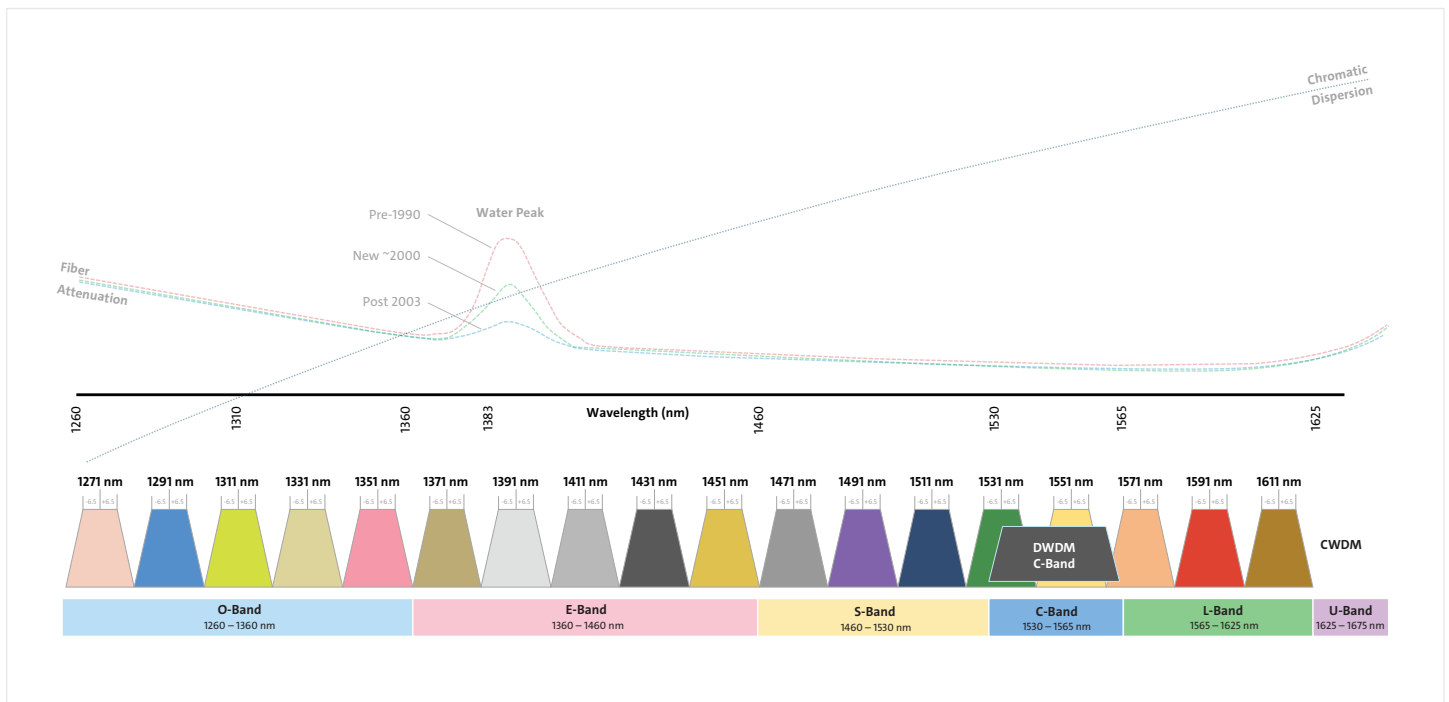# CORNING

Dense Wavelength Division Multiplexing
Solutions Guide

Dense Wavelength Division Multiplexing (DWDM)

Corning DWDM multiplexers and demultiplexers utilize advanced thin-film filter and athermal waveguide technology designed for low insertion loss, high isolation, and excellent temperature stability in a totally passive device. They are available in various channel counts at ITU industry standard 100 and 200 GHz spacing, in both the C- and L-band. Corning's DWDM devices are Telcordia GR-1209 and GR-1221 qualified and have a wide variety of packaging options.

