Overview

The AC-SFP155M-ICO-MSA electrical transceiver offers full duplex STM-1 electrical (155 Mbit/s) SDH transport over coaxial cables. The interface is fully compliant to ITU-T G.703 (ES1) signal specification. The module is compatible with the SFP Multi-Source Agreement (MSA) standard.

Typical applications include SDH Multiplexer systems or ATM-switch and IP-router equipment supporting SDH physical interfaces. The module is fully interchangeable with STM-1 or OC-3 optical SFP modules and provides system developers an easy migration to STM-1 electrical interfaces.

- Add STM-1e option to existing STM -1o SFP designs
- 155 Mbit/s CMI transceiver in SFP
- INF-8074i MSA Compliant
- Low Power, 650 mW
- Single supply voltage, +3.3 V
- Applications :
  - STM -1: Microwave Radio
  - SONET/SDH Multiplexers

Features

— Designed for Industry-Standard MSA compliant, Small Form Factor Pluggable (SFP) ports
— STM-1 electrical interface compatible with G.703, ES1, CMI encoded signal
— Standard coaxial cable connectors, DIN 1.0/2.3 75 Ω according to CECC 22230
— Low power, high performance CMI encoder/decoder integrated in module
— Identification (EEPROM) according SFP MSA. Two options: STM-1e programmed or STM-1o programmed (allows immediate application in systems employing STM-1o SFPs)
— Single +3.3 V power supply operation
— Jitter specification exceeds ITU-T G.825 and ETSI EN 300 462-4-1
—Typical cable length: 100 m (attenuation at 78 MHz less than 13.7 dB)
—Operating Case Temperature: – 40 to + 85 °C
—RoHS compliant (including lead-free)

Installation

The AC-SFP155M-ICO-MSA module is designed in conformance with the SFP Multi-Source Agreement (SFF document INF-8074i) and can be installed, hot pluggable, in any system port with a compliant SFP cage. The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design and the 3-stage pin sequence at the electrical interface to the host board. The module housing

makes initial contact with the host board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD). The module pins sequentially contact the Ground (1), Power (2) and Signal pins (3) of the host board surface mount connector. Note that the case and the circuit ground are internally connected. This ensures that the outer conductors of the coaxial cables are grounded[1]. The printed circuit board card-edge connector is depicted in figure below.

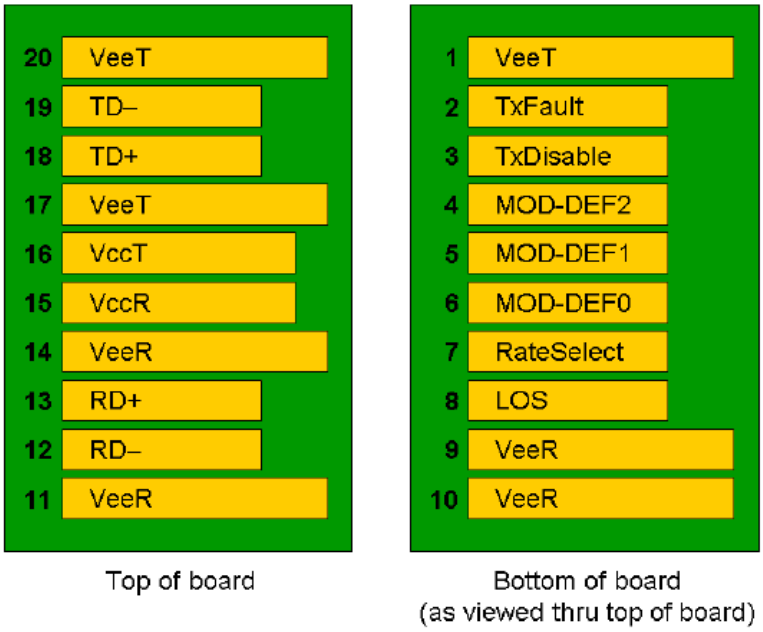

Figure 1

Mechanical Specification

The mechanical features of the AC-SFP155M-ICO-MSA include a plastic housing with over-moulded coaxial connectors. The plastic housing is covered with a folded metal housing for shielding purpose. Over-moulding results in a very robust attachment of the coax to the housing. Figure 2 provides an overview of all mechanical features and Figure 3 shows the exact physical dimensions. These module dimensions are fully compliant with the SFP MSA document. The coaxial connectors on the front of the module are on an 8 mm pitch which enables use of standard 1.0/2.3 cable connector parts with a diameter less than 8 mm.

