Methode Electronics

DM7041-xx SFP 1000BASE-T Transceiver

KEY FEATURES:

- Supports Links up to 100m using Cat 5 Cable
- IEEE 802.3z, IEEE 802.3u, IEEE 802.3ab compliant
- SFP MSA Compliant
- Hot-pluggable SFP footprint
- RJ-45 connector
- 1000BASE-T, full duplex default operating mode
- 10/100/1000BASE-T operation on platforms supporting SGMII
- I^2C 2-Wire Serial Interface for Serial Id and PHY Registers
- Auto MDI/MDIX Crossover
- Low Power Consumption
  - (1.0W MAX, 800mW TYP, 100m @ 1.0G)
- ROHS compliant
- Robust Die Cast Housing
- Bail Latch Style ejector mechanism
- Unshielded and Shielded cable support
- Commercial operating temperature range {-5 to 85C}
- FCC Class A compliant

Product Overview:

The 1000BASE-T SFP is a 10/100/1000BASE-T capable copper transceiver module compliant to the SFP (Small Form-factor Pluggable) Transceiver MSA . It can be used to provide a Gigabit Ethernet IEEE 802.3 compliant physical layer interface to network platforms that have MSA compliant SFP ports or cages

Functional Description:

The DM7041-xx SFP module has two interfaces: the host interface and the MDI (Medium-Dependent Interface). The MDI provides 1000BASE-T connectivity over the Category-5 cable. The host interface provides the data transfer over the 1.25 GHz PECL differential interface to the host board and control and configuration functions through the serial management interface.

The module provides for transparent Auto-Negotiation between the MAC and the link partner on the copper side. The MAC performs 1000BASE-X Auto-Negotiation. The MAC sees the 1000BASE-T SFP transceiver as if it was an optical transceiver. On the MDI side the transceiver performs 1000BASE-T Auto-Negotiation according to the IEEE 802.3u, Clause 28.

The default mode of operation after power-up is 10/100/1000BASE-T, full duplex, over SGMII interface.

The management interface is I^2C 2-wire serial interface, which provides the access to the EEPROM containing transceiver's ID data, security key and other information. Also, the serial management interface provides access to the transceiver's PHY registers, via address ACh (7bit 0x56).

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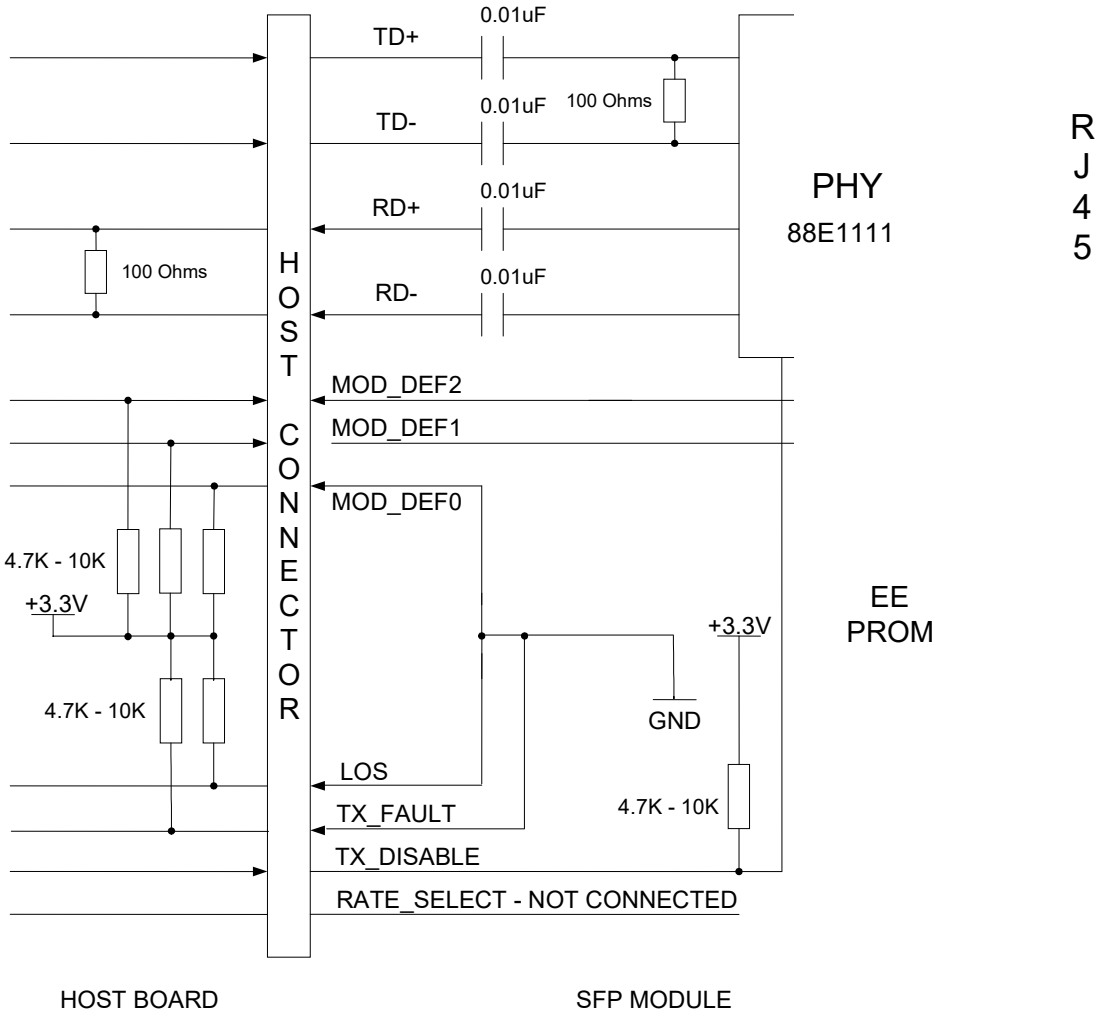

