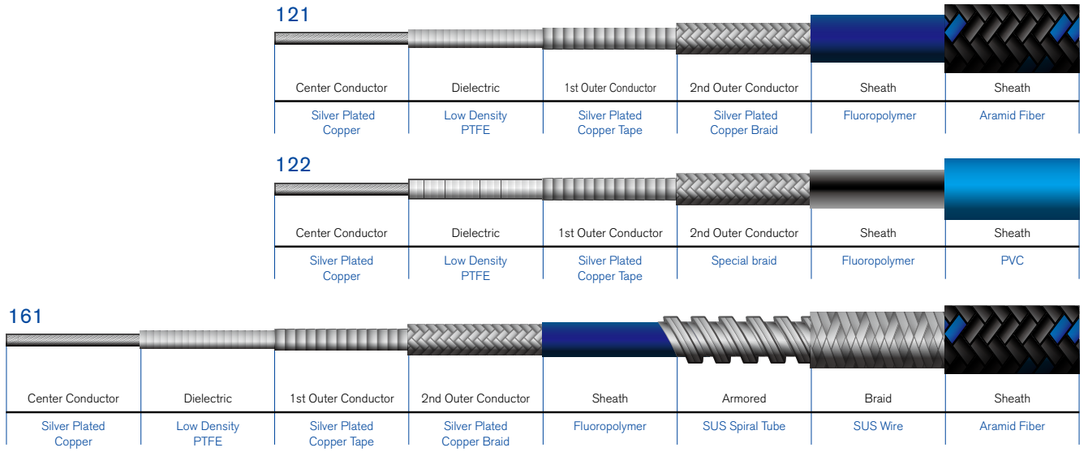
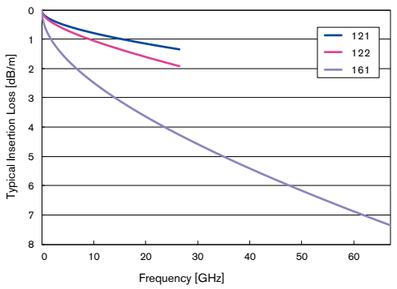
1 Series

Cable Assemblies with Wide Temperature and High Durability for Measuring Instruments

We line up 121 of the heat-resistant type that can be used under a wide range of temperatures (-65 - +125°C) in the microwave measurement. And 122 of the high-durability type (that can be used under the temperature range from -35°C to +85°C) of which the mechanical life is drastically extended by applying a cabling structure that we developed in the robot cable.



1 Series Typical Insertion Loss



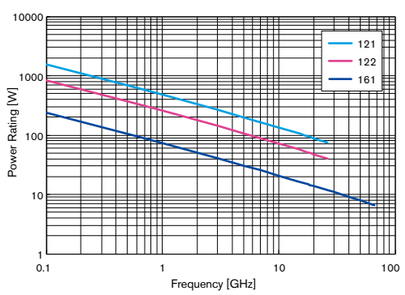
Simple Criteria for Cable Selection	
Insertion Loss	The larger the cable outer diameter, the lower the insertion loss.
Frequency Range	The smaller the cable, the higher mode frequency.
Power Rating	The larger the cable outer diameter, the higher the power rating.
Flexibility	The smaller the cable, the better the flexibility.
Mass	The smaller the cable, the lighter the cable.

Power Rating

The diagram to the right shows the relationship between frequency and power rating.
The values are calculated at 25 °C and at sea level.
The power rating will need to be corrected for different ambient temperatures and altitude.
Power ratings may decrease, depending on the connector selected.

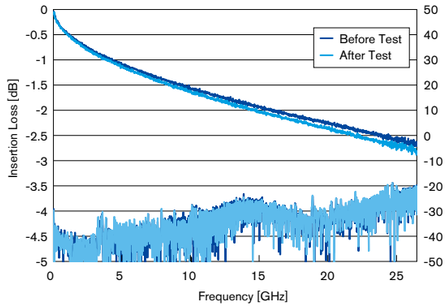
* The above figures are measured values for reference only.

