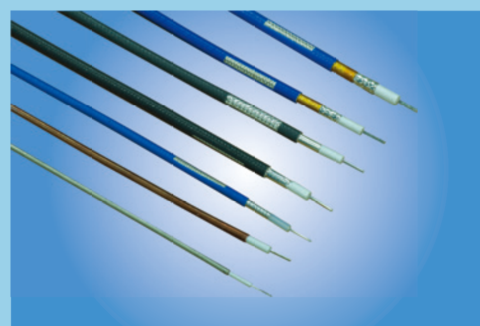
Focus & Simple

Focusimple Electronics Co.,Ltd



High Performance Coax Cable & Cable Assemblies

Focus & Simple

Focusimple

ABOUT US ↘

Founded:2013

Original Intention:Provide suitable signal transmission and test solution for valuable customers.

Capability:R&D of cable and connectors up to 110GHz, Processes such as PTFE wrapping /PTFE extruding/Helical spiral copper beltwinding /Armor braiding/Jacket coating/Assembly

Upgrade:15000 square meter new facility under put into operation.

Standard:ISO certified, RoHS and REACH compliance, meets MIL-C-17

Internationalization:Product in both inch and metric available,Oversea distributors,Customers in over 30 countries,Western management and working environment

Management :Senior and middle management are with rich experiences from famous microwave cable/connector companies, large global companies,and with master/bachelor's degree.

Product :Cable and Cable Assemblies:

FSA- FSG: Featured in low loss/phase stable/economic/ultra-flexible/semi-rigid etc, and up to 40GHz.

FSH: An innovative cable that can be used as semi-rigid while can be easily hand formed, and it is phase stable,up to 40GHz

PT: Lotus core, which is 3 times lower in phase change under room temperature, up to 70GHz

Flexline: Ultr-flexible test line, up to 26.5GHz

Duraline: Durable and cost performance test line, up to 26.5GHz

Fabtest: Test solution for millimeter wave

TVAC: Test solution for thermal vacuum testing, up to 40GHz

Connectors: SMA, N-type, TNC, 3.5mm, 2.92mm, 2.4mm, 1.85mm, 1.0mm connectors for above cables; multi-port connectors, bulk-head, one turn,self-lock, long tail, short-end connectors;

Adapters: Various high precision adapters, and blind mating adapters.

Probe and Probe Assembly: APS and FPS series for wafer testing and PCB testing.

Leadtime:2-4 weeks standard deliver y, and 4-6 weeks for customized products.

Enterprise Culture:Vision: To be best test expert in global RF and microwave field!

Philosophy: Stay Focused and be Simple

Focus in core business, continuous simplify processes.

Focus on customers' benefit, treat customer in sincerest and simplest way.

Our Advantages

Create value for customers

High performance, superior quality

Price-competitive

Short lead time

Professional technical assistance

Customization available

- GB/T19001-2016
- ISO9001:2015 Quality Management System Certification
- ISO14001-2015 Environmental Management System Certificate
- ISO45001-2018 Occupational Health Management System Certificate
- Intellectual Property Management System Certification Certificate

- GJB973A
- GJB681A
- GBT17737.1
- GBT17738.1
- IEC 61196-1-111
- IEC 60966-1

CONTENTS

Cable Characteristics and Introduction

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Product advantages

Series	Features	Insertion Loss	Stability	Flexibility	Temperature phase	Economical efficiency
FSA	Excellent shielding performance & durability	B	B	C	B	B
FSB	Excellent phase stability & amplitude	A	A	B	A	C
FSE	Excellent repeated bending ability & flexibility	B	A	A	A	C
FSC	Excellent shielding performance & durability,Economical efficiency	C	C	C	C	A
FSF	Excellent phase stability & amplitude ,Economical efficiency	B	B	B	B	A
FSG	Excellent repeated bending ability & flexibility,Economical efficiency	C	C	A	B	A
FSD	Low-loss semi-rigid cable with excellent shielding performance	A	-	-	B	B
FSH	Flexible bending, replacement of semi-rigid cable assembly & right angle connector	B	B	A	B	B
PT	Stable temperature-phase and flexible low-loss RF cable	B	C	B	A	B

Cable introduction

FSA Series
High Performance Low Loss Flexible Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(℃)
FSA-460	26.5	1.95	76%	>100dB	4.50	50	-55~+200
FSA-520	26.5	1.55	76%	>100dB	5.20	60	-55~+200
FSA-630	18	1.02	76%	>100dB	6.00	90	-55~+200

FSB Series
High Performance Ultra-Low Loss Phase Stable Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(℃)
FSB-220	40	4.48	82%	>90dB	2.20	14	-55~+165
FSB-360	40	2.56	82%	>90dB	3.60	33	-55~+165
FSB-500	26.5	1.25	83%	>90dB	5.20	63	-55~+165
FSB-800	18	0.67	83%	>90dB	7.80	130	-55~+165
FSB-1200	10	0.35	83%	>90dB	12.00	280	-55~+165

FSC Series
High Performance Semi-Flexible Alternative Flexible Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(℃)
FSC-160	18	5.57	70%	>90dB	1.60	7	-55~+125
FSC-280	26.5	4.41	70%	>90dB	2.80	22	-55~+125
FSC-400	26.5	2.81	70%	>90dB	4.00	49	-55~+125

FSD Series
High Performance Low Loss Semi-Rigid Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(℃)
FSD-047A-TP/TM	20	5.70	70%	>165dB	1.19	6	-60~+150
FSD-086-TP/TM	50	4.15	76%	>165dB	2.18	19	-60~+250
FSD-120-TP/TM	40	2.35	76%	>165dB	3.05	35	-60~+250
FSD-141-TP/TM	26.5	1.72	76%	>165dB	3.58	43	-60~+250

Cable Characteristics and Introduction

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FSE Series

High Performance Ultra-Flexible Phase Stable Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(°C)
FSE-330-PU	50	4.90	74%	>90	4.00	30	-40~+85
FSE-500-PU	26.5	1.54	80%	>90	5.50	53	-40~+85
FSE-800-PU	18	0.80	83%	>90	8.20	145	-40~+85

FSF Series

High Performance Ultra-Flexible Phase Stable Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(°C)
FSF-280	26.5	3.72	76%	>90	2.60	18	-55~+125
FSF-350	18	1.93	76%	>90	3.50	29	-55~+155
FSF-500	13.5	0.98	76%	>90	5.20	60	-55~+155
FSF-750	13.5	0.64	76%	>90	7.80	110	-55~+155

FSG Series

Ultra-Flexible Economical Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(°C)
FSG-400	18	2.44	76%	>90	4.00	30	-55~+85
FSG-600	13.5	1.42	76%	>90	6.00	63	-55~+85
FSG-850	13.5	0.72	76%	>90	8.20	125	-55~+85

FSH Series

High Performance Flexible Phase Stable Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(°C)
FSH-250	40	4.55	70%	>90	2.50	18	-55~+125
FSH-250-L	40	5.09	74%	>90	2.50	16	-55~+165
FSH-260-L	50	4.81	76%	>90	2.64	17	-55~+165
FSH-360	26.5	2.19	76%	>90	3.61	31	-55~+165

PT Series

High Performance Temperature Phase Stable Low Loss Coax Cable

Cable	Frequency(GHz)	Insertion loss(dB/m)	VP	Shielding Effectiveness	Cable diameter(mm)	Weight(g/m)	Temperature range(°C)
PT-055	70	11.72	80%	>90	1.40	5.6	-55~+165
PT-086	40	4.70	82%	>90	2.20	13	-55~+165
PT-160	40	2.94	82%	>90	4.00	40	-55~+165
PT-200	26.5	1.99	82%	>90	5.00	57	-55~+165

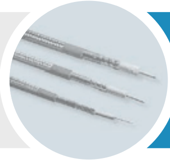
Note: Frequencies represent the operating frequency, and the insertion loss represents the insertion loss at @ operating frequency (GHz).

Connector Selection

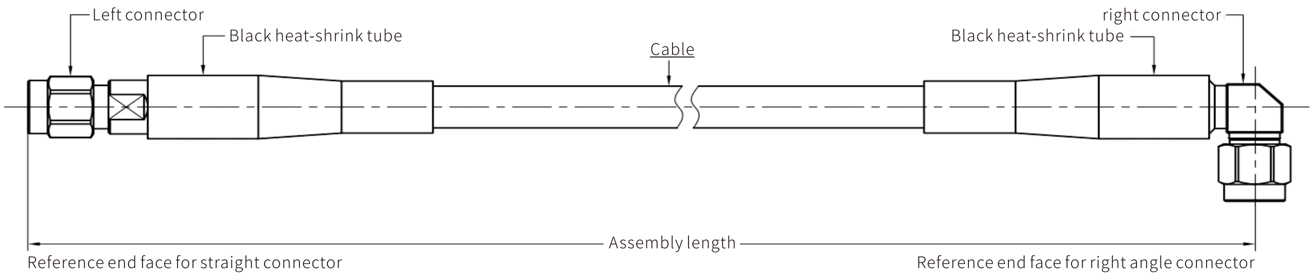
	FSA			FSB					FSC			FSD				FSE			FSF				FSG			FSH				PT			
	460	520	630	220	360	500	800	1200	160	280	400	047	086	120	141	330	500	800	280	350	500	750	400	600	850	250	250L	260L	360	055	086	160	200
1.85mm Male												○																		○			
1.85mm Female												○																					
2.4mm Male					○											●												●					
2.4mm Female					○											●												○					
2.92mm Male					●											●										●	●	●	○		○	○	
2.92mm Male Right Angle																										○	○						
2.92mm Female					●											●																	
3.5mm Male	○				○	●									●		○				●										○		
3.5mm Female						○									●						○												
SMA Male	●	●	○	●	●	●	●			●	●		●	●	●		●	○	●	●	●	●	○	○	○	●	●	●	●	○	○	○	○
SMA Male Right Angle	○			○	●	●	○	○	○	●									●	●	●												
SMA Female				○	○		○																			●	●			○			
N Male	●	●	●			●	●	○			●						●	○			●	●	○	○	○			○					
N Male Right Angle	○					●															●												
N Female	○		○			○	○														○												
TNC Male	○	○	●			○	○											○			○												
SMP Female										●									●														
SMP Female Right Angle										●									●							○	○						
SSMP Female										○									○														
SC Male								○																									
7/16 Male								○																									
page	P6 for details			P10 for details					P14 for details			P18 for details				P22 for details			P26 for details				P30 for details			P34 for details				P40 for details			

Note: See the introduction of each series for detailed electrical performance of connectors.

Test Method



Assembly Length Definition



Assembly length tolerance standards (except for bunched cable assembly)

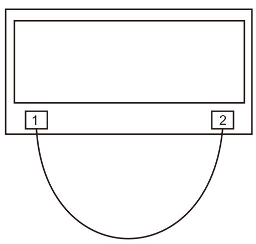
1. L⩽1m，tolerance: +10/-0mm；
2. L>1m，tolerance :+1%/-0mm；
3. L ⩽ 1m, tolerances for cable assembly with phasing matching, time delay and armoring requirements: +20/-0mm；
4. L >1m, tolerances for cable assembly with phasing matching, time delay and armoring requirements: +2%/-0mm；
5. Measure the length of an assembly with a straight connector, counting the length from the end face of the straight connector；
6. Measure the length of an assembly with a right angle connector, counting the length from the center line of the right angle connector；

Calibration Before Test

1. Setting basic parameters before calibration, such as start/cut-off frequency, scan points, scan time, bandwidth, power, etc；
2. Once on the calibration page, select the corresponding calibrator. Screw the calibration pieces OPEN, SHORT and LOAD into the port to be calibrated according to the system prompts；
3. Press Measure in sequence to calibrate, press Finish to complete the calibration；
4. When the screen shows 1.01 and 0dB at both S11 and S22 windows or when the waveform in S11/S22 window has no peak and the curve in S12/S21 window has no warp, it means the calibration is successful；

VSWR and IL Test

1. Connect the cable assembly to the VNA at ambient temperature.
2. Set the frequency as required, then test the VSWR and IL values on static conditions.



Mechanical Amplitude and Phase Stability Test

1. Connect the cable assembly to the VNA and clear attenuation and phase settings.；
2. Hold the connectors between the cable assembly and VNA to prevent the connectors from jittering and affecting the data during the test；
3. Hold a single or multi-turn cable in the hand, then shaking it up and down at a rate of about 10 cm and a frequency of about 2 times per second；
4. When the attenuation and phase curves become stable, record the maximum value of the change in phase and attenuation over the entire frequency band；
5. If necessary, repeat the operation several times to ensure cable performance；

Lab Testing Capability

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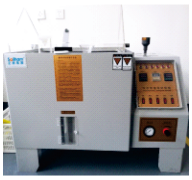
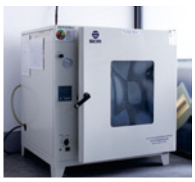
Type	Test items	Test method/standard	Test range/capacity	Accuracy rate	Main test equipment
Electrical property tests	VSWR/IL/Phase/Differential impedance/VSWR/IL/Phase/ Differential impedance/Eye diagram/Time domain / Characteristic impedance/ Time delay etc.	EIA-364-108、SJ 2331-1983 SJ 2474-1984	50MHz~40GHz	±2%	VNA: Keysight N5230C Keysight E8363B
			10MHz~67GHz	±2%	VNA：CETC No.41
			10MHz~110GHz	±2%	VNA：CETC No.41 AV3672E
	Insulation withstand voltage test	EIA-364-20、IEC-512-4-1	0~5KVAC/0~6KVDC 0.01mA~20mA	±2%	Tonghui Insulation withstand voltage tester
	Cable characteristic impedance /Vop test	EIA-364-103、EIA-364-106	Pulse amplitude (50Ωload)：300mV	±2%	Tektronic TDR tester
Appearance and dimensional tests	Appearance inspection	IPC 620	Magnification：8X~100X	/	CCD Electronic Magnifier
	Dimensional measurements	EIA-36418	X300*Y200mm	0.001mm	Two dimensional measuring machine
		EIA-36418	0~15mm	0.001mm	Height gauges / micrometers
Mechanical property tests	Plug and pull life test	IEC512-9-1、EIA-364-09	/	/	Plug and pull life tester
	Conductor elongation test	GB/T4909	0~80%	±2%	Elongation Tensile Tester
	Tensile/retention force test	EIA364-13	≤2000N	±1N	Elongation Tensile Tester
	Cable bending and swaying test	GB/T 17738.1-1999	±90°	±5%	Bending and swaying testers
Environmental Characteristics tests	High-temperature test	IEC-68-2-2	+250 ℃	±2 ℃	High- temperature test chamber
	Low temperature test	IEC-68-2-1	-60 ℃	±1℃	Programmable high-low temperature test chamber
	High-low temperature cycle test	IEC-68-2-14	-60 ℃~+150 ℃		
	High-low temperature impact test	IEC 68-2-33	-60 ℃~+250 ℃	±2 ℃	High-temperature test chamber+ high-low temperature test chamber
	Waterproof test	IEC 60529	IP*8	±5%	Waterproof test tube
	X array gamma analysis for metal plating	GB/T 16921 ASTM B568	Element：Au/Ni/Cu/ Sn/Ag/Alloy Test minimum value : Φ0.16mm	±5%	Film thickness tester
	X array gamma analysis for metal soldering	/	450*450mm	7μm	Offline X-Ray tester：AX9100
	X-fluorescence spectrometer	IEC 62321-5:2013	RoHs 4 items for metal	MDL2mg/kg	RoHS 1.0
		ICE 62321-4:2013+A1:2017			
		IEC 62321-7-1:2015			
		IEC 62321-6:2015			
	GC-MS (Gas Chromatography Mass Spectrometry)	IEC 62321-8:2017	DEHP/BBP/DBP/DIBP	MDL30mg/kg	RoHS 1.0
	Salt spray test	GJB360B-2009 101	+5 ℃~+55℃	±3%	Salt spray tester


Film Thickness Tester


High and low temperature Alternating Test Chamber


Salt Spray Test Chamber


High Temperature Oven


Network Analyzer


TDR


RoHS1.0


RoHS2.0

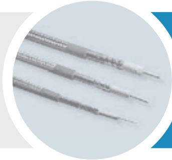

Bending and Swing Tester


Elongation Tensile Tester


2D Measuring Instrument


Insulation Resistance Tester

FSA | High Performance Low Loss Flexible Coax Cable



Product features

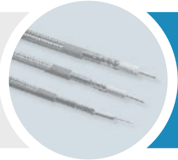
- Meets MIL-C-17
- High phase and attenuation stability vs bending
- Good bending performance
- Low loss
- High power handling
- Robust structure
- Long service life

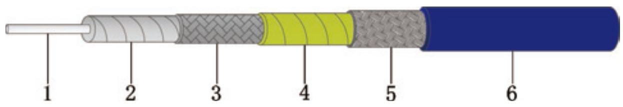
FSA series cable provides an economical solution for applications requiring high strength and resistance to bending, turning and crushing. It offers low loss, high power handling, reliability,resistance to harsh environments, durability, and long life.

