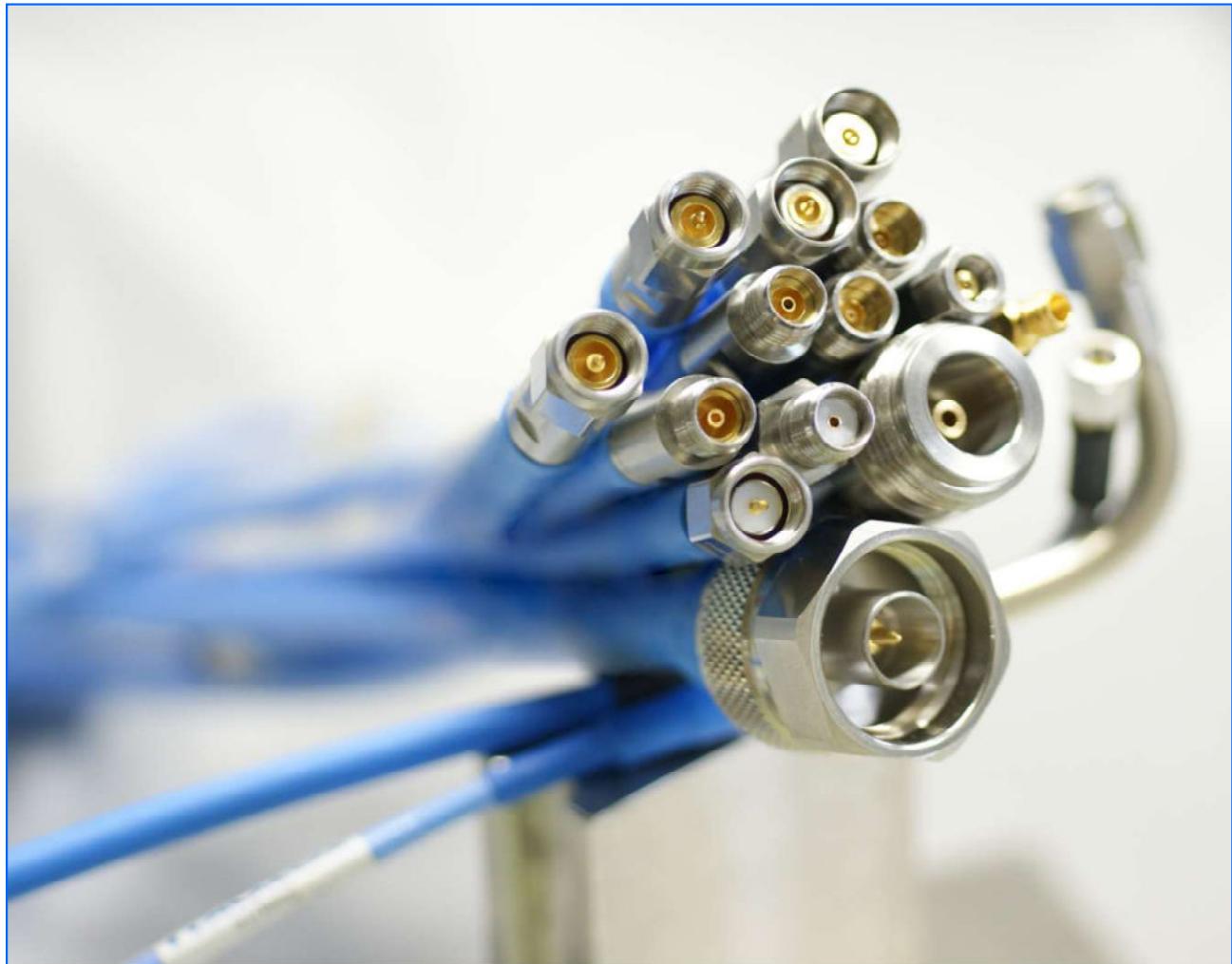


FLEXIBLE COAXIAL CABLE ASSEMBLIES for microwave

マイクロウェーブ用同軸ケーブルアセンブリ

Wavemolle



■ Highly Flexible

■ We released flexible cable assembly supporting 110 GHz first in the world.

■ Mating Flexibility

(It supports

- Plug ⇔ jack conversion
- Connector type conversion
- Different type connector plug ⇔ jack conversion, etc.)

■ Lower Attenuation characteristics

■ Low Reflection characteristics

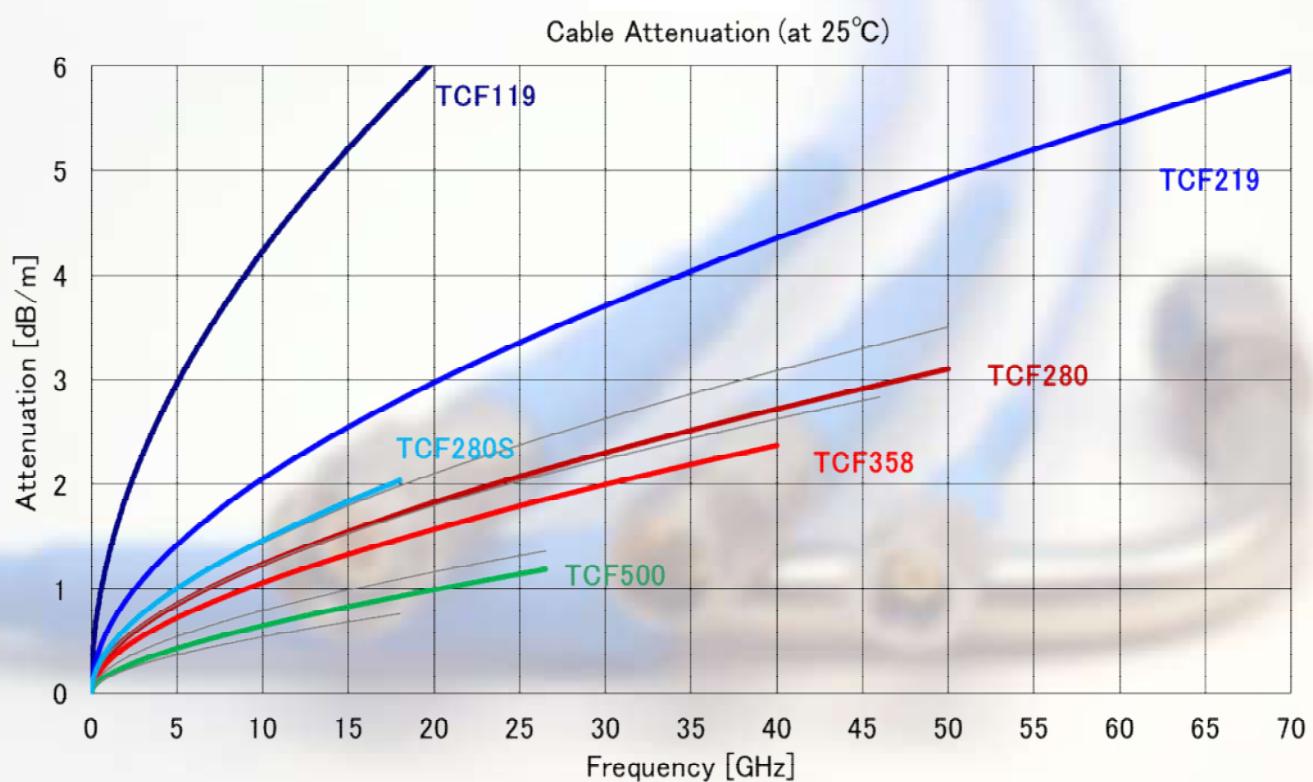
■ Solid Phase Stability over Temperature and Bending

■ It can use for ultra high speed digital signal transmission.

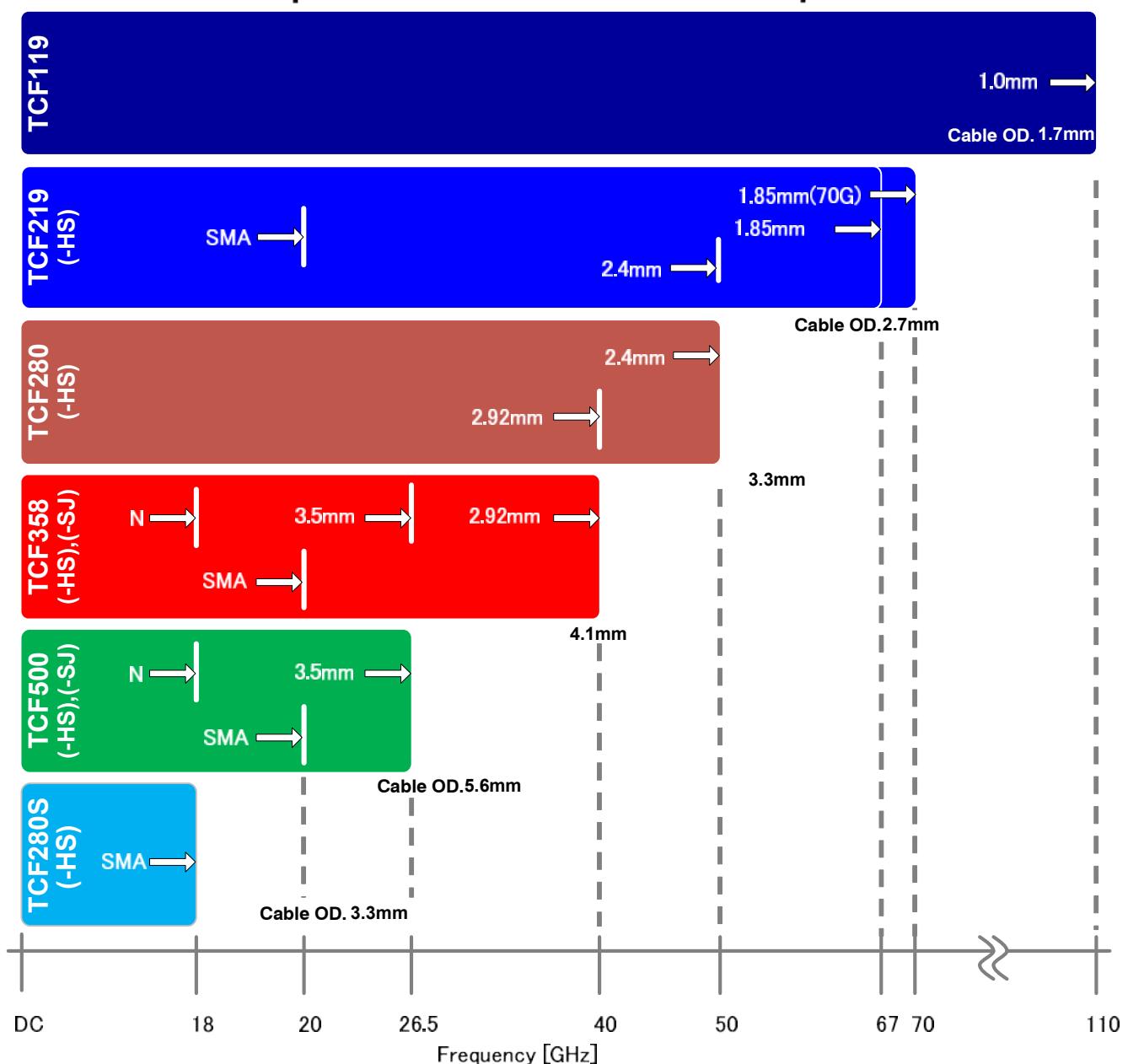
(For differential transmission, it is possible to

- adjust the phase between two or more cables
- absolute phase adjustment.)

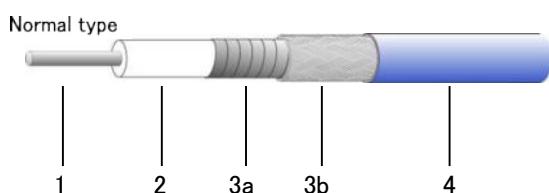
■ Attenuation of cable



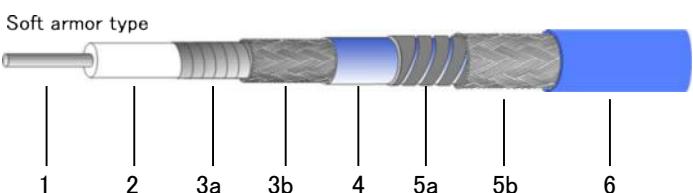
■ Cable Lineup (and connector lineup)



■ Cable Structure



- 1: Inner conductor – Solid silver plated copper (Solid or Stranded)
- 2: Insulation – Porous PTFE
- 3: Outer conductor – a. Silver plated copper tape
b. Silver plated copper braid
- 4: Jacket(Inner sheath) – FEP (blue) , ETFE(TCF280SHS)



- 5: Armor jacket – a. Stainless steel coil (flat wire)
– b. Stainless steel wire braid
- 6: Outer sheath – PVC (blue)

■ Cable specification

Structure details

	Center Conductor	Dielectric	Outer Conductor	(Inner) Sheath		H Armor Outer Sheath		HS Armor Outer Sheath		SJ type (soft jacket)	
	Material	Material	Material	Material	O.D.[mm]	Material	O.D.[mm]	Material	O.D.[mm]	Material	O.D.[mm]
TCF119	Solid SPC	Porous PTFE	Silver plated copper Tape & Braid	FEP (blue)	1.7	—	—	—	—	—	—
TCF219(HS)	Solid SPC			FEP (blue)	2.7	Olefin	7.6	PVC	7.1	—	—
TCF280(HS)	Solid SPC			FEP (blue)	3.3	Olefin	7.6	PVC	7.1	—	—
TCF280S(HS)	Strand SPC			ETFE(gray)	3.3	Olefin	7.6	PVC	7.1	—	—
TCF358(HS)(SJ)	Solid SPC			FEP (blue)	4.1	Olefin	8.6	PVC	7.7	Olefin	(5.2)
TCF500(HS)(SJ)	Solid SPC			FEP (blue)	5.6	Olefin	10.2	PVC	9.2	Olefin	(6.8)

