Specification for Dispersion Slope Compensating Module for TW-RS Transmission Fiber in the C-band

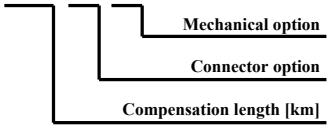
TWRS-DK

Version 1.12 – 2015-09-09

ofs
A Furukawa Company

1 Ordering information

Order code format: **TWRSDK-S-xxx-yy-zz**



The following table lists the nominal dispersion for the various compensation lengths:

Compensated fiber length [km]	Nominal Dispersion 1550 nm [ps/nm]	Order Code
20	-90	TWRSDK_S_020-yy-zz
40	-180	TWRSDK_S_040-yy-zz
60	-270	TWRSDK_S_060-yy-zz
80	-360	TWRSDK_S_080-yy-zz
100	-450	TWRSDK_S_100-yy-zz
120	-540	TWRSDK_S_120-yy-zz
140	-630	TWRSDK_S_140-yy-zz
160	-720	TWRSDK_S_160-yy-zz
180	-810	TWRSDK_S_180-yy-zz
200	-900	TWRSDK_S_200-yy-zz
220	-990	TWRSDK_S_220-yy-zz
240	-1080	TWRSDK_S_240-yy-zz
260	-1170	TWRSDK_S_260-yy-zz
280	-1260	TWRSDK_S_280-yy-zz
300	-1350	TWRSDK_S_300-yy-zz
Custom compensation lengths available on request		

'yy' in order code reflects choice of connectors:

Connector code	Connector type
01	LC/PC connectors, 0.9 mm cable
02	SC/UPC connectors, 2.7 mm cable
03	FC/APC connectors (wide key), 3 mm cable
04	FMU/UPC connectors, 1.7 mm cable
05	SC/APC connectors, 3 mm cable
06	LC/APC connectors, 0.9 mm cable
07	SC/APC connectors, 0.9 mm cable
08	FC/APC connectors (narrow key), 0.9 mm cable
09	E2000 connectors, 2.7 mm cable
10	FC/PC connectors, 3 mm cable
Other connector types available on request	

'zz' in order code reflects choice of mechanical solution (see section 4 for details)

Mechanical code	Mechanical package
01	Standard spool
10	Standard DSCM box
Other spool sizes and DSCM box types available on request	

Example:
TWRSDK_S_180-01-01: DSCM for compensation of 180 km TWRS, with LC/FC connectors, standard spool.

1.1 Rack for mounting standard DSCM box:

The standard box can be rack mounted in a 19” or 21” rack with the following rack mounts:

Order code	Rack type
DSCM-Rack-19-1	19” rack mount
DSCM-Rack-21-1	21” rack mount

See section 4 for details and drawings.

2 Operating and Storage Conditions

2.1 Operating and Storage Temperature & Humidity

Item	Symbol	Min	Max	Unit
Environmental operating temperature	T_{OP}	-5	+70	°C
Environmental operating (relative) humidity	X_{OP}	5	85	%
Environmental storage temperature	T_{ST}	-40	+70	°C
Environmental storage (relative) humidity	X_{ST}	5	85	%

2.2 Operating Wavelength Range

The operating wavelength range of the TWRS-DK DSCM modules is 1530 nm – 1565 nm

2.3 Absolute Maximum Ratings

Applicable for the full operating temperature range T_{OP} without causing irreversible damage to the module.

Item	Symbol	Max	Unit	Remarks
Total optical input power	P_{TOT}	23	dBm	Connector face is clean

3 Optical Properties

This section describes the optical properties of the TWRS-DK DSCM. Unless otherwise stated, all parameters are valid EOL, over temperature and wavelength.

