

# CFP2-ER4 Transceiver

## 100G-BASE 40km CFP2



### Features:

- Hot pluggable CFP2 MSA package
- 3.3V Power supply and MDIO management interface for digital diagnostics
- Duplex LC Connector Interface
- Integrated 4-LAN WDM TOSA/ROSA for up to 40km link over G.652 SMF
- Operating data rate from 103.125Gbps to 111.8Gbps
- Compliant with 100GBASE-ER4
- CFP-MSA-CFP2-HW-Specification compliant
- Operating Case Temperature: 0 ~ +70°C
- Power consumption less than 9W



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### Applications:

- 100GBase-ER4 Ethernet
- OTU4 4L1-9C1F

### Product Description

TC2-HG40-31DCR CFP2 transceivers are designed for use in 100 Gigabit Ethernet links over 40km single module fiber, and it compliant to the CFP2 MSA CFP2 HW and IEEE 802.3ba 100GBASE-ER4. Digital diagnostics are available via MDIO as specified in the CFP2 MSA Management Interface Specification. The transceiver's designs are optimized for high performance and cost efficiency to provide customers the best solutions for Datacom and Telecom applications. The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC.

## Ordering information

Part No.	Data Rate	Laser	Fiber Type	Distance <sup>*Note1</sup>	Optical Interface	Bail color	Temp. <sup>*Note2</sup>	DDMI
TC2-HG40-31DCR	103.125G~111.8G	4-LANE: 1295.56, 1300.05, 1304.58, 1309.14,	SMF	40km	LC	Blue	ST	YES

Note1: with 9/125µm SMF

Note2: ST: 0 ~ +70deg C

## Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883G Method 3015.7	Class 1C (>1000 V)
Electrostatic Discharge to the enclosure	EN 55024:1998+A1+A2 IEC-61000-4-2 GR-1089-CORE	Compliant with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022:2006 CISPR 22B :2006 VCCI Class B	Compliant with standards Noise frequency range: 30 MHz to 6 GHz. Good system EMI design practice required to achieve Class B margins. System margins depend on customer host board and chassis design.
Immunity	EN 55024:1998+A1+A2 IEC 61000-4-3	Compliant with standards. 1kHz sine-wave, 80% AM, from 80 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits.
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1:2007 EN (IEC) 60825-2:2004+A1 EN (IEC) 60950-1:2006+A1+A11+A12	CDRH compliant and Class I laser product. TUV Certificate No. <a href="#">R50271605</a>
Component Recognition	UL and CUL EN60950-1:2006	TUV Certificate No. <a href="#">E344594</a> (CB:JPTUV-053877)
RoHS2.0	20011/65/EU	Compliant with standards

## Absolute Maximum Ratings<sup>\*Note3</sup>

Parameter	Symbol	Min	Max	Unit
Storage Temperature	TS	-40	+85	°C
Supply Voltage	V <sub>CC</sub>	-0.3	3.6	V
Operating Humidity	-	5	85	%

Note3: Exceeding any one of these values may destroy the device permanently.

## Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit
Operating Case Temperature	T <sub>C</sub>	0		70	°C
Power Supply Voltage	V <sub>CC</sub>	3.2	3.3	3.4	V
Bit Rate			103.125	111.8	Gbps
Power dissipation	P			9	W

## Performance Specifications – Electrical

Parameter	Symbol	Min	Typ.	Max	Unit	Notes
<b>Transmitter</b>						
Input Amplitude (Differential)	V <sub>IH</sub>	85		900	mVpp	AC coupled inputs
Input Impedance (Differential)	Z <sub>IH</sub>	80	100	120	ohms	R <sub>in</sub> >100kohms@DC
<b>Receiver</b>						
Output Amplitude (Differential)	V <sub>out</sub>	200		900	mVpp	AC coupled outputs
Output Impedance (Differential)	Z <sub>out</sub>	80	100	120	ohms	
Output Rise/Fall Time	Tr/Tf	12			ps	20%~80%

## Performance Specifications – Optical

( 100GBASE-ER4 )