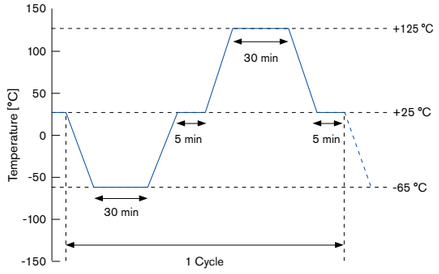
Power Rating of 1 Series at Sea Level



Heat Cycle Test for 121

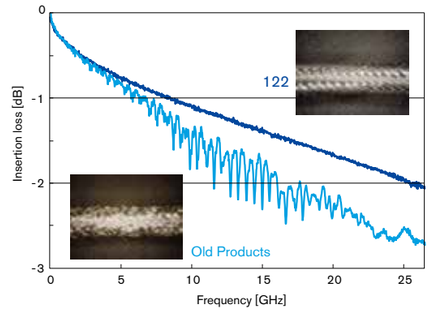
121-02000DMSDMS



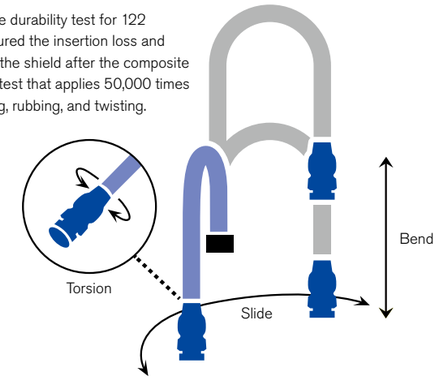


The cycle indicated above chart was repeated 30 times.
We measured the insertion and return loss of the specimen that was taken out from the tester after the 30 cycles.

Composite Durability Test for 122

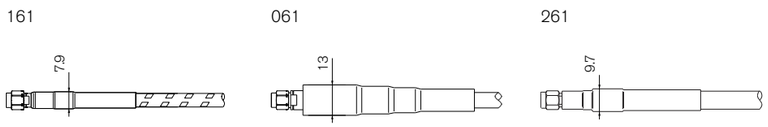


Composite durability test for 122
We measured the insertion loss and observed the shield after the composite durability test that applies 50,000 times of bending, rubbing, and twisting.



Slimness Comparison of Maximum Outer Diameter

- Cable assemblies with a small diameter at the neck, making it the most suitable for a Multiport VNA
- Torque Driver is available to mount on narrow pitch connector arrangement board



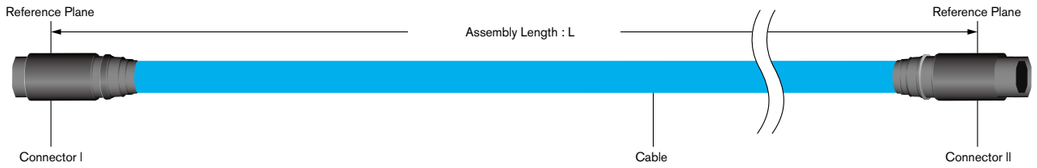
Cable	161	061	261
Maximum Outer Diameter [mm]	7.9	13	9.7

Exzmple of Commection to a Murti-Pert VNA

* The above figures are measured values for reference only.

1Series

Placing Orders



Example 1

Catalog No.

MWX121 - 02000 DMS DMS

Cable : MWX121

Assembly Length : 2000 mm

Connector I : 3.5 mm (m) Straight

Connector II : 3.5 mm (m) Straight

Example2

Catalog No.

MWX122 - 01000 DFC DMC

Cable : MWX122

Assembly Length : 1000 mm

Connector I : 3.5 mm (f) Straight Torque Canceller

Connector II : 3.5 mm (m) Straight Torque Canceller

The unit of Assembly Length is mm.
Shown as a five-digit number.
If the number consists of fewer than five digits, remember to add zero (s) to the left of the first digit to make it five digits.
The Assembly Length is measured based on the reference planes, not on the connector ends, shown at the figure to the left.

Example3

Catalog No.

MWX161 - 00610 LMS VMS /B

Cable : MWX161

Assembly Length : 610 mm

Connector I : 2.4 mm (m) Straight

Connector II : 1.85 mm (m) Straight

Armored : Armored-Type

- The order of Connector I and Connector II is determined by the alphabetical order of the first letter of the Connector Code.
  In the case of DMS (3.5mm(m) and AMS (SMA(m), Connector I : AMS, Connector II : DMS
- The order of Connector I and Connector II when the first letter of the Connector Code is the same depends on the alphabetical order of the second and subsequent letters.
  In the case of DMS (3.5mm(m) and DFS (3.5mm(f), Connector I : DFS, Connector II : DMS

Delivery time

1 series will be shipped within 11 business days after received order.

* Leadtime may be effected by larger order volume.

