

# QSFP-DD 400GE SR8 100 m Optical Transceiver Module

## OM3680SX200

ETSC's OM3680SX200 is a parallel 400GE Quad Small Form Factor Pluggable double density (QSFP-DD) SR8 optical module designed for optical communication applications. The optical module uses a 4-level pulse amplitude modulation (PAM4) format. The optical module provides point-to-point 400 Gigabit Ethernet links over eight pairs of multimode fiber, with a reach of up to 100 m for OM4 (MMF) and 70 m for OM3 (MMF).

It is compliant with QSFP-DD MSA standard and IEEE 802.3cm 400GBASE-SR8 standard and IEEE 802.3bs 400GAUI-8 standard. Digital diagnostics functions are available via the I2C interface, as specified by the QSFP-DD MSA..



### FEATURES

- QSFP-DD MSA compliant
- QSFP-DD CMIS4.0 Management interface compliant
- IEEE 802.3cm 400GBASE-SR8 standard compliant
- IEEE 802.3bs 400GAUI-8 standard compliant
- Digital diagnostic functions
- 8 channels full-duplex transceiver module
- 425 Gbit/s aggregate bit rate
- Maximum link length of 70 m OM3, 100 m OM4 with FEC
- Single MPO-16/APC receptacle
- Maximum power dissipation < 10 W
- Operating case temperature range 0 to 70°C
- Single 3.3 V power supply
- RoHS 2.0 compliant

### APPLICATIONS

- 400G Ethernet
- Data center network

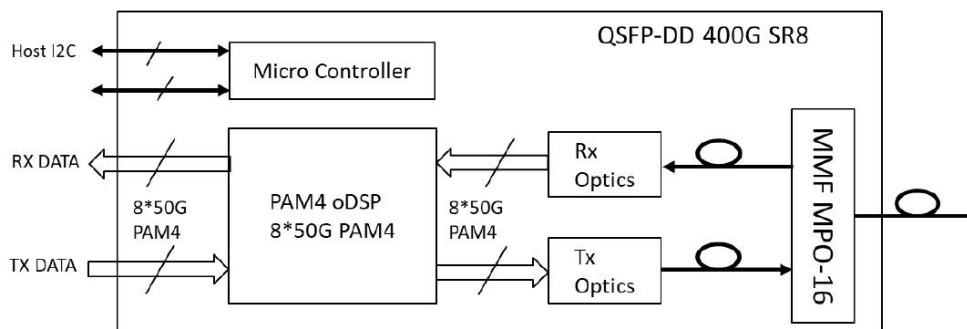


Figure 1. Transceiver Block Diagram

## Pin Descriptions

The QSFP-DD SR8 module edge connector consists of a single paddle card with 38 pads on the top and 38 pads on the bottom for a total of 76 pads. The pads are defined in such a manner so as to accommodate insertion of a QSFP module into a QSFP-DD receptacle.