The module is optimized for application in a “mesh-ground” environment. Note that application of the module in a “star-ground” environment may lead to unexpected ground loops. Potentially, currents that are caused by such ground loops may damage the module or another component in the loop.

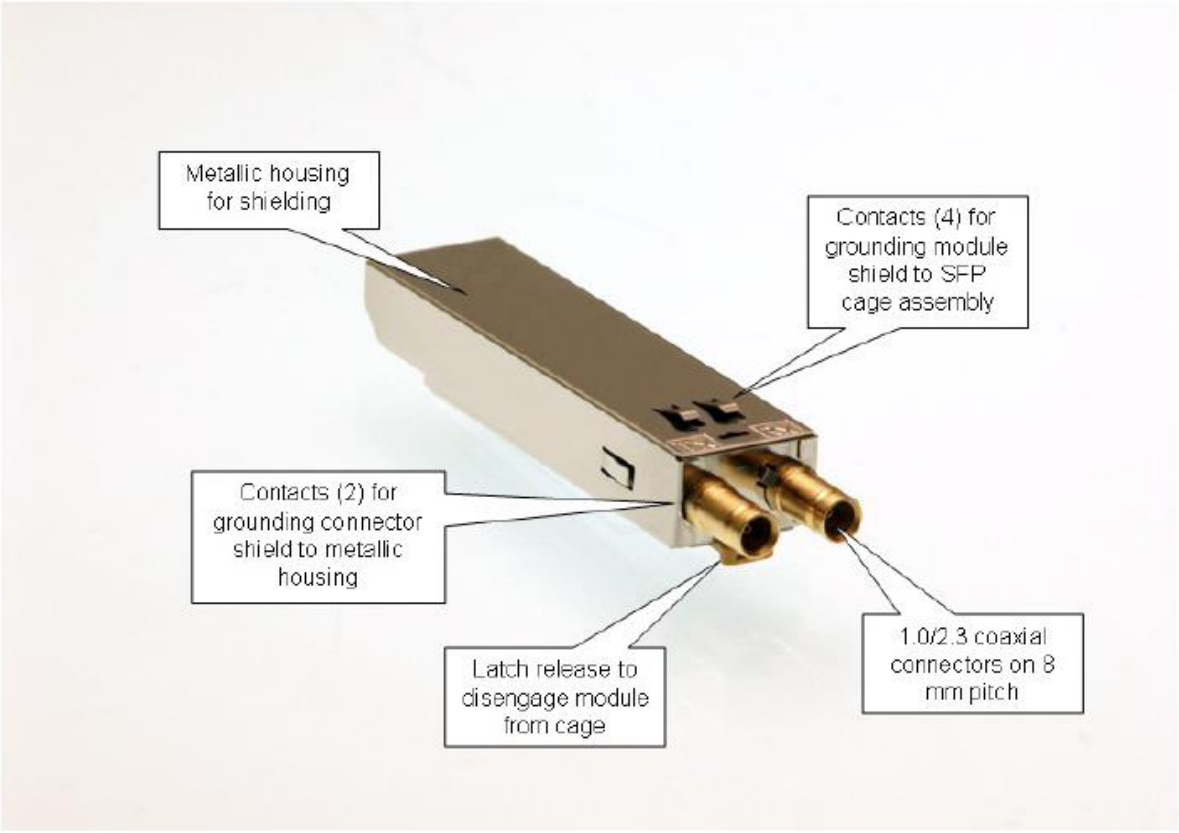

Figure 2

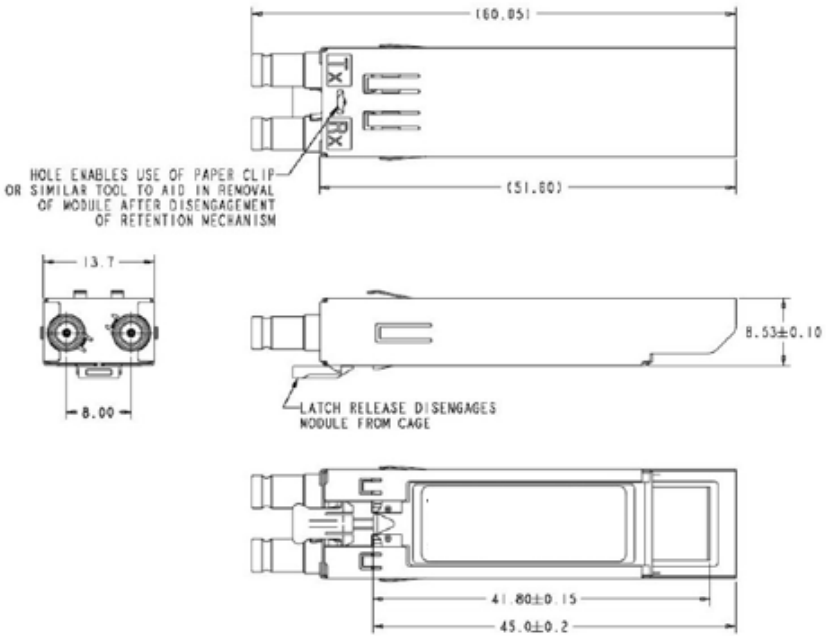

Figure 3

The metal shield is fitted over a plastic housing and grounds onto the outer RF contacts and cage. There is a latch release on the module to disengage the module from the cage. After applying the latch release, removal of the module is possible by pulling the coaxial cable. As an additional aid, there is a small hole

in the shield between the coax connectors. The module can also be pulled out using a paper clip, small screwdriver or similar tool.

Block Diagram

Figure 4 illustrates the major functional components of the AC-SFP155M-ICO-MSA module. In the transmit direction (LVDS to CMI), an LVDS timing recovery circuit assisted by an auxiliary oscillator at 19.44 MHz, derives a clock to forward the signal through the CMI encoding stage. Subsequently the CMI symbols are shaped according to figures Figure 4 using a band-gap reference. In the receive direction (CMI to LVDS), the signal is equalized to a fixed level, after which the clock is recovered and the CMI symbols decoded into a binary NRZ data stream. Loss of CMI input is alarmed on the corresponding output pin. Additional Power filtering and EEPROM identification circuits complete the module functions.

