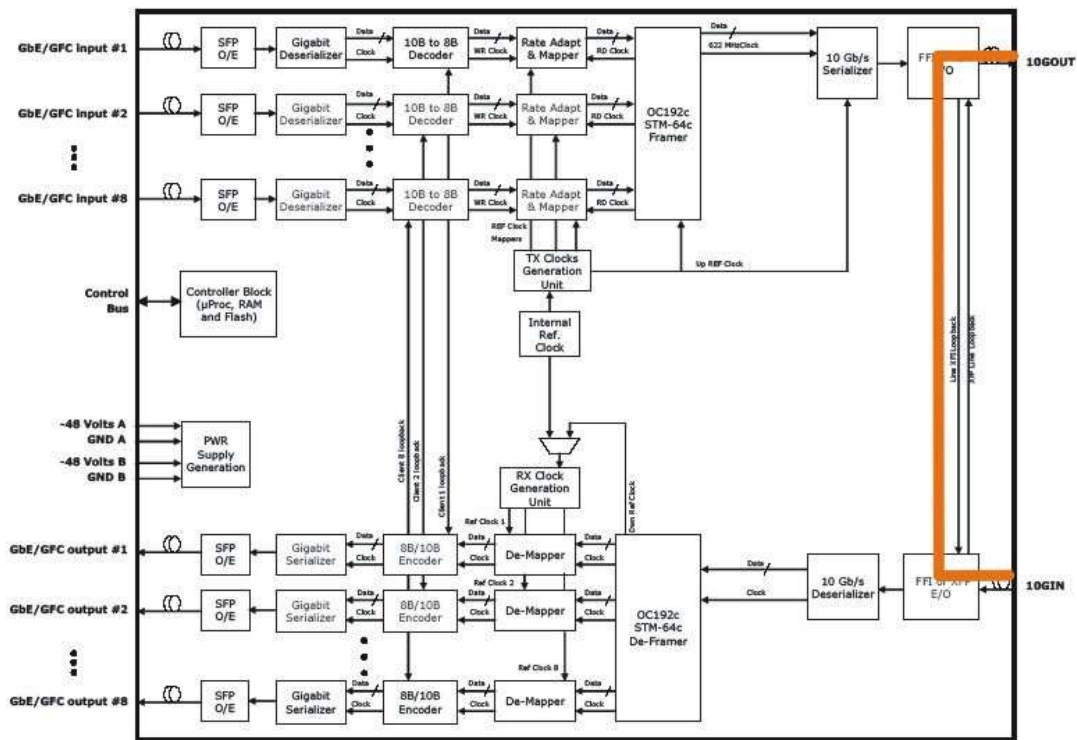


Figure 8: Signal data path in XFP line loop-back operation.

Clock Generation Unit

UpStream Clock Generation Unit

The UpStream Clock generation unit generates all internal clock signals required by the upstream part of the MS43062xM. The reference clock is internal to the MS43062xM and has a stability of +/- 20 ppm.

The following information is made available to the controller block:

- Upstream clock multiplier unit not locked

DownStream Clock Generation Unit

The DownStream Clock generation unit generates all internal clock signals required by the downstream part of the MS43062xM.

It generates in particular the GbE/GFC reference clocks which are fed to the individual de-mappers.

Under normal operation, this block is driven by the recovered clock from the incoming 10 Gb/s signal. In case of failure of the incoming signal, this block is driven by the MS43062xM upstream reference clock.

The following information is made available to the controller block:

- DownStream clock recovery unit not locked

Controller Block

The controller block is composed of a microprocessor associated with Flash and RAM memories.

The controller block collects information from different functional blocks and configures the HW according to a configuration file received.

The raw information (alarms, monitoring, inventory ...) generated by the HW are processed by the microprocessor and delivered to the Management Board as high level consolidated data.

Power Supplies

The power supply block generates from the received external -48 volts, the different internal supplies needed.

Interface Specifications

Client Interfaces Optical Characteristics

Client interfaces are provided by SFP transceivers. The optical characteristics are therefore given in the data sheet of the SFPs plugged into the MS43062xM module.

