Smart solutions for smart networks

Version 1.1

SFP-COPPER-PAM

SFP Copper Wire Modem

BROADBAND
1.5 to 18Mbps

LONG DISTANCE
6 km max

INDUSTRIAL GRADE
-40~+85°C

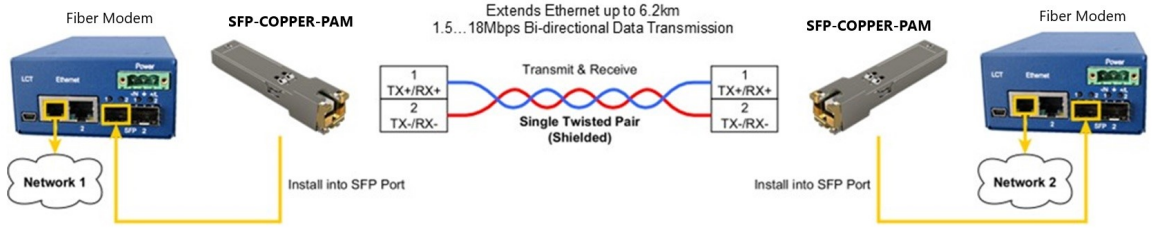
Introduction

The new **SFP-COPPER-PAM** is a single pair, low power SFP (Small Form-factor Pluggable) Ethernet copper wire modem using the transmission friendly Pulse Amplitude Modulation (PAM) technology. The modem is optimized for a duplex connection speed in the range of 1.5...18Mbps over a pair of copper wires up to 6200 meters. The **SFP-COPPER -PAM** can be plugged into any Ethernet device with SFP ports that supports 100BASE- FX and/or 1000BASE-X.

Pulse Amplitude Modulation means a much smaller frequency bandwidth than comparable modules with VDSL/ADSL technology. This technology influences the other systems less and the transmission on copper cables is more save and for harsh environments.

The configuration is possible by Web or Telnet access. The modem supports fixed and automatic transmission rate selection. The training or recovery time for the copper line connection (link synchronization) in Fixed Rate Mode is very fast (2..10 seconds). In Auto Rate Mode, SFP modems automatically adjust the transmission rate to the optimum performance that line conditions can support. The copper line interface has 1500V RMS or 2250V DC isolation and its protection meets ITU-T Rec. K.20/K.21.

Application



- Ethernet Extender, 1.5..18Mbps
- Industry 4.0 Applications
- Switch & Router Enhancement
- Single Pair Wire Ethernet Modem