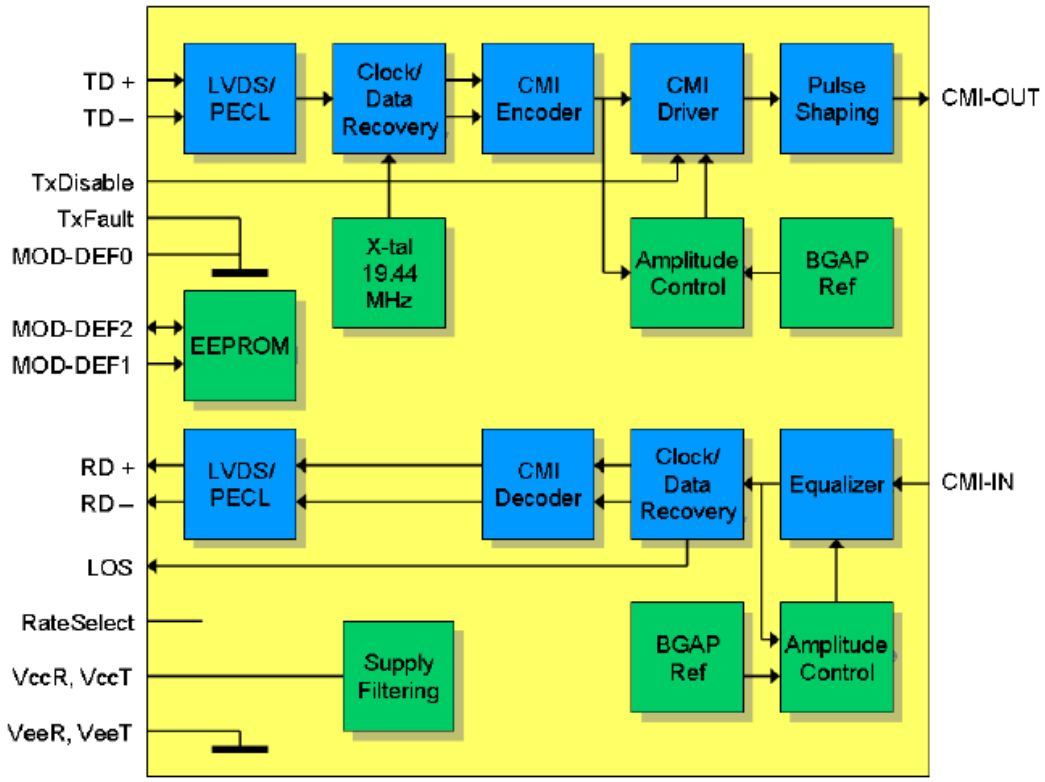

Figure 4

Pin assignment

Pin Number	Signal Name	Signal Type	Contact Sequence	Function	Notes
1	VeeT	Ground	1	Transmitter Ground	
2	TxFault	Output	3	Transmitter Fault Indication	Not used; tied to ground
3	TxDisable	Input	3	Transmitter Disable	
4	MOD-DEF2	Input/Output	3	Module Definition 2	Serial ID Data
5	MOD-DEF1	Input	3	Module Definition 1	Serial ID Clock
6	MOD-DEF0	Output	3	Module Definition 0	Module Present
7	RateSelect	Input	3	Rate Selection	Not Connected
8	LOS	Output	3	Receiver Loss of Signal	
9	VeeR	Ground	1	Receiver Ground	
10	VeeR	Ground	1	Receiver Ground	
11	VeeR	Ground	1	Receiver Ground	
12	RD–	Output	3	Inverted Receiver Data Out	NRZ Data to host board
13	RD+	Output	3	Receiver Data Out	NRZ Data to host board
14	VeeR	Ground	1	Receiver Ground	
15	VccR	Power	2	Receiver Power	
16	VccT	Power	2	Transmitter Power	
17	VeeT	Ground	1	Transmitter Ground	
18	TD+	Input	3	Transmitter Data In	NRZ Data from host board
19	TD–	Input	3	Inverted Transmitter Data In	NRZ Data from host board
20	VeeT	Ground	1	Transmitter Ground	

Absolute Maximun Rating

Parameter	Min	Typ	Max	Unit
Case temperature	-40		85	°C
Storage and transport temperature	-40		125	°C
Supply voltage (VccT, VccR)	0		4	V
Input Voltage	0		VccT	V
Differential Input Voltage Swing (TD+, TD-)	0		2.7	V
Relative Humidity	5		95	%

Electrical Interface

Operating Characteristic

Parameter	Min	Typ	Max	Unit
Supply voltage (VccT, VccR)	3.135	3.3	3.465	V
Power Dissipation			650	mW

Transmit Direction

Parameter	Symbol	Min	Typ	Max	Unit
Single-ended Input Voltage (TD+, TD–)	Vin,pp	250		1200	mV
Differential Input Voltage (TD+, TD–)	Vin,pp	500		2400	mV
Input Differential Impedance	Zin	80	100	120	Ω
TxFault (connected to ground)			0		V
TxDisable (output disabled)	Vdis-dis	2.0		VccT	V
TxDisable (output enabled)	Vdis-en	0		0.8	V
TxDisable Input Current	Idis	-1		50	mA

Note 1. The TxDisable input is pulled up inside the module with a 4.7kΩ- 10kΩresistor.