Similar Cable Replacement Table

F+S	TIMES	ASTROLAB	SEMFLEX	MCC	H+S
FSA-460	SFT-142	32022	HP160S	UFA147A	SF-102
FSA-520	SFT-205	32055	HP190S	UFA205A	SF-104
FSA-630	SFT-304	32051	HP305S		

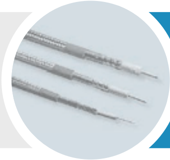
FSA | Specification



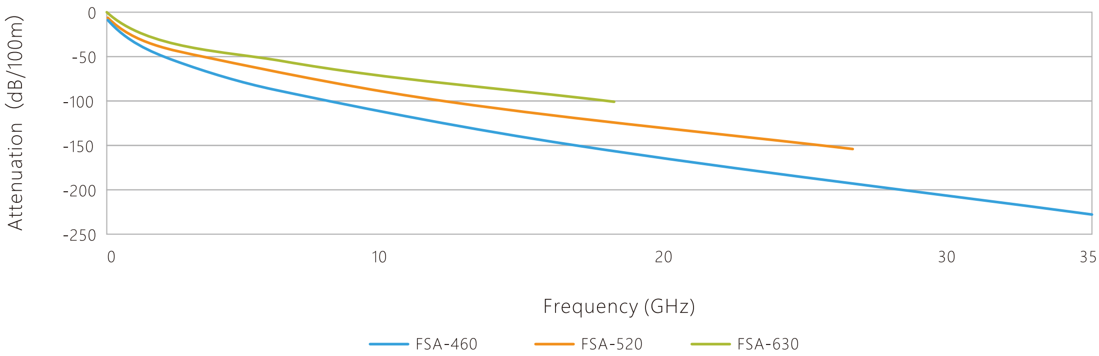


1	Center Conductor	SPC	
2	Dielectric	PTFE	
3	Dielectric	SPC Tape	
4	Interlayer	High Temperature Aluminum Foil	
5	Outer Shield	SPC Wire	
6	Jacket	FEP	

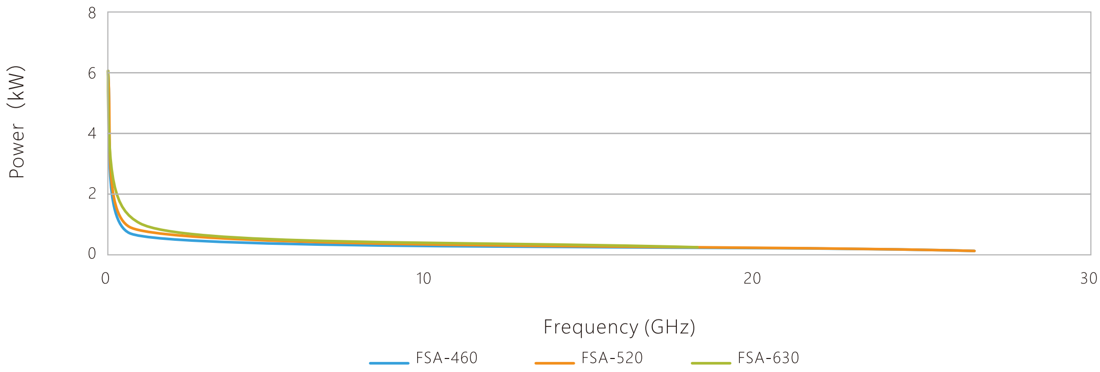
	FSA-460			FSA-520			FSA-630		
Physical & Mechanical Specifications									
Dimensions	mm	Inch		mm	Inch		mm	Inch	
Jacket	4.50	0.177		5.20	0.205		6.00	0.236	
Bend Radius: Installation	20	0.787		25	0.984		32	1.260	
Bend Radius: Repeated	46	1.811		52	2.047		63	2.480	
Weight	50 g/m	0.034 lbs/ft		60 g/m	0.040 lbs/ft		90 g/m	0.060 lbs/ft	
Temperature Range	-55～+200℃（-67～+392°F）								
Electrical Specifications									
Operating Frequency	26.5 GHz			26.5 GHz			18 GHz		
Max Phase Stability(±°)	±8			±10			±10		
Max Amplitude Stability (±dB)	±0.15			±0.10			±0.10		
Impedance	50 Ω								
Shielding Effectiveness	＞100 dB								
Velocity of Propagation	76%								
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)								
Frequency (MHZ)	dB/m	dB/ft	kW	dB/m	dB/ft	kW	dB/m	dB/ft	kW
1000	0.354	0.108	0.569	0.277	0.084	0.726	0.222	0.068	1.024
2000	0.504	0.154	0.400	0.395	0.120	0.509	0.317	0.097	0.716
4000	0.719	0.219	0.280	0.565	0.172	0.355	0.455	0.139	0.499
8000	1.032	0.315	0.195	0.813	0.248	0.247	0.658	0.201	0.345
10000	1.160	0.354	0.174	0.915	0.279	0.219	0.742	0.226	0.306
18000	1.583	0.483	0.127	1.255	0.383	0.160	1.022	0.312	0.222
26500	1.949	0.594	0.103	1.550	0.473	0.130			
Attenuation at Frequency	$dB/m = \frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$								
K1	1.0994853			0.8562336			0.6827428		
K2	0.0006019			0.0005906			0.0005906		



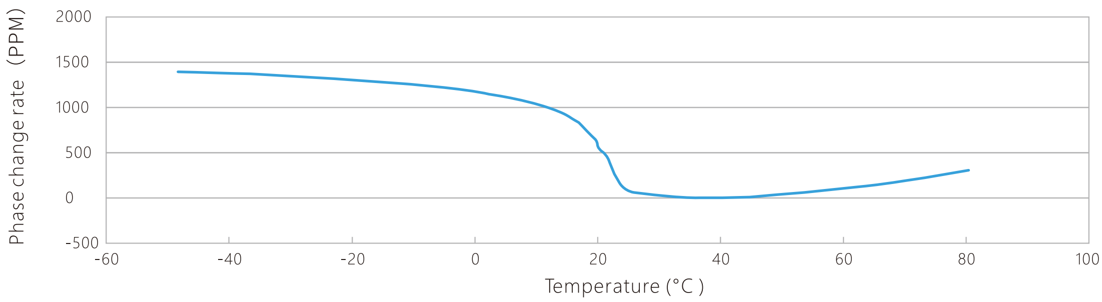
Frequency & Attenuation



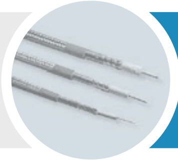
Frequency & Power



Temperature Phase (PPM)



FSA | Connector & Assembly



Assembly Selection Information

FSAXXX - XXXXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

Length unit suffix
IN:Inch
M:Meter
F:Foot

Cable Type
460
520
630

Connector type, independent on both sides
Refer to connector selection table for code

For example: FSA460-SMNM-01.00M

Optional Connectors

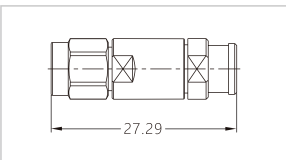
Connector Code	Connection Type	Operating Frequency(GHz)	FSA-460	FSA-520	FSA-630	Typical VSWR	Max VSWR
35M	3.5mm Male	26.5GHz	○			1.25	1.30
SM	SMA Male	26.5GHz	●	●		1.25	1.30
		18GHz			○	1.25	1.30
SMR	SMA Male Right Angle	26.5GHz	○			1.30	1.35
NM	N Male	18GHz	●	●	●	1.25	1.30
NMR	N Male Right Angle	18GHz	○			1.30	1.35
NF	N Female	18GHz	○		○	1.30	1.35
TM	TNC Male	18GHz	○	○	●	1.25	1.30

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

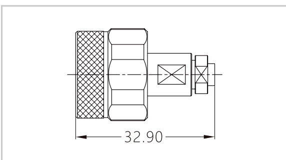
Connector drawing

FSA460

SMA Male for FSA-460

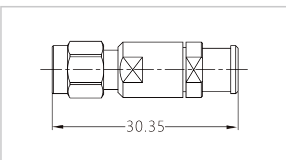


N Male for FSA-460

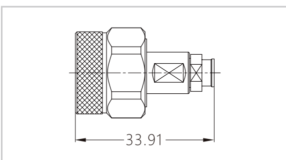


FSA520

SMA Male for FSA-520

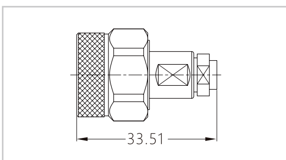


N Male for FSA-520

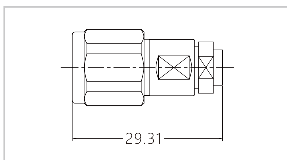


FSA630

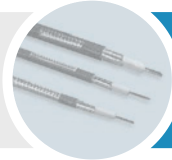
N Male for FSA-630



TNC Male for FSA-630



FSB | High Performance Ultra-Low Loss Phase Stable Coax Cable



Product features

- Meets MIL-C-17
- Ultra-low loss
- Excellent mechanical and temp phase stability
- Excellent ampllitude stability
- Light weight

The FSB cable series comprehensively provides higher performance than typical low loss and phase stable cables with wide applications.

Similar Cable Replacement Table

F+S	MCC	GORE	TIMES	IW	HAROUR	SEMFLEX
FSB-220		3506				
FSB-360	UFB142A	3507		1401		
FSB-500	UFB205A	3449	HF190	1801		
FSB-800	UFB311A	3450	HF290	2801	LLS290	La290

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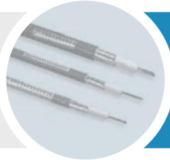
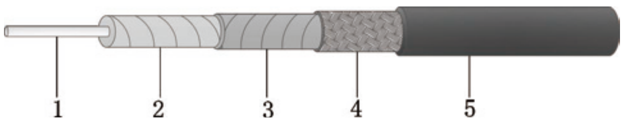
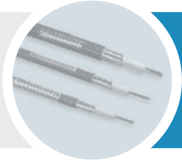
FSB | Specification



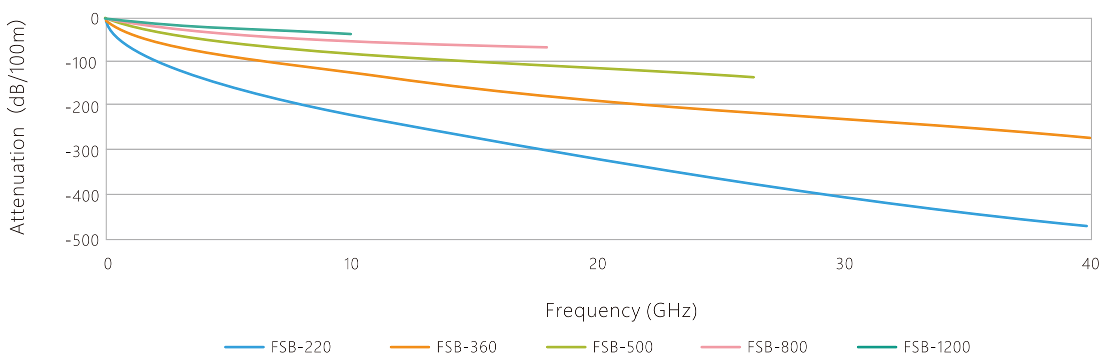


1	Center Conductor	SPC
2	Dielectric	PTFE
3	Outer Conductor	SPC Tape
4	Outer Shield	SPC Wire
5	Jacket	FEP

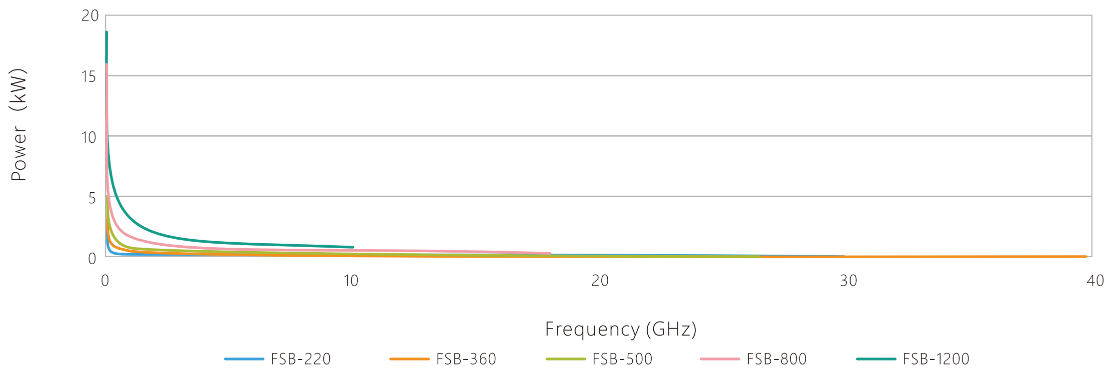
	FSB-220			FSB-360			FSB-500			FSB-800			FSB-1200		
Physical & Mechanical Specifications															
Dimensions	mm	Inch		mm	Inch		mm	Inch		mm	Inch		mm	Inch	
Jacket	2.20	0.087		3.60	0.142		5.20	0.205		7.80	0.307		12.00	0.472	
Bend Radius: Installation	15.0	0.591		18.0	0.709		20.0	0.787		35.0	1.378		60.0	2.362	
Bend Radius: Repeated	22.0	0.866		36.0	1.417		50.0	1.969		80.0	3.150		110.0	4.331	
Weight	14 g/m	0.009 lbs/ft		33 g/m	0.022 lbs/ft		63 g/m	0.042 lbs/ft		130 g/m	0.087 lbs/ft		280 g/m	0.188 lbs/ft	
Temperature Range	-55～+165℃（-67～+329°F）														
Electrical Specifications															
Operating Frequency	40 GHz			40 GHz			26.5 GHz			18 GHz			10 GHz		
Max Phase Stability(±°)	±10			±8			±5			±5			±5		
Max Amplitude Stability(±dB)	±0.15			±0.15			±0.10			±0.10			±0.05		
Impedance	50Ω														
Shielding Effectiveness	＞90 dB														
Velocity of Propagation	82%			82%			83%			83%			83%		
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)														
Frequency (MHZ)	dB/m	dB/ft	kW	dB/m	dB/ft	kW	dB/m	dB/ft	kW	dB/m	dB/ft	kW	dB/m	dB/ft	kW
1000	0.631	0.192	0.271	0.375	0.114	0.511	0.230	0.070	0.875	0.148	0.045	1.812	0.099	0.030	3.045
2000	0.901	0.275	0.190	0.534	0.163	0.359	0.327	0.100	0.615	0.211	0.064	1.269	0.144	0.044	2.108
4000	1.291	0.394	0.132	0.761	0.232	0.252	0.466	0.142	0.431	0.302	0.092	0.886	0.209	0.064	1.448
8000	1.860	0.567	0.092	1.089	0.332	0.176	0.666	0.203	0.301	0.434	0.132	0.615	0.308	0.094	0.984
10000	2.095	0.639	0.082	1.223	0.373	0.157	0.748	0.228	0.268	0.489	0.149	0.547	0.350	0.107	0.867
18000	2.877	0.877	0.059	1.667	0.508	0.115	1.019	0.311	0.197	0.671	0.205	0.398			
26500	3.559	1.085	0.048	2.048	0.624	0.094	1.252	0.382	0.160						
40000	4.480	1.366	0.038	2.557	0.780	0.075									
Attenuation at Frequency	$dB/m=\frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$														
K1	1.9500000			1.1684700			0.7156867			0.4563799			0.2985150		
K2	0.0014500			0.0005500			0.0003280			0.0003280			0.0005100		



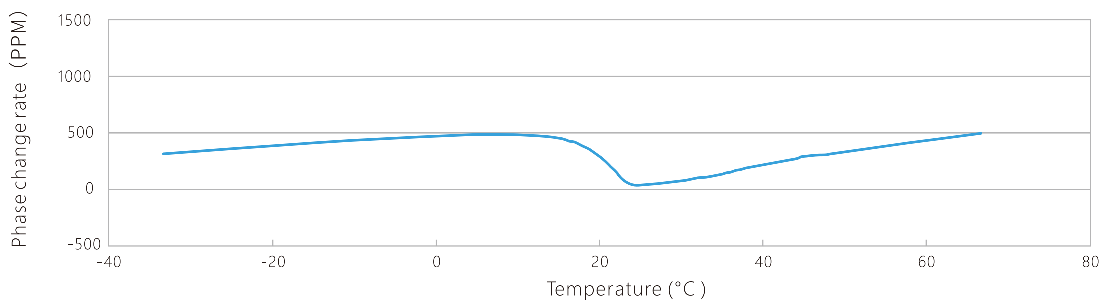
Frequency & Attenuation

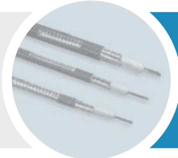


Frequency & Power



Temperature Phase (PPM)





Assembly Selection Information

FSBXXXX-XXXXXXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Cable Type
220
360
500
800
1200

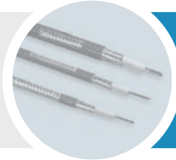
Connector type, independent on both sides
Refer to connector selection table for code

For example: FSB360-29M29M-01.00M

Optional Connectors

Connector Code	Connection Type	Operating Frequency (GHz)	FSB-220	FSB-360	FSB-500	FSB-800	FSB-1200	Typical VSWR	Max VSWR
24M	2.4mm Male	50GHz		○				1.30	1.35
24F	2.4mm Female	50GHz		○				1.30	1.35
29M	2.92mm Male	40GHz		●				1.25	1.30
29F	2.92mm Female	40GHz		●				1.25	1.30
35M	3.5mm Male	26.5GHz		○	●			1.25	1.30
35F	3.5mm Female	26.5GHz			○			1.25	1.30
SM	SMA Male	26.5GHz	●	●	●			1.25	1.30
		18GHz				●		1.25	1.30
SMR	SMA Male Right Angle	18GHz			●	○		1.30	1.35
		12GHz	○	●				1.30	1.35
SF	SMA Female	18GHz	○	○		○		1.25	1.30
NM	N Male	18GHz			●	●		1.25	1.30
		10GHz					○	1.30	1.35
NMR	N Male Right Angle	12GHz			●			1.30	1.35
NF	N Female	18GHz			○	○		1.30	1.35
TM	TNC Male	18GHz			○	○		1.30	1.35
SCM	SC Male	10GHz					○	1.30	1.35
716M	7/16 Male	7.5GHz					○	1.30	1.35

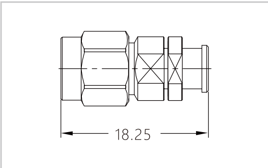
Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.