3.1 Residual Dispersion

The residual dispersion RD is defined as

$$RD(\lambda) = D_{TWRS}(\lambda) + D_{DSCM}(\lambda),$$

with

$$D_{LEAF}(\lambda) = -65.25 + 0.045\lambda,$$

where λ is the wavelength in units of nm. The dispersion model above leads to a dispersion of 4.5 ps/nm/km and a slope of 0.045 ps/nm^2/km at 1550 nm.

The table below shows the residual dispersion spec of the TWRS-DK DSCM

Nominal Compensation Length [km]	Residual Dispersion BOL RT [ps/nm/km]	Residual Dispersion EOL over temperature [ps/nm/km]
All modules	±0.20	±0.22

The typical residual dispersion is shown in the figure below:

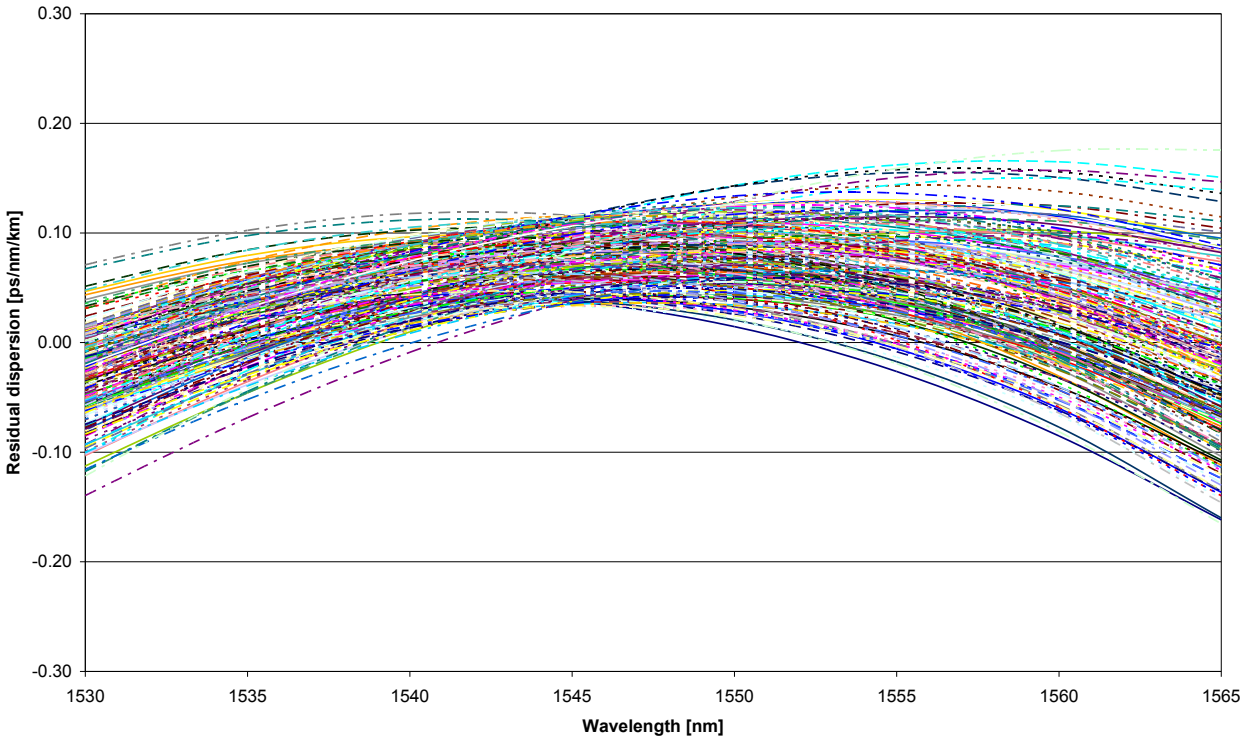


Figure 1: Typical residual dispersion for TWRS-DK DSCMs

3.2 Dispersion

The following table defines the dispersion characteristics of the TWRS-DK DSCMs:

