Asterfusion 400G QSFP-DD ZR4 Duplex LC SMF 80-120km Optical Transceiver

Features

- 8 x 53.125Gb/s PAM4 electrical modulation
- 4 x 106.25Gb/s PAM4 optical modulation
- 80-120km over SMF with FEC
- Power consumption < 19W
- Hot Pluggable QSFP-DD form factor
- Duplex LC connector receptacle
- I2C interface is supported to read and control the status of this product
- Built-in digital diagnostic functions
- Compliant with CMIS
- Operating case temperature 0°C to +70°C
- 3.3V power supply voltage
- Class 1 laser safety
- RoHS compliant

Overview

The Asterfusion QSFP-DD 400G ZR4 optical transceiver module is designed for 400 Gigabit Ethernet applications and long-distance data transmission. It supports amplified DWDM DCI transmission reach of 80km to 120km over SMF, compliant with OIF-400ZR standard. The module also supports other fiber types, such as hollow-core fibers. Digital diagnostics functions are available via a TWI interface as CMIS specified. The QSFP-DD 400G ZR optical transceiver module adopts a 7nm coherent DSP ASIC, narrow linewidth tunable laser, and integrated coherent optical engine to deliver high-performance transmission solutions for customers. The module supports the Dual Polarization 16QAM (DP-16QAM) modulation format and interoperability is assured through CFEC. Moreover, the ZR module can support 4x100GbE.

The form factor of OT-400G-QDD-ZR4 is QSFP-DD Type 2A and the optical interface uses Duplex LC connectors. It is compatible with the Common Management Interface Specification (CMIS), QSFP-DD MSA, and 400GAUI-8 standard.

Product Applications

- Data Center Interconnection
- Telecom Backbone
- 5G backhaul

Networking

This product is suitable for connecting two switches or routers over long distances.

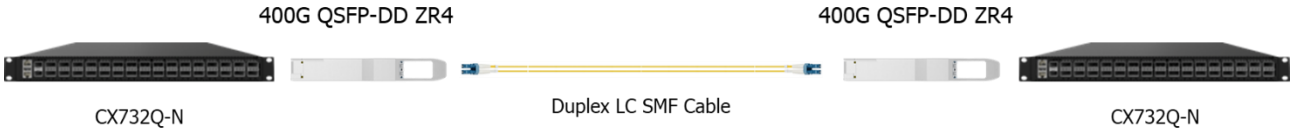

Figure 1 Connect two 400G-port switches

Specifications

Transmission Modes and Performance							
Line Data Rate (Gbit/s)	Min Grid Spacing (GHz)	Baud Rate (Gbaud)	Modulation Format	FEC OH	Bits per Symbol	Max. Power Dissipation (W)	Rx OSNR (dB)
400	75	59.84	DP-16QAM	15%	8	19	<26dB

Electrical Specifications

Transmitter Electrical Characteristics (With Recommended Operating Conditions)						
Parameter	Symbol	Min	Typical	Max	Units	Notes
Signaling rate per lane	BPS		53.125		Gbps	PAM4 Mode
Differential voltage pk-pk	TVdiff	750		900	mVpp	
Differential Output Impedance	TRD	80	100	120	Ω	
Transition time	Trise/Tfall	12			ps	
Return Loss			see note		dB	

Notes:

1. GAUI-8/CAUI-4 TP4 Differential Output Return Loss SDD22(db)=

   -9.5+0.37*f, for 0.01<=f<=8GHz

   -4.75+7.4*log10(f/14), for 8<=f<=19GHz

2. GAUI-8/CAUI-4 TP4 Common mode to Differential mode Output Return Loss SDD22(db)=

   -22+(20/25.78)*f, for 0.01<=f<=12.89GHz

   -15+(6/25.78)*f, for 12.89<=f<=19GHz

3. CEI-56G VSR PAM4 SDD22(db)=

   -11, for 0.05<f<fb/7.5

   -6.0+9.2*1og10((15*f)/(7*fb)), for fb/7.5<=f<=fb

4. CEI-56G VSR PAM4 SDC22(db) SCD22(db) -25+20*(f/fb), for 0.05<f<fb/2 -18+6*(f/fb), for fb/2<f<fb
5. CEI-28G VSR TP4 SDD22(db) -11, for 0.05<f<fb/7 -6+9.2*log10(2f/fb), for fb/7<f<fb
6. CEI-28G VSR TP4 SDC22(db), SDC22(db) -25+20*(f/fb), for 0.05<f<fb/2 -18+6*(f/fb), for fb/2<f<fb