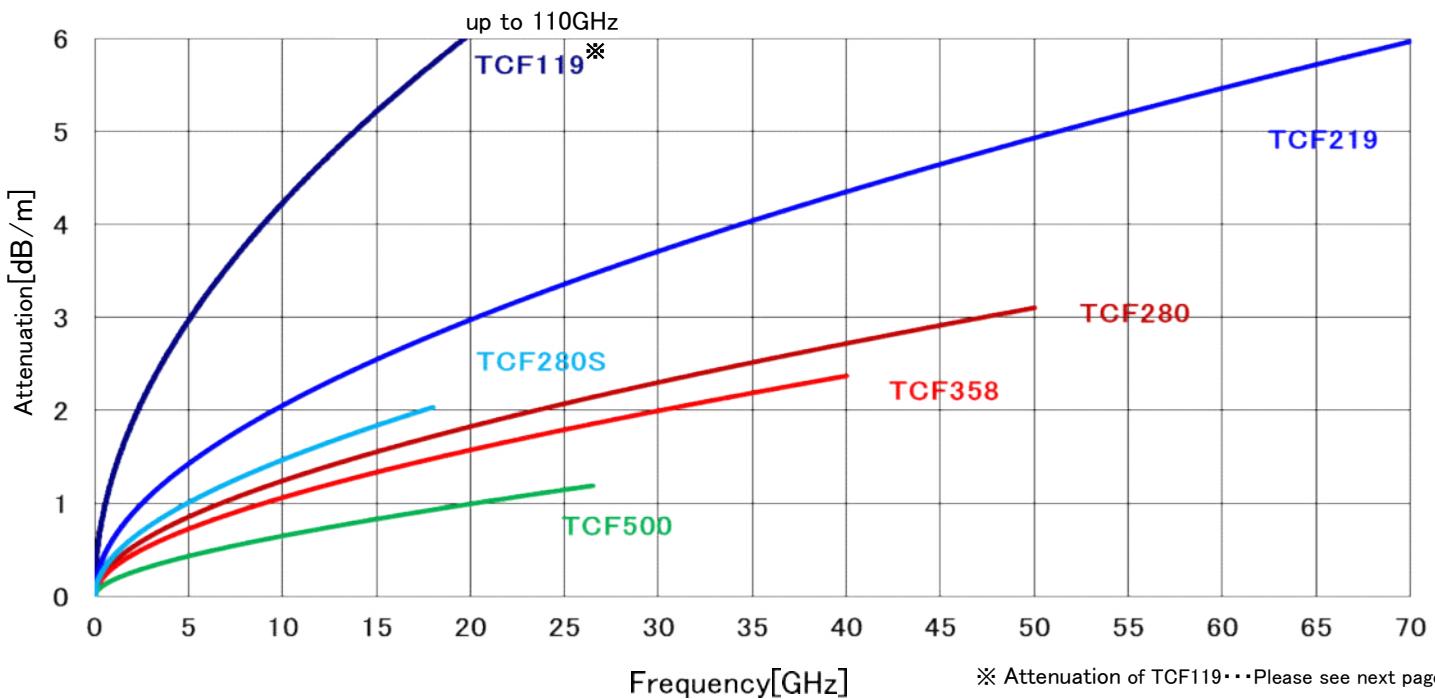
※SPC : Silver plated copper

Electrical, Mechanical characteristics

	Characteris tic impedance	Capacitance	Time Delay	Transmissio n rate	Moding frequency	Min. Bending radius(static)	Temp range			
							without armor	with "H" armor	with "HS" armor	SJ type (Soft Jacket)
TCF119	50	85	4.3	78	134	10	-65 ~ +125	—	—	—
TCF219(HS)	50	85	4.3	78	75	15	-65 ~ +125	-30 ~ +85	-30 ~ +105	—
TCF280(HS)	50	85	4.3	78	52	20	-65 ~ +125	-30 ~ +85	-30 ~ +105	—
TCF280S(HS)	50	85	4.3	78	48	20	-65 ~ +125	-30 ~ +85	-30 ~ +105	—
TCF358(HS)(SJ)	50	85	4.3	78	41	20	-65 ~ +125	-30 ~ +85	-30 ~ +105	-55~+105
TCF500(HS)(SJ)	50	85	4.3	78	27	25	-65 ~ +125	-30 ~ +85	-30 ~ +105	-55~+105

■ Cable attenuation (Nominal)

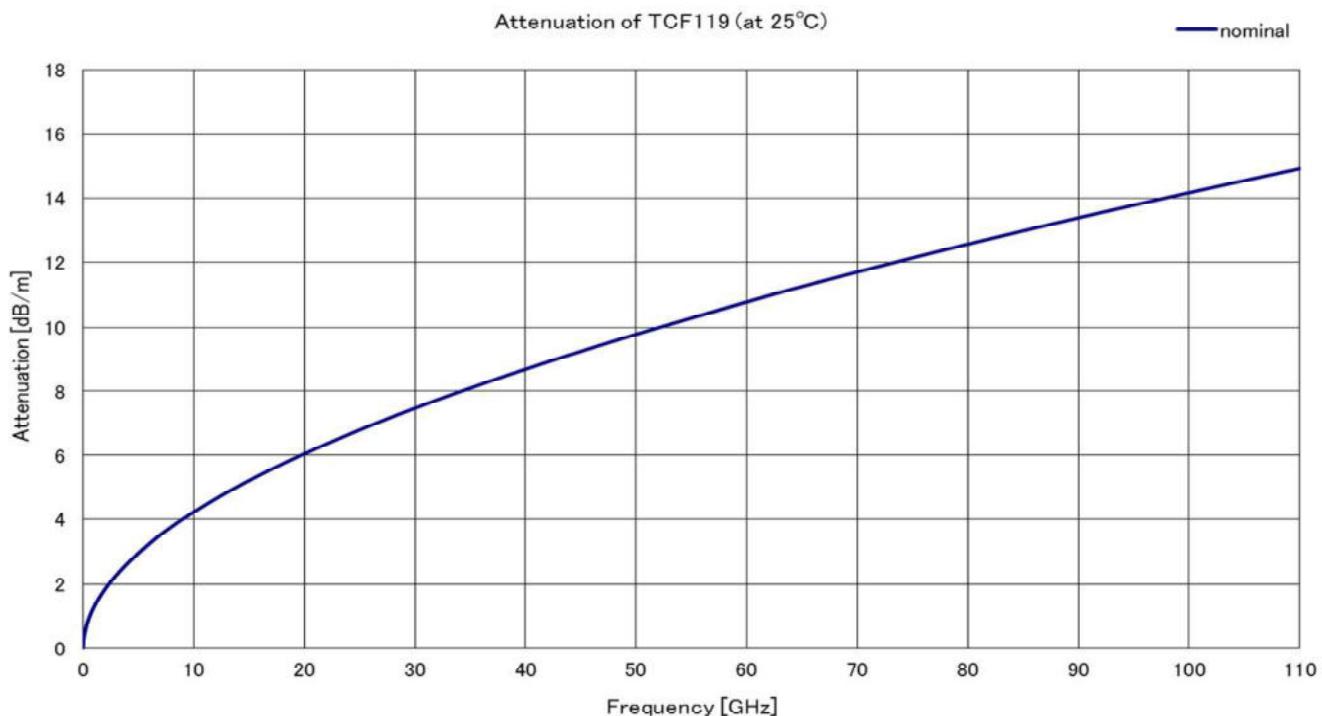
Cable Attenuation (at 25°C)



※ Attenuation of TCF119...Please see next page

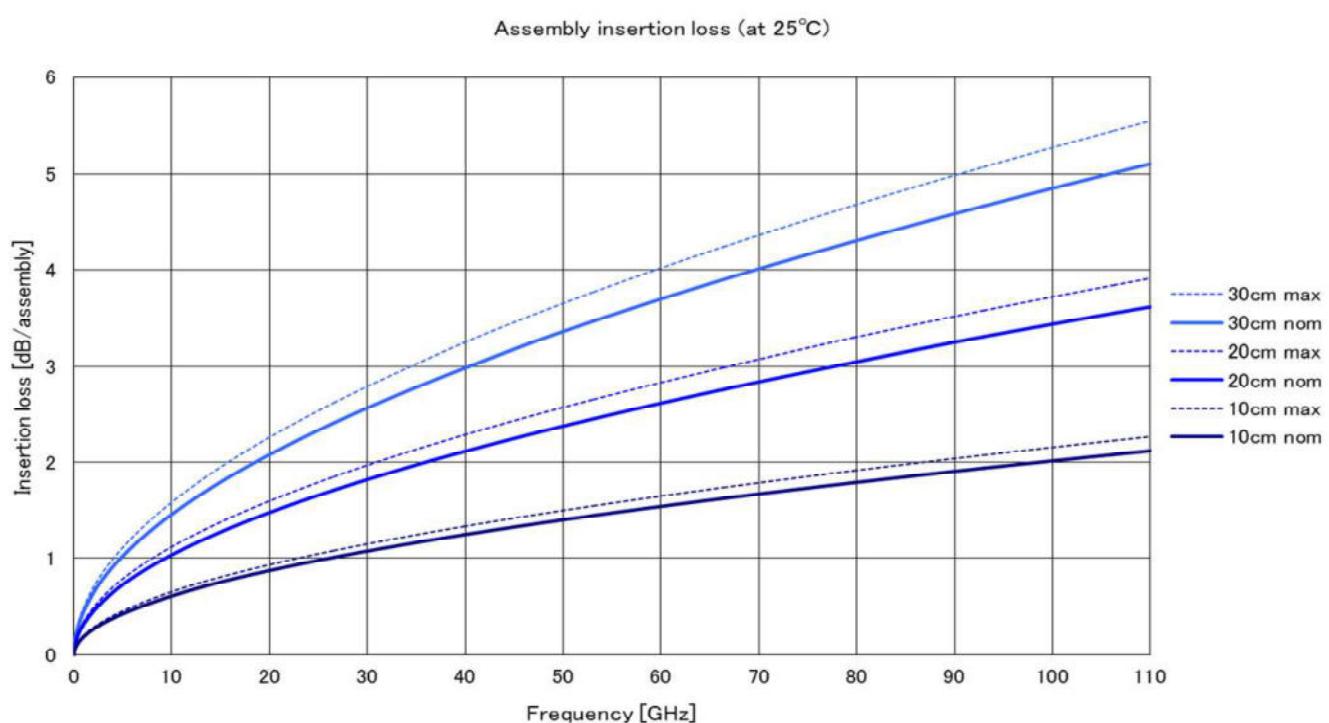
■ Cable attenuation

Cable attenuation (25°C) [dB/m] = Conductor loss coefficient * \sqrt{f} [GHz] + Dielectric loss coefficient * f [GHz]
 1.300 (typical) × \sqrt{f} [GHz] + 0.0117 (typical) × f [GHz]



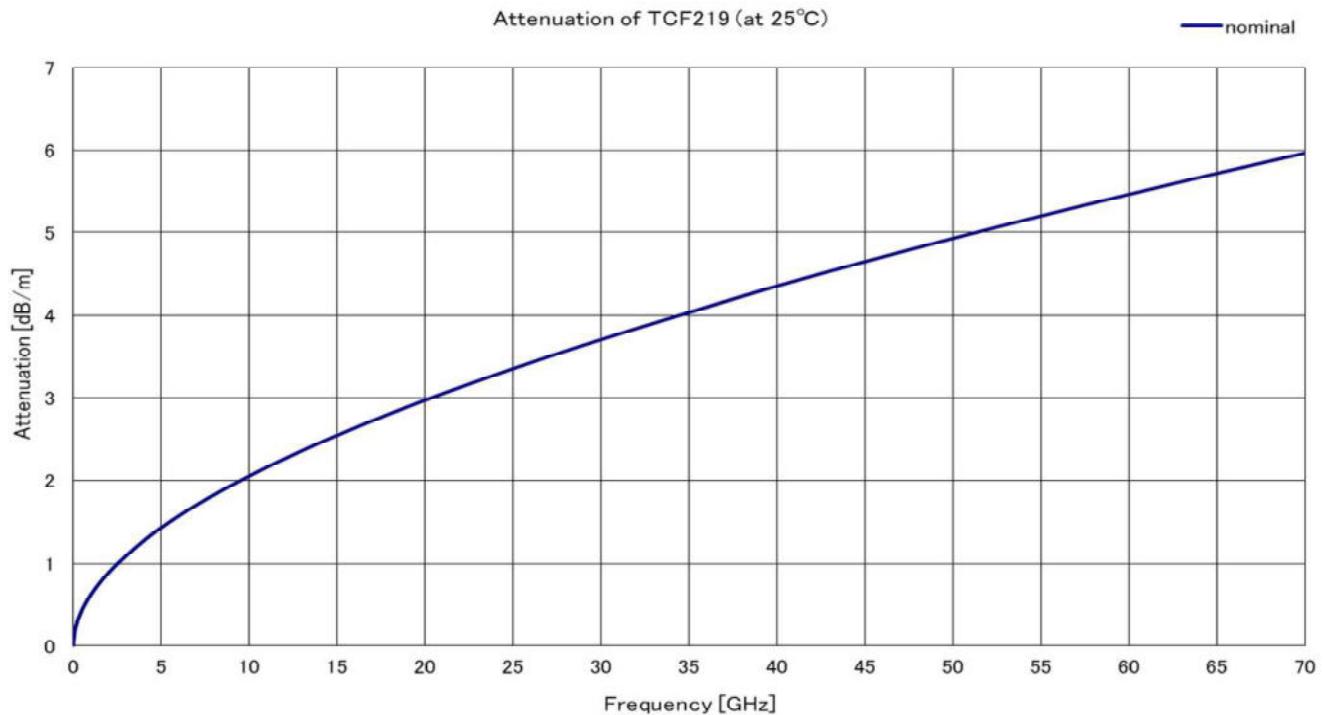
■ Assembly insertion loss

Assembly insertion loss (25°C) = Cable attenuation (25°C) * assembly length + 0.06 * \sqrt{f} [GHz]



