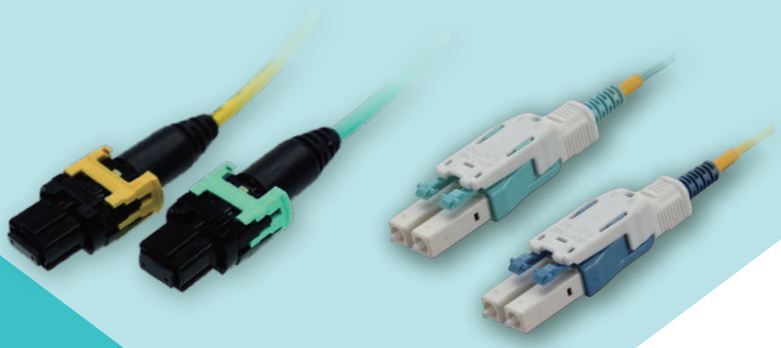
SUMITOMO ELECTRIC
Connect with Innovation



Fiber optic products

for broadband solutions

Web site

SUMITOMO ELECTRIC GROUP

Contents

Optical Fibers & Cables

Optical Fibers

Product Information

Single-mode Optical Fibers

Product Name	PureBand™ PB	PureBand™ [LL] PB	PureBand™-Plus PB Plus	PureBand™-R PB-R	PureBand™-R [LL] PB-R	PureAccess™ PA	PureAccess™ [A2] PAA2
Standards Compliance	G.652.D	G.652.D	G.652.D/G.657.A1	G.652.D/G.657.A1	G.652.D/G.657.A1	G.652.D/G.657.A1	G.652.D G.657.A2/B2
Available Coating Diameter	250 μm	250 μm	250 μm 200 μm	250 μm 200 μm	250 μm	250 μm 200 μm 180 μm	250 μm 200 μm 180 μm
Minimum Bending Radius	25 mm	25 mm	10 mm	10 mm	10 mm	10 mm	7.5 mm
Mode Field Diameter at 1310 nm	9.2 ± 0.4 μm	9.2 ± 0.4 μm	8.9 ± 0.4 μm	9.2 ± 0.4 μm	9.2 ± 0.4 μm	8.6 ± 0.4 μm	8.6 ± 0.4 μm
Cable Cut-off Wavelength	≤ 1260 nm	≤ 1260 nm	≤ 1260 nm	≤ 1260 nm	≤ 1260 nm	≤ 1260 nm	≤ 1260 nm
Attenuation at 1310 nm	≤ 0.35 dB/km	≤ 0.32 dB/km	≤ 0.35 dB/km	≤ 0.35 dB/km	≤ 0.32 dB/km	≤ 0.35 dB/km	≤ 0.35 dB/km
Attenuation at 1383 nm (After H_2 aging)	≤ 0.35 dB/km	≤ 0.32 dB/km	≤ 0.35 dB/km	≤ 0.35 dB/km	≤ 0.32 dB/km	≤ 0.35 dB/km	≤ 0.35 dB/km
Attenuation at 1550 nm	≤ 0.20 dB/km	≤ 0.18 dB/km	≤ 0.20 dB/km	≤ 0.20 dB/km	≤ 0.18 dB/km	≤ 0.21 dB/km	≤ 0.21 dB/km
Attenuation at 1625 nm	≤ 0.23 dB/km	≤ 0.20 dB/km	≤ 0.23 dB/km	≤ 0.23 dB/km	≤ 0.20 dB/km	≤ 0.22 dB/km	≤ 0.22 dB/km
Zero Dispersion Wavelength	1300–1324 nm	1300–1324 nm	1300–1324 nm	1300–1324 nm	1300–1324 nm	1300–1324 nm	1300–1324 nm
PMD Link Design Value	≤ 0.06 ps/√km	≤ 0.06 ps/√km	≤ 0.06 ps/√km	≤ 0.06 ps/√km	≤ 0.06 ps/√km	≤ 0.06 ps/√km	≤ 0.06 ps/√km

Optical Fibers

Ultra-Low Loss Single-mode Optical Fibers for Terrestrial Application

Product Name	PureAdvance™ -80 PAD	PureAdvance™ -110 PAD	PureAdvance™ -125 PAD
ITU-T Compliance	G.654.C / G.652.B	G.654.E	G.654.E
MFD at 1550 nm	10.5 ± 0.7 μm	11.7 ± 0.7 μm	12.5 ± 0.5 μm
Effective area (Typical) at 1550 nm	85 μm^2	110 μm^2	125 μm^2
Attenuation at 1550 nm	≤ 0.17 dB/km	≤ 0.16 dB/km	≤ 0.16 dB/km
Attenuation (Typical) at 1550 nm	0.160 dB/km	0.156 dB/km	0.156 dB/km
Cable cut-off wavelength (λcc)	≤ 1520 nm (G.654.C) ≤ 1260 nm (G.652.B)	≤ 1520 nm	≤ 1520 nm

Submarine Optical Fibers

Product Name	PureBand™ Submarine PBS	Z Fiber™ LL Z	PureAdvance™ -110 Submarine PAD	Z-PLUS Fiber™ ULL Z+	Z-PLUS Fiber™ 130 Z+ 130	Z-PLUS Fiber™ 150 Z+ 150
ITU-T Compliance	G.652.D	G.654.C	G.654.B, G.654.D	G.654.B, G.654.D	G.654.D	G.654.D
Effective area (Typical) at 1550 nm	83 μm^2	85 μm^2	110 μm^2	112 μm^2	130 μm^2	150 μm^2
Attenuation (Typical) at 1550 nm	0.174 dB/km	0.156 dB/km	0.154 dB/km	0.148 dB/km	LL: 0.152 dB/km ULL: 0.148 dB/km	LL: 0.150 dB/km ULL: 0.144 dB/km

Optical Fibers & Cables

Optical Fibers

Submarine Fibers

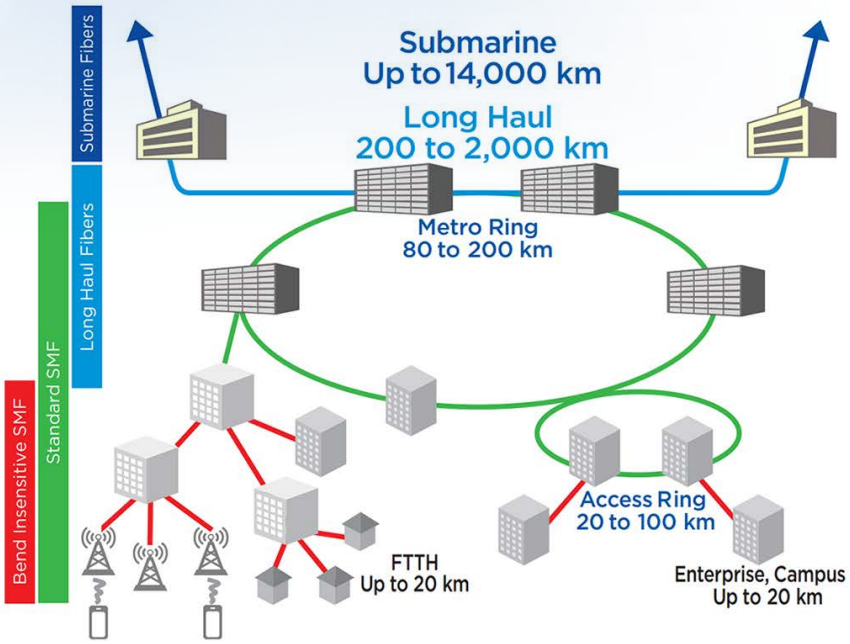
ITU-T	Product Name
G.654.B/C/D	Z Fiber™ Series Z

Long Haul Fibers

ITU-T	Product Name
G.654.E/G.654.C	PureAdvance™ Series PAD

Standard SMF/Bend Insensitive SMF

ITU-T	Product Name
G.652.D	PureBand™ PB
G.652.D	PureBand™ LL PB
G.652.D and G.657.A1	PureBand™-R PB-R
G.652.D and G.657.A1	PureBand™-R LL PB-R
G.652.D and G.657.A1	PureBand™-Plus PB Plus
G.652.D and G.657.A1	PureAccess™ PA
G.652.D and G.657.A2	PureAccess™ [A2] PAA2



Multi-mode optical fibers

	Core diameter: 50 μm			Core diameter: 62.5 μm
	General purpose	Broadband		General purpose
	Enhanced flexural characteristic ϕ30mm(R15mm)			
	PureEther™-Access1G 1G	PureEther™-Access10G 10G	PureEther™-Access10G+ 10G+	EG6 EG6
Optical fiber code	GI(PE-A1G)	GI(PE-A10G)	GI(PE-A10G+)	GI(62.5)
Transmission loss	3.0 dB/km max. (λ=850nm) 1.0 dB/km max. (λ=1300nm)	3.0 dB/km max. (λ=850nm) 1.0 dB/km max. (λ=1300nm)	3.0 dB/km max. (λ=850nm) 1.0 dB/km max. (λ=1300nm)	3.5 dB/km max. (λ=850nm) 1.5 dB/km max. (λ=1300nm)
Transmission band	500 MHz•km min. (λ=850nm) 500 MHz•km min. (λ=1300nm)	1500 MHz•km min. Effective band 2000 MHz•km min. (λ=850nm) 500 MHz•km min. (λ=1300nm)	3500 MHz•km min. Effective band 4700 MHz•km min. (λ=850nm) 500 MHz•km min. (λ=1300nm)	200 MHz•km min. (λ=850nm) 500 MHz•km min. (λ=1300nm)
Min. permissible bending radius[*1]	15mm	15mm	15mm	30mm
Standards	IEC60793-2-10 A 1a.1 type OM2*-compliant	IEC60793-2-10 A 1a.2 type OM3*-compliant	Compatible with upper grade of IEC60793-2-10 A 1a.2 type OM4*-compliant	IEC60793-2-10 A 1b type OM1*-compliant
		Can transmit signals to a maximum distance of 300 m at a rate of 10 gigabits	Can transmit signals to a maximum distance of 550 m at a rate of 10 gigabits	

Optical Fibers

Ethernet standards and recommended optical fibers

Standard name			Wavelength	Form Factor	Optical connecter	MM:OM2 1G	MM:OM3 10G	MM:OM4 10G+	SM:OS1 SM	SM:OS1,OS2 PB PAPB PAA2
100Gigabits Ethernet	IEEE802.3ba	100GBASE-SR10	850nm	CFP/CFP2	MPO	—	100m	150m	—	—
		100GBASE-SR4	850nm	CFP4/QSFP28	MPO	—	70m	100m	—	—
		100GBASE-LR4	LAN-WDM	CFP/CFP2/ CFP4/QSFP28	LC	—	—	—	—	10,000m
		100GBASE-ER4	LAN-WDM	CFP/CFP2	LC	—	—	—	—	40,000m
40Gigabits Ethernet	IEEE802.3ba	40GBASE-SR4	850nm	CFP/QSFP+	MPO	—	100m	150m	—	—
		40GBASE-LR4	CWDM	CFP/QSFP+	LC	—	—	—	10,000m	10,000m
	IEEE802.3bg	40GBASE-FR	1550nm	CFP	LC	—	—	—	2,000m	2,000m
10Gigabits Ethernet	IEEE802.3ae	10GBASE-SR	850nm	SFP+	LC	82m	300m	550m	—	—
		10GBASE-LR	1310nm	SFP+	LC	—	—	—	10,000m	10,000m
		10GBASE-ER	1550nm	SFP+	LC	—	—	—	40,000m	40,000m
Gigabits Ethernet	IEEE802.3z	1000BASE-SX	850nm	SFP	LC	550m	550m	550m	—	—
		—	850nm	SFP	LC	—	1000m*	1000m*	—	—
		1000BASE-LX	1300nm	SFP	LC	550m	550m	550m	—	—
			1310nm	SFP	LC	—	—	—	5,000m	5,000m

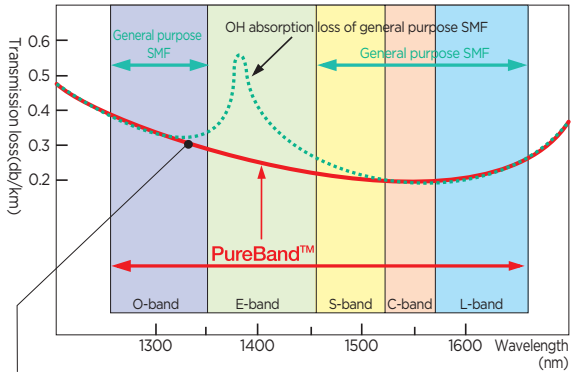
*: The table above shows the values actually measured by Sumitomo Electric. Different values may be measured if different cabling and network equipment and devices are used.

The world's industry leading G.652.D and G.657.A1

PureBand™ and PureAccess™

These optical fibers will meet the future need for a substantial increase in the transmission capacity of trunk lines that link local bases.

These fibers comply with ITU-T G.652.D and are usable over a wide wavelength range from 1260 nm to 1625 nm.
Fully compatible with general purpose SM fibers, PureBand™ and PureAccess™-PB fibers have been widely used to construct local community informatization infrastructures.



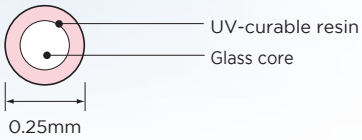
Significant reduction of OH absorption loss in 1383 nm waveband

Optical Fibers & Cables

Primary Coated Fiber/Secondary Jacketed Fibers/Fiber Ribbons

0.25 mm (UV) Primary Coated Fiber

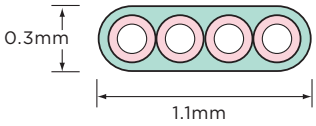
An optical fiber made by cladding a glass core with UV curable resin to form a diameter of 0.25 mm



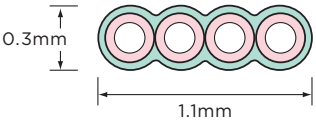
Fiber Ribbons

A fiber ribbon made by laying a group of primary coated fibers in parallel and cladding them with UV-curable resin. Since each fiber ribbon can be fusion-spliced as a unit, fiber ribbon splice time is saved substantially compared with single fiber.

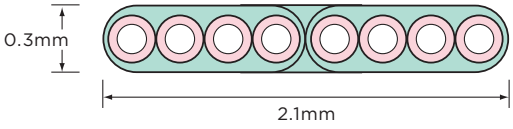
4-fiber ribbon [fiber ribbon code: 4]



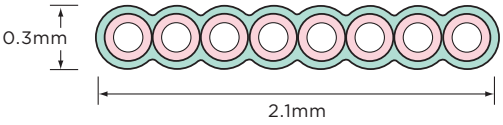
4-fiber EZbranch™ ribbon [fiber ribbon code: 4/(EZB)]



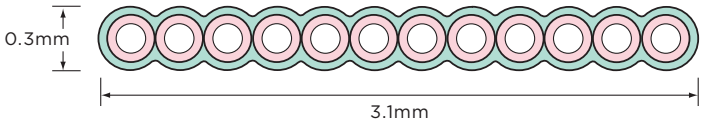
Split type 8-fiber ribbon [fiber ribbon code: 8]



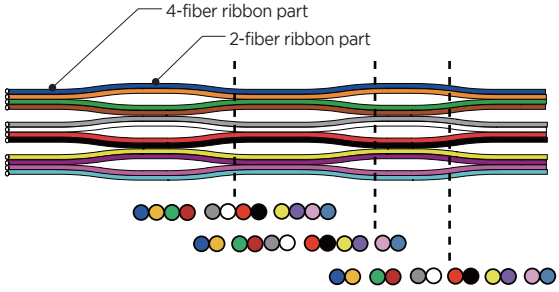
8-fiber EZbranch™ ribbon [fiber ribbon code: 8/(EZB)]



12-fiber FREEFORM RIBBON™ [fiber ribbon code:12/(FFR)] NEW



12-Fiber FREEFORM RIBBON™



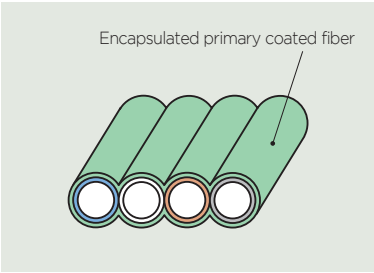
Primary Coated Fibers/Secondary Jacketed Fibers/Fiber Ribbons

Fiber Ribbon for Mid-Span Entry (EZbranch™)

EZbranch™; optical fiber ribbon that can be split for breakout and branching after cable installation

If you try removing the ribbon matrix of the optical fiber ribbon in the midst of its length, the probability is that you could break the fiber or damage the coating of the fiber. Or should you succeed taking individual fibers successfully, it would take several minutes accompanied by the unbearable uneasiness during the process.

However, with our EZbranch™ optical ribbon, a single fiber of optical fiber ribbon can be easily separated by gently snapping and pulling on the optical fiber ribbon using our exclusive tool due to its unique structure with deliberately designed depressions between fibers. The separation can be done in 30 to 40 seconds with no danger of open circuits.



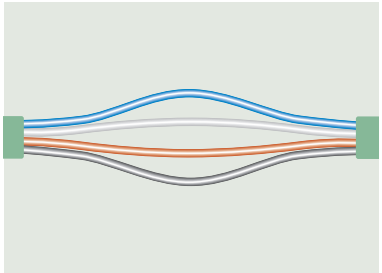


Fig.1
Construction of EZbranch™

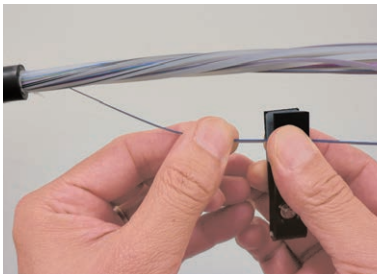


Fig.2
Mid-span entry with tool and the separation of fibers

EZbranch™ optical fiber ribbon conforms to standard specifications for optical fiber ribbon, and connection is compatible with conventional optical fiber ribbon; wiring parts such as cabinets and closures for conventional optical fiber ribbon can be used as is.

Intermediate single core branching is possible, greatly increasing the utilization efficiency of the fiber

Any unused fiber in the optical fiber ribbon can be separated and connected to form an intermediate single core branch for a new subscriber, without cutting any passing single fiber ribbon, eliminating any waste of the fiber.

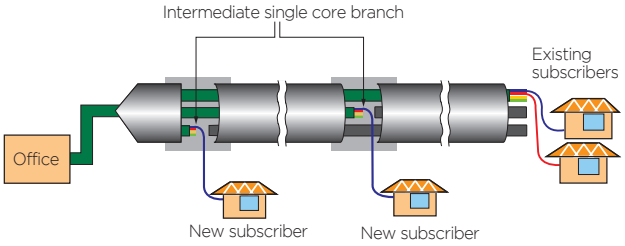
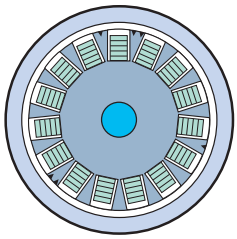


Fig.3
Taking separate fiber out of the identical ribbon fiber can increase the efficiency.

EZbranch™ ribbon can be used in many kinds of fiber ribbon cables

We have the cable product range with EZbranch™ ribbon fiber as we have them with the conventional fiber ribbon. And thanks to the thin ribbon matrix, the fiber ribbon experience lower PMD in EZbranch™ statistically than that of the conventional ribbon.



SZ standard ribbon slotted cable
24-fiber, 60-fiber, 100-fiber, 200-fiber, 300-fiber, 400-fiber, 640-fiber

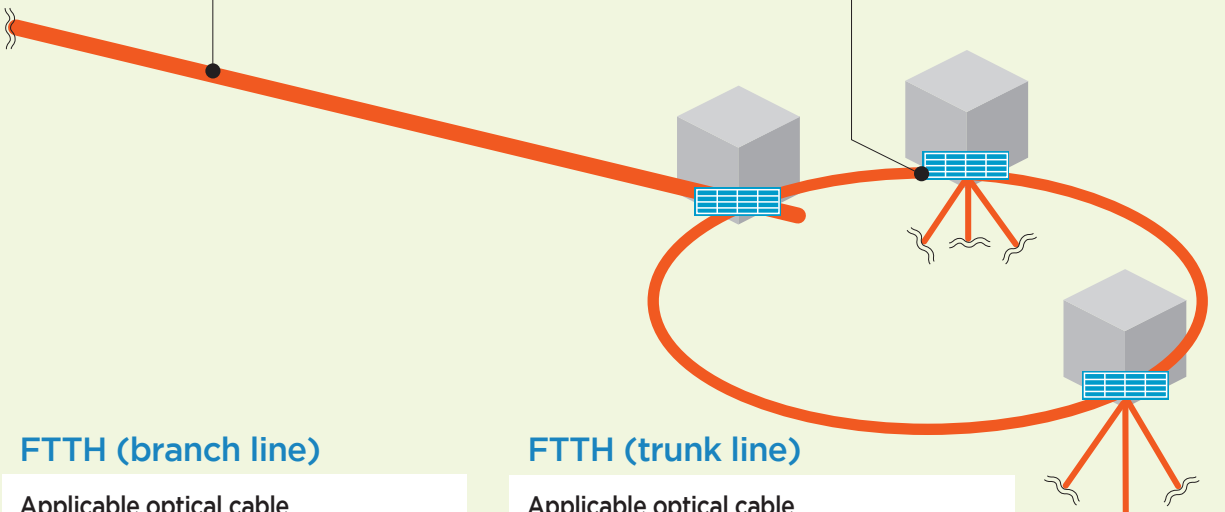
Fig.4
Variety of EZbranch™ applications with cables

EZbranch™ exercise its performance best with the bending insensitive fiber PureAccess™ in FTTx applications. Drop/Indoor cable with PureAccess™ EZbranch™ ribbon will give you new opportunities of wiring the optical fiber into the premises.

Optical Fibers & Cables

Optical Cable Selection Guide

Optical Cable Applications



Long haul

Applicable optical cable
- FREEFORM RIBBON™ slot cable ➡ **p.10**
- SZ slotted core ribbon cable ➡ **p.10**
- Microduct Cable ➡ **p.11**

Stage Area Network

Applicable optical cable
- PureFlex™-slim cable ➡ **p.29**

FTTH (branch line)

Applicable optical cable
- SZ slotted core ribbon cable ➡ **p.10**
- Slackly-suspended distribution aerial cable ➡ **p.13**
- Microduct Cable ➡ **p.11**

FTTH (trunk line)

Applicable optical cable
- FREEFORM RIBBON™ slot cable ➡ **p.10**
- SZ slotted core ribbon cable ➡ **p.10**
- Microduct Cable ➡ **p.11**

FTTH (Subscriber line)

Applicable optical cable
- Drop cable ➡ **p.12**

Subscriber House

Applicable optical cable
- Indoor cable ➡ **p.15**
- PureFlex™-slim cable ➡ **p.29**

Local Area Network

Applicable optical cable
- Microduct Cable ➡ **p.11**
- SZ slotted core ribbon cable ➡ **p.10**
- Premises cable ➡ **p.15**
- Indoor cable ➡ **p.15**
- PureFlex™-slim cable ➡ **p.29**

Optical Cable Selection Guide

Cable Line Up

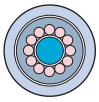
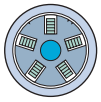
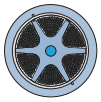
Wide range of cable Line UP from back born, metropolitan network and FTTH application

FTTH Cables

Tight buffered drop and indoor cables enable you quick and smooth installing in MDU and houses. They also suitable for additional installation into a duct already occupied with other cables, owing to small cable size, ultra low friction jacket and preferable rigidness. All our FTTx cable is RoHS compliant and most of them are halogen free.

Distribution and Trunk cables

Sumitomo offers two types of cable to match to your network, one is loose tube cables which widely used in the world and the other is ribbon slotted cables which achieve high fiber density and excellent mechanical performance.

Cable Type	Application	Product	Construction	Features	Fiber Count	Page
FTTx cable	Access	Indoor cable (Tight jacked)		Very compact tightly-jacketed cable for indoor application	1 - 12	→ p.15
		Drop cable (Tight jacked)		Very compact aerial drop cable with easy handling	1 - 8	→ p.12
		Slackly-suspended distribution aerial cable		Very compact and easy mid-span access. Ribbon can be separated easily with pliable structre.	24	→ p.13
	Interconnection	PureFlex™-slim/ PureFlex™		Practically robust preconnectorized cord Easy and safe	1 or 2	→ p.29
Premises cable	Break-out	Premises		Conventional layer structure with Laminated Aluminum Polyethylene sheath	2 - 16	→ p.15
Ribbon slotted core cable	Distribution	SZ slotted core ribbon cable		Ribbon cable with easy mid-span access	24 - 800	→ p.10
	Long haul/ Distribution	FREEFORM RIBBON™ slotted core cable		High fiber count & compact size with pliable EZbranch™	864 - 6912	→ p.10
Microduct cable	Long haul / Distribution	Microduct Cable with FREEFORM RIBBON™		High-packing density cable for air blown installation	144 - 864	→ p.11

Optical Fibers & Cables

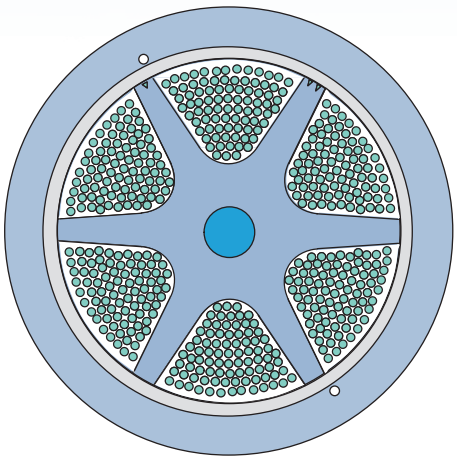
General Purpose Optical Cables

FREEFORM RIBBON™ Slot Cable for High Fiber Count & Compact size NEW

12-fiber FREEFORM RIBBON™ can realize so compact cable by packing many fibers at high density.