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter</b>						
Channel data rate			25.7812		Gbps	
Data rate variation		-100		100	ppm	
Centre Wavelength	λ <sub>C<sub>T0</sub></sub>	1294.53	1295.56	1296.59	nm	
	λ <sub>C<sub>T1</sub></sub>	1299.02	1300.05	1301.09	nm	
	λ <sub>C<sub>T2</sub></sub>	1303.54	1304.58	1305.63	nm	
	λ <sub>C<sub>T3</sub></sub>	1308.09	1309.14	1310.19	nm	
Total Average Launch Power	P <sub>out</sub>			8.9	dBm	
Average Launch Power per Lane	P <sub>avg</sub>	-2.9		2.9	dBm	
Difference in Launch power between any two lanes(OMA)				3.6	dB	
Launch power in OMA minus TDP, per lane	P <sub>omatdp</sub>	-2.3			dB	
Extinction Ratio	ER	8			dB	
Average Launch Power of TX_DIS Transmitter per lane	P <sub>OFF</sub>			-30	dBm	TX_dis=H
SMSR	SMSR	30			dB	
Optical Return Loss Tolerance	T <sub>RL</sub>			20	dB	
Transmitter reflectance	T <sub>ef</sub>			-12	dB	

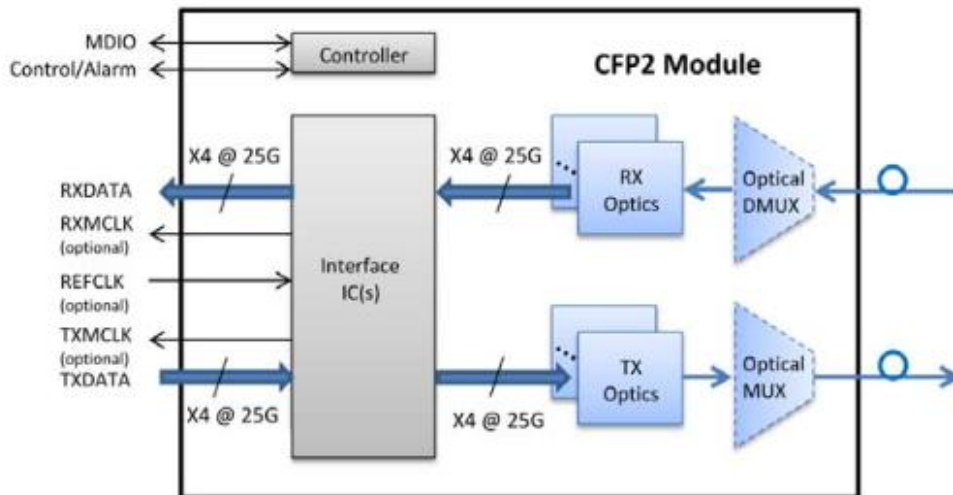
Optical Eye Mask {X1, X2, X3, Y1, Y2, Y3}	IEEE802.3ba-2010 Compliant			NOTE4	
<b>Receiver</b>					
Channel data rate	25.7812			Gbps	
Data rate variation	-100	100		ppm	
Centre Wavelength	$\lambda_{CT0}$	1294.53	1295.56	1296.59	nm
	$\lambda_{CT1}$	1299.02	1300.05	1301.09	nm
	$\lambda_{CT2}$	1303.54	1304.58	1305.63	nm
	$\lambda_{CT3}$	1308.09	1309.14	1310.19	nm
Damage threshold	$\lambda_c$	5.5		dBm	
Average receiver power per lane	Pin	-20.9	4.5		dBm
Receive power OMA per Lane	Poma-in			4.5	dBm
Receiver Sensitivity(OMA) per lane	Psen			-21.4	dBm
Stressed Receiver Sensitivity per Lane	Psen_str			-17.9	dBm
Receiver Reflectance	Ref			-26	dB
Rx-Lane LOS Assert			-35	-26	dBm
Rx-Lane LOS De-assert				-25	dBm
Rx-Lane LOS Hysteresis			0.5		dB