Receiver Electrical Characteristics (With Recommended Operating Conditions)						
Parameter	Symbol	Min	Typical	Max	Units	Notes
Signaling rate per lane	BPS		53.125		Gbps	PAM4 Mode
Differential voltage pk-pk	RVdiff	900			mVpp	AC coupled
Differential Output Impedance	RRD	80	100	120	Ω	
Transition time	Trise/Tfall	12			ps	
Return Loss			See note		dB	
Stress input test			see IEEE 802.3bs 802.3bm CEI-56G-VSR-PAM4 OIF-CEI-03.1			

Notes:

1. GAUI-8/CAUI-4 TP1 Differential Intput Return Loss SDD11(db) =

   -9.5+0.37*f, for 0.01<=f<=8GHz

   -4.75+7.4*log10(f/14), for 8<=f<=19GHz

2. GAUI-8/CAUI-4 TP1 Differential mode to Common mode to Intput Return Loss SDD11(db) =

-22+(20/25.78)*f, for 0.01<=f<=12.89GHz

-15+(6/25.78)*f, for 12.89<=f<=19GHz

3. CEI-56G VSR PAM4 TP1 SDD11 (db)=

   -11, for 0.05<f<fb/7.5

   -6.0+9.2*1og10((15*f)/(7*fb)), for fb/7.5<=f<=fb

4. CEI-56G VSR PAM4 TP1 SDC11(db) SCD11 (db) -22+14*(f/fb), 0.05<f<fb/2 for -18+6*(f/fb), for fb/2<f<fb
5. CEI-28G VSR TP1 SDD11(db) -11, for 0.05<f<fb/7 -6+9.2*log10(2f/fb), for fb/7<f<fb
6. CEI-28G VSR TP1 SDC11(db), SDC11(db) -22+14*(f/fb), 0.05<f<fb/2 for -18+6*(f/fb), for fb/2<f<fb

Optical Specifications

Transmitter Optical Characteristics				
Parameter	Min	Max	Units	Notes
Transmitter frequency range	191.3	196.1	THz	OIF-400ZR-01.0 grid. Frequency range over which the specifications hold unless noted otherwise
Transmitter laser frequency stability	-1.8	1.8	GHz	Frequency stability relative to Transmitter Frequency set point.
Tx Spectral Excursion		32	GHz	See OIF-400ZR-01.0 13.1.201
Tx output signal power	-10	-6	dBm	Measured at optical connector
Total output power with Tx disable		-20	dBm	Tx Disable ==false
Total output power during wavelength switching		-20	dBm	Applicable to module with tunable optics
Inband (IB) OSNR	34		dB/0.1nm	See OIF-400ZR-01.0 13.1.230
Out-of-band (OOB) OSNR	23		dB/0.1nm	See OIF-400ZR-01.0 13.1.231
Transmitter reflectance		-20	dB	Looking into the Tx

Receiver Optical Specification				
Parameter	Min	Max	Units	Notes
Frequency offset between received carrier and LO	3.6	+3.6	GHz	Acquisition Range
Input power range	-12	0	dBm	See OIF-400ZR-01.0 13.1.310
OSNR tolerance		26	dB/0.1nm	See OIF-400ZR-01.0 13.1.330

Optical return loss	20		dB	Optical reflectance at Rx connector input
Optical path OSNR penalty tolerance		0.5	dB	See OIF-400ZR-01.0 13.1.342
Optical input power transient tolerance	+/-2		dB	See OIF-400ZR-01.0 13.1.353