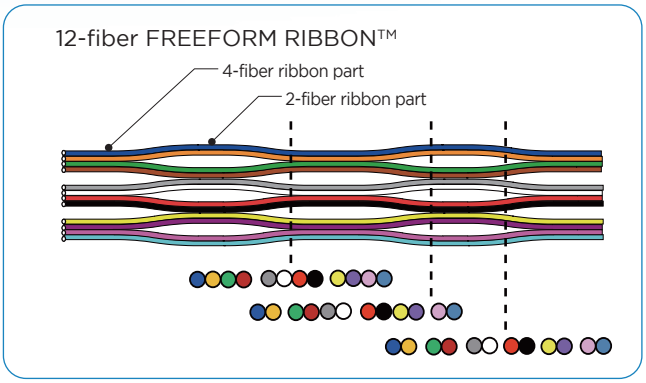
Optional Optional
PE sheath | Water blocking | Flame retardant | Metal free

RoHS compliant | FTTH (trunk line) | FTTH (branch line) | LAN (vertical)



1152 fiber type

12-fiber FREEFORM RIBBON™



12-fiber FREEFORM RIBBON™

Fiber count		432	576	864	1152	1728	3456	6912
Cable Diameter (mm)	200um	15.5	15.5	19	-	25	28	30
	250um	18.5	18.5	21	25	26	32	-
Reccomended Duct size	200um	1.25 inch					1.5inch	2.0inch
	250um	1.25 inch				1.5inch	2.0inch	-
Tensile strength	200um	2670N						
	250um							
Min. Bending radius After installation (mm)	200um	300			-	350		420
	250um	300					350	-
Min. Bending radius during installation (mm)	200um	310		380	-	500	560	740
	250um	370		420	500	520	640	-

Available optical fibers for this cable: PA

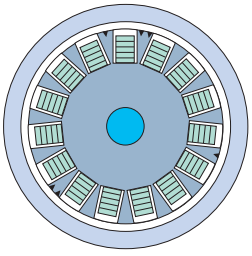
SZ slotted core ribbon cable

- Water blocking by dry water swellable tape
- EZbranch™ available as well as usual 4 and 8-fiber ribbon
- Easy accessibility to fibers in the midst of the cable because of SZ stranding groove configuration.
- Easy to remove outer sheath and water-swelable tape over the slot rod manually without special tool.
- Suitable for mass-fusion splice

Optional Optional
PE sheath | Water blocking | Flame retardant | Metal free

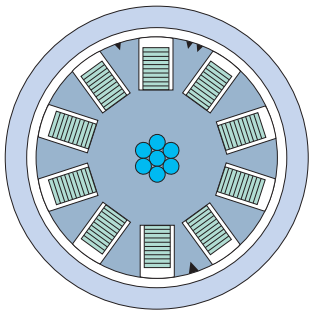
RoHS compliant | FTTH (trunk line) | FTTH (branch line) | LAN (vertical)

Fiber ribbon available for this cable: EZbranch



300 fiber type

4-fiber ribbon type



800 fiber type

8-fiber ribbon type

Available optical fibers for this cable: PA

*1: 400-, 640-, and 800-fiber cables are excluded.

4-fiber ribbon type/4-fiber EZbranch™ type

Fiber count		24	60	100	144	200	300
Fiber diameter [mm]		0.25					
Cable diameter [mm]		8.5	9.5	11.5	14	15.5	20.5
Cable weight [kg/km]		65	75	110	140	180	320
Strength member [mm]		1.4	1.6	2.0		2.3	2.6
Maximum load [N]		900	1180	1850		2440	3120
Bending radius [mm]	After installation	85	95	115	140	155	205
	During installation	170	190	230	280	310	410

8-fiber ribbon type/8-fiber EZbranch™ type

Fiber count		288	400	576	640	800
Fiber diameter [mm]		0.25				
Cable diameter [mm]		16.5	20	22		28.5
Cable weight [kg/km]		210	290	410	420	600
Strength member [mm]		2.3	2.6	7/1.4		
Maximum load [N]		2440	3120	5700		
Bending radius [mm]	After installation	165	200	220		285
	During installation	330	400	440		570

*: Values for cables with polyethylene sheath

Note: Please note that the values for some types of ribbon cables may differ from those given in the table above. For your specific inquiry, contact Sumitomo Electric.

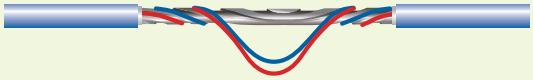
General Purpose Optical Cables

Fiber Ribbon in SZ-grooved spacer-the solution for mid- span access

- Conventional helical grooved spacer has a merit of high fiber density in a cable, but it takes time and labor to take out fiber ribbon out of the groove in the mid-span. Probability is that you are forced to place the branching point at the jointing box.
- With SZ-shape grooved spacer all you have to do to take the fiber of the groove is removing the jacket. You can access to the fiber anywhere you want and it gives you a flexible design for the network, especially in aerial distribution cable.

Helical shaped grooved spacer

SZ shape grooved spacer



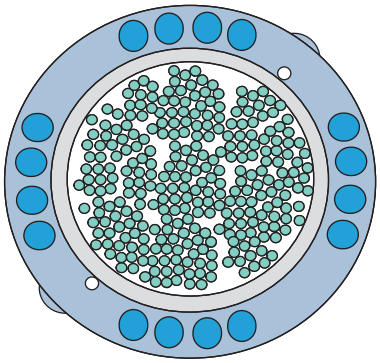
Microduct Cable with FREEFORM RIBBON™ for Air blown installation NEW

- High fiber density
- Water blocking by dry water swellable tape
- 12-fiber FREEFORM RIBBON™
- Suitable for mass fusion splice

Optional

PE sheath | Water blocking | Metal free | Flame retardant

RoHS compliant | FTTH (trunk line) | FTTH (branch line) | LAN (vertical)



12-fiber FREEFORM RIBBON™

Fiber count		144	192	288	432	864
Cable Diameter (mm)	200um	7.2	7.6	9.5	10.5	13.5
	250um	8.0	8.7	10.5	12.5	14.9
Min. Duct size (mm)	200um	10	12	13	14	18
	250um	12	13	14	18	20
Tensile strength (N)	200um	500				1000
	250um					
Min. Bending radius After installation (mm)	200um	150				200
	250um					300
Min. Bending radius during installation (mm)	200um	150	155	190	210	270
	250um	160	180	210	250	300

Available optical fibers for this cable	PA

Optical Fibers & Cables

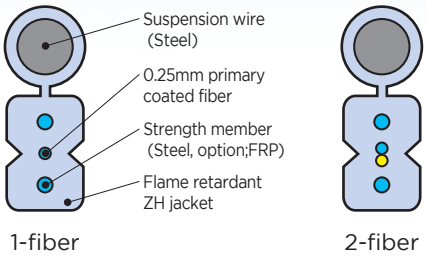
General Purpose Optical Cables

Drop Cable (0.25mm primary coated fiber)

- Easy access to the fiber in the midst of the cable with proper tool
- Suitable for introducing the fiber into the premises
- Suitable for additional installation into the duct occupied with other cables

Flame retardant

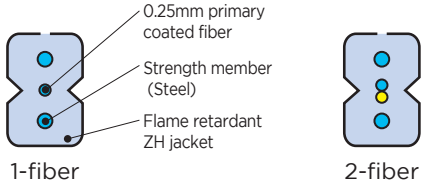
RoHS compliant FTTH (subscriber line)



Fiber count	1	2	8
Fiber diameter [mm]	0.25		
Cable diameter [mm]	2×4.5 (Including messenger wire)		2.5×6.5
Cable weight [kg/km]	20		25
Suspension wire	1.2		
Maximum load [N]	660		
Bending radius [mm]	30 (After installation)		50
	60 (During installation with tension)		100

These figures are nominal value.

Available optical fibers for this cable	PA PAA2



Fiber count	1	2
Fiber diameter [mm]	0.25	
Cable diameter [mm]	2×1.6	2.1×1.6
Cable weight [kg/km]	6	
Strength Member	0.4×2	
Maximum load [N]	150	
Bending radius [mm]	15 (After installation)	
	30 (During installation with tension)	

These figures are nominal value.

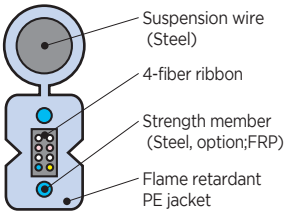
Available optical fibers for this cable	PA PAA2

Drop Cable (4-fiber ribbon)

- Easy access to the fiber in the midst of the cable with proper tool
- Suitable for introducing fiber into the building
- Suitable for additional installation into the duct occupied with other cables
- Single fibers accessible in the mid-span

Flame retardant

RoHS compliant FTTH (branch line) FTTH (subscriber line)



Fiber count	4	8
Fiber diameter [mm]	0.25	
Cable diameter [mm]	2×6 (Including messenger wire)	
Cable weight [kg/km]	2.5	
Suspension wire	1.2	
Maximum load [N]	660	
Bending radius [mm]	30 (After installation)	
	60 (During installation with tension)	

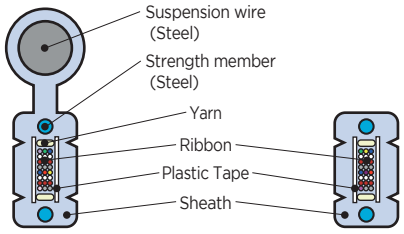
These figures are nominal value.

Available optical fibers for this cable	PA PAA2

General Purpose Optical Cables

Slackly-suspended distribution aerial cable

- Easy access to the fiber in the midst of the cable with proper tool
- Suitable for introducing the fiber into the premises
- FREEFORM RIBBON™ contains 4 fibers and easy to branch to single fiber



24-fiber

RoHS compliant

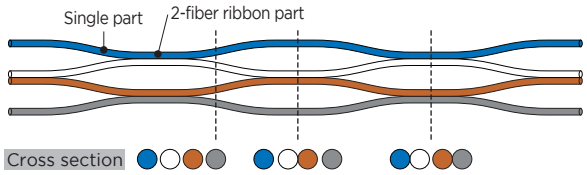
FTTH (subscriber line)

	With Messenger wire	Without Messenger wire
Fiber Count	24	
Fiber Diameter [mm]	0.25	
Cable Weight [kg/km]	70	25
Suspension wire	2.6	—
Maximum load [N]	3,120	450
Bending radius [mm]	40	

These figures are nominal value.

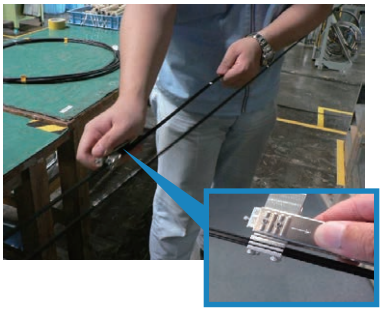
Available optical fibers for this cable	PA PAA2

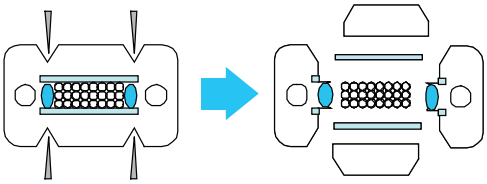
FREEFORM RIBBON™



Uniquely designed jacket structure for easy access to fibers in the midst of the cable with a specialized tool.

1. Divide jackets





2. Take out fibers

Work time Reduced by 90%

Optical Fibers & Cables

General Purpose Optical Cables

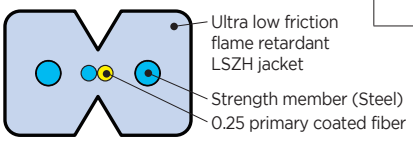
Low Friction Indoor Cable

PureAccess™ allows you quick and easy installation and higher cable density in conduit

50% Size down
80% Dynamic friction down
*(Compared with Sumitomo conventional type)
Low Smoke characteristic

- Suitable for additional installation into a duct already occupied other cables, owing to small cable size and ultra low friction jacket.
- Easy access to the fiber in the middle of the cable with proper tool
- Suitable for in-building wiring
- Field assembly connector available directly (1-fiber)

RoHS, LSZH, FR



Cable type	Flexible		Rigid	
Fiber count	1	2	1	2
Fiber diameter [mm]	0.25			
Cable diameter [mm]	1.6×2.0			1.6×2.1
Cable weight [kg/km]	6		7	
Strength member [mm]	0.4		0.5	
Maximum load [N]	150			
Bending radius [mm]	30 (After installation)			
	60 (During installation with tension)			

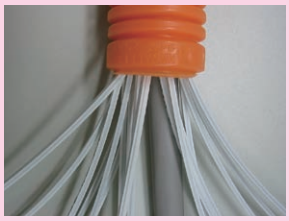
These figures are nominal value.

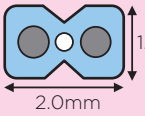
Available optical fibers for this cable	PA PAA2

How many indoor cables can we install into a common pile?

Pipe : Dia.22mm x 20m,
w/Dia.8mm Copper cable

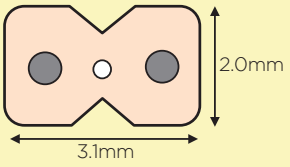
Low Friction type w/ PureAccess™





30 cables inserted

Conventional type w/ Standard SMF

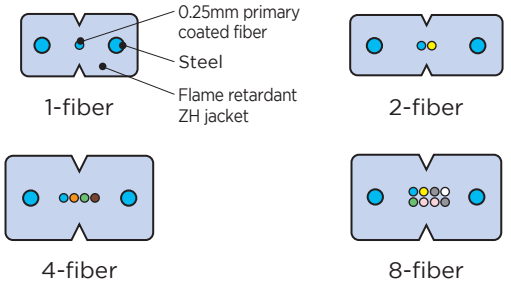


6 cables inserted

5 times as much cables can be installed into a same pipe!

Indoor Cable (0.25mm primary coated fiber)

- Easy access to the fiber in the midst of the cable with proper tool
- Suitable for in-building wiring
- Suitable for additional installation into the duct occupied with other cables
- Field assembly connector available directly (1 or 2-Fiber)



Flame retardant · RoHS compliant · Subscriber House · LAN (vertical)

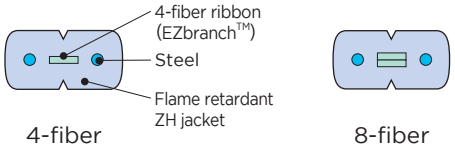
Fiber count	1	2	4	8
Fiber diameter [mm]	0.25			
Cable diameter [mm]	2.0×3.0		2.0×4.0	2.5×4.0
Cable weight [kg/km]	10		15	
Strength member [mm]	0.4×2			
Maximum load [N]	150			
Bending radius [mm]	30 (After installation)			
	60 (During installation with tension)			

These figures are nominal value.

Available optical fibers for this cable	PA · PAA2

Indoor Cable (4-fiber ribbon)

- Easy access to the fiber in the midst of the cable with proper tool
- Suitable for in-building wiring
- Suitable for additional installation into the duct occupied with other cables



RoHS compliant · LAN (vertical) · Flame retardant

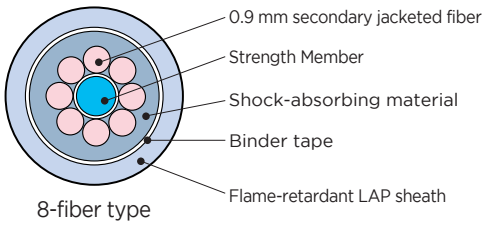
Fiber count	4	8
Fiber diameter [mm]	0.25	
Cable diameter [mm]	2.0×4.0	
Cable weight [kg/km]	15	
Strength member [mm]	0.4×2	
Maximum load [N]	150	
Bending radius [mm]	30 (After installation)	
	60 (During installation with tension)	

These figures are nominal value.

Available optical fibers for this cable	PA · PAA2

Premises Cable (0.9mm tight buffered fiber)

- LAP sheath blocks the penetration of moisture
- Suitable for introducing fibers into the building as well as outside installation



Available optical fibers for this cable	SM · PB · PA · DSF · 1G · 10G · 10G+ · EG6

RoHS compliant · LAN (vertical) · LAP sheath · Water blocking · Flame retardant

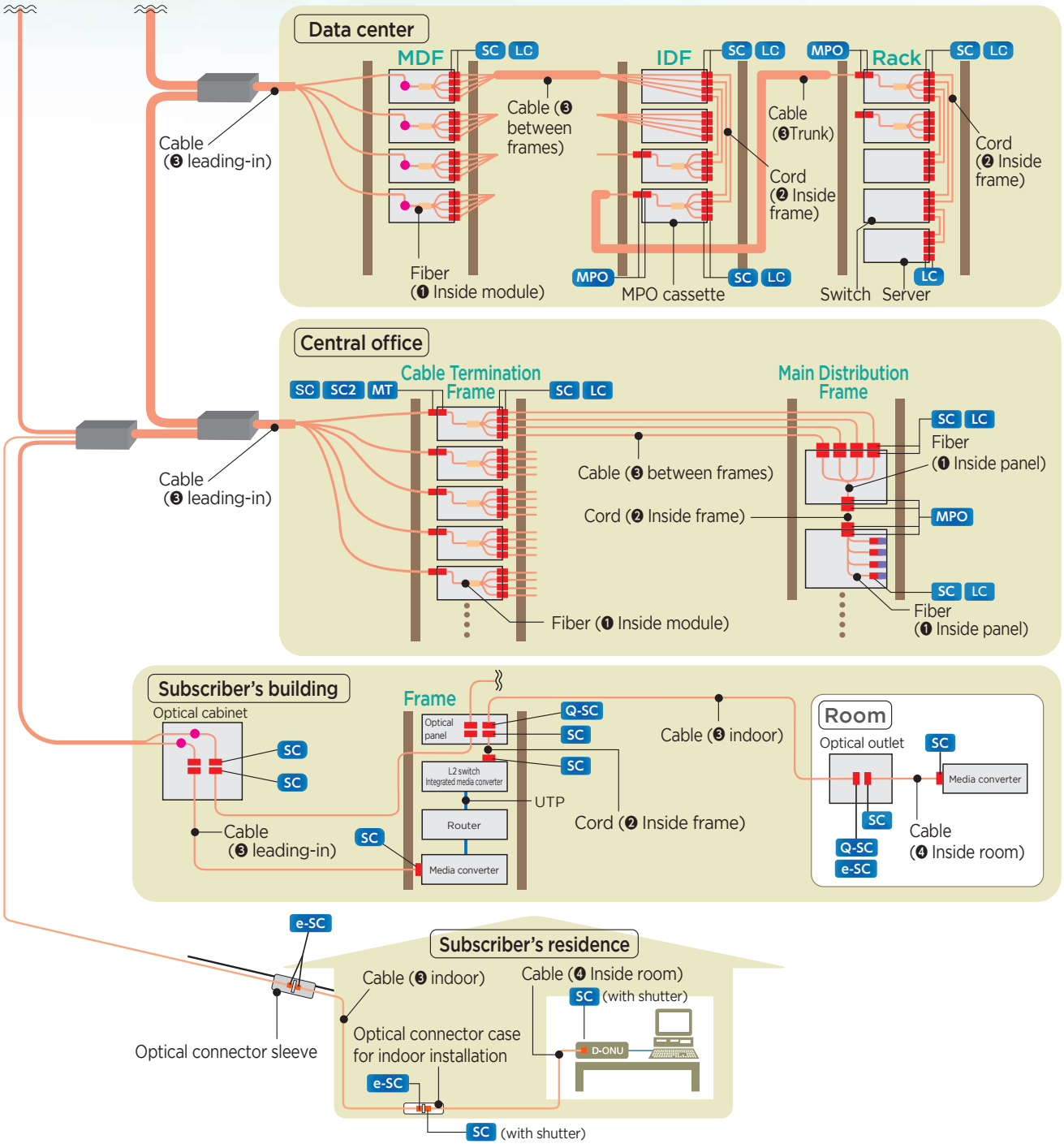
Fiber count		2	4	6	8	10	12	16
Fiber diameter [mm]		0.9						
Cable diameter [mm]		9				12		13
Cable weight [kg/km]		85				140		170
Strength member [mm]		1.6				2.3		2.6
Maximum load [N]		1180				1570		2060
Bending radius [mm]	After installation	90				120		135
	During installation	180				240		270

*: Values for cables with a flame-retardant LAP sheath

Cable type designation	(Number of fibers)NH(optical fiber code) - L - LAP - FR Example: 8NHGI (PE-A1G) - L - LAP - FR

Optical Connectors

Application Example of Optical Connectors in Access Network



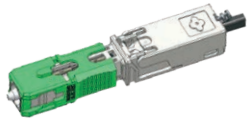
Point of use	Typical fiber configuration	Typical optical connector
❶ Inside panel or module	Fiber	SC LC
❷ Inside frame	Cord	SC LC MPO
❸ Between frames, indoor, leading-in	Cable	SC Q-SC e-SC
❹ Indoor	Optical cable for indoor installation	SC

Field Installable Connectors (Mechanical Type)

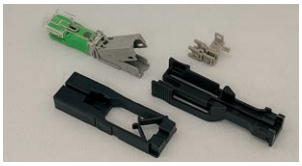
"Quick SC", "Quick LC" and "e-SC" connector series enables easy and quick fiber termination on site

e-SC (for flat cable :2x3mm, 1.6x2mm, 2x2mm) NEW

- Renewed by enhancing the workability
- Compatible with factory-assembled conventional SC
- Easy and quick assembly (within 2 minutes)
- No need electric power, adhesive on site
- Reliable assembly with assembly guide jig and cut spacer appended to connector kit
- Available to re-assembly



e-SC



Connector kit

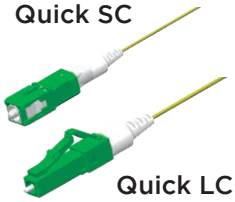
e-SC for flat cable		
Product Name	e-SC-APC<SM>A-6-D	e-SC-UPC<SM>F-6-D
Fiber Type	SM <Note 1>	
Polish	APC	UPC
Insertion Loss (against master plug)	Typ. ≦0.3dB (max. 0.6dB)	Typ. ≦0.2dB (max. 0.5dB)
Return Loss (against master plug)	Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)
Operating Temperature	-40 to 75°C	
Housing Color	SM.APC Green	SM.SPC Blue
Interface	IEC 61754-4	
Qualification	ANSI/TIA 568.3-D	

<Note 1> SM: ITU-T G657.A1&A2

Quick SC and Quick LC (for single fiber)

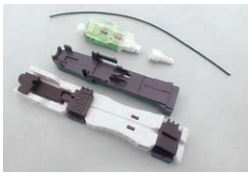
- Compatible with factory –assembled conventional SC and LC
- Easy and Quick assembly (within 2 minutes) without special tool
- No need electric power, adhesive on site
- Reliable assembly with assembly guide jig and fiber holder appended to connector kit
- Applicable for both 250μm fiber and 900μm fiber
- Available splice inspection with visible light source on site

Quick SC



Quick LC

Connector kit



	Quick-SC for fiber					Quick LC for fiber				
Product Name	Q-SC-APC<SM>-025/090-A-T	Q-SC-SPC<SM>-025/090-F-T	Q-SC-PC<62.5>-025/090-F-T	Q-SC-PC<50>-025/090-F-T	Q-SC-PC<10G>-025/090-F-T	Q-LC-APC<SM>-025/090-A-T	Q-LC-SPC<SM>-025/090-F-T	Q-LC-PC<62.5>-025/090-F-T	Q-LC-PC<50>-025/090-F-T	Q-LC-PC<10G>-025/090-F-T
Fiber Type	SM		MM62.5	MM50	MM50 (10G)	SM		MM62.5	MM50	MM50 (10G)
Fiber Diameter	250μm or 900μm Tight Buffer <Note 1> <Note 2>					250μm or 900μm Tight Buffer <Note 1> <Note 2>				
Polish	APC	SPC	PC			APC	SPC	PC		
Insertion Loss (against master plug)	Typ. ≦0.3dB (max. 0.75dB)	Typ. <0.2dB (max. 0.5dB)	Typ. <0.1dB (max. 0.3dB)			Typ. ≦0.3dB (max. 0.75dB)	Typ. <0.2dB (max. 0.5dB)	Typ. <0.1dB (max. 0.3dB)		
Return Loss (against master plug)	Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)	Typ. ≧35dB (min. 22dB)			Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)	Typ. ≧35dB (min. 22dB)		
Operating Temperature	-40 to 75°C					-40 to 75°C				
Housing Color	SM.APC Green	SM.SPC Blue	MM62.5 Beige	MM50 Black	MM50(10G) Aqua	SM.APC Green	SM.SPC Blue	MM62.5 Beige	MM50 Black	MM50(10G) Aqua
Interface	IEC 61754-4					IEC 61754-20				
Qualification	ANSI/TIA 568.3-D					ANSI/TIA 568.3-D				

<Note 1> Tight buffered 900μm except for Nylon coated fiber
<Note 2> SM: ITU-T G652.B&D, G657.A1&A2 / MM62.5: IEC60793-2-10 A1b / MM50: IUT-T G.651.1, IEC60793-2-10 A1a.1, IEC60793-2-10 A1a.2

Quick SC and Quick LC (for 2mm/3mm round cord)

- Same Installation as 900μm fiber type
- No crimping process and crimping tools
- Optional tools helps the installation easier

- Optional tools.