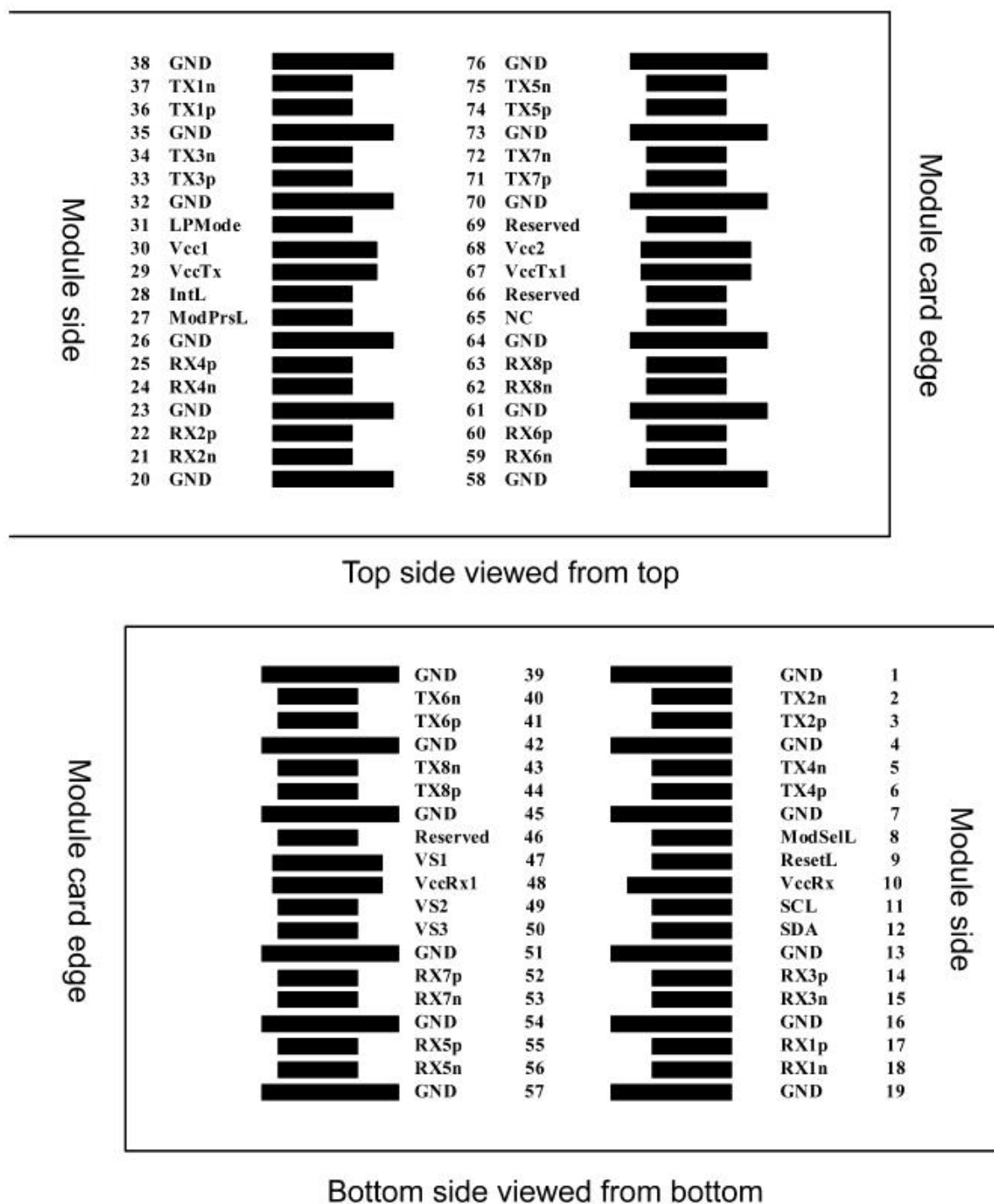


Figure 2. MSA compliant Connector

Pin	Logic	Symbol	Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	
7		GND	Ground	1
8	LVTTL-I	ModSelL	Module Select	
9	LVTTL-I	ResetL	Module Reset	
10		VccRx	+3.3 V Power Supply	2
11	LVC MOS-I/O	SCL	2-wire serial interface clock	
12	LVC MOS-I/O	SDA	2-wire serial interface data	
13		GND	Ground	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power supply	2
30		Vcc1	+3.3 V Power supply	2
31	LVTTL-I	LPMode	Low Power mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Input	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Input	
38		GND	Ground	1
39		GND	Ground	1

Pin	Logic	Symbol	Description	Notes
40	CML-I	Tx6n	Transmitter Inverted Data Input	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	
42		GND	Ground	1
43	CML-I	Tx8n	Transmitter Inverted Data Input	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	
45		GND	Ground	1
46		Reserved	For Future Use, No Connect	
47		VS1	Module Vendor Specific 1, No Connect	
48		VccRx1	+3.3 V Power Supply	2
49		VS2	Module Vendor Specific 2	
50		VS3	Module Vendor Specific 3	
51		GND	Ground	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	
53	CML-O	Rx7n	Receiver Inverted Data Output	
54		GND	Ground	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	
56	CML-O	Rx5n	Receiver Inverted Data Output	
57		GND	Ground	1
58		GND	Ground	1
59	CML-O	Rx6n	Receiver Inverted Data Output	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	
61		GND	Ground	1
62	CML-O	Rx8n	Receiver Inverted Data Output	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	
64		GND	Ground	1
65		NC	No Connect	
66		Reserved	For Future Use, No Connect	
67		VccTx1	+3.3 V Power supply	2
68		Vcc2	+3.3 V Power supply	2
69		Reserved	For Future Use, No Connect	
70		GND	Ground	1
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input	
72	CML-I	Tx7n	Transmitter Inverted Data Input	
73		GND	Ground	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	
75	CML-I	Tx5n	Transmitter Inverted Data Input	
76		GND	Ground	1

