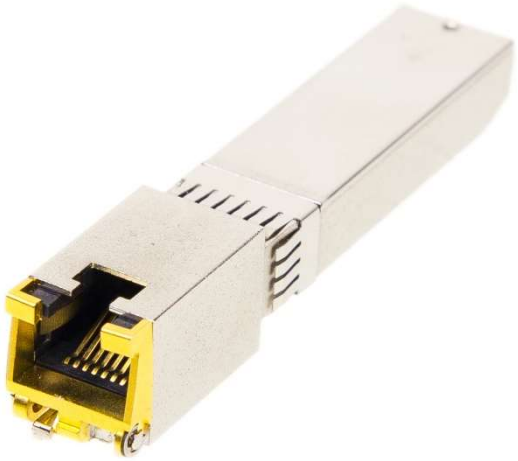
Methode Electronics

DM7053 SFP+ 100/1000/2.5/5/10G Transceiver

KEY FEATURES:

- Supports 10GBase-T Links up to 30m using Cat6a Cable
- Supports 100/1000/2.5/5G – up to 100m Using Cat5e or better
- SFF-8431 and SFF-8432 MSA Compliant
- NBase-T Compliant
- Low Power Consumption
  - (1.5W MAX, 1.25W TYP, 30m @ 10G)
  - (1.5W MAX, 1.2W TYP, 50m @ 5G)
  - (1.5W MAX, 1.1W TYP, 50m @ 2.5G)
  - (1.0W MAX, 800mW TYP, 100m @ 1.0G)
- Fast Retrain EMI Cancellation Algorithm
- Low EMI Emissions
- I2C 2 Wire Serial Interface for Serial Id and PHY Registers
- Auto-negotiates with other NBASE-T PHYs
- MDI/MDIX Crossover
- Multiple Loopback Modes for Testing and Troubleshooting
- Built-in Cable Monitoring and Link Diagnostic Features
  - Cable Length Measurements
  - Opens/Shorts
- Robust Die Cast Housing
- Bail Latch Style ejector mechanism
- Unshielded and Shielded cable support



Product Overview:

The DM7053 copper transceiver module is a high performance integrated duplex data link for bi-directional communication over copper cable. The DM7053 SFP+ module is compliant with the IEEE 802.3bz standard. It is specifically designed for high-speed communication links that require 10G over Cat6a cable or 2.5/5G over Cat 5e cable.