Cord Tool (for removing outer sheath and making slits)

Quick SC

Quick LC

Connector kit

	Quick-SC for round cord					Quick LC for round cord				
Product Name	Q-SC-APC<SM>-#-A-T	Q-SC-SPC<SM>-#-F-T	Q-SC-PC<62.5>-#-F-T	Q-SC-PC<50>-#-F-T	Q-SC-PC<10G>-#-F-T	Q-LC-APC<SM>-#-A-T	Q-LC-PC<SM>-#-F-T	Q-LC-PC<62.5>-#-F-T	Q-LC-PC<50>-#-F-T	Q-LC-PC<10G>-#-F-T
Fiber Type	SM		MM62.5	MM50	MM50 (10G)	SM		MM62.5	MM50	MM50 (10G)
Fiber Diameter	2mm or 3mm <Note 1> <Note 2>					2mm or 3mm <Note 1> <Note 2>				
Polish	APC	SPC	PC			APC	SPC	PC		
Insertion Loss (against master plug)	Typ. ≦0.3dB (max. 0.75dB)	Typ. <0.2dB (max. 0.5dB)	Typ. <0.1dB (max. 0.3dB)			Typ. ≦0.3dB (max. 0.75dB)	Typ. <0.2dB (max. 0.5dB)	Typ. <0.1dB (max. 0.3dB)		
Return Loss (against master plug)	Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)	Typ. ≧35dB (min. 22dB)			Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)	Typ. ≧35dB (min. 22dB)		
Operating Temperature	-40 to 75°C					-40 to 75°C				
Housing Color	SM.APC Green	SM.SPC Blue	MM62.5 Beige	MM50 Black	MM50(10G) Aqua	SM.APC Green	SM.SPC Blue	MM62.5 Beige	MM50 Black	MM50(10G) Aqua
Interface	IEC 61754-4					IEC 61754-20				
Qualification	ANSI/TIA 568.3-D					ANSI/TIA 568.3-D				

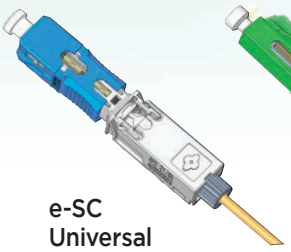
<Note 1> Tight buffered 900μm except for Nylon coated fiber
<Note 2> SM: ITU-T G652.B&D, G657.A1&A2 / MM62.5: IEC60793-2-10 A1b / MM50: IUT-T G.651.1, IEC60793-2-10 A1a.1, IEC60793-2-10 A1a.2

Optical Connectors

Field Installable Connectors (Mechanical Type)

e-SC Universal NEW */e-LC Universal (for multi-fiber medias)*

- Renewed by enhancing the workability (e-SC Universal)
- Available for six types of fiber media with universal cable holder
- Same assembly procedure as e-SC for flat cable after fitting fiber media to universal cable holder



e-SC Universal

e-LC Universal

Connector Kit (ex. e-SC Universal)

e-SC Universal / e-LC Universal (for multi-fiber medias)				
Product Name	e-SC-APC<SM>A-6-U	e-SC-UPC<SM>F-6-U	e-LC-APC<SM>-025H-A-T	e-LC-UPC<SM>-025H-F-T
Fiber Type	SM<Note 1>			
Fiber Diameter	250μm, 900μm tight Buffer, 2mm cord, 3mm cord, Flat cable (2x3mm or 1.6x2mm or 2x2mm)			
Polish	APC	UPC	APC	UPC
Insertion Loss (against master plug)	Typ. ≦0.3dB (max. 0.6dB)	Typ. ≦0.2dB (max. 0.5dB)	Typ. ≦0.3dB (max. 0.75dB)	Typ. ≦0.2dB (max. 0.5dB)
Return Loss (against master plug)	Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)	Typ. ≧60dB (min. 50dB)	Typ. ≧50dB (min. 40dB)
Operating Temperature	-40 to 75°C			
Housing Color	SM.APC Green	SM.UPC Blue	SM.APC Green	SM.UPC Blue
Interface	IEC 61754-4		IEC61754-20	
Qualification	ANSI/TIA 568.3-D			

<Note 1> SM: ITU-T G657.A1&A2

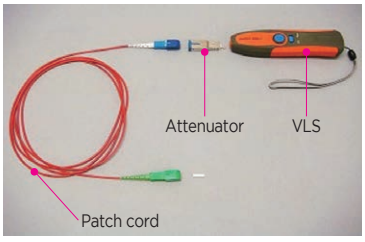
Assembly Tool Kit

- Available for Quick SC, Quick LC, e-SC and e-SC/e-LC Universal type

① Carrying Bag
② Fiber Cleaver
③ Fiber Stripper
④ Nipper
⑤ Alcohol Bottle
⑥ Cotton Pad

Visible Light Source(VLS) Kit

- The light power of this VLS is optimized to check splice visual inspection for SEI field installable connector.



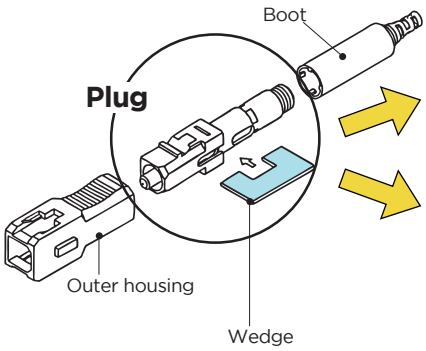
Before fiber insertion

After fiber insertion

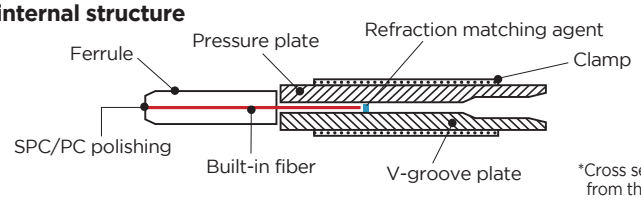
If assembly is succeeded, red light power can be decreased.

Connector termination principle based on mechanical splice technology on site

Structure



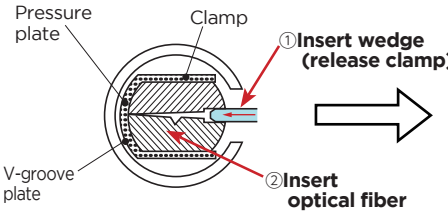
Plug internal structure



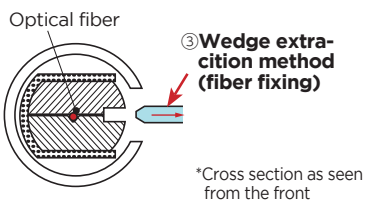
*Cross section as seen from the side

Fiber fixing mechanism

Insert wedge, Insert optical fiber



Wedge extraction method (fiber fixing)



*Cross section as seen from the front

Field Installable Connectors (Fusion Splice Type)

Lynx-CustomFit™ Splice-On Connector Ver.2

Splice-on fiber optic connector enabling quick, easy and reliable permanent field terminations

- Eliminating crimping process and crimping tools
- Requires neither adhesives, hand polishing, nor matching gel
- Compatible with Sumitomo Splicers and other brands
- Can apply for the place required low return loss as analog transmission, etc.
- Can apply for wide temperature range.

	SC	LC	FC	ST	Q8MPO / 12MPO
Interface standard	IEC61754-4	IEC61754-20	IEC61754-13	IEC 61754-2	IEC61754-7-1
Insertion Loss (against master plug)	SMF: Ave.0.2dB, Max. 0.3dB MMF: Ave.0.1dB, Max. 0.25dB				SMF,MMF Low Loss (LL) Max. 0.4dB SMF Standard Loss Max. 0.75dB
Return Loss (against master plug)	SMF: ≥ 60dB (APC), ≥ 55dB (UPC) MMF: ≥ 30dB (PC)				SMF: ≥ 55dB

Lineup for Single fiber connector

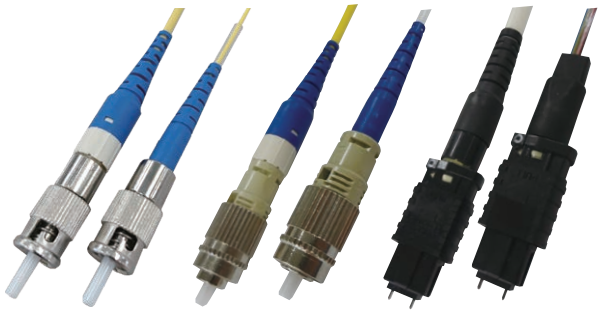
Connector type	Polishing type	fiber type	Connector Color	fiber / Cord diameter	Boot type
SC LC FC ST*1	APC	SM	Green	250 / 900μm Tight Buffer 900μm Loose Buffer 2mm with 900μm Tight Buffer 2mm with 900μm Loose Buffer 3mm with 900μm Tight Buffer	Standard boot Short boot *2
	UPC	SM	Blue		
	PC	MM50(OM2)	Black		
		MM50(OM3)	Aqua		
		MM62.5(OM1)	Beige		

*1 ST connector is available for SM(UPC polishing) and MM(PC polishing).
*2 Short boot is available for SC and LC type of 250 / 900 μm tight buffer.

Lineup for MPO connector

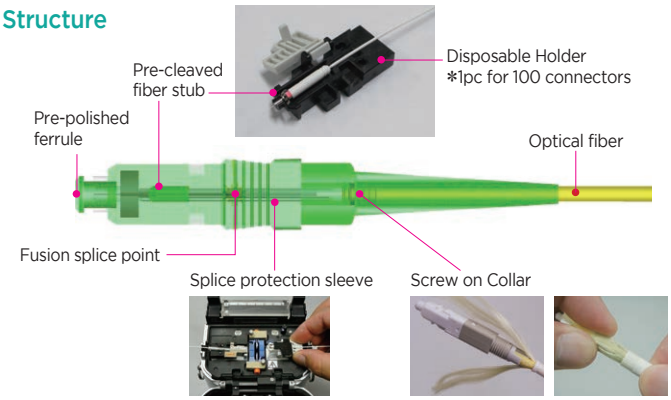
Guide Pin	fiber/Polishing type	Connector color	Cord diameter
With / Without guide pin	SM Low loss	Yellow	RBN: 8c/12c Bare Ribbon RND: 8c/12c Round cord (ϕ3mm) RBC: 8c/12c Ribbon cord
	SM Standard loss	Green	
	MM50(OM2) Low loss*	Black	
	MM50(OM3) Low loss	Aqua	

*MM50(OM2) Low Loss type is available for 12c(12-fiber).



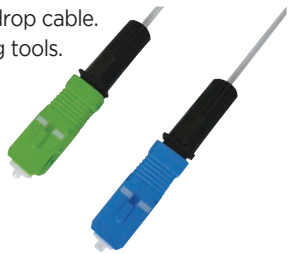
Please refer the web site to check the applicable fusion splicer.

Structure



e-SC Fusion™ Connector

- Compatible with the rectangular drop cable.
- No crimping process and crimping tools.



- Assembly Tools

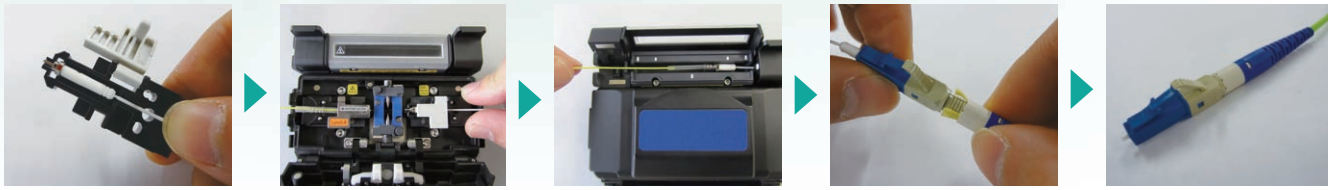
Fiber cleaver	Jacket remover	Aramid yarn snips	Cable Holder
			

	e-SC Fusion™ Connector	
Ordering Code	ESCF-SC/APC	ESCF-SC/UPC
Fiber Type	SM	
Applicable Cable	Indoor Cable/Drop Cable 1.6×2.0 to 2.0×3.1 (mm)	
Polish	APC	UPC
Insertion Loss	SM: Typ. ≤ 0.15dB, Max. ≤ 0.3dB (against master plug)	
Return Loss	SM: ≥ 60dB (APC), ≥ 50dB (UPC) (against master plug)	
Operating Temperature	-40 to +75°C	
Housing Color	SM.APC Green	SM.UPC Blue
Interface	IEC 61754-4	
Qualification	IEC 61753-1 Cat.OP	

Optical Connectors

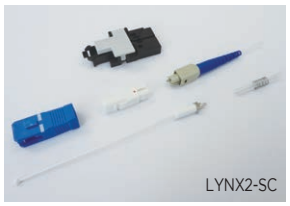
Field Installable Connectors (Fusion Splice Type)

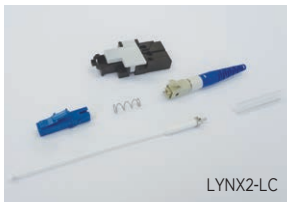
Assembly procedures

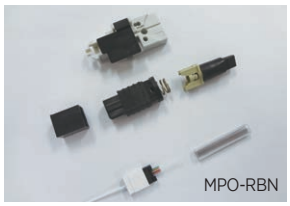


① Set Ferrule on Holder ② Fusion Splicing ③ Shrinking Sleeve ④ Secure Kevlar ⑤ Complete

Connector Kit







Assembly procedure video

There is the case that an address is changed without a notice and cannot watch.

Assembly Tools

Tool Name [Part No.]		An appropriate Sumitomo Electric fusion splicer	Fiber cleaver	Jacket remover	Hot jacket remover	Sheath splitter [LYNX-CORDTOOL-1.6-2.4]	Sheath splitter [LYNX-CORDTOOL-2.0-3.0]	Aramid yarn snips	ST assembly tool [LYNX2-ST-ASSEMBLY-TOOL]
Appearance									
Single Fiber	Cord	● with all current models	●	●	—	● for 1.6 / 2.4mm cord	● for 2 / 3mm cord	●	● for ST connector
	Fiber		●	●	● for 0.2-0.4mm fiber	—	—	—	● for ST connector
MPO	RoundCord/ RibbonCord	● with ribbon fiber splicer	●	—	●	—	● for round cord / ribbon cord	●	—
	Bare Ribbon		●	—	●	—	—	—	—

Fiber holders for single fiber connector

Type	Left side (setting fiber / cord)	Right side (setting ferrule sub-assembly)
250μm fiber	FHS-025 LYNX2-S-LB5(2MM)	LYNX2-C (Plastic, Standard) * LYNX2-UML-C (Metal, Option)
900μm Tight Buffer	FHS-09 LYNX2-UML-S	
900μm Loose Buffer	LYNX2-S-LB5(2MM)	
2mm cord with 900μm Tight Buffer	LYNX2-UML-S	
2mm cord with 900μm Loose Buffer	LYNX2-S-LB5(2MM)	
3mm cord with 900μm Tight Buffer	LYNX2-UML-S	

* 1 pc of LYNX-C holder is supplied with every 100 connectors.

Fiber holders for MPO connector

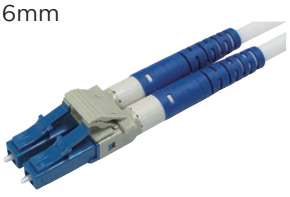
Type	Left side (setting fiber / cord)	Right side (setting ferrule sub-assembly)
Bare Ribbon	12-fiber: FHM-12V 8-fiber: FHM-8	LYNX2-C(MT) (Plastic, Standard) * LYNX2-C(MT) Metal (Metal, Option)
Round Cord		
Ribbon Cord		

* 1 pc of LYNX2-C(MT) holder is supplied with every 100 connectors.

Lynx-CustomFit™ Duplex LC clip

Lynx2-LC turns into Duplex type easily

- One piece, Simple design
- Easy installation, Retrofittable and detachable design
- LC for 250μm / 900μm Tight Buffer, 250μm / 900μm Tight Buffer(Short Boot), 900μm Loose Buffer, 1.6mm and 2mm types are available
- Clip size: W13.4mm × H12.6mm

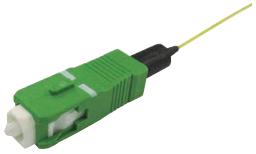


Note: In case of the optical cord with 2.4mm or larger diameter, please ask the ordering code of the connector.

Lynx-CustomFit™ Short Boot application

Compact size for small cabinet

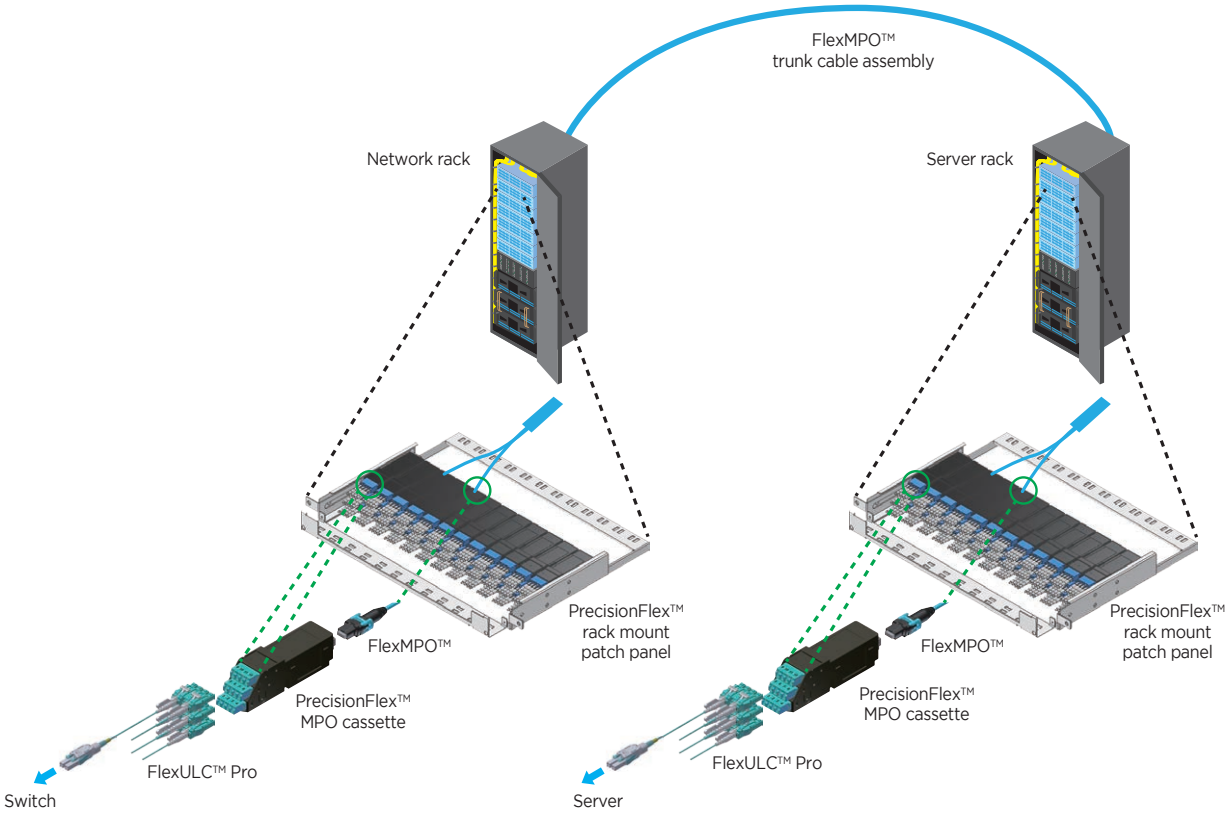
- Short Silicone Boot
- SC and LC for 250μm and 900μm Tight Buffer types are available



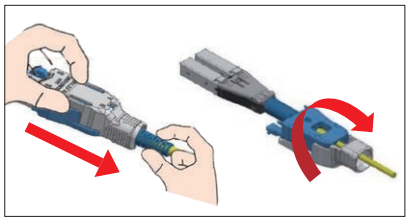
MPO cabling solution

MPO cabling solution

Our MPO cabling solution enables users to efficiently install high-density connections between optical switches and servers.

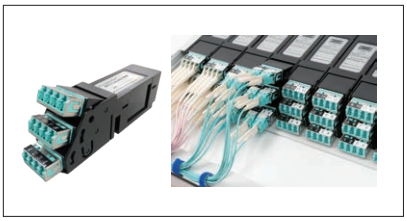


FlexULC™ Pro
Uniboot LC connector



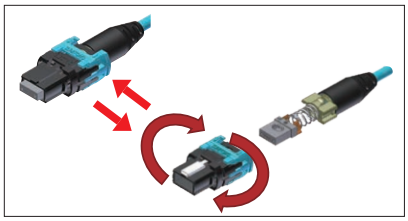
-Easy to change polarity
-Applicable with ϕ1.6mm slim cord

PrecisionFlex™
MPO cassettes & rack mount patch panel



-Unique LC adaptor tiltup design
-144 Fibers per 1U high-density connections

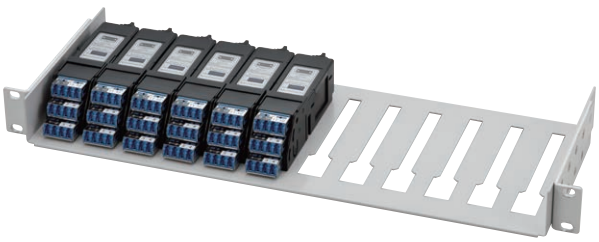
FlexMPO™ connector



-Ultra compact
-Easy to change polarity

MPO cassettes for 19 inch rack (Fixable Modle)

NEW



- More cost efficiency
- Max.12 MPO cassettes per 1RU.

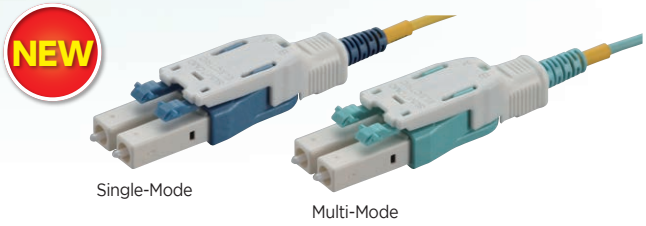
Product name	Code tray	Capacity of 12MPO cassettes	Capacity of LC connectors	Size	Dimensions W×H×D(mm)	Weight
PFCST-1U-S	●	Max.12	Max.144	1U	440×44×345	Approx. 2.2kg
PFCST-1U-F12	-	Max.12	Max.144	1U	440×44×209	Approx. 1.0kg

Optical Connectors

MPO cabling solution

FlexULC™ Pro

New Uniboot LC connector with easy handling for high-density applications

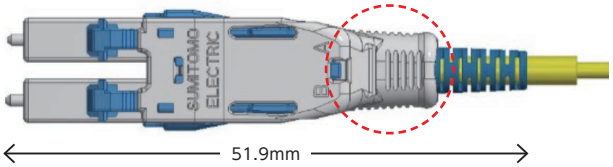


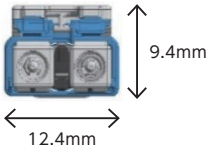
Single-Mode

Multi-Mode

Refined design, Compact body

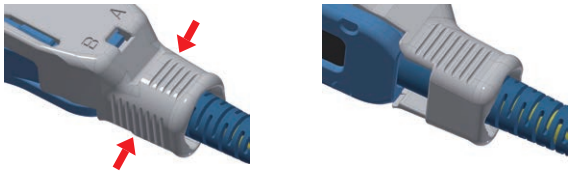
■Approx. 52 mm body allows users to handle easily even in limited workspaces.





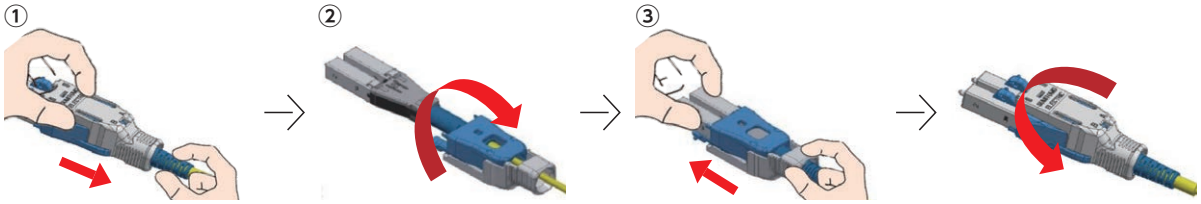
Front

User friendly design, Push-Pull with outer housing



Easy polarity change, Toolless

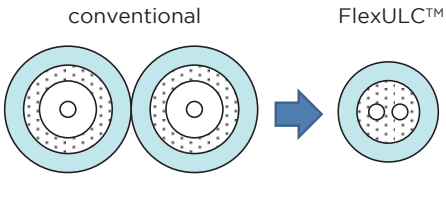
■Unique housing design enables users to change polarity without exposing fibers and tools.

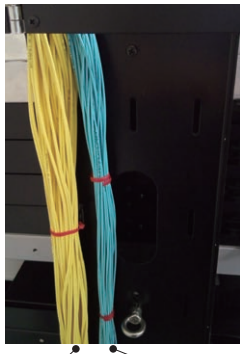


Slide outer housing　Reverse　Reinstall　Completed

Applicable for dia.1.6mm round cord

■Cable's congestion and workability in racks are improved by using dia. 1.6mm slim round cord.