Connector Codes

Connector		Cable		
		121	122	161
Type	Maximum Operating Frequency	26.5 GHz	26.5 GHz	67.0 GHz
N (m) Straight	18.0 GHz	NMS	NMS	
N (m) Torque Canceller	18.0 GHz		NMC	
SMA (m) Straight	18.5 GHz	AMS	AMS	
SMA (m) Torque Canceller	18.5 GHz		AMC	
3.5mm (m) Straight	26.5 GHz	DMS	DMS	DMS
3.5mm (m) Torque Canceller	26.5 GHz		DMC	
3.5mm (f) Straight	26.5 GHz	DFS	DFS	
3.5mm (f) Torque Canceller	26.5 GHz		DFC	
2.92mm (m) Straight	40.0 GHz			KMS
2.4mm (m) Straight	50.0 GHz			LMS
1.85mm (m) Straight	67.0 GHz			VMS

m : male (plug) f : female (jack)

Please provide a catalog number when placing an order.

- The smallest frequency among the maximum operating frequencies of the connectors and cables to be used is the maximum operating frequency of the assembly.
- Please inquire separately for products with connector symbols in gray, as they require a longer delivery time.

* The above figures are measured values for reference only.

1 Series Cable Assemblies with Wide Temperature Range & High Durability for Measuring Instruments

121

Features

- Phase Stability: Static Bending
- Maximum Operating Frequency: 26.5 GHz
- Temperature Operating Frequency: -65 to 125℃
- Days to Ship: 11 Business Days
- RoHS Compliant

Property

Electrical Properties

Maximum Operating Frequency	26.5 GHz
Characteristic Impedance (Typical)	50±1 Ω
Capacitance (Typical)	88 pF/m
Propagation Delay (Typical)	4.28 ns/m
Velocity of Propagation (Typical)	78 %
Higher Mode Frequency (Typical)	27.0 GHz
VSWR (Typical)	1.33
Maximum Frequency Insertion loss (26.5 GHz)	1.3 dB/m

Mechanical Properties

Cable Outer Diameter	6.6 mm
Minimum Bending Radius (Inner Side)	30 mm
Cable Mass (Typical)	80 g/m
Continuous Operating Temperature Range	-65~+125 ℃
Assembly Length	200~5,000 mm

Order Form Example

Please provide the following information when placing an order.

Example MWX121

* See P. 1-4 "Connector Codes"

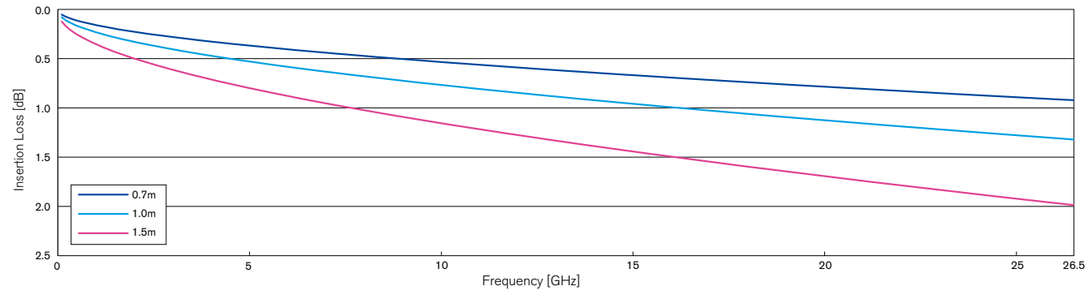
Assembly Length: 1000mm
Connector Ⅰ : 3.5 mm (f) Straight
Connector Ⅱ : 3.5 mm (m) Straight

Catalog No.
MWX121-01000DFSDMS
a b c

a. Cable
b. Assembly Length
c. Connector

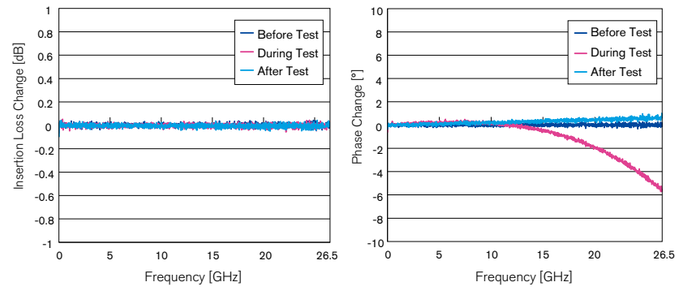
Technical Data

Cable Typical Insertion Loss



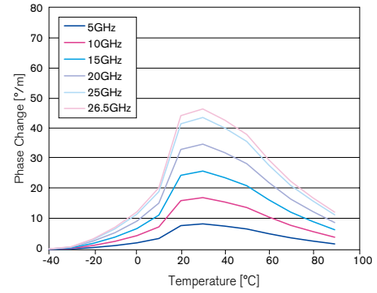
Typical Insertion Loss $(0.0077\times f\,[GHz]+0.215\times\sqrt{f\,[GHz]}+0.02)\times L\,[m]$ **Maximum Insertion Loss** $(0.0077\times f\,[GHz]+0.215\times\sqrt{f\,[GHz]}+0.02)\times 1.12\times L\,[m]$

Static Bending Data (Insertion Loss, Phase) Bending Radius : 30 mm



* The cable was wrapped 360° around ø60mm mandrel.