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

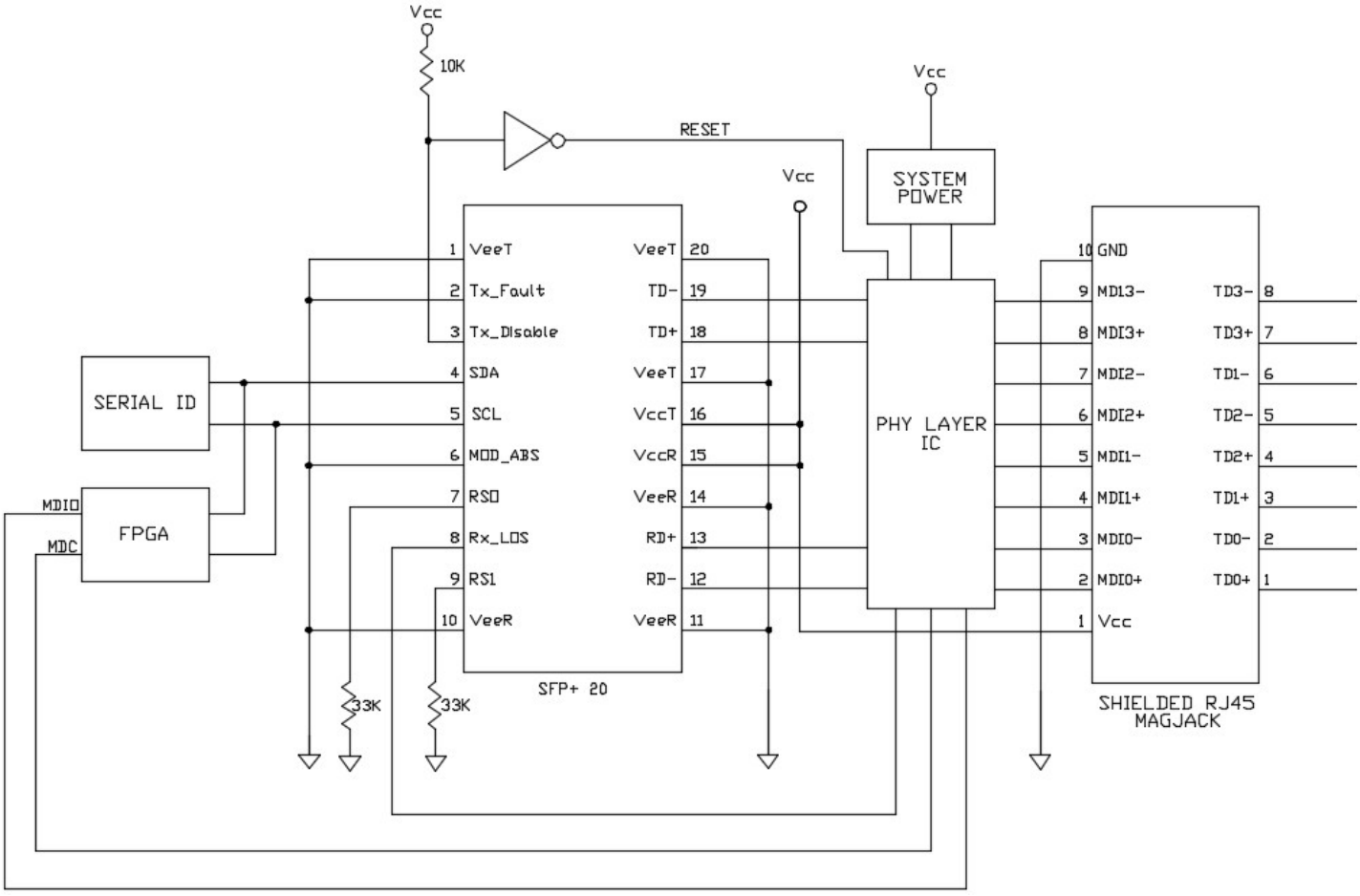
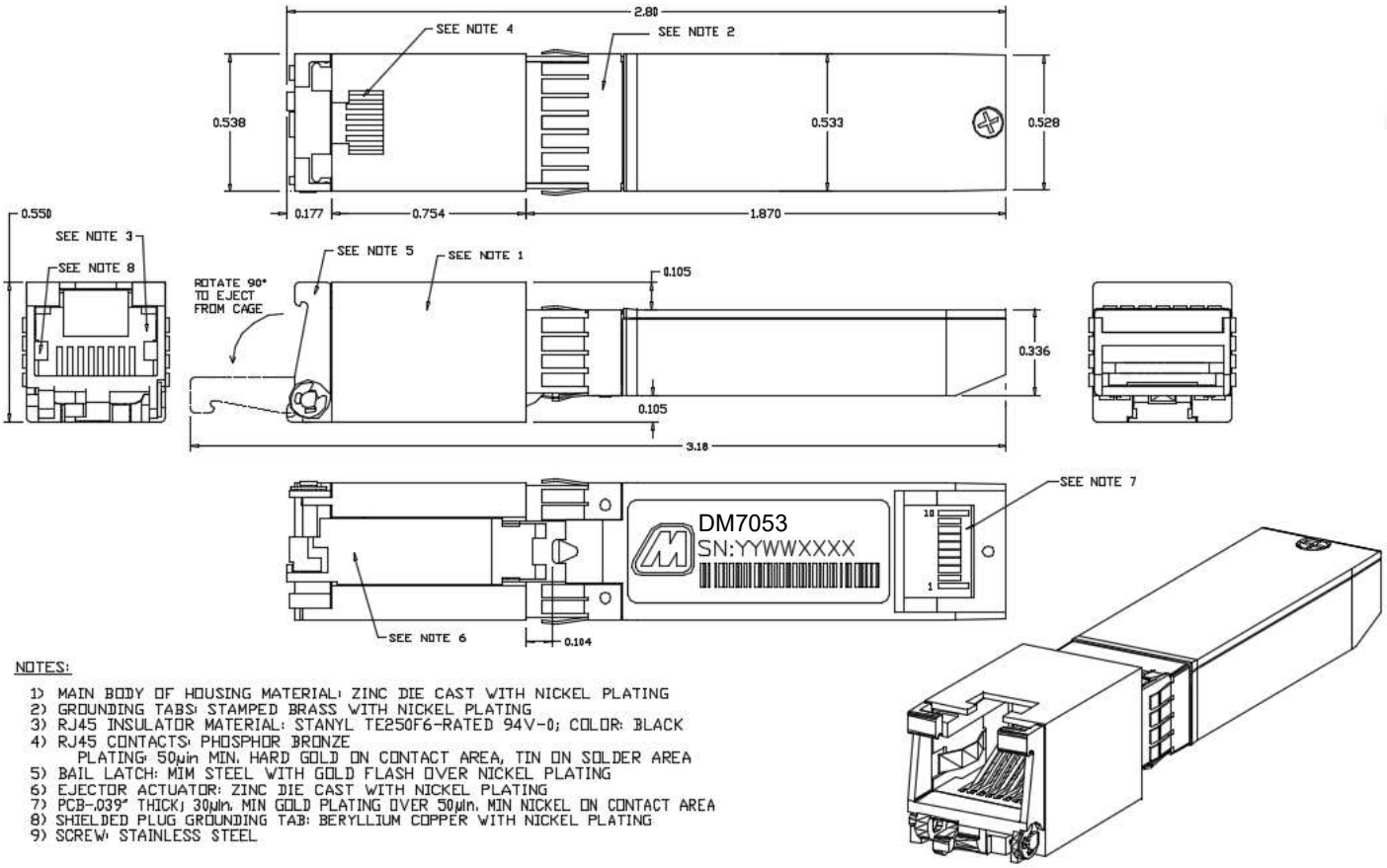