Features	Benefits
Passive and outside plant hardened	No power or temperature-controlled environment required
Epoxy-free optical path	Higher reliability
Low insertion loss and high isolation	Minimum impact on insertion loss budgets and lower transmission costs
Transport protocol independent	Flexibility
Standards	Approvals and Listings: Telcordia qualified

ITU-T G.694.1 DWDM Standard

Ordering Information | DWDM Solutions

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1   **2**   **3**   **4**   **5**   **6**   **7**   **8**   **9**   **10**   **11**   **12**

1 **Select product family.**
CTX = CentrixTM cassette
EG1 = EDGETM WDM Module
EMR = EMF/FMS Right Hand Module
EML = EMF/FMS Left Hand Module
E2R = EMF/FMS Right Hand
        Double Module
E2L = EMF/FMS Left Hand
        Double Module
LG1 = LGX Single Width Module
LG2 = LGX Double Width Module
RAK = 1RU Shelf   R2K = 2RU Shelf

Hardened Preconn terminals
V28 = Evolv 2x8

Splice Trays
BK7 = BPEO K7 Tray
CL1 = Insert for 2541, 2543 long and
       short trays (BPEO and Fiber Dome)

2 **Select Com connector.**
B3 = LC APC   6C = SC APC
A9 = LC UPC   3C = SC UPC
MA = mDC APC   MU = mDC UPC
44 = OptiTap®   77 = OptiTip® (pin)
P# = Pushlok™   90 = 900 µm loose tube
      (# = 1 fiber, 2 fiber)
25 = 250 µm fiber

3 **Select channel/function connector.**
B3 = LC APC   6C = SC APC
A9 = LC UPC   3C = SC UPC
MA = mDC APC   MU = mDC UPC
44 = OptiTap®   77 = OptiTip® (pin)
P# = Pushlok   90 = 900 µm loose tube
      (# = 1 fiber, 2 fiber)
25 = 250 µm fiber

4 **Select WDM function option.**
A = Mux (1 Com)
B = DeMux (1 Com)
C = Dual (Mux and DeMux; 2 Com)
See Note 1

5 **Select channel spacing**
1 = 100 GHz
2 = 200 GHz

6 **Select number of channels.**
04 = Four Channels
06 = Six Channels
08 = Eight Channels
12 = 12 Channels
16 = 16 Channels
20 = 20 Channels
24 = 24 Channels
32 = 32 Channels
40 = 40 Channels
44 = 44 Channels
48 = 48 Channels
See Note 2

7 **Starting channel number.**
(refer to page 8, channel grid).
01 = 1577.03 nm/190.10 THz
72 = 1520.25 nm/197.20 THz

8 **Channel sequencing.**
0 = Adjacent (no skip)
1 = 8 skip 1
See Note 3

9 **Reserved for serialization.**
- = None

10 **Select monitor/test option.**
N = None
1 = Single Fiber Mux or DeMux
     Single directional test point (Tx) 1%
2 = Single Fiber Mux or DeMux
     Single directional test point (Tx) 2%
5 = Single Fiber Mux or DeMux
     Single directional test point (Tx) 5%
A = Single Fiber In, two directional
     1% test points (Tx and Rx)
B = Single Fiber In, two directional
     2% test points (Tx and Rx)
C = Single Fiber In, two directional
     5% test points (Tx and Rx)
D = Two Fibers In, two directional
     test points 1% (Tx and Rx)
E = Two Fibers In, two directional
     test points 2% (Tx and Rx)
F = Two Fibers In, two directional
     test points 5% (Tx and Rx)
See Notes 4 and 5