Figure 1: Block Diagram

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Mechanical Description

The transceiver shall be compliant with common SFP mechanical outline.

1000BASE-T SFP Transceiver Dimensions
Figure 2 Illustrates the Mechanical Dimensions of the Transceiver

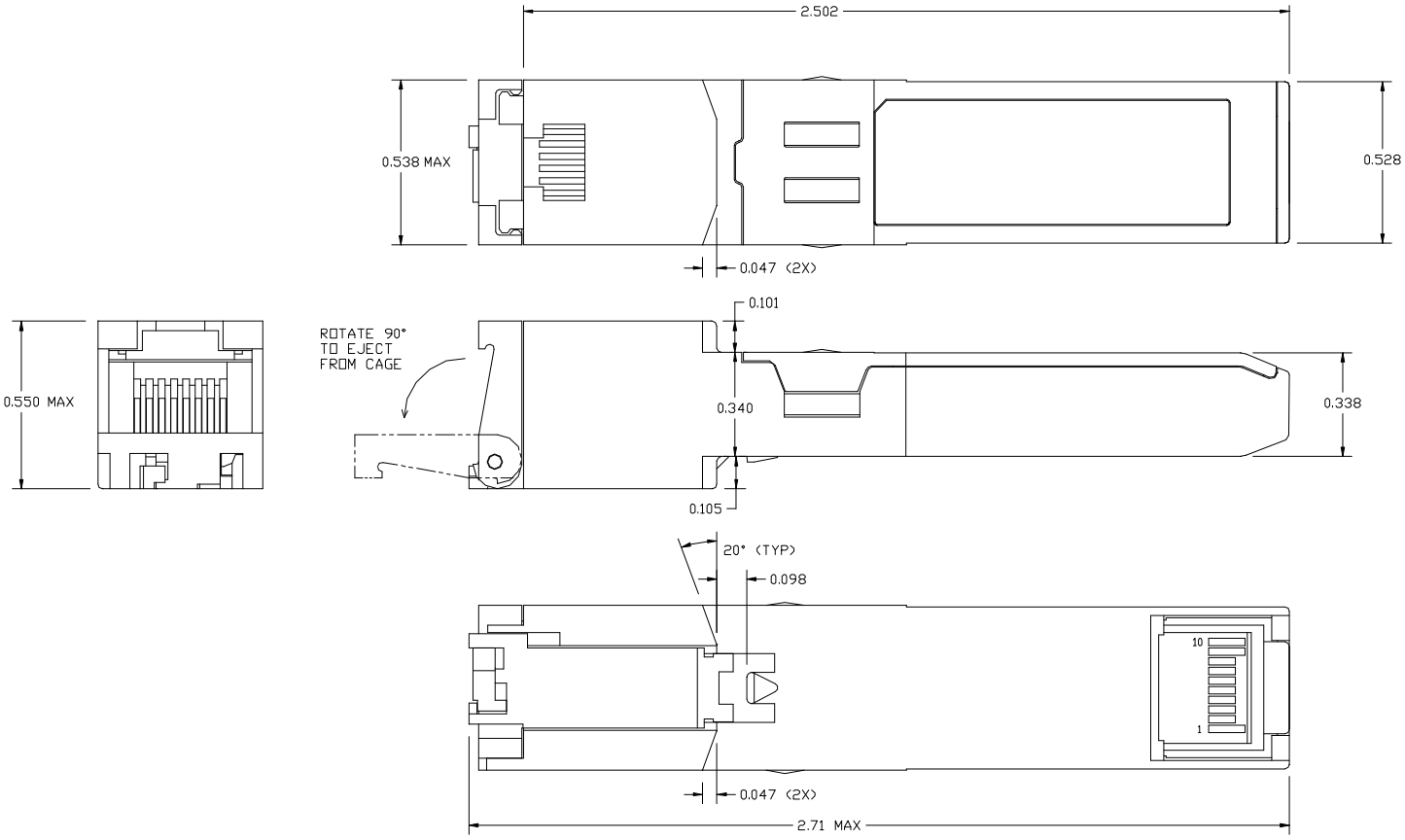

Figure 2: Mechanical Dimensions

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Pin	*Logic*	*Symbol*	*Name/Description*	*Plug Sequence*	*Note*
1		VeeT	Transmitter Ground	1	1
2	LVTTL-O	Tx_Fault	Transmitter Fault, internally tied to GND, not operational	3	
3	LVTTL-I	Tx_Disable	Transmitter Disable – Used as a reset.	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, connected to VeeT or VeeR in the module	3	
7	LVTTL-I	RS0	Rate Select 0, not used, internally pulled to GND with 33k Ohms	3	
8	LVTTL-O	Rx_LOS	Receiver Loss of Signal Indication	3	2
9	LVTTL-I	RS1	Rate Select 1, tied internally to GND	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.
Note 2: LOS operation is an option, can be operational or GND.

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.

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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 modules, when integrated into the host systems, will be required to meet the Regulatory, Customer and Compliance requirements. To achieve this, the module must be evaluated in considering its use in the equipment designs. The transceiver module shall meet the current version, at the time of manufacturing, of the applicable EMI/EMC specifications for telecom and datacom equipment for North America, European, Japan and Telcordia standards.