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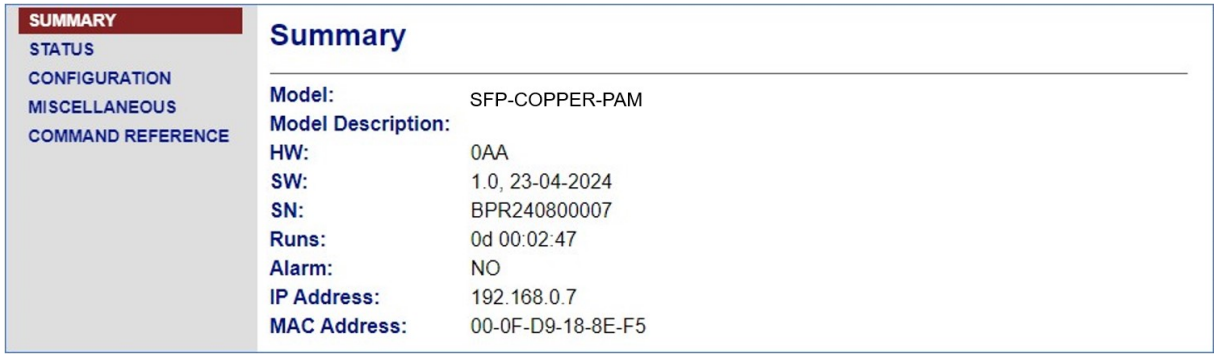
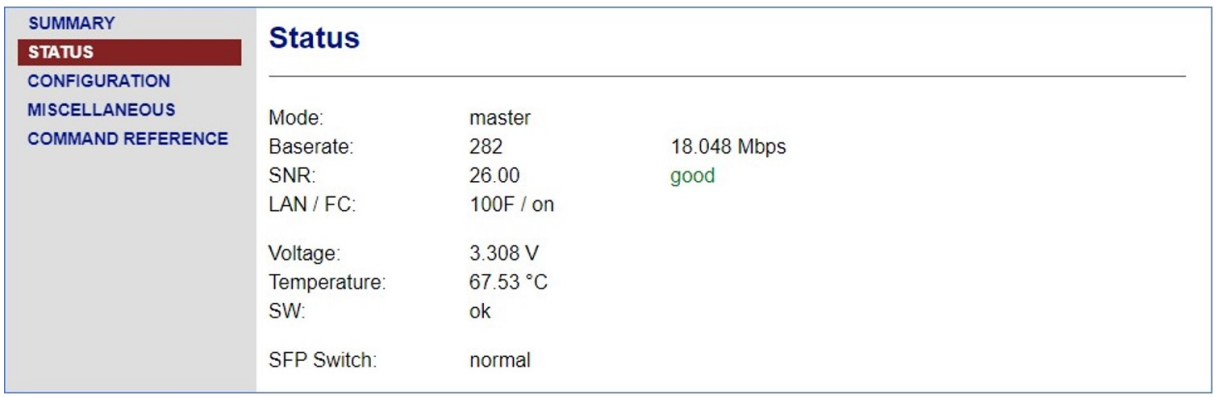
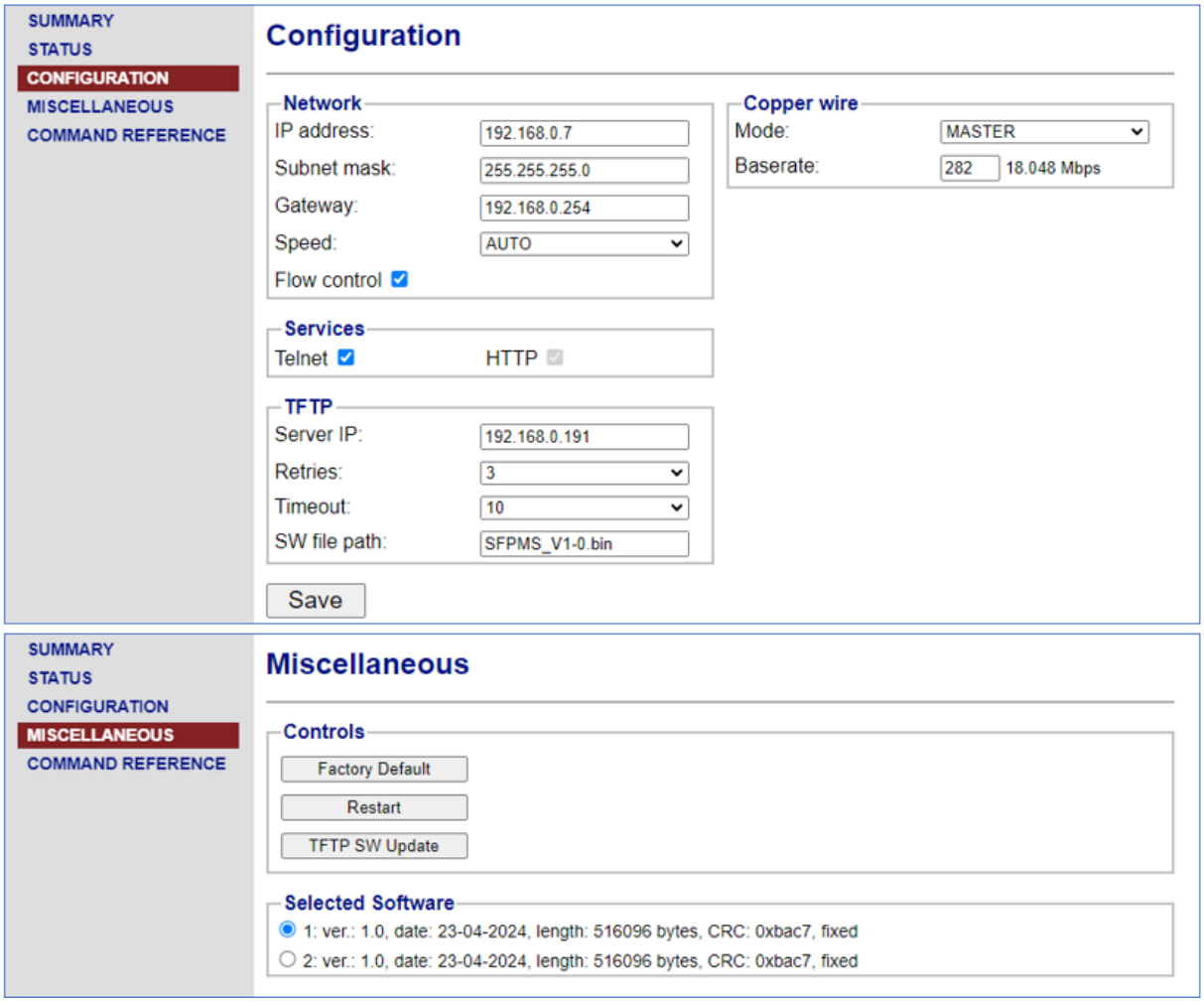
Product Features