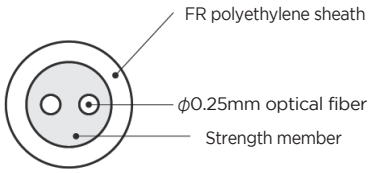
zip cords　duplex cords

Comparison of bundled 72-fiber cord status

MPO cabling solution

Round cord with FlexULC™ Pro connectors

- FlexULC™ Pro patch cords are applicable for various applications such as 10G/25G/100G LC Ethernet connections and LC optical patch panels
- Applying with world top class ϕ1.6mm 2-fiber slim cords allows users to improve cable congestions, handling more easily.
- Flammability (LSZH grade)



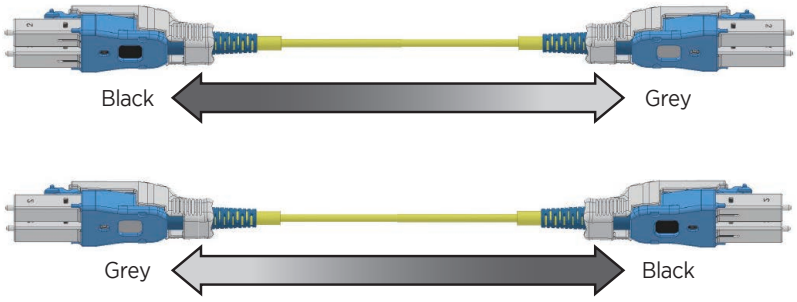
ϕ 1.6mm Round cord (2-fiber)

ECO-OP/F LS ZH

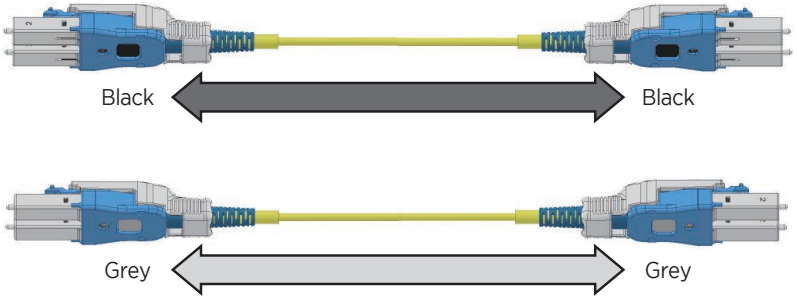
Cable type	Round cord
Fiber count	2
Nom. Cable Diameter [mm]	1.6
Nom. Weight [kg/km]	3.0
Max. tensile strength [N]	80
Min. bend radius [mm]	OS2:7.5 OM3:15 OM4:15

	Single-Mode	Multi-Mode
Insertion Loss	≦0.5dB	≦0.3dB
Return Loss	≧40dB	≧25dB
Applicable Media	ϕ 1.6mm Round cord (2-fiber)	
Polarity change	Available	
Interface	IEC61754-20	

LSZH cord assembly with FlexULC™ Pro connectors



TIA568.3 A-to-A



TIA568.3 A-to-B

Ordering Information

Fiber Count	Fiber type	Connector A/ polishing	Connector B/ polishing	Porarity	Product Name
2	OS2 SM(PA-A2)	FlexULC/SPC	FlexULC/SPC	A-to-A	2-FULC.S-FULC.S-SM(PA-A2)-LR-A-L
		FlexULC/SPC	FlexULC/SPC	A-to-B	2-FULC.S-FULC.S-SM(PA-A2)-LR-B-L
	OM3 GI(PE-A10G)	FlexULC/PC	FlexULC/PC	A-to-A	2-FULC.P-FULC.P-GI(PE-A10G)-LR-A-L
		FlexULC/PC	FlexULC/PC	A-to-B	2-FULC.P-FULC.P-GI(PE-A10G)-LR-B-L
	OM4 GI(PE-A10G+)	FlexULC/PC	FlexULC/PC	A-to-A	2-FULC.P-FULC.P-GI(PE-A10G+)-LR-A-L
		FlexULC/PC	FlexULC/PC	A-to-B	2-FULC.P-FULC.P-GI(PE-A10G+)-LR-B-L

Optical Connectors

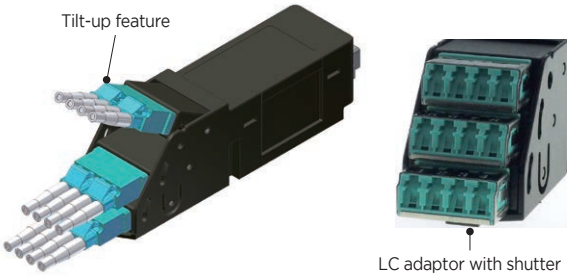
MPO cabling solution

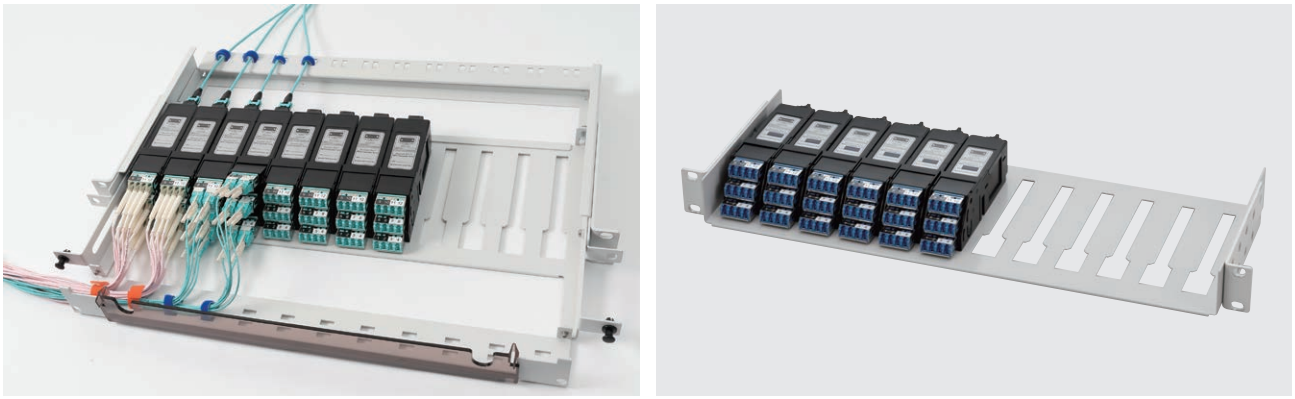
PrecisionFlex™ MPO cassettes & rack mount patch panel

Unique design MPO cassettes and rack mount patch panel with easy handling and high-density connection.

- New rack mount patch panel can accommodate max.144-Fiber connections per 1RU.
- 12pcs cassettes (12-fiber) can be arranged horizontally on new patch panel.
  This allows users to install and remove the cassettes easily.
- Unique LC adaptor tilt-up feature has been applied and allows users to connect and release easily.
  LC adaptor has a shutter and has been enhanced dust resistance.
- New MPO cassette has 12-fiber(12MPO) and 24-fiber(24MPO) configurations.

Front view: LC adaptor arrangement





1U rack mount patch panel

Ordering Information

PrecisionFlex™ MPO cassette

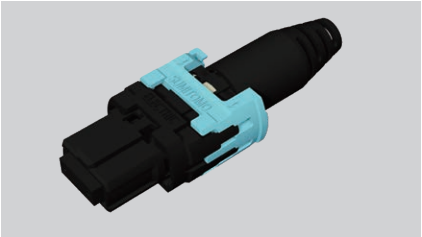
Product name	Fiber count	Fiber type	Connector	Insertion loss (dB)	Dimensions W×H×D(mm)
PFCST-SM-1X12MPOM-LC-S	12	SM OS1/OS2	12MPO-LC	SM:0.65 MM:0.55 (Against Master)	34×150×40
PFCST-MM-1X12MPOM-LC-S	12	MM OM3/OM4	12MPO-LC		34×150×40

PrecisionFlex™ 1U rack mount panel

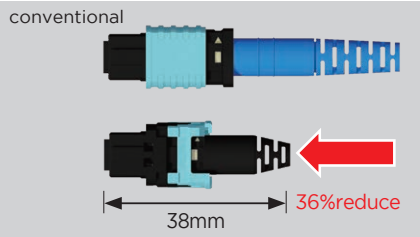
Product name	Code tray	Capacity of 12MPO cassettes	Capacity of LC connectors	Size	Dimensions W×H×D(mm)	Weight
PFCST-1U-S	●	Max.12	Max.144	1U	440×44×345	Approx. 2.2kg
PFCST-1U-F12	-	Max.12	Max.144	1U	440×44×209	Approx. 1.0kg

MPO cabling solution

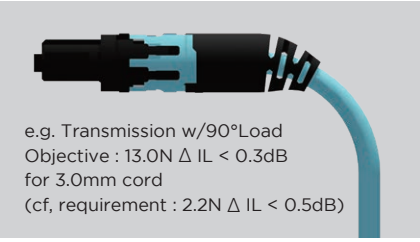
FlexMPO™ Housing for Round cord (dia. 3.0mm. dia.3.8mm)



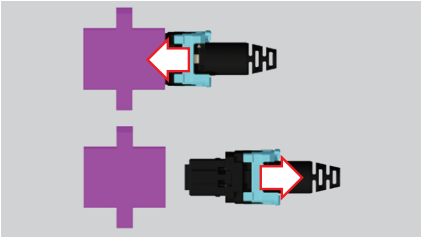
Easy to Use & Ultra compact



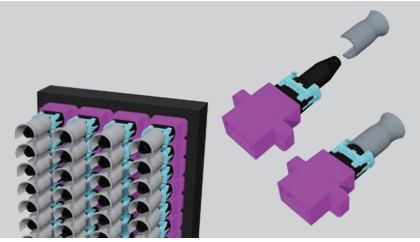
World Top Class, Super Short



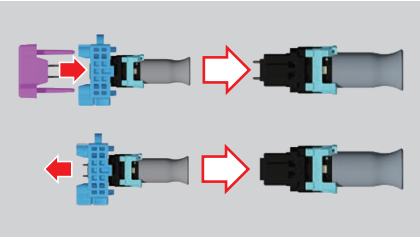
Telcordia GR1435 Objective spec. compliant



Push-Pull with outer housing
(Like SC connection)



Push-Pull and compact Tab
(Can set after mounting)



Can change gender w/o disassembly
Can change polarity(w/ disassembly)

MPO Connector

Features

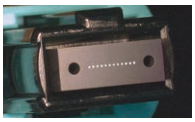
- Easy to attach/detach by a push-on action
- Enables high-density connection of many fibers as a unit

Ribbon cord Ribbon

Connector	MPO (1 row type)			
Fiber Type	SM		MM62.5,MM50,MM50 (10G)	
Media Type	Bare Ribbon, 3mm Round Cord, Jacketted Ribbon Cord			
Fiber Count	8,12		12	
Polish	APC		Flat PC	
Insertion Loss*	Std.Loss	Low Loss	Std.Loss	Low Loss
Maximum	0.75dB	0.35dB	0.75dB	0.35dB
Typical**	0.2dB	0.1dB	0.15dB	0.08dB
Return Loss*	≥ 55dB		—	

MPO (1 row type)

- With 12-fiber ribbons arranged on ferrule



MPO (1 row type)

Q8MPO

- Only both side 4 fibers are embedded in the connector. Suitable for QSFP+ module connection.

MPO (2 row type)

Features

- With two 12-fiber ribbons arranged in parallel on a ferrule, 24 fibers are connected as a unit.
- Most suitable for high-density fiber connection

MPO (2 row type)

Connector	MPO (2 row type)			
Fiber Type	SM		MM62.5,MM50,MM50 (10G)	
Media Type	Bare Ribbon, 3.8mm Round Cord, Jacketted Ribbon Cord			
Fiber Count	24			
Polish	APC		Flat PC	
Insertion Loss*	Std.Loss	Low Loss	Std.Loss	Low Loss
Maximum	0.75dB	0.35dB	0.75dB	0.35dB
Typical**	0.2dB	0.15dB	0.2dB	0.15dB
Return Loss*	≥ 55dB		—	

*: Values against master plug
**: Reference Values

Connector	Common				
Housing Color	SM,Std Loss Green	SM,Low Loss Yellow	MM62.5 Beige	MM50 Black	MM50(10G) Aqua
Interface	IEC 61754-7				

*: At the time of order, specify whether or not the guide pin is necessary.

New MPO was awarded a elite score in Lightwave Magazine's 2016 Innovation Review!

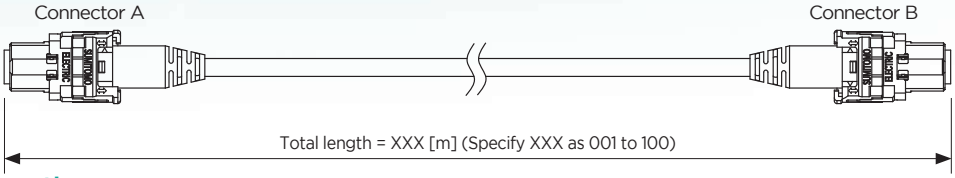
Optical Connectors

MPO cabling solution

Round cord with FlexMPO™ connectors

- Round cross section for any direction bending at installation
- UL1651 flammability(Plenum grade)

Fiber count	8	12	24
Fiber Diameter [mm]	0.25		
Nom. Cable Diameter [mm]	3	3	3.8
Nom. weight [kg/km]	9.0	9.0	13
Max. tensile strength [N]	100		
Min bend radius [mm]	25		



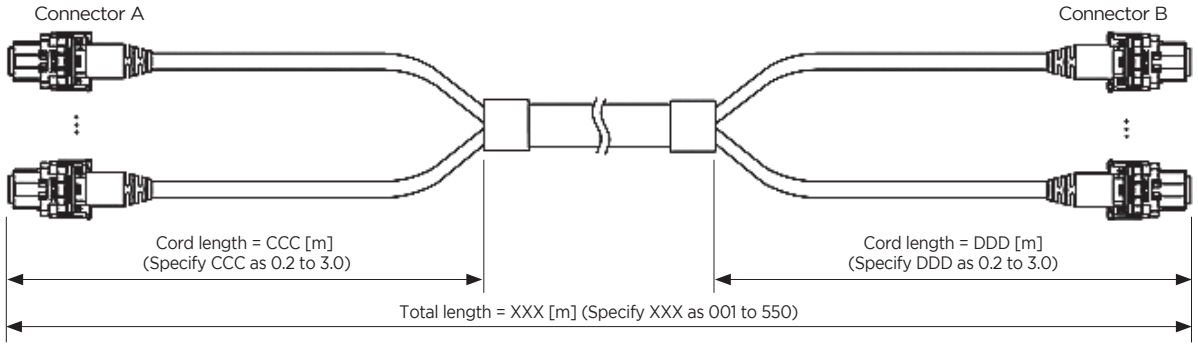
Ordering Information

Fiber Count	Fiber type	Connector A	Connector B	MPO Polarity TIA-568.3	Insertion Loss	Product Name
8	OM3 PEA10G	No pin Q8MPO	No pin Q8MPO	Type-B	Low Loss	3A008AP-VJ1VJ1ZZZB-XXXM
	OM4 PEA10G+			Type-B		4A008AP-VJ1VJ1ZZZB-XXXM
12	OS2 PAPB	No pin 12MPO	No pin 12MPO	Type-A		2A012LP-VD1VD1ZZZA-XXXM
	OM3 PEA10G			Type-A		3A012AP-VD1VD1ZZZA-XXXM
				Type-B		3A012AP-VD1VD1ZZZB-XXXM
	OM4 PEA10G+			Type-A		4A012AP-VD1VD1ZZZA-XXXM
				Type-B		4A012AP-VD1VD1ZZZB-XXXM
24	OS2 PAPB	No Pin 24MPO	No Pin 24MPO	Type-A		2A024LP-VD1VD1ZZZA-XXXM
	OM3 PEA10G			Type-A		3A024AP-VD1VD1ZZZA-XXXM
	OM4 PEA10G+			Type-A		4A024AP-VD1VD1ZZZA-XXXM

Trunk cable with FlexMPO™ connectors

- Optical cables with enhanced mechanical strength for backbone cabling and horizontal cabling

Fiber count	8	12	24	24	48
Fiber count per sub unit	8	12	12	24	12
Fiber Diameter [mm]	0.25				
Nom. Cable Diameter [mm]	5.5	5.5	10	6.5	10
Nom. weight [kg/km]	40	40	85	50	85
Max. tensile strength [N]	660	660	660	660	660
Min bend radius [mm]	55	55	100	65	100



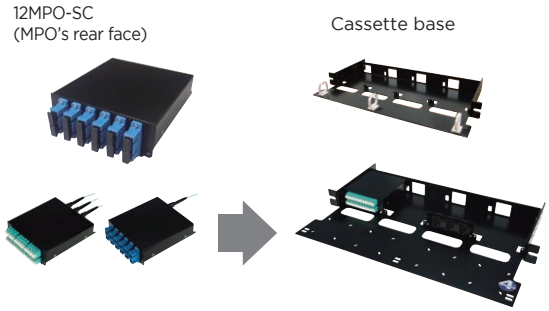
Ordering Information

Fiber Count	Fiber count per sub	Fiber type	Connector A	Connector B	MPO Polarity TIA-568.3	Insertion Loss	Product Name
8	8	OM3 PEA10G	No pin Q8MPO	No pin Q8MPO	Type-B	Low Loss	3C008AJ-VJ1-CCC-VJ1-DDDB-XXXM
		OM4 PEA10G+			Type-B		4C008AJ-VJ1-CCC-VJ1-DDDB-XXXM
12	12	OS2 PAPB	No pin 12MPO	No pin 12MPO	Type-A		2C012LJ-VD1-CCC-VD1-DDDA-XXXM
		OM3 PEA10G			Type-A		3C012AJ-VD1-CCC-VD1-DDDA-XXXM
					Type-B		3C012AJ-VD1-CCC-VD1-DDDB-XXXM
		OM4 PEA10G+			Type-A		4C012AJ-VD1-CCC-VD1-DDDA-XXXM
					Type-B		4C012AJ-VD1-CCC-VD1-DDDB-XXXM
24	12	OM3 PEA10G	No pin 12MPO×2	No pin 12MPO×2	Type-B		3C024AJ-VD1-CCC-VD1-DDDB-XXXM
	24	OS2 PAPB	No pin 24MPO	No pin 24MPO	Type-A		2D024LJ-VD1-CCC-VD1-DDDA-XXXM
		OM3 PEA10G			Type-A		3D024AJ-VD1-CCC-VD1-DDDA-XXXM
		OM4 PEA10G+			Type-A		4D024AJ-VD1-CCC-VD1-DDDA-XXXM
48	12	OM3 PEA10G	No pin 12MPO×4	No pin 12MPO×4	Type-A		3C048AJ-VD1-CCC-VD1-DDDA-XXXM

MPO Cassettes

MPO Cassette

- A cassette that makes it easy to switch the connection between a multi-fiber MPO connector and single-fiber connector (SC or LC)
- Can be accommodated in the 1U space of a 19 inch rack
- Can accommodate maximum of 24 fibers x 8 cables (192 fibers)



Product name		MPO cassette	
Max. number of connectable fibers		12	24
Connector		12MPO-SC	12MPO×2-LC
Adapter-fitting face		MPO Rear face	MPO Rear face
Insertion loss	Low	0.55 dB max. (Against Master)	
	Standard	1.05 dB max. (Against Master)	
Fiber Type		MM50, MM50 (10G)	
Fixing method		Screw	
Place of installation		MPO cassette base	
Dimensions		108(W)×116(D)×39(H) mm (excepting protrusions)	

*: Single-fiber adapters should be placed on the front face.
*: The MPO plugs are fitted with a guide pin.

Product name	MPO cassette base A	MPO cassette base C
19-inch rack-mountable	✓	✓
Cord tray	✓	—
Number of MPO cassette per cassette base	4 cassettes/cassette base	4 cassettes/cassette base
Number of adaptor panel per cassette base	4 panels/cassette base	4 panels/cassette base
Size	1U	1U
Dimensions	470(W)×43.5(H)×230(D)mm	462(W)×43.5(H)×134(D)mm

Optical Fan-out

Transition Pieces

Features

- Various types of devices for separating multi-fiber ribbons into individual fibers are available.


FO8 for 8-fiber cord

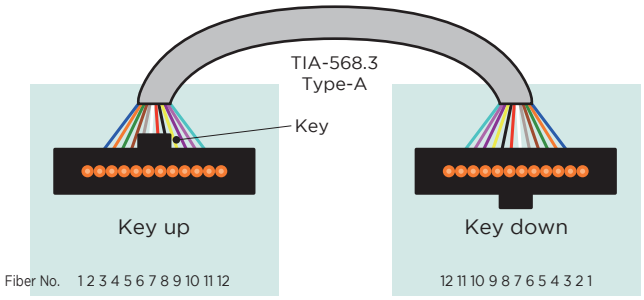

Breakout Box for 12-fiber ribbon

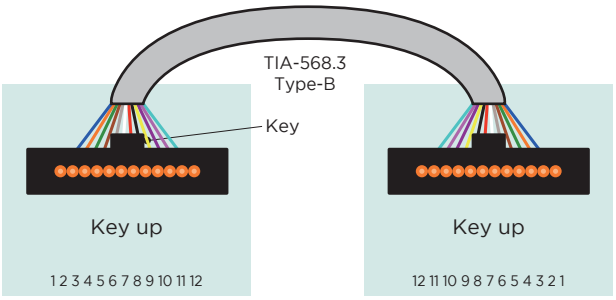
Shape	Type	Number of usable fibers	External dimensions[mm]	Shape on Multi-fiber side	Shape on Single-fiber side
Round	F08	2,4,8	ϕ8×50	Cord	Cord
	F011L	12	ϕ11×54	Cord	Cord
Rectangular	Breakout Box	4,8,12	39×11×5	Ribbon	ϕ0.9mm fiber

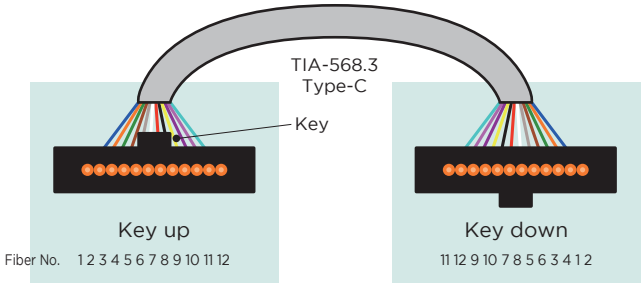
* For more information about the cord to be connected on the single fiber side, contact Sumitomo Electric.