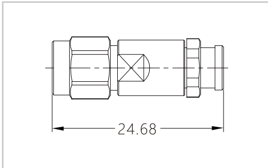
Connector drawing

FSB-220

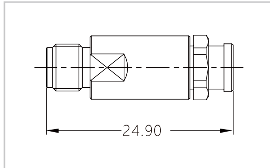
SMA Male for FSB-220



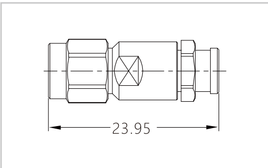
2.92mm Male for FSB-360



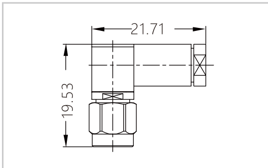
2.92mm Female for FSB-360



SMA Male for FSB-360

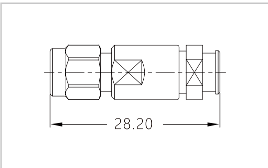


SMA Male R/A for FSB-360

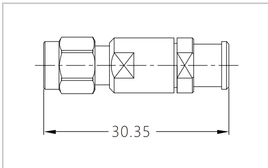


FSB-500

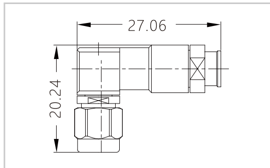
3.5mm Male for FSB-500



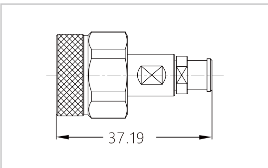
SMA Male for FSB-500



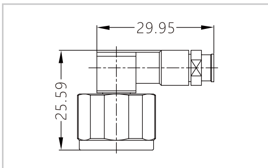
SMA Male R/A for FSB-500



N Male for FSB-500

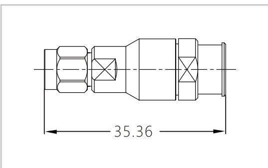


N Male R/A for FSB-500

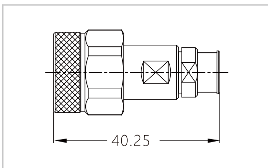


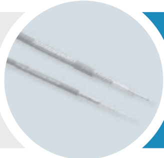
FSB-800

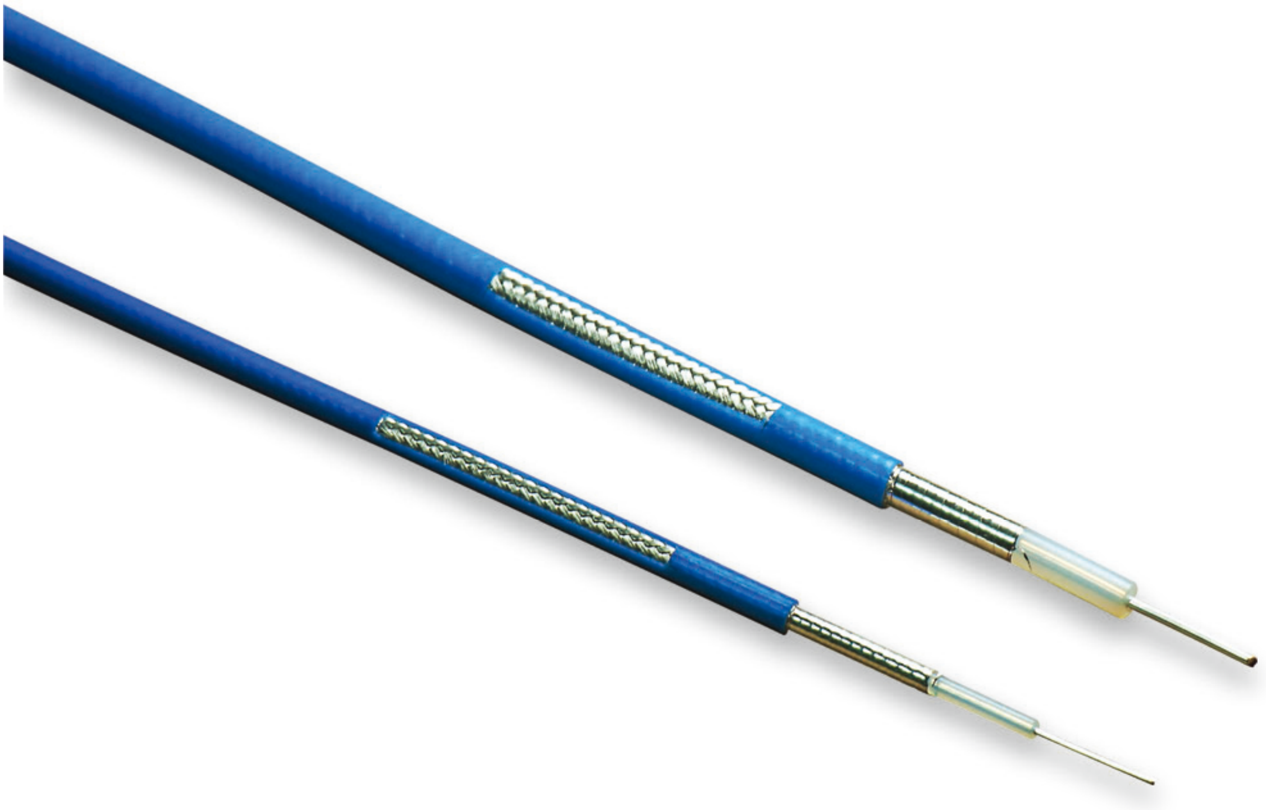
SMA Male for FSB-800



N Male for FSB-800







Product features

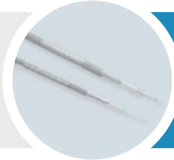
- Meets MIL-C-17
- Cost well controlled
- Flexibility
- Greater bending cycles
- Good electrical properties
- Long service life
- Replace to semi-rigid cable

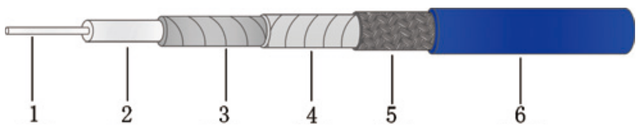
FSC series cable provides an economical replacement for hand formable cable and applications requiring greater flexibility and bending cycles. This series matches the performance of Times TFlex cables and uses the same connectors with standard semi-rigid cable. Typical applications for FSC series cable are test setups, interconnection, and instrumentation. It is available for quick deliver y, with customization, and low MOQ.

Similar Cable Replacement Table

F+S	TIMES	H+S	HABIA	HARBOUR
FSC-280	TFLEX-405	MULTIFLEX86	MULTIBEND86	SS405
FSC-400	TFLEX-402	MULTIFLEX141	MULTIBEND141	SS402

FSC | Specification





1	Center Conductor	SPC Clad Steel
2	Dielectric	PTFE
3	Outer Conductor	SPC Tape
4	Interlayer	PET
5	Outer Shield	SPC Wire
6	Jacket	FEP

	FSC-160			FSC-280			FSC-400		
Physical & Mechanical Specifications									
Dimensions	mm	Inch		mm	Inch		mm	Inch	
Jacket	1.6	0.063		2.8	0.110		4.0	0.157	
Bend Radius: Installation	6	0.236		14	0.051		20	0.787	
Bend Radius: Repeated	16	0.630		28	1.102		40	1.575	
Weight	7 g/m	0.005 lbs/ft		22 g/m	0.015 lbs/ft		49 g/m	0.033 lbs/ft	
Temperature Range	-55~+125℃（-67~+257°F）								
Electrical Specifications									
Operating Frequency	18GHz			26.5GHz			26.5GHz		
Max Phase Stability(±°)	±8			±5			±8		
Max Amplitude Stability (±dB)	±0.25			±0.20			±0.10		
Impedance	50 Ω								
Shielding Effectiveness	＞90 dB								
Velocity of Propagation	70%								
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)								
Frequency (MHZ)	dB/ m	dB/ft	kW	dB/ m	dB/ft	kW	dB/ m	dB/ft	kW
1000	1.198	0.365	0.038	0.693	0.211	0.100	0.382	0.116	0.267
2000	1.715	0.523	0.027	1.003	0.306	0.069	0.563	0.172	0.181
4000	2.467	0.752	0.019	1.465	0.447	0.047	0.842	0.257	0.121
8000	3.572	1.089	0.013	2.164	0.660	0.032	1.283	0.391	0.080
10000	4.032	1.229	0.011	2.461	0.750	0.028	1.476	0.450	0.069
18000	5.574	1.699	0.008	3.482	1.062	0.020	2.161	0.659	0.047
26500				4.408	1.344	0.016	2.805	0.855	0.036
Attenuation at Frequency	$dB/m=\frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$								
K1	3.6740161			2.0669291			1.0824000		
K2	0.0035795			0.0039370			0.0039370		

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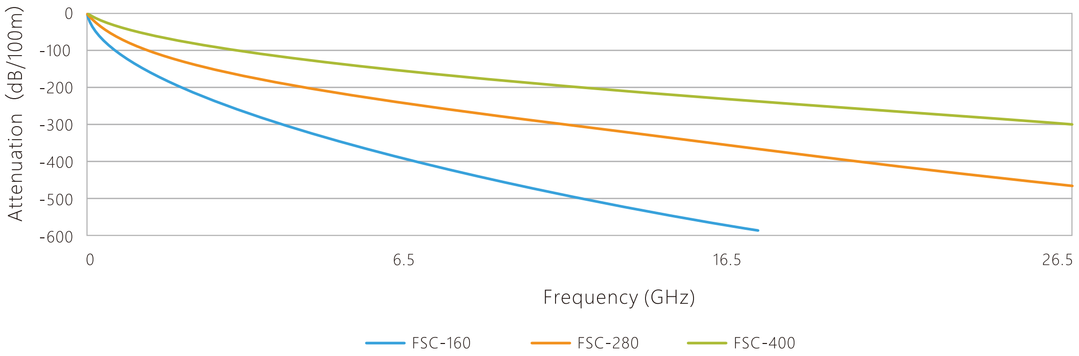
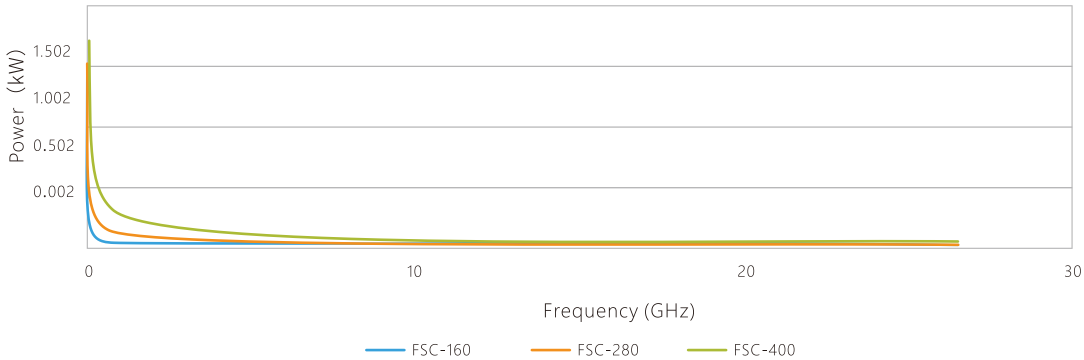
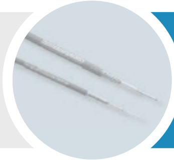
Frequency & Attenuation



Frequency & Power





Assembly Selection Information

FSCXXX-XXXXXXXXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Cable Type
160
280
400

Connector type, independent on both sides
Refer to connector selection table for code

For example: FSC280-SMPFSMPFR-01.00M

Optional Connectors

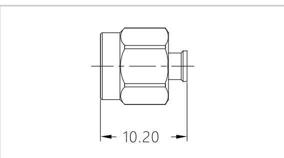
Connector Code	Connection Type	Operating Frequency (GHz)	FSC-160	FSC-280	FSC-400	Typical VSWR	Max VSWR
SM	SMA Male	26.5GHz		●	●	1.25	1.30
SMR	SMA Male Right Angle	18GHz	○		○	1.30	1.35
		14GHz		●		1.30	1.35
NM	N Male	18GHz			●	1.25	1.30
SMPF	SMP Female	18GHz		●		1.30	1.35
SMPFR	SMP Female Right Angle	18GHz		●		1.30	1.35
SSMPF	SSMP Female	40GHz		○		1.40	1.50

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

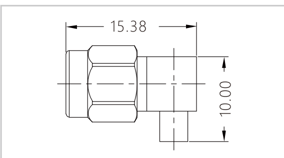
Connector drawing

FSC-280

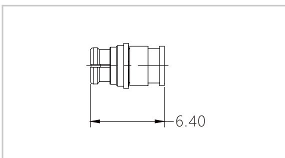
SMA Male for FSC-280



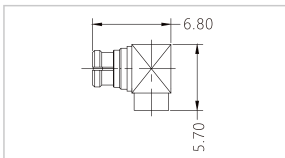
SMA Male R/A for FSC-280



SMP Female for FSC-280

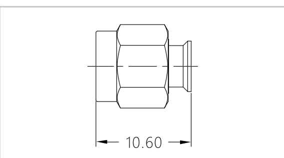


SMP Female R/A for FSC-280

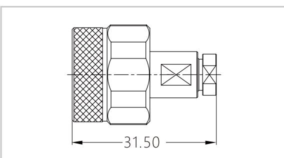


FSC-400

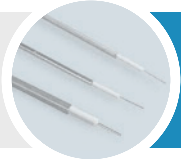
SMA Male for FSC-400



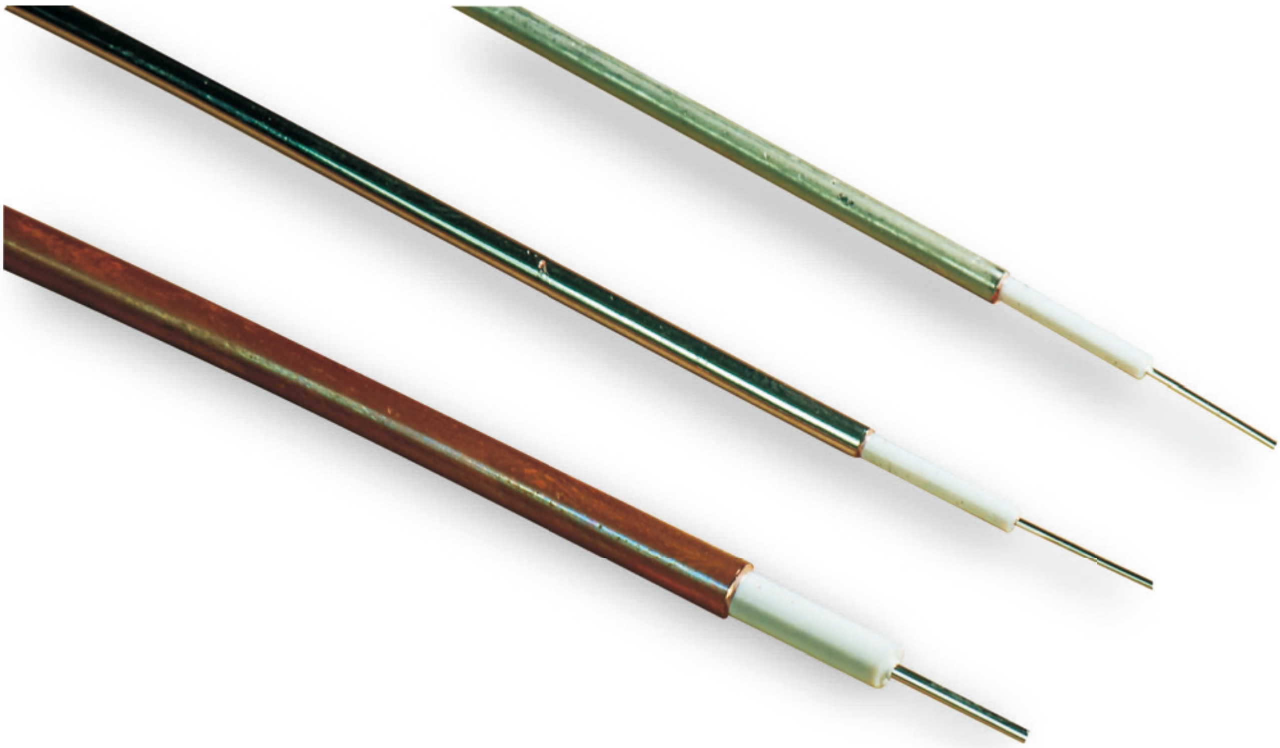
N Male for FSC-400



FSD | High Performance Low Loss Semi-Rigid Coax Cable



Focusimple



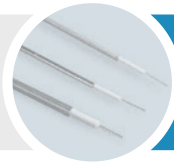
Product features

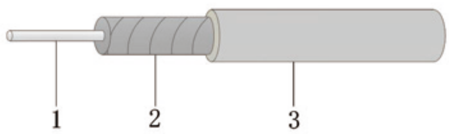
- Wide temperature operating range
- Lesstemperature-relatedphase change
- Lower loss
- Higher power handling
- Lighter weight
- Plenty connector options

FSD series is an upgrade of traditional semi-rigid cable. It adopts advanced low-density PTFE wrapped dielectric to replace traditional solid PTFE dielectric. Compared to traditional semi-rigid cable, FSD series can effectively reduce the attenuation by 30%, the temperature phase decrease by 100%, weight reduced by approximately 20%. The standardize cable structure can easily adapt to the standardize semi-rigid and conformable cable connectors.Typical FSD cable applications include test setups, inter connection , and instrumentation.

Similar Cable Replacement Table

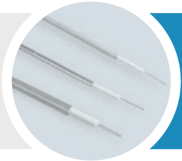
F+S	TIMES	MCC
FSD-086-TP/TM	CLL50086	UT-085-LL
FSD-120-TP/TM		UT-120-LL
FSD-141-TP/TM	CLL50141	UT-141-LL



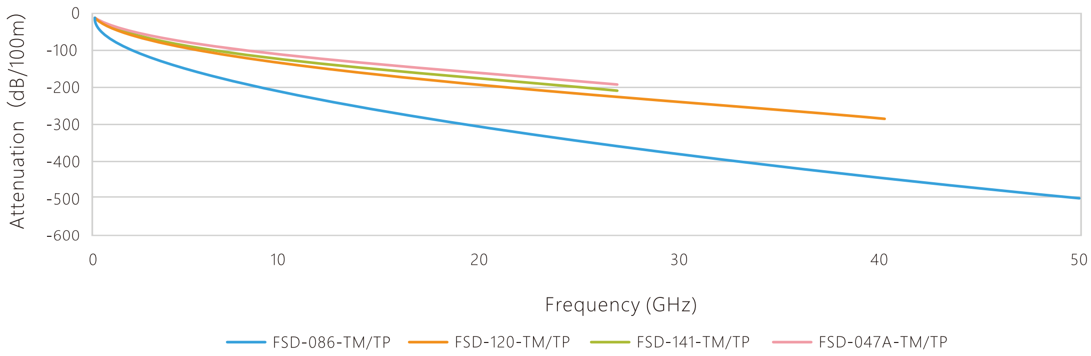


1	Center Conductor	SPC
2	Dielectric	PTFE
3	Outer Conductor	Tri-alloy Plating
		TP-Tin Plating

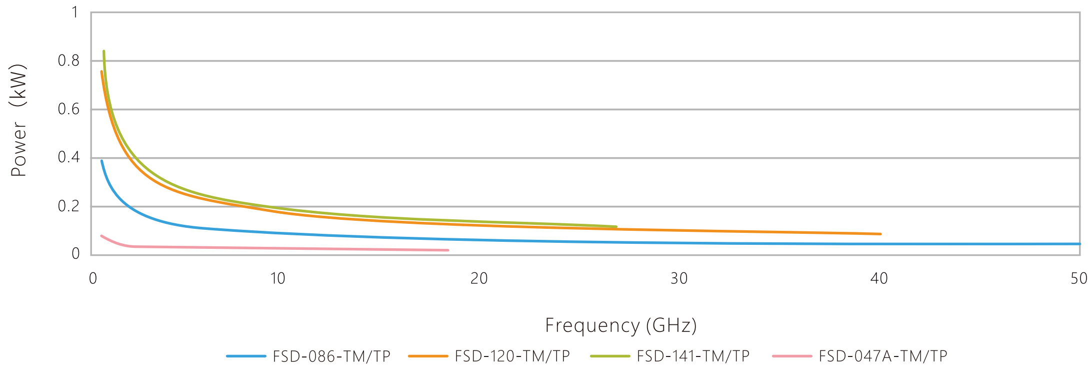
	FSD-047A-TM/TP			FSD-086-TM/TP			FSD-120-TM/TP			FSD-141-TM/TP		
Physical & Mechanical Specifications												
Dimensions	mm	Inch		mm	Inch		mm	Inch		mm	Inch	
Jacket	1.19	0.047		2.18	0.086		3.05	0.120		3.58	0.141	
Bend Radius: Installation	5	0.197		7	0.276		10.5	0.413		12.5	0.492	
Weight	6 g/m	0.004 lbs/ft		19 g/m	0.013 lbs/ft		35 g/m	0.024 lbs/ft		43 g/m	0.029 lbs/ft	
Temperature Range	-60~+150℃（-76~302°F）			-60~+250℃（-76~482°F）								
Electrical Specifications												
Operating Frequency	20 GHz			50 GHz			40 GHz			26.5 GHz		
Impedance	50Ω											
Shielding Effectiveness	＞165dB											
Velocity of Propagation	70%			76%			76%			76%		
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)											
Frequency (MHZ)	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW
1000	1.204	0.367	0.047	0.550	0.168	0.259	0.340	0.104	0.528	0.310	0.094	0.590
2000	1.728	0.527	0.033	0.782	0.238	0.183	0.484	0.147	0.371	0.442	0.135	0.414
4000	2.494	0.760	0.023	1.113	0.339	0.128	0.691	0.211	0.259	0.631	0.193	0.289
8000	3.628	1.106	0.016	1.587	0.484	0.090	0.991	0.302	0.181	0.907	0.276	0.201
10000	4.102	1.250	0.014	1.781	0.543	0.080	1.114	0.340	0.161	1.020	0.311	0.179
18000	5.700	1.738	0.010	2.417	0.737	0.059	1.522	0.464	0.118	1.396	0.426	0.131
26500				2.960	0.902	0.048	1.874	0.571	0.096	1.721	0.525	0.106
35000				3.428	1.045	0.042	2.180	0.665	0.082			
40000				3.680	1.122	0.039	2.346	0.715	0.076			
50000				4.146	1.264	0.034						
Attenuation at Frequency	$dB/m=\frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$											
K1	3.6716383			1.7220000			1.0550000			0.9610400		
K2	0.0043000			0.0005900			0.0005904			0.0005904		