- Industrial & Intelligent PAM Modem for copper lines
- Single Pair of Copper Wire to 100BASE-FX/1000BASE-X
- Automatic 100BASE-FX/1000BASE-X detection
- Packet size up to 2048 bytes
- Supports Flow Control (FC)
- Extends Ethernet up to 6200 Meters Over 1 Pair
- Pulse Amplitude Modulation (PAM)
- 1.536..18.048Mbps Bi-directional Data Transmission
- Automatic Speed Selection Mode (Auto Rate Mode)
- Fast Link Synchronization, typical Time to Link is 3 seconds in Fixed Rate Mode
- Fast Link Recovery, typical Reconnection Time is 3 seconds if link interruption is shorter than 2 seconds
- HTTP Web GUI and Telnet CLI (Command Line Interface)
- Low Power (< 800mW)
- Digital Diagnostic Monitoring (DDM) Available
- Single +3.3V DC Power Supply
- Hot-pluggable SFP Modem
- Operating Temperature -40°C to +85°C
- Temperature Sensor Included
- Voltage Measurement Included
- Fully Metallic Enclosure for Low EMI
- Compliant with SFP MSA Specification
- Software Upgradable
- Push-in & Crimp Connectors Included
- Connector with Snap-in Locking

Web Interface Configuration







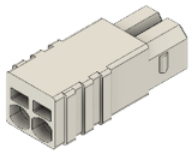
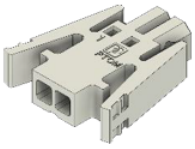
Telnet CLI Command Structure

The command structure is according to ITU-T Rec. M.3400 (Telecommunication Management Networks). Please see the Help for the command descriptions in the CLI or the COMMAND REFERENCE Menu in the WEB interface for further information.

Main Menu		
PM Performance management	**FMM** Fault and maintenance management	**CM** Configuration management
	SFPVIEW RESET SERNUM SOFTUPDATE SOFTINFO STATUS TFTP SOFTUPDATE M(AIN) H(ELP)	MASTER BASERATE ETHSD FC GATEWAY NETCONFIG NETMASK SETIP TFTPIP TFTP RETRIES TFTP TIMEOUT TFTP FILEPATH TELNET ON/OFF HTTP ON/OFF SOFTSELECT 1/2 FACTORY DEFAULT APPLY M(AIN) H(ELP)

Connector and Pin Description

Part Number	Type	Description	
	Phoenix Contact, 1815264 PTSM 0,5/ 2-HV-2,5-THR WH R32	Pin 1	Analog TX+/RX+
		Pin 2	Analog TX-/RX-