Nominal Compensation Length [km]	Dispersion @ 1530 nm BOL RT [ps/nm]			Dispersion @ 1550 nm BOL RT [ps/nm]			Dispersion @ 1565 nm BOL RT [ps/nm]		
	min	typical	max	min	typical	max	min	typical	max
20	-76.0	-73	-68.0	-94.0	-88	-86.0	-107.5	-104	-99.5
40	-152.0	-145	-136.0	-188.0	-177	-172.0	-215.0	-208	-199.0
60	-228.0	-218	-204.0	-282.0	-265	-258.0	-322.5	-312	-298.5
80	-304.0	-290	-272.0	-376.0	-354	-344.0	-430.0	-416	-398.0
100	-380.0	-363	-340.0	-470.0	-442	-430.0	-537.5	-520	-497.5
120	-456.0	-435	-408.0	-564.0	-531	-516.0	-645.0	-624	-597.0
140	-532.0	-508	-476.0	-658.0	-619	-602.0	-752.5	-728	-696.5
160	-608.0	-580	-544.0	-752.0	-708	-688.0	-860.0	-832	-796.0
180	-684.0	-653	-612.0	-846.0	-796	-774.0	-967.5	-936	-895.5
200	-760.0	-725	-680.0	-940.0	-885	-860.0	-1075.0	-1040	-995.0
220	-836.0	-798	-748.0	-1034.0	-973	-946.0	-1182.5	-1144	-1094.5
240	-912.0	-870	-816.0	-1128.0	-1061	-1032.0	-1290.0	-1248	-1194.0
260	-988.0	-943	-884.0	-1222.0	-1150	-1118.0	-1397.5	-1352	-1293.5
280	-1064.0	-1016	-952.0	-1316.0	-1238	-1204.0	-1505.0	-1456	-1393.0
300	-1140.0	-1088	-1020.0	-1410.0	-1327	-1290.0	-1612.5	-1560	-1492.5

Nominal Compensation Length [km]	Dispersion @ 1530 nm EOL over temperature [ps/nm]		Dispersion @ 1550 nm EOL over temperature [ps/nm]		Dispersion @ 1565 nm EOL over temperature [ps/nm]	
	min	max	min	max	min	max
20	-76.4	-67.6	-94.4	-85.6	-107.9	-99.1
40	-152.8	-135.2	-188.8	-171.2	-215.8	-198.2
60	-229.2	-202.8	-283.2	-256.8	-323.7	-297.3
80	-305.6	-270.4	-377.6	-342.4	-431.6	-396.4
100	-382.0	-338.0	-472.0	-428.0	-539.5	-495.5
120	-458.4	-405.6	-566.4	-513.6	-647.4	-594.6
140	-534.8	-473.2	-660.8	-599.2	-755.3	-693.7
160	-611.2	-540.8	-755.2	-684.8	-863.2	-792.8
180	-687.6	-608.4	-849.6	-770.4	-971.1	-891.9
200	-764.0	-676.0	-944.0	-856.0	-1079.0	-991.0
220	-840.4	-743.6	-1038.4	-941.6	-1186.9	-1090.1
240	-916.8	-811.2	-1132.8	-1027.2	-1294.8	-1189.2
260	-993.2	-878.8	-1227.2	-1112.8	-1402.7	-1288.3
280	-1069.6	-946.4	-1321.6	-1198.4	-1510.6	-1387.4
300	-1146.0	-1014.0	-1416.0	-1284.0	-1618.5	-1486.5