**Notes**

1. QSFP-DD uses common ground (GND) for all signals and supply (power). All are common within the QSFP- DD module and all module voltages are referred to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.
2. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 shall be applied concurrently. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 may be internally connected within the module in any combination. Each connector Vcc pin is rated for a maximum current of 1000 mA.

## Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Maximum supply voltage	Vcc	-0.3	3.3	3.6	V	
Storage temperature	Ts	-40		85	°C	
Relative humidity	RH	5		85	%	1
Damage threshold, each lane	THd	5			dBm	

**Notes**

1. Non-condensing.

## Operating Environments

Electrical and optical characteristics below are defined under this operating environment, unless otherwise specified.

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Supply voltage	Vcc	3.135	3.3	3.465	V	
Case temperature	Tc	0		70	°C	
Data rate, each lane			26.5625		GBd	
Data rate accuracy		-100		100	ppm	
Modulation format		PAM4				
Link distance with OM3 MMF				70	m	
Link distance with OM4 MMF				100	m	
Link distance with OM5 MMF				100	m	

**Notes**

1. Initialization Flows: The Host Initialization Flows of CMIS Rev4.0 Standard Appendix C are recommended.

## Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Power dissipation			9	10	W	
Steady state current	Icc			3189	mA	1
Instantaneous peak current				4000	mA	
Sustained peak current				3300	mA	

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Module-to-Host electrical specifications at TP4 (module output)						
Differential voltage pk-pk	Vpp			900	mV	
Common mode voltage	Vcm	-350		2850	mV	2
AC common-mode output voltage (RMS)				17.5	mV	
Transition time	Trise/Tfall	9.5			ps	20%~80%
Differential termination resistance mismatch				10	%	
Near-end ESMW (eye symmetry mask width)		0.265			UI	
Near-end eye height, differential		70			mV	
Far-end ESMW (eye symmetry mask width)		0.20			UI	
Far-end eye height, differential		30			mV	
Far-end pre-cursor ISI ratio		-4.5		2.5	%	
Differential output return loss		IEEE 802.3-2018 Equation (83E-2)			dB	
Common to differential mode con- version return loss		IEEE 802.3-2018 Equation (83E-3)			dB	
Host-to-Module electrical specifications (module input)						
Differential termination resistance mismatch				10	%	
Overload differential voltage pk-pk	Vpp	900			mV	TP1a
DC common mode voltage	Vcm	-350		2850	mV	TP1
Single-ended voltage tolerance		-0.4		3.3	V	TP1a
Module stressed input test		IEEE 802.3bs 120E.3.4.1				TP1a
Differential input return loss		IEEE 802.3-2018 Equation (83E-5)			dB	TP1
Differential to common mode input return loss		IEEE 802.3-2018 Equation (83E-6)			dB	TP1

**Notes**

1. The module must stay within its declared power class.
2. DC common mode voltage is generated by the host. Specification includes effects of ground offset voltage.

## Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Center wavelength	$\lambda_c$	840		868	nm	
<b>Host-to-Module electrical specifications (module input)</b>						
RMS spectral width				0.65	nm	
Average launch power, each lane	PAVG	-6.5		4	dBm	
Outer optical modulation amplitude (OMA outer), each lane	POMA	-4.5		3	dBm	
Launch power in OMA outer minus TDECQ, each lane		-5.9			dBm	
Transmitter and dispersion eye closure for PAM4, each lane	TDECQ			4.5	dB	
TDECQ – 10log10 (Ceq), each lane				4.5	dB	
Extinction ratio, each lane	ER	3			dB	