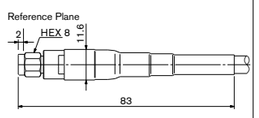
121 Phase Change vs. Temperature



The cable was measured in chamber every 20 ℃ from -40 to 90 ℃, 1 hour after the temperature changed.

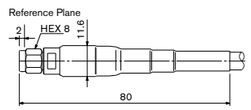
Connector

SMA (m) Straight (Code : AMS)



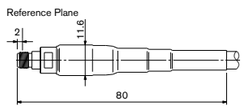
Maximum Operating Frequency : 18.5 GHz / Mass : 14g

3.5mm (m) Straight (Code : DMS)



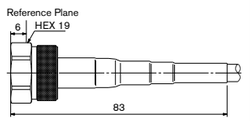
Maximum Operating Frequency : 26.5 GHz / Mass : 13g

3.5mm (f) Straight (Code : DFS)



Maximum Operating Frequency : 26.5 GHz / Mass : 12g

N (m) Straight (Code : NMS)



Maximum Operating Frequency : 18.0 GHz / Mass : 36g

*Refer to P0-4 Connector Code Table for othrer applicable connectors.

* The above figures are measured values for reference only.

1 Series Cable Assemblies with Wide Temperature Range & High Durability for Measuring Instruments

122

Features

- Phase Stability: Static Bending
- Cable Flexibility
- Maximum Operating Frequency: 26.5 GHz
- Temperature Range: -30 to 85°C
- Bending Resistant Cable
- Torque Canceller
- Days to Ship: 11 Business Days
- RoHS Compliant

Property

Electrical Properties

Maximum Operating Frequency	26.5 GHz
Characteristic Impedance (Typical)	50±1 Ω
Capacitance (Typical)	89 pF/m
Propagation Delay (Typical)	4.39 ns/m
Velocity of Propagation (Typical)	76 %
Higher Mode Frequency (Typical)	27.0 GHz
VSWR (Typical)	1.33
Maximum Frequency Insertion loss (26.5 GHz)	1.9 dB/m

Mechanical Properties

Cable Outer Diameter	6.5 mm
Minimum Bending Radius (Inner Side)	30 mm
Cable Mass (Typical)	79 g/m
Continuous Operating Temperature Range	-30~+85 °C
Assembly Length	300~3,000 mm

Order Form Example

Please provide the following information when placing an order.

Example MWX122

* See P. 1-4 "Connector Codes"

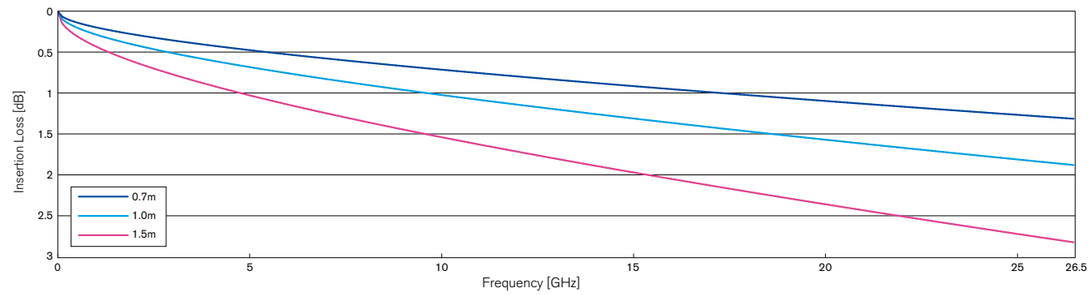
Assembly Length: 1000 mm
Connector Ⅰ : 3.5 mm (f) Straight Torque Canceller
Connector Ⅱ : 3.5 mm (m) Straight Torque Canceller