Figure 1: Block Diagram

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149



NOTES:

1) MAIN BODY OF HOUSING MATERIAL: ZINC DIE CAST WITH NICKEL PLATING
2) GROUNDING TABS: STAMPED BRASS WITH NICKEL PLATING
3) RJ45 INSULATOR MATERIAL: STANYL TE250F6-RATED 94V-0; COLOR: BLACK
4) RJ45 CONTACTS: PHOSPHOR BRONZE
   PLATING: 50µin MIN. HARD GOLD ON CONTACT AREA, TIN ON SOLDER AREA
5) BAIL LATCH: MIM STEEL WITH GOLD FLASH OVER NICKEL PLATING
6) EJECTOR ACTUATOR: ZINC DIE CAST WITH NICKEL PLATING
7) PCB-.039" THICK, 30µin. MIN GOLD PLATING OVER 50µin. MIN NICKEL ON CONTACT AREA
8) SHIELDED PLUG GROUNDING TAB: BERYLLIUM COPPER WITH NICKEL PLATING
9) SCREW: STAINLESS STEEL

Figure 2: Mechanical Dimensions

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Pin	*Logic*	*Symbol*	*Name/Description*	*Plug Sequence*	*Note*
1		VeeT	Transmitter Ground	1	1
2	LVTTL-O	Tx_Fault	Transmitter Fault	3	2
3	LVTTL-I	Tx_Disable	Transmitter Disable –	3	
4	LVTTL-I/O	SDA	2-wire Serial Interface Data Line	3	
5	LVTTL-I/O	SCL	2-wire Serial Interface Clock	3	
6		Mod_ABS	Module Absent, connect to VeeT or VeeR in the module	3	
7	LVTTL-I	RS0	Rate Select 0	3	
8	LVTTL-O	Rx_LOS	Receiver Loss of Signal Indication	3	2
9	LVTTL-I	RS1	Rate Select 1	3	
10		VeeR	Receiver Ground	1	1
11		VeeR	Receiver Ground	1	1
12	CML-O	RD-	Receiver Inverted Data Output	3	
13	CML-O	RD+	Receiver Non-Inverted Data Output	3	
14		VeeR	Receiver Ground	1	1
15		VccR	Receiver 3.3V Supply	2	
16		VccT	Transmitter 3.3V Supply	2	
17		VeeT	Transmitter Ground	1	1
18	CML-I	TD+	Receiver Inverted Data Output	3	
19	CML-I	TD-	Transmitter Inverted Data Input	3	
20		VeeT	Module Transmitter Ground	1	1
Note 1: The module signal grounds should be isolated from the module case.					

Table 1: SFP+ Module Electrical Pin Definition

Mating of SFP Transceiver to SFP Host Board Connector

The pads on the PCB of the SFP transceiver shall be designed for a sequenced mating as follows:

First mate:	Ground contacts
Second mate:	Power contacts
Third mate:	Signal contacts

The SFP MSA specification for a typical contact pad plating for the PCB is 0.38 micrometers minimum hard gold over 1.27 micrometers minimum thick nickel. To ensure the long-term reliability performance after a minimum of 50 insertion removal cycles, the contact plating of the transceiver is 0.762 micron (30 microinches) over 3.81 micron (150 microinches) of Ni on Cu contact pads.