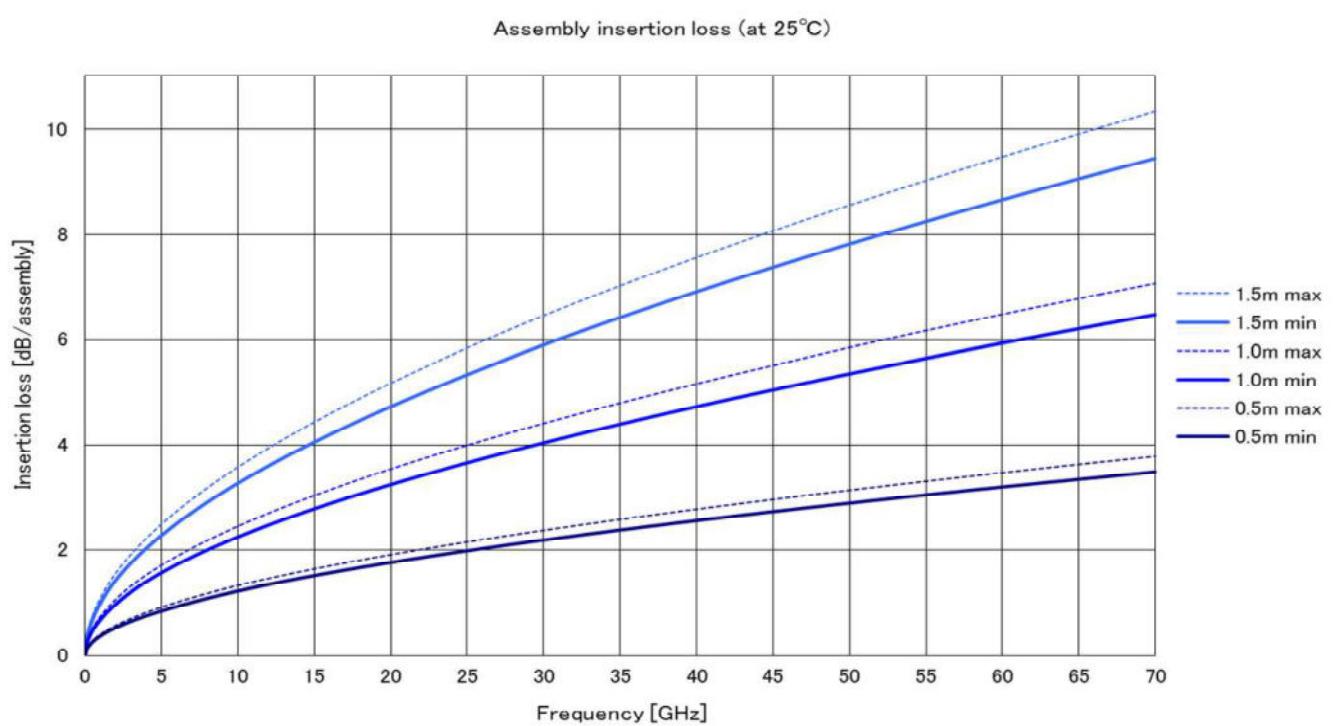
■ Cable attenuation

Cable attenuation (25°C) [dB/m] = Conductor loss coefficient * \sqrt{f} [GHz] + Dielectric loss coefficient * f [GHz]
 0.610 (typical) × \sqrt{f} [GHz] + 0.0123 (typical) × f [GHz]



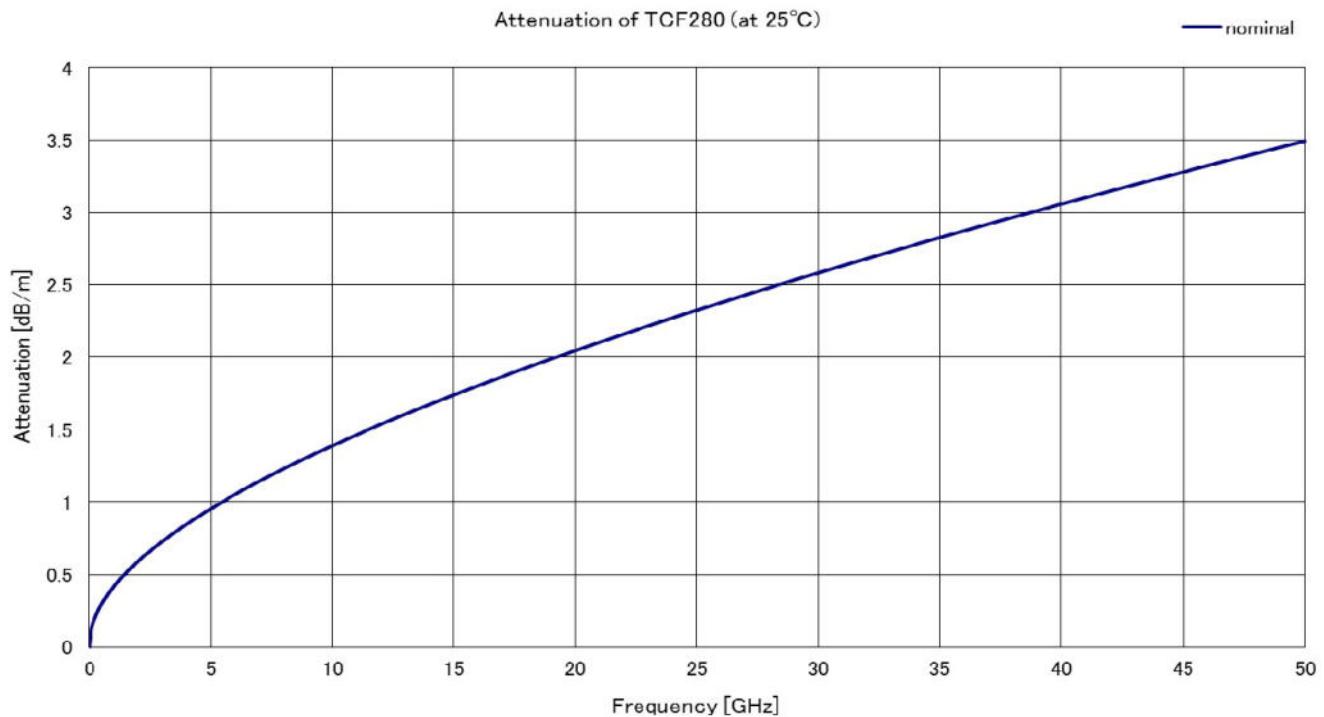
■ Assembly insertion loss

Assembly insertion loss (25°C) = Cable attenuation (25°C) * assembly length + 0.06 * \sqrt{f} [GHz]



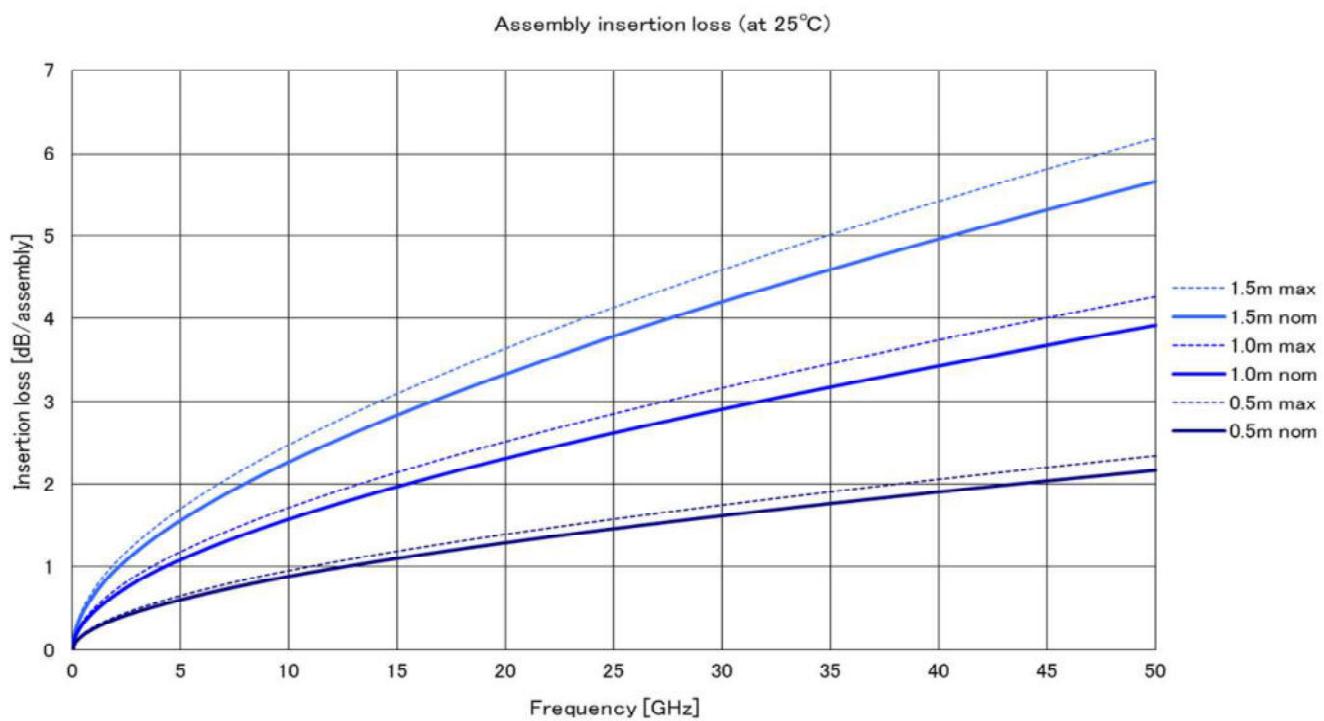
■ Cable attenuation

Cable attenuation (25°C) [dB/m] = Conductor loss coefficient * \sqrt{f} [GHz] + Dielectric loss coefficient * f [GHz]
 0.395 (typical) $\times \sqrt{f}$ [GHz] + 0.0140 (typical) $\times f$ [GHz]



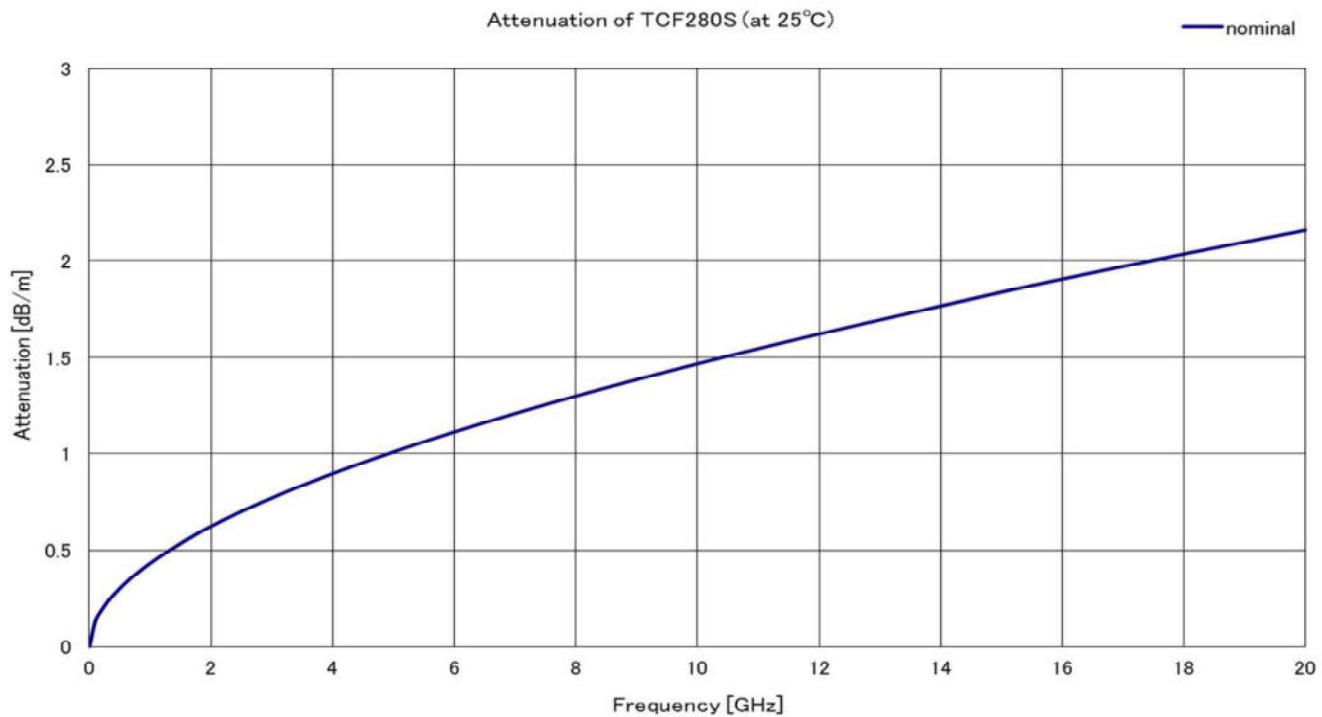
■ Assembly insertion loss

Assembly insertion loss (25°C) = Cable attenuation (25°C) * assembly length + 0.06 * \sqrt{f} [GHz]



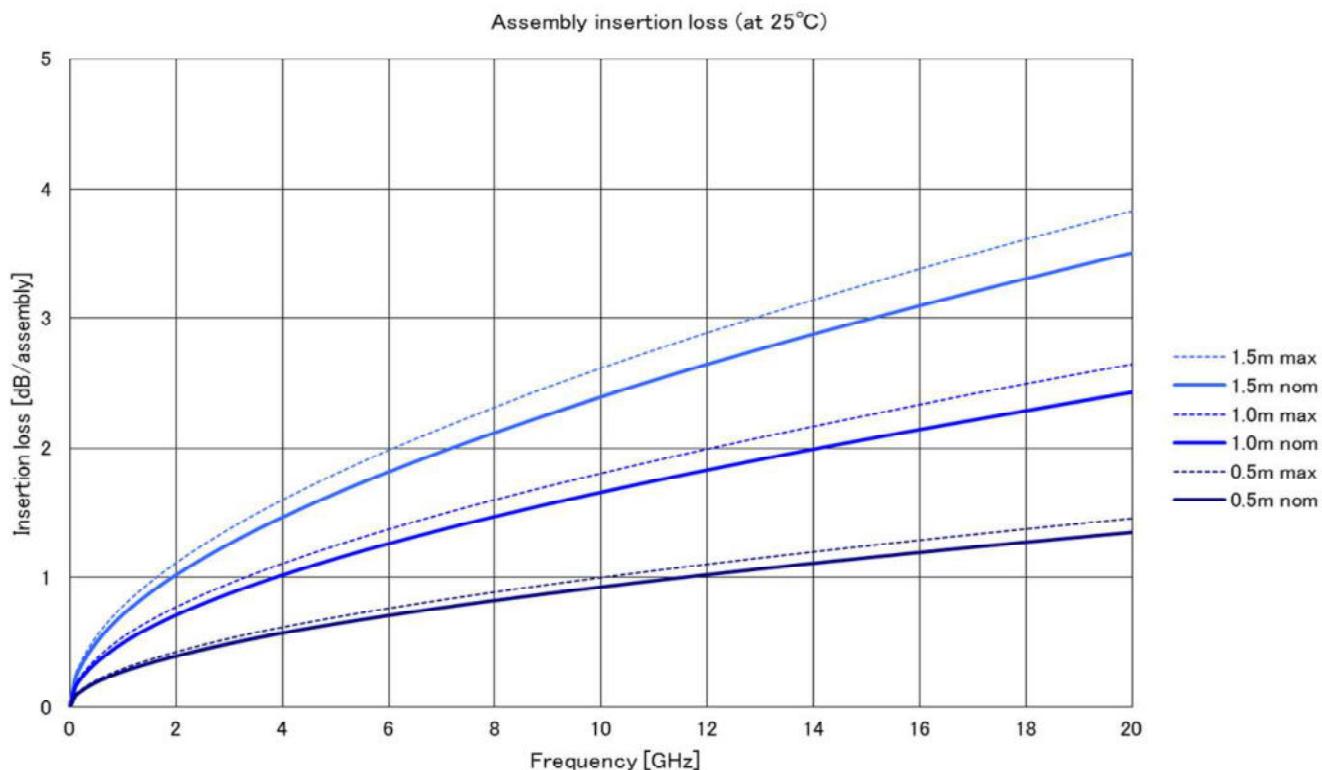
■ Cable attenuation

Cable attenuation (25°C) [dB/m] = Conductor loss coefficient * \sqrt{f} [GHz] + Dielectric loss coefficient * f [GHz]
 $0.420 \text{ (typical)} \times \sqrt{f} \text{ [GHz]}$ $+ 0.0140 \text{ (typical)} \times f \text{ [GHz]}$