Catalog No.
MWX122-01000DFCDMC
a b c

a. Cable
b. Assembly Length
c. Connector

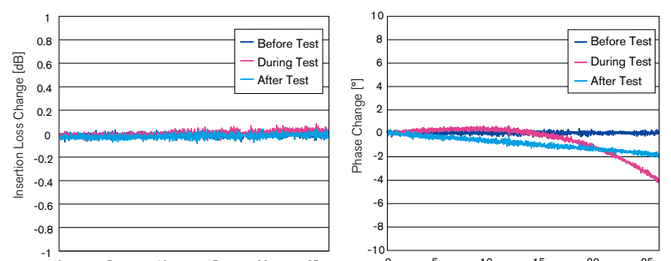
Technical Data

Cable Typical Insertion Loss



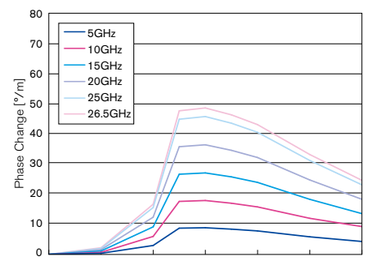
Typical Insertion Loss (0.022f [GHz]+0.25$\sqrt{f}$ [GHz]+0.025)×L [m] **Maximum Insertion Loss** (0.022f [GHz]+0.25$\sqrt{f}$ [GHz]+0.025)×1.12×L [m]

Static Bending Data (Insertion Loss, Phase) Bending Radius : 30 mm



* The cable was wrapped 360° around ø60mm mandrel.

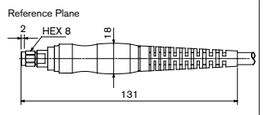
122 Phase Change vs. Temperature



The cable was measured in chamber every 20 °C from -30 to 90 °C, 1 hour after the temperature changed.

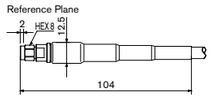
Connector

SMA (m) Torque Canceller (Code : AMC)



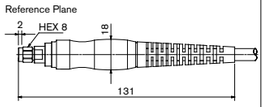
Maximum Operating Frequency : 18.5 GHz / Mass : 41g

SMA (m) Straight (Code : AMS)



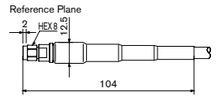
Maximum Operating Frequency : 18.5 GHz / Mass : 15g

3.5mm (m) Torque Canceller (Code : DMC)



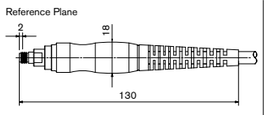
Maximum Operating Frequency : 26.5 GHz / Mass : 41g

3.5mm (m) Straight (Code : DMS)



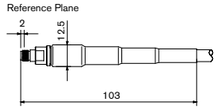
Maximum Operating Frequency : 26.5 GHz / Mass : 15g

3.5mm (f) Torque Canceller (Code : DFC)



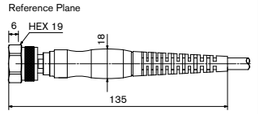
Maximum Operating Frequency : 26.5 GHz / Mass : 40g

3.5mm (f) Straight (Code : DFS)



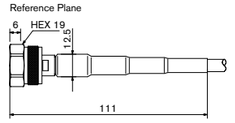
Maximum Operating Frequency : 26.5 GHz / Mass : 14g

N (m) Torque Canceller (Code : NMC)



Maximum Operating Frequency : 18.0 GHz / Mass : 67g

N (m) Straight (Code : NMS)



Maximum Operating Frequency : 18.0 GHz / Mass : 41g

*Refer to P0-4 Connector Code Table for othrer applicable connectors.

* The above figures are measured values for reference only.

1 Series Cable Assemblies with Wide Temperature Range & High Durability for Measuring Instruments

161

Features

- Phase Stability: Static Bending
- Phase Stability: Temperature Change
- Slim and Durable
- Maximum Operating Frequency: 67.0 GHz
- Temperature Range: -65 to 125°C
- Days to Ship: 11 Business Days
- RoHS Compliant

Property

Electrical Properties

Maximum Operating Frequency	67.0 GHz
Characteristic Impedance (Typical)	50±1 Ω
Capacitance (Typical)	90 pF/m
Propagation Delay (Typical)	4.35 ns/m
Velocity of Propagation (Typical)	77 %
Higher Mode Frequency (Typical)	70.0 GHz
VSWR (Typical)	1.43
Maximum Frequency Insertion loss (67.0 GHz)	7.3 dB/m

Mechanical Properties

Maximum Outer Diameter	7.9 mm
Cable Outer Diameter	6.5 mm
Minimum Bending Radius (Inner Side)	30 mm
Cable Mass (Typical)	79 g/m
Continuous Operating Temperature Range	-65~+125 °C
Armored Side Pressure	196 N/cm
Assembly Length	600~1,500 mm

Order Form Example

Please provide the following information when placing an order.