MPO polarity & Basic connection with optical transceivers

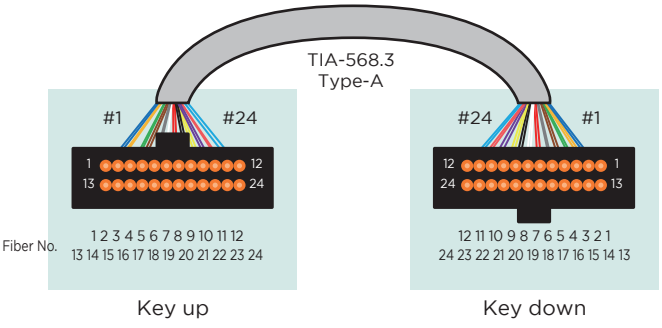
12MPO connector polarity







24MPO connector polarity

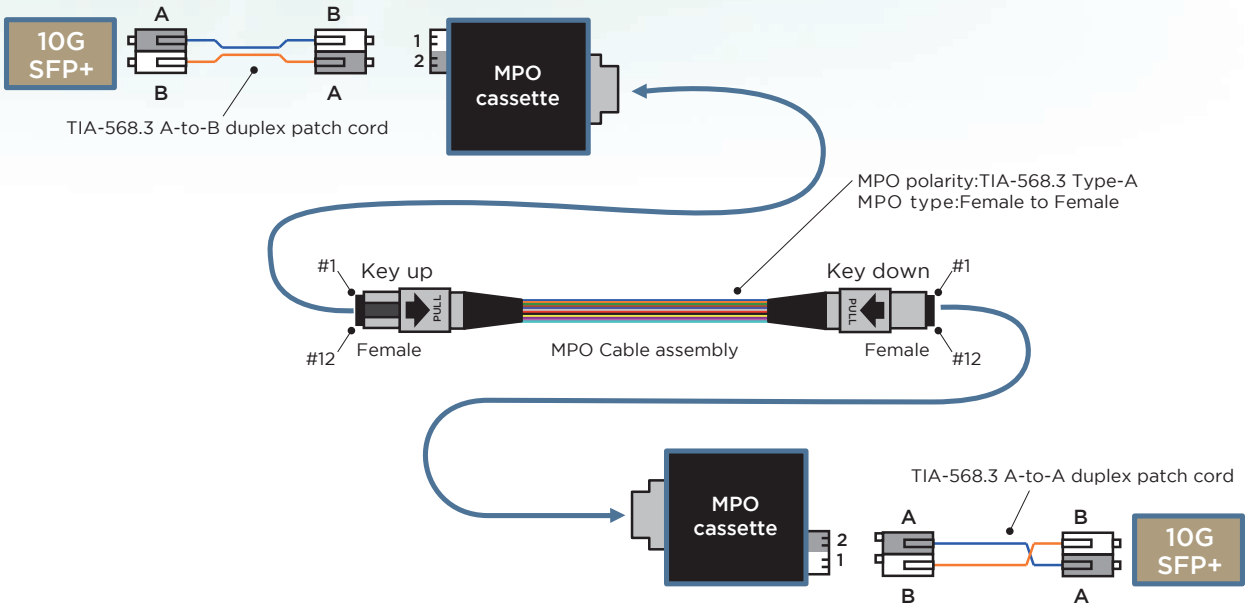


Optical Connectors

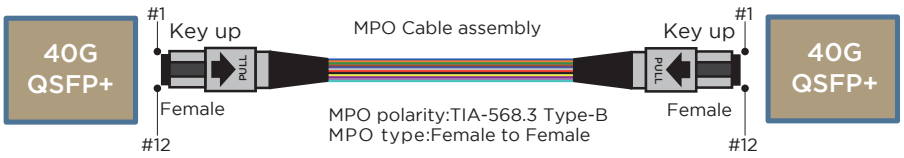
MPO polarity & Basic connection with optical transceivers

Basic connectivity of 10G BASE-SR(12 MPO)

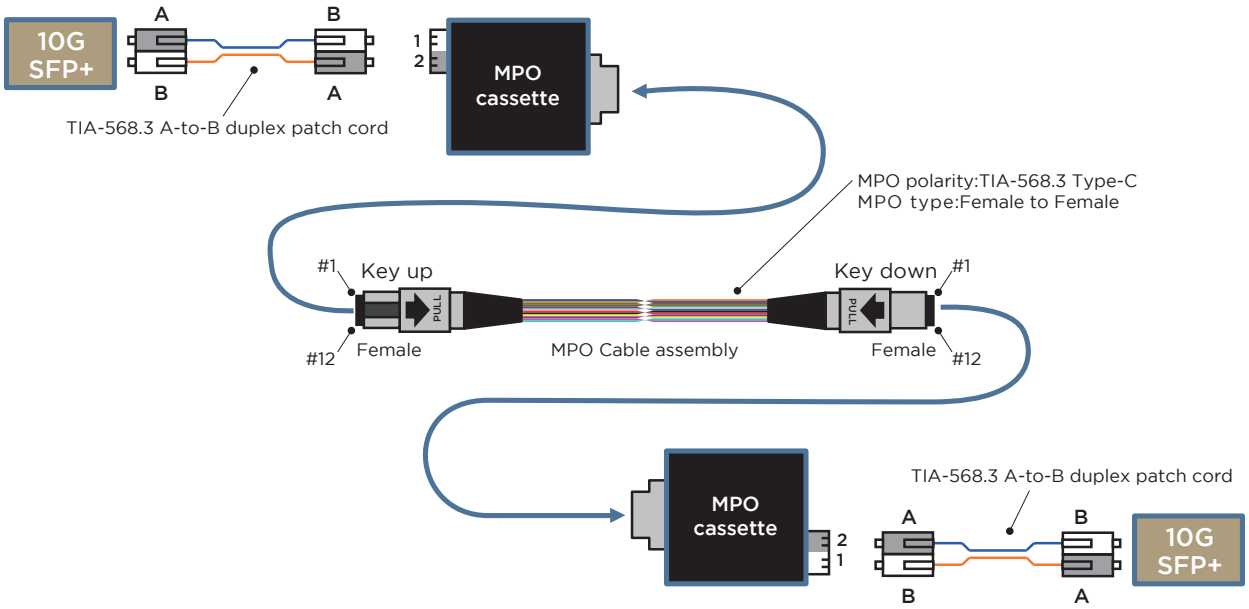
TYPE-A



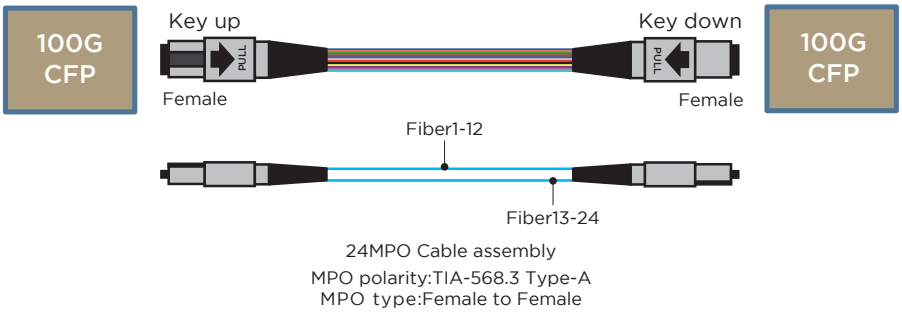
Basic connectivity of 40G BASE-SR4 without patch cord (12MPO/Q8MPO)



TYPE-C



Basic connectivity of 100G BASE-SR10 (24MPO)



Tough and Flexible Cable Assembly for Indoor Installation / SC Connector with shutter

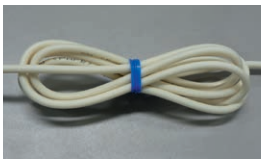
PureFlex™-slim cable

Adequate strength, remarkable tenacity, and exceptional ease of storage.
PureFlex™-slim is an epoch-making fiber-optic cable for indoor installation, allowing the technician to handle it as casually as a power cord.

- New face of the PureFlex™ series of sturdy cables are resistant to being stepped on and bending. Just 3 mm in outside diameter, PureFlex™-slim brings about substantial improvements in reliability and look.
- Makes the most of the highly bending-resistant Access series fibers. (Permisisible bending radius of 15mm when incorporating PureAccess™-PB and of 7.5mm for use with PureAccess™-[A2])
- Strong and tenacious, this cable can be tied up to make an excess length compact or can be accommodated in an ONU with ease.

Cable type	PureFlex™-slim
Number of fibers	1
Standard cable outside diameter	3.0mm
Permissible side pressure	< 0.1dB @ 1200 N/25mm for 1min
Permissible bending radius	7.5mm (When incorporating G.657.A2) 10mm (When incorporating G.657.A1)
Applicable connector	SC with shutter

Adequate strength



Remarkable tenacity

Exceptional ease of storage

Strong against right-angle bending

SC connector with shutter

Substantially improved SC connector with its ease of handling.
When disconnected, the shutter at the end of the connector closes to prevent soiling or damage to the ferrule end face.

- When the connector is engaged, the shutter self-retracts in the connector.
- Designed not to allow leakage of light, this connector prevents the light from entering the eye.

Fully compatible with SC connector

The SC connector with shutter accommodates any cord or cable that can be attached to an SC connector.

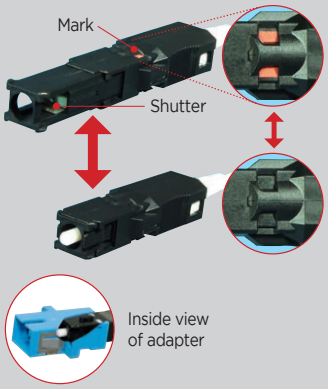
Connector type	s-SC
Applicable fiber (Optical fiber code)	SM(PAA2)
Connecting Loss (To master)	< 0.5dB
Return Loss (Type of polishing)	> 40dB (SPC)
Housing color	Black
Connector boot color	White

Connector disengaged from adapter

The shutter housing extends automatically and the metal shutter closes.

Connector engaged with adapter

As the shutter opens by itself, the connector serves as an ordinary SC connector.



Optical Connectors

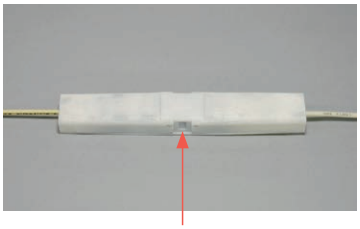
Optical Connector Cases / Optical Connector Sleeves

Optical Connector Case for Indoor Installation

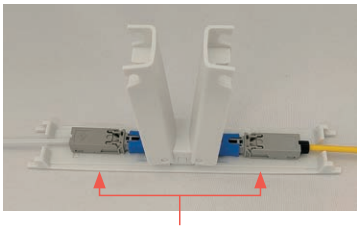
Facilitates connection between in-coming cable and premise cable such as PureFlex™-slim cable

- e-SC connector assembled with in-coming cable connects to SC connector at the end of PureFlex™-slim cable.
- Easy to implement high reliable indoor wiring with PureFlex™-slim cable.
- Its structure allows to joint with cable protection guide (duct) for smart indoor wiring.

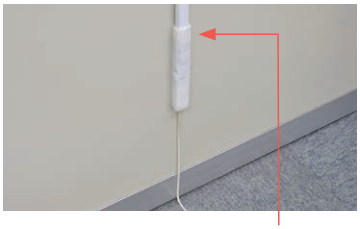
Product name	Optical connector case
Capacity of connection	1
Connection	SC, SC with shutter, and e-SC
Installation	Indoor floor or wall
Dimensions	25(W)×15(H)×140(L) mm



SC adapter is encased here.



Connectors are removable independently of each other.
No possibility of loss of a cover.



The case is joined to a cable protection guide.

Optical Connector Sleeve

Accommodate SC connectors in a compact body

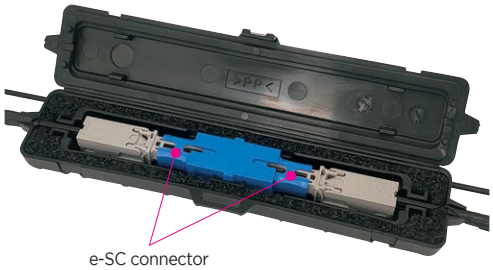
- Easy to equip a demacation point in FTTx and LAN network
- Compact, smart, design to fit in the installation circumstance

Features of optical connector sleeve ME4

- Allows indoor FTTx installation work to be separated from outdoor FTTx installation work
- Aerial installation hanging on the suspension wire of drop cable without install onto the wall of the user's house

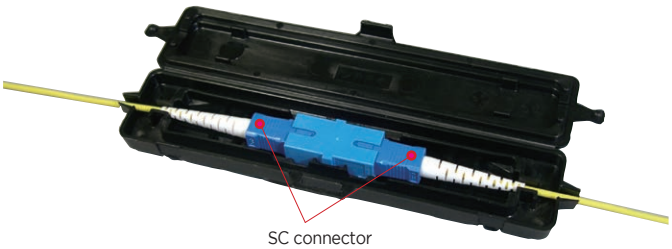
Product name	Optical connector sleeve ME4	Optical connector sleeve MS1
Installation	Outdoor	Indoor
Applicable Connector	e-SC connector	SC Connector, e-SC connector
Capacity of connection	1	
IP code	IPX4	—
Composition	Connector Sleeve with gasket ×1 Accessories (Self-bonding tape etc.)	Connector Sleeve ×1 Accessories (Tapping screws etc.)

Optical connector sleeve ME4 (outdoor use)



e-SC connector

Optical connector sleeve MS1 (Indoor use)



SC connector
(cord diameter up to ø2 mm)

Optical Closures / Optical cabinet

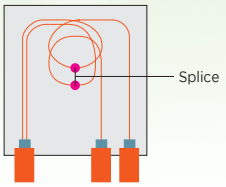
For Underground/Pole mount

[GP4-224]/ [GP4-212]

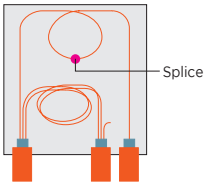
- Dome type, compact in size suitable for hand hole
- Can accommodate drop cable (option)
- Re-usable sealing system allows re-assembly without additional material
- Easy to open/close cover with buckle fastener

* Example of use : The product does not include cables or cords.

Straight/branch joint



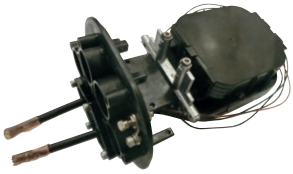
Mid-span joint with excess length of cable



Product name		GP4-224		GP4-212	
Installation		Underground/ Pole mount			
Joint type		Straight / branch joint	Mid-span joint with excess Length of cable	Straight / branch joint	Mid-span joint with excess Length of cable
Splice capacity	Single fiber (0.25mm)	144 splices (144 fibers)	96 splices (96 fibers)	96 splices (96 fibers)	72 splices (72 fibers)
	4-fiber ribbon	60 splices (240 fibers)	40 splices (160 fibers)	40 splices (160 fibers)	30 splices (120 fibers)
Number of trays		6 splice trays (24C tray)	4 splice trays (24C tray) and 1 loop tray	8 splice trays (12C tray)	6 splice trays (12C tray) and 1 loop tray
Cable entry capacity		Main:2cable, Branch:2 cables			
Applicable cable diameter		Main:ϕ5-12mm or ϕ10-16mm, Branch:ϕ8-16mm			
Operating temperature		−20-+60°C			
IP Code		IP68			
Dimensions		205(W)×155(D)×275(H)mm			
Weight		Approx. 3.0 kg			

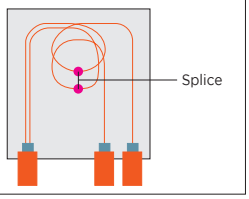
[GP4-424] / [GP4-412]

- Compact and light weight closure
- 96f single splice capacity for GP4-424, 72f single splice capacity for GP4-412
- Capacity for 2 main cables and max. 4 branch joint or 16 round type drop cables, or 32 flat type drop cables
- Easy cable sealing with reusable mechanical sealing system
- Easy mounting on and removal from pole or wall by snap on mounting kit

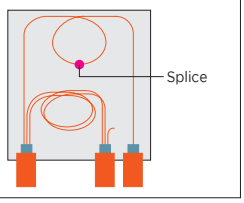


* Example of use: The product does not include cables or cords.

Straight/branch joint



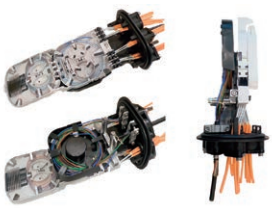
Mid-span joint with excess length of cable



Product name	GP4-424	GP4-412
Installation	Underground or Wall/Poll mount	
Splice capacity (Single fiber)	96 fibers	72 fibers
Number of splice per tray	24 splices	12 splices
Cable entry capacity	Main 2 cables, Branch 4 cables or 16 round drop cables or 32 flat drop cables	
Applicable cable diameter	Main Cable ϕ5-12mm or ϕ10-16mm, Branch cable ϕ8-20mm Round Drop ϕ3.5-7.5mm, Flat Drop 1.8-2.5x 3.0-4.5mm	
Operating temperature	-20 - +60°C	
IP rating	IP68	
Dimension	205(W)X155(D)X275(H)mm	
Weight	Approx. 3.0kg	

[GP4-424 NDC]

- ISP/OSP demarcation design by color coded tray system
- Compact and light weight closure
- Capacity for 2 main cables and max. 16 round type drop cables or max. 32 flat type drop cables
- Seamless work from drop cable installation, to drop fiber splicing by interconnected optical splitter mountable drop tray and splicing tray
- Easy and quick drop cable fixing system with newly developed cassette style drop cable retainer



* Example of use: The product does not include cables or cords.

Product name	GP4-424 NDC
Installation	Underground or Wall/Poll mount
Splice capacity (Single fiber)	Max. 48 fibers (Max. 24 fibers per side)
Capacity of optical splitter	1X8: 3pcs, 1X16: 3pcs
Cable entry capacity	Main 2 cable, Round Drop 16, Flat Drop 32
Applicable cable diameter	Main Cable ϕ5-12mm or ϕ10-16mm, Round Drop ϕ3.5-7.5mm, Flat Drop 1.8-2.5x 3.0-4.5mm
Operating temperature	-20 - +60°C
IP rating	IP68
Dimension	205(W)X155(D)X275(H)mm
Weight	Approx. 3.0kg

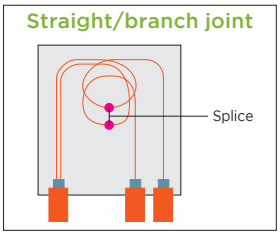
Optical Closures / Optical cabinet

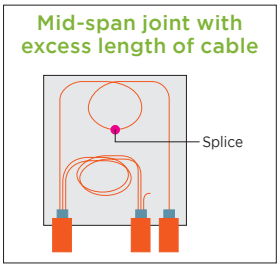
For Underground / Pole mount / Wall mount

[GP8]

- High density dome type closure with compact size
- 288f single splice capacity
- Capacity for 2 main cables and max. 6 branch joints, or 24 round type drop cables, or 48 flat type drop cables
- Easy cable sealing with reusable mechanical sealing system
- Easy mounting on and removal from pole or wall by snap on mounting kit

* Example of use: The product does not include cables or cords.



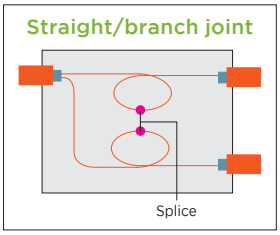


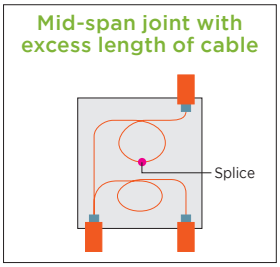
Product name	GP8	
Installation	Underground or Wall/Poll mount	
Applicable fiber	Single fiber	12-fiber Freeform Ribbon™
Splice capacity	288 fibers	250 μm:432 fibers 200 μm:864 fibers
Number of splice per tray	24 splices per tray	6 splices (72 fibers) per tray
Cable entry capacity	Main 2 cables, Branch 6 cables or 24 round drop cables or 48 flat drop cables	
Applicable cable diameter	Main Cable ϕ8-20mm, Branch cable ϕ8-20mm Round Drop ϕ3.5-7.5mm, Flat Drop 1.8-2.5x 3.0-4.5mm	
Operating temperature	-20 - +60°C	
IP rating	IP68	
Dimension	280(W)X214(D)X317(H)mm	
Weight	Approx. 4.0kg	

[GI4]

- Compact and light weight closure
- 2 main cables, 2 branch cables capacity and 192f single splice capacity
- Accepts a wide range of cable diameters with universal grommet design
- Applicable usage for in-line or butt end
- Easy cable sealing with reusable mechanical sealing system

* Example of use: The product does not include cables or cords.



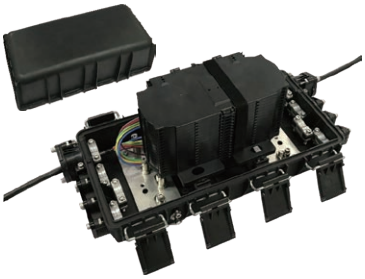


Product name	GI4	
Installation	Underground or Wall mount	
Applicable fiber	Single fiber	12-fiber Freeform Ribbon™
Splice capacity	192 fibers	432 fibers
Number of splice per tray	24 splices per tray	6 splices (72 fibers) per tray
Cable entry capacity	Main 2 cables, Branch 2 cables or 8 round drop cables or 16 flat drop cables	
Applicable cable diameter	Main Cable ϕ8-20mm, Branch cable ϕ8-20mm, Round Drop ϕ3.5-7.5mm, Flat Drop 1.8-2.5x 3.0-4.5mm	
Operating temperature	-20 - +60°C	
IP rating	IP68	
Dimension	225(W)X141(D)X465(H)mm	
Weight	Approx. 3.5kg	

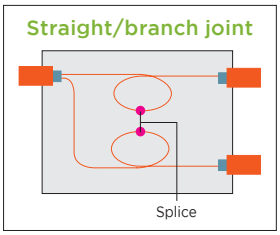
For Underground

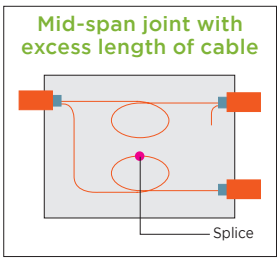
[GI8s]

- High density in-line closure of compact size
- 384f single splice and max. 432f single splice capacity by changing position of tray base
- Capacity for 2 main cables and max. 6 branch joints, or 24 round type drop cables, or 48 flat type drop cables
- The latest inline closure with separate main cable port for easy installation of high-count cable
- Single piece gasket which is independent from the cable port grommets, providing secure air and water tightness



* Example of use : The product does not include cables or cords other than the module.



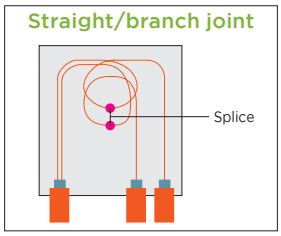


Product name	GI8s	
Installation	Underground	
Applicable fiber	Single fiber	12-fiber Freeform Ribbon™
Splice capacity	384 fibers (16 trays) / max. 432 fibers (18 trays)	720 fibers (10trays) / max. 864 fibers (12 trays)
Number of splice per tray	24 splices per tray	6 splices (72 fibers) per tray
Cable entry capacity	Main 2 cables, Branch 6 cables or 24 round drop cables or 48 flat drop cables	
Applicable cable diameter	Main Cable ϕ8-24mm, Branch cable ϕ8-20mm Round Drop ϕ3.5-7.5mm, Flat Drop 1.8-2.5x 3.0-4.5mm	
Operating temperature	-20 - +60°C	
IP rating	IP68	
Dimension	228(W)X517(L)X225(H)mm	
Weight	Approx. 7.5kg	

[GI-TN]

- High-capacity
- Suitable for high-fiber count 12-fiber ribbon cable
- Re-usable sealing system allows reassembly without additional material
- Easy to open/close cover with buckle fastner

* Example of use: The product does not include cables or cords other than the module.

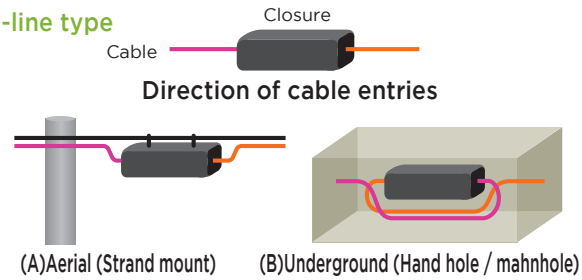


Product name		GI-TN
Installation		Underground
Joint type		Straight / Branch joint(option)
Splice capacity	Single fiber (0.25mm)	288 splices (288 fibers)
	12-fiber ribbon	432 splices (5184 fibers) (Pliable Ribbon) 144 splices (1728 fibers) (Standard Ribbon)
Number of trays		24 trays
Cable entry capacity		Main: 2 cables, Branch: 1cable
Applicable cable diameter		Main: ϕ8~35, Branch: ϕ8~35 mm
Operating temperature		−20~+60°C
IP Code		IP 68
Dimensions		293(W)×246(H)×618(L)mm
Weight		Approx. 12 kg

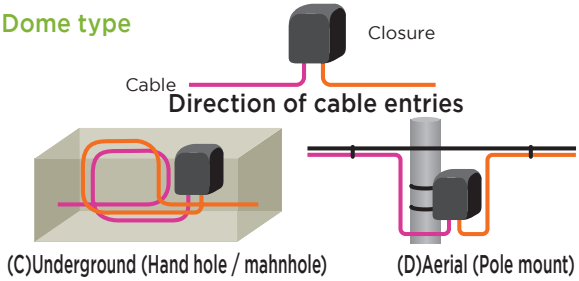
About In-line type and Dome type

Closure is categorized as In-line type or Dome type by the direction of cable entries.
In-line type has cable entries at both sides and used for aerial or manhole (big enough to work inside).
Dome type has cable entries at one side and is used for hand hole (small and unable to work inside).
In case of installation into hand hole, joint work is done at outside, then closure and the excess length of cables are stored into handhole.
When storing closure, In-line type needs larger space than Dome type because it has Cable slacks at both sides.

In-line type



Dome type

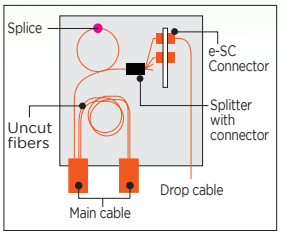


Optical Closures / Optical cabinet

Optical cabinet

[CTB01]

- Compact and slim design to fit into limited spaces, such as inside poles or lamp posts
- Complete demarcation between Main cable and drop and/or pigtail
- Pass through fiber storage
- Wall and pole mount
- IP55 rated



Product name		CTB01
Installation		Pole mount / Wall mount
Joint type		Straight / branch joint, Mid-span joint with excess length of cable + Connectorized splitter / FO cord
Splice capacity	Single fiber (0.25mm)	8 splices (8 fibers)*In case of connectorized splitter / cord pre-installed,6 splices (6 fibers)
Connector-connection capacity		8
Uncut-fiber capacity		100 fibers(250μm single fiber)
Splitter capacity		1×4 : 2 or 1×8 : 1
Connector type		SC , LC
Cable entry capacity		Main: 2 cables, Drop: 8 cables
Applicable cable diameter		Main: ϕ8-12mm, Drop: 1.8-2.5 × 3.0-4.5mm
IP Code		IP 55
Dimensions		100(W)×190(H)×50(D)mm
Weight		Approx. 0.5 kg

* Example of use : The product does not include cables.

Fiber-optic systems

High Density 1X2 Optical Switch

High Density 1X2 Optical Swith[IX-OPTSW]

■**High Density**
19 inch Rack applicble, 32 of 1X2 switch per sub rack

■**Mass scale Switching**
512 Switches are cotroled by Only one trigger signal to switch to backup line

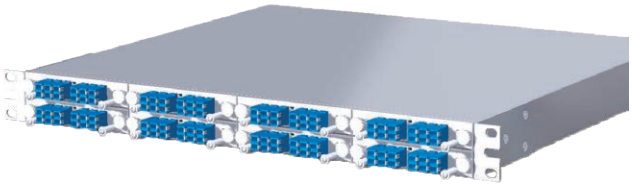
■**High cost advantage**
Lower initial cost by unit architecture Low power consumption (10W typ.)