MS430620M Line Interface characteristics

Line optical interfacing is provided by XFP transceivers. The optical characteristics are therefore given in the data sheet of the XFPs plugged into the MS430620M module.

MS430624M Line Interface characteristics

FFI 40 km Line Interface characteristics

The MS430624M can provide 40 km B&W or DWDM optical interfaces through the MICROSENS FFI modules.

General	Value			Unit
	Min.	Typ.	Max.	
Bit Rate nominal	9.95308		10.70944	GHz
Line Coding	NRZ			-
Optical path max attenuation	-	-	11	dB
Optical path min attenuation	-	3	-	dB
Max path penalty @800ps/nm	-	-	2	dB
Transmitter	Value			Unit
B&W wavelength (opt. 305)	1530	-	1560	nm
DWDM Wavelength range (100 GHz grid) (opt. 306)	1529.55	-	1563.05	nm
	191.8	-	196	THz
Centre wavelength tolerance (EOL) (opt. 306)	- 100	-	+ 100	pm
	- 10	-	+ 10	GHz
SMSR	30	-	-	dB
Pout (average value)	-1	-	+2	dBm
Extinction Ratio	8.2	-	-	dB
Receiver	Value			Unit
Wavelength Range	1525	-	1570	nm
Pin _{max} (BER @ 10 ⁻¹² , average value, ER=10dB)	-	-	-1	dBm
Pin _{min} (sensitivity for BER @ 10 ⁻¹² , average value, ER=10dB)	-	-17	-14	dBm
Receiver Reflectance			-27	dB

FFI 60 km Line Interface characteristics

The MS430624M can provide 60 km B&W or DWDM optical interfaces through the MICROSENS FFI modules.

General	Value			Unit
	Min.	Typ.	Max.	
Bit Rate nominal	9.95308		10.70944	GHz
Line Coding	NRZ			-
Optical path max attenuation	-	-	16	dB
Optical path min attenuation	-	11	-	dB
Max path penalty @800ps/nm	-	-	2	dB
Transmitter	Value			Unit
B&W wavelength (opt. C)	1530	-	1560	nm
DWDM Wavelength range (100 GHz grid) (opt. D)	1529.55	-	1563.05	nm
	191.8	-	196	THz
Centre wavelength tolerance (EOL) (opt. D)	- 100	-	+ 100	pm
	- 10	-	+ 10	GHz
SMSR	30	-	-	dB
Pout (average value)	-2	-	+2	dBm
Extinction Ratio	10	-	-	dB
Receiver	Value			Unit
Wavelength Range	1525	-	1570	nm
Pin _{max} (BER @ 10 ⁻¹² , average value, ER=10dB)	-	-9	-	dBm
Pin _{min} (sensitivity for BER @ 10 ⁻¹² , average value, ER=10dB)	-	-20	-18	dBm
Receiver Reflectance			-27	dB

FFI 80 km Line Interface characteristics

The MS430624M can provide 80 km B&W or DWDM optical interfaces through the MICROSENS FFI modules.

General	Value			Unit
	Min.	Typ.	Max.	
Bit Rate nominal	9.95308		10.70944	GHz
Line Coding	NRZ			-
Optical path max attenuation	-	-	22	dB
Optical path min attenuation	-	11	-	dB
Max path penalty @1600ps/nm	-	-	2	dB
Transmitter	Value			Unit
B&W wavelength (opt. 310)	1530	-	1560	nm
DWDM Wavelength range (100 GHz grid) (opt. 311)	1529.55	-	1563.05	nm
	191.8	-	196	THz
Centre wavelength tolerance (EOL) (opt. 311)	- 100	-	+ 100	pm
	- 10	-	+ 10	GHz
SMSR	30	-	-	dB
Pout (average value)	-2	-	+2	dBm
Extinction Ratio	10	-	-	dB
Receiver	Value			Unit
Wavelength Range	1525	-	1570	nm
Pin _{max} (BER @ 10 ⁻¹² , average value, ER=10dB)	-	-9	-	dBm
Pin _{min} (sensitivity for BER @ 10 ⁻¹² , average value, ER=10dB)	-	-26	-24	dBm
Receiver Reflectance			-27	dB