RJ45 Connector

RJ45 connector shall support shielded and unshielded cables. Also, the connector is mechanically robust enough and designed to prevent loss of link, when the cable is positioned or moves in different angles. The connector shall pass the "wiggle" RJ45 connector operational stress test. During the test, after the cable is plugged in, the cable is moved in circle to cover all 360 deg in the vertical plane, while the data traffic is on. There shall be no link or data loss.

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Latch Requirements

The SFP transceiver latch should be mechanically robust and designed to prevent unintentional unlatching during insertion or extraction of the transceiver cable. The transceiver is designed with a "Bail type ejector latch mechanism" that allows the SFP module to be easily released from the cage, when the adjacent SFP ports in both rows are also populated and regardless of whether the SFP module is placed in the lower or upper row. The latch shall also pass the "wiggle" RJ45 connector stress test.

Measurement	Minimum	Maximum	Units	Comments
SFP transceiver insertion	N/A	18	Newtons	Measure without the force from any cage kick out springs. Module to be inserted into nominal cage.
SFP transceiver extraction	N/A	12.5	Newtons	Measure without the force from any cage kick out springs. Module to be inserted into nominal cage.
SFP transceiver retention	90	170	Newtons	No functional damage to module below 90N..
Insertion/removal cycles, SFP transceiver	50	N/A	Cycles	No functional damage to module, cage or connector

Table 2 Insertion, Extraction and Retention Forces for SFP Transceivers

Regulatory Requirements

The SFP transceiver installed into the host system requires meeting Compliance Requirements listed in this paragraph.

In order to achieve this, the module must be evaluated in considering its use in the equipment designs. Unless otherwise specified, the transceiver module shall meet the current version, at the time of manufacturing, of the applicable EMI/EMC specifications for telecommunication network and information technology/multimedia equipment.

Radiated Emission (RE)

The DM7053 CuSFP transceiver shall meet the applicable FCC Part 15 emission requirements.

DM7053 CuSFP transceiver minimum emission requirements are:

- **Class B** radiated emission requirements by using **shielded** cables at least 4dB margin.

10.0 KHz – 18.0 GHz is recommended frequency range for radiated emission testing.

Electrostatic Discharge (ESD)

In addition the the CuSFP module or host platform shall not show susceptibility to conducted immunity when applied to the interface cable per the requirements of IEC 6100-4-2:

- Contact ESD only to the accessible portions of the module (i.e. front panel connector receptacle). 8 kV - Air Discharge and 4 kV – Contact discharge.

- **Criteria B** (see paragraph 6.7 for Criteria's definition) should be used as a measurable effect from ESD applied (25 discharges by polarity – both air/contact) to the system used with CuSFP modules

Traffic generation and Susceptibility criteria.

Traffic generation and monitoring.

A minimum 50% utilization should be established for preliminary investigation when possible, with final evaluation being performed with a worst-case utilization.

Susceptibility Criteria:

The disturbances will be applied to the system as a whole. Data losses will be reported according to the following:
Performance Criteria:

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Performance Criteria A
During the test and after the test, system with CuSFP module shall continue to operate:
- without degradation resulting in no greater than 1% of packets per second dropped,
- with zero requests for retry, beyond requests resulting from the 1% per second allowable data loss
- with no degradation in the data transmission rate, beyond requests resulting from the 1% per second allowable data loss
- without protocol failure
- without loss of link
- without alarm signaling triggered.

Monitoring Method:
The Traffic Generator will be monitored. The link, speed, retry rates, etc, status during the test will be reviewed by equipment status logs after the test, and monitored by LED observation during the test.

Performance Criteria B
Error rate, request for retry and speed of data transmission rate may be degraded during the application of the test. Degradation of the performance as described in criteria A is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test. In these cases, operator response is not permitted to re-initiate an operation.

Monitoring Method:
The Traffic Generator will be monitored. The link, speed, retry rates, etc, status during the test will be reviewed by equipment status logs after the test, and monitored by LED observation during the test.

Performance Criteria C
Degradation of the performance as described in criteria A is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test or can be restored after the test by the operator.

Monitoring Method:
The Traffic Generator will be monitored. The link, speed, retry rates, etc, status during the test will be reviewed by equipment status logs after the test, and monitored by LED observation during the test. .