■**High reliability**
Duplicated power (hot-swappable) Having a latching mechanism Maintenance features conforming to versatile SNMP

Product name		IX-OPTSW
Management	Management protocol	SNMP
	Interface	10/100BASE-T
Power supply		AC100-240V(50/60Hz)
Cooling system		Forced blowing using a cooling fan unit
Operating conditions	Temperature	0~+50°C
	Humidity	5~90%(Non-condensing)
Dimensions		440(W)×430(D)×44(H)mm(EIA 1U)

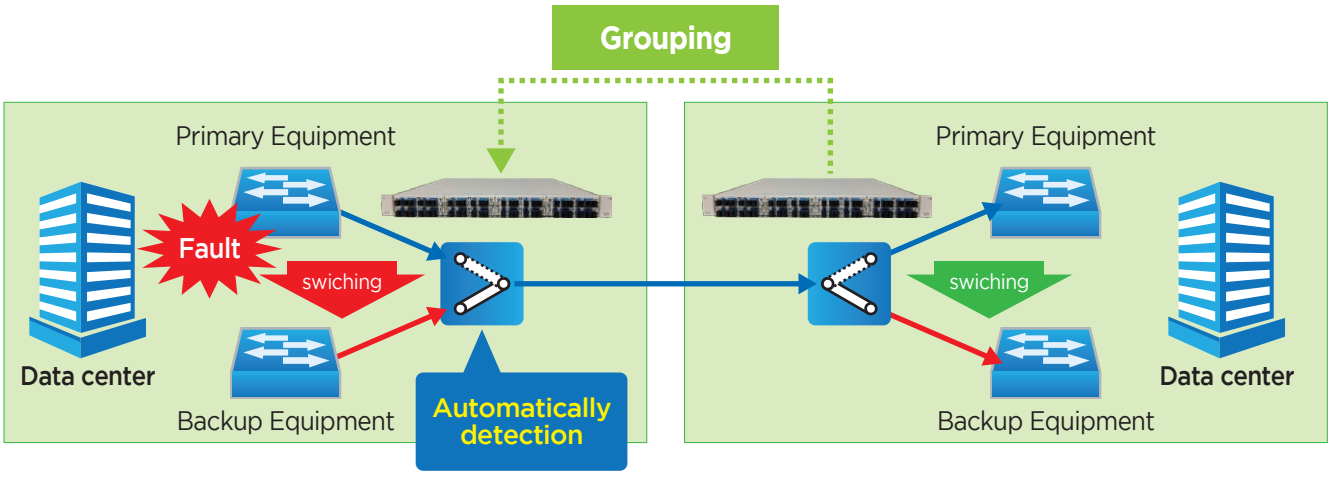
Optical/functional specification example(Optical switch unit)

Insertion Loss	≦1.5dB
Switchng Time	≦10msec
Fiber break detection threshold	-40~+10dBm
Switching protection time	1~1000msec
Optical connector	LC



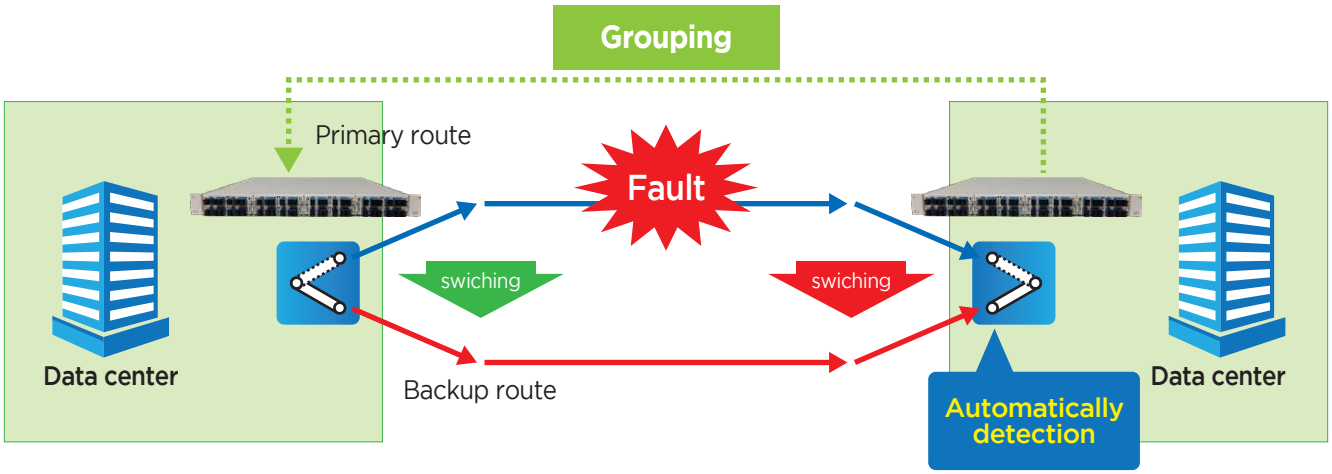
Application 1. Redundant for equipment

■Rapid shifts from primary epuipment to backup one
■Simultaneous switching at opposite side equipment by grouping function
■Applicable for all optical transmission equipment because of protocal and bit-rate free



Application 2. Redundant for Optical route

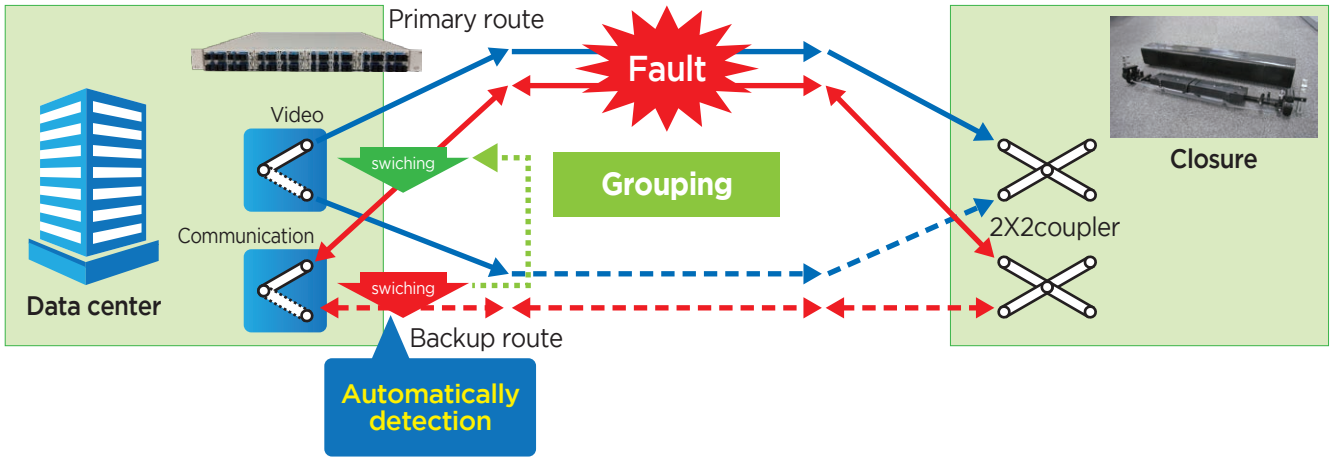
■Rapid shifts from primary route to backup one
■Simultaneous switching at opposite side switch by grouping function



High Density 1X2 Optical Switch

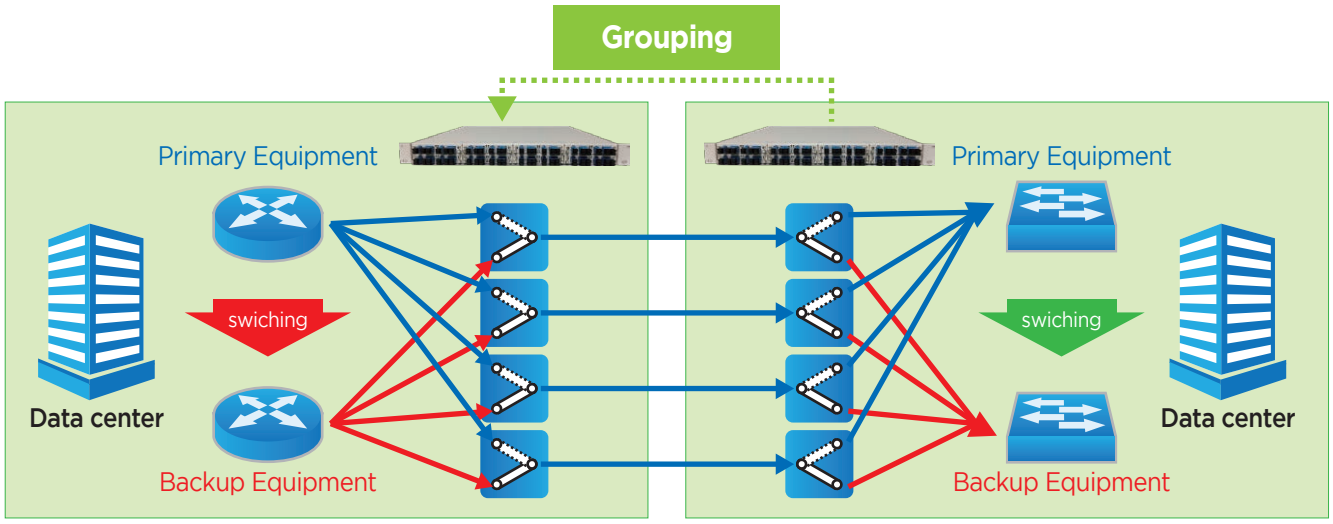
Application 3. Redundant for dual play system

- Monitoring communication signal By using grouping function video route can switch to backup route without individual monitoring



Application 4. Efficiency for maintenance and operation

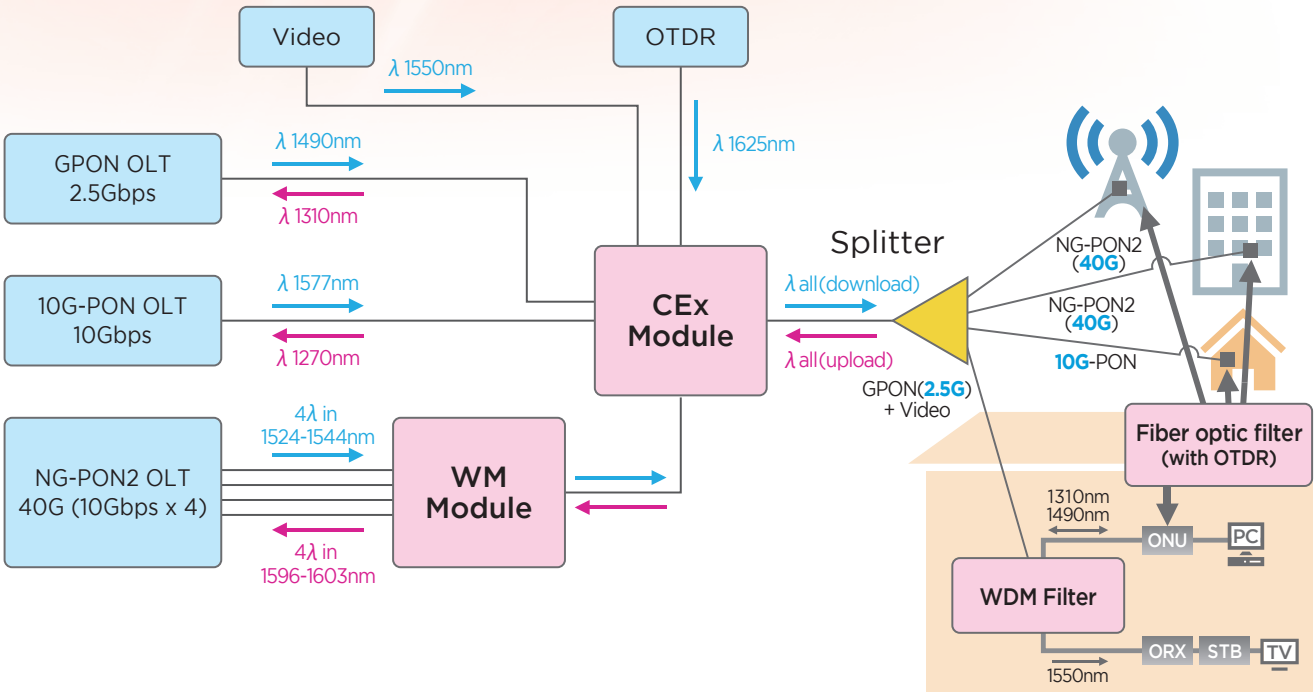
- Rapid shifts from primary epuipment to backup one
- Simultaneous switching at opposite side switch by grouping function, so it applicable to link aggregation system



Passive optical products

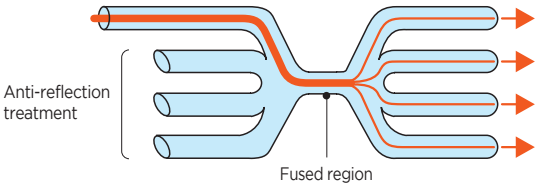
Filters and couplers

Passive Optical Network with several communication systems



Optical fiber coupler and PLC splitter structures

Optical fiber coupler (ex. 1x4 splits.)

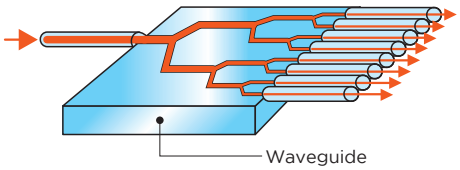


Optical fiber coupler has bundles of optical fibers fused together, as shown above.

The input light is equally split into two or four parts at the fused region and output via ports.

Optical fiber couplers are most suitable for 1x2 or 1x4 splits since those with few splits are relatively simple to fabricate.

PLC splitter (ex. 1x8 splits.)



PLC splitter is waveguide joined with optical fibers, as shown above.

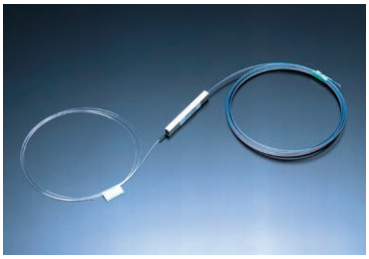
The waveguide made of sheet glass has optical channels in the form of tree-like branches. While being guided through the channels, light is equally divided into Multiple ports (up to 64) and output via ports.

PLC splitters are optimal for 1x2 to 1x64 split applications since they facilitate the construction of many optical circuits in a compact size.

Optical splitters/optical splitter modules

PLC splitter (Bare Fiber)

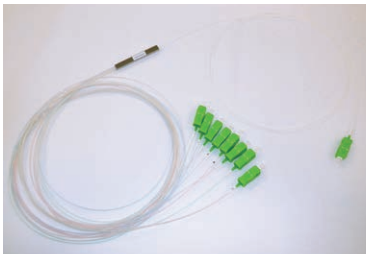
- Broadband
- Wide product line up from 1x2 to 1x64 splits
- High reliability



No. of ports	1×2	1×4	1×8	1×16	1×32	1×64
Wavelength	1260~1650nm					
Insertion loss	≤4.0dB	≤7.5dB	≤10.3dB	≤13.5dB	≤16.7dB	≤20.4dB
Loss uniformity	≤0.6dB	≤0.8dB	≤1.0dB	≤1.0dB	≤1.3dB	≤2.0dB
Return loss	≥55dB					
Operating/storage temperature range	−40~+85°C/−40~+85°C					
Dimensions (W×H×L)	4X4X40mm	4X4X40mm	4X4X40mm	7X4X50mm	7X4X50mm	12X4X60mm

PLC splitter (ϕ0.9 mm tube)

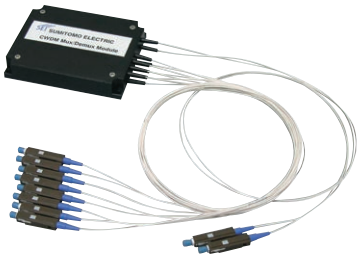
- Small foot print with ϕ0.9 mm tube.
- Broadband
- Wide product line up from 1x2 to 1x32 splits
- High reliability



No. of ports	1×2	1×4	1×8	1×16	1×32
Insertion loss (with connector)	≤4.4dB	≤7.9dB	≤10.7dB	≤13.9dB	≤17.1dB
Connector Type	SC/UPC or SC/APC				
Dimensions (W×H×L)	7X4X60mm	7X4X60mm	7X4X60mm	12X4X60mm	20X6X80mm

CWDM module (Mux/Demux)

- 20nm Spacing of CWDM Channel Plan
- Low Insertion Loss
- High Isolation



Channel	4ch	8ch
Operating wavelength	λc±6.5nm	
Insertion loss	≤ 2.5dB	≤ 3.5dB
Isolation	≥ 30dB	
Directivity	≥ 50dB	
Return loss	≥ 40dB	
Operating temperature	−20~+70°C	
Dimensions	120(L)×80(W)×8(H)mm	

WDM module

- Can combine and separate optical signals into each wavelength with optical filter.
- WM module : used for 8 wavelengh of NG-PON2
- CEx module: used for GPON, 10G-PON, NG-PON2, Video, and OTDR.
- Low insertion loss and high resolution

	WM Module	CEx Module
Optical Wave length[nm]	NG-PON2 : 1524-1544, 1596-1603	GPON : 1290~1310, 1480~1500
		10G-PON : 1260~1280, 1575~1580
		NG-PON2 : 1524-1544, 1596-1603
		Video : 1550~1560
		OTDR : 1625
Insertion Loss	≤ 2.8dB	≤ 2.0dB
Isolation	≥ 30dB	≥ 30dB (Except Video, OTDR)
		≥ 15dB (Video, OTDR)
PDL	≤ 0.3dB	≤ 0.3dB
Return Loss	≥ 45dB	≥ 45dB
Directivity	≥ 50dB	≥ 50dB

Optical splitter module (for Cabinet)

SMC

- Compact size (business card size) for Cabinet.
- Installable inside the narrow space of MDF.
- Attaches to cabinet door with magnet.
- Fits in 19 inch rack (1U).

SMC<4S><1>

SMC<8S><1>

Product name	SMC ⟨2S⟩ ⟨P2⟩	SMC ⟨2A⟩ ⟨P2⟩	SMC ⟨4S⟩ ⟨P2⟩	SMC ⟨4A⟩ ⟨P2⟩	SMC ⟨8S⟩ ⟨P2⟩	SMC ⟨8A⟩ ⟨P2⟩
Branch	2		4		8	
Connector type	SC/SPC	SC/APC	SC/SPC	SC/APC	SC/SPC	SC/APC
Dimensions	57(W)×85(D)×28(H)mm				57(W)×85(D)×42(H)mm	

P2=0 : Without magnet
P2=1 : With magnet

H-PCF

Fiber-optic cords/cables

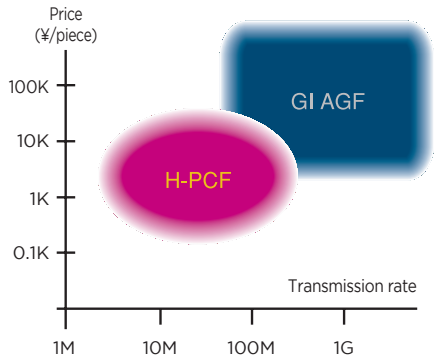
Features of Hard Plastic Clad Silica Fiber (H-PCF)

Advantages of H-PCF over conventional optical communication fibers

① High NA feature (capability to capture a large amount of light) ensures compatibility with low-cost optical modules (electrical-to-optical and optical-to-electrical transducers).

② Another feature of H-PCF is its suitability for use with easy-to-fit crimp & cleave optical connectors. As an optical fiber for medium- to long-distance transmission involving the use of many optical modules and connectors, H-PCF is effective in reducing system installation costs and extending transmission distances.

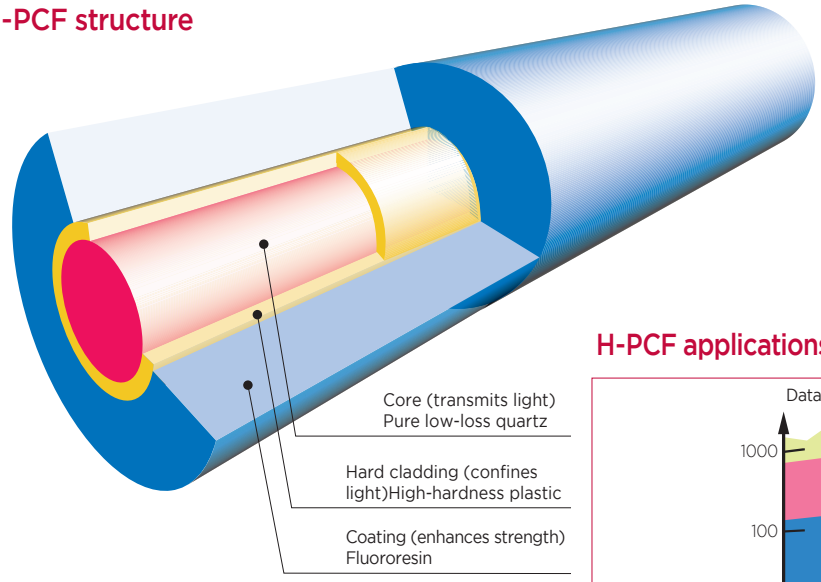
Approximate optical module pricing



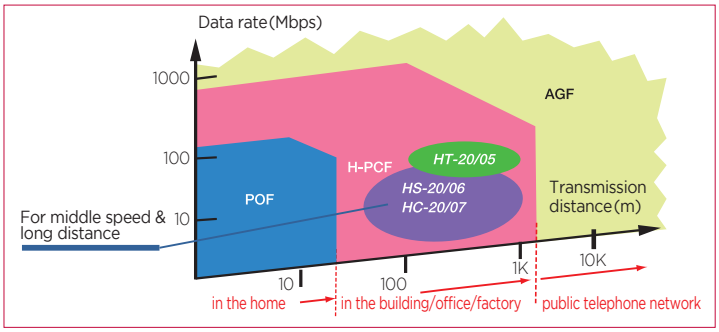
Assembling crimp & cleave optical connector
(optical connector CF-2071)

Crimping ferrule → Cleaving optical fiber → Optical connector assembly

H-PCF structure

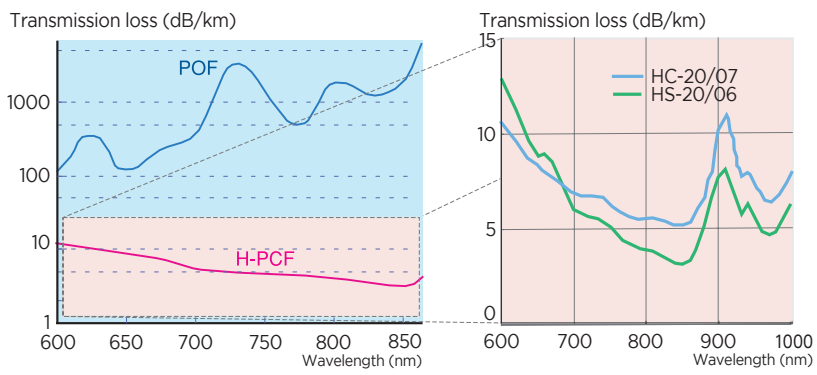


H-PCF applications, data rates, and transmission distances



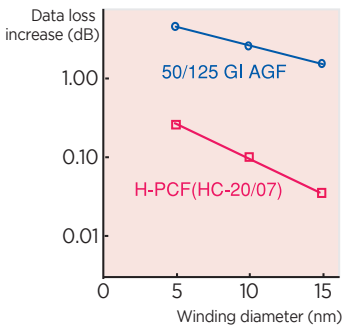
Excellent wavelength characteristics

Transmission loss versus wavelength



Excellent mechanical characteristics

Bending loss characteristics



Fiber-optic cords/cables

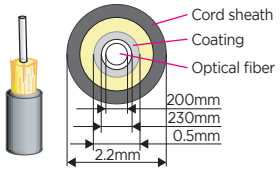
Standard type (HC)

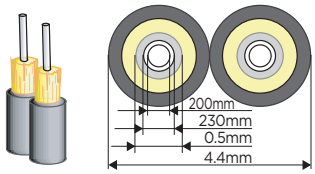
H-PCF fiber types

Product name	HC-20/07
Category	Standard SI
Fiber type	HC
Refraction-index profile	
Core material	Silica glass
Core diameter [μm]	200
Cladding material	Fluoroacrylate
Cladding diameter [μm]	230
NA	0.4*2
Attenuation [dB/km]	7
Bandwidth [MHz/km]	14*2
Test wavelength [nm]	800 band
Application	General industries and FA

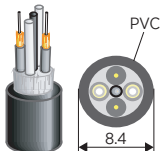
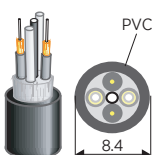
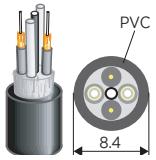
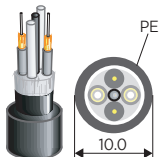
*1. The figure depends on the light source. Contact us for further information.
*2. The figures are for reference purposes.

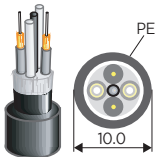
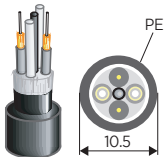
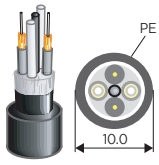
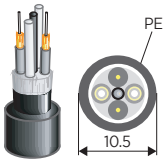
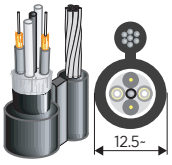
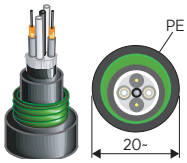
H-PCF cords

Cord type	Single-fiber cord
Schematic drawing	
Outer diameter	2.2mm

Cord type	2-fiber cord
Schematic drawing	
Outer diameter	2.2×4.4mm

H-PCF cables (2-fiber cables are shown as examples.)