Example MWX161

* See P. 1-4 "Connector Codes"

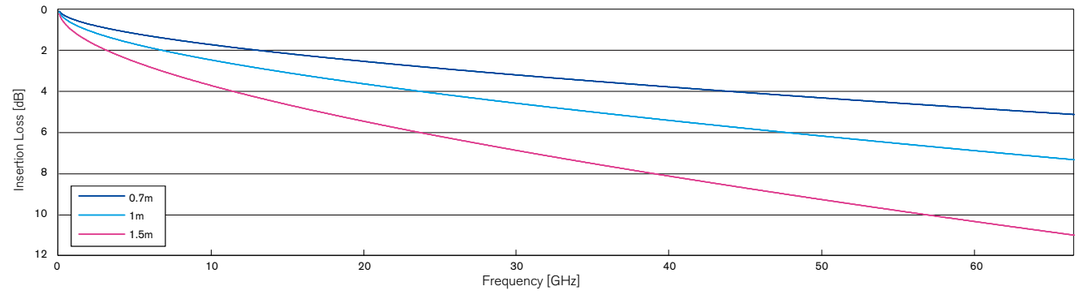
Assembly Length: 610 mm
Connector I : 2.4 mm (m) Straight
Connector II : 1.85 mm (m) Straight

Catalog No.
MWX161-00610LMSVMS/B
a b c d

a. Cable
b. Assembly Length
c. Connector
d. Armored

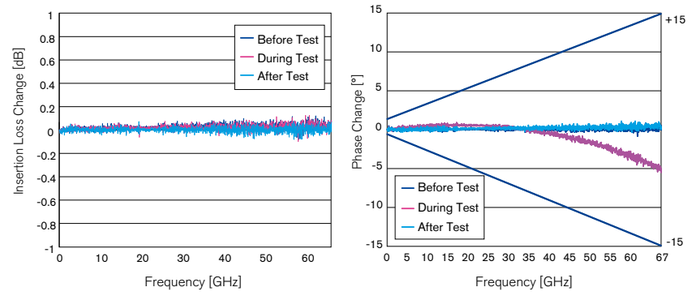
Technical Data

Cable Typical Insertion Loss



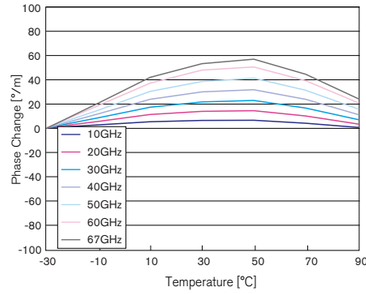
Typical Insertion Loss (0.0232×f [GHz]+0.702×√f [GHz]+0.02)×L [m] **Maximum Insertion Loss** (0.0232×f [GHz]+0.702×√f [GHz]+0.02)×1.12×L [m]

Static Bending Data (Insertion Loss, Phase) Bending Radius : 30 mm



* Guaranteed value within ±5.7° at 67.0 GHz (In shipping value)
* The cable was wrapped 360° around ø60mm mandrel.

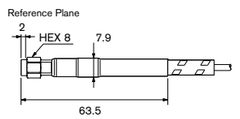
161 Phase Change vs. Temperature



The cable was measured in chamber every 20 °C from -30 to 90 °C, 1 hour after the temperature changed. Figure shows the excellent phase stability over the temperature changes.

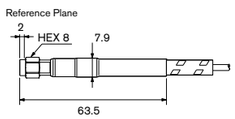
Connector

3.5mm (m) Straight (Code : DMS)



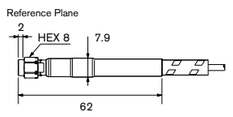
Maximum Operating Frequency : 26.5 GHz / Mass : 8g

2.92mm (m) Straight (Code : KMS)



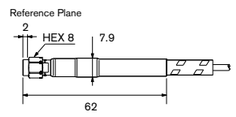
Maximum Operating Frequency : 40.0 GHz / Mass : 8g

2.4mm (m) Straight (Code : LMS)



Maximum Operating Frequency : 50.0 GHz / Mass : 8g

1.85mm (m) Straight (Code : VMS)



Maximum Operating Frequency : 67.0 GHz / Mass : 8g

* The above figures are measured values for reference only.