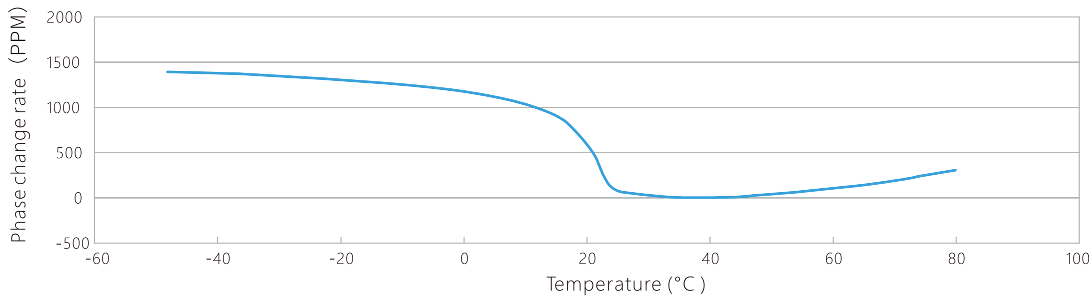
Frequency & Attenuation

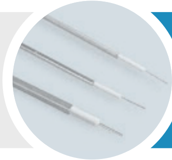


Frequency & Power



Temperature Phase (PPM)





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Assembly Selection Information

FSDXXXXXX-XXXXXXXXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Cable Type

086TP	141TP
086TM	141TM
120TP	047ATP
120TM	047ATM

Connector type, independent on both sides
Refer to connector selection table for code

For example: FSD086TM-SMSM-00.30M

Optional Connectors

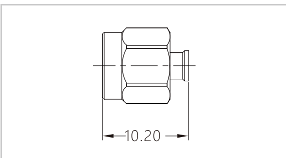
Connector Code	Connection Type	Operating Frequency (GHz)	FSD-047A-TM/TP	FSD-086-TM/TP	FSD-120-TM/TP	FSD-141-TM/TP	Typical VSWR	Max VSWR
18M	1.85mm Male	67GHz	○				1.35	1.40
18FBH	1.85mm Female Bulkhead	67GHz	○				1.35	1.40
35M	3.5mm Male	26.5GHz				●	1.25	1.30
35FBH	3.5mm Female Bulkhead	26.5GHz				●	1.25	1.30
SM	SMA Male	26.5GHz		●		●	1.25	1.30
		18GHz			●		1.25	1.30

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

Connector drawing

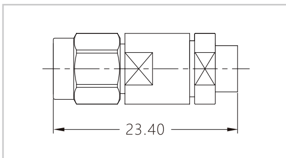
FSD-086-TM/TP

SMA Male for FSD-086-TM/TP



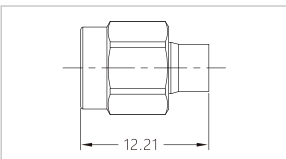
FSD-120-TM/TP

SMA Male for FSD-120-TM/TP

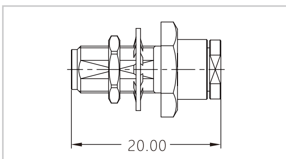


FSD-141-TM/TP

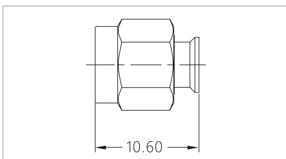
3.5mm Male for FSD-141-TM/TP



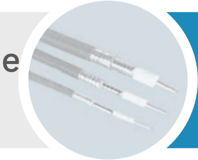
3.5mm Female Bulkhead for FSD-141-TM/TP



SMA Male for FSD-141-TM/TP



FSE | High Performance Ultra-Flexible Phase Stable Coax Cable

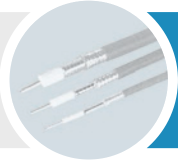


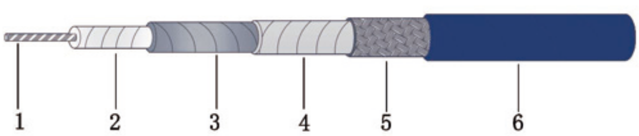
Product features

- Ultra flexible
- Phase stable
- Durable repeat bending
- Low loss
- Good shielding

FSE series uses international leading low loss and stable RF cable technical-19 stranded conductor, low density PTFE dielectric, silver plated flat heli-foil. This is the lowest loss structure among the flexible cables. This product can be widely used in repeated bending, ultra-flexible, extra requirement of ultra-low loss and phased application.

FSE | Specification





1	Center Conductor	Stranded SPC
2	Dielectric	PTFE
3	Outer Conductor	SPC Tape
4	Interlayer	PTFE
5	Outer Shield	SPC Wire
6	Jacket	PUR

	FSE-330-PU			FSE-500-PU			FSE-800-PU		
Physical & Mechanical Specifications									
Dimensions	mm	Inch		mm	Inch		mm	Inch	
Jacket	4.00	0.157		5.50	0.217		8.20	0.323	
Bend Radius: Installation	16	0.630		20	0.787		33	1.299	
Bend Radius: Repeated	36	1.417		50	1.969		82	3.228	
Weight	30 g/m	0.020 lbs/ft		53 g/m	0.036 lbs/ft		145 g/m	0.097 lbs/ft	
Temperature Range	-40~+85℃ (-40~+185°F)								
Electrical Specifications									
Operating Frequency	50 GHz			26.5 GHz			18 GHz		
Max Phase Stability(±°)	±10			±6			±6		
Max Amplitude Stability (±dB)	±0.10			±0.10			±0.10		
Impedance	50Ω								
Shielding Effectiveness	>90dB								
Velocity of Propagation	74%			80%			83%		
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)								
Frequency (MHZ)	dB/ m	dB/ Ft	kW						
1000	0.581	0.177	0.108	dB/ m	dB/Ft	kW	dB/ m	dB/ Ft	kW
2000	0.833	0.254	0.075	0.283	0.086	0.435	0.177	0.054	1.269
4000	1.199	0.366	0.052	0.402	0.123	0.306	0.252	0.077	0.890
8000	1.739	0.530	0.036	0.574	0.175	0.214	0.361	0.110	0.621
10000	1.964	0.599	0.032	0.821	0.250	0.150	0.520	0.159	0.432
18000	2.719	0.829	0.023	0.923	0.281	0.133	0.585	0.178	0.384
26500	3.385	1.032	0.019	1.257	0.383	0.098	0.803	0.245	0.280
40000	4.296	1.310	0.015	1.544	0.471	0.080			
50000	4.901	1.494	0.013						
Attenuation at Frequency	$dB/m=\frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$								
K1	1.7798616			0.8811000			0.5476560		
K2	0.0018415			0.0004150			0.0003772		

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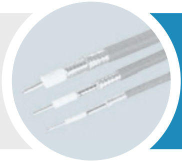
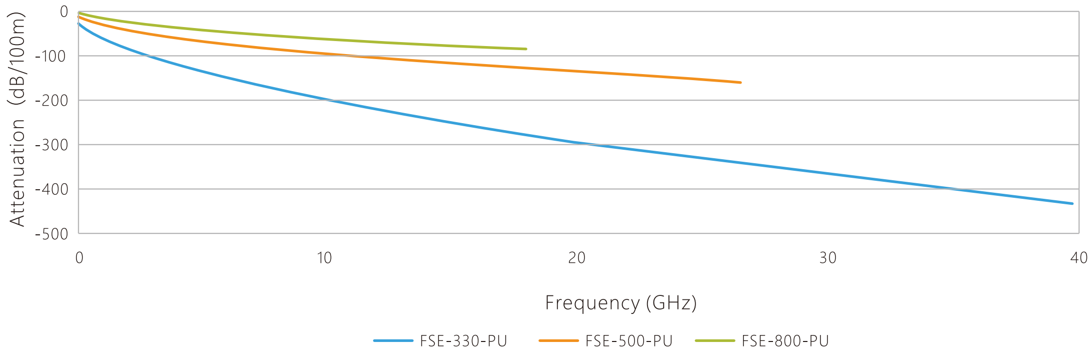
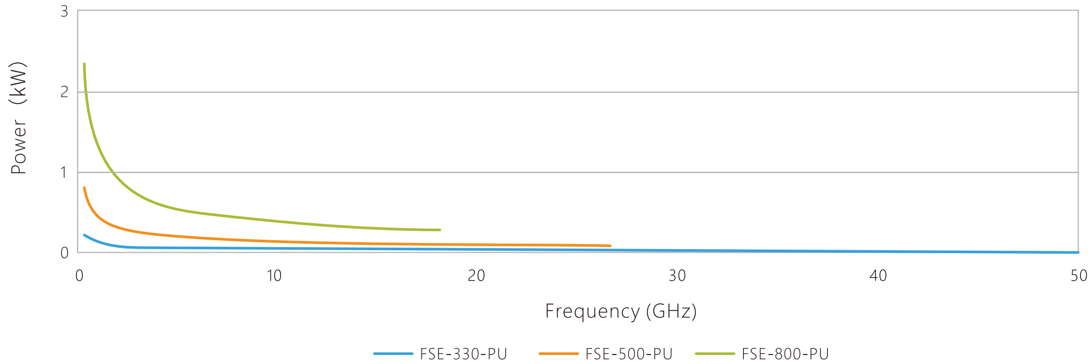


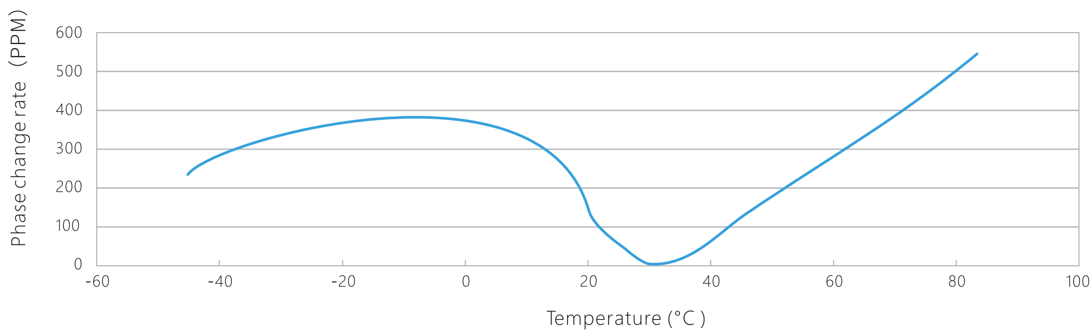
Frequency & Attenuation



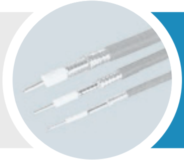
Frequency & Power



Temperature Phase (PPM)



FSE | Connector & Assembly



Assembly Selection Information

FSEXXXXX-XXXXXX - XX.XXXX

- Length: Add 0 if the length code is less than 4 digits. For example,8=08.00
- IN:Inch
  M:Meter
  F:Foot
- Cable Type
  330PU
  500PU
  800PU
- Connector type, independent on both sides
  Refer to connector selection table for code

For example: FSE330PU-24M24M-36.00IN

Optional Connectors

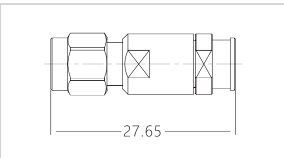
Connector Code	Connection Type	Operating Frequency (GHz)	FSE-330-PU	FSE-500-PU	FSE-800-PU	Typical VSWR	Max VSWR
24M	2.4mm Male	50GHz	●			1.30	1.35
24F	2.4mm Female	50GHz	●			1.30	1.35
29M	2.92mm Male	40GHz	●			1.25	1.30
29F	2.92mm Female	40GHz	●			1.25	1.30
35M	3.5mm Male	26.5GHz		○		1.25	1.30
SM	SMA Male	18GHz		●	○	1.25	1.30
NM	N Male	18GHz		●	○	1.25	1.30
TM	TNCA Male	18GHz			○	1.25	1.30

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

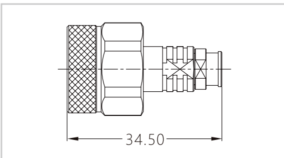
Connector drawing

FSE-500-PU

SMA Male for FSE-500-PU

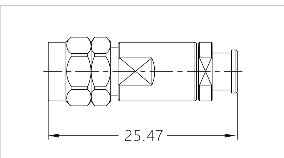


N Male for FSE-500-PU

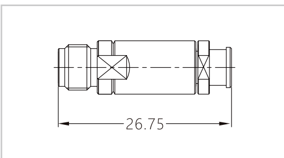


FSE-330-PU

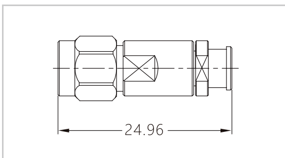
2.4mm Male for FSE-330-PU



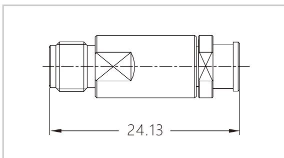
2.4mm Female for FSE-330-PU



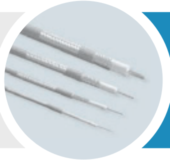
2.92mm Male for ESE-330-PU



2.92mm Female for FSE-330-PU



FSF | High Performance Low Loss Economical Coax Cable

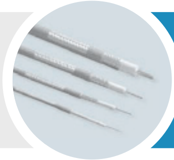


Product features

- Meets MIL-C-17
- Low cost
- Low loss
- Good amplitude stability
- Good high temperature
- performance
- Good fire resistance

FSF series cable combines low cost with low loss while meeting military performance requirements. This cable uses a low-density PTFE tape core dielectric and AL tape outer conductor. It is especially suited for longer cable assemblies and typical applications including interconnections, base stations, and wireless.

FSF | Specification



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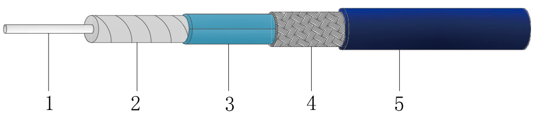
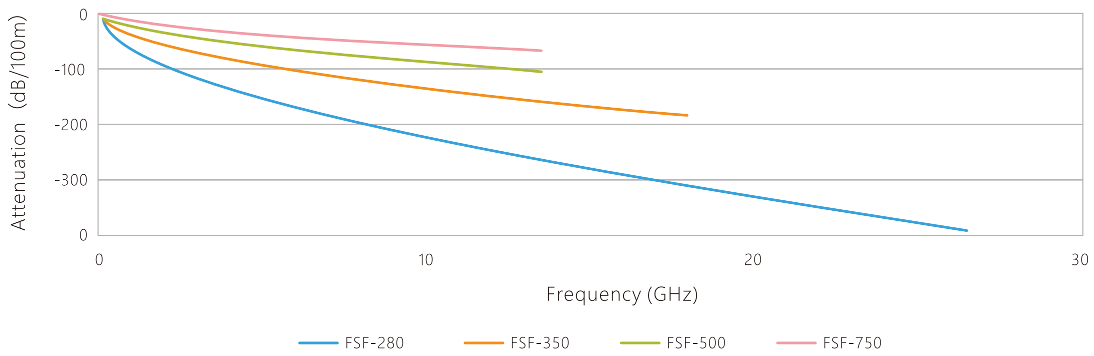


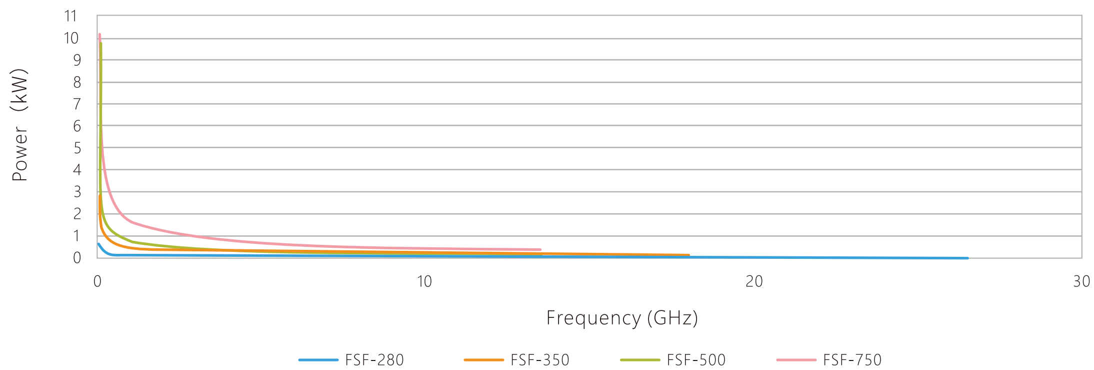
1	Center Conductor	SPC
2	Dielectric	PTFE
3	Outer Conductor	Self-Adhesive Aluminum Foil
4	Outer Shield	SPC Wire
5	Jacket	FEP