Type/Application	Standard	Flexible	Nonmetallic
Inside a control board	Cord	—	—
Indoor*2	Product name:2-C-V 	Product name:2-C-VCT 	Product name:NM2-C-V 
Outdoor	Product name:2-C-LAP 	—	—
Feature	—	Highly flexible	No metal included

Type/Application	Flame-retardant	Fire-resistant	Overhead	Underground
Inside a control board	—	—	—	—
Indoor*2	Product name:SF2-C-LAP 	Product name:SF-400-OPT*3 	—	—
Outdoor	Product name:SF2-C-LAP 	Product name:SF-400-OPT*3 	Product name:2-C-LAP-SSD 	Product name:2-C-LAP-MAZE 
Feature	Resists the spread of fire.	Resistance to fire*3	With messenger wire	With metal armor

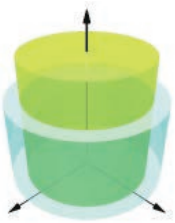
*1. In cases where the cable length needs to be 200 m or more, or if a great tension will be applied to the cable during laying, such as when pulling the cable with a winch, use a multi-type optical fiber cable with a center tension member.
*2. A LAP-sheathed outdoor cable must be used even for indoor use if a cable is anticipated to be soaked or immersed in water.
*3. Fiber-optic cables of this class meet the criteria for heat-resistant fiber-optic cables (Circular Notice No. 178 dated December 12, 1986, by the Director, Fire and Ambulance Service Division, Fire and Disaster Management Agency, Ministry of Home Affairs). They resist heating in a pattern following the fire temperature curve, reaching 380°C in 15 minutes, and are suitable for control and operation purposes in fire protection systems.
* For eco-friendly types and composite feeder line types, consult us.

H-PCF

Fiber-optic cords/cables

Compound-glass-fiber-compatible type (HS)

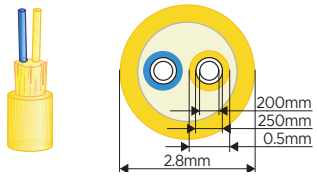
H-PCF fiber types

Product name	HS-20/06
Category	Standard SI
Fiber type	HS
Refraction-index profile	
Core material	Silica glass
Core diameter [μm]	200
Cladding material	Fluoroacrylate
Cladding diameter [μm]	250
NA	0.46*
Attenuation [dB/km]	6
Bandwidth [MHz/km]	10*
Test wavelength [nm]	800 band
Application	General industries and FA

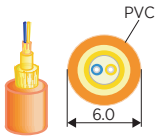
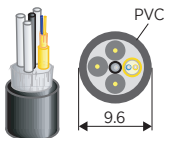
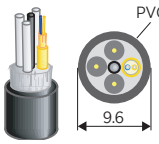
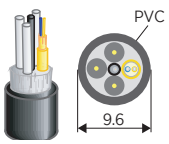
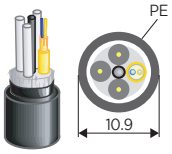
* The figures are for reference purposes.

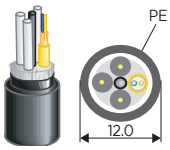
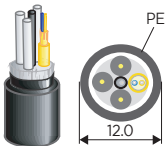
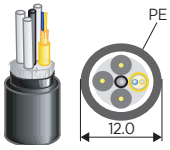
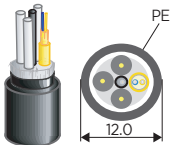
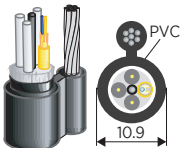
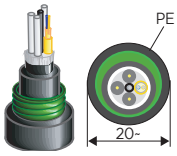
- As pure silica glass with no impurities is used as a core for the compound-glass-fiber-compatible fiber, attenuation is less than half that with the compound-glass fiber, enabling data transmission with improved system margin and higher reliability.
- The use of pure silica glass instead of inherently weak compound glass and reinforcement with hard polymer cladding results in mechanically strong, reliable fiber cords and cables.
- Highly accurate connector attachment is possible without a cumbersome and skill-requiring polishing process (only cleaving with the special cutter is required).

H-PCF cords

Cord type	2-fiber round cord
Schematic drawing	
Outer diameter	2.8mm

H-PCF cables (2-fiber cables are shown as examples.)

Type/Application	Standard	Reinforced type	Flexible	Nonmetallic
Inside a control board	Cord	—	—	—
Indoor*2	Product name:2-FOD-V*1 	Product name:2-D-V 	Product name:2-D-VCT 	Product name:NM2-D-V 
Outdoor	Product name:2-D-LAP 		—	—
Feature	—	Center tension member	Highly flexible	No metal included

Type/Application	Flame-retardant	Fire-resistant	Overhead	Underground
Inside a control board	—	—	—	—
Indoor*2	Product name:SF2-D-LAP 	Product name:SF-400-OPT*3 	—	—
Outdoor	Product name:SF2-D-LAP 	Product name:SF-400-OPT*3 	Product name:2-D-LAP-SSD 	Product name:2-D-LAP-MAZE 
Feature	Resists the spread of fire.	Resistance to fire*3	With messenger wire	With metal armor

*1. In cases where the cable length needs to be 200 m or more, or if a great tension will be applied to the cable during laying, such as when pulling the cable with a winch, use a multi-type optical fiber cable with a center tension member.
*2. A LAP-sheathed outdoor cable must be used even for indoor use if a cable is anticipated to be soaked or immersed in water.
*3. Fiber-optic cables of this class meet the criteria for heat-resistant fiber-optic cables (Circular Notice No. 178 dated December 12, 1986, by the Director, Fire and Ambulance Service Division, Fire and Disaster Management Agency, Ministry of Home Affairs). They resist heating that follows the fire temperature curve, reaching 380°C in 15 minutes, and are suitable for control and operation purposes in fire protection systems.
* For ecological types and composite feeder line types, consult us.

Installation location

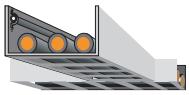
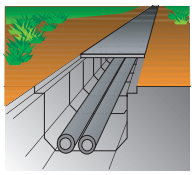
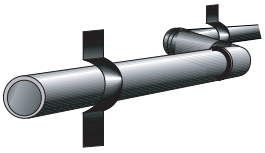
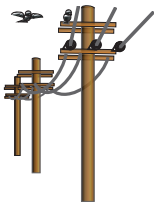
Installation location and application category

○.....Suitable ×.....Not to be used

Type	Inside panel	Rack	Trough	Conduit	Outdoor conduit	Overhead	Buried
Single-fiber cord	○	×	×	○*1,*2	×	×	×
2-fiber cord	○	×	×	○*1,*2	×	×	×
Indoor cable (2-C-V etc.)	○	○*1,*2	○*1,*2	○*1,*2	×	×	×
Outdoor cable (2-C-LAP etc.)	○	○	○	○	○	×*3	×
Self-support cable (2-C-LAP-SSD etc.)	—	—	—	—	—	○	×
Steel-armored cable (2-C-LAP-MAZE etc.)	—	—	—	—	—	—	○

* Excessive tensions and side pressures must be avoided.
* The weatherability of colored sheaths is low. Always choose black cables for installation in places exposed to direct sunlight.
*1. A LAP-sheathed outdoor cable must be used even for indoor use if a cable is anticipated to be soaked or immersed in water.
*2. Since cable sheaths are made of PVC, it is recommended to use LAP-sheathed cables (with the outermost layer being made of polyethylene) where an oil or chemical harmful to PVC is used. Flame-resistant cables must be used for installation in a culvert (in accordance with Article 143 of the Electric Installation Engineering Standards).
*3. The cables are suitable if appropriate hangers are used.

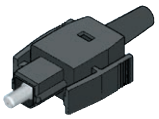
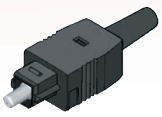
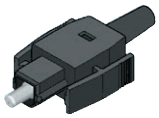
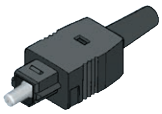
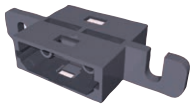
Installation location requirements

	Rack	Trough	Conduit	Outdoor conduit	Overhead
Installation location					
Cord	Provide protection against damage caused by falling objects.	—	—	—	—
Cable	Provide protection against excessive forces if present.	Provide protection against excessive forces if present.	Conduits are assumed to be made of steel or PVC.	Avoid any sections immersed in water.	Excessive tension or vibration must not be applied.

H-PCF

Optical connectors/tools

For standard (HC) cords/cables

Applicable standard	JIS F01(FC)	JIS F05		JIS F07	
	The optical connectors shown below can be factory-attached to various standard cords or cables at your request.				
Optical connector-equipped cable	—	Glue & polish type			Crimp & polish type
		Product name:CF-1001H	Product name:CF-1501H	Product name:CF-2071H	Product name:CF-2071TE
	—				
Optical connectors (field assembled) and fitting tools	Another option for the user is to purchase the desired items from the various standard cables and optical connectors shown below and to assemble them using the tools shown below.*1				
	Crimp & and cleave type				
	Product name:CAF-230C-P	Product name:CF-1071	Product name:CF-1571	Product name:CF-2071	
					
	Use the tools below to assemble the crimp & cleave connectors shown above.				
	Product name:CAK-0057-EX				
					
Reference fiber	Consult us.	Product name:CAT-1001H*2		Product name:CAT-2001H*2	
Inline adapter	—	—		Product name:IAT-4000*3	
		—			

*1. Users are recommended to attend our technical workshop provided for the correct use of these products. For more information, visit: http://www.optigate.jp/course/hpcf_course.html
*2. For other types of H-PCF fiber than the HC-20/07, contact us.
*3. Due to the insertion of an inline adaptor, the transmission distance is shortened.

For cords/cables of compound-glass-fiber-compatible type (HS)

Applicable standard	Optical connector	Tool	Power tester	Reference fiber	Inline adapter
	Product name:DL-72	Product name:CAK-0068-EX	Product name:CAT-7200*1	Product name:CAT-7201H	Product name:IAT-7000*2
JIS F08				—	

*1. Two power tester sets are required for the measurement of cables after laying.
*2. Due to the insertion of an inline adaptor, the transmission distance is shortened.

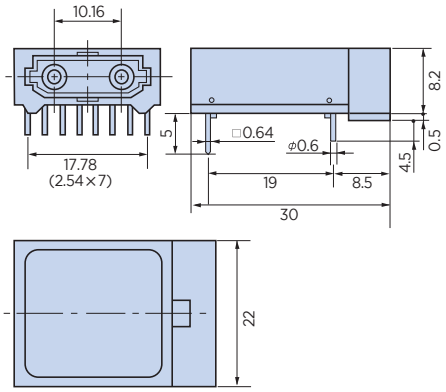
Fiber-optic transmission modules SUMILINK™ for short optical link applications

High-reliability type (metal can/ceramic package)

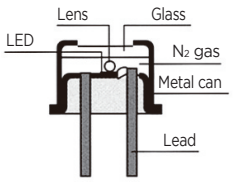
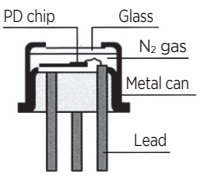
Product name		DF-2310
	Transmitting module	
	Receiving module	
Peak emission wavelength		870nm
Data rate (NRZ)*1		DC-4Mbps
Applicable fiber		200/230(HC-20/07)
Applicable optical connector*2	JIS	F07
	Glued	CF-2001H,CF-2071H
	Crimped	CF-2071
Dynamic range*3		11dB
Maximum transmission distance*4		1000m
Storage temperature		−40~+85°C
Operating temperature		−20~+75°C
Package		Metal can
Note		TTL interface, +5 V single power supply

*1. The figures are typical values, which are subject to change depending on the duty ratio of the transmitted signal and other operating conditions.
*2. Factory-assembled glued connectors and easily field-assembled crimped connectors are available as compatible optical connectors. Regarding mating, these connectors are either lever-locked or friction-locked. To assemble a crimped optical connector, the CAK-0057-EX is required. For detailed information, ask our sales staff for technical data sheets and specifications.
*3. The figures are typical design values, which are subject to change depending on the data rate, storage and operating temperatures, and other conditions.
*4. For detailed information, ask our sales staff for technical data sheets and specifications.

Dimensional drawings for high-reliability type



Description and features of each package

Package	Metal can	
Structure	Transmitting end 	Receiving end 
Reliability	◎	
Feature	●Hermetically sealed construction for excellent resistance to moisture ●Protection of chip surfaces from external stresses ●More costly than molded plastic packages	●Hermetically sealed construction for excellent resistance to moisture ●High noise-immunity due to DF-2310 body encased in a metal case ●Protection of chip surfaces from external stresses ●More costly than molded plastic packages

Notes on the selection and use of optical links

- Although Sumitomo Electric is striving to improve the quality and reliability of its products (“Product”), semiconductor products commonly malfunction or fail. It is the customer’s responsibility to implement necessary, safe designs of hardware, software, and overall systems that incorporate the Product so that any malfunction or failure of the Product will not result in endangering life, injury, or damage to property.
- The Product is intended for use in general electronic equipment (computers, personal electronic equipment, office equipment, measuring equipment, industrial robots, home appliances, etc.).
- The Product is neither intended nor warranted for use in equipment that requires exceptionally high levels of quality and reliability, or the failure or malfunction of which may threaten life, cause injury, or damage property, or have a serious impact on society (“Specific Use”).
- Specific Use includes, and is not limited to, nuclear-related equipment, aerospace equipment, medical equipment, equipment in automobiles, trains, ships and other transportation, traffic signal equipment, combustion/explosion-related equipment, safety devices, elevators, escalators, electric power equipment, and financial equipment. Application of the Product for Specific Use must be avoided.
- Sumitomo Electric will review and decide whether or not your use falls under Specific Use. In the case that we determine your use falls under Specific Use, we will not sell you the Product, as a general rule.

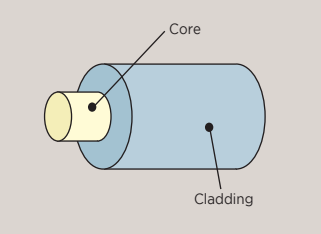
Basic information

Basic information on optical fibers/cables

Here're the tips useful to know about the optical

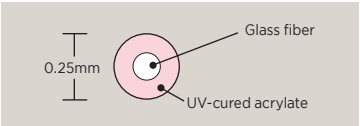
Construction of Optical Fiber

An optical fiber for the telecommunication is made of glass designed to guide light along its length by total internal reflection. The glass fiber has nominal diameter of 125μm (0.125mm) and covered with plastic jacket for protection to form 250μm or 900μm in diameter. The central part of the glass fiber which guides light is called "core" and the "cladding" around it has lower refractive index than the "core" to confine the guided light. Silica glass is fragile; therefore, it is covered with a protective jacket. There are three typical coatings for the optical fiber.



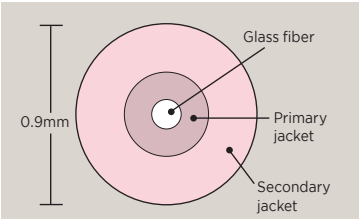
Primary coated fiber

This is covered with a UV cured-Acrylate to a diameter of nominal 0.25mm. Since it has an extraordinary small diameter, it has a superior capacity to fit a large number of fibers into a cable and is used widely.



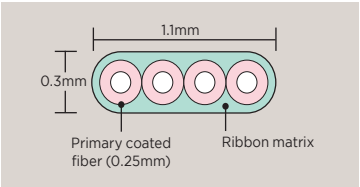
Secondary jacketed fiber

Or tight or semi-tight buffered fiber. This is optical fiber covered with thermoplastic to a diameter of 0.9mm. Compared to 0.25mm fiber, it is stronger, easier to handle and is widely used in LAN wiring and other small fiber-count cable.



Ribbon fiber

Ribbon fiber provides an excellent way to boost the productivity of connector assemblies and facilitates mass fusion splicing for greater productivity. The ribbon is composed of 4,8 or 12 colored fibers for fiber counts as great as 1000. The fibers are encapsulated by a UV-acrylate material which can be easily removed with standard strippers for mass splicing or easily peeled apart for single fiber access. Ribbon can be spliced at once with mass –fusion splicer and easy for identification in high fiber-count cable.



Fiber Categories

Here's the most common description of the varieties of telecommunication fibers.

MMF (multimode fiber)
- OM1 or MMF(62.5/125)
- OM2/OM3 (G.651 or MMF(50/125))

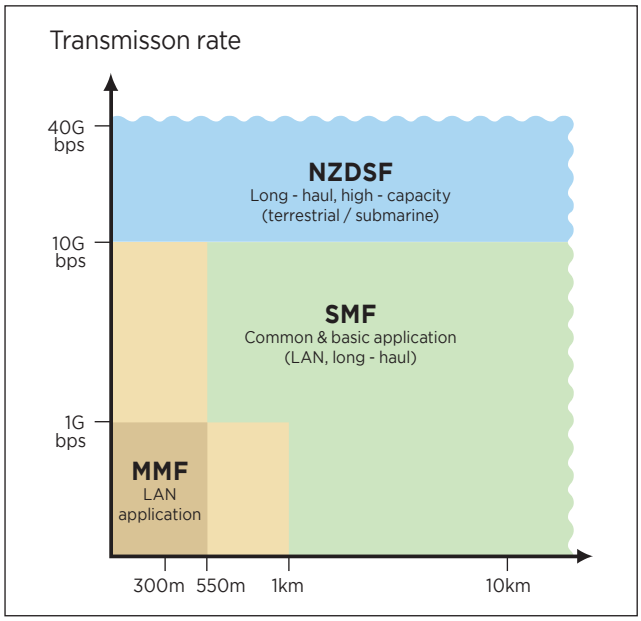
SMF (single-mode fiber)
- G.652 (dispersion non-shifted SMF)
- G.653 (dispersion shifted SMF)
- G.654 (cut-off shifted SMF)
- G.655 (NZDSF)
- G.656 (low dispersion slope NZDSF)
- G.657 (bending insensitive SMF)

Technically you can use any fibers for FTTx as far as the optical budget allows, but the most common application for FTTx shall be by G.652 and G.657.

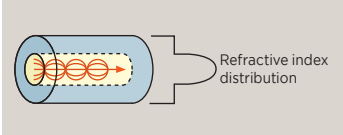
G.651 (multi mode fiber)

Multi mode fiber (MMF) is used for communication over short distance, such as LAN and datacenter. MMF classified M1 to M4 according to ISO/IEC. Each bandwidth and distance is defined as follows.

	Bandwidth	1Gb/s Link	1Gb/s Link	10Gb/s Link	10Gb/s Link
	850/1300nm	1000BASE-SX	1000BASE-LX	10BASE-SR	10BASE-LX4
OM1	200/500	275m	550m	33m	300m
OM2	500/500	550m	550m	82m	300m
OM3	1500/200	1000m	550m	300m	300m
OM4	3500/500	1100m	550m	550m	300m



ITU-T G.651 is another name for OM2/OM3 or MMF(50/125). ITU-T recommendation does not have OM1 or MMF(62.5/125) which is still popular in US. The core of MMF(50/125) has a refractive index profile gradually changing from the center of the core to the cladding, which enables multiple of transmission light (mode) travel with nearly the same velocity.



Basic information on optical fibers/cables

G.652 (dispersion non-shifted SMF)
It is the most common SMF in the world. It is tuned to minimize the dispersion (which gives the deformation to the signal) around the wavelength at 1310nm. You can use 1550 nm wavelength window for the shorter distance or with the dispersion compensating fiber or module. G.652A/B is the basic SMF and G.652C/D is the category for Low-water-peak SMF.

G.653 (dispersion shifted fiber)
It is designed to minimize the dispersion at around 1550nm where the optical loss is the smallest.

G.654 (cut-off shifted fiber)
Official name for G.654 is “cut-off shifted fiber”, but it is better known as low attenuation fiber. Sumitomo’s Z Fiber™ has the world record of 0.154 dB/km.
Thanks to this low attenuation the major application for G.654 is in the submarine and terrestrial long-haul application such as 400km reach without repeater.

G.655 (NZDSF)
NZDSF is short for NZDSF for wide band transport fiber. G.653 has designed to have zero dispersion at 1550nm, but G.655 has positive or negative dispersion intently. The reason for that is to reduce the undesirable effect of the non-linear phenomenon which interfere with the adjacent wavelength in DWDM system. The first generation NZDSF such as PureMetro™ has smaller dispersion of around or less than 5ps/nm/km to make the dispersion compensation easier. On the other hand the second generation NZDSF such as PureGuide™ has larger dispersion of around 10ps/nm/km to enhance the DWDM capacity to double.

G.656 (low-slope dispersion NZDSF)
It is a kind of NZDSF which has stricter requirements on the dispersion slope which enables to guarantee the DWDM performance in wider wavelength range.

G.657 (bending insensitive fiber)
This category is introduced to specify macrobending performance, which sports implementation in FTTH and access network.
G.657.A is fully compliant with ITU.T-G.652 specification, on the other hand, G.657.B is required higher macrebending performance but not necessary to comply with G.652.

	10 mm	7.5 mm	5 mm
G.652 compliant	G.657.A.1	G.657.A.2	
G.652 not required		G.657.B.2	G.657.B.2

Classification of Techniques Used for Optical Fiber Connection/Splicing

Optical fibers are joined either by fusion/mechanical splice, which is a permanent joint, or by connectors, which can be disengaged repeatedly. Optical connectors are used mostly at joints that need to be switched for optical service operation and maintenance reasons, while permanent joints are in use mostly in other applications.

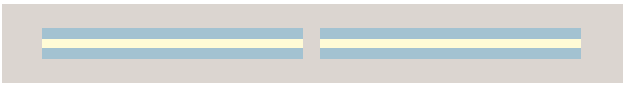
Mechanisms of Light Loss at Optical Fiber Joint

When joining optical fibers, the opposed cores must be properly aligned. Optical fiber connector/splice loss occurs mostly in the following manner.

(1) Poor concentricity
Poor concentricity of joined optical fibers causes a connector/splice loss. In the case of general purpose single-mode fibers, the value of connector/splice loss is calculated roughly as the square of the amount of misalignment multiplied by 0.2. (For example, if the light source wavelength is 1310 nm, misalignment by 1 μm results in approximately 0.2 dB of loss.)

(2) Axial run-out
A connector/splice loss occurs due to an axial run-out between the light axes of optical fibers to be joined. For example, it is necessary to avoid an increased angle at fiber cut end when using an optical fiber cleaver before fusion splicing, since such an angle can result in splicing of optical fibers with run-out.

(3) Gap
An end gap between optical fibers causes a connector/splice loss. For example, if optical fiber end faces are not correctly butt-joined in mechanical splicing, a splice loss.

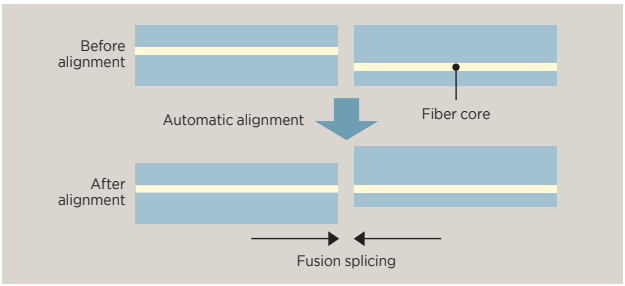


(4) Reflection
An end gap between optical fibers results in 0.6 dB of return loss at the maximum due to the change in refractive index from the optical fiber to the air. Cleaning optical fiber ends is important for optical connectors. In addition, the whole optical connector ends should be cleaned because loss can also occur due to dirt between optical connector ends.

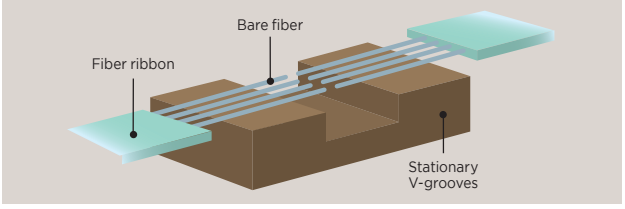
Classification and Principles of Fusion Splices

Fusion splicing involves the melting and joining of optical fibers using heat generated by an electric arc between electrodes. Fusion splicing is classified into the two methods, as follows.

(1) Core alignment method(core alignment)
Optical fiber cores observed with a microscope are positioned with the help of image processing so that they are concentrically aligned. Then, an electric arc is applied to the fiber cores. The fusion splicer used has cameras for observation and positioning in two directions.



(2) Stationary V-groove alignment method (cladding alignment)
This fusion splicing method uses V-grooves produced with high precision to position and orient optical fibers and utilizes the surface tension of melted optical fibers for alignment effects (cladding alignment). Splices made by this method achieve low loss thanks to the recent advancement of optical fiber production technology, which has improved the dimensional accuracy regarding the placement of core. This method is primarily used for splicing a multi-fiber cable in a single action.



Basic information

Basic information on optical fiber connection/splicing

Notes on Fusion Splicing

Fusion splicing procedures comprise
(1) the fitting of a fiber protection sleeve, (2) removal of cover layers, (3) fiber cleaning, (4) fiber cleaving, (5) fusion splicing, and (6) reinforcing the splice.

(1) Fitting of Fiber Protection Sleeve

The fiber protection sleeve is used to protect optical fibers exposed at the splice. Make sure that one of the optical fibers is passed through the protection sleeve before fusion splicing.

(2) Removal of Cover Layers

Using a jacket remover, remove the cover layers to expose the fiber glass.
Notes:

* After cover layer removal, off-cuts are present in the jacket remover. Remove off-cuts from the jacket remover and clean the blade.
* To remove cover layers from a fiber ribbon, use a heated jacket remover. For successful removal, warm the cover layers for about 5 seconds before removal.