Matching Connectors, included when ordering the SFP Module			
Part Number	Type	Description	
	Phoenix Contact, 1704853 PTSM 0,5/ 2-P-2,5 WH	Connection method	Push-in spring connection
		Conductor cross section solid	0.14 mm² ... 0.5 mm²
		Conductor cross section flexible	0.2 mm² ... 0.5 mm²
		Conductor cross section AWG	24 ... 20
		Stripping length	6 mm
	Phoenix Contact, 1015464 PTCM 0,5/ 2-PL-2,5 WH	Connection method	Crimp connection
		Conductor cross section flexible	0.14 mm² ... 0.75 mm²
		Conductor cross section AWG	26 ... 18
		Stripping length	4.1 mm ... 4.6 mm
	Phoenix Contact, 1013780 PTCM-MP-P 0,34-0,75	Connection method	Crimp connector for 1015464
		Conductor cross section flexible	0.34 mm² ... 0.75 mm²
		Conductor cross section AWG	22 ... 18
		Stripping length	4.1 mm ... 4.6 mm
	Phoenix Contact, 1013781 PTCM-MP-P 0,14-0,5	Connection method	Crimp connector for 1015464
		Conductor cross section flexible	0,14 mm² ... 0,5 mm²
		Conductor cross section AWG	26 ... 20
		Stripping length	4.1 mm ... 4.6 mm

Performance on Copper Cable

Part Number	Diameter	Distance (Meter)					
		1536 kbps	4352 kbps	7168 kbps	10000 kbps	14016 kbps	18048 kbps
Cable U72 (installation cable)	0.4mm, AWG-26	1600	1100	950	800	650	450
Cable U72 (installation cable)	0.5mm, AWG-24	2100	1400	1100	950	750	500
Cable U72 (installation cable)	0.8mm, AWG-20	3800	2500	2100	1800	1400	1000
Siemens 6XV1830-5EH10 (PROFIBUS cable)	1.0mm, AWG-18	6200	4100	3400	2900	2300	1600

The performance (distance) results may differ from this table, because noisy environment or multipair cable with additional disruptive services differences in cable values (bandwidth, crosstalk etc), just same diameter bad installation, cables are not twisted, not using a paired cable

Parameter	Symbol	Packet Size (byte)	Typical @ kbps			Unit	Note
			1536	10000	18048		
Latency	L	64	0.788	0.137	0.085	ms	
		128	1.144	0.283	0.136	ms	
		256	1.670	0.390	0.239	ms	
		512	2.980	0.658	0.444	ms	
		1024	6.131	1.250	0.856	ms	
		1280	7.557	1.614	1.061	ms	
		1518	8.641	1.852	1.252	ms	
		2048	11.530	2.439	1.678	ms	

For a link connection (SFP to SFP) you must double this value.

Link Health	Symbol	Maximum @ kbps			Unit	Note
		1536	10000	18048		
Jitter	J	3.151	0.963	1.174	us	

Link Health SNR	Symbol	SNR Value	Unit	Note
Poor	SNR	< 17.29	dB	
Marginal	SNR	17.29 < SNR < 20.38	dB	
Good	SNR	> 20.38	dB	

Parameter	Symbol	Min	Typical	Max	Unit	Note
Time to link *Fixed Rate mode*		2	3	10	second	Note1)
Time to link *Auto Rate mode*		25	30	180	second	Note1)

Note1): The line parameters must allow link establishing with the selected Baserate

Operation mode		Link interruption duration	
Master	Slave	shorter than 2 seconds	longer than 2 seconds
Fixed Rate	Fixed Rate	fast reconnection in 2..10 seconds	fast reconnection in 2..10 seconds
Fixed or Auto Rate	Auto Rate	fast reconnection in 2..10 seconds	full handshake in 30..180 seconds

Technical Specification

SFP Host Interface

SFP Host Connector Power (MSA Compliant)						
Parameter	Symbol	Min	Typical	Max	Unit	Note
Input Voltage	Vcc	3.135	3.3	3.465	V DC	
Input Current	Icc		230	255	mA	