	FSF-280			FSF-350			FSF-500			FSF-750		
Physical & Mechanical Specifications												
Dimensions	mm	Inch		mm	Inch		mm	Inch		mm	Inch	
Jacket	2.60	0.102		3.50	0.138		5.20	0.205		7.80	0.307	
Bend Radius: Installation	12	0.472		14	0.551		20	0.787		35	1.378	
Bend Radius: Repeated	28	1.102		35	1.378		52	2.047		75	2.953	
Weight	18 g/m	0.012 lbs/ft		29 g/m	0.019 lbs/ft		60 g/m	0.040 lbs/ft		110 g/m	0.074 lbs/ft	
Temperature Range	-55~+125℃（-67~+257°F）			-55~+150℃（-67~+302°F）								
Electrical Specifications												
Operating Frequency	26.5 GHz			18 GHz			13.5 GHz			13.5 GHz		
Max Phase Stability(±°)	±8			±10			±5			±8		
Max Amplitude Stability (±dB)	±0.10			±0.10			±0.10			±0.10		
Impedance	50Ω											
Shielding Effectiveness	＞90dB											
Velocity of Propagation	76%											
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)											
Frequency (MHZ)	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW
1000	0.607	0.185	0.100	0.424	0.129	0.461	0.238	0.073	0.766	0.151	0.046	1.674
2000	0.874	0.267	0.070	0.606	0.185	0.323	0.343	0.105	0.532	0.218	0.067	1.155
4000	1.269	0.387	0.048	0.868	0.265	0.225	0.498	0.152	0.366	0.319	0.097	0.790
8000	1.861	0.567	0.033	1.250	0.381	0.156	0.729	0.222	0.250	0.473	0.144	0.534
10000	2.110	0.643	0.029	1.408	0.429	0.139	0.827	0.252	0.220	0.538	0.164	0.469
13500	2.504	0.763	0.024	1.654	0.504	0.118	0.981	0.299	0.186	0.642	0.196	0.393
18000	2.959	0.902	0.021	1.933	0.589	0.101						
26500	3.721	1.134	0.016									
Attenuation at Frequency	$dB/m=\frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$											
K1	1.8300000			1.3110233			0.7180000			0.4480000		
K2	0.0028000			0.0009680			0.0010880			0.0008980		

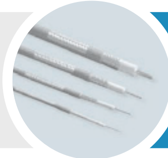
Frequency & Attenuation



Frequency & Power



FSF | Connector & Assembly



Assembly Selection Information

FSFXXX-XXXXXXXXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Cable Type
280
350
500
750

Connector type, independent on both sides
Refer to connector selection table for code

For example: FSF280-SMSM-01.00M

Optional Connectors

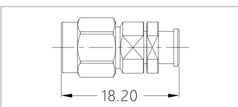
Connector Code	Connection Type	Operating Frequency (GHz)	FSF-280	FSF-350	FSF-500	FSF-750	Typical VSWR	Max VSWR
SSMPF	SSMP Female	40GHz	○				1.40	1.50
35M	3.5mm Male	26.5GHz			●		1.30	1.35
35F	3.5mm Female	26.5GHz			○		1.30	1.35
SM	SMA Male	26.5GHz	●		●		1.30	1.35
		18GHz		●		●	1.30	1.35
SMR	SMA Male Right Angle	18GHz		●	●			
		14GHz	●				1.30	1.35
NM	N Male	18GHz			●	●		
NMR	N Male Right Angle	12GHz			●		1.35	1.40
NF	N Female	18GHz			○		1.30	1.35
TM	TNCA Male	18GHz			○		1.30	1.35
SMPF	SMP Female	18GHz	●				1.30	1.35
SMPFR	SMP Female Right Angle	18GHz	●				1.35	1.40

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

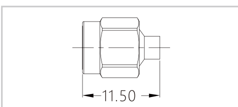
Connector drawing

F280

TS-C280-SM-A

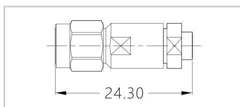


TS-C280-SM-B

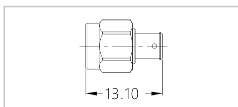


F350

TS-F350-SM-B

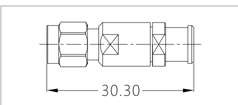


TS-F350-SM-A

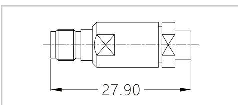


F500

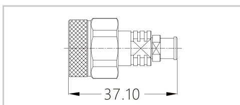
TS-B500-SM-A



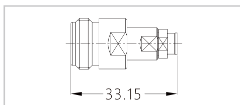
TS-B500-SF-B



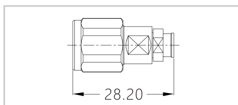
TS-B500-NM-D



TS-B500-NF-A

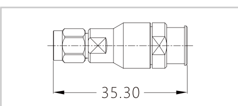


TS-B500-TM-A

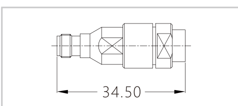


F750

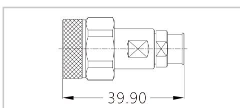
TS-B800-SM-B



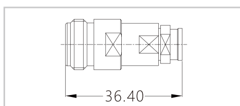
TS-B800-SF-A



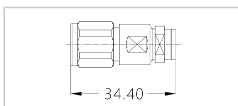
TS-B800-NM-J



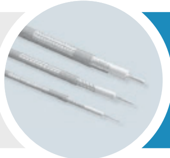
TS-B800-NF-A



TS-B800-TM-A



FSG | Ultra-Flexible Economical Coax Cable

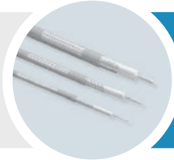


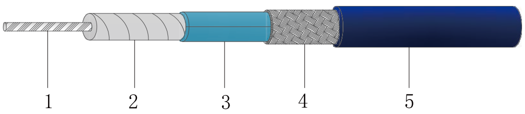
Product features

- Cost effective product
- Ultra-Flexible
- Long working life
- Short lead time

FSG Series is specially designed by Focusimple after communicating with customers. And based on the good understanding of coaxial cable materials and construction, this stable low loss, low cost cable becomes a wise option for vehicle and wireless market.

FSG Specification



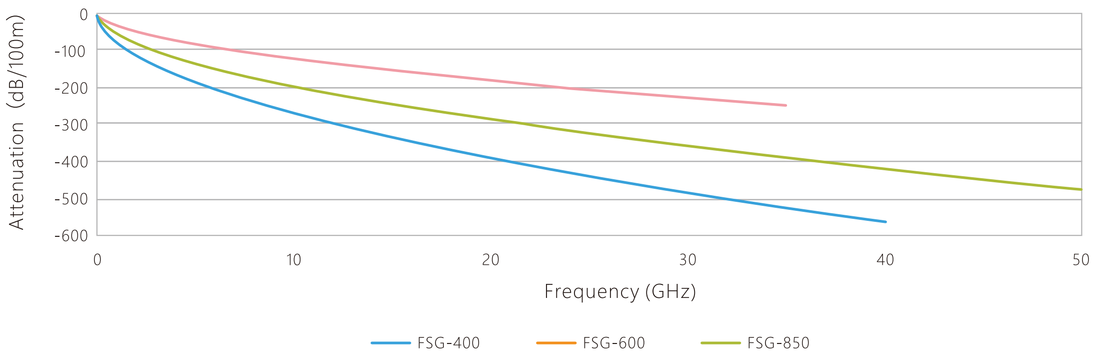


1 Center Conductor	Stranded SPC	
2 Dielectric	PTFE	
3 Outer Conductor	Self-Adhesive Aluminum Foil	
4 Outer Shield	SPC Wire	
5 Jacket	PUR	

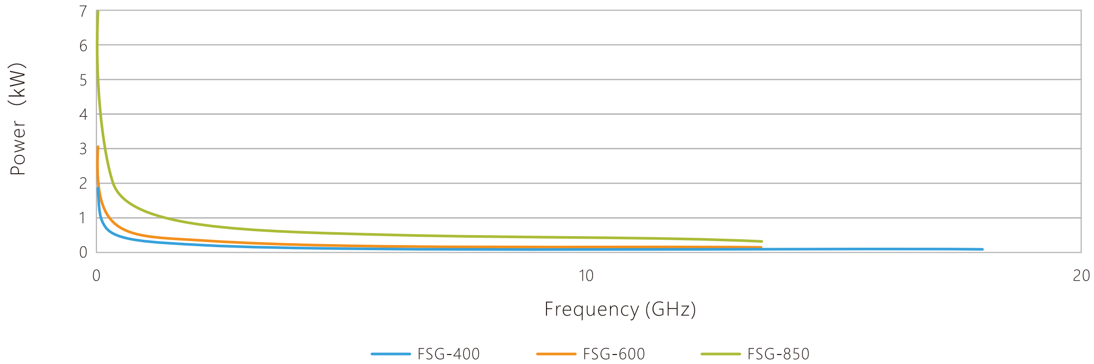
	FSG-400			FSG-600			FSG-850		
Physical & Mechanical Specifications									
Dimensions	mm	Inch		mm	Inch		mm	Inch	
Jacket	4.00	0.157		6.00	0.236		8.20	0.323	
Bend Radius: Installation	16	0.630		20	0.787		35	1.378	
Bend Radius: Repeated	40	1.575		60	2.362		82	3.228	
Weight	30 g/m	0.020 lbs/ft		63 g/m	0.042 lbs/ft		125 g/m	0.084 lbs/ft	
Temperature Range				-55～+85℃（-67～+185℉）					
Electrical Specifications									
Operating Frequency	18GHz			13.5GHz			13.5GHz		
Max Phase Stability(±°)	±10			±5			±5		
Max Amplitude Stability (±dB)	±0.1			±0.1			±0.1		
Impedance	50Ω								
Shielding Effectiveness	＞90 dB								
Velocity of Propagation	76%								
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)								
Frequency (MHZ)	dB/m	dB/Ft	kW	dB/m	dB/ Ft	kW	dB/ m	dB/Ft	kW
1000	0.460	0.140	0.291	0.341	0.104	0.497	0.176	0.054	1.151
2000	0.672	0.205	0.199	0.492	0.150	0.344	0.253	0.077	0.800
8000	1.486	0.453	0.090	1.053	0.321	0.161	0.535	0.163	0.378
10000	1.699	0.518	0.079	1.196	0.365	0.142	0.606	0.185	0.334
18000	2.442	0.744	0.055						
Attenuation at Frequency	$dB/m=\frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$								
K1	1.3437405			1.0245600			0.5339645		
K2	0.0035500			0.0017130			0.0007236		

FSG | Test Data

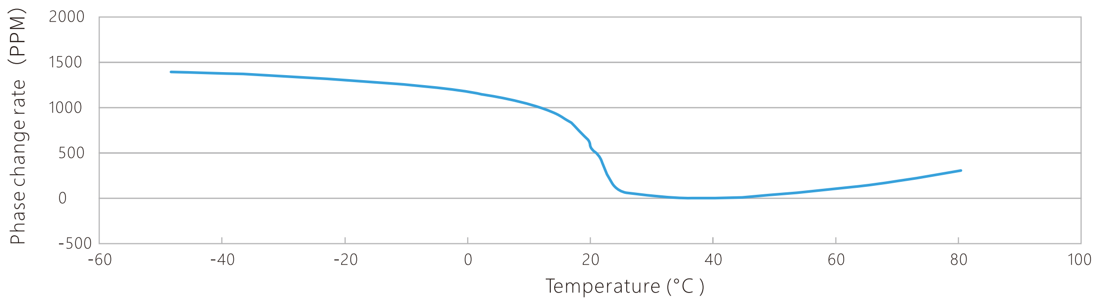
Frequency & Attenuation

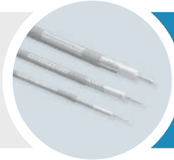


Frequency & Power



Temperature Phase (PPM)





Assembly Selection Information

FSGXXX-XXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Cable Type
400
600
850

Connector type, independent on both sides
Refer to connector selection table for code

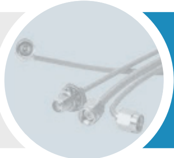
For example: FSG400-SMNM-01.00M

Optional Connectors

Connector Code	Connection Type	Operating Frequency (GHz)	FSG-400	FSG-600	FSG-850	Typical VSWR	Max VSWR
SM	SMA Male	26.5GHz	○			1.30	1.35
		18GHz		○	○	1.30	1.35
NM	N Male	18GHz	○	○	○	1.30	1.35

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

FSH | High Performance Flexible Phase Stable Coax Cable



Product features

- Excellent bending phase, amplitude stability
- Stainless steel outer shield, high tensile strength
- Triple shielding structure, good insulation
- Bending at random and maintaining shape stability
- Stainless steel soldering-free connector

FSH-series cables are featured with excellent bending property, high strength of retention and outstanding phase stability.

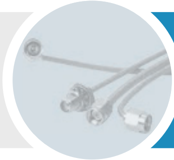
The first benefit of these features is that the FSH cable assemblies can be bent from the root of connectors, which makes them capable of replacing right angle connectors. At the same time, the specially made short-end connector can largely save the installation space. This unique characteristic can save engineers from the problems of balancing between the limited system space and reasonable cable layout. It makes the building of a neat and compact system easier and more pleasant. Also, compared with semi-rigid cable assembly, FSH series can be bent flexibly according to site applications, without requiring customized length or bending shape designing. Thus significant expense on engineering resources and transportation will be saved, and overall cost of use will be reduced.

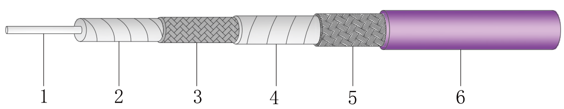
Owing to the soldering-free designing on connectors, embrittlements and cracks on soldering points between cables and connectors are perfectly avoided. Cost and weight are saved once again.

Similar Cable Replacement Table

F+S	Astrolab minibend	MCC	GORE	TIMES	IW	HAROUR	SEMFLEX
FSH-250	32081						
FSH-360	32022						
FSH-260L	32024						

FSH | Specification





1	Center Conductor	SPC
2	Dielectric	PTFE
3	Outer Conductor	SPC Tape
4	Interlayer	Aluminum Foil
5	Outer Shield	Stainless Steel Wire
6	Jacket	FEP

	FSH-250			FSH-250-L			FSH-260-L			FSH-360		
Physical & Mechanical Specifications												
Dimensions	mm	Inch		mm	Inch		mm	Inch		mm	Inch	
Jacket	2.50	0.098		2.50	0.098		2.64	0.104		3.61	0.142	
Bend Radius: Installation	12.50	0.492		12.50	0.492		13.20	0.520		18.05	0.728	
Bend Radius: Repeated	25.00	0.984		25.00	0.984		26.00	1.024		36.00	1.417	
Weight	18 g/m	0.012 lbs/ft		16 g/m	0.011 lbs/ft		17 g/m	0.011 lbs/ft		31 g/m	0.021 lbs/ft	
Temperature Range	-55~+125℃ (-67~+257°F)			-55~+165℃ (-67~+329°F)								
Electrical Specifications												
Operating Frequency	40 GHz			40.0 GHz			50.0 GHz			26.5 GHz		
Max Phase Stability(±°)	±8			±8			±8			±8		
Max Amplitude Stability(±dB)	±0.15			±0.15			±0.15			±0.15		
Impedance	50Ω											
Shielding Effectiveness	> 90 dB											
Velocity of Propagation	70%			74%			76%			76%		
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)											
Frequency (MHZ)	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW	dB/ m	dB/ Ft	kW
1000	0.829	0.253	0.103	0.721	0.220	0.103	0.601	0.183	0.103	0.398	0.121	0.346
2000	1.180	0.360	0.073	1.029	0.314	0.072	0.858	0.262	0.072	0.567	0.173	0.243
4000	1.684	0.513	0.051	1.474	0.449	0.050	1.228	0.375	0.050	0.809	0.247	0.170
8000	2.412	0.735	0.036	2.121	0.647	0.035	1.768	0.539	0.035	1.159	0.353	0.119
10000	2.711	0.826	0.032	2.388	0.728	0.031	1.990	0.607	0.031	1.303	0.397	0.106
18000	3.697	1.127	0.023	3.275	0.999	0.023	2.729	0.832	0.023	1.778	0.542	0.078
26500	4.546	1.386	0.019	4.047	1.234	0.018	3.372	1.028	0.018	2.188	0.667	0.063
40000	5.682	1.732	0.015	5.088	1.551	0.015	4.240	1.293	0.015			
50000							4.809	1.466	0.013			
Attenuation at Frequency	$dB/m = \frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$											
K1	2.5808091			2.2320000			1.8600000			1.2380700		
K2	0.0013000			0.0015600			0.0013000			0.0006499		

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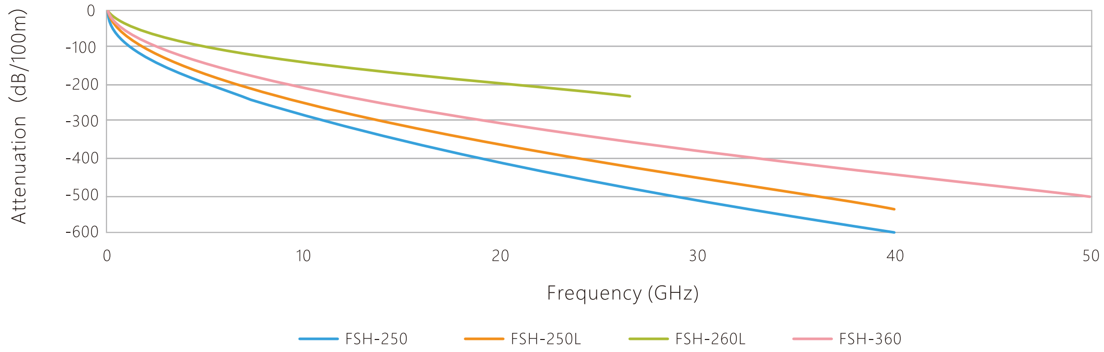
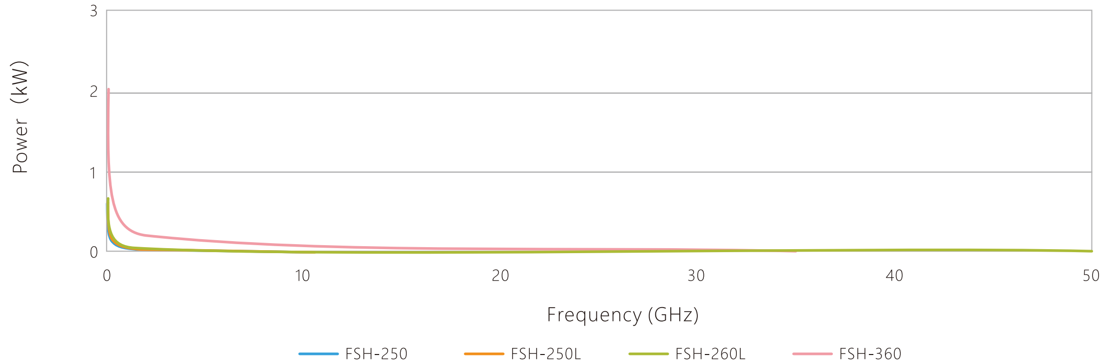
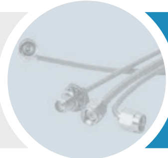
Frequency & Attenuation



Frequency & Power





Assembly Selection Information

FSHXXXXXXXXXXXX - XXXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Connector type, independent on both sides
Refer to connector selection table for code