11 **Select upgrade, express,**
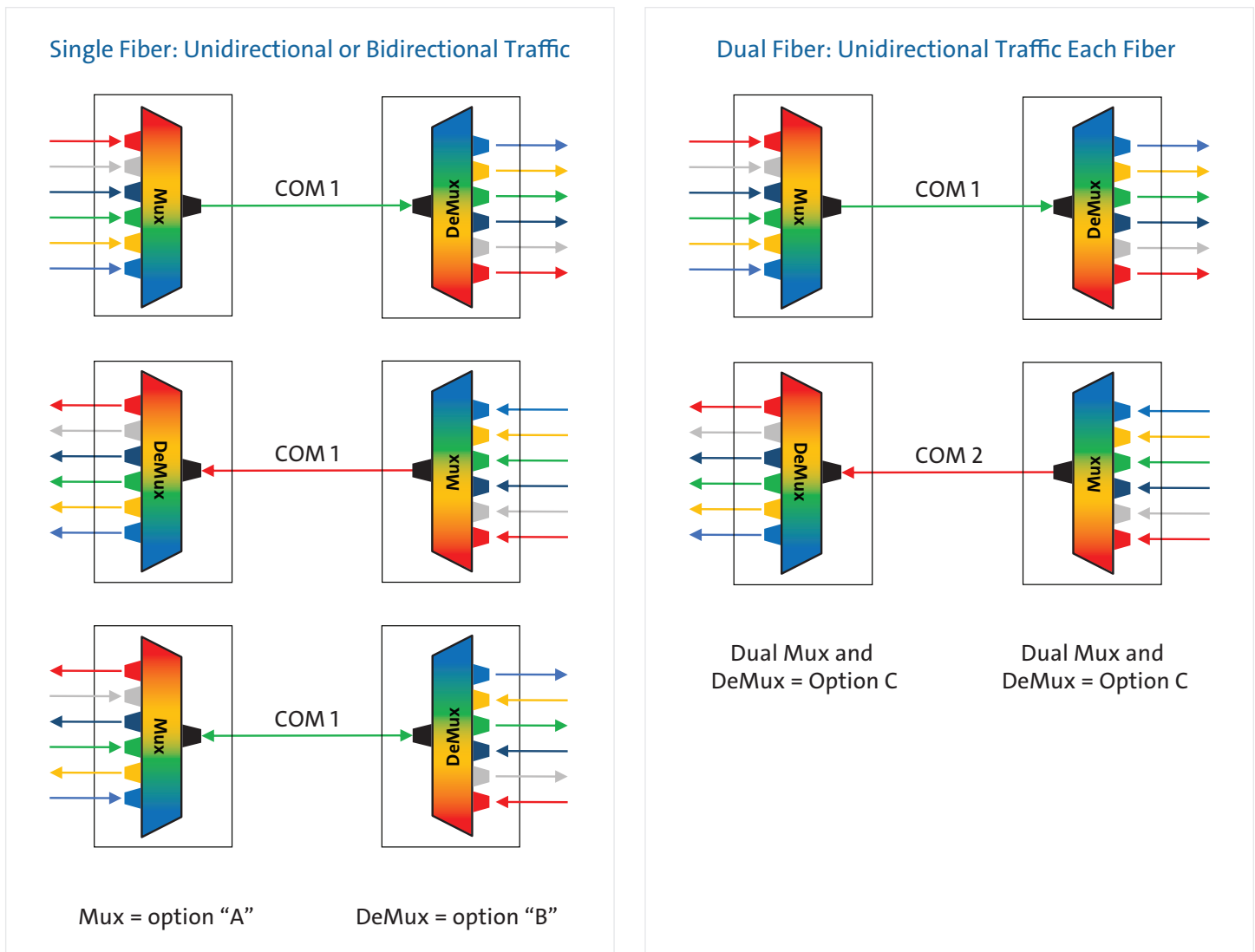**OTDR option.**
N = None
U = Upgrade (UPG)
E = Express (EXP)
B = Upgrade (UPG) and Express (EXP)
T = OTDR (1625 nm – 1675 nm)
A = Upgrade (UPG) and OTDR
     (1625 nm – 1675 nm)
C = Express (EXP) and OTDR
     (1625 nm – 1675 nm)
D = Upgrade (UPG), Express (EXP)
     and OTDR (1625 nm – 1675 nm)
W = OTDR (1640 nm – 1660 nm)
X = UPG and OTDR
     (1640 nm – 1660 nm)
Y = EXP and OTDR
     (1640 nm – 1660 nm)
Z = UPG, EXP, and OTDR
     (1640 nm – 1660 nm)

12 **Select total number of WDMs**
in solution.
1 = 1   7 = 7
2 = 2   8 = 8
3 = 3   9 = 9
4 = 4   A = 10
5 = 5   B = 11
6 = 6   C = 12
See Note 6

Note 1: Functions–Mux, DeMux, or Both

Single Fiber: Unidirectional or Bidirectional Traffic

COM 1

COM 1

COM 1

Mux = option "A"   DeMux = option "B"

Dual Fiber: Unidirectional Traffic Each Fiber

COM 1

COM 2

Dual Mux and
DeMux = Option C

Dual Mux and
DeMux = Option C

Note 2: Number of Channels

The number of ITU channels in the Mux or DeMux. If the Dual (Mux and DeMux) option is selected, there is no need to add the Mux and DeMux channels. For example, if 16 is selected for the number of channels, it would be 16 channels for Mux and 16 channels for the DeMux (options A, B, or C in section 4).