The transceiver shall meet EMI/EMC specifications tested simultaneously (32 and 48 transceivers) and connected to Category 5 cables running PRBS pattern or other data patterns at all applicable speeds for the specific network platforms

Radiated Emission (RE)

The 1000BASE-T SFP transceiver shall meet the applicable Class A requirements for electromagnetic emissions at least 6 dB margin

RF Immunity

The transceiver shall meet the requirements for Radio Frequency Immunity in accordance with IEC 61000-4-3 (80-1000 MHz) and GR-1089 or equivalent elsewhere.
This includes no significant measurable effect from a 10 V/m, 80% AM Modulated field applied between 10 kHz to 10 GHz to the SFP module. If measurable effects are recorded, then data indicating performance with field strength and receiver sensitivity are required.

Electrostatic Discharge (ESD)

The transceiver shall meet the requirements for Direct and Indirect ESD in accordance with IEC 61000-4-2:

- Direct ESD only to the accessible portions of the module (i.e. front panel connector receptacle). 15 kV (Air Discharge and 8 kV (Contact)).
- Indirect ESD 8 kV (contact discharge method used to apply discharge to coupling plane).

Conducted Immunity

The module or the host platform shall not show susceptibility to conducted immunity when applied to the interface cable per the requirement of IEC 61000-4-6. The module shall operate error free under the worst case conditions (10V).

Fast Transients

The module or the host platform shall not show susceptibility to fast transients when applied to the interface cable per the requirements of IEC 61000-4-4. The module shall operate error free under the worst case conditions (1 kV for signal port).