Flammability

The PCB of the SFP module shall be min. V-0 UL flame rated. Applicable standards:
UL/CSA 60950 and IEC 60950.

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Environmental and Quality Requirements

Accelerated Aging

The SFP+ transceiver module shall be subjected to an accelerated aging test that exposes the module to 85C case temperature while being powered at 3.3V for 2000 hours.
Failure criteria: The product is considered to have failed this test if any of the following occurred:

1. Failure of test unit to perform ping or traffic test;
2. Excessive corrosion of components.

Relative Humidity (Non-Operational)

The SFP+ transceiver module shall be subjected to the temperature and humidity profile as per MIL STD 202G Method 103B,
- Test description: The module shall be subjected to the temperature and humidity profile of 85C/85% RH for 1000 hours. The product shall be non-operational during this entire period.
- Failure criteria: The product is considered to have failed this test if any of the following occurred:

1. Failure of test unit to perform ping or traffic test;
2. Excessive corrosion of components.

Shock and Vibration

- 16 2.5/5G NBase-T SFP+ copper transceivers shall be subject to mechanical shock test and vibration test.
- Mechanical shock test
  The mechanical shock test shall use the following specification:
  A half-sine wave shock shall be applied on the DUT, 5 times per direction for 6 directions.
  Peak acceleration of the input 1500G. Pulse width of half-sine wave 0.5ms.
- Vibration test
  The vibration test shall use the following specification:
  A random vibration input for a period of 4 min per cycle, 4 cycle per axis.
  The input acceleration level shall be 20G over the frequency band of 20 to 2000 Hz.
- Failure criteria: The product is considered to have failed this test if any of the following occurred:
  1. Failure of test unit to perform ping or traffic test;
  2. Excessive corrosion of components.

Temperature Cycling

Thirty-two Modules shall be place in a temperature cycling chamber (16 operational and 16 non-operational). The temperature extremes shall be -5°C to +85°C. The dwell time at each temperature extreme shall be 10 minutes. The transition time between each temperature extreme shall be 8 minutes. 100 thermal cycles shall be complete. There shall be no evidence of any electrical or physical degradation to the samples, as a result of the thermal cycling.

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	Ts	-40	85	°C	
Case Operating Temperature	Tc	-5	85	°C	
Relative Humidity	RH	5	95	%	
Supply Voltage (3.3V)	Vcc		3.6	VDC	
Low Speed Input Voltage		-0.5	Vcc+0.3	V	
Two-Wire Interface Input Voltage		-0.3	Vcc+0.5	V	

Table 3: Module Specifications: Absolute Maximum Operating Conditions

Parameter	Symbol	Min	Typ	Max	Typ	Units	Notes
Operating Case Temperature	Tc	0		85		°C	
Supply Voltage (3.3V)	Vcc	3.135	3.3	3.465		VDC	
Power (30m @ 25C ambient, 10Gbps)				1.5	1.25	W	Using Cat6a Cable
Power (50m @ 25C ambient, 5Gbps)				1.5	1.2	W	Using Cat5e Cable
Power (50m @ 25C ambient, 2.5Gbps)				1.5	1.1	W	Using Cat5e Cable
Power (100m @ 25C ambient, 1.0Gbps)				1.0	0.8	W	Using Cat5e Cable

Table 4: Module Specifications: Recommended Operating Conditions

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Serial Identification

The module identification is located in the EEPROM, which is accessed over the 2-wire serial management interface. The address of the EEPROM is 0xA0 (1010000X). The following table shows the SFP+ EEPROM memory map and the actual data.