3.3 Insertion loss

Nominal Compensation Length [km]	Insertion Loss BOL RT [dB]		Insertion EOL over temperature [dB]		Max Wavelength Dependent Loss [dB]	
	min	max	min	max	BOL RT	EOL temp
20	0.5	1.7	0.5	2.2	0.30	0.40
40	0.8	2.2	0.8	2.7	0.30	0.40
60	1.0	2.8	1.0	3.3	0.30	0.40
80	1.2	3.3	1.2	3.8	0.35	0.45
100	1.5	3.8	1.5	4.3	0.35	0.45
120	1.7	4.4	1.7	4.9	0.40	0.50
140	1.9	4.9	1.9	5.4	0.45	0.55
160	2.2	5.4	2.2	5.9	0.50	0.60
180	2.4	6.0	2.4	6.5	0.55	0.65
200	2.6	6.5	2.6	7.0	0.60	0.70
220	2.9	7.0	2.9	7.5	0.65	0.75
240	3.1	7.6	3.1	8.1	0.70	0.80
260	3.3	8.1	3.3	8.6	0.75	0.85
280	3.6	8.6	3.6	9.1	0.75	0.85
300	3.8	9.2	3.8	9.7	0.80	0.90

3.4 Polarization Effects

Nominal Compensation Length [km]	PMD [ps]		PDL [dB]
	typical	max	max
20	0.09	0.30	0.1
40	0.13	0.40	
60	0.16	0.50	
80	0.18	0.55	
100	0.20	0.60	
120	0.22	0.65	
140	0.24	0.75	
160	0.26	0.80	
180	0.27	0.80	
200	0.29	0.85	
220	0.30	0.90	
240	0.32	0.95	
260	0.33	1.00	
280	0.34	1.05	
300	0.35	1.05	

3.5 Length and Delay

Nominal Compensation Length [km]	Length [km]			Delay [us]		
	min	typical	max	min	typical	max
20	0.4	0.7	1.1	2.2	3.4	6.2
40	0.9	1.4	2.1	4.5	6.8	12.3
60	1.3	2.1	3.1	6.8	10.1	18.4
80	1.8	2.7	4.1	9.1	13.5	25.0
100	2.3	3.4	5.1	11.4	16.9	31.0
120	2.7	4.1	6.1	13.7	20.0	37.0
140	3.2	4.8	7.2	16.0	24.0	43.0
160	3.7	5.5	8.2	18.3	27.0	49.0
180	4.1	6.2	9.2	20.0	30.0	55.0
200	4.6	6.9	10.2	22.0	34.0	62.0
220	5.1	7.5	11.2	25.0	37.0	68.0
240	5.5	8.2	12.2	27.0	41.0	74.0
260	6.0	8.9	13.2	29.0	44.0	80.0
280	6.5	9.6	14.3	32.0	47.0	86.0
300	6.9	10.3	15.3	34.0	51.0	92.0

3.6 Nonlinearity

Nominal Compensation Length [km]	Typical Effective Area [μm^2]	Typical Nonlinear Coefficient γ [1/(W-km)]	Typical Fiber Attenuation [dB/km]	Typical Splice Loss (per end) [dB]
All modules	14	8.1	0.59	0.5