Cable Type
FSH-250 = 25
FSH-250-L = 25L
FSH-260-L = 26
FSH-360 = 36

For example: FSH2629M29M-300

Optional Connectors

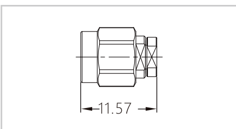
Connector Code	Connection Type	Operating Frequency (GHz)	FSH-250	FSH-250-L	FSH-260-L	FSH-360	Typical VSWR	Max VSWR
24M	2.4mm Male	50GHz			●		1.30	1.35
24F	2.4mm Female	50GHz	●	●	○		1.30	1.35
29M	2.92mm Male	40GHz	○	○	●	○	1.25	1.30
29MR	2.92mm Male Right Angle	40GHz	●	●			1.30	1.35
SM	SMA Male	26.5GHz	●	●	●	●	1.25	1.30
SFBH	SMA Female Bulkhead	18GHz					1.25	1.30
NM	N Male	18GHz	○	○	○		1.25	1.30
SMPFR	SMP Female Right Angle	18GHz					1.30	1.35

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

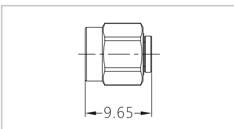
Connector drawing

FSH-250

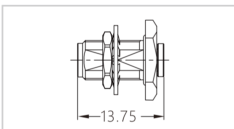
2.92mm Male for FSH-250



SMA Male for FSH-250

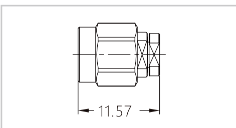


SMA Female Bulkhead for FSH-250

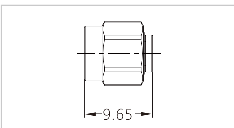


FSH-250-L

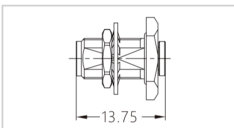
2.92mm Male for FSH-250-L



SMA Male for FSH-250-L

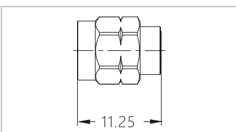


SMA Female Bulkhead for FSH-250-L

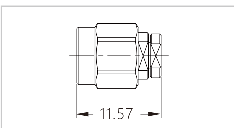


FSH-260-L

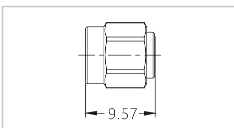
2.4mm Male for FSH-260-L



2.92mm Male for FSH-260-L

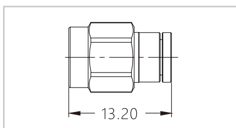


SMA Male for FSH-260-L

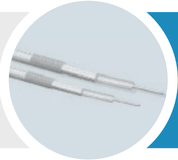


FSH-360

SMA Male for FSH-360



PT | High Performance Temperature Phase Stable Low Loss Coax Cable

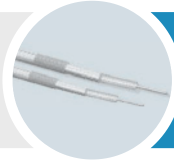


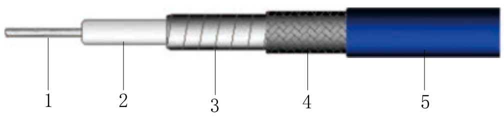
Product features

- Light weight and flexible
- Great temperature phase stability
- Low loss
- High power handling capacity
- Long bending life
- Economical

PT series temperature phase stable cables isgreat in mechanical and electrical characters. In some special applications, a harsh requirement on the temperature phase stability of cable assembly is essential. However, when the status of the facility itself or the environment varies, the dielectric constant changes along with the thermal expansion, consequently, the electrical length of cable assemblies will differ. To create value for customer, Focsuimple developed PT series, the Flexible Temperature-Phase Stable Low Loss Cable.

PT | Specification

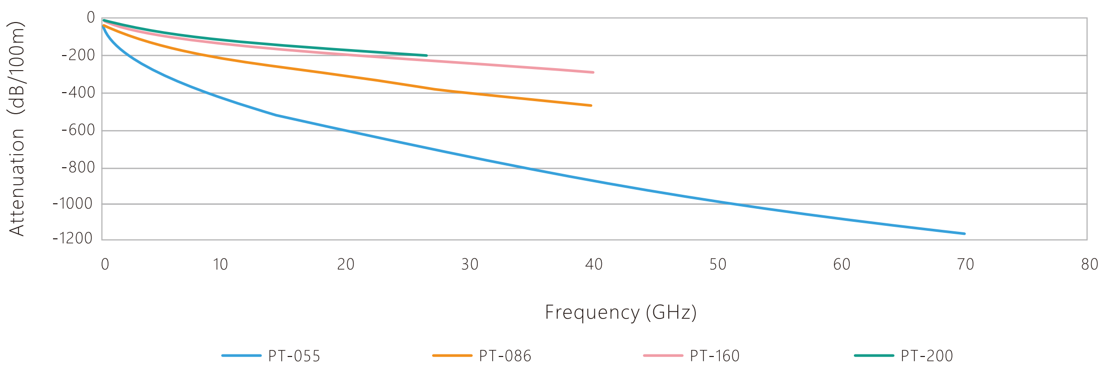




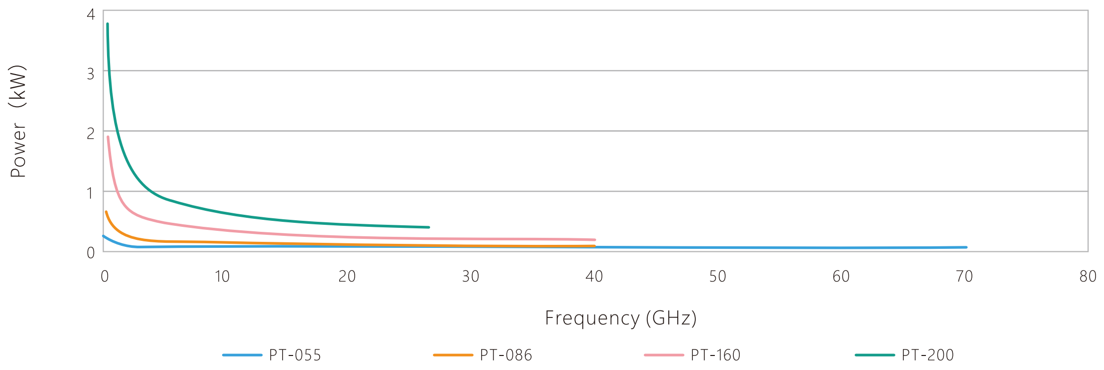
1 Center Conductor	SPC	
2 Dielectric	Profile-extruded F4	
3 Outer Conductor	SPC Foil	
4 Outer Shield	SPC	
5 Jacket	FEP	

	PT-055			PT-086			PT-160			PT-200		
Physical & Mechanical Specifications												
Dimensions	mm	Inch		mm	Inch		mm	Inch		mm	Inch	
Jacket	1.40	0.055		2.20	0.087		4.00	0.158		5.00	0.197	
Bend Radius: Installation	7	0.280		15	0.591		24	0.950		25	0.790	
Bend Radius: Repeated	14	0.56		22	0.87		48	1.90		50	1.97	
Weight	5.6 g/m	0.004 lbs/ft		13 g/m	0.009 lbs/ft		40 g/m	0.027 lbs/ft		57 g/m	0.038 lbs/ft	
Temperature Range	-55～+165℃ (-67～+329°F)											
Electrical Specifications												
Operating Frequency	70 GHz			40 GHz			40 GHz			26.5 GHz		
Max Amplitude Stability (±dB)	±0.15			±0.15			±0.15			±0.15		
Impedance	50Ω											
Shielding Effectiveness	>90 dB											
Velocity of Propagation	80%			82%			82%			82%		
Attenuation & Power Handling	Attenuation (+25°C Ambient) & Power Handing(+40°C Ambient; Sea Level; VSWR1:1)											
Frequency (MHZ)	dB/ m	dB/Ft	kW	dB/m	dB/ Ft	kW	dB/m	dB/ Ft	kW	dB/ m	dB/ Ft	kW
1000	1.357	0.414	0.061	0.663	0.202	0.163	0.388	0.118	0.509	0.325	0.099	1.006
2000	1.923	0.586	0.043	0.946	0.288	0.114	0.558	0.170	0.355	0.468	0.143	0.698
4000	2.726	0.831	0.030	1.356	0.413	0.079	0.806	0.246	0.246	0.679	0.207	0.481
8000	3.869	1.180	0.021	1.953	0.595	0.055	1.173	0.358	0.169	0.995	0.303	0.329
10000	4.332	1.321	0.019	2.200	0.671	0.049	1.327	0.405	0.149	1.128	0.344	0.290
18000	5.839	1.780	0.014	3.021	0.921	0.036	1.847	0.563	0.107	1.581	0.482	0.207
20000	6.161	1.878	0.013	3.200	0.976	0.034	1.962	0.598	0.101	1.681	0.513	0.194
26500	7.113	2.168	0.012	3.737	1.139	0.029	2.309	0.704	0.086	1.986	0.606	0.165
40000	8.782	2.678	0.009	4.704	1.434	0.023	2.944	0.898	0.067			
50000	9.850	3.003	0.008									
67000	11.456	3.493	0.007									
70000	11.718	3.573	0.007									
Attenuation at Frequency	$dB/m = \frac{K1*\sqrt{FMHz}+K2*FMHz}{100}$											
K1	4.2735000			2.0475000			1.1823955			0.9810220		
K2	0.0005880			0.0015225			0.0014490			0.0014692		

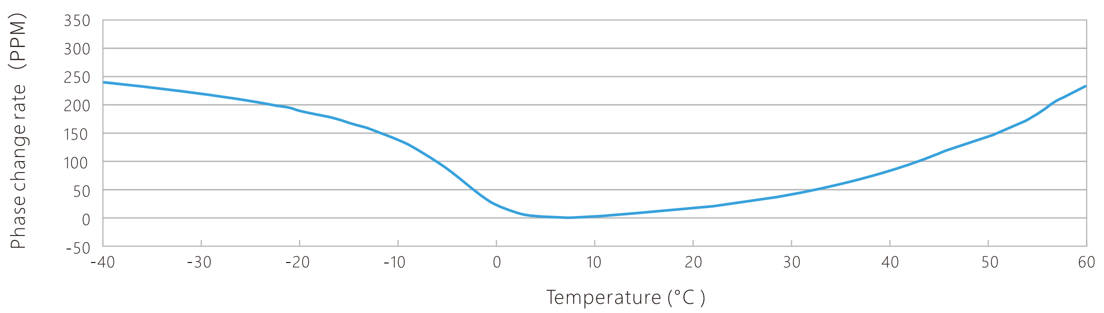
Frequency & Attenuation

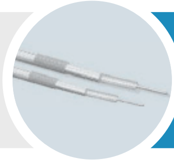


Frequency & Power



Temperature Phase (PPM)





Focusimple

Assembly Selection Information

PTXXX-XXXXXX - XX.XXXX

Length
Add 0 if the length code is less than 4 digits
For example,8=08.00

IN:Inch
M:Meter
F:Foot

Cable Type
055
086
160
200

Connector type, independent on both sides
Refer to connector selection table for code

For example: PT160-SMSM-01.00M

Optional Connectors

Connector Code	Connection Type	Operating Frequency (GHz)	PT-055	PT-086	PT-160	PT-200	Typical VSWR	Max VSWR
18M	1.85mm MALE	67GHz	○				1.30	1.35
29M	2.92mm MALE	40GHz		○	○		1.25	1.30
35M	3.5mm MALE	26.5GHz		○			1.25	1.30
SM	SMA Male	18GHz	○	○	○	○	1.25	1.30
SF	SMA Female	18GHz	○				1.25	1.30

Note:
● = stocked and ○ = designed but not stocked. For other connectors, please contact Focusimple.

ARMORS | Armor Solutions

Ultra-Flexible Armors

Advantages	Typical Applications
Ultra-flexible Waterproof Anti-stress,Anti-torsion High temperature resistance	Lab test

Part Number	FSK-121		FSK-108		FSK-107		FSK-109	
Dimension	mm	Inch	mm	Inch	mm	Inch	mm	Inch
Inner Diameter Of Steel Armor	3.00	0.118	4.10	0.161	5.70	0.224	8.50	0.335
Outer Diameter Of Steel Armor	3.60	0.142	4.80	0.189	6.60	0.260	9.30	0.366
Anti-torsion Layer	3.95	0.156	5.25	0.207	7.11	0.280	9.75	0.384
Waterproof Layer	4.09	0.161	5.50	0.217	7.35	0.289	9.85	0.388
PTFE Braid Jacket	4.65	0.183	6.00	0.236	7.95	0.313	10.40	0.409
Minimum Bending Radius	11.5	0.453	21	0.827	30	1.181	36.5	1.437
Anti-pressure Strength (N / 5cm)	1000		1000		1000		700	
Temperature Range	-55℃/125℃ (-67°F/257°F)							
Suitable Cables	FSB-220		FSB-360		FSB-500		FSB-800	
	FSB-230		Gore 3507		Gore 3449		Gore 3450	
	Gore 3506							

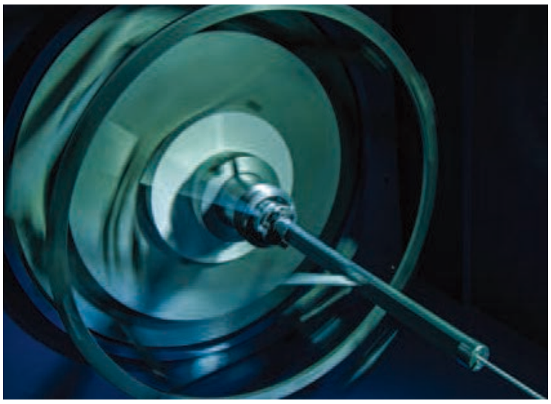
Flexible Armors

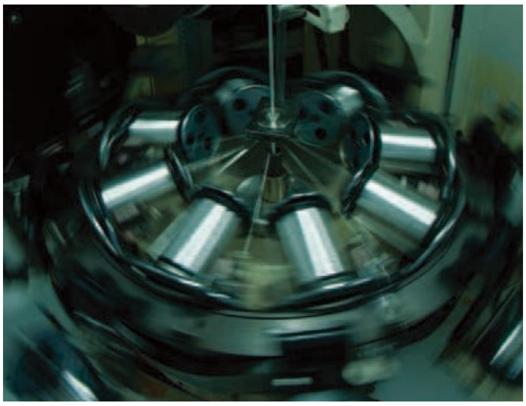
Advantages	Typical Applications
Flexible Anti-stress,Anti-torsion Cutting resistance High temperature resistance	Field assay Field military equipment

Part Number	FSK-110		FSK-127		FSK-101		FSK-106	
Dimension	mm	Inch	mm	Inch	mm	Inch	mm	Inch
Inner Diameter Of Stainless Steel Double-Buckle	6.20	0.244	10.00	0.394	6.20	0.244	10.00	0.394
Outer Diameter Of Stainless Steel Double-Buckle	8.40	0.331	12.50	0.492	8.40	0.331	12.50	0.492
Torsional Layer	8.97	0.353	13.22	0.520	8.85	0.348	13.22	0.520
PUR Jacket	10.80	0.425	15.75	0.620	10.00	0.394	14.50	0.571
Minimum Bending Radius	40		60		40		60	
Anti-pressure Strength (N / 5cm)	2000		2000		2000		2000	
Temperature Range	-55℃/85℃ (-67°F/185°F)				-55℃/125℃ (-67°F/257°F)			
Suitable Cables	FSB-500		FSB-800		FSB-500		FSB-800	
	Gore 3449		Gore 3450		Gore 3449		Gore 3450	

RF Cable Technology

Materials and processes of coax cable determine its performance. Focusimple has professional R&D engineering team who have a lot of experience in this industry and well understand the key point. In addition, international top ranked materials as well as fixed temperature and humidity workshop, enables Focusimple capability to provide high quality and high performance products just to customers' needs.





Center Conductor

Standard center conductor materials as below. All of them are following Focusimple raw material procurement specifications which is generated from ASTM.

- Solid SPC - Low loss, High Power
- Stranded SPC - Flexiable, Phase Stable
- Bare Coppoer - Low Cost

Dielectric

Dielectric materials are critical for coax cables. Dielectric constant, dissipating factor and temperature property will determine the quality of cable. Focusimple selects the world class materials as our dielectric materials as below:

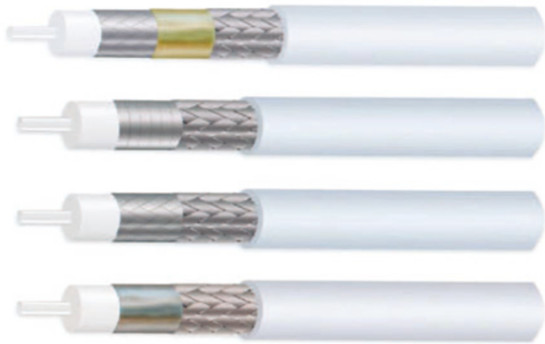
- Solid PTFE Temp(-65°to 125°); VoP(70%)
- ND - PTFE Temp(-65°to 200°); VoP(76%)
- LD - PTFE Temp(-65°to 165°); VoP(83%)
- Foam FEP Temp(-65°to 150°); VoP(83%)

www.focusimple.com Email:int@focusimple.com

RF Cable Technology

Outer Conductor

Focusimple is capable of providing three types of combinations outer conductor and each of them presents the high level of industry.



SPC Ribbon Braid - Low Loss, Long Bending Life
SPC Tape Helical - Ultra Low Loss, Phase & Attenuation Stable
Oxygen-free Copper - Low Cost, Low Loss

Outer Shield

Ribbon Braid + Polyemide Foil + Wire Braid
- Tri-sheilding, High Torque Resistance, Mechanically Strong

Helical SPC Tape + Wire Braid
- 100% Coverage, Phase Stable vs Flexure

Ribbon Braid / Helical SPC Tape + Ribbon Braid
- Light Weight, Flexible

Folded Aluminum Tape + Wire Braid
- Low Cost, Low Loss

Jacket

Focusimple takes Dupont's FEP as jacket materials by default, PFA, ETFE and TPE are available based on customer's choice.

PTFE-High Temperature (-65 To 200°C),
Moistureproof, Anti-corrosion, Antiflaming

To select the best RF coaxial cable for your new applications, it is necessary to understand well the construction, performance and applications of the coaxial cable. The best choice is not only to meet the engineering design needs, but also to balance the cost of the whole project. Focusimple has a deep understanding of cables, will explain professional suggestions for you, which can help you to make the best choice.

Focusimple is a professional high-end coaxial cable supplier. We have a wide range of RF cable for your selection. Meanwhile, we can also provide customized products according to your unique project designing requirement.

In order to better select RF cable, we need to understand some parameters of the RF cable. In the following section, we will discuss some parameters of the RF cable. The following is a detailed analysis of the parameters:

1.Characteristic Impedance
2.VSWR & Return Loss
3.Attenuation & Loss
4.Attenuation Stability (Mechanical Amplitude)
5.Phase vs. Temperature
6.Phase stability
7.Velocity of Propagation
8.Average Power Handling
9.Capacitance
10.Cut-off Frequency
11.Operating Temperature

1 Characteristic Impedance

The characteristic impedance is determined by the ratio of the diameter of the outer conductor to the inner conductor of the coaxial cable and the dielectric constant of the insulating medium between the two conductors. Because the RF energy always transfers on the conductor surface of the RF cable, the conductor diameter refers to the outer diameter of the inner conductor and the inner diameter of the outer conductor. The impedance is selected to match the entire system requirements.