SFP Host Connector Data (MSA Compliant)						
Parameter	Symbol	Min	Typical	Max	Unit	Note
Data Rate	TD/RD		100 1000		Mbps Mbps	100Base-FX 1000Base-X

SFP Modem Interface

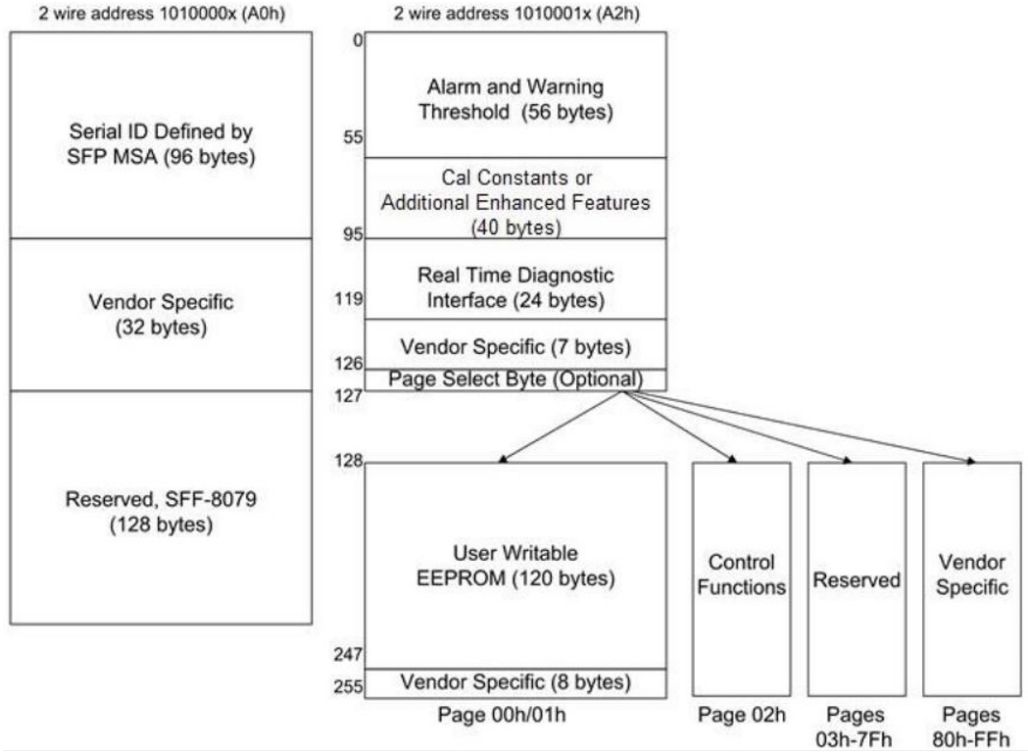
SFP Analog Modem Interface						
Parameter	Symbol	Min	Typical	Max	Unit	Note
Output Voltage	Vout	2.0	2.4	2.6	Vp2p	Peak-to-peak
Line Impedance	Z		114		Ohm	
Transmit Bandwidth		0.05		36	MHz	
Data Rate		1.536		18.048	Mbps	Duplex
Isolation		1500			Vrms	

Environment

Operating Conditions						
Parameter	Symbol	Min	Typical	Max	Unit	Note
Storage Temperature	Ts	-40		+85	°C	
Operating Temperature	To	-40		+85	°C	
Relative Humidity	RH	5		95	%	non-condensing

ID & Diagnostic and Control/Status Fields Memory Map

The SFP MSA defines an enhanced memory map with a digital diagnostic monitoring interface for SFP transceivers that allows pseudo real time access to device operating parameters. It defines a 256 bytes memory map which is accessible over a 2-wire serial interface at the 8-bit address 1010000X (A0h), the ID fields. The digital diagnostic monitoring interface makes use of the 8-bit address 1010001X (A2h).