Note 3: Channel Sequencing

This is the sequencing of channels starting at the channel number selected in section 6. None (no-skip) is the complete sequence. 8-skip-1 will skip a channel between sequences of 8.
Example, for 16 channels is selected with 20 as the starting channel, the sequencing would be Adjacent (no skip): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 (low to high for Mux, high to low for DeMux) 8 skip 1: 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36 (low to high for Mux, high to low for DeMux)

Note 4: Test/Monitor Fiber Terminations

For splice tray options with bare fiber for Com and Add/Drop channels, the test ports will default to SC APC terminations for field access.

Note 5: Test/monitor port options.

WDM Function Options (A= Mux, B= Mux and DeMux, C = DeMux)			Test/Monitor Options (1%, 2%, 5%)
A	Single Fiber Mux, Single directional test point (Tx)	CWDM — Test Tx — % — COM	1, 2, 5
B	Single Fiber Mux, Single directional test point (Rx)	CWDM — Test Rx — % — COM	1, 2, 5
A, B	Single Fiber in (bidirectional Mux/DeMux), two directional test points (Tx and Rx)	CWDM — Test Rx — Test Tx — % — COM	A, B, C
C	Two Fibers in (Mux AND DeMux), two directional test points (Tx and Rx)	CWDM — Test Rx — % — COM / CWDM — Test Tx — % — COM	D, E, F

Note 6

This option allows for multiple instances of a particular Mux/DeMux in one module or cassette. The maximum number of devices allowed is dependent on the form factor of the module/cassette, the connector type chosen, and the number of services being combined.

Inside Plant

Centrix™

EMF (Right; double height)

LGX (Single and double wide modules)

EMF (Right; double height)

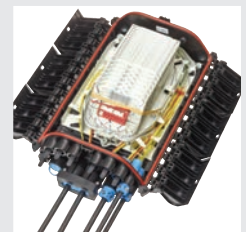EDGE™

1 and 2 RU Shelf

Outside Plant

K7 WDM Tray (BPEO)

WDM Insert for 2542 and 2543 trays (BPEO and Fiber Dome)

Evolv® (2x8) with Pushlok™

BPEO Closure

FiberDome Closure

Hardware Capacities

IPS Platform	Connector (fiber) Capacity		
	SC	LC	MDC (2-fiber)
Centrix™ (CTX)	24	36	
LGX Single Wide (LG1)	12	28	
LGX Double Wide (LG2)	24	56	
EDGE™ WDM Module (EG1)		12	18 (36)
EMF (Right Hand) Single Height (EMR)	12	24	
EMF (Left Hand) Single Height (EML)	12	24	
EMF (Right Hand) Double Height (E2R)	24	48	
EMF (Left Hand) Double height (E2L)	24	48	
1RU Shelf (RAK)	22	44	
2RU Shelf (R2K)	44	88	

Hardened Precon Terminal	Connector (fiber) Capacity	
	Pushlok™ (1-fiber)	Pushlok (2-fiber)
Evolv® 2x8 (V28)	18	18 (36)

Spliced - splice tray/insert	Fiber Leg Capacity
	Fiber (250 µm or 900 µm)
BPEO K7 Tray (BK7)	28
Fiber Dome and BPEO Tray Inserts (CL1)	14