Data Address	Field Size	Field Name	Field Description	Field Value	Value Description
BASE ID FIELDS					
0	1	Identifier	Type of transceiver	03	SFP TRANSCEIVER
1	1	Ext. Identifier	Extended identifier of type of serial transceiver	04	WITH SERIAL ID
2	1	Connector	Code for connector type	22	RJ45 Connector
3-10	8	Transceiver	Code for electronic or optical compatibility	00,00,00,00, 00,00,00,00	10G Base-T is Undefined in SFF-8472
11	1	Encoding	Code for serial encoding algorithm	00	UNSPECIFIED
12	1	BR, Nominal	Nominal signaling rate, units of 100Mbits/sec	64	Up to 10Gb Bit Rate
13	1	Rate Identifier	Type of rate select functionality	00	UNSPECIFIED
14	1	Length (SMF, km)	Link length supported for single mode fiber, units of km	00	NA
15	1	Length (SMF)	Link length supported for single mode fiber, units of 100m	00	NA
16	1	Length (50μm)	Link length supported for 50μm OM2 fiber, units of 10m	00	NA
17	1	Length (62.5μm)	Link length supported for 62.5μm OM1 fiber, units of 10m	00	NA
18	1	Length (cable)	Link length supported for copper or direct attach cable, units of m	1E	30m @ 10G
19	1	Length (OM3)	Link length supported for 50μm OM3 fiber, units of 10m	00	RESERVED
20-35	16	Vendor name	SFP vendor name (ASCII)	4D,65,74,68, 6F,64,65,20, 45,6C,65,63, 2E,20,20,20	Methode Elec (ASCII)
36	1	Transceiver	Code for electronic or optical compatibility	1C	10G Base-T Short Reach
37-39	3	Vendor OUI	SFP transceiver vendor IEEE company ID	00,17,05	Methode OUI
40-55	16	Vendor PN	Part number provided by SFP transceiver vendor (ASCII)	44,4D,37,30, 35,33,20,20, 20,20,20,20 20,20,20,20	DM7053 (ASCII)
56-59	4	Vendor rev	Revision level for part number provided by vendor (ASCII)	2D,20,35,33	56: Part Rev "-" 57: Reserved 58: FPGA FW "5" 59: PHY FW "3"
60-61	2	Wavelength	Laser wavelength (Passive/Active Cable Specification Compliance)	00,00	RESERVED
62	1	Unallocated		00	RESERVED
63	1	CC_BASE	Check code for Base ID Fields (addresses 0 to 62)	VARIES	
EXTENDED ID FIELDS					
64-65	2	Options	Indicates which optional SFP signals are implemented	02,12	Power Class II, TxDis / RXLOS
66	1	BR, max	Upper bit rate margin, units of %	00	
67	1	BR, min	Lower bit rate margin, units of %	00	
68-83	16	Vendor SN	Serial number provided by vendor (ASCII)	VARIES	(ASCII)
84-91	8	Date code	Vendor's manufacturing date code	VARIES	YY-MM-DD-LOT#
92	1	Diagnostic Monitoring Type	Indicates which type of diagnostic monitoring is implemented (if any)	00	None included
93	1	Enhanced Options	Indicates which optional enhanced features are implemented (if any)	00	None included
94	1	SFF-8472 Compliance	Indicates which revision of SFF-8472 the transceiver complies with	00	None included
95	1	CC_EXT	Check code for the Extended ID Fields (addr. 64 to 94)	VARIES	
VENDOR SPECIFIC ID FIELDS					
96-127	32	Vendor Specific	Vendor Specific EEPROM	All FF's	
128-255	128	Reserved	Reserved	All FF's	

Table 5: SFP+ MSA Serial ID Data

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149

Protocol for I2C to MDIO Bridge

The Transceiver contains a Bridge device to allow the Host I2C interface to communicate with the PHY's MDIO interface. In order for this to work the following protocol must be used.

The I2C Slave Address for the Bridge is 0x56 + R/W Bit or 0xAC for a write and 0xAD for a read.

To write to a PHY register the I2C Master needs to send a 6 Byte I2C frame. The first Byte is the I2C Slave Address with R/W Bit = 0 or 0xAC. The second Byte contains the 5 Bit MDIO Device Address in Bits 4:0 with Bits 7:5 = 0. The next 2 Bytes are the 16 Bit Register Address with the MSB first, and the last 2 Bytes are the 16 Bit Data with the MSB first.

To read from a PHY register the I2C Master needs to first send a 4 Byte I2C frame. The first Byte is the I2C Slave Address with R/W Bit = 0 or 0xAC. The second Byte contains the 5 Bit MDIO Device Address in Bits 4:0 with Bit 5 = 1 and Bits 7:6 = 0. The next 2 Bytes are the 16 Bit Register Address with the MSB first. Then the I2C Master starts a second frame by sending the I2C Slave Address with R/W Bit = 1 or 0xAD. The I2C Master will then receive 2 Bytes containing the 16 Bit Data with the MSB first from the Slave.

Examples:

Master		Slave		S	Start		P	Stop										

Write 0x000A to DEVAD 1 Register 0xA819

S	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0
1	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	P

Read 0x000A from DEVAD 1 Register 0xA819

S	1	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0
1	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	P
S	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	1	0	1	P									

METHODE ELECTRONICS, INC.

7447 West Wilson Avenue
Chicago, IL 60706
Phone: 708-867-6777 Fax: 708-867-3149