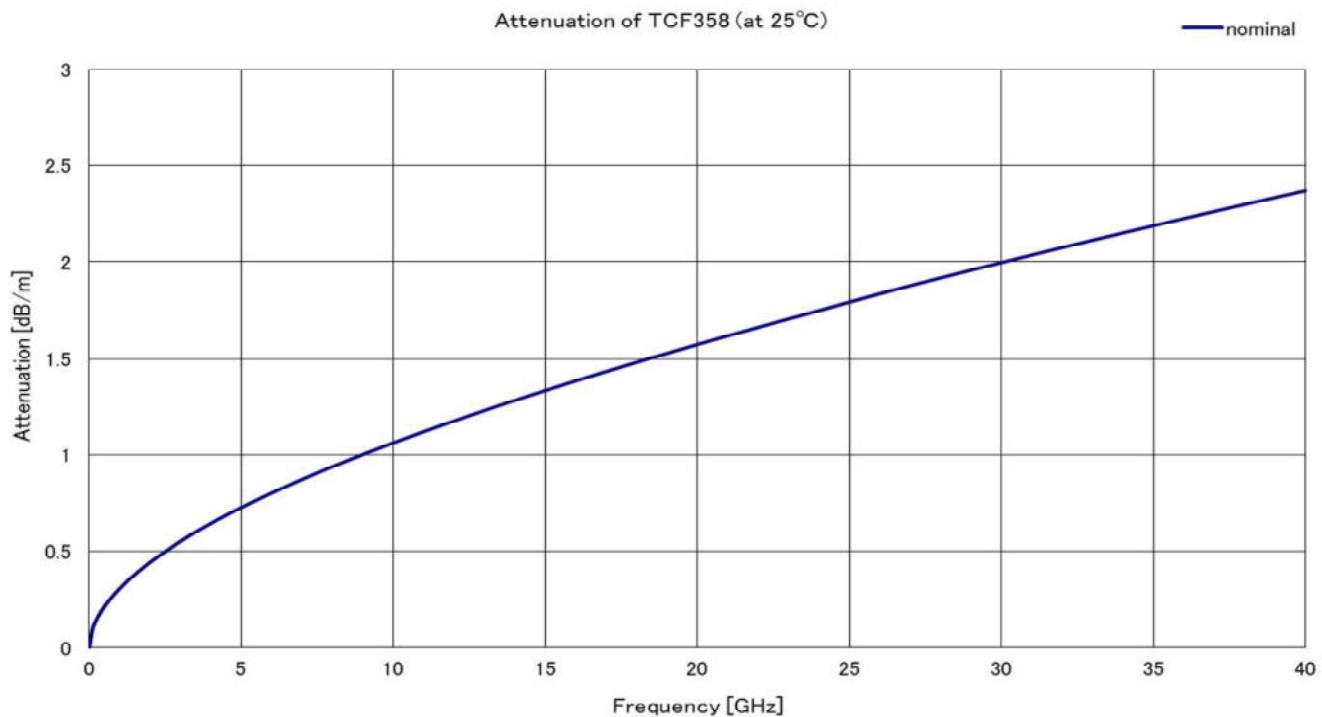
■ Assembly insertion loss

Assembly insertion loss (25°C) = Cable attenuation (25°C) * assembly length + $0.06 \times \sqrt{f}$ [GHz]



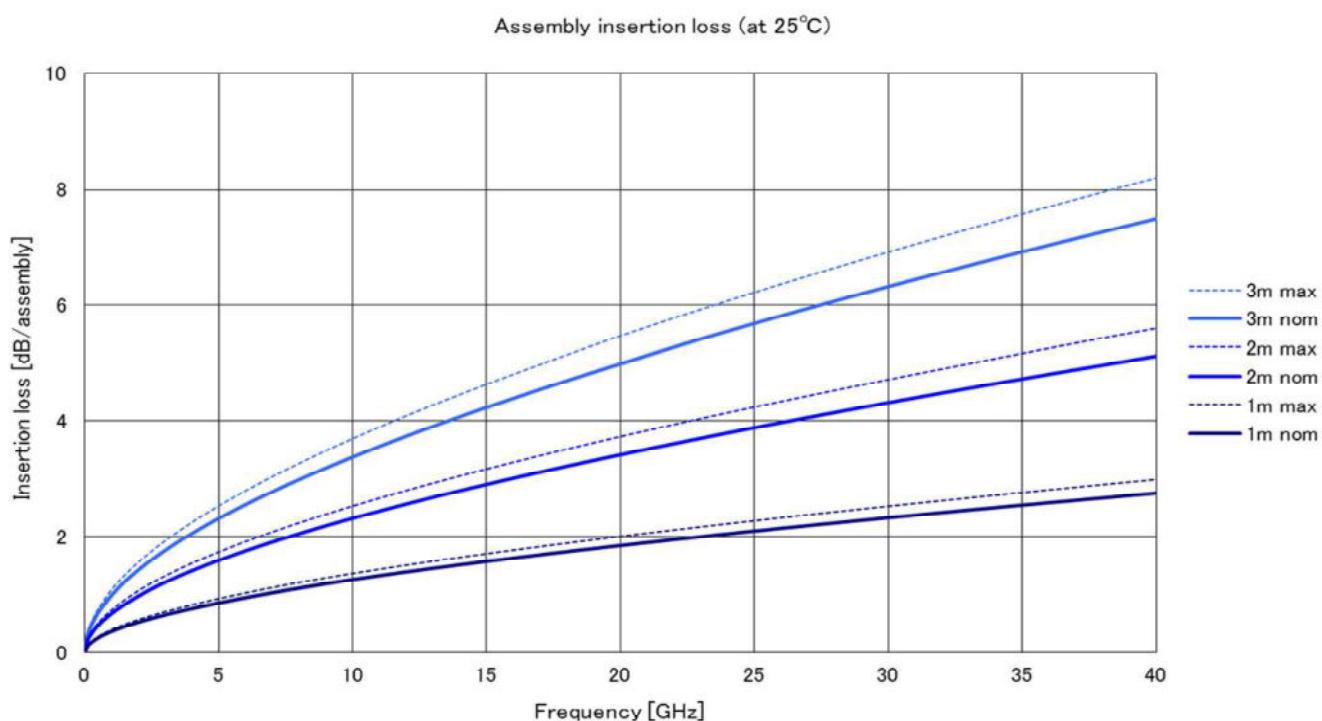
■ Cable attenuation

Cable attenuation (25°C) [dB/m] = Conductor loss coefficient * \sqrt{f} [GHz] + Dielectric loss coefficient * f [GHz]
 $0.297 \text{ (typical)} \times \sqrt{f} \text{ [GHz]} + 0.0123 \text{ (typical)} \times f \text{ [GHz]}$



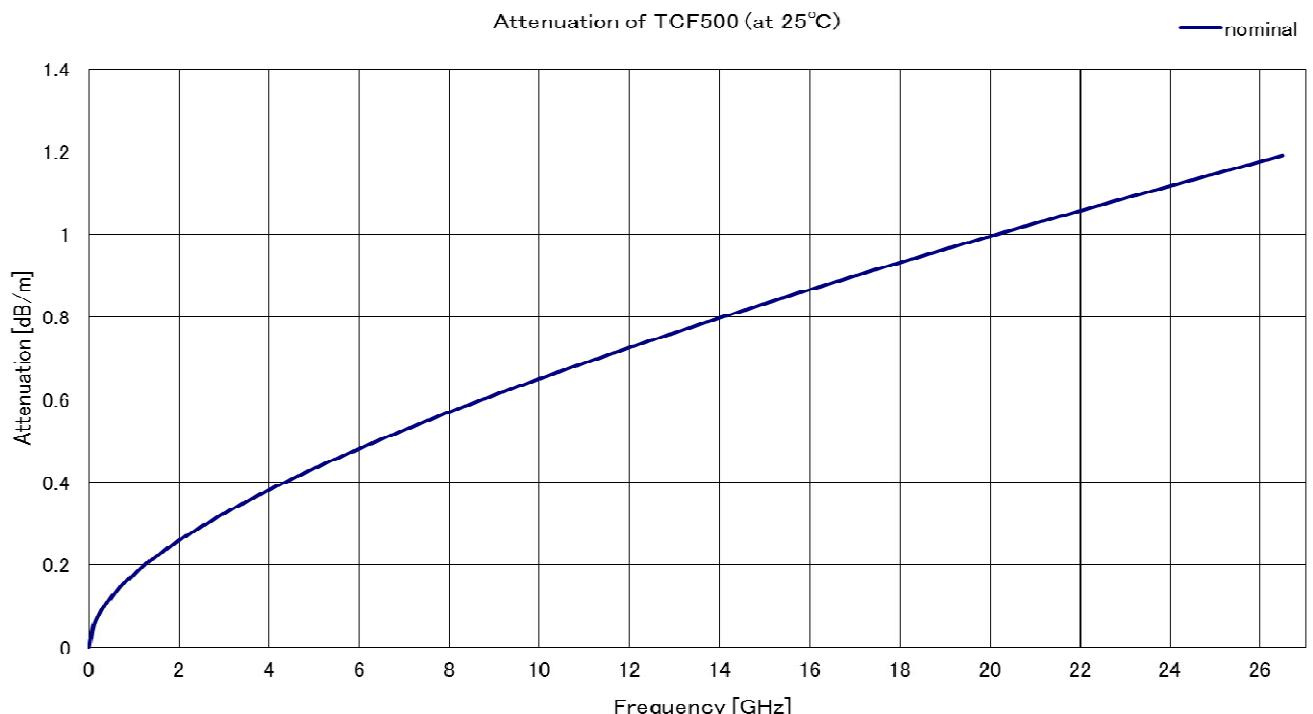
■ Assembly insertion loss

Assembly insertion loss (25°C) = Cable attenuation (25°C) * assembly length + 0.06 * \sqrt{f} [GHz]



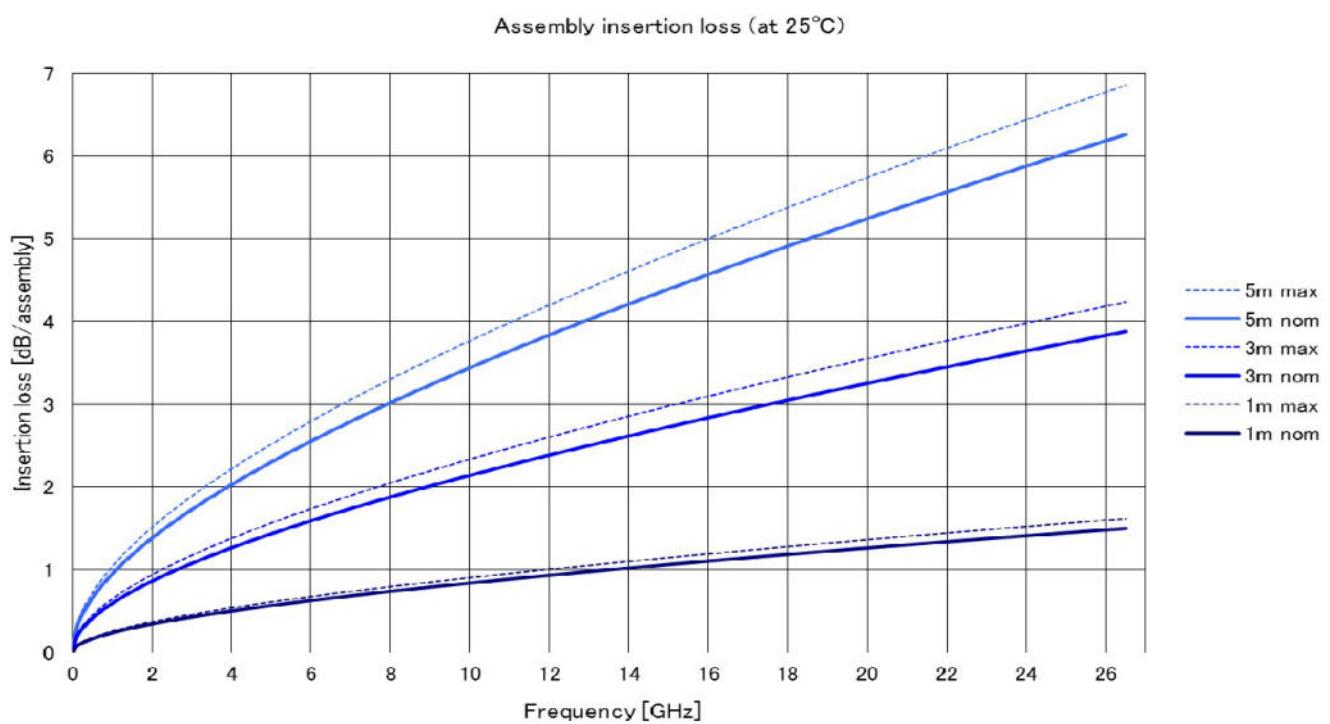
■ Cable attenuation

Cable attenuation (25°C) [dB/m] = Conductor loss coefficient * \sqrt{f} [GHz] + Dielectric loss coefficient * f [GHz]
 0.165 (typical) × \sqrt{f} [GHz] + 0.0129 (typical) × f [GHz]