Sample Configurations and Part Numbers

DWDM Configuration Examples	Example Hardware Description	# fibers/ ports required	Part Number Examples		# fibers/ ports required	Part Number Examples
			Mux (A)	DeMux (B)		MUX and DeMUX (C)
8CH DWDM 100 GHz, 20-27	8 Channel DWDM; LGX Single Wide Module, LC APC Com, LC APC Channels, 100GHz, channels 20-27, Directional Test (5%), UPG, EXP, 1 Device	12	LG1DB3B3A108200-5B1	LG1DB3B3B108200-5B1	24	LG1DB3B3C108200-FB1
8CH DWDM 100 GHz, 19-26	8 Channel DWDM; EDGE Module, LC UPC COM, LC UPC Channels, 100GHz, channels 19-26, UPG, 1 Device	10	EG1DA9A9A108190-NU1	EG1DA9A9B108190-NU1		
16CH DWDM 100 GHz, 20-35	16 Channel DWDM; Centrix™ Cassette, LC APC Com, LC APC Channels, 100GHz, channels 20-35, Directional Test (1%), 1 Device	18	CTXDB3B3A116200-1N1	CTXDB3B3B116200-1N1	36	CTXDB3B3C116200-DU1
20CH DWDM 100 GHz, 21-40	20 Channel DWDM; EMF Right Hand Single Height Module, LC UPC Com, LC UPC Channels, 100GHz, channels 21-40, Test TX (1%) and Test Rx (1%), UPG, 1 Device	24	EMRDA9A9A120200-AU1	EMRDA9A9B120200-AU1		
40CH DWDM 100 GHz, 20-59	40 Channel DWDM; 2RU Shelf, LC APC Com, LC APC Channels, 100GHz, channels 20-59, Directional Test (2%), EXP, 1 Device	43	R2KDB3B3A140200-2E1	R2KDB3B3B140200-2E1	86	R2KDB3B3C140200-EE1
16CH DWDM 100 GHz, 21-37 (skip 29)	16 Channel DWDM; Evolv® 2x8 Terminal; Single-Fiber Pushlok™ Com, Single-Fiber Pushlok Channels, 100GHz, channels 21-28 + 30-37, UPG, 1 Device	26	V28DP1P1A116211-NU1	V28DP1P1B116211-NU1		
4CH DWDM 100 GHz, 20-23	4 Channel DWDM; Splice Tray Insert (2143 tray compatible), 900 µm loose tube Com and 900 µm loose tube Channels, 100GHz, channels 20-23, EXP, 1 Device	6	CL1D9090A110200-NE1	CL1D9090B110200-NE1	12	CL1D9090C110200-NE1

DWDM Channels

100 GHz Channels	Wavelength (in nm)	Frequency (in THz)	100 GHz Channels	Wavelength (in nm)	Frequency (in THz)		Popular Channels
(DWDM Channel C36)	1548.51	193.60	(DWDM Channel C72)	1520.25	197.20		C60
(DWDM Channel C35)	1549.32	193.50	(DWDM Channel C71)	1521.02	197.10		C59
(DWDM Channel C34)	1550.12	193.40	(DWDM Channel C70)	1521.79	197.00		C58
(DWDM Channel C33)	1550.92	193.30	(DWDM Channel C69)	1522.56	196.90		C57
(DWDM Channel C32)	1551.72	193.20	(DWDM Channel C68)	1523.34	196.80		C56
(DWDM Channel C31)	1552.52	193.10	(DWDM Channel C67)	1524.11	196.70		C55
(DWDM Channel C30)	1553.33	193.00	(DWDM Channel C66)	1524.89	196.60		C54
(DWDM Channel C29)	1554.13	192.90	(DWDM Channel C65)	1525.66	196.50		C53
(DWDM Channel C28)	1554.94	192.80	(DWDM Channel C64)	1526.44	196.40		C52
(DWDM Channel C27)	1555.75	192.70	(DWDM Channel C63)	1527.22	196.30		C51
(DWDM Channel C26)	1556.55	192.60	(DWDM Channel C62)	1527.99	196.20		C50
(DWDM Channel C25)	1557.36	192.50	(DWDM Channel C61)	1528.77	196.10		C49
(DWDM Channel C24)	1558.17	192.40	(DWDM Channel C60)	1529.55	196.00		C48
(DWDM Channel C23)	1558.98	192.30	(DWDM Channel C59)	1530.33	196.90		C47
(DWDM Channel C22)	1559.79	192.20	(DWDM Channel C58)	1531.12	195.80		C46
(DWDM Channel C21)	1560.61	192.10	(DWDM Channel C57)	1531.90	195.70		C45
(DWDM Channel C20)	1561.42	192.00	(DWDM Channel C56)	1532.68	195.60		C44
(DWDM Channel C19)	1562.23	191.90	(DWDM Channel C55)	1533.47	195.50		C43
(DWDM Channel C18)	1563.05	191.80	(DWDM Channel C54)	1534.25	195.40		C42
(DWDM Channel C17)	1563.86	191.70	(DWDM Channel C53)	1535.04	195.30		C41
(DWDM Channel C16)	1564.68	191.60	(DWDM Channel C52)	1535.82	195.20		C40
(DWDM Channel C15)	1565.50	191.50	(DWDM Channel C51)	1536.61	195.10		C39
(DWDM Channel C14)	1566.31	191.40	(DWDM Channel C50)	1537.40	195.00		C38
(DWDM Channel C13)	1567.13	191.30	(DWDM Channel C49)	1538.19	194.90		C37
(DWDM Channel C12)	1567.95	191.20	(DWDM Channel C48)	1538.98	194.80		C36
(DWDM Channel C11)	1568.67	191.10	(DWDM Channel C47)	1539.77	194.70		C35
(DWDM Channel C10)	1569.59	191.00	(DWDM Channel C46)	1540.56	194.60		C34
(DWDM Channel C09)	1570.42	190.90	(DWDM Channel C45)	1541.35	194.50		C33
(DWDM Channel C08)	1571.24	190.80	(DWDM Channel C44)	1542.14	194.40		C32
(DWDM Channel C07)	1572.06	190.70	(DWDM Channel C43)	1542.94	194.30		C31
(DWDM Channel C06)	1572.89	190.60	(DWDM Channel C42)	1543.73	194.20		C30
(DWDM Channel C05)	1573.71	190.50	(DWDM Channel C41)	1544.53	194.10		C29
(DWDM Channel C04)	1574.54	190.40	(DWDM Channel C40)	1545.32	194.00		C28
(DWDM Channel C03)	1575.37	190.30	(DWDM Channel C39)	1546.12	193.90		C27
(DWDM Channel C02)	1576.20	190.20	(DWDM Channel C38)	1546.92	193.80		C26
(DWDM Channel C01)	1577.03	190.10	(DWDM Channel C37)	1547.72	193.70		C25
							C24
							C23
							C22
							C21