Note 2. The TD+ and TD– inputs are AC-coupled inside the module

Receive Direction

Parameter	Symbol	Min	Typ	Max	Unit
Single-ended Output Voltage (RD+, RD–)	Vout,pp	185	700	1000	mV
Differential Output Voltage (RD+, RD–)	Vout,pp	370	1400	2000	mV
Output Differential Impedance	Zout	80	100	120	Ω
LOS Output Voltage (true)	Vlos,h			VccR+0.3	V
LOS Output Voltage (false)	Vlos,l	0		0.8	V
Data Rise/Fall Time (10% – 90%)	Trise, Tfall			2.0	ns

Module definition

Parameter		Symbol	Min	Typ	Max	Unit
MOD_DEF1,2 Input Voltage	High	Vih	0.7 * VccR		VccR + 0.3	V
	Low	Vil	0		0.3 * VccR	V
MOD_DEF2 Output Voltage	High	Voh	2.0		VccR	V
	Low	Vol	0		0.4	V
MOD_DEF2 Sink Current		Imod_def2			3	mA

MOD_DEF1 and MOD_DEF2 must be pulled up to VccR with a 4.7kW - 10kW resistor on the host board.

Transmitter Timing

Parameter	Symbol	Min	Max	Unit	Condition
TxDisable assert time	t_off		10	ms	Time from rising edge of TxDisable to when the STM-1e output is isolated, see figure Figure.
TxDisable negate time	t_on		1	ms	Time from falling edge of TxDisable to when the STM-1e output is according specified output level, see figure Figure.
Time to initialize	t_init		300	ms	From power on to operational, see figures Figure and Figure.
LOS Assert Time	t_loss_on		100	ms	Time from loss of signal state to LOS assert, see figure Figure (NOTE 1).
LOS Deassert Time	t_loss_off		100	ms	Time from non-LOS state to LOS deassert, see figure Figure (NOTE 1).
Serial ID Clock Rate	f_serial_clock		100	kHz	

Note 1. SFF INF-8074i requires a maximum value of 100 µs for t_loss_on/off in case of optical ports. For (electrical) CMI ports, a value of 100 ms is required to get a reliable alarm function.

Power on initialization procedures

This subsection describes the relationship between the switching of the power and TxDisable. Figure 5 applies when the module is inserted while power is on and figure Figure 6 applies when power is turned-on, while SFP is already plugged-in. Note that TxFault is not supported so its value does not affect the power-on procedure.