FFI Line Interfaces wavelength table

The following table gives the MS430624M wavelength plan:

306xx and 311xx codification	Optical Output Frequency (THz)	Optical Output Wavelength (nm)
BP	196,0	1529.55
BR	195,9	1530.33
BT	195,8	1531.12
BV	195,7	1531.90
BX	195,6	1532.68
BZ	195,5	1533.47
CB	195,4	1534.25
CD	195,3	1535.04
CF	195,2	1535.82
CH	195,1	1536.61
CK	195,0	1537.40
CM	194,9	1538.19
CP	194,8	1538.98
CR	194,7	1539.77
CT	194,6	1540.56
CV	194,5	1541.35
CX	194,4	1542.14
CZ	194,3	1542.94
DB	194,2	1543.73
DD	194,1	1544.53
DF	194,0	1545.32
DH	193,9	1546.12
DK	193,8	1546.92
DM	193,7	1547.72
DP	193,6	1548.51
DR	193,5	1549.32
DT	193,4	1550.12
DV	193,3	1550.92
DX	193,2	1551.72
DZ	193,1	1552.52
EB	193,0	1553.33
ED	192,9	1554.13
EF	192,8	1554.94
EH	192,7	1555.75
EK	192,6	1556.55
EM	192,5	1557.36
EP	192,4	1558.17
ER	192,3	1558.98
ET	192,2	1559.79
EV	192,1	1560.61
EX	192,0	1561.42
EZ	191,9	1562.23
FB	191,8	1563.05

Front Panel Layout

The MS430620M occupies two slots in the chassis.

MS430620M

Line and Clients are XFP and SFP cages capable of hosting standard XFP/SFP modules.

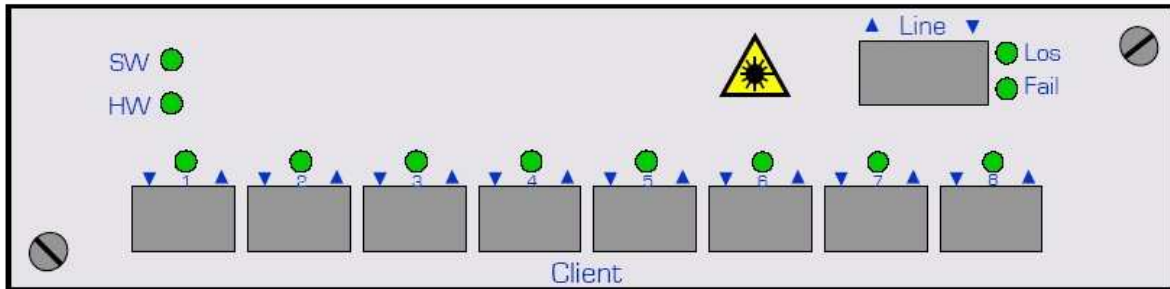


Figure 9: MS430620M front panel layout.

MS430624M-x / MS430624M-x-nn

Line is a dual LC connector mounted on the MS430624M front panel.

Clients are SFP cages capable of hosting standard SFP modules.

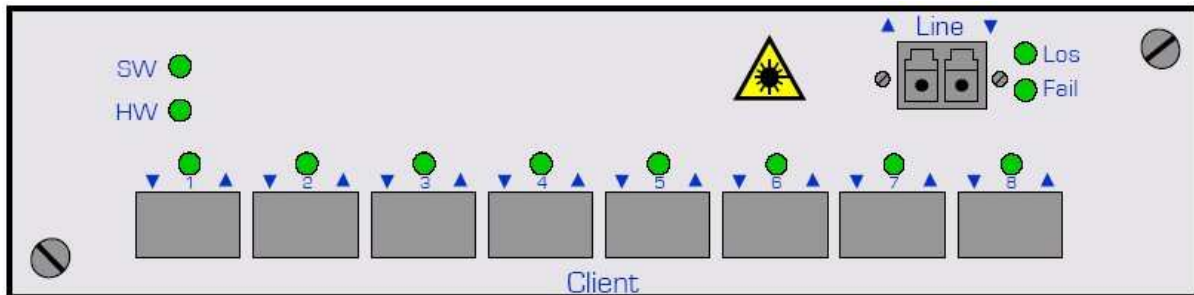


Figure 10: MS430624M-x-nn front panel layout.