Base/Extended ID Fields, Address A0h

Address	Name	Content (Hex)	Description
0	Identifier	03	SFP
1	Ext. Identifier	04	SFP function is defined by 2-wire interface ID
2	Connector	00	Unspecified
3-10	Transceiver	00 00 00 00 00 00 40 00	Twisted Pair (TP)
11	Encoding	00	Unspecified
12	Signaling Rate, Nominal	00	Unspecified
13	Rate Identifier	00	Unspecified
14-17	Link length fiber	00 00 00 00	
18	Length copper cable	C8	Minimum 200 meter
19	Supported length copper cable	FA	5800 meter
20-35	Vendor name	46 6C 65 78 44 53 4C 20 20 20 20 20 20 20 20 20	FlexDSL
36	Transceiver compliance	00	Not specified
37-39	Vendor OUI	00 0F D9	00 0F D9
40-55	Vendor PN	43 4F 50 53 46 50 4D 53 50 41 4D 20 20 20 20 20	COPSFPMSPAM

56-59	Vendor rev	31 2E 30 20	1.0
60-61	Wavelength	00 00	
62	Fiber Channel Speed 2	00	
63	CC_BASE	xx	Check code for Base ID Fields (addresses 0-62)
64-65	Options	00 12	TX_DISABLE and Loss of Signal implemented
66	Signaling Rate, max	00	Unspecified
67	Signaling Rate, min	00	Unspecified
68-83	Vendor Serial Number	xx	
84-91	Date code	yy yy mm mm dd dd 20 20	Year yy yy, Month: mm mm, Day: dd dd, Lot:
92	Diagnostic Monitoring Type	20	Internally calibrated
93	Enhanced Options	00	
94	SFF-8472 Compliance	09	Includes functionality described in Rev 12.4 of SFF-8472
95	CC_EXT	xx	Check code for the Extended ID Fields (addresses 64-94)
96-106	Vendor Specific, Flex PN	xx	SFPMS xxxx
107-118	Vendor Specific, Flex SN	xx	Manufacturer/Year/Week/SerialNumber
119-124	Vendor Specific, MAC-address	00 0F D9 xx yy zz	00:0F:D9:xx:yy:zz
125-127	Vendor Specific		Unspecified
128-255	Reserved		

Diagnostic and Control/Status Fields, Address A2h

Address	Name	Content (Hex)	Description
0-119	Standard DDM values	00	Unspecified
96	Temperature MSB	xx	Internally measured temperature, according SFF-8472
97	Temperature LSB	xx	Internally measured temperature, according SFF-8472
96	Supply Voltage MSB	xx	Internally measured supply voltage, according SFF-8472
97	Supply Voltage LSB	xx	Internally measured supply voltage, according SFF-8472
120	SW Version MSB	zz	Value zz.yy
121	SW Version LSB	yy	Value zz.yy
122	RX SNR MSB	zz	Value in dB zz.yy
123	RX SNR LSB	yy	Value in dB zz.yy
124	TX Voltage	00 or 01	0 = 1.2V_{p2p}, 1 = 2.4V_{p2p}
125-126	Vendor Specific	00	Unspecified
127	Optional Page Select	00	

Safety/EMC/ROHS/WEEE/MTBF

Safety	EN 62368-1:2020/A11:2020 IEC 62368-1:2020/A11:2020	
EMC	EN 300 386 V2.1.1:2016 EN 55032:2015/A11:2020 EN 55035:2017/A11:2020 EN 61000-4-2:2009 EN 61000-4-3:2020 EN 61000-4-4:2012 EN 61000-4-5:2014 + A1:2017 EN 61000-4-6:2014	 class B criterion A ± 8 kV contact discharge, ± 15 kV air discharge 10 V/m (80-1000 MHz) ± 4 kV data line ± 2 kV data line 10 V (150 kHz-80 MHz)
RoHS	RoHS2 Directive 2011/65/EU and 2015/863/EU	
WEEE	WEEE Directive 2012/19/EU	
MTBF	Lifetime: 1'158'748 H, λ (10^{-9} h^{-1}) = 863, Siemens Norm SN 29500, Temperature 40°C	