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Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter</b>						
Channel data rate				27.95		Gbps
Data rate variation			-20	20		ppm
Centre Wavelength	$\lambda_{CT0}$	1294.53	1295.56	1296.59		nm
	$\lambda_{CT1}$	1299.02	1300.05	1301.09		nm
	$\lambda_{CT2}$	1303.54	1304.58	1305.63		nm
	$\lambda_{CT3}$	1308.09	1309.14	1310.19		nm
Total Average Launch Power	Pout			8.9		dBm
Average Launch Power per Lane	Pavg	-2.9			2.9	dBm
Difference in Launch power between any two lanes(OMA)				3.6		dB
Extinction Ratio	ER	8				dB
Average Launch Power of TX_DIS Transmitter per lane	P <sub>OFF</sub>			-30		dBm TX_dis=H
SMSR	SMSR	30				dB
Optical Return Loss Tolerance	T <sub>RL</sub>			20		dB
Transmitter reflectance	Tef			-12		dB
Optical Eye Mask {X1, X2, X3, Y1, Y2, Y3}				G.959.1 Compliant		NOTE4
<b>Receiver</b>						
Channel data rate				27.95		Gbps

Data rate variation		-20	20	ppm	
Centre Wavelength	$\lambda_{CT0}$	1294.53	1295.56	1296.59	nm
	$\lambda_{CT1}$	1299.02	1300.05	1301.09	nm
	$\lambda_{CT2}$	1303.54	1304.58	1305.63	nm
	$\lambda_{CT3}$	1308.09	1309.14	1310.19	nm
Damage threshold	$\lambda_c$	5.5		dBm	
Average receiver power per lane	Pin	-20.7	4.5	dBm	
Maximum channel power difference			4.5	dB	
Maximum Mean total input power			10.5	dBm	
Maximum optical path penalty			2.5	dB	
Receiver Reflectance	Ref		-26	dB	
Rx-Lane LOS Assert		-35	-26	dBm	
Rx-Lane LOS De-assert			-25	dBm	
Rx-Lane LOS Hysteresis		0.5		dB	