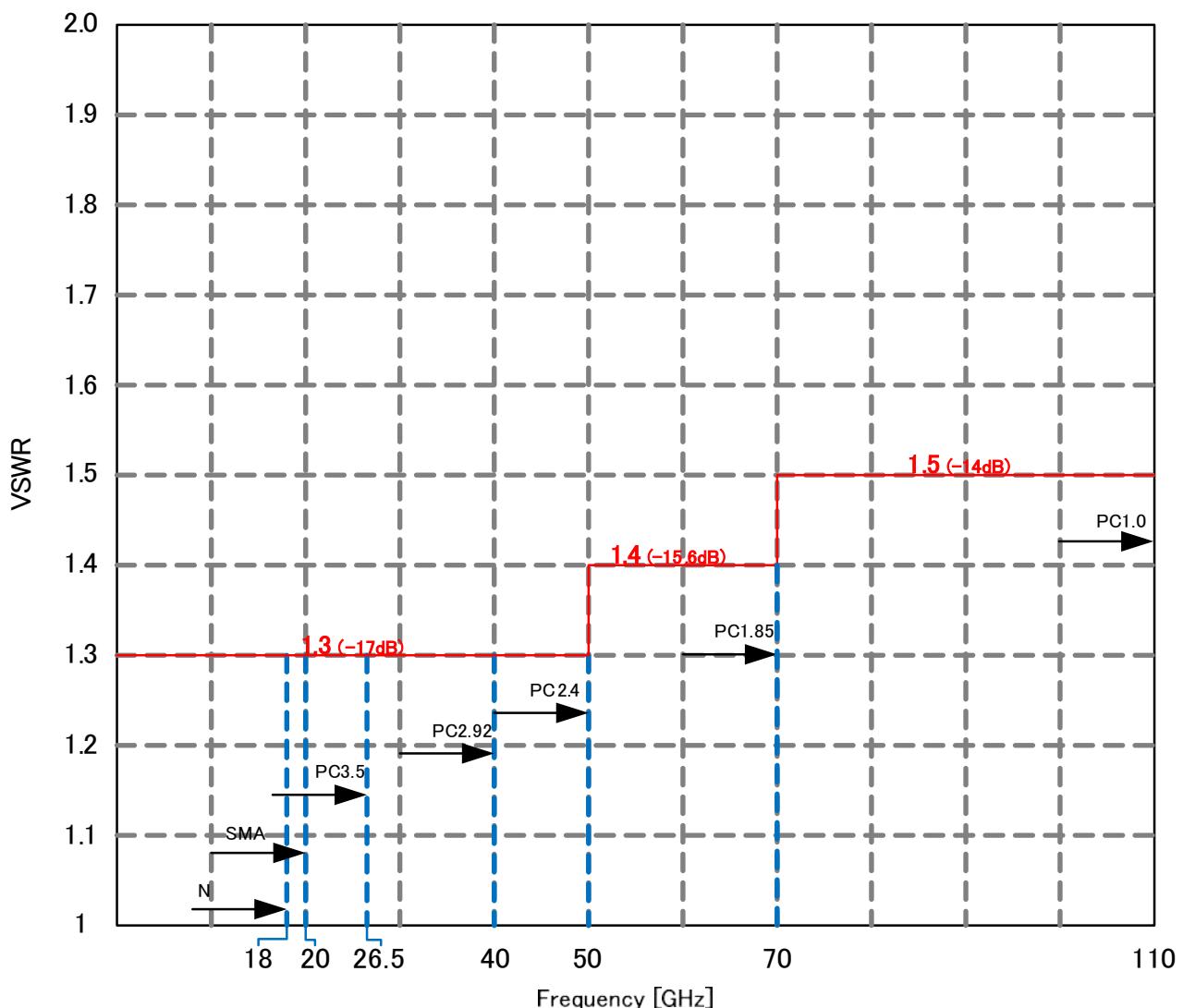


■ Assembly insertion loss

Assembly insertion loss (25°C) = Cable attenuation (25°C) * assembly length + 0.06 * \sqrt{f} [GHz]



■ VSWR Spec



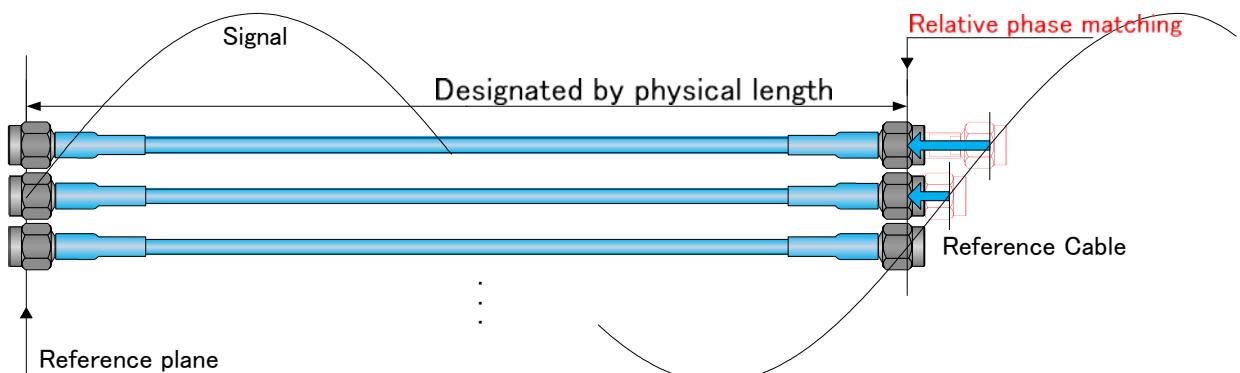
■ Phase matching assemblies technology

Phase matching in two or more cable assemblies is available before delivery. An additional work is done by the method of connecting the cable and the connector of original TOTOKU after a strict phase is measured, and the adjustment to the electrical length of hope and two or more phase matching are done.

There is no uselessness of the cable and the connector depending on an original connection method, and the offer by the low price is possible.

Relative phase matching

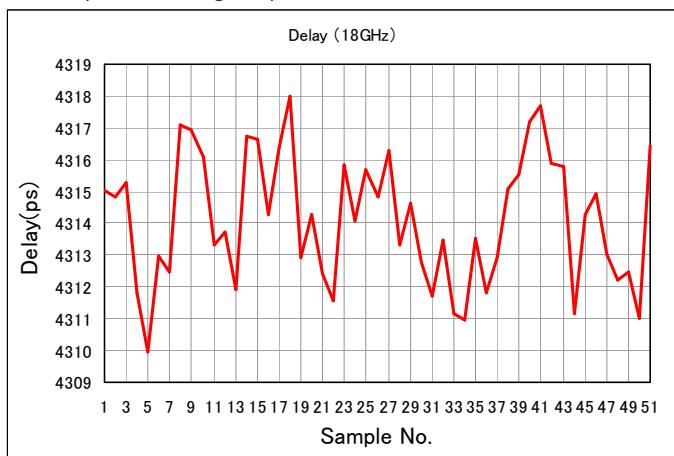
Phase matching in two or more cable assemblies



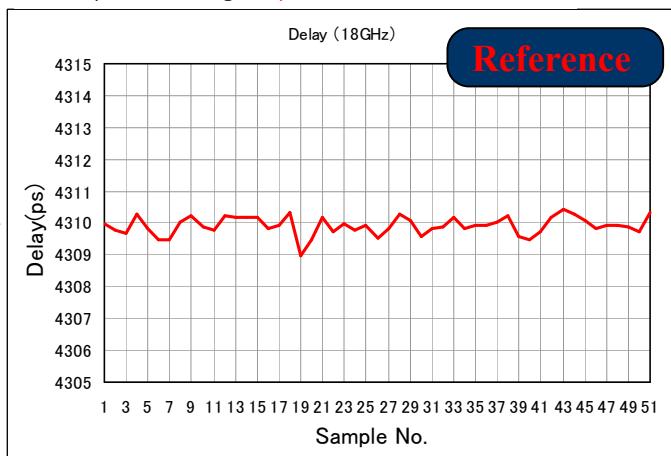
Phase (Electrical length) matching of 51 assemblies is enumerated as an example.

51 assemblies Assembly length:1m Measure frequency:18GHz

BEFORE phase matching $\pm 5\text{ps}$ / 51assemblies

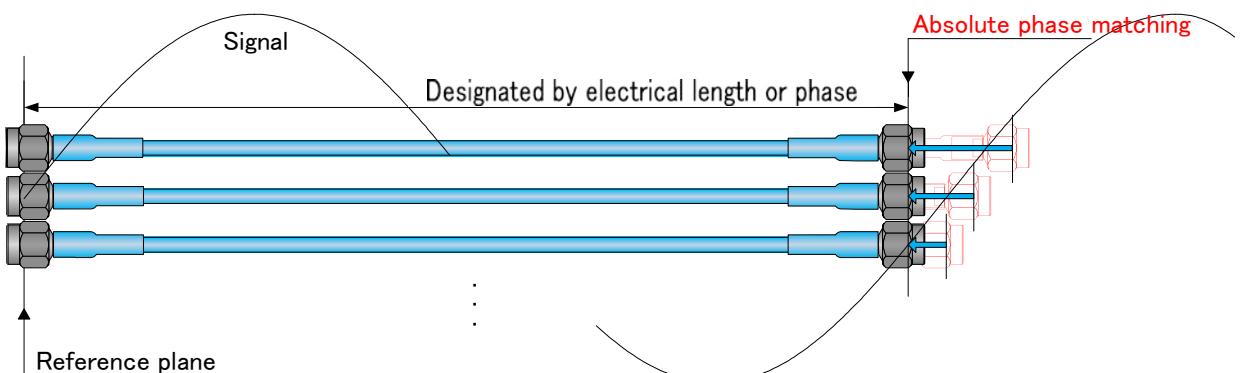


AFTER phase matching $\pm 1\text{ps}$ / 51assemblies



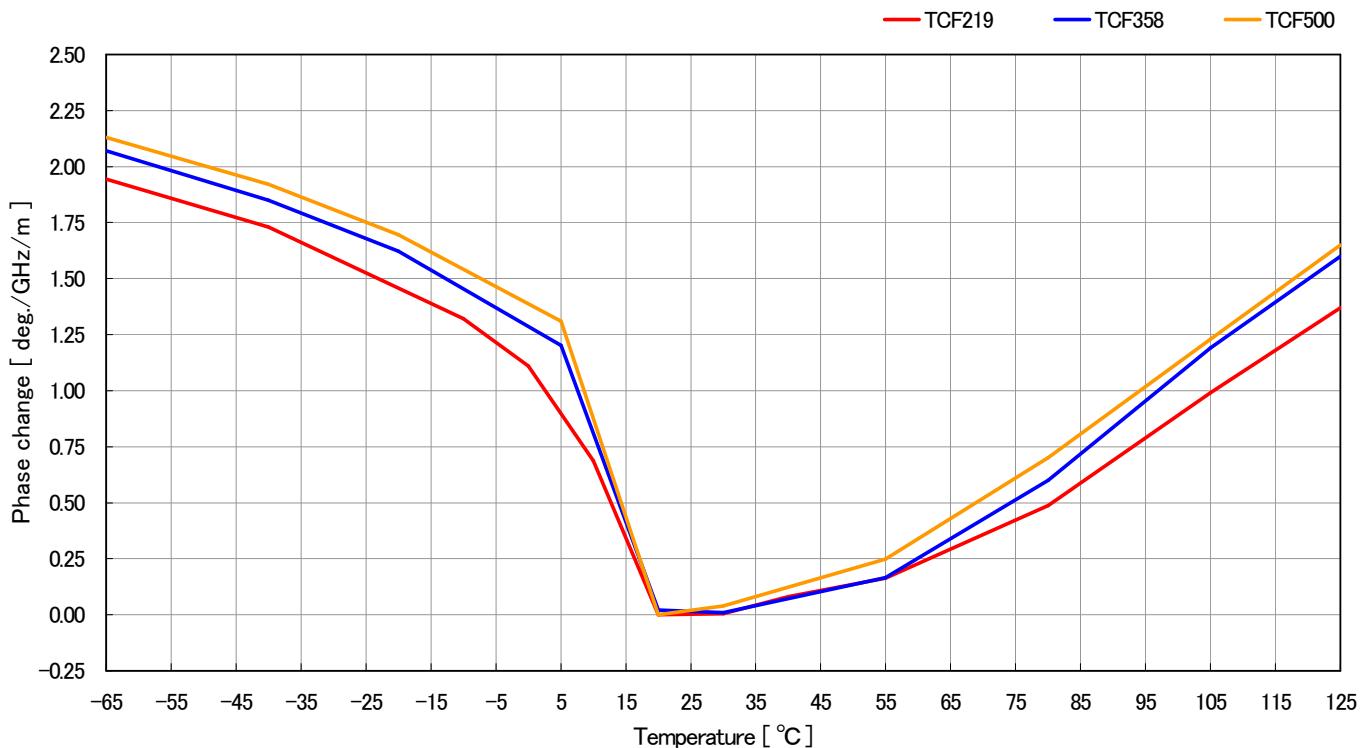
Absolute phase matching

Appoint the electrical length.



■ Phase variation for temperature change

Phase variation for temperature change of Wavemolle (TCF Cable Assembly)



■ Phase change After bending

【Test method】

①before the test



②during the test



③after the test



①before the test

②during the test($\phi 100$ 360° bending)

③after the test

②during the test($\phi 60$ 360° bending)

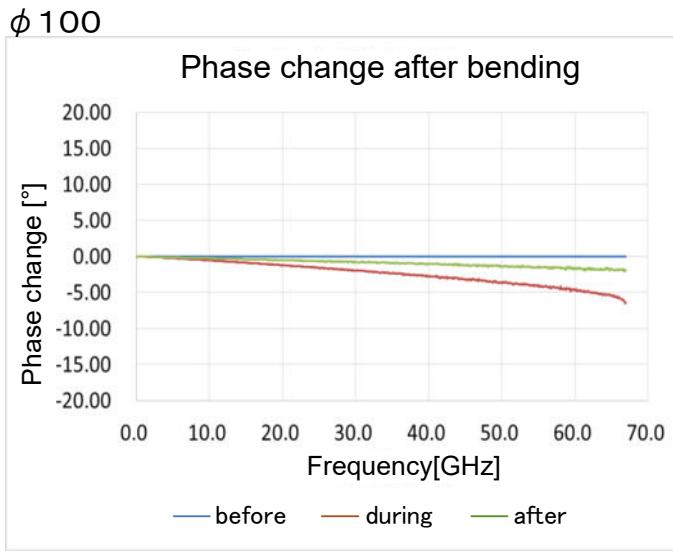
③after the test

②during the test($\phi 40$ or $\phi 30$ 360° bending)

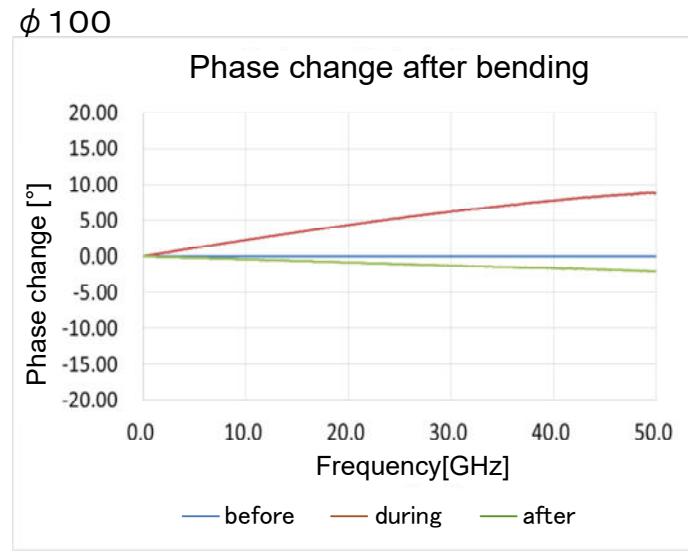
③after the test

Measured each phase change.