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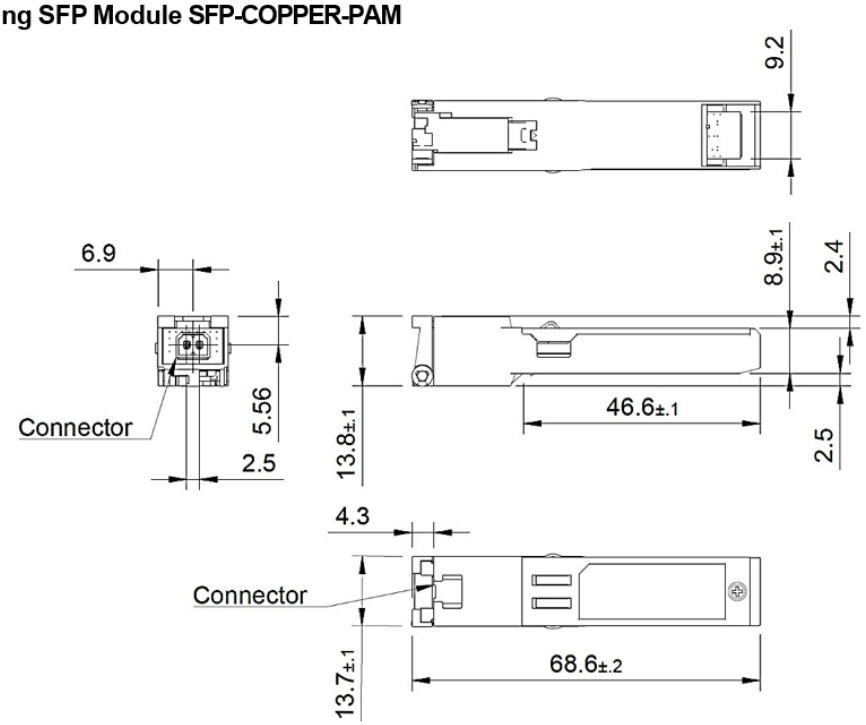
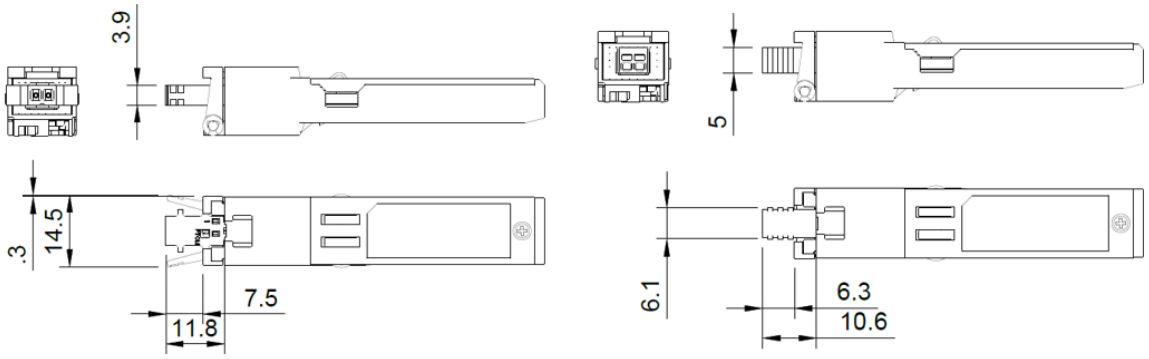
Mechanical Specification

Outline Drawing SFP Module SFP-COPPER-PAM



Outline Drawing SFP-COPPER-PAM with Connector



Outline Drawing with Connector 1015464

Outline Drawing with Connector 1704853

Ordering Information

Référence	Description
SFP-COPPER-PAM	Industrial 1.5...18Mbps SFP Ethernet Copper Wire modem (PAM),Reach up to 6200 meter, 100Base-FX/1000Base-X SFP Connection,-40°C to +85°C, AWG 18-26 Combicon XC with Snap-in Locking connector

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