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Surge on Signal Ports

The module or the host platform shall not show susceptibility to surge on signal ports when applied to the interface cable per the requirements of IEC 61000-4-5. The module shall operate error free under the worst case conditions (2 kV common mode, 1 kV differential mode).

Safety

Isolation requirement (HiPot)

The SFP module shall meet at least one of the following isolation requirements as per IEC 60950:
- 1500 Vrms at 50 to 50 Hz applied for 60 sec.
- 2250 Vdc applied for 60 sec

Flammability

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

Labeling

- Description: 1G SFP Cu RJ45 ROHS
- Model Number: DM7041-x
- YY= Year (2016=16, 2017=17…)
- WW= Week of year
- XXXX= BASE 10 serial number
- Part number options:
  - DM7041-R → LOS Grounded, EEprom locked.
  - DM7041-R-L → LOS Operational, EEprom locked.
  - DM7041-RW → LOS Grounded, EEprom writable.
  - DM7041-RW-L → LOS Operational, EEprom writable.

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Environmental and Quality Requirements

Storage Temperature

The SFP transceiver module shall be capable of storage in –40 to +85 deg C (non-condensing environment).

Operating Temperature

The SFP transceiver module shall be capable of operating within specifications in –5 to +85 deg C case temperature.

Relative Humidity (Non-Operational)

The SFP module shall be subjected to the temperature and humidity profile as per MIL STD 810 Method 507.3, Procedure III.
- Test description: The module shall be subjected to the temperature and humidity profile detailed in the Aggravated Humidity test in MIL-STD-810 Method 507.3, Procedure III, for five 24 hour cycles. The maximum relative humidity is 95%. 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.

Four Corner Test

This test consists of passing traffic over 100m cable while margining 3.3V voltage +/- 5% at -5 deg C and +55 deg C ambient temperature. There shall be no loss of link or lost frames.

Shock

During the shock test, an SFP module is plugged into an SFP port of a Gigabit Ethernet switch.

Operational

After 50 insertion/removal cycles the SFP module shall be plugged into an SFP port of a Gigabit Ethernet switch and subjected to the following test conditions. The Target Minimum Velocity Change Input shall be 2.39 m/s.
- Test description: The product shall be subjected to one each half sine impact for each direction (positive and negative) in each of three axes at the specified velocity change limit above. The pulse width shall be 2 ms or less.
- Failure Criteria: The product is considered to have failed this test if any of the following occurred:
    1. Excessive exterior damage such that the product is considered unsalable.
    2. Structural, power or other system damage that render the unit to be unsalable.
    3. Failure of test unit to perform ping or traffic test.

Non-Operational

After 50 insertion/removal cycles the SFP module shall be plugged into an SFP port of a Gigabit Ethernet switch and subjected to the following test conditions. The parameters are specified in the following table:

Minimum Peak Acceleration Input	Maximum Peak Acceleration Input	Minimum Velocity Change (m/s)	Minimum Velocity Change (in/sec)
65G	80G	4.78	188

Table 3: Non-Operational Shock Parameters

- Test description: Product shall be subjected to one each trapezoidal shock pulse impact for each direction (positive and negative) in each of 3 axes at a level not to exceed the maximum peak acceleration value above. Trapezoidal shock pulse generation is per ASTM D3332. As a minimum, the product should be tested and pass at its minimum peak acceleration input level above or until it fails, whichever occurs first.
- Failure criteria: The product is considered to have failed this test if any of the following occurred:
    1. Excessive exterior damage such that the product is considered unsalable
    2. Structural, power or other system damage that render the unit to be unsalable
    3. Failure of test unit to perform ping or traffic test.

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Vibrations

During the vibrations test, an SFP module is plugged into an SFP port of a Gigabit Ethernet switch.