Specifications

Parameters	4CH		8CH		16CH		32CH	40CH
CH Spacing (GHz)	100G	200G	100G	200G	100G	200G	100G	100G
DWDM CH IL (dB)	2.0	2.0	3.2	3.2	4.0	4.0	4.8	5.2
UPG IL (dB)	1.8	1.8	3.0	3.0	3.5	3.5	4.5	4.9
Ripple in Passband (dB)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Adjacent CH Isolation (dB)	30	30	30	30	30	30	30	30
Non-Adj CH Isolation (dB)	45	45	45	45	45	45	45	45
Directivity (dB)	50	50	50	50	50	50	50	50
Return Loss (dB)	45	45	45	45	45	45	45	45
PDL (dB)	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4
PMD (dB)	0.15	0.15	0.15	0.15	0.2	0.2	0.25	0.25
With Express Port								
DWDM CH IL (dB)	2.7	2.7	3.9	3.9	4.7	4.7	5.5	5.9
Express Port IL (dB)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Express Port Isolation (dB)	15	15	15	15	15	15	15	15
With 5% Tap								
CH IL (dB)	2.4	2.4	3.6	3.6	4.4	4.4	5.2	5.6
DeMux Tap (dB)	16	16	16	16	16	16	16	16
Mux Tap (dB)	18	18	20	20	21	20	21	22
With 2% Tap								
CH IL (dB)	2.3	2.3	3.5	3.5	4.3	4.3	5.1	5.5
DeMux Tap (dB)	19	19	19	19	19	19	19	19
Mux Tap (dB)	21	21	22	22	23	23	24	24
With 1% Tap								
CH IL (dB)	2.2	2.2	3.4	3.4	4.2	4.2	5.0	5.4
DeMux Tap (dB)	22	22	22	22	22	22	22	22
Mux Tap (dB)	25	25	26	26	27	27	27	28