Technical Specifications

Type	8 port Gigabit Ethernet/Fibre Channel TDM Multiplexer Module	
Connectors	Local ports: SFP, Line ports: XFP or FFI	
Line data rate	9.953 Gbps	
LED displays	<i>SW</i>	Software loading
	<i>HW</i>	Hardware ready
	<i>Los</i>	Signal lost
	<i>Fail</i>	Transmission failure
Power consumption	27 W	
Operating temperature	0°C to 50°C	
Storage temperature	-20°C to 85°C	

Order Information

Art. No.	Description	Connectors
Modules		
MS430620M	TDM Multiplexer Module, client interface 8xGbE/GFC, line interface XFP	1x XFP 8x SFP
MS430624M-x	TDM Multiplexer Module, client interface 8xGbE/GFC, line interface FFI B&W	1x FFI 8x SFP
MS430624M-x-nn	TDM Multiplexer Module, client interface 8xGbE/GFC, line interface FFI DWDM	1x FFI 8x SFP

Optical Interfaces

Active Line Interface (XFP)

MS100400D	XFP 10 Gbps Pluggable Transceiver, Multimode 850nm, 10GBASE-SR, 1200-M5-SN-I, 1200-M5ESN-I, 1200-M6-SN-I
MS100410D	XFP Multiprotocol 11.1 Gbps Pluggable Transceiver, Single Mode 1310nm LC 10km, OC-192 SR-1, STM I-64.1, 10GBASE-LR/LW, 1200-SM-LL-L
MS100411D	XFP Multiprotocol 10.5 Gbps Pluggable Transceiver, Monomode 1310nm LC 10km, 10GBASE-LR/LW, 1200-SM-LL-L
MS100420D	XFP Multiprotocol 10 Gbps Pluggable Transceiver, Single Mode 1550nm LC 40km, OC-192 IR-2/IR-3, STM S-64.2b/S-64.3b, 10GBASE-ER/EW + FEC
MS100430D	XFP Multiprotocol 10 Gbps Pluggable Transceiver, Single Mode 1550nm LC 80km, OC-192 / STM-64 ITU-T G.959.1 P1L1-2D2 ITU-T G.709, 10GBASE-ZR/ZW 80km, 10G Fibre Channel, 10G Ethernet with ITU-T G.709 FEC