The most common impedances for coaxial cables are 50 ohms and 75 ohms. Others from 35 ohms to 185 ohms are also sometimes used. In the microwave and radio transmission mainly choose 50 ohms, cable television and video monitoring system mainly choose 75 ohms, 85 ohms and 100 ohms are mainly used in the data transmission system.

In order to match the system for better transmission performance, the choice of cable impedance must match the impedance of other components in the system. Usually the classification of impedance is mainly the result of the long practice of synthetically balancing the system power requirement and attenuation requirement. As shown in figure 1, the transmission system with a 75 ohms impedance has the lowest attenuation, while a 35 ohms impedance system delivers the best power.

Therefore, when selecting the RF cable, the most important thing is to select the impedance of the cable according to the impedance of the system.

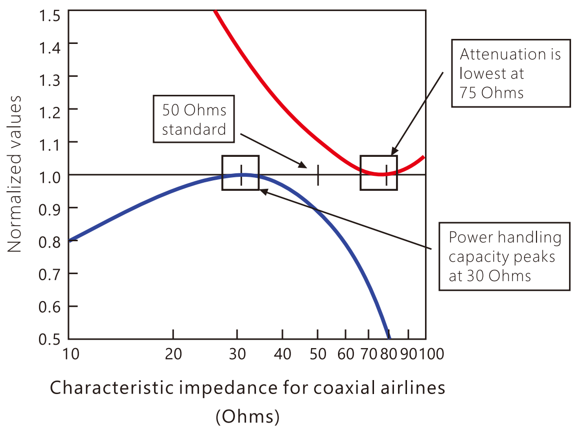


Figure 1. Impedance & Attenuation & Power

2 VSWR & Return Loss

When RF energy is transmitted through the coaxial cable assembly, the following three conditions occur:

a. The energy is transferred to the other end of component, which is usually what we expect.

b. The energy is converted into heat emission and leakage as it passes through the cable.

c. The energy reflected back to the transmitting port of the signal.

The VSWR and return loss is used to measure the size of the reflected signal. It is defined as the sum of the reflected signals due to impedance mismatch. The VSWR is obtained by the ratio of the peak to trough of the reflected signal, while the return loss is calculated logarithmically by measuring the ratio of the reflected power back to the input power. VSWR, return loss, reflection coefficient and matching efficiency can be seen in table 1. In addition, we can see from the table that the energy loss caused by VSWR is very small. For example, when VSWR is 1.3, the energy loss is only 1.7%, which is equivalent to the energy loss caused by the loss of 0.075 db.

The generation of VSWR or return loss is mainly caused by impedance mismatch. The RF signal will reflect when it encounters the change of impedance in the transmission process. According to the change of impedance, the reflection coefficient can be calculated, so the value of VSWR can be calculated. Figure 2 shows the reason and calculation method of VSWR.

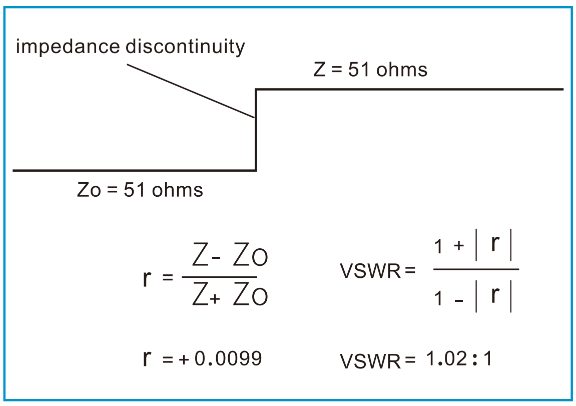


Figure2. VSWR and Impedance change

This impedance inconsistency of VSWR is mainly due to the connector and the installation of the connector from the cable assembly. In the connector itself, due to the consideration of interface standard and cable structure size, there will be some steps, which will cause the jump of impedance. A good connector design can get a good VSWR by compensating to eliminate some of the jump, but none of them can completely eliminate the jump of impedance. Therefore, the connector and the installation of the connector are usually the main reason for the high VSWR. Of course, the cable itself can also affect VSWR. We can see from figure 3 that VSWR of the same cable assembly can remove part of VSWR variation of the connector through the "gate" function of the network analyzer.

In addition, we can also see from the VSWR waveform of the cable assembly that the reflection points caused by impedance matching mainly come from the connector. We can calculate that the bandwidth of VSWR waveform is exactly equal to the length of the cable, which means that the connector creates a higher VSWR of the bandwidth of the assembly length. On the other hand, we can get the reason why VSWR of the long cable assembly is relatively narrow and VSWR of the short cable assembly is relatively wide, which is caused by the difference in the bandwidth frequency with the length of the cable assembly as the wavelength. Figure 4 shows the waveform of VSWR of components of different lengths.

If the impedance of the cable changes regularly and periodically, VSWR of the cable assembly will appear a high peak at a fixed frequency. See figure 5. The height of this peak is directly related to the length of the cable assembly. The longer the assembly is, the higher the peak will be.

In addition, if the peak appears at the high frequency, the short cable assembly is also evident. This is due to the larger number of periodic overlays that cause the echo. The peak of VSWR is a headache for each cable manufacturer, which is directly related to the precision, material and technology of the equipment. In general, some manufacturers adopt "peak shifting" technology to meet customers' demand for a good VSWR at a certain bandwidth.

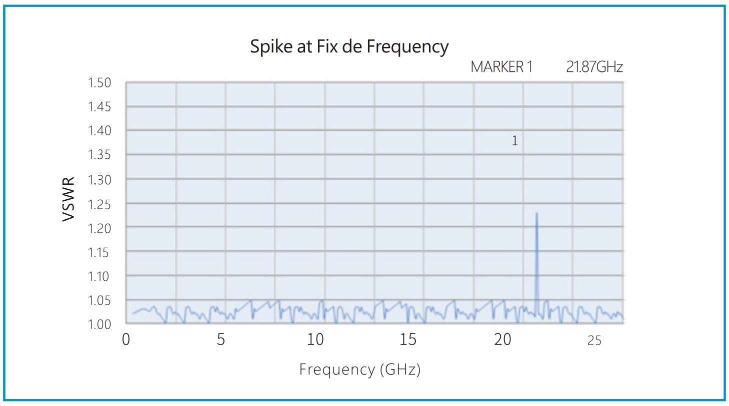


Figure 5. Peak of VSWR of Cable Assembly

In order to obtain a good VSWR, the connector design must match the cable, the connector installation must be firm and accurate, the test equipment and test system need to be well calibrated. In general, professional manufacturers of cable and connector can provide lower VSWR products.

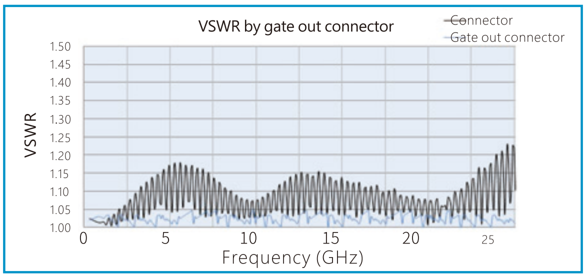


Figure 3. "gate" function , VSWR

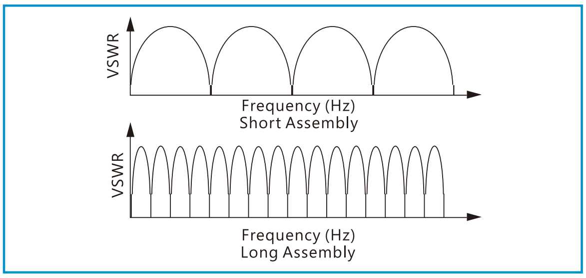


Figure 4. Waveform of long cable assembly and short cable assembly

Connector Type(:1)	Return Loss (dB)	Reflection Coefficient	Mismatch Loss (dB)	Matching Efficiency (%)
1.01	46	0.005	0.000	100.00
1.02	40	0.010	0.0000	99.99
1.03	37	0.015	0.001	99.98
1.04	34	0.020	0.002	99.96
1.05	32	0.024	0.003	99.94
1.06	31	0.029	0.004	99.92
1.07	29	0.034	0.005	99.89
1.08	28	0.038	0.006	99.85
1.09	27	0.043	0.008	99.81
1.10	26	0.048	0.010	99.77
1.12	25	0.057	0.014	99.68
1.14	24	0.065	0.019	99.57
1.16	23	0.074	0.024	99.45
1.18	22	0.083	0.030	99.32
1.20	21	0.091	0.036	99.17
1.22	20	0.099	0.043	99.02
1.25	19	0.111	0.054	98.77
1.30	18	0.130	0.075	98.30
1.35	17	0.149	0.097	97.78
1.38	16	0.160	0.112	97.45
1.44	15	0.180	0.144	96.75
1.50	14	0.200	0.177	96.00
1.59	13	0.228	0.231	94.81
1.68	12	0.254	0.289	93.56
1.80	11	0.286	0.370	91.84
2.00	10	0.333	0.512	88.89
2.20	9	0.375	0.658	85.94
2.40	8	0.412	0.807	83.04
2.60	7	0.444	0.956	80.25
3.20	6	0.524	1.393	72.56
3.80	5	0.583	1.806	65.97
4.80	4	0.655	2.436	57.07
5.83	3	0.707	3.011	49.99

Table 1. VSWR, Return and Matching Loss, Efficiency

3 Attenuation & Loss

Loss refers to the loss of energy during the transmission of the signal in the cable assembly. When the RF signal is transmitted in the cable assembly, part of the energy is converted into heat and consumed, and part of the energy is leaked out through the outer conductor of the cable. The sum of these two energy losses is called loss, or attenuation. It is usually expressed as the dB value per unit length at a fixed frequency point, because the loss increases with the increase of frequency.

For a RF system, the loss usually has a strict index, after all, the loss of energy is very large, the loss of energy of 3dB attenuation is 50%. Therefore, it is very important for rf systems to reduce the loss of cables and cable assemblies. The increased cost of selecting a low-loss cable is much less than that of selecting a high-loss cable to increase the amplifier.

The magnitude of attenuation depends on the loss of conductor and dielectric. To some extent, the loss of coaxial cables is similar to the DC resistance of power cables. Thick cables have lower conductor loss due to thicker conductors, thereby reducing the overall cable loss. The dielectric loss has nothing to do with the size of the cable. The loss of the dielectric has a linear relationship with the frequency change, while the loss of the conductor has a linear relationship with the square root of the frequency. Therefore, the proportion of dielectric loss gradually increases with increasing frequency. Figure 6 is the relationship between cable conductor and dielectric loss of FSB-800.

There are many factors that affect the attenuation, which can be divided into material factors and technological factors. Judging from the material factors, the main factors affecting the attenuation are as following:

a. Inner conductor structure (single and twisted);

b. Outer conductor structure (braid and wrapped);

c. Conductor material (different electrical conductivity);

d. dielectric materials.

Let's take FSA-460 and FSD-141from Focusimple as examples to introduce the detail about material impact on the loss.

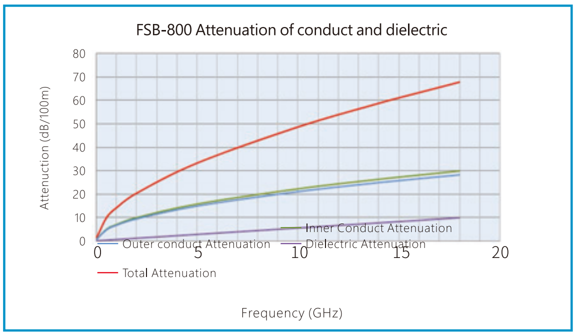


Figure 6. FSB-800 Loss Variation

3.1 Influence Of Inner Conductor Structure On Attenuation

When designing a coaxial cable, sometimes a single-core conductor or a multi-core conductor is selected according to the customer's need for cable flexibility. A multi-core conductor is more flexible than a single-core conductor. But choosing flexibility, the cable with the same size and structure will sacrifice some loss. This is mainly because the unevenness of the conductor surface causes the increasing of surface resistance.

Figure 7 compares the loss after replacing the center conductor with a 19-core twisted conductor using FSA-460 as an example. From the figure, we can see that the increased loss after replacing the center conductor with multiple cores is very obvious. The increased attenuation is about 10%.

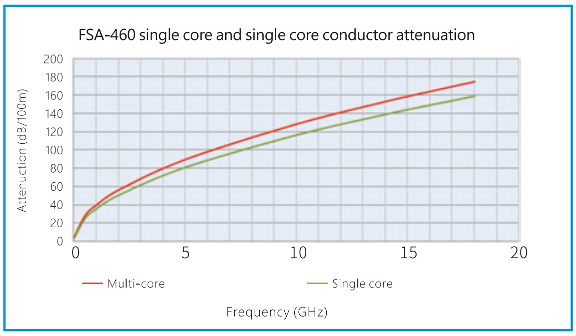


Figure 7. FSA-460 Attenuation Comparison Of Single-core Conductor And Multi-core Conductor

3.2 Effect Of Outer Conductor Structure On Attenuation

The outer conductor structure has a relatively richer choice than the inner conductor. For the flexible cable, there are usually silver-plated round wire braid, silver-plated flat wire braid, and silver-plated copper tape wrapping.

Silver-plated round wire braid is the basic structure of the most traditional RG cable, and the cost is very low; silver-plated round wire is a structure invented in the 1960s, which has relatively low attenuation, good bending stability, and stable high temperature characteristics. Silver-plated copper tape wrapped is invented in the 1980s, which is characterized by ultra-low loss and excellent mechanical phase, but the cost is also the highest one, and the production process is also more demanding. This structure is currently the mainstream military cables structure

Figure 8 is based on the FSA-460 as the prototype, to show the attenuation contrast by replacing the outer conductor into silver-plated round wire braid and silver-plated copper tape wrapping structures. It can be seen from the comparison that the loss of silver-plated copper tape wrapping is about 20% lower than silver-plated flat wire braid loss. While the silver-plated round wire braid will be affected by diameter of the braided wire, the number of wires and the number of braiding machine spindles, there will be some changes.

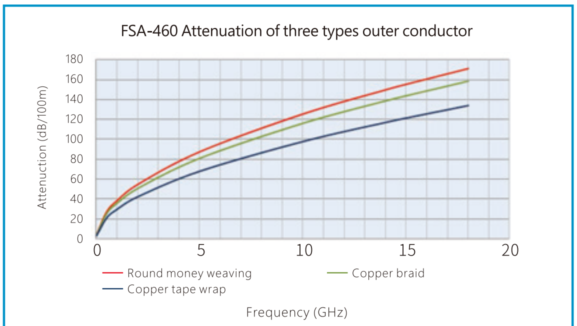


Figure 8. FSA-460 Attenuation Of Different Outer Conductors

3.3 Effect Of Conductor Materials On Attenuation

For coaxial cables, the current mainstream conductor materials are silver-plated copper, oxygen-free copper and aluminum. For high-end cables, copper and silver-plated copper materials are mainly used. Copper uses copper-clad aluminum to reduce weight and cost, because of the "skin effect" of the RF signal, the signal is only transmitted in the surface of the conductor, the silver-plated copper or copper-clad aluminum can be considered to be the electrical conductivity of silver and copper. The size of the electrical conductivity will affect the attenuation of the cable conductor. For the silver-plated thickness of the silver-plated copper conductor, Focusimple strictly select the silver-plated thickness in accordance with ASTM standard to ensure the attenuation

Figure 9 takes FSA-460 from Focusimple as an example, the centerof the cable in the full frequency band. conductor is replaced with oxygen-free copper, and the outer conductor is replaced with oxygen-free copper flat wire braid. The attenuation index obtained is Compared with the standard FSA-460. It can be seen from the comparison that when the inner and outer conductors are replaced with oxygen-free copper, the increased attenuation is still relatively large, around 15%.

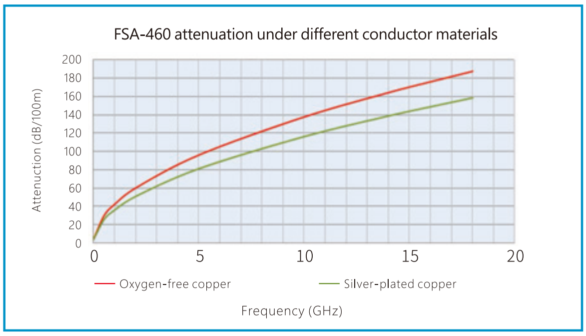


Figure 9. FSA-460 Attentions Of Different Conductor Materials

3.4 Effect Of Dielectric Materials On Attenuation

The conductor materials of the coaxial cable also has a relatively rich choice. For the perspective of military cables, there are mainly solid PTFE material and low-density PTFE material. Solid PTFE material is the main material of the traditional RG series cable. It is relatively simple in process and high in yield. It is currently mainly used in civilian products, especially in smart antenna of mobile communication. But the low-density PTFE material, that is the microporous PTFE material is a material invented by American GORE company. After being stretched, PTFE maintains the characteristics of the original PTFE material, greatly improving the electrical performance of the material, and in the meantime, significantly reducing the weight of the material. the current military RF cable use low density PTFE material. According to the difference in material density, low density PTFE is divided into 76% and 83% transmission rate.

Figure 10 is an example of a half- steel cable FSD-141, which illustrates the effect of three different dielectrics on cable loss. Replace the traditional solid PTFE 141 half-steel cable that pushes the core wire with a low-density PTFE dielectric cable. With the same outer diameter, the loss will increase by about 30%. As for comparison between 76% rate and 83% rate, from the point of view of attenuation, there is basically no obvious difference.

In addition, the attenuation is also greatly affected by the production technology, dielectric wrapping, material oxidation, and weaving technology will all have a certain impact on the attenuation. A good and stable production technology is an important means to ensure the stability of cable batch attenuation.

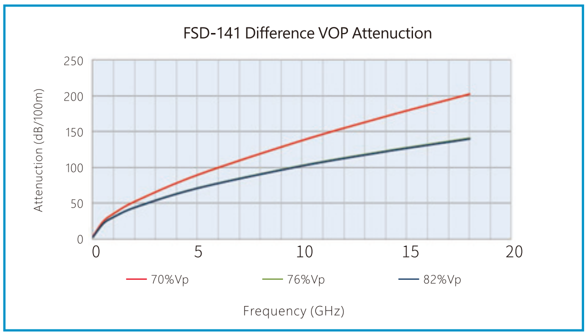


Figure 10. FSD-141Attenuation Of Different Dielectric Materials

3.5 The Effect Of Temperature On Attenuation

Attenuation is usually measured at room temperature 25 °C, temperature changes have an impact on attenuation, which can be corrected by a correction factor. The effect of temperature on attenuation is mainly due to the change in resistance of the productor as the temperature increases and the power factor of the dielectric increases. Figure 11 is the curve of FSB-330-P cable attenuation with temperature. It can be seen from the curve that the attenuation is basically linear with the temperature change. At room temperature, the fission process of PTFE is only a small inflection point, which is basically negligible. The slope of the attenuation curve of each cable structure is slightly different, so it is recommended to obtain more comprehensive data with the manufacturers.