*Operation Temperature : -40°C to +85°C

*DWDM 100G bandwidth: 0.12 nm; DWDM 200G bandwidth: 0.25 nm
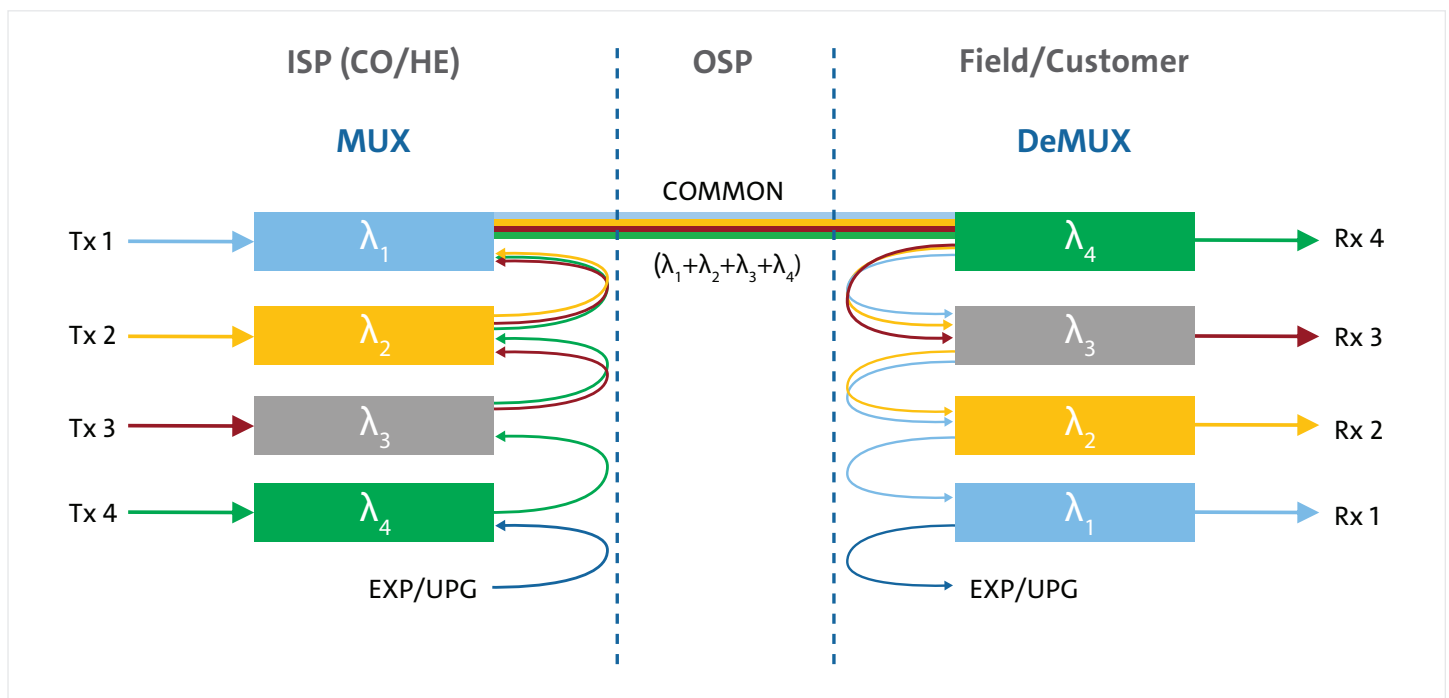
*DeMux tap IL measured from Com to tap port; Mux tap IL measured from DWDM port to tap port

*Optical parameters measured with connectors

DWDM Considerations

If DWDM is to be overlaid on CWDM, CWDM 1531 nm and 1551 nm channel spectrum is used.
- If DWDM is to be amplified, amplify prior to combining with CWDM.
- If using CWDM 1531 nm and/or 1551 nm channels for DWDM, some DWDM channels are 'clipped' and not usable.
  - If DWDM is to be amplified, amplify prior to combining with CWDM.
  - If using CWDM 1531 nm and/or 1551 nm channels for DWDM, some DWDM channels are 'clipped' and not usable.
    - 1531 nm DWDM passband: C44 − C59
    - 1551 nm DWDM passband: C20 − C43

- For balancing TFF (thin-film filter) cascade losses (tilt), have Mux and DeMux reversed.
  - i.e., when Mux is selected, low-to-high channel number.
  - i.e., when DeMux is selected, high-to-low channel number.

ISP (CO/HE)	OSP	Field/Customer
MUX		DeMUX

Tx 1 → λ_1 COMMON ($\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4$) λ_4 → Rx 4
Tx 2 → λ_2 λ_3 → Rx 3
Tx 3 → λ_3 λ_2 → Rx 2
Tx 4 → λ_4 λ_1 → Rx 1
EXP/UPG EXP/UPG

Note: to balance the insertion loss, reversing the order of the filters on one side of the link is considered to not penalize the last channel added/dropped.

Notes:

For further information

refer to Application Engineering Note: **Selecting Passive Wavelength Division Multiplexing Hardware – AEN177**, or contact Customer Care at 1-800-743-2675, **CCSAmericas@corning.com**.