Mechanical Dimensions

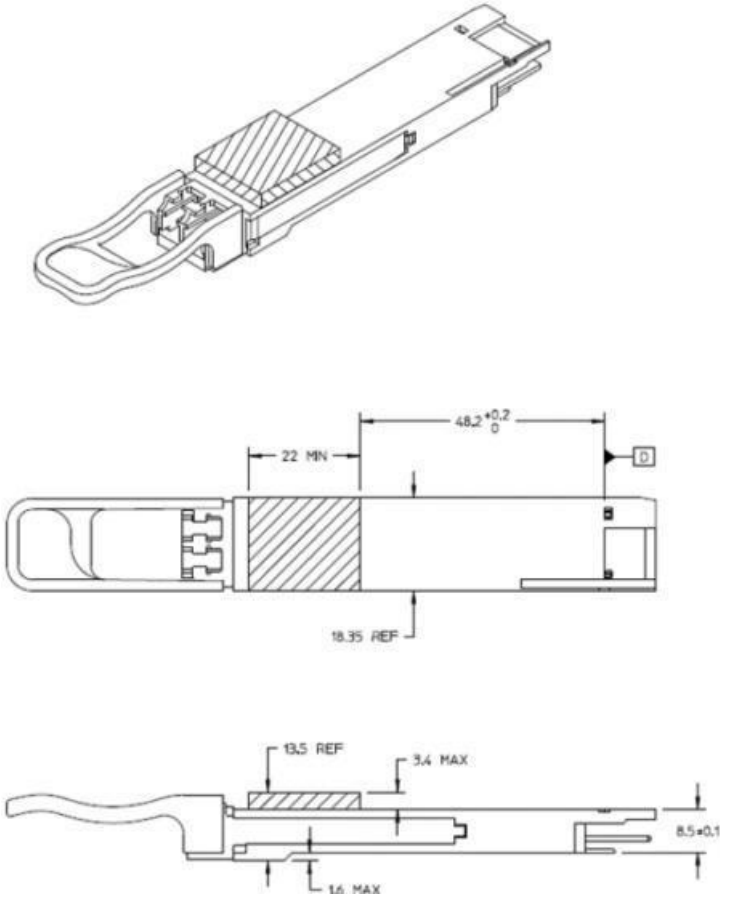

Figure 2 Mechanical Specifications (mm)

Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Note
Storage Temperature	TS	-40	85	ºC	
Operating Case Temperature	TOP	-5	75	ºC	
Relative Humidity (Non-condensing)	RHO	15	85	%	
Power Supply Voltage	VCC	0	3.6	V	

Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units	Notes
Operating Case Temperature	TOP	0		70	ºC	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Operating Power Supply Current	ICC			7.2	A	Instantaneous peak current
				6.6		Sustained peak current
				6		Steady current
Module Power consumption				19	W	

Module Requirements TX

Parameter	Min	Max	Units	Condition/comments
Transmitter laser disable time		100	Ms	See OIF-400 ZR-01.0 13.1.400
Transmitter turn-up time from warm start		180	s	The maximum time from Module Low Pwr to DataPath activated state
Transmitter turn-up time from cold start		200	s	The maximum time from deassertion of Re setS==false to DataPath Activated state while LoPweS==false
Transmitter wavelength switching time		180	s	The maximum time to change wavelengths including turn up time Applicable to modules with tunable optics
Output power monitor Accuracy	-2.0	2.0	dB	Total output power measurement including all ASE contribution. Measurement accuracy does not contribute to allowable output power signal window

Module Requirements TX

Parameter	Default	Min	Max	Units	Condition/comments
Receiver turn-up time from warm start			10	s	Upon RX_LOS de-assert, Receiver has been turned up previously
Receiver turn-up time from			200	s	From module reset, with valid optical input

cold start					signal preset
Input total power monitor accuracy		-4	4	dB	See OIF-400ZR-01.0 13.1.530
Input channel power monitor Accuracy		-4	4	dB	The module reports the channel power as received by the module
Optical Rx_LOS Assert Threshold	-21	-22	-18	dBm	Channel power
Optical RX_LOS Hysteesis		1.0	2.5	dBm	RX_LOS cleared

PIN Description

The electrical interface of QSFP-DD module consists of 76 contacts edge connectors. It complies with the QSFP-DD MSA Specification, see http://www.qsfp-dd.com .