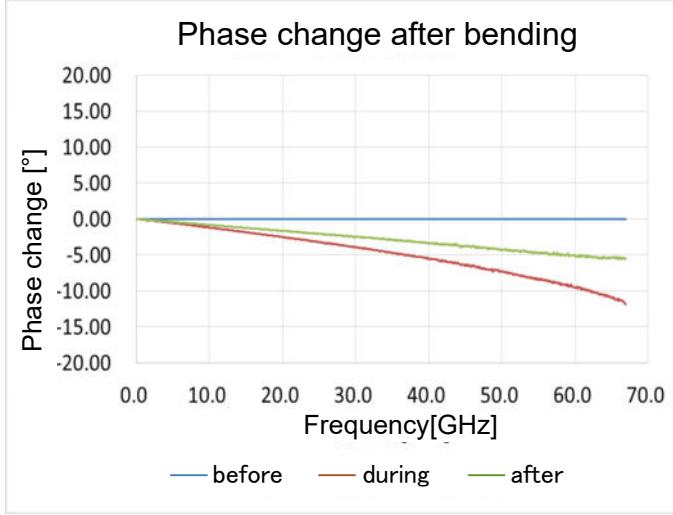
【TCF219】



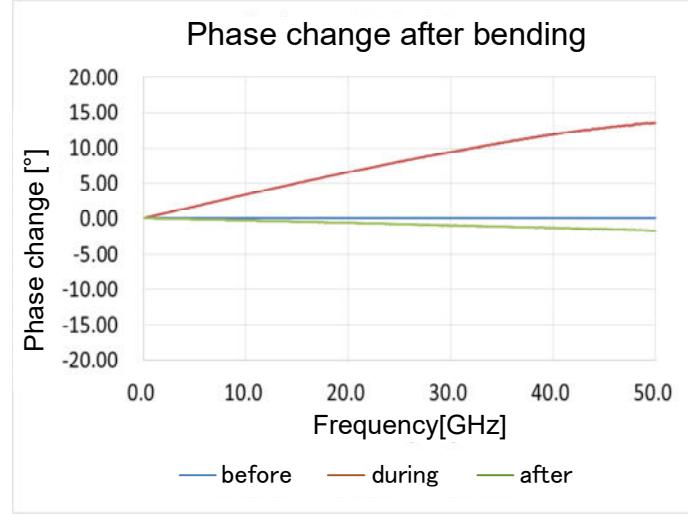
【TCF280】



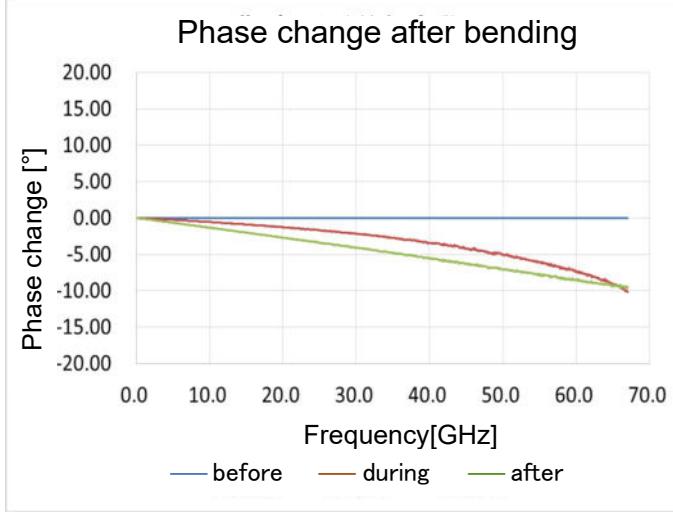
$\phi 60$



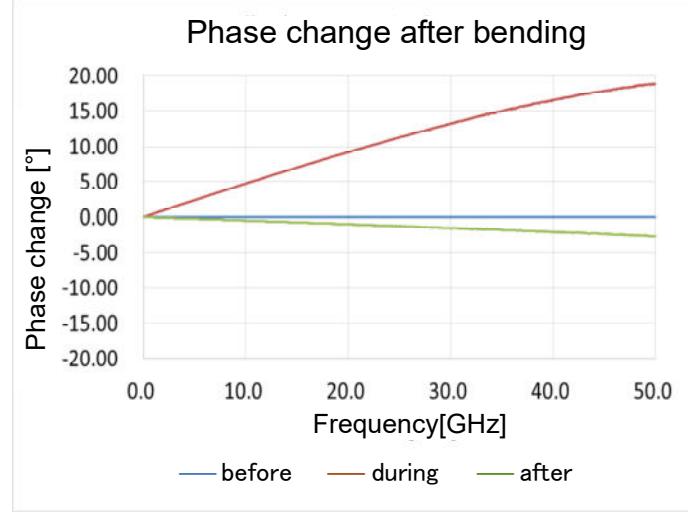
$\phi 60$



$\phi 30$

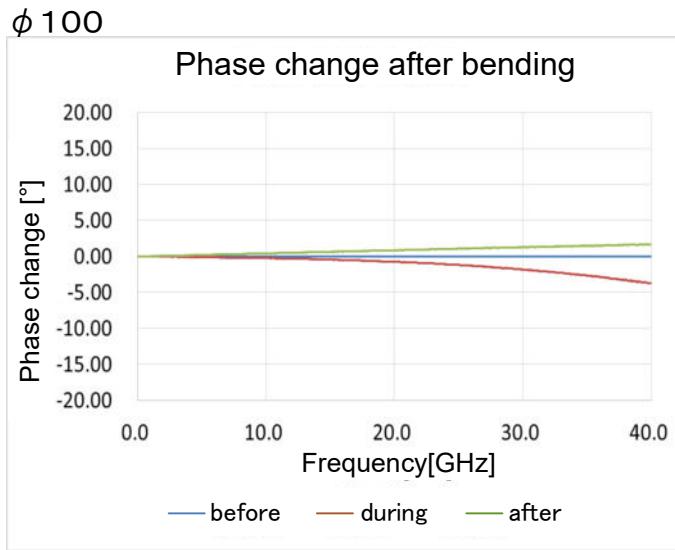


$\phi 40$

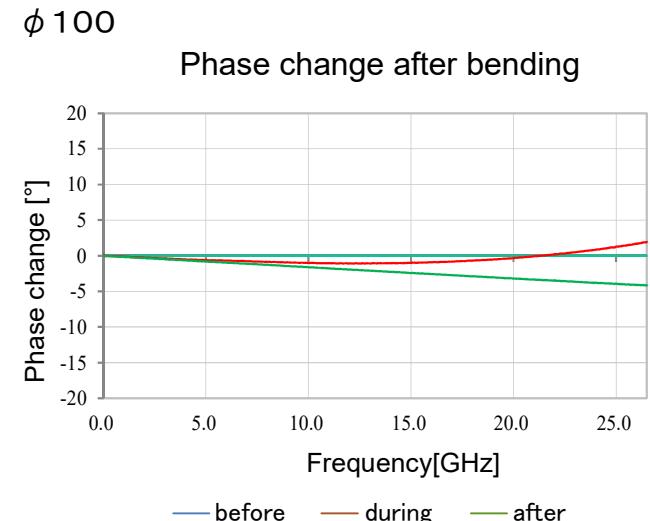


※ Reference date for Phase change is measured values, not guarantee values.

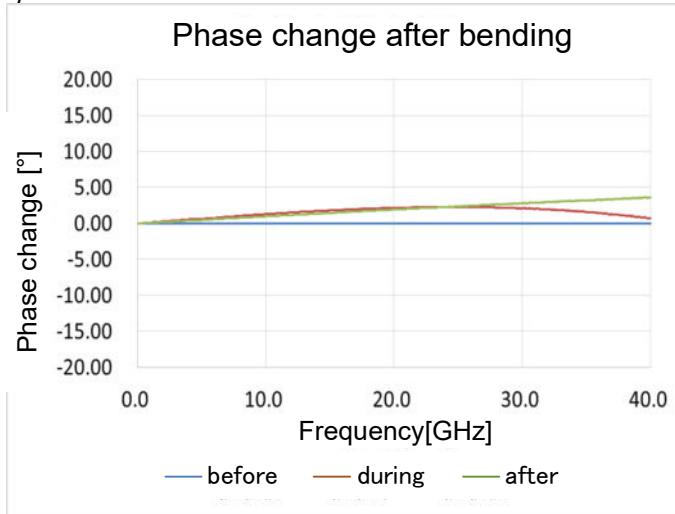
【TCF358】



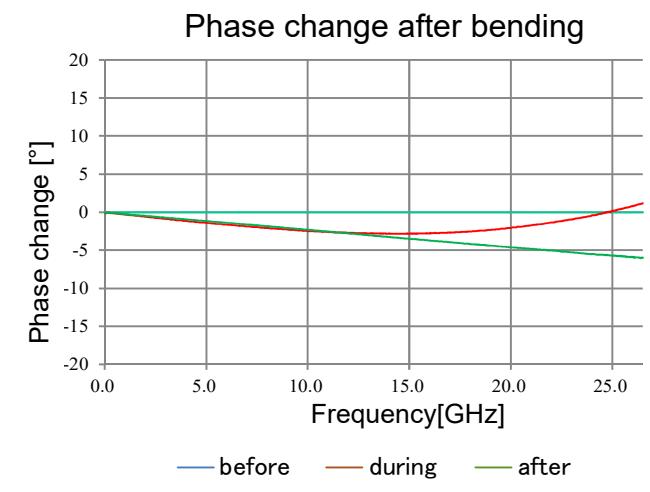
【TCF500】



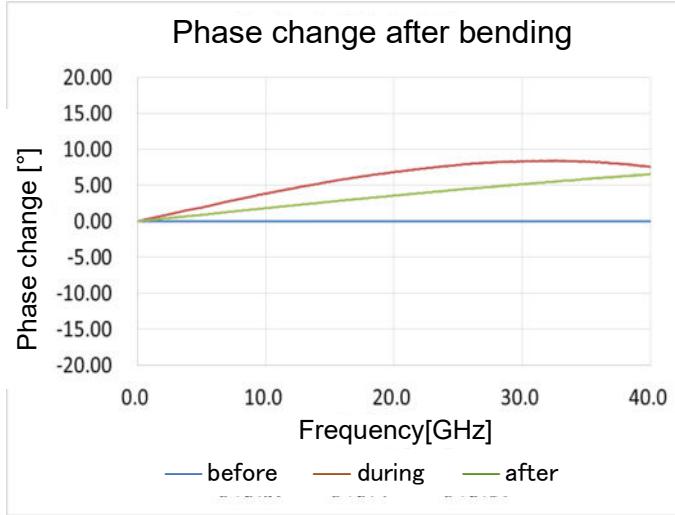
$\phi 60$



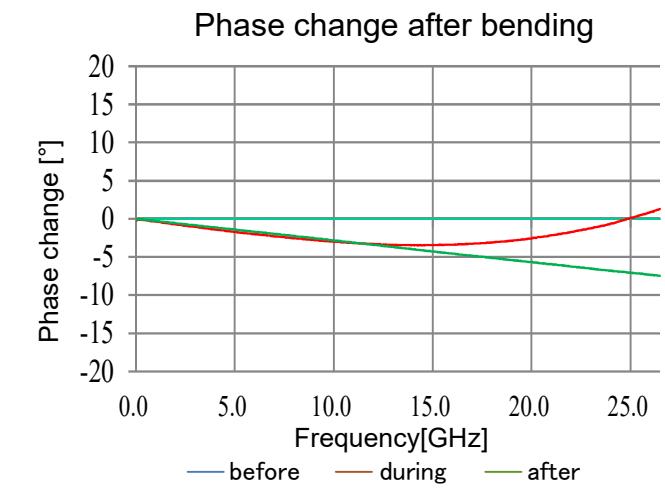
$\phi 60$



$\phi 40$

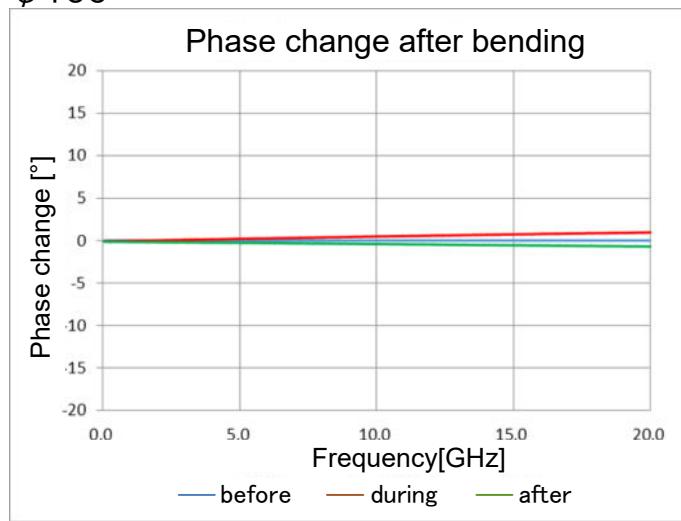
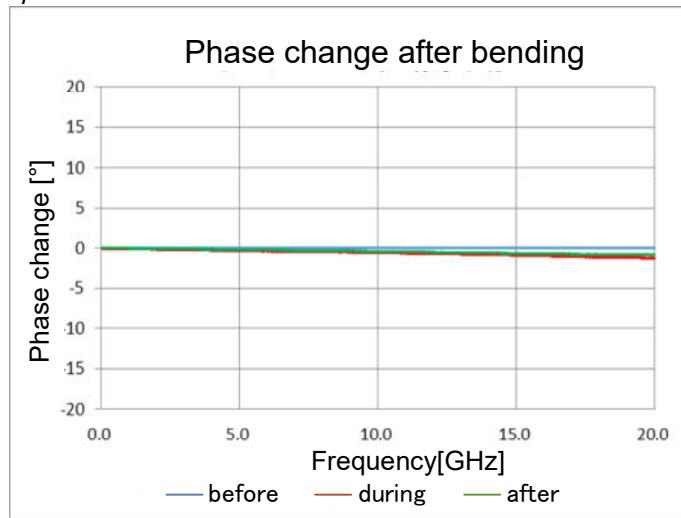
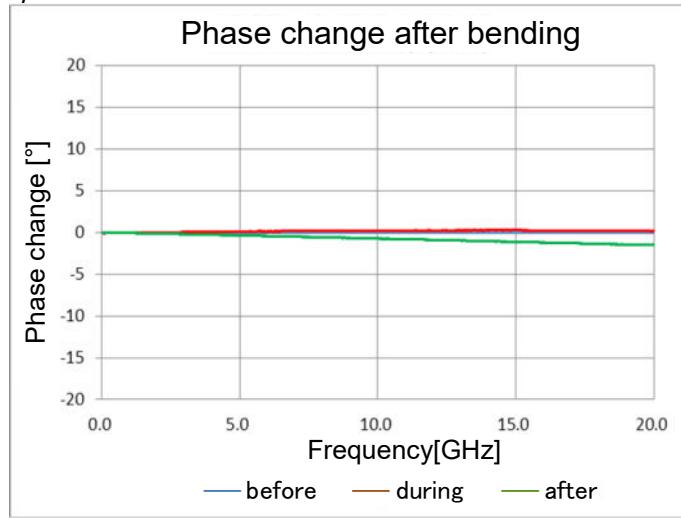


$\phi 50$



※ Reference date for Phase change is measured values, not guarantee values.