Operational

After minimum of 50 insertion/removal cycles the SFP module shall be plugged into an SFP port of a Gigabit Ethernet switch and subjected to the following test conditions.
- Test description: The test shall be run at standard room conditions. The product shall be fixtured to the table of the vibration test machine in each of 3 mutually perpendicular axes and subjected to a random vibration input for a period of 2 hours per axis. The input acceleration level shall be 0.41 Grms over the frequency band of 3 to 500 Hz with spectral break points of 0.0005 G^2/Hz at 10 Hz and 200 Hz and 5dB/octave roll off at each end. MIL-STD-810, Method 514.4 shall be used as a guideline. The product shall be powered and continuously running the ping or traffic test during the test. Fixturing the product to the vibration table shall insure that the product follows the input amplitude.
- Failure criteria: The product is considered to have failed this test if any of the following occurred:
    1. Excessive exterior damage such that the product is considered unsalable;
    2. Structural, power or other system damage that render the unit to be unsalable;
    3. Failure of test unit to perform ping or traffic test.

Non-Operational

After minimum of 50 insertion/removal cycles the SFP module shall be plugged into an SFP port of a Gigabit Ethernet switch and subjected to the following test conditions.
- Test description: The test shall be run at standard room conditions. The product shall be fixtured to the table of the vibration test machine in each of 3 mutually perpendicular axes and subjected to a random vibration input for a period of 30 minutes per axis. The input acceleration level shall be 1.12 Grms over the frequency band of 3 to 500 Hz with spectral break points of 0.0065 G^2/Hz at 10 Hz and 100 Hz and 5dB/octave roll off at each end. MIL-STD-810, Method 514.4 shall be used as a guideline.
- Failure criteria: The product is considered to have failed this test if any of the following occurred:
    1. Excessive exterior damage such that the product is considered unsalable;
    2. Structural, power or other system damage that render the unit to be unsalable;
    3. Failure of test unit to perform ping or traffic test.

Altitude

During the altitude test, an SFP module is plugged into an SFP port of a Gigabit Ethernet switch.

Operational

- Test description: The product shall be subjected to an altitude of 3000 meters for 2 hours. The rate of change to and from 3000 meters shall be 10 m/s maximum, as referenced in MIL-STD-810, Method 500.3. The chamber temperature shall be set to 25 deg C.
- 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. Visible delamination or other physical effect rendering the unit unsalable.

Non-Operational

- Test description: The product shall be subjected to an altitude of 4570 meters for 20 hours. The rate of change to and from 4570 meters shall be 10 m/s maximum, as referenced in MIL-STD-810, Method 500.3. The chamber temperature shall be set to 25 deg C +/- 5 deg C and uncontrolled relative humidity.
- 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. Visible delamination or other physical effect rendering the unit unsalable.

Fire Spread Test

The SFP module shall be compliant to the GR-63-CORE, Section 5.2.3.

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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 4: Module Specifications: Absolute Maximum Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units	Notes
Operating Case Temperature	Tc	-5		85	°C	
Supply Voltage (3.3V)	Vcc	3.135	3.3	3.465	VDC	
Power (100m @ 25C ambient, 1.0Gbps)			0.8	1.0	W	Using Cat5 Cable

Table 5: Module Specifications: Recommended Operating Conditions

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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	00	Unspecified
3-10	8	Transceiver	Code for electronic or optical compatibility	00,00,00,08, 00,00,00,00	1000BASE-T Ethernet Compliant
11	1	Encoding	Code for serial encoding algorithm	01	8B/10B
12	1	BR, Nominal	Nominal signaling rate, units of 100Mbits/sec	0d	1250 bps GbE 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	64	100m @ 1G
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	01	PHY REG 2 [15:8]
37-39	3	Vendor OUI	SFP transceiver vendor IEEE company ID	00,00,00	Undefined OUI
40-55	16	Vendor PN	Part number provided by SFP transceiver vendor (ASCII)	44,4d,37,30, 34,31,2D,xx, xx,20,20,20 20,20,20,20	DM7041-xx (ASCII)
56-59	4	Vendor rev	Revision level for part number provided by vendor (ASCII)	43,20,20,20	56: Part Rev "-" 57: Reserved 58: Reserved 59: Reserved
60-61	2	Wavelength	Laser wavelength (Passive/Active Cable Specification Compliance)	41,0c	PHY REG 2 [7:0], PHY REG 3 [15:8]
62	1	Unallocated		C1	PHY REG 3 [7:0]
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	00,00	
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	Checksum
96-127	32	Vendor Specific	Vendor Specific EEPROM	All FF's	
128-255	128	Reserved	Reserved	All FF's	

Table 6: SFP MSA Serial ID Data

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