QSFP56-DD Pin Description

Pin #	Logic	Symbol	Description	Plug Sequence
1		GND	Ground	1B
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B
3	CML-I	Tx2p	Transmitter Non- Inverted Data Input	3B
4		GND	Ground	1B
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B
6	CML-I	Tx4p	Transmitter Non- Inverted Data Input	3B
7		GND	Ground	1B
8	LVTTL-I	ModSelL	Module Select	3B
9	LVTTL-I	ResetL	Module Reset	3B
10		VccRx	+3.3V Power Supply Receiver	2B
11	LVCMOS-I/O	SCL	2-wire serial interface clock	3B
12	LVCMOS-I/O	SDA	2-wire serial interface data	3B
13		GND	Ground	1B
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B
15	CML-O	Rx3n	Receiver Inverted Data Output	3B
16	GND	Ground	1B	
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B
18	CML-O	Rx1n	Receiver Inverted Data Output	3B
19		GND	Ground	1B
20		GND	Ground	1B
21	CML-O	Rx2n	Receiver Inverted Data Output	3B
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B
23		GND	Ground	1B

24	CML-O	Rx4n	Receiver Inverted Data Output	3B
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B
26		GND	Ground	1B
27	LVTTL-O	ModPrsL	Module Present	3B
28	LVTTL-O	IntL	Interrupt	3B
29		VccTx	+3.3V Power supply transmitter	2B
30		Vcc1	+3.3V Power supply	2B
31	LVTTL-I	InitMode	Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE	3B
32		GND	Ground	1B
33	CML-I	Tx3p	Transmitter Non- Inverted Data Input	3B
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B
35		GND	Ground	1B
36	CML-I	Tx1p	Transmitter Non- Inverted Data Input	3B
37	CML-I	Tx1n	Transmitter Inverted Data Input	3B
38		GND	Ground	1B
39		GND	Ground	1A
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A
41	CML-I	Tx6p	Transmitter Non- Inverted Data Input	3A
42		GND	Ground	1A
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A
44	CML-I	Tx8p	Transmitter Non- Inverted Data Input	3A
45		GND	Ground	1A
46		Reserved	For future use	3A
47		VS1	Module Vendor Specific 1	3A
48		VccRx1	3.3V Power Supply	2A
49		VS2	Module Vendor Specific 2	3A
50		VS3	Module Vendor Specific 3	3A
51		GND	Ground	1A
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A
53	CML-O	Rx7n	Receiver Inverted Data Output	3A
54		GND	Ground	1A
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A
56	CML-O	Rx5n	Receiver Inverted Data Output	3A
57		GND	Ground	1A
58		GND	Ground	1A
59	CML-O	Rx6n	Receiver Inverted Data Output	3A
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A
61		GND	Ground	1A
62	CML-O	Rx8n	Receiver Inverted Data Output	3A
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A
64		GND	Ground	1A
65		NC	No Connect	3A
66		Reserved	For future use	3A

67		VccTx1	3.3V Power Supply	2A
68		Vcc2	3.3V Power Supply	2A
69		Reserved	For Future Use	3A
70		GND	Ground	1A
71	CML-I	Tx7p	Transmitter Non- Inverted Data Input	3A
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A
73		GND	Ground	1A
74	CML-I	Tx5p	Transmitter Non- Inverted Data Input	3A
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A
76		GND	Ground	1A