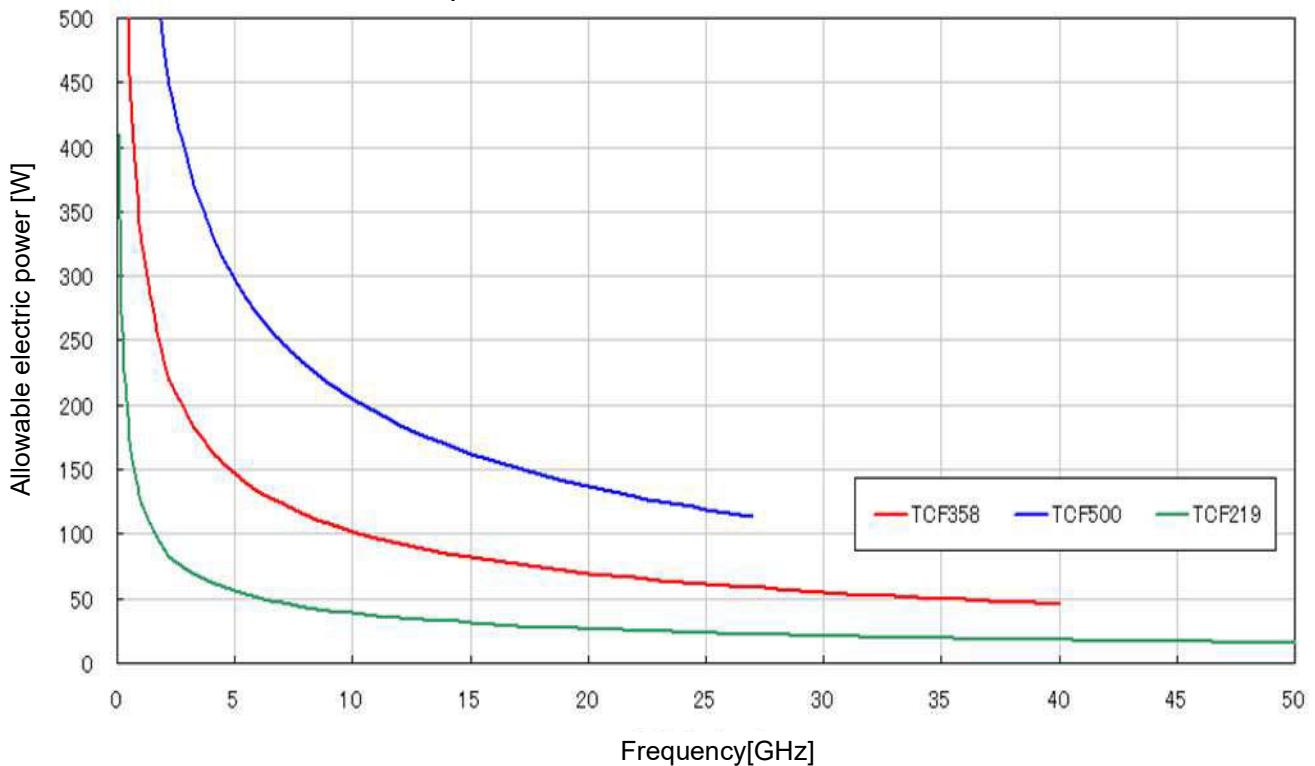
[TCF280SHS]

 $\phi 100$  $\phi 60$  $\phi 40$ 

※ Reference date for Phase change is measured values, not guarantee values.

■ Maximum C.W. power of cables

(at +25°C ambient temperature and sea level)



■ Lateral pressure performance

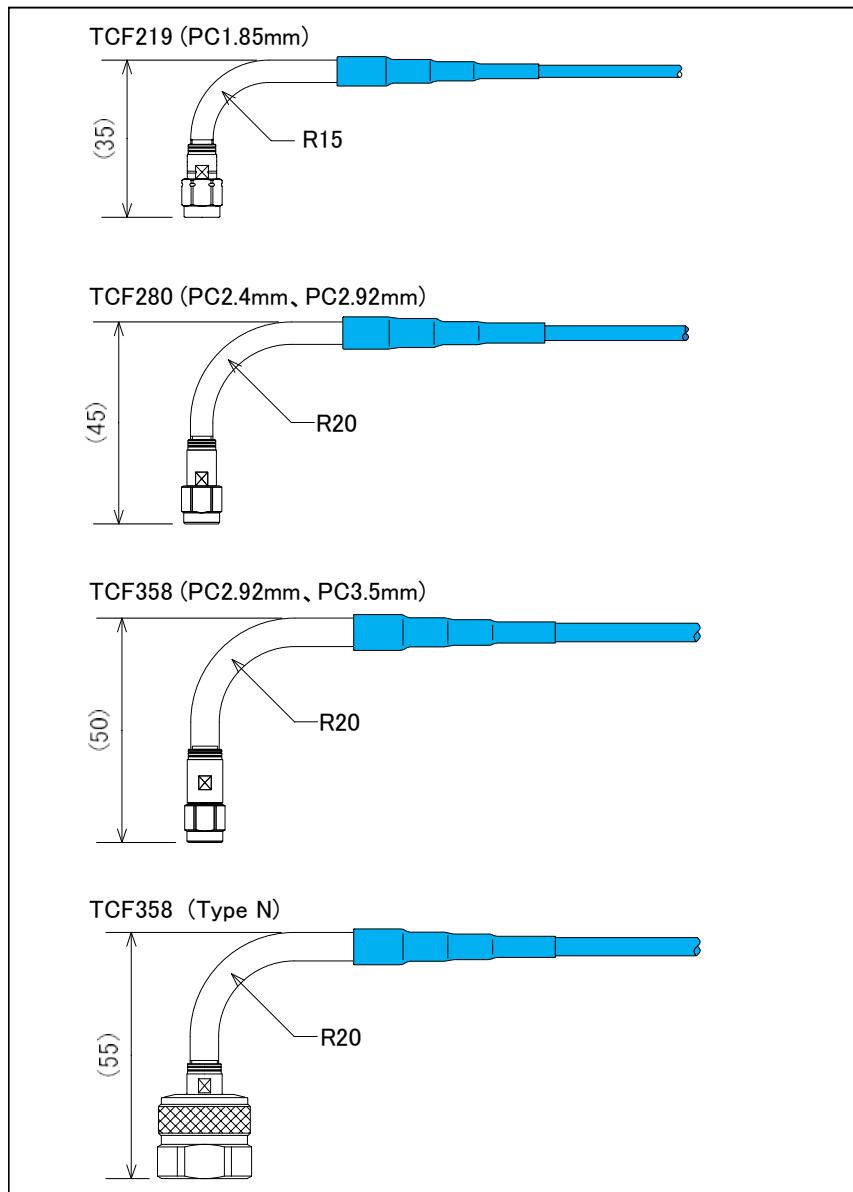
TOTOKU cable type	Armor type	Lateral pressure performance typical(N/cm) *1,2
TCF358	Normal	47
TCF500	Normal	65
TCF280	Normal	36
TCF219	Normal	29
TCF358H	Standard armor	770
TCF500H	Standard armor	690
TCF358HS	Soft armor	500
TCF500HS	Soft armor	370
TCF280HS	Soft armor	400
TCF219HS	Soft armor	430
TCF119	Soft armor	330

*1 Data shows typical values, not guaranteed values.

*2 It is the force that the electrical characteristic can secure.

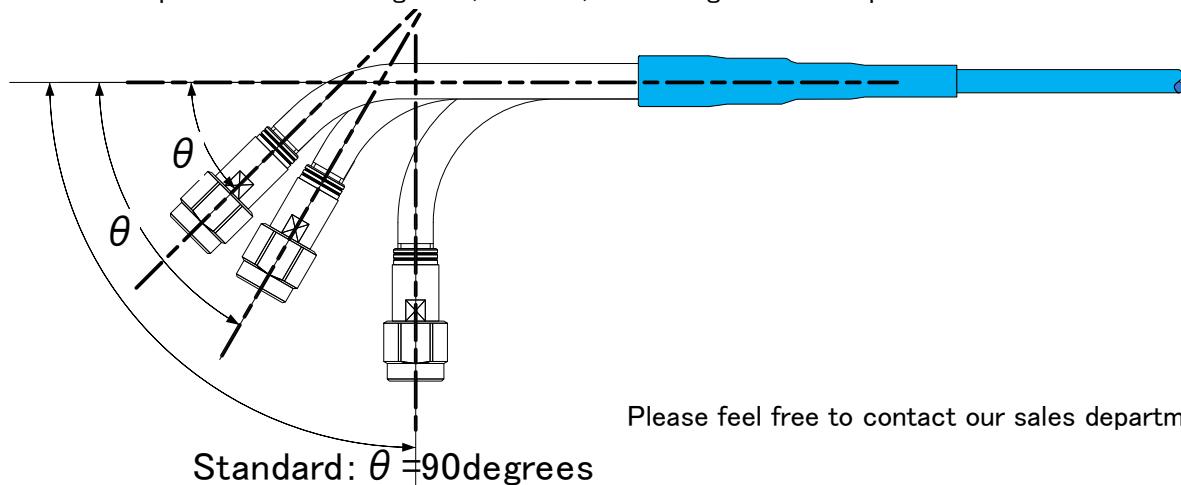
It is in a condition that the cable or armor was crushed a little.

■ Terminal shape correspondence



■ Special terminal shape correspondence

We cope as well as 90 degrees (standard) in forming of terminal part.



		ケーブルタイプ/Cable type																		
		非補強タイプ/Normal						SJタイプ/soft jacket		標準アーマー補強タイプ/Standard armor				柔軟アーマー補強タイプ/Soft armor						
中心導体: Inner conductor:		単線 Solid						単線 Solid		単線 Solid						撚線 Stranded				
	コネクタ 記号	500	358	280	219	128	280S	500SJ	358SJ	500H	358H	280H	219H	500HS	358HS	280HS	219HS	119	280SHS	
コネクタタイプ/Connector type	N-P	D	○	○				△	○	○	○			○	○					
	N-J	E	○	○				△	○	○	○			○	○					
	N-LP	DL	○	○				△	○	○	○			○	○					
	N-LJ	EL	○	○				△	○	○	○			○	○					
	SMA-P	A	○	○		○	○	○	○	○	○	○		○	○	○	○	○	○	
	SMA-J	B	○	○			○	○	○	○	○	○		○	○	○	○	○	○	
	3.5-P	F	○	○				△	○	○	○			○	○					
	3.5-J	G	○	○				△	○	○	○			○	○					
	3.5-LP	FL		○					○		○				○					
	3.5-LJ	GL		○					○		○				○					
50GHz	2.92-P	K		○	○	○	○		○		○			○	○	○	○	○		
	2.92-J	M		○	○	○	○		○		○			○	○	○	○	○		
	2.92-LP	KL		○	○	○	○		○		○			○	○	○	○	○		
	2.92-LJ	ML		○	○	○	○		○		○			○	○	○	○	○		
	SMP-J	SMP					○													
	2.4-P	Q			○	○								○	○	○	○	○		
	2.4-J	R			○	○								○	○	○	○	○		
	2.4-LP	QL			○	○								○	○	○	○	○		
	2.4-LJ	RL			○	○								○	○	○	○	○		
	SMPM-J	SMPM				○	△													
67GHz	1.85-P	T				○	○							○				○		
	1.85-J	U				○	○							○				○		
	1.85-LP	TL				○	○							○				○		
	1.85-LJ	UL				○	○							○				○		
	1.85-P	T ※70G				○								○				○		
	1.85-J	U ※70G				○								○				○		
	1.85-LP	TL ※70G				○								○				○		
	1.85-LJ	UL ※70G				○								○				○		
	1.0-P	X					○											○		
	1.0-J	Y					○											○		
110GHz	1.0-LP	XL					○											○		
	1.0-LJ	YL					○											○		
	ケーブル適用可能最大長(m) Assembly maximum length (m)		50	21	16	9	0.7	10	3	3	50	21	16	9	10	10	10	9	0.7	10
	ケーブル標準最大長(m) Standard maximum length (m)		20	21	5	2	0.3	1	3	3	20	21	5	2	10	10	5	2	0.3	1

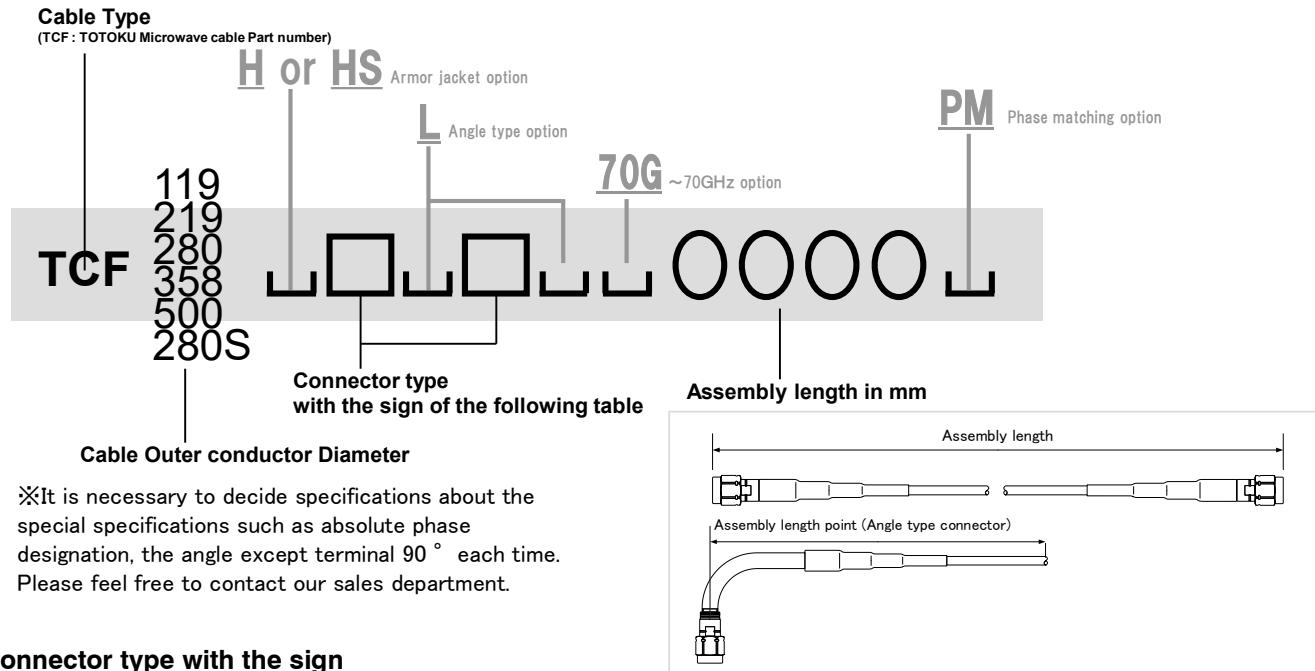
ケーブル標準最大長(m)を超える長さのアセンブリについては都度弊社営業までご相談ください。

When you need an assembly of length more than cable standard maximum length, please inquire to our sales department at each time.