MS100422D-nn	XFP Multiprotocol 10Gbps DWDM Transceiver, DWDM Single Mode LC 15dB / 40km, nn: ITU C-Band Channel 17-61, OC-192 IR-2/IR-3, STM S-64.2b/5-64.3b, 10GBASE-ER/EW + FEC
MS100432D-nn	XFP Multiprotocol 10Gbps DWDM Transceiver, DWDM Single Mode LC 23dB / 80km, nn: ITU C-Band Channel 17-61, OC-192 / STM-64 ITU-T G.959.1 P1L1-2D2 ITU-T G.709, 10GBASE-ZR/ZW 80km, 10G Fibre Channel, 10G Ethernet with ITU-T G.709 FEC
Active Fixed Fiber Interface (FFI)	
option A	10G Fixed Fiber Interface, 1550nm 40km LC connector
option B	10G Fixed Fiber Interface, DWDM 40km LC connector
option C	10G Fixed Fiber Interface, 1550nm 60km LC connector
option D	10G Fixed Fiber Interface, DWDM 60km LC connector
option E	10G Fixed Fiber Interface, 1550nm 80km LC connector
option F	10G Fixed Fiber Interface, DWDM 80km LC connector
Active Pluggable Interface (SFP) B&W	
MS100200D	SFP Pluggable Transceiver GBE/1x Fibre Channel, Multimode 850nm LC
MS100210D	SFP Pluggable Transceiver GBE/1x Fibre Channel, Single Mode 1310nm LC 10km
MS100213D	SFP Pluggable Transceiver GBE/1x Fibre Channel, Single Mode 1550nm LC 50km
MS100060D	SFP Pluggable Transceiver SR-1 2km, 1310nm, LC connector, Multirate 100..2488 MBit/s, OC-3/12/48 STM-1/4/16, GBE, 1x/2x FC
MS100061D	SFP Pluggable Transceiver IR-1 15km, 1310nm, LC connector, Multirate 100..2488 MBit/s, OC-3/12/48 STM-1/4/16, GBE, 1x/2x FC
MS100062D	SFP Pluggable Transceiver IR-2 40km, 1550nm, LC connector, Multirate 100..2488 MBit/s, OC-3/12/48 STM-1/4/16, GBE, 1x/2x FC
MS100063D	SFP Pluggable Transceiver LR-1 40km, 1310nm, LC connector, Multirate 100..2488 MBit/s, OC-3/12/48 STM-1/4/16, GBE, 1x/2x FC
MS100064D	SFP Pluggable Transceiver LR-2 80km, 1550nm, LC connector, Multirate 100..2488 MBit/s, OC-3/12/48 STM-1/4/16, GBE, 1x/2x FC
MS100360D	SFP Pluggable Transceiver 1x/2x/4x Fibre Channel, Multimode 850nm 500m (50/125µm), LC
MS100364D	SFP Pluggable Transceiver 1x/2x/4x Fibre Channel, Single Mode 1310nm 4km, LC
MS100366D	SFP Pluggable Transceiver 1x/2x/4x Fibre Channel, Single Mode 1310nm 10km, LC
MS100368D	SFP Pluggable Transceiver 1x/2x/4x Fibre Channel, Single Mode 1310nm 30km, LC
Active Pluggable Interface (SFP) CWDM	
MS100270D-ww	SFP Pluggable Multirate CWDM Transceiver max. 2,67 GBit/s, Monomode LC 1ww0nm DFB Laser, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, Gigabit Ethernet, 1x/2x FC, min. 20dB Budget
MS100272D-ww	SFP Pluggable Multirate CWDM Transceiver max. 2,67 GBit/s, Monomode LC 1ww0nm DFB Laser, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, Gigabit Ethernet, 1x/2x FC, min. 28dB Budget
MS100273D-ww	SFP Pluggable Multirate CWDM Transceiver max. 2,67 GBit/s, Monomode LC 1ww0nm DFB Laser, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, Gigabit Ethernet, 1x/2x FC, min. 30dB Budget, low dispersion penalty
MS100280D-ww	SFP Pluggable Transceiver 1x/2x/4x Fibre Channel, CWDM Single Mode 1ww0nm, min. 17dB Budget, 40km, LC
Active Pluggable Interface (SFP) DWDM	
MS100320D-nn	DWDM Multirate Line Interface 100 Mbps..2.7 Gbps for Fast Ethernet, STM-1/OC-3, STM-4/OC-12, STM-16/OC-48, ESCON, Gigabit Ethernet, 1x/2x Fibre Channel, Single Mode DWDM Laser, nn: ITU C-Band Channel 17-60, LC connector, min. 28dB Budget

MS100321D-nn	DWDM Multirate Line Interface 100 Mbps..2.7 Gbps for Fast Ethernet, STM-1/OC-3, STM-4/OC-12, STM-16/OC-48, ESCON, Gigabit Ethernet, 1x/2x Fibre Channel, Single Mode DWDM Laser, nn: ITU C-Band Channel 17-60, LC connector, min. 120km
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MS100390D-nn	SFP Pluggable Transceiver 1x/2x/4x Fibre Channel, DWDM Single Mode, min. 24dB Budget, LC
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Chassis

MS430500M	19" Chassis 2 HU, 5 module slots, 2x 48 VDC power supplies, incl. Backplane
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MS430502M	19" Chassis 6 HU, 5 module slots, 2x 48 VDC power supplies, incl. Backplane
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MS430520M	Management Module, 1x RJ-45 Ethernet, 1x SUBD9
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