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter transition time, each lane				34	ps	
Average launch power of OFF transmitter, each lane	POFF			-30	dBm	
RIN12OMA				-128	dB/Hz	
Optical return loss tolerance				12	dB	
Encircled flux		≥ 86% at 19 um ≤ 30% at 4.5 um			Encircled flux	
Receiver						
Average receiver power, each lane		-8.4		4	dBm	
Receiver power, each lane (OMA)				3	dBm	
Damage threshold, each lane	THd	5			dBm	
Receiver reflectance				-12	dB	
LOS assert	LosA	-24.6			dBm	
LOS de-assert	LosD			-8	dBm	
LOS hysteresis	LosH	0.5			dB	
Receiver sensitivity (OMA outer), each lane	Sen			Max (–6.5,SE CQ –7.9)	dB	
Stressed receiver sensitivity (OMA) , each lane	SRS			-3.4	dBm	
Conditions of stressed receiver sensitivity test						
Stressed eye closure for PAM4, lane under test	SECQ			4.5	dB	
SECQ – 10log10 (Ceq), lane under test				4.5	dB	
OMA outer of each aggressor lane				3	dBm	

## EEPROM Definitions

Refer to CMIS Rev4.0 used for QSFP-DD.

## Digital Diagnostic Monitoring Functions

Digital diagnostic management interface (DDMI) is realized by I2C interface in compliance with CMIS 4.0. Diagnostic management functions are realized, and the data addresses are listed in the form below.

Performance Item	Related bytes	Monitor error	Notes
Module temperature	Lower Page (14 to 15)	$\leq \pm 3^{\circ}\text{C}$	1, 2
Module voltage	Lower Page (16 to 17)	$\leq \pm 3\%$	2
Transmitter optical power	Upper Page11h (154 to 169)	$\leq \pm 3\text{ dB}$	2
Bias current	Upper Page11h (170 to 185)	$\leq \pm 10\%$	2
Receiver optical power	Upper Page11h (186 to 201)	$\leq \pm 3\text{ dB}$	2

### Notes

- Actual temperature test point is fixed on module case around laser array.
- Full operating temperature range.

## Alarm and Warning Thresholds

OM3680SX200 supports alarms function, indicating the values of the preceding basic performance are lower or higher than the thresholds.

Performance item	Alarm threshold bytes (Page02h memory)	Unit	Low threshold	High threshold
Temperature warning	132 to 135	°C	0	70
Voltage warning	140 to 143	V	3.135	3.465
Ibias warning	188 to 191	mA	4	9
Tx power warning	180 to 183	dBm	-6.5	5.5
Rx power warning	196 to 199	dBm	-7	5.5
Temperature alarm	128 to 131	°C	-10	80
Voltage alarm	136 to 139	V	2.97	3.63
Ibias alarm	184 to 187	mA	2	11
Tx power alarm	176 to 179	dBm	-9.5	7
Rx power alarm	192 to 195	dBm	-10	7