△は開発中の物です。弊社営業までご相談ください。△ is in development, please inquire to our sales department.

※70G:次ページの"品番"の項をご確認ください。※70G:Please confirm an item of "model number" of following page.

Part Number Designation



note 1 “-m” after a connector type shows a straight male connector (also called “PLUG”) and “-f” shows a straight female (also called “JACK”) connector.

note 2 TCF cable assemblies are available with armoring. In this case, sign “H” is added after the Cable Outer Diameter. Please ask an applicable type.

note 3 TCF cable assemblies are available with bending by connector area. In this case, sign “L” is added after the sign of connector type. Please ask an applicable type.

note 4 TCF cable assemblies are available with Phase matching, in this case, sign “PM” is added after the assembly length. Please ask an applicable type.

note 5 For TCF cable, many variations in mating connectors are available.

(e.g. TCF280 series: 2.92mm connector to one end and 2.4mm connector to the other end)

Please ask for details.

Name of assembly (Examples)

TCF219 TLU 1200 → TCF219 cable 1200mm length assembly.

1.85mm angle type male connector and 1.85mm straight female connector.

TCF358 AB 500 → TCF358 cable 500mm length assembly.

SMA straight male connector and SMA straight female connector.

TCF280 RK 700 → TCF280 cable 700mm length assembly.

PC2.4mm straight female connector and 2.92mm straight male connector.

TCF358 FF 300 PM → TCF358 cable 300mm length assembly.

PC3.5mm straight male connector both side , added phase matching option.

※ Model number of 1.85mm connector assembly for 70GHz

TCF219TU70G1000 → TCF219 cable 1000mm length assembly.
1.85mm straight male connector and 1.85mm straight female connector.(DC~70GHz)

TCF219HSTU70G1000 → TCF219 cable 1000mm length assembly reinforced by HS armor.
1.85mm straight male connector and 1.85mm straight female connector.(DC~70GHz)

TCF219 flexible coaxial cable assembly for **70GHz** with 1.85mm connector

Feature

○Cable

Expanding frequency range up to 70GHz by improved outer conductor

○Precision connector

Expanding frequency range up to 70GHz by improved inner structure

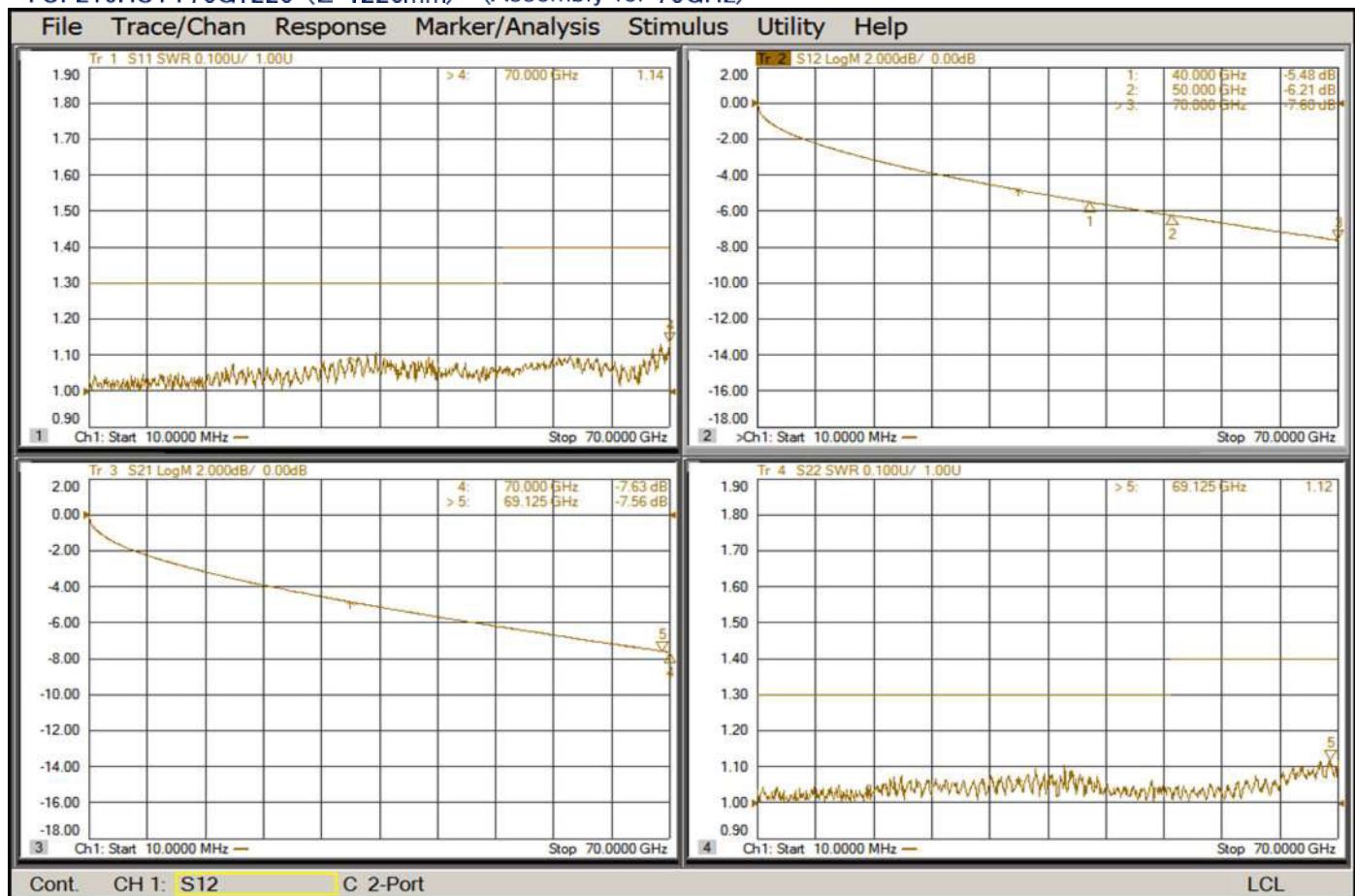


Corresponds also to

- Flexible armor ("HS" armor) type
- Right angle type.

«Reference data»

TCF219HSTT70G1220 (L=1220mm) (Assembly for 70GHz)



TCF128 flexible coaxial cable assembly for 110GHz with 1.0mm connector

■ Feature

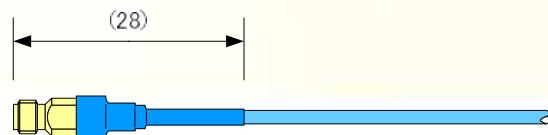
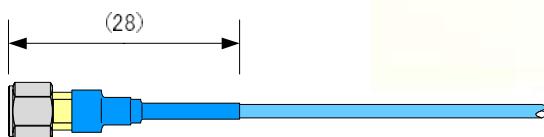
- World largest broadband area:DC~110GHz
- Easy handling ,easy fixing by without armor
- Low-reflection and Low-attenuation realized by means of dedicated connector and unique fixing
- Corresponding to arbitrary length
- Excellent mating reproducibility



■ Application

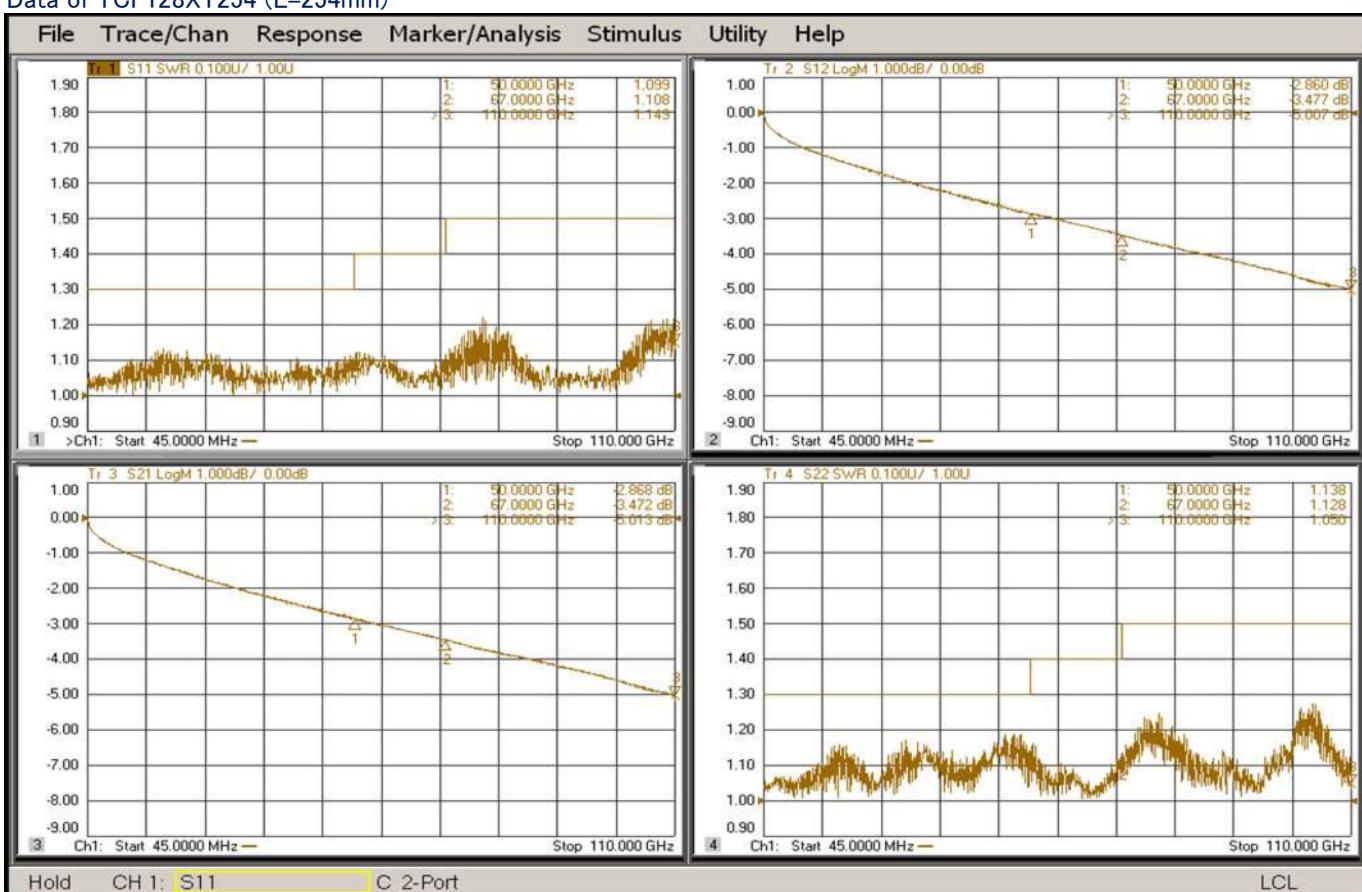
- Millimetric wave radar
- High-frequency device wiring material
- Measuring instruments lead wire
- Optical device
- Semiconductor tester
- Metal and optical Info-communications device

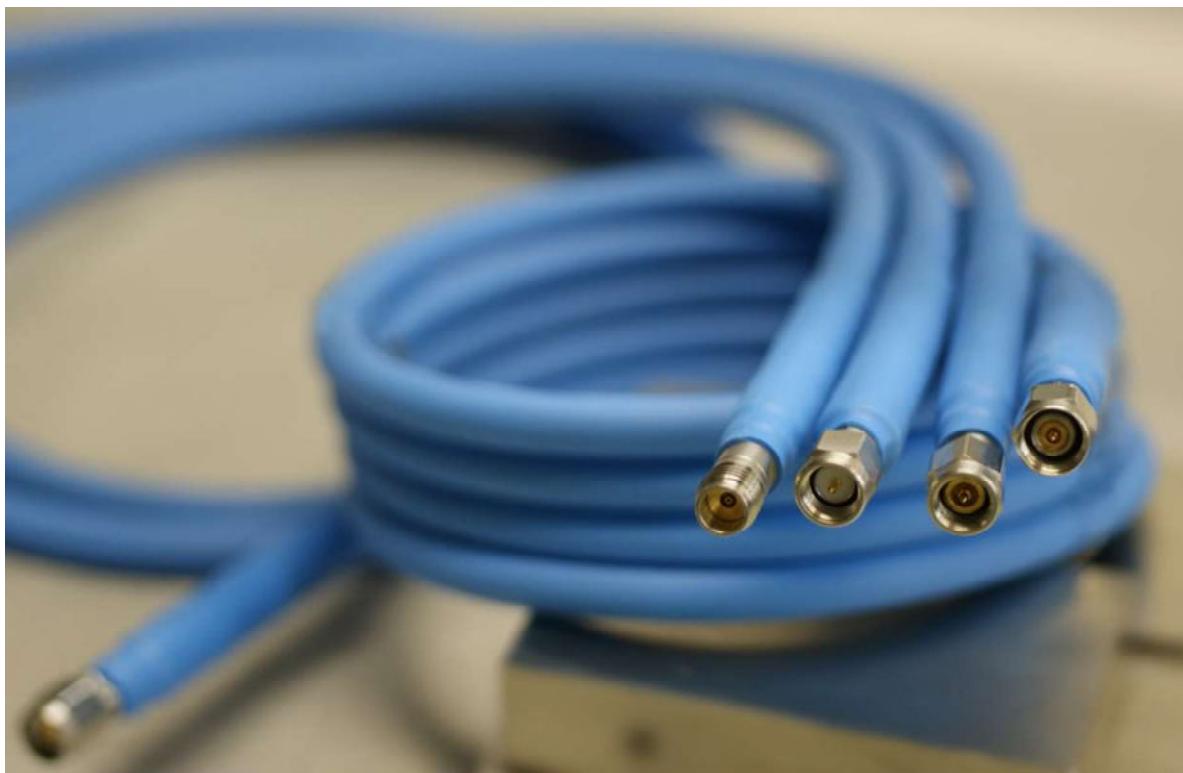
■ Terminal structure



«Reference data»

Data of TCF128XY254 (L=254mm)



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