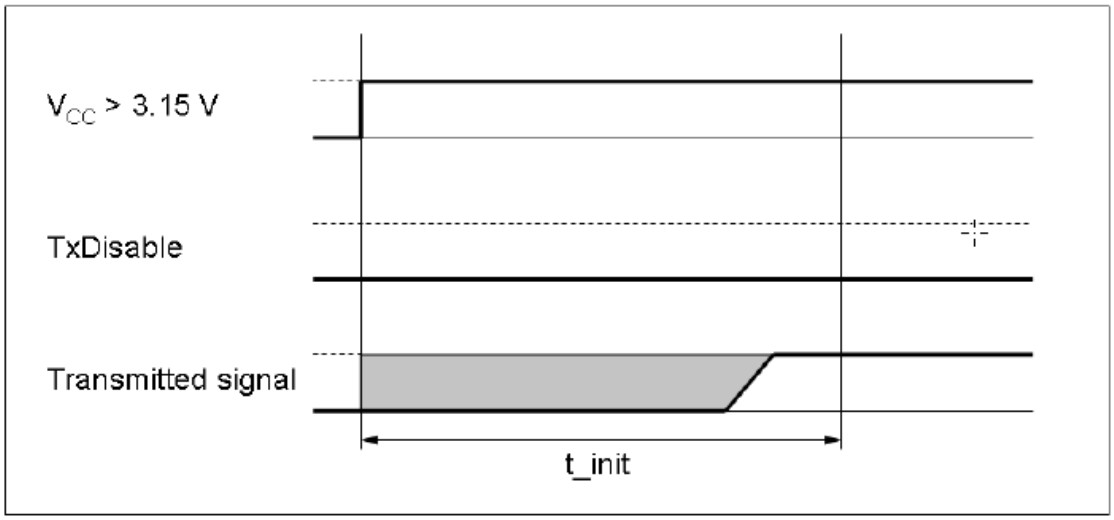

Figure 5

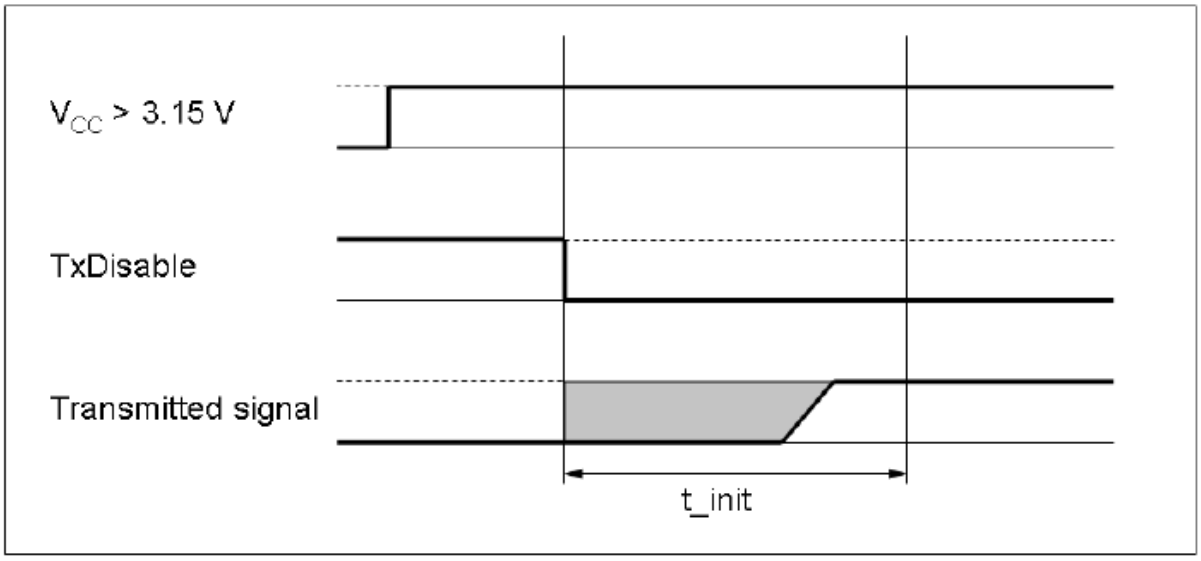

Figure 6 Tx Disable Asserted

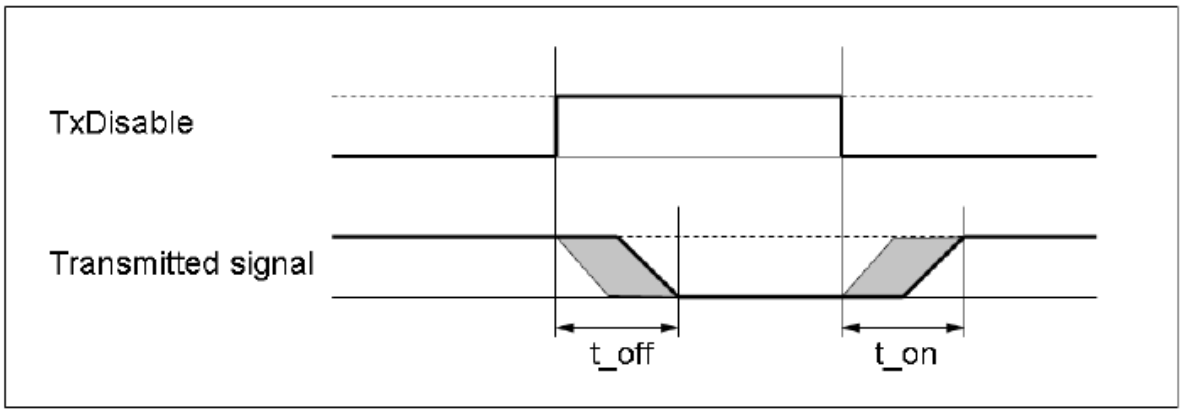

Figure 7: Tx Disable normal operation

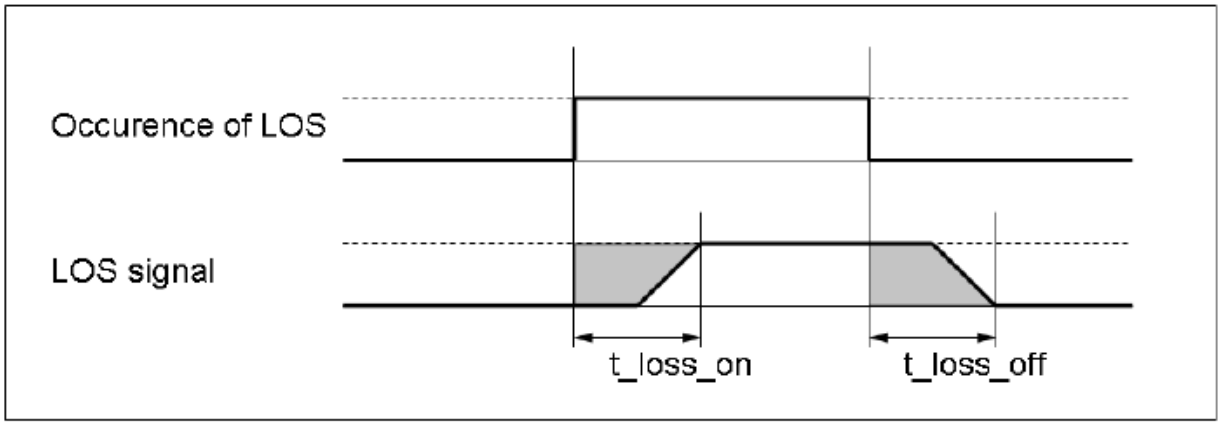

Figure 8: LOS indication

Electrical Interface

Transmitter side

The transmit side accepts NRZ data at the TD +/- inputs and outputs CMI encoded data on the STM-1e customer coaxial cable connector. The AC-SFP155M-ICO-MSA module performs CMI encoding and decoding in accordance with G.703.