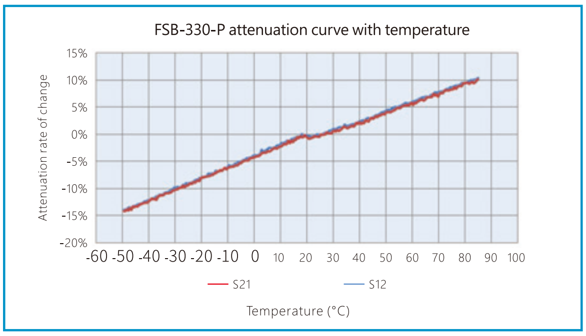


Figure 11. Attenuation Curve With Temperature

4 Attenuation Stability

Attenuation stability refers to the change in the attenuation of a cable assembly after one rotation along the dynamic bending radius of the cable. It is often referred to amplitude stability abroad, and becomes insertion loss stability in GB 17738.1. The standard defines the measurement method in detail.

Attenuation stability is critical for cable assemblies, it also affects the accuracy of RF system. The size of attenuation stability mainly depends on the processing technology of the cable. For this point, each manufacturer has its own unique experience and skills. Typically, the structure of SPC tape wrapping is slightly better than silver flat wire, but as the number of bending increases, the reliability of silver-plated copper tape wrapping is far less than silver flat braided structure. In addition, the attenuation stability of single-core center conductor is better than multi-core conductor. But the most critical factor is the processing technology of the cable. Figure 12 is the maximum result given by Focusimple for multiple tests of FSB series.

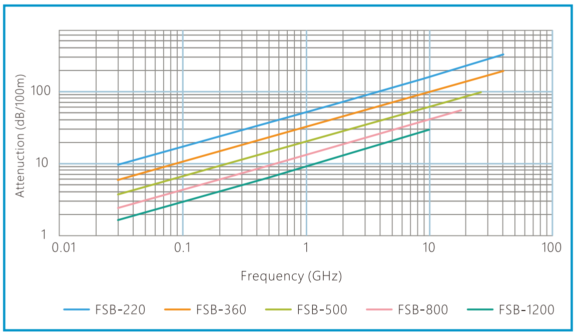


Figure 12. The Attenuation Stability Of FSB Series Cable

5 The Temperature Phase

The temperature phase, which is called "phase change with temperature" in GB-17738.1, refers to the determination of the phase change caused by the change electrical cable length when the cable assembly is working within the operating temperature range. There are detailed measurement methods in GB-17738.1.

We know that when the radar system detects a target, it determines the target's position by receiving the signal time when it is emitted and returned to the system. Both the transmission and reception of electromagnetic wave signals need to be performed through coaxial cable, but if the electrical length of the coaxial cable assembly of different TR unit of a same radar system is different, this causes the reception time is inconsistent due to the transmission time the cable assembly, which affects the positioning accuracy of the entire radar system. Therefore, the magnitude of the temperature phase change is very important to the accuracy of some RF systems.

The main reason for the temperature Phase is the thermal expansion and contraction of the materials, which causes the physical length of the cable to change, and thus the electrical length. For the coaxial cable, it is mainly the change of the electrical length that is integrated by the thermal expansion and contraction of the copper conductor and the thermal deformation of the dielectric material. That is, because the conductor material constituting the coaxial cable mainly uses silver-plated copper material, then the difference in temperature phase is mainly caused by the dielectric material. We can see the influence of different dielectric materials on the temperature phase through figure 13.

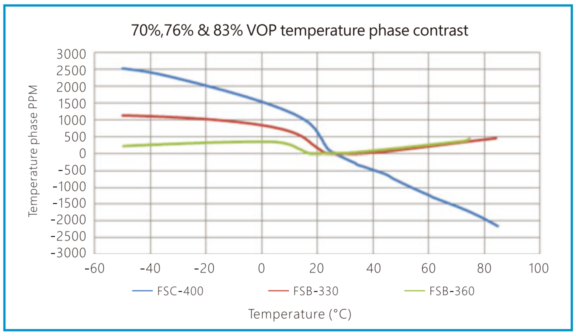


Figure 13. The Temperature Phase Of Different Rate Dielectric

From the figure, we can see that with the increase of propagation rate of the dielectric material, that is, with the air proportion increases in the dielectric material, the change of temperature phase decreases obviously.

For the temperature phase, multiple cable assemblies are used simultaneously due to the final application, in this case, it is also necessary to examine the consistency of temperature phase changes between different cable assemblies of the same cable. Moreover, the temperature change of the same cable from low to high and from high to low are also slightly different, that is, the repeatability of temperature change. If you need to learn more about these data in detail, you can contact the manufacturer, who can provide detailed test data.

6 Phase Stability

Phase stability, also called RF stability, refers to the magnitude of the change in phase degree during the physical bending of the cable. This is an important indicator to inspect the accuracy and stability of the cable.

Phase stability is mainly related to the production technology of the cable in the process of processing, and also the structure of the cable. Normally, the phase stability of a small-diameter cable is better than that of a large-diameter cable, and the phase stability of a stranded conductor is slightly better than that of a single-core conductor. Figure 14 shows the phase stability of the three cables of FSB series, The test method is the test result obtained by rotating 360°along the minimum bending radius of the cable.

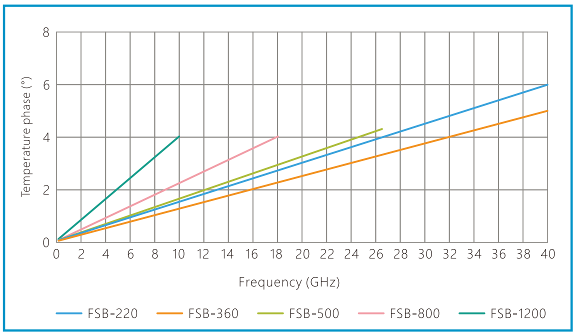


Figure 14. Phase Stability Of FSB Series

7 Transmission Rate

Transmission rate refers to the percentage of the transmission speed of electromagnetic wave in the RF signal in the dielectric relative to the speed of light. For coaxial cables, it mainly depends on the dielectric constant between the center conductor and the outer conductor of the coaxial cable. Meanwhile, transmission rate has a corresponding relationship with the delay of the cable, and the three can be converted to each other through formulas.

The consistency of transmission rate is also very important, especially when producing phase-matched cable assemblies. The consistency of transmission rate will have a direct impact on the matching of the physical length and electrical length of the phase-matched cable. Besides, when choose the cable of delay wire, after meet the requirement of attenuation, try to choose low propagation velocity of the cable to reduce the length and cost.

8 Average Power

When a coaxial cable transmits a signal, the attenuation of the cable generates heat between the inner and outer conductors of the coaxial cable. The power handling capacity of the cable is mainly reflected in the ability of the cable to withstand the heat generated by the attenuation. There are two most important factors that affect the average power of the cable: one is the maximum operating temperature of the cable; the other is the attenuation of the cable itself. In other words, the better the attenuation of the cable is, the smaller the heat generated by the cable itself, and the greater the power the cable withstands. At the same time, under the same conditions, the higher the operating temperature that the cable can withstand, the greater power the cable withstand.

In demanding situations, when considering the effective average power, the ambient temperature also needs to be considered. The level of the ambient temperature directly affects the heat dissipation capacity of the cable, which directly affects the transmission power of the cable. Figure 15 is the influence factors of PTFE dielectric cable in different ambient temperature. This needs to be considered in engineering applications.

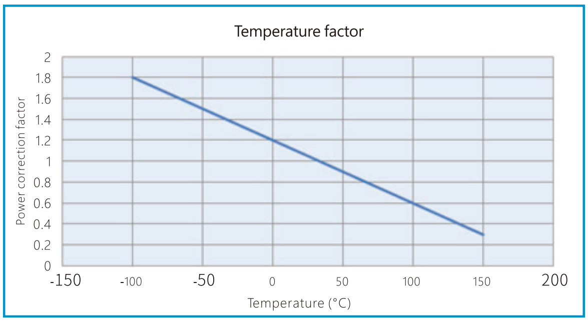


Figure 15. The Affect Factors Of Average Power Temperature

9 Capacitance

The capacitance of the coaxial cable is related to the dielectric constant of the cable and the characteristic impedance of the cable, once these two parameters are determined, the capacitance of the cable is already determined. The capacitance has nothing to do with the structure and size of the cable. When using AC voltage to measure dielectric withstand voltage, it needs to consider the capacitance values of the cable. As the length of the cable increases, the capacitance value increases, so that the leakage current increases, so it is recommended to use DC measurement or short cable measurement.

10 Cut-off Frequency

The cut-off frequency of a coaxial cable means that energy can be transmitted below a certain frequency point. When the signal frequency is higher than this cut-off frequency, the signal can pass; when the signal frequency is lower than the cut-off frequency, the signal output will be substantially attenuated. The cut-off frequency is related to the conductor diameter and transmission rate of the cable, the larger the cable diameter, the lower the cut-off frequency of cable. Above the cut-off frequency, VSWR and attenuation are not significantly increased, but we strongly recommend that the cable must be selected below the cut-off frequency.

11 Operating Temperature

The operating temperature of the cable depends on dielectric material and sheath material used for the cable. In addition, only silver-plated conductors are suitable for long-term work in environment above 80°. The working temperature of different dielectric materials and sheath materials are as follows:

Polytetrafluoroethylene PTFE	-75°Cto+250°C
Polythene PE	-65°Cto+80°C
Foamed polyethylene PE	-65°Cto+80°C
Fluorinated ethylene propyleneFEP	-70°Cto+200°C
Polyvinyl chloridePVC	-50°Cto+85°C
ETFE	-65°Cto+150°C
PFA	-65°Cto+250°C
Nylon	-40°Cto+105°C
Silastic	-70°Cto+200°C

The above temperatures is only the temperature range of conventional material model, the detailed data should be subject to the data provided by the material manufacturers.

In addition, some materials can increase the maximum temperature of the material by irradiation crosslinking.

National Standard (GB)

MIL-STD-810H Environmental engineering considerations and laboratory tests

IEC 60966-1-2019 Radio frequency and coaxial cable assemblies -Part 1: Generic specification - General requirements and test methods

IEC 60096-0-1-2012 Radio frequency cables - Part 1- 0: Guide to the design of detail specifications - Coaxial cables

IEC 61169-1-2013 Radio frequency connectors -Part 1: Generic specification - General requirements and measuring methods

IEC 61196-1-2005 Coaxial communication cables - Part 1: Generic specification - General, definitions and requirements

Aerospace Standards (QJ)

QJ 603A-2006	General technical requirements for cable assembly production
QJ 3136-2001	Preparation, assembly and installation of radio frequency coaxial cable components
QJ 165B-2014	General technical requirements for the installation of aerospace electronic and electrical products
QJ 2828-1996	Electronic assembly term
QJ 3117A-2011	Technical requirements for manual welding process for aerospace electronic and electrical products

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Engineering Applications

Common Formlas for Coaxial Cables

Impedance Ohms

$Z_0=138\cdot V_p\cdot \log(D/d\cdot k_s)=60\cdot V_p\cdot \ln(D/d\cdot k_s)$

$Z_0=138\cdot \log(D/d\cdot k_s)/\sqrt{\varepsilon}=60\cdot \ln(D/d\cdot k_s)/\sqrt{\varepsilon}$

$Z_0=\sqrt{L/C}$

Propagation Rate Vp And Dielectric Constant

$V_p=1/\sqrt{\varepsilon}$

$\varepsilon=1/(V_p)^2$

Time Delay (nS/m)

$Td=3.33/Vp=3.33\cdot\sqrt{\varepsilon}$

Capacitance (pF/m)

$C=24\cdot\varepsilon/\log(D/d\cdot k_s)=55.6\cdot\varepsilon/\ln(D/d\cdot k_s)$

$C=24/(V_p^2\cdot\log(D/d\cdot k_s))=55.6/(V_p^2\cdot\ln(D/d\cdot k_s))$

$C=1016/(Z_0\cdot V_p)$

Inductance (uH/m)

$L=0.46\cdot\log(D/d\cdot k_s)=0.199\cdot\ln(D/d\cdot k_s)$

$L=Z_0^2\cdot C\cdot 1\times10^{-6}$

Attenuation (dB/100m)

$a=K_1\cdot\sqrt{F}+K_2\cdot F$

Cut-off Frequency (Ghz)

$F_{co}=190\cdot Vp/(D+d\cdot k_s)$

$F_{co}=190/(\sqrt{\varepsilon}\cdot(D+d\cdot k_s))$

Wavelength (mm)

$Lw=300\cdot Vp/F_{GHz}$

$Lw=300/(F_{GHz}\cdot\sqrt{\varepsilon})$

Physical Length Per Degree (mm)

$D_L=300\cdot Vp/(F_{GHz}\cdot 360)$

$D_L=300/(F_{GHz}\cdot\sqrt{\varepsilon}\cdot 360)$

Electron Degree(°)

$\Phi=L_{TH}\cdot F_{GHz}\cdot 360/(300\cdot Vp)$

$\Phi=L_{TH}\cdot F_{GHz}\cdot 360\cdot\sqrt{\varepsilon}/300$

Frequency (Ghz)

$F=300\cdot Vp/Lw$

$F=300/(Lw\cdot\sqrt{\varepsilon})$

Temperature Phase (ppm)

$PTC=\Delta\Phi\cdot 1\times10^6/(\Phi\cdot\Delta T)$

Degree Of Temperature Phase Change (ppm)

$\Delta\Phi=\Phi\cdot PTC\cdot 1\times10^{-6}$

$\Delta\Phi=L_{TH}\cdot F_{GHz}\cdot 360/(300\cdot Vp)\cdot PTC\cdot 1\times10^{-6}$

$\Delta\Phi=L_{TH}\cdot F_{GHz}\cdot 360\cdot\sqrt{\varepsilon}/300\cdot PTC\cdot 1\times10^{-6}$

Return Loss (dB)

$RL=-20\cdot\log\Gamma$

$RL=-20\cdot\log((VSWR-1)/(VSWR+1))$

VSWR

$VSWR=1+\Gamma/(1-\Gamma)$

$VSWR=1+10^{-RL/20}/(1-10^{-RL/20})$

Matching Efficiency

$ME=[1-(VSWR-1/(VSWR+1))^2]\cdot 100$

Matching Loss

$MML=-10\cdot\log[1-(VSWR-1/(VSWR+1))$

Common Standards For RF Cables, Connectors And Components

Material	Dielectric Constant	Dielectric Loss Angle	Capacitance	Temperature
PTFE	2.07	0.0003	95.9	-75 to +250
Polyethylene	2.3	0.0003	101.1	-65 to +80
Foam Polyethylene	1.29-1.64	0.0001	75.72-85.38	-65 to +100
Polyvinylchloride	3.0-8.0	0.07-0.16	115.47-188.56	-50 to +105
Polyamide	3.5-4.6	0.03-0.4	124.72-254.73	-60 to +120
Silicone Rubber	2.1-3.5	0.007-0.016	96.61-124.72	-70 to +250
Ethylene Propylene	2.24	0.00046	99.8	-40 to +105
FEP	2.1	0.0007	96.6	-70 to +200
Low Density PTFE	1.38-1.73	0.00005	78.3-87.7	-75 to +250
Foam FEP	1.45	0.0007	80.3	-75 to +200
Polyimide	3.0-3.5	0.002-0.003	115.5-124.7	-75 to +300
PFA	2.1	0.001	96.6	-75 to +260
ETFE	2.6	0.005	107.5	-75 to +150
ECTFE	2.5	0.0015	105.4	-65 to +150
PVDF	7.8	0.02	186.2	-75 to +125

Band Division Table

<table>
<tr><th colspan="4">Radar Naming Method</th><th colspan="3">ITU Naming Method</th></tr>
<tr><th>Band Letter Representation</th><th>Frequency Range</th><th>Metric Length Indication</th><th>Typical Application</th><th>Synbol</th><th>Frequency Range</th><th>Radar Dedicated Frequency Band Allocated By Itu (Region 3)</th></tr>
<tr><td>HF</td><td>3-30MHz</td><td>Ten Meters Wave</td><td>1. Long-distance short barge communication
2. AM broadcasting</td><td>HF</td><td>3-30MHz</td><td>—</td></tr>
<tr><td>VHF</td><td>30-300MHz</td><td>Meepo</td><td>1. Aviation/surface radio navigation positioning
2. Broadcast</td><td>VHF</td><td>30-300MHz</td><td>223-230MHz</td></tr>
<tr><td>UHF</td><td>30-1000MHz</td><td rowspan="3">Decimeter wave</td><td rowspan="3">1. Mobile communication: GSM/WCDMA/TDSCDMA/LTE
2. Wireless communication: WLAN/Bluetooth.WIMAX
3. GPS satellite navigation
4. Digital broadcasting communication: DVB
5. RFID</td><td rowspan="3">UHF</td><td rowspan="3">0.3-3GHz</td><td rowspan="2">420-450MHz
890-942MHz
(216-450MHz is usually called P band)</td></tr>
<tr><td>L</td><td>1-2GHz</td></tr>
<tr><td>S</td><td>2-4GHz</td><td>1215-1400MHz</td></tr>
<tr><td>C</td><td>4-8GHz</td><td rowspan="4">Centimeter wave</td><td rowspan="4">1. Broadcast Satellite
2. Meteorological satellite
3. Earth exploration satellite
4. Radar
5. Radio Astronomy</td><td rowspan="4">SHF</td><td rowspan="4">3-30GHz</td><td>2300-2500MHz
2700-3700MHz
4200-4400MHz
5250-5925MHz</td></tr>
<tr><td>X</td><td>8-12GHz</td><td rowspan="2">8.5-10.68GHz
13.4-14GHz
15.7-17.7GHz</td></tr>
<tr><td>Ku</td><td>12-18GHz</td></tr>
<tr><td>K</td><td>18-27GHz</td><td>24.05-24.25GHz</td></tr>
<tr><td>Ka</td><td>27-40GHz</td><td rowspan="2">Millimeter Wave
(8 millimeter wave:)</td><td rowspan="2">1. Radar
2. Satellite communications
3. Radio Astronomy</td><td rowspan="2">EHF</td><td rowspan="2">30-300GHz</td><td>33.4-36GHz</td></tr>
<tr><td>V</td><td>40-75GHz</td><td>59-64GHz</td></tr>
<tr><td>W</td><td>75-110GHz</td><td rowspan="2">Around 40GHz
3 millimeter wave
Around 100GHz</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>76-81GHz
92-100GHz</td></tr>
<tr><td>mm</td><td>110-300GHz</td><td>126-142GHz
144-149GHz
231-235GHz</td></tr>
</table>

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