(3) Fiber Cleaning

After cover layer removal, clean the fiber glass with alcohol.
Notes:

* Debris of cover layers if remaining on the fiber glass can cause poor concentricity in fusion splicing or increased splice loss. Clean the glass fiber thoroughly.
* In the case of a multi-fiber cable, fiber ends may stick together due to alcohol, causing defective cleaving of fibers. Flip lightly with a finger to spread out the fibers.

(4) Fiber Cleaving

Follow the optical fiber cleaver operating procedure to cut the fiber.
Notes:

* The loss characteristic of a fusion splice depends on the cleaving. To reduce cleaving defects, clean the fiber holder and blade of optical fiber cleaver on a regular basis.
* Keep the cleaved end of an optical fiber away from an object including your fingers to eliminate the causes of defective splices.
* Avoid scattering fiber off-cuts.

(5) Fusion Splicing

Fusion-splice optical fibers following the operation manual of the fusion splicer.
Notes:

* Dirt in the V-grooves or clamp of a fusion splicer can cause an unusual light loss due to poor concentricity. Clean the fusion splicer thoroughly.
* It is possible to detect faulty conditions of cleaved end if pre-splicing inspection capability with dual-axis observation is available.
* If the fiber has a curl, lightly squeeze the fiber with fingers to remove the curl. The placed fiber should bend downward.

(6) Splice Reinforcing

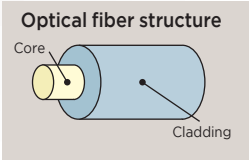
Cover the optical fiber splice with the fiber protection sleeve.
Reinforce the fiber with the sleeve on the heater.
Notes:

* Avoid bending or twisting the fiber when moving it so as not to break the fiber.
* Position the fiber protection sleeve so that its midpoint is close to the center of the splice.
* When placing the reinforcement, make sure that the glass fiber is straight.

Optical Fiber Terms

Core diameter

A parameter of multimode optical fibers. It represents the diameter of the circle that best approximates the circumference of the core region. The smaller the value of the core diameter, the broader the services band. Fibers commonly used today have a core diameter of 50μm



Mode field diameter (MFD)

A parameter of single-mode optical fibers, MFD corresponds to the diameter of the spread of electric field distribution in propagation mode (light path). Light usually passes through the core region. However, in the case of a single-mode optical fiber, the light leaks into the cladding region. Therefore, single-mode optical fibers are specified by MFD rather than core diameter. MFD is slightly greater than the core diameter. The smaller the MFD, the higher the required accuracy of alignment for connection/splicing. Furthermore, the larger the MFD difference of two joined fibers, the greater the connector/splice loss.

Cladding diameter

The diameter of the circle best approximating the cladding surfaces. The larger the cladding diameter difference of two joined fibers, the greater the connector/splice loss.

Cable cutoff wavelength

A parameter of single-mode optical fibers. An optical fiber cannot be a single-mode fiber if it is used at a wavelength shorter than the cable cutoff wavelength, which is determined by optical fiber structure, involving refraction index distribution and core diameter.

Proof test

Screening is a technique intended to remove the glass defects of a fiber and improve its structural reliability. A given level of elongation strain is applied to the overall length of an optical fiber to break the fiber at its low-strength section. The screening level is the value of the elongation strain. The higher the value of screening level, the higher the reliability of the optical fiber.

Transmission loss

Transmission loss is a value that indicates the decrease of optical power of light propagating between two points of optical fiber. It is expressed as follows:

$\alpha = -(10/L)\log(P2/P1)$
where, L: cable length
P1: incident power
P2: transmitted power

The transmission distance becomes short when transmission loss grows.

Transmission band

A parameter of multi-mode optical fibers. The transmission band is the frequency at which the magnitude of the baseband transfer function decreases to a specified value (6 dB). In other words, the value indicates to what frequency the signal is transmitted without distortion.
The higher the transmission band, the higher the usable transmission frequency, hence larger-capacity transmission.

Zero-dispersion wavelength

A parameter of single-mode optical fibers. At the zero-dispersion wavelength, the wavelength dispersion decreases to zero. Transmission at a wavelength of a large absolute value of wavelength dispersion results in greater dispersion and therefore higher optical pulse distortion. Optical fibers designed so that the zero-dispersion wavelength is about 1310 nm or 1550 nm are known as the general-purpose SM or the dispersion-shifted optical fiber, respectively.

Zero-dispersion slope

A parameter of single-mode optical fibers. The zero-dispersion slope represents the gradient of dispersion at the zero-dispersion wavelength. In general, the greater the zero-dispersion slope, the higher the absolute value of dispersion at any wavelength.

Basic information on optical fiber connection/splicing

Cable-Related Terms

Maximum permissible tension

The maximum tension means that an optical cable is allowed to undergo during installation. It should be remembered that the maximum permissible tension does not mean the cable is capable of sustaining the tension constantly after installation.

Maximum permissible bending radius

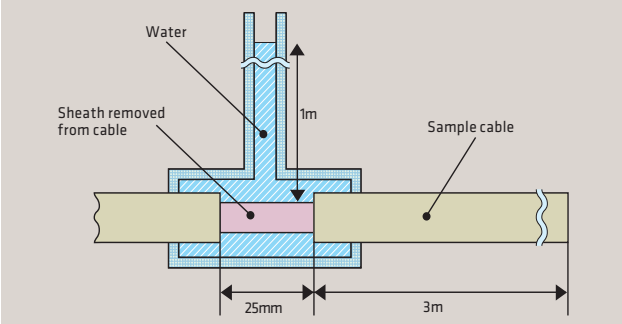
The maximum radius is defined that a fiber-optic cable can be bent. The maximum permissible bending radius applicable during installation differs from that applicable after installation. In general, when a fiber-optic cable is installed, maximum permissible bending radius is about 20 times the cable outside diameter. After installation, it is about 10 times the cable outside diameter.

Operating temperature range

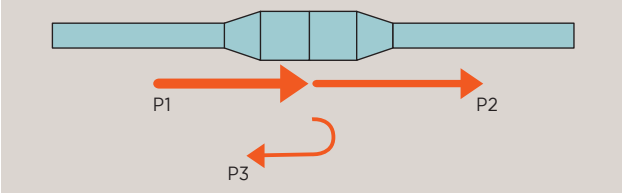
The operating temperature range shows suitable environment for fiber-optic cable installation. In general, the operating temperature range of a cable designed for outdoor use is within -20 to +60°C.
With a cable designed for indoor use, this range is about -10 to +40°C.

Waterproof property

In general, fiber-optic cables installed underground are required to be waterproof. While various test methods are used, Sumitomo Electric adapts the method shown below.



Optical Connector Terms



Connector loss

Optical loss from one of two joined fibers to the other.
The connector loss is expressed by the following equation.

$\alpha = -10\log(P2/P1)$ (dB)

P1: optical power immediately before connection
P2: optical power immediately after connection

The greater this value, the larger the optical power decrease, hence the shorter the transmission distance.

Return loss

The ratio expressed in decibels of the power of the light entering a connector to the power of the light reflected from the connected end face.
The return loss is expressed, as follows.

$\alpha = -10\log(P3/P1)$ (dB)

P1: optical power immediately before connection
P3: power of light reflected from connection

The higher the value, the weaker the power of reflected light, hence the lower the noise level.

Ferrule polishing method

The connection characteristics of a connector differ depending on the ferrule polishing method adopted.

Terms Related to Optical Termination / Junction Box and Closure

Dustproof waterproof property

In general, optical termination / junction boxes and closures are required to be protected from foreign matter and water leaks (principally for outdoor applications). IP codes specified in JIS C 0920 or IEC 60529 are used to indicate protection classes.

Protection Index

IP □□ : International Protection
- Second characteristic numeral (degree of protection against the ingress of water)
- First characteristic numeral (degree of protection against the ingress of foreign matter)

Characteristic Numeral		Degree of protection (brief description)	Recommended installation
First characteristic numeral	0	Not protected.	
	1	Protected against foreign matter of 50mm diameter and greater.	
	2	Protected against foreign matter of 12.5mm diameter and greater.	Indoor
	3	Protected against foreign matter of 2.5mm diameter and greater.	Indoor
	4	Protected against foreign matter of 1.0mm diameter and greater.	Outdoor
	5	Dust-protected	
	6	Dust-tight	
Second characteristic numeral	0	Second characteristic numeral Not protected.	
	1	Protected against vertically falling water droplets.	
	2	Protected against vertically falling water droplets when enclosure is tilted up to 15°.	
	3	Protected against water sprayed at an angle up to 60° degrees on either side of the vertical.	Aerial
	4	Protected against water splashed from any direction.	Aerial
	5	Protected against water jets.	
	6	Protected against powerful water jets.	
	7	Protected against the effects of temporary immersion in water.	Under ground
	8	Protected against the effects of continuous immersion in water.	
X		Protection degree not specified.	

Code examples

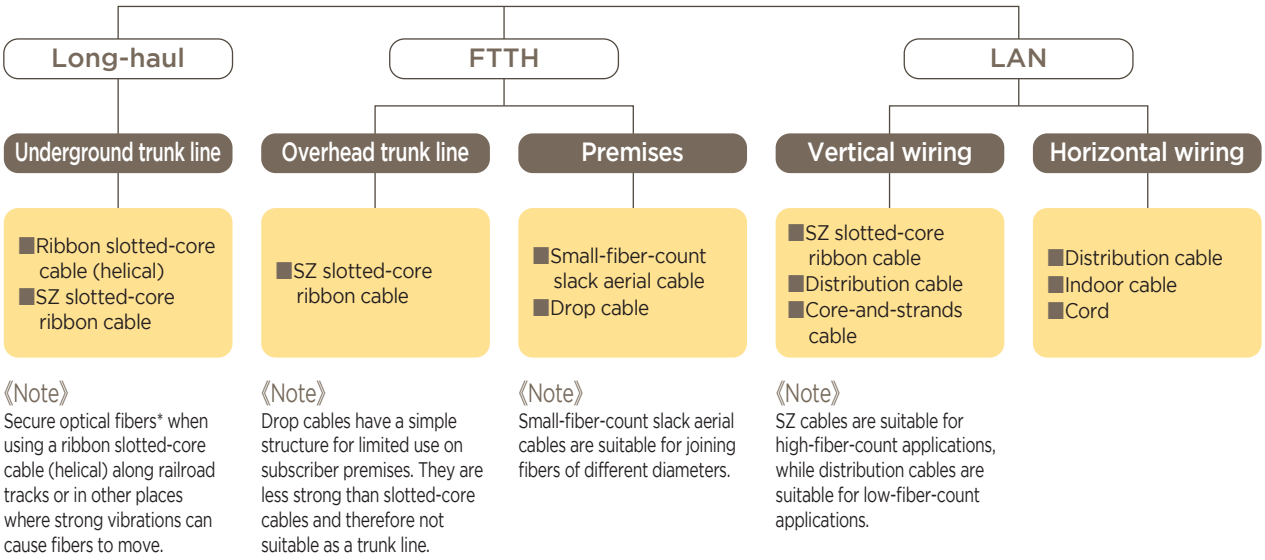
IP54 : Dust-protected and protected against splashing water
IP3X : Protected against foreign matter of 2.5 mm diameter and greater.
Protection against water not specified.
IPX7 : Protection against foreign matter not specified.
Protected against the effects of temporary immersion in water.

Basic information

Notes on optical cable selection and installation

The following are points to bear in mind when selecting suitable optical cables for a specific application and installation location and for proper installation work.

Selecting a basic optical cable structure (recommended structure)



《Note》
Secure optical fibers* when using a ribbon slotted-core cable (helical) along railroad tracks or in other places where strong vibrations can cause fibers to move.

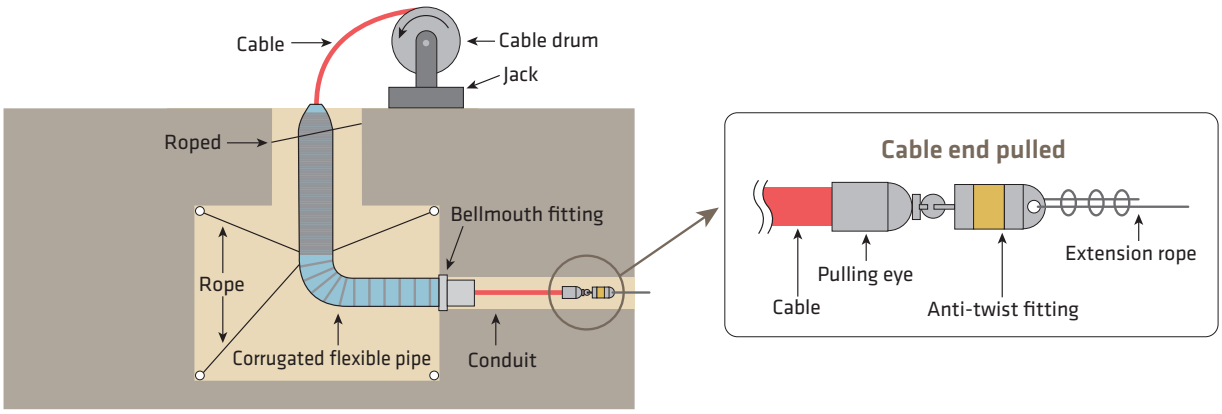
《Note》
Drop cables have a simple structure for limited use on subscriber premises. They are less strong than slotted-core cables and therefore not suitable as a trunk line.

《Note》
Small-fiber-count slack aerial cables are suitable for joining fibers of different diameters.

《Note》
SZ cables are suitable for high-fiber-count applications, while distribution cables are suitable for low-fiber-count applications.

* Securing fibers means fastening fiber ribbons and slotted spacers with an adhesive or the like.

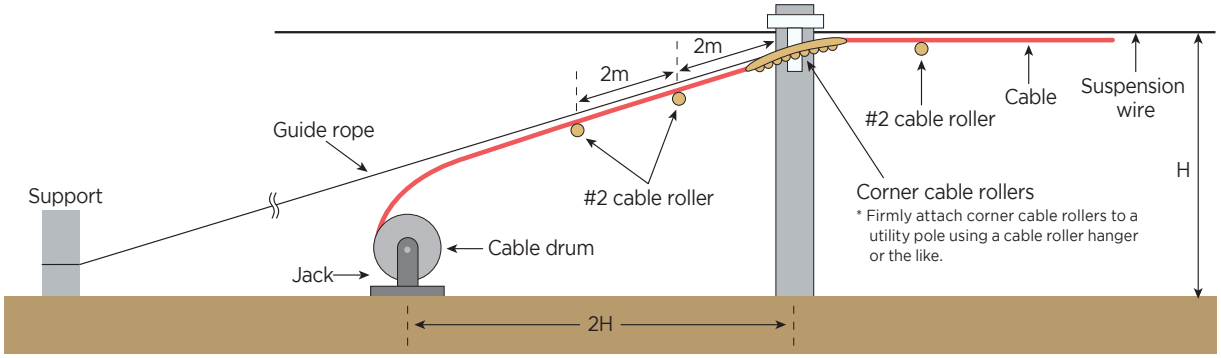
Example underground trunk installation method



■Attach a pulling eye or other similar fitting on one end of the optical cable.
■Use an anti-twist fitting or the like, as shown above right, to avoid twisting in the optical cable during installation.
■Place the cable drum right above the opening of the conduit, as shown above left, in order to unwind the cable in a smooth curve from the drum. When unwinding, take care so as not to twist or form a kink in the cable. Moreover, use a corrugated flexible pipe and a bellmouth fitting to protect the cable.
■To lay an optical cable over a long distance, pull the tension member instead of the cable sheath and monitor the tension in the cable to avoid over-tension. Over-tension can result in detaching the pulling eye or squashing the cable. The maximum allowable tension differs according to the cable type, and specifications are given for individual cables. For more detailed information, refer to the relevant specifications.
■For installation along railroad tracks or in other places where strong vibrations can cause fibers to move, use a ribbon slotted-core cable (helical) with fibers secured or an SZ slotted-core ribbon cable.

Notes on optical cable selection and installation

Example overhead trunk installation method



- Use an anti-twist fitting or the like to avoid twisting in the optical cable during installation.
- Hanger rollers tend to cause twisting in the cable for structural reasons. If you are using hanger rollers, use them with the utmost care during the installation of a long cable since hanger rollers are likely to affect the cable in such installation.
- Place the cable drum 2H or more apart from the utility pole (H: cable roller mounting height), as shown above, to avoid sharp bends in the optical cable. It is recommended to use an 11-wheel cable roller with a 300 mm corner radius to avoid squashing the cable during installation.
- To lay an optical cable over a long distance, pull the tension member instead of the cable sheath and monitor the tension in the cable to avoid over-tension. Over-tension can result in detaching the pulling eye or squashing the cable. The maximum allowable tension differs according to the cable type, and specifications are given for individual cables. For more detailed information, refer to relevant specifications.
- If it is unavoidable to use a ribbon slotted-core cable (helical), always secure the fibers in order to prevent them from moving due to vibration after installation.
- Figure 8 cables need to be twisted once every 10 m or so to reduce vibration caused by winds.

Example on-premises installation method

- When installing a cable, it is important to monitor tensions in the cable and bend radii to ensure they are within the limits.
- When installing a drop cable onto subscriber premises, the suspension wire must be anchored.
- When securing the suspension wire of a drop cable, making a sharp bend in the optical fiber can result in a break. Use care not to break the fiber.

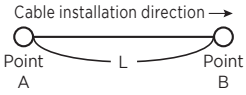
Example cable tension calculation method

The following are example formulae used in tension calculation.

(1)Straight section

$$T=10 \cdot f \cdot W \cdot L$$

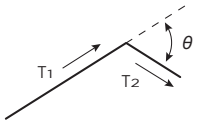
T : tension in straight section (N)
10 : acceleration due to gravity (m/S²)
f : coefficient of friction
W : cable weight (kg/m)
L : length of straight section (m)



(2)Bent section

$$T_2=T_1 \cdot K$$

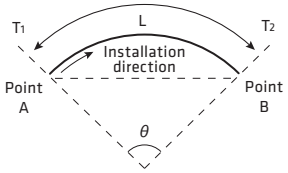
T_1 : tension immediately preceding bent section (N)
T_2 : tension immediately following bent section (N)
K : tension increase rate
f : coefficient of friction
θ : crossing angle



(3)Curved section

$$T_2=(T_1+T) \cdot K$$

T_1 : tension immediately preceding curved section (N)
T_2 : tension immediately following curved section (N)
T : 10fWL
K : tension increase rate
f : coefficient of friction
θ : crossing angle



Tension increase rate used in tension calculation (one case of underground conduit)

Combination	Cable plus Conduit made of flexible PE pipes and flexible pipe for cable protection	Tension increase rate (K)
Coefficient of friction	0.5	
Crossing angle (θ°)	6-10	1.10
	11-16	1.15
	17-20	1.20
	21-25	1.25
	26-30	1.30
	31-34	1.35
	35-38	1.40
	39-42	1.45

Basic information

FAQs

Q1 Is there any limit to the degree of bend in an optical cable?

A1 In general, the minimum allowable bend radius of a cable is 10 times the outside diameter of the cable or the minimum bend radius of the fibers in the cable, whichever is larger. The minimum allowable bend radius of optical fibers is generally 30 mm. Accordingly, bending an optical cable to a bend radius of less than 30 mm should be avoided, however small the cable diameter. However, Sumitomo Electric has developed PureEther-Access and PureAccess-PB, an MM fiber and an SM fiber respectively, both of which feature a minimum allowable bend radius of 15 mm. Moreover, Sumitomo Electric has developed a 7.5 mm bend-radius SM fiber PureAccess-A2, representing a breakthrough in the optical cable bend radius.

Q2 Multimode optical fibers have a core diameter of 50μm or 625μm. What differences are there between these specifications?

A2 The 62.5μm core diameter is used commonly in the United States, while the 50μm core diameter is generally used in Japan. The difference in core diameter entails the use of different transmission equipment. Optical fibers made to the larger 62.5μm core diameter spec are easier to connect with transmission equipment, which implies the use of low-cost equipment. In contrast, the 50μm core diameter spec necessitates the use of relatively costly equipment, yet with the advantage of optical fibers enabling a broader band. In recent years, the 50μm core diameter spec has been on the way to the mainstream due to the popular use of the Gigabit Ethernet, for instance the 10-Gigabit Ethernet, incorporating broad-band optical fibers.

Q3 Which optical cables offer resistance to moisture or water?

A3 Typical examples of such cables are the LAP-sheathed and WB types. The LAP-sheathed cable has the inside of the sheath lined with aluminum tape to provide resistance to moisture or water. If the sheath is damaged, water may enter and spread in the cable. The WB cable has fibers wrapped with a water-absorbing tape rendering it moisture/water-resistant. The water-absorbing material swells in the event of water ingress to prevent the spread of water in the cable.

■LAP-sheathed cables have “LAP” in their product names.

Example: Core-and-strands cable [8NHGI(PE-A1G)—L—LAP—FR]

■WB cables have “WB” in their product names.

Example: SZ slotted-core ribbon cable [100SM(PAPB)—SZ4R—WB—E]

Q4 In case SM fibers with the different mode field diameter were spliced, the splicing loss was extremely large. Is there a good solution to this problem?

A4 The OTDR method is in wide use for measuring the splice loss. When the splicing loss of SM fibers with the different mode field diameter is measured by OTDR, the measurement value is not the true splicing loss but the apparent splicing loss.
The OTDR measures the level of radiation scattered back by the optical line and collected by the receiver of the instrument. Since the backscatter coefficient depends on the mode field diameter of the fiber, the splicing loss differs by the direction of the incident light.
The error in a measurement made in one direction will be positive (Fig.1), and the error in the other direction will be negative (Fig.2). The use of an average of readings taken in opposite directions cancels the error due to differences in the backscatter coefficient of the two fibers (Fig.3). Even the same SM fibers (the nominal mode diameter: 9.2 um) have different mode field diameters within a design tolerance of +/-0.4 um. If the accurate splice loss is desired, it is necessary to conduct the measurement in two directions.

Apparent splice loss by one way OTDR measurement

Fig.1 In case pulse is incident into the fiber with smaller MFD.

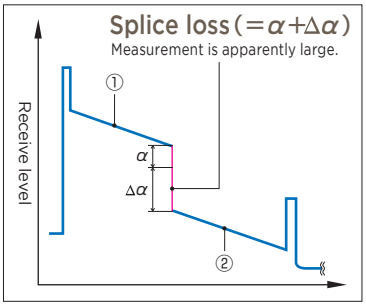
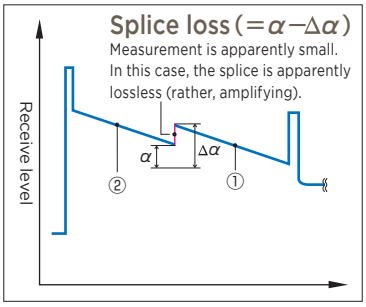
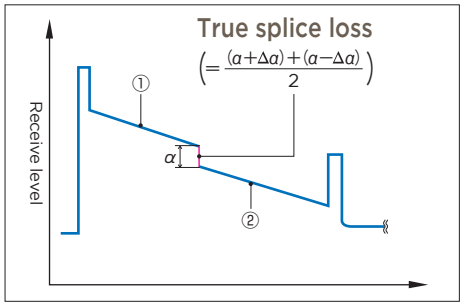


Fig.2 In case pulse is incident into the fiber with larger MFD.



True splice loss by two way OTDR measurement

Fig.3 The use of an average of readings taken in opposite directions cancels the error.



①: Fiber with smaller MFD. (Larger backscatter coefficient)
②: Fiber with larger MFD. (Smaller backscatter coefficient)
α: True splice loss
Δα: Error of splice loss

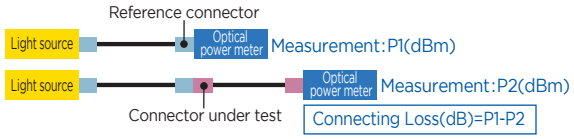
FAQs

Q5 Is there any good method to measure the connecting loss?

A5 ■Single mode

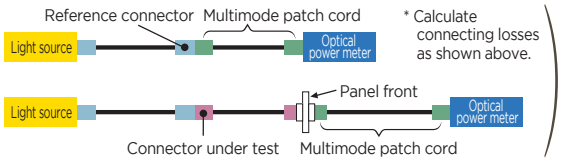
Set up is shown in Fig.1. It is compliant to IEC 61300-3-4.

Fig.1



In case the connector is impossible to connect an optical power meter, use a multimode patch cord on the receiving end as shown in Fig.2.

Fig.2



■Multimode

Figure 3 shows the set up for measuring the multimode connector. It is compliant to IEC 61300-3-4.

The objective of a mode filter is to remove unwanted transient higher order modes and eliminate measurement inaccuracies. The mode filter consists of five, close-wound turns on a smooth round mandrel whose diameter is selected to ensure transient modes have been attenuated and steady-state conditions have been achieved. The diameter of the mandrel may differ from fiber to fiber depending on fiber and coating type. The typical mandrel diameters are shown in Table 1.

Fig.3

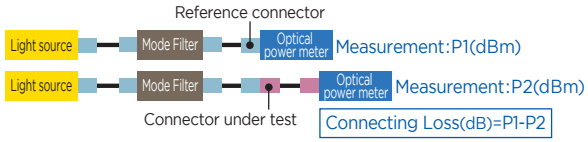


Table 1. Mandrel diameter sizes

Fiber size (um)	Mandrel diameter (mm)
50	18
62.5	20

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