Series Common Properties

Connector Insertion Loss [dB/connector]

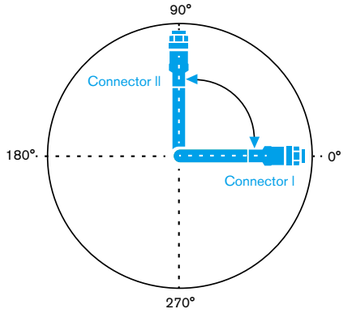
Connector Type	Connector Insertion Loss	Frequency [GHz]						
		1.0 GHz	10.0 GHz	18.5 GHz	26.5 GHz	40.0 GHz	50.0 GHz	67.0 GHz
SSMA (m) Straight	0.03√f	0.03	0.09	0.13	-	-	-	-
SMA (m) Straight	0.03√f	0.03	0.09	0.13	0.15	0.19	-	-
SMA (f) Straight	0.03√f	0.03	0.09	0.13	-	-	-	-
SMA (m) Right Angle	0.07√f	0.07	0.22	0.3	-	-	-	-
SMA (m) Swept	0.04√f	0.04	0.13	0.17	-	-	-	-
TNC (m) Straight	0.07√f	0.07	0.22	0.3	-	-	-	-
N (m) Straight	0.05√f	0.05	0.16	0.22	-	-	-	-
N (f) Straight	0.05√f	0.05	0.16	0.22	-	-	-	-
N (m) Swept	0.06√f	0.06	0.19	0.26	-	-	-	-
SMP (f) Straight	0.12√f	0.12	0.38	0.52	-	-	-	-
SMPM (f) Straight	0.12√f	0.12	0.38	0.52	0.62	0.76	0.85	0.98
3.5mm (m) Straight	0.03√f	0.03	0.09	0.13	0.15	-	-	-
3.5mm (f) Straight	0.03√f	0.03	0.09	0.13	0.15	-	-	-
3.5mm (m) Swept	0.04√f	0.04	0.13	0.17	0.21	-	-	-
2.92mm (m) Straight	0.03√f	0.03	0.09	0.13	0.15	0.19	-	-
2.92mm (f) Straight	0.03√f	0.03	0.09	0.13	0.15	0.19	-	-
2.92mm (m) Swept	0.04√f	0.04	0.13	0.17	0.21	0.25	-	-
2.4mm (m) Straight	0.042√f	0.04	0.13	0.18	0.22	0.27	0.3	-
2.4mm (f) Straight	0.042√f	0.04	0.13	0.18	0.22	0.27	0.3	-
1.85mm (m) Straight	0.065√f	0.065	0.206	0.28	0.33	0.41	0.46	0.53
1.85mm (f) Straight	0.065√f	0.065	0.206	0.28	0.33	0.41	0.46	0.53
1.0mm (m) Straight	0.065√f	0.065	0.206	0.28	0.33	0.41	0.46	0.53
1.0mm (f) Straight	0.065√f	0.065	0.206	0.28	0.33	0.41	0.46	0.53

Tolerances for Assembly Length

Tolerance values of 0, 1, 2 and 3 series are shown below.
Please contact us if your tolerance requirements for phase matching are more stringent.

Assembly Length [mm]	Tolerance [mm]
L≦1000	±10
1000<L≦2000	±20
2000<L≦5000	±50
5000<L	±100

About Customer-Specified Swept and Right-Angle Connectors



The angle of Connector II relative to Connector I when Connector I is assumed to be at 0° (as viewed from the direction of Connector I) is indicated by three digits following the catalog number.
(The indication is omitted if the angle is 0°.)
Example : If Connector II is at an angle of 90° when viewed from the direction of Connector I :
MWX312-01000AMRAMR-090

Technical Data

Return Loss – VSWR Conversion Table

Return Loss dB	Voltage Standing Wave Ratio VSWR	Reflection Coefficient
60	1.002	0.001
50	1.006	0.003
40	1.020	0.010
35	1.036	0.018
30	1.065	0.032
29	1.074	0.035
28	1.083	0.040
27	1.094	0.045
26	1.106	0.050
25	1.119	0.056
24	1.135	0.063
23	1.152	0.071
22	1.173	0.079
21	1.196	0.089
20	1.222	0.100
19	1.253	0.112
18	1.288	0.126
17	1.329	0.141
16	1.377	0.158
15	1.433	0.178
14	1.499	0.200
13	1.577	0.224
12	1.671	0.251
11	1.785	0.282
10	1.925	0.316