## Internal reference structure



## Pin Layout

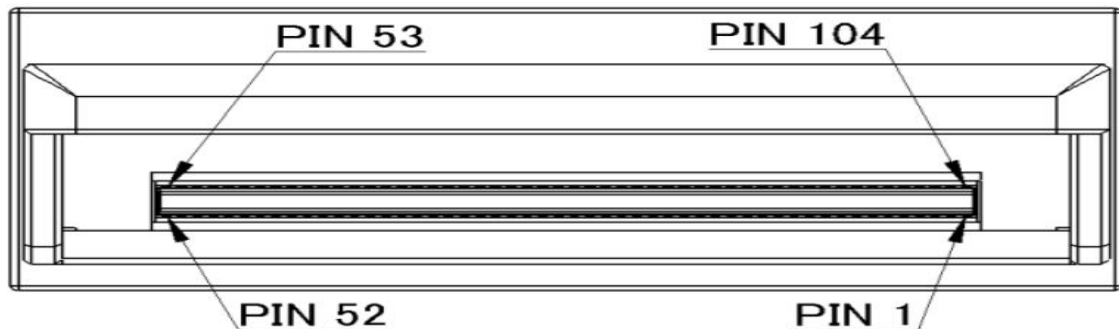


Figure 5. CFP2 Module Pad Layout

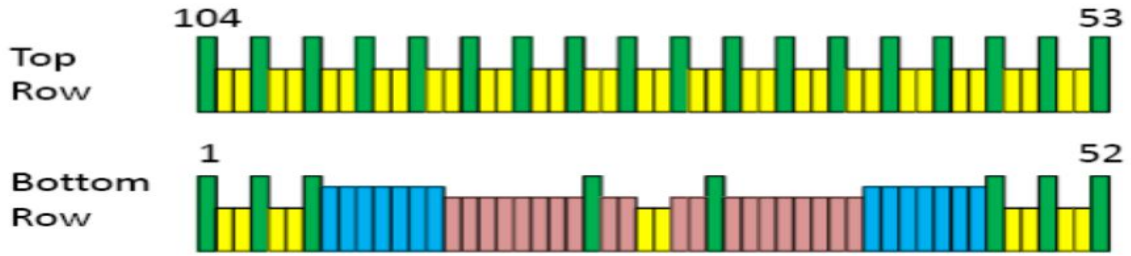


Figure 6. CFP2 Pin Map Connector

	Bottom Row	Bottom Row		Top Row	Top Row
1	GND	52	3.3V_GND	53	GND
2	(TX_MCLKn)	51	(RX_MCLKp)	54	N.C.
3	(TX_MCLKp)	50	(RX_MCLKn)	55	N.C.
4	GND	49	3.3V_GND	56	GND
5	N.C.	48	N.C.	57	RX0p
6	N.C.	47	N.C.	58	RX0n
7	3.3V_GND	46	3.3V_GND	59	GND
8	3.3V_GND	45	3.3V_GND	60	RX1p
9	3.3V	44	3.3V	61	RX1n
10	3.3V	43	3.3V	62	GND
11	3.3V	42	3.3V	63	N.C.
12	3.3V	41	3.3V	64	N.C.
13	3.3V_GND	40	3.3V_GND	65	GND
14	3.3V_GND	39	3.3V_GND	66	N.C.
15	VND_IO_A	38	VND_IO_E	67	N.C.
16	VND_IO_B	37	VND_IO_D	68	GND
17	PRG-CNTL1	36	VND_IO_C	69	RX2p
18	PRG-CNTL2	35	PRTADR2	70	RX2n
19	PRG-CNTL3	34	PRTADR1	71	GND
20	PRG-ALRM1	33	PRTADRO	72	RX3p
21	PRG-ALRM2	32	MDIO	73	RX3n
22	PRG-ALRM3	31	MDC	74	GND
23	GND	30	GND	75	N.C.
24	TX_DIS	29	MOD_ALRMN	76	N.C.
25	RX_LOS	28	MOD_RSTn	77	GND
26	MOD_LOPWR	27	MOD_ADS	78	(REFCLKp)
				79	(REFCLKn)

Figure 7. CFP2 Module Pin Map <sup>\*Note5</sup>

Note5: Pin 15, 16, 36, 37, 38, are internally used and NOT allowed to connect any signal and power supply or GND;  
Pin 2, 3, 50, 51 are disabled unless MCLK output is enabled via MDIO.

## Pin Function Definitions

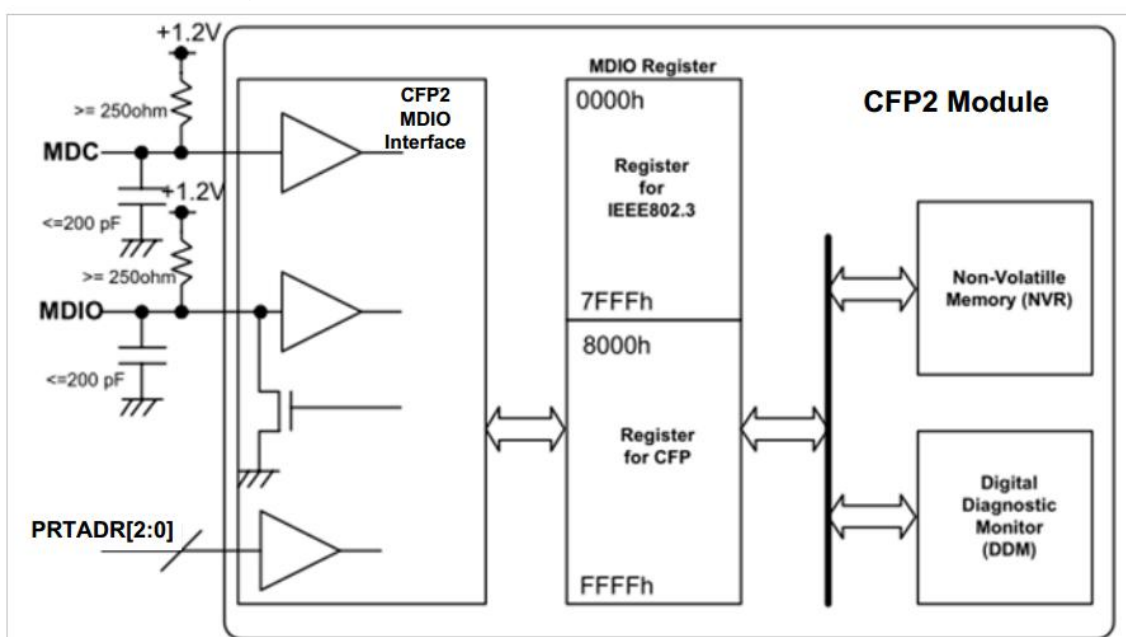
Pin Num.	Name	Function	I/O	LOGIC
1,4,23,30,49 52,53,56,59,62 65,68,71,74,77 80,83,86,89,92 95,98,101,104	GND			
2	(TX_MCLKn)	Not Support	O	CML
3	(TX_MCLKp)			
5,6,47,48,54 55,63,64,66,67	N.C.	No Connect		