## Mechanical Specifications

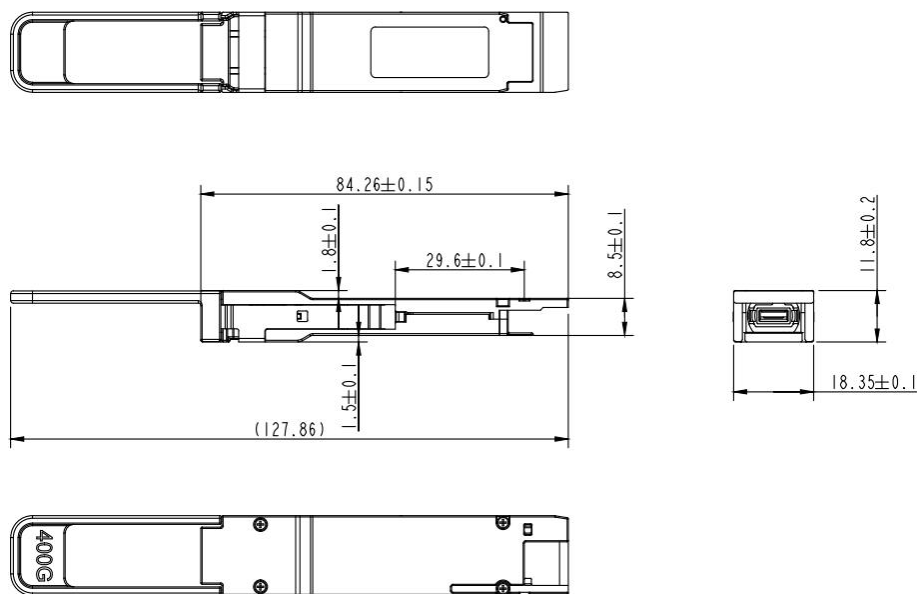


Figure 3 OM3680SX200 mechanical dimensions



## Optical Interface

The QSFP-DD 400GE SR8 optical interface port shall be a male MPO-16 APC receptacle. The recommended location and numbering of the optical ports for each of the Media Dependent Interfaces is shown in Figure 4. The transmitter and receiver optical lanes shall occupy the positions depicted in Figure 4 when looking into the MDI receptacle with the connector keyway feature on top.

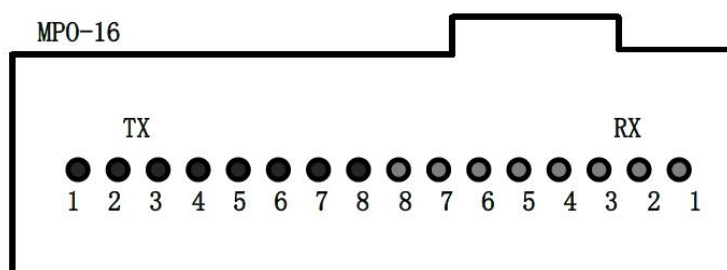


Figure 4 Optical media dependent interface port assignments

### Notes

1. The module uses MPO-16 APC receptacle. It may need every optical connector of the transmission link with APC interface for lower optical reflectance.

## Regulatory Compliance

The QSFP-DD 400GE SR8 optical transceiver is RoHS 2.0 compliant and complies with international electromagnetic compatibility (EMC) and product safety requirements and standards.

Feature	Agency	Standard	Performance
Safety	NRTL	UL 62368-1 CAN/CSA C22.2 No. 62368-1	NRTL recognized component for US and CAN
	TUV	EN 62368-1 IEC 60825-1:2014 EN 60825-1:2014 IEC 60825-2:2004+A1:2006+A2:2010 EN 60825-2:2004+A1:2006+A2:2010	TUV certificate
	FDA	U.S. 21 CFR 1040.10	FDA/CDRH certified with accession number according to Laser Notice 56
Electromagnetic Compatibility	Radiated emissions	EMC Directive 2014/30/EU EN 55032 CISPR 32 FCC rules 47 CFR Part 15 ICES-003 AS/NZS CISPR 32	Class B digital device with a minimum -6dB margin to the limit when tested with a metal enclosure. Final margin may vary depending on system application, good system EMI design practice, ie: suitable metal enclosure and well-bonding, is required to achieve Class B margins at the system level. Tested frequency range: 30 MHz to 40 GHz or 5th harmonic (5 times the highest frequency), whichever is less.
	ESD	EMC Directive 2014/30/EU EN 55035 CISPR 35 IEC/EN 61000-4-2	Withstands discharges of $\pm 8$ kV contact, $\pm 15$ kV air.
	Radiated immunity	EMC Directive 2014/30/EU EN 55035 CISPR 35 IEC/EN 61000-4-3	Field strength of 10 V/m from 80 MHz to 6 GHz.
Restriction of Hazardous Substances	RoHS	EU Directive 2011/65/EU (EU) 2015/863	

## ESD Design

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wrist straps.

Parameter	Threshold value	Notes
ESD of all the QSFP-DD module pins	1 kV	Human Body Model
Air discharge during operation	15 kV	
Direct contact discharges to the case	8 kV	

## Safety Specification Design



### Cautions

Do not look into fiber end faces without eye protection using an optical meter (such as magnifier and microscope) within 100 mm, unless you ensure that the laser output is disabled. When operating an optical meter, observe the operation requirements.

CAUTION-Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Attention – L'utilisation des commandes ou réglages ou l'exécution des procédures autres que celles spécifiées dans les présentes exigences peuvent être la cause d'une exposition à un rayonnement dangereux.

## Ordering Information

Part Number	Description
OM3680SX200	QSFP-DD 400GE SR8 100 m OM4 & 70 m OM3