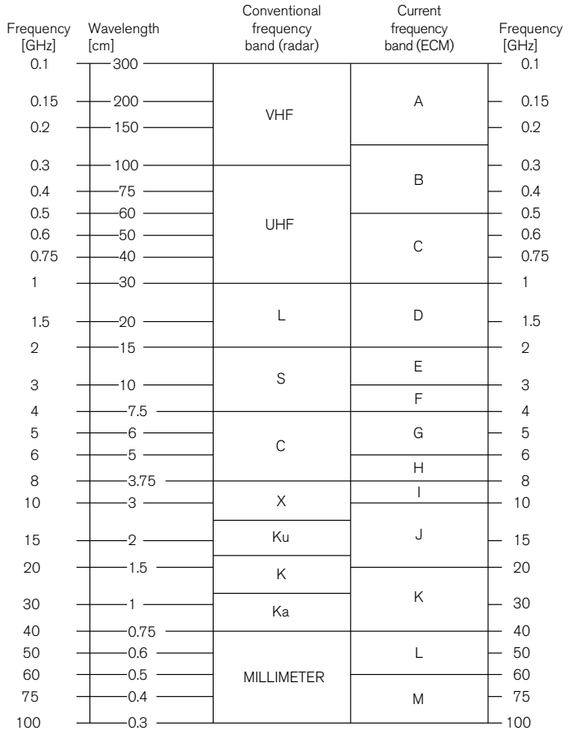
VSWR – Return Loss Conversion Table

Voltage Standing Wave Ratio VSWR	Return Loss dB	Reflection Coefficient	Propagation Loss dB
1.01	46.1	0.005	0.0001
1.02	40.1	0.010	0.0004
1.03	36.6	0.015	0.0010
1.04	34.2	0.020	0.0017
1.05	32.3	0.024	0.0025
1.06	30.7	0.029	0.0037
1.07	29.4	0.034	0.0050
1.08	28.3	0.038	0.0063
1.09	27.3	0.043	0.0080
1.10	26.4	0.048	0.0100
1.15	23.1	0.070	0.0213
1.20	20.8	0.091	0.0361
1.25	19.1	0.111	0.0538
1.30	17.7	0.130	0.0740
1.35	16.5	0.149	0.0975
1.40	15.6	0.167	0.1228
1.45	14.7	0.184	0.1496
1.50	14.0	0.200	0.1773
1.60	12.7	0.231	0.2382
1.70	11.7	0.259	0.3016
1.80	10.9	0.286	0.3706
1.90	10.2	0.310	0.4388
2.00	9.5	0.333	0.5104
3.00	6.0	0.500	1.2494
4.00	4.4	0.600	1.9382

db Table

Power Ratio P2/P1	dB Dp	Current Ratio/ Voltage Ratio I_2/I_1·V_2/V_1	dB Di·Dv
×0.01	-20dB	×0.01	-40dB
×0.1	-10dB	×0.1	-20dB
×1	0dB	×1	0dB
×2	3.0dB	×2	6.0dB
×3	4.8dB	×3	9.5dB
×4	6.0dB	×4	12.0dB
×5	7.0dB	×5	14.0dB
×6	7.8dB	×6	15.6dB
×7	8.5dB	×7	16.9dB
×8	9.0dB	×8	18.1dB
×9	9.5dB	×9	19.1dB
×10	10dB	×10	20dB
×100	20dB	×100	40dB
×1000	30dB	×1000	60dB

Frequency Band Name and Code



Power : $Dp = 10\log_{10}\frac{P_2}{P_1}$[dB]

Current : $Di = 20\log_{10}\frac{I_2}{I_1}$[dB]

Voltage : $Dv = 20\log_{10}\frac{V_2}{V_1}$[dB]

- Power level "dBm" represents the absolute value with respect to the standard 0[dBm] for 1[m/W]. P[mW] is given by 10log10P[dBm].

1. VSWR $= \frac{1+\rho}{1-\rho} = \frac{1+10^{-\frac{RL}{20}}}{1-10^{-\frac{RL}{20}}}$

2. Return Loss RL (dB) $= -20\log\rho$
$= -20\log\frac{VSWR-1}{VSWR+1}$

3. Reflection Coefficient $\rho = (VSWR-1)/(VSWR+1) = 10^{-\frac{RL}{20}}$

4. Propagation Loss α (dB) $= -10\log(1-\rho^2)$
$= -10\log\left(1-\left(\frac{VSWR-1}{VSWR+1}\right)^2\right)$

Relationship between frequency and wavelength
$f = \frac{c}{\lambda}$ where $c = 2.998\times10^{8}$[m/s]
Relationship between phase change θ[°],
frequency f [GHz],
cable length L[mm]and
propagation delay τ[nsec]
$L = 0.8328\times\theta\div\sqrt{\varepsilon_r}\div f$
$\theta = 1.201\times L\times\sqrt{\varepsilon_r}\times f$
$\theta = 360\times f\times\tau$
where εr is the specific dielectric constant of the cable insulator.
Air : $\varepsilon r = 1$, Dense PTFE : $\varepsilon r \fallingdotseq 2.1$

* The above figures are measured values for reference only.