75,76,81,82,90 91,93,94,102,103				
7,8,13,14, 39,40,45,46	3.3V_GND	3.3V Module Supply Voltage Return Ground, can be separate or tied together with Signal Ground		
9,10,11,12, 41,42,43,44	3.3V	3.3V Module Supply Voltage		
15	VND_IO_A	Module Vendor I/O. Must No Connect at host board	I/O	
16	VND_IO_B	Module Vendor I/O. Must No Connect at host board	I/O	
17	PRG_CNTL1	Programmable Control 1 set over MDIO, MSA Default: TRXIC_RSTn, TX & RX ICs reset, "0": reset, "1" or NC: enabled = not used , 4.75kohm pull up in the module	I	LVC MOS w/ PUR
18	PRG_CNTL2	Programmable Control 2 set over MDIO, MSA Default: Hardware Interlock LSB, "00": ≤8W, "01":≤16W, "10": ≤24W, "11" or NC: ≤32W = not used ,4.75kohm pull up in the module	I	LVC MOS w/ PUR
19	PRG_CNTL3	Programmable Control 3 set over MDIO, MSA Default: Hardware Interlock MSB, "00": ≤8W, "01": ≤16W, "10": ≤24W, "11" or NC: ≤32W = not used ,4.75kohm pull up in the module	I	LVC MOS w/ PUR
20	PRG_ALARM1	Programmable Alarm 1 set over MDIO, MSA Default: HIPWR_ON, "1": module power up completed, "0": module not high powered up	O	LVC MOS
21	PRG_ALARM2	Programmable Alarm 2 set over MDIO, MSA Default: MOD_READY, "1": Ready, "0": not Ready.	O	LVC MOS
22	PRG_ALARM3	Programmable Alarm 3 set over MDIO, MSA Default: MOD_FAULT, fault detected, "1": Fault, "0": No Fault	O	LVC MOS
24	TX_DIS	Transmitter Disable for all lanes, "1" or NC = transmitter disabled, "0" = transmitter enabled	I	LVC MOS w/ PUR
25	RX_LOS	Receiver Loss of Optical Signal, "1": low optical signal, "0": normal condition	O	LVC MOS
26	MOD_LOPWR	Module Low Power Mode. "1" or NC: module in low power (safe) mode, "0": power-on enabled 4.75kohm pull up in the module	I	LVC MOS w/ PUR
27	MOD_ABS	Module Absent. "1" or NC: module absent, "0": module present, Pull Up Resistor on Host	O	GND
28	MOD_RSTn	Module Reset. "0" resets the module, "1" or NC = module enabled, 4.75kohm Pull Down Resistor in Module	I	LVC MOS w/ PUR
29	GLB_ALARMn	Global Alarm. "0": alarm condition in any MDIO Alarm register, "1": no alarm condition, Open Drain, Pull Up Resistor on Host	O	LVC MOS
31	MDIO	Management Data I/O bi-directional data (electrical specs as per 802.3ae and 802.3ba)	I/O	1.2V COMS
32	MDC	Management Data Clock (electrical specs as per 802.3ae and 802.3ba)	I	1.2V COMS
33	PRTADR0	MDIO Physical Port address bit 0	I	1.2V COMS
34	PRTADR1	MDIO Physical Port address bit 1	I	1.2V COMS
35	PRTADR2	MDIO Physical Port address bit 2	I	1.2V COMS