4 Mechanical Design

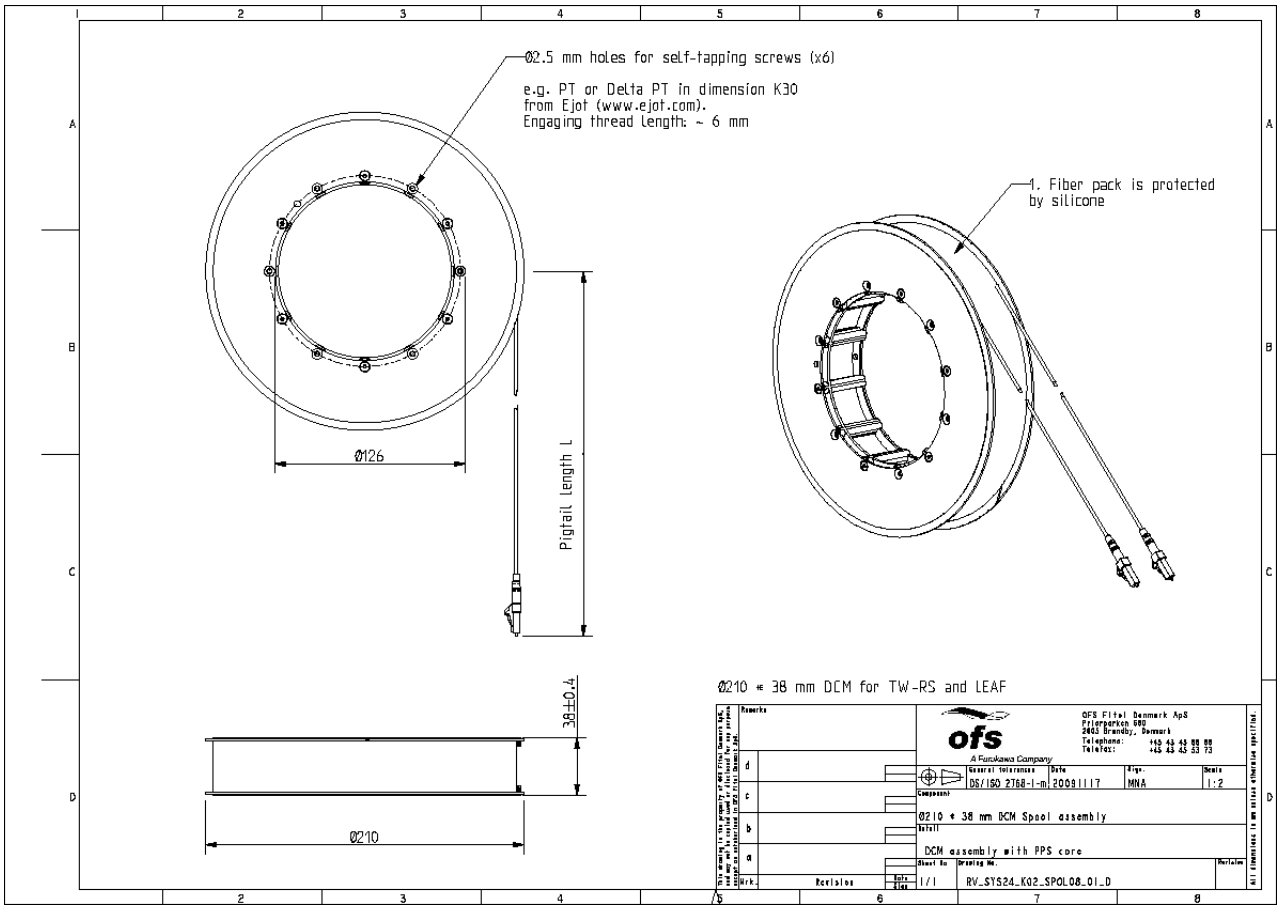
The standard TWRS-DK DSCMs are available in two mechanical options

Option code	Description	Dimensions	Drawing no
01	Fibre spool	Ø210 mm x 38 mm	rv_sys20_spol_114_210_38_04_d
10	Standard box	224 mm x 238 mm x 45 mm	rv_sys04_k02_asm01_00_d