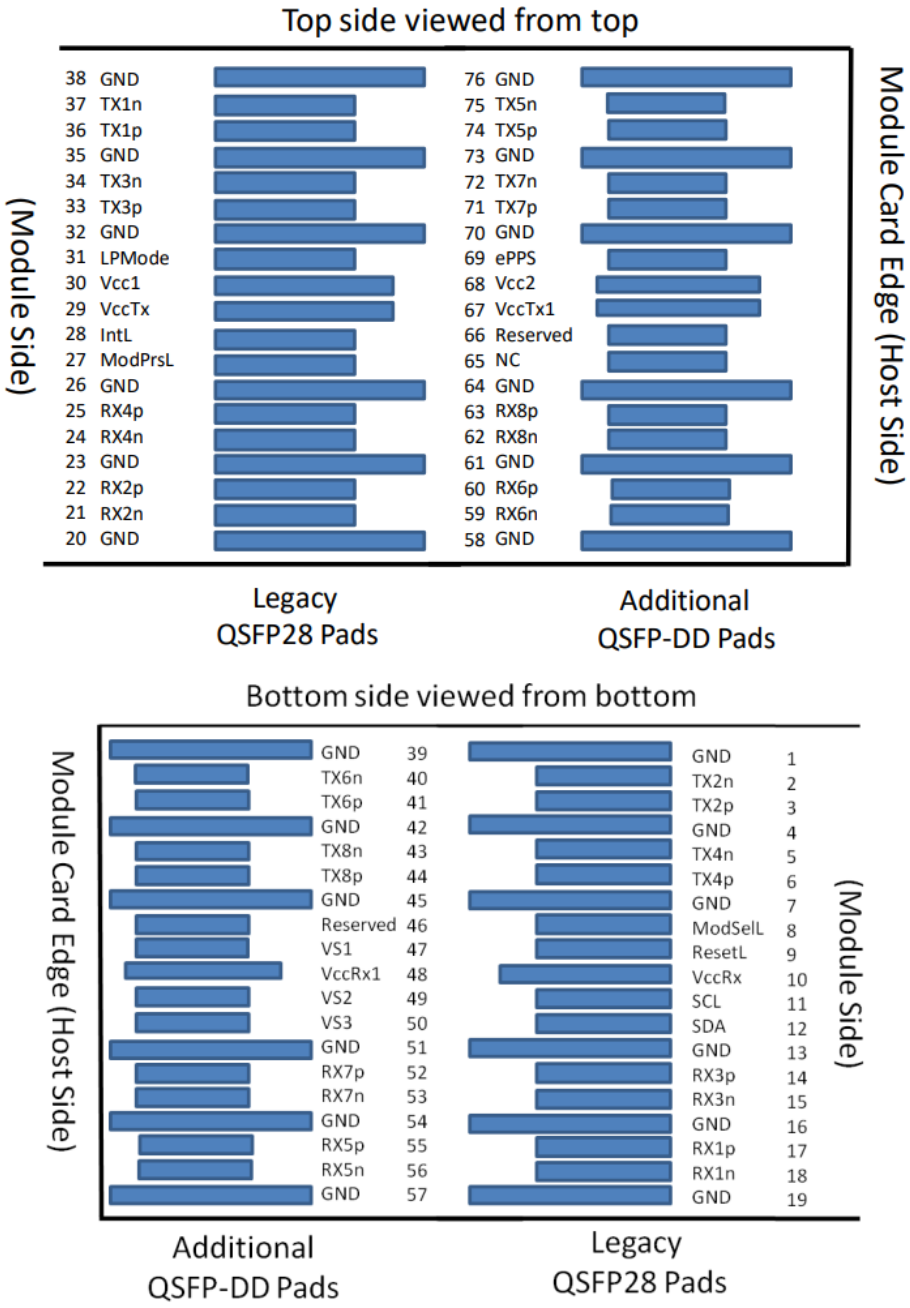

Figure 3 Electrical Pin-out Details

QSFP-DD Control and Sense Signals

Parameter	Symbol	Min	Max	Unit	Description
SCL and SDA	VOL	0	0.4	V	IOL (max)=3 mA for fast mode, 20 mA for Fast-mode plus
SCL and SDA	VIL	-0.3	Vcc*0.3	V	
SCL and SDA	VIH	Vcc*0.7	Vcc+0.5	V	
Capacitance for SCL and SDA I/O signal	Ci		14	pF	ResetL shall be pulled to Vcc in the module. A low level on it for longer than t_Reset_init initiates a complete module reset.
Total bus capacitive load for SCL and SDA	Cb		100	pF	For 400 kHz clock rate use 3 kohm pullup resistor, max. For 1000 kHz clock rate refer to [1].
	Cb		200	pF	For 400 kHz clock rate use 1.6 kohm pullup resistor, max. For 1000 kHz clock rate refer to [1].
LPMode, ResetL and ModSelL	VIL	-0.3	0.8	V	
	VIH	2	Vcc+0.3	V	
	|Iin|		360	uA	0V<Vin<Vcc
ePPS	|Iin|		TBD	uA	0V<Vin<Vcc
IntL	VOL	0	0.4	V	IOL=2.0 mA
	VOH	Vcc-0.5	Vcc+0.3	V	10 kohm pull-up to Host Vcc
ModPrsL	VOL	0	0.4	V	IOL= 2.0mA
	VOH				ModPrsL can be implemented as a short-circuit to GND on the module

Note:

1. All Vendor Specific, Reserved, No Connect and ePPS (if not used) pins may be terminated with 50 Ohms to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor specific and Reserved pads shall have an impedance to GND that is greater than 10kohms and less than 100pF.

Timing for QSFP-DD soft control and status functions					
Parameter	Symbol	Min	Max	Unit	Description
Mgmt InitDuration	Max MgmtInit Duration		2000	ms	Time from power on,hot plug or rising edge of reset until completion of the MgmtInit State
ResetL Assert Time	t_reset_init	10		us	Minimum Pulse time on the ResetLsignal to

					initiate a module reset
IntL Assert Time	ton_intL		200	ms	
IntL Deassert Time	Toff_intL		500	us	Time from clear on read operation of associated flag until Vout:IntL=Voh. This includes deasset times for Rx LOS, TX Fault and other flag bits