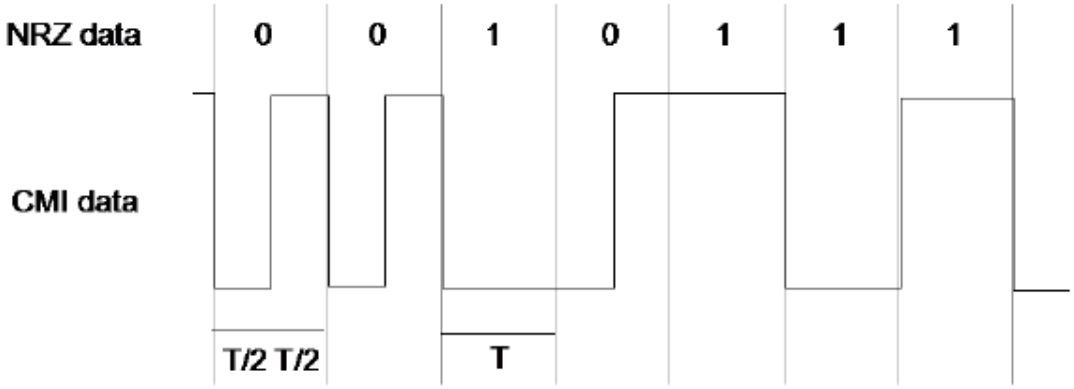

Figure 9: CMI Coding/Decoding rule

Transmitter Parameter

Parameter	Min	Typ	Max	Unit	Reference
Output Pulse Amplitude	0.9	1.0	1.1	V	G.703 GR-253-CORE
Output Pulse Amplitude	0.92	1.0	1.08	V	
10-90% Rise Times to Steady State Amplitudes	—	—	2.0	ns	G.703 GR-253-CORE
10-90% Rise Times to Steady State Amplitudes	—	—	1.8	ns	
Transition Timing Tolerance Negative Transitions Positive Transitions at UI Boundaries Positive Transitions at Mid-Interval Boundaries	 -0.1 -0.5 -0.35	 — — —	 0.1 0.5 0.35	ns	G.703 GR-253-CORE
Transition Timing Tolerance Negative Transitions Positive Transitions at UI Boundaries Positive Transitions at Mid-Interval Boundaries	 -0.09 -0.48 -0.33	 — — —	 0.09 0.48 0.33	ns	
Jitter at Transmit Output for 155 Mbit/s Interface > 12 kHz 500 Hz to 1.3 MHz 65 kHz to 1.3 MHz	 — — —	 — — —	 0.01 0.5 0.075	 UIrms UIpp UIpp	G.783 G.813 EN 300 462-4-1
Jitter Peaking (0-2.0 MHz)	—	—	0.5	dB	
Output Return Loss (8 MHz to 240 MHz)	15	—	—	dB	G.703
Output Return Loss (8 MHz to 240 MHz) (1)	18	—	—	dB	

Receiver side and CMI coding

The receive accepts CMI encoded data on the STM-1E customer coaxial cable connector and outputs NRZ data at the RD +/- outputs to the host system board. The module performs CMI encoding and decoding in accordance with G.703.

Parameter	Min	Typ	Max	Unit	Reference
0 dB Reference Level at receiver (1)		0.5		Vpp	
Analogue Loss of Signal: Threshold to Assert (2) Threshold to Clear (2) Histeresys Time to Assert / Deassert	 — 18 1	 — — — 100	 24 — 4	 dB dB dB ms	
Receiver Sensitivity (allowed attenuation at 78 MHz assuming a cable with f characteristic)	12.7	—	—	dB	G.703 GR-253-CORE
Receiver Sensitivity (allowed attenuation at 78 MHz assuming a cable with f characteristic)	13.7	14.2	—	dB	
Jitter Transfer: (3) 3 dB Bandwidth (155 Mbit/s) Peaking	 0.7 —	 TBD —	 1.5 0.5	 MHz dB	
Generated Jitter (3)	—	—	0.025	UIpp	
Jitter Tolerance	See section “Receiver Jitter Tolerance”				G.825
Allowed Frequency Deviation (w.r.t. 155.520 MHz)	20	—	—	ppm	G.703
Allowed Frequency Deviation (w.r.t. 155.520 MHz)	100	—	—	ppm	
Input Return Loss (8 MHz to 240 MHz)	15	—	—	dB	G.703
Input Return Loss (8 MHz to 240 MHz) (4)	18	—	—	dB	

Note 1. Line coupling is required to attenuate 1.0 Vpp nominal line amplitude by 6 dB so the 0 dB reference amplitude at the module CMI input is 0.5 Vpp.
Note 2. Below the nominal transmission pulse amplitude of 1.0 V at the line output.
Note 3. Receiver Jitter Transfer and Generated Jitter are module design specifications. There is no directly applicable ITU-T or Telcordia standard.
Note 4. This specification is valid at STM-1E connector interface level.