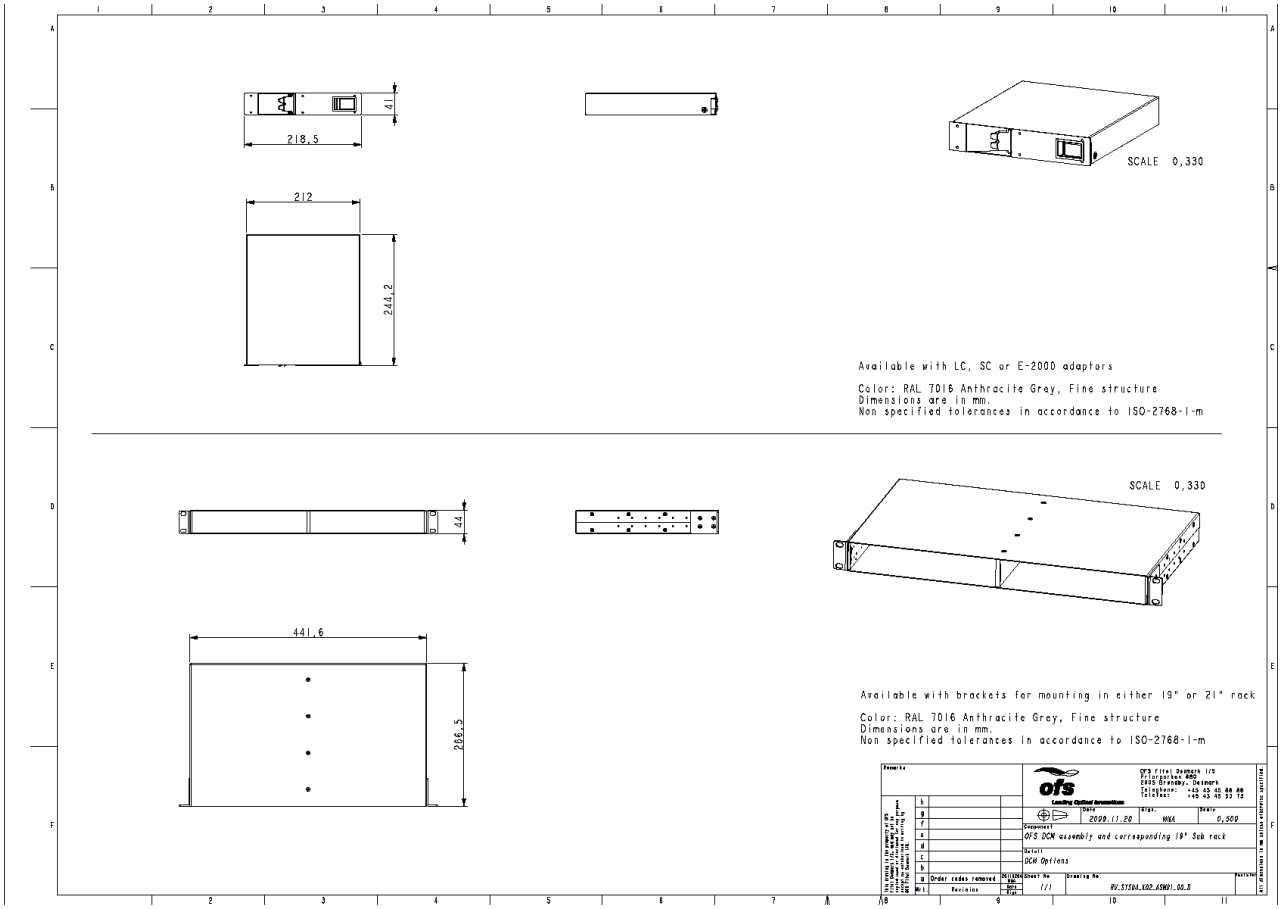
Furthermore, a rack mount that allows two modules to be mounted in a 19" rack is also available (ordered separately).

Order code	Rack type	Drawing no
DSCM-Rack-19-1	19" rack	rv_sys04_k02_asm01_00_d.pdf
DSCM-Rack-21-1	21" rack	

4.1 Reference Spool Drawing



4.2 Reference Box and Rack Drawing



5 Test Data

Detailed test data in paper/and or electronic format can be supplied, including the following

- IL @ 1550 nm
- IL over operating wavelength range
- WDL
- Dispersion @1530, 1550 and 1565 nm
- Max absolute residual dispersion
- PMD

6 List of Acronyms

BOL	Beginning of life
DSCM	Dispersion slope compensating module
EOL	End of life
PDL	Polarization dependent loss
PMD	Polarization mode dispersion
RT	Room temperature (~22 degrees Celsius)
WDL	Wavelength dependent loss (max-min over wavelength)

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