Rx LOS Assert Time	Ton_los		100	ms	Time from Rx Los condition present to Rx Los bit set (value=1b) and IntL asserted
Tx Fault Assert Time	Ton_Txfault		200	ms	Time from Tx fault state to Tx fault bit set (value=1b) and IntL asserted.
Flag Assert Time	Ton_flag		200	ms	Time from occurrence of condition trigging flag to associated IntL assertion is inhibited
Mask Asset Time	Ton_mask		100	ms	Time from mask bit (value=1b) cleared Until associated IntL operation resumes
Module Select Wait time Data Path Deinit MaxDuration Data PathInit Max Duration ModulePwrDn Max Duration	ModSelL Wait Time DataPathDeinit_MaxDuration DatapathInit_MaxDuration ModulePwrDn_MaxDuration				See Common Management Interface Specification Table 8-28
Note 1. Power on is defined as the instant when supply voltage reaches and remains at or above the minimum level					
Note 2. Measured from low to high SDA edge of the STOP condition of the read transaction					
Note3. measured from low to high SDA edge of the Stop condition of the write transaction					
Note 4. Rx LOS condition is defined at the optical input by the relevant standard					

Regulatory Compliance

Asterfusion OT-400G-QDD-ZR4 transceivers are Class 1 Laser Products. They are certified per the following standards:

Feature	Standard
Laser Safety	IEC/EN 60825-1:2014 (3rd Edition) FDA 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007)

Electrical Safety	EN 62368-1:2014 IEC 62368-1:2014 UL 62368-1: 2014
CE EMC	EN55032:2015 EN55035:2017 EN61000-3-2:2014 EN61000-3-3:2013
FCC	FCC Part 15, Subpart B ANSI C63.4-2014

References

1. QSFP-DD MSA Specification
2. CMIS 4.0
3. OIF-400ZR-01.0

Order Information

Part Number	Description
OT-400G-QDD-ZR4	400G, QSFP-DD, ZR4, Duplex LC, DWDM4, 80-120km

Warranty and Service Support

Asterfusion optical transceivers come with 2-year Basic H/W service and warranty.

To acquire more info about company, products, and solutions: *www.cloudswit.ch*
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