50	VND_IO_C	Module Vendor I/O. Must No Connect at host board	I/O
51	VND_IO_D	Module Vendor I/O. Must No Connect at host board	I/O
53	VND_IO_E	Module Vendor I/O. Must No Connect at host board	I/O
50	RX_MCLKn	RX Monitor Clock Output (Negative)	O
51	RX_MCLKp	RX Monitor Clock Output (Positive)	O
57	RX0p	Lane 0 Receiver Output (Positive)	O HS I/O
58	RX0n	Lane 0 Receiver Output (Negative)	O HS I/O
60	RX1p	Lane 1 Receiver Output (Positive)	O HS I/O
61	RX1n	Lane 1 Receiver Output (Negative)	O HS I/O
69	RX2p	Lane 2 Receiver Output (Positive)	O HS I/O
70	RX2n	Lane 2 Receiver Output (Negative)	O HS I/O
72	RX3p	Lane 3 Receiver Output (Positive)	O HS I/O
73	RX3n	Lane 3 Receiver Output (Negative)	O HS I/O
84	TX0p	Lane 0 Transmitter Input (Positive)	I HS I/O
85	TX0n	Lane 0 Transmitter Input (Negative)	I HS I/O
87	TX1p	Lane 1 Transmitter Input (Positive)	I HS I/O
88	TX1n	Lane 1 Transmitter Input (Negative)	I HS I/O
96	TX2p	Lane 2 Transmitter Input (Positive)	I HS I/O
97	TX2n	Lane 2 Transmitter Input (Negative)	I HS I/O
99	TX3p	Lane 3 Transmitter Input (Positive)	I HS I/O
100	TX3n	Lane 3 Transmitter Input (Negative)	I HS I/O
78	REFCLKp	Reference Clock Input (Positive)	I
79	REFCLKn	Reference Clock Input (Negative)	I

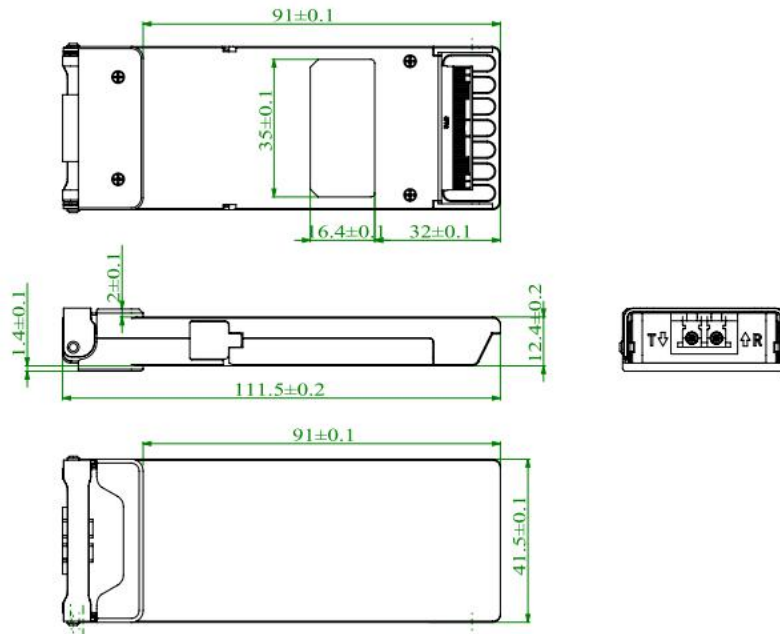
## Management Interface

TC2-HG10-30DCR CFP2 transceivers supports the MDIO interface specified in IEEE802.3 Clause 45. This 2-wire management data I/O interface is provided for the module status monitoring and control. The management data clock (MDC) provides clocking for the data that is passed on the MDIO port. Three further pins allow for loading of a port address (PORT\_ADDR0-2) into the module.





## Mechanical Specifications



## Eye Safety

This single-mode transceiver is a Class 1 laser product. It complies with IEC-60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

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