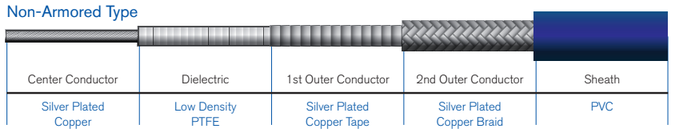
2 Series

Flexible Cable Assemblies for Measuring Instruments

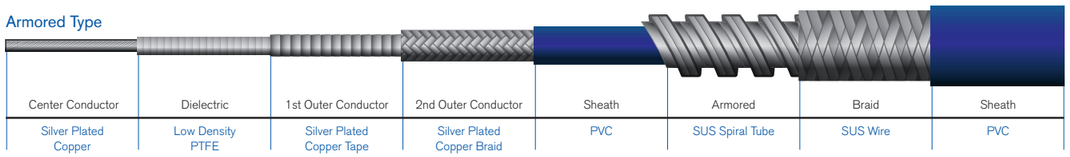
The 2 series offer flexibility and low repulsion to reduce stress loads to the device umder test objects with excellent phase stability against bending in intensive use of microwave measurement.

Non-Armored Type



Center Conductor	Dielectric	1st Outer Conductor	2nd Outer Conductor	Sheath
Silver Plated Copper	Low Density PTFE	Silver Plated Copper Tape	Silver Plated Copper Braid	PVC

Armored Type

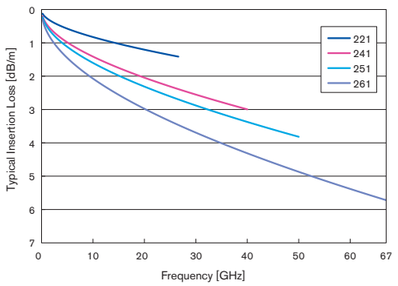


Center Conductor	Dielectric	1st Outer Conductor	2nd Outer Conductor	Sheath	Armored	Braid	Sheath
Silver Plated Copper	Low Density PTFE	Silver Plated Copper Tape	Silver Plated Copper Braid	PVC	SUS Spiral Tube	SUS Wire	PVC

Lightweight Armored Type (for Fixed Wiring)

Center Conductor	Dielectric	1st Outer Conductor	2nd Outer Conductor	Sheath	Armored	Sheath
Silver Plated Copper	Low Density PTFE	Silver Plated Copper Tape	Silver Plated Copper Braid	PVC	SUS Spiral Tube	PVC

2 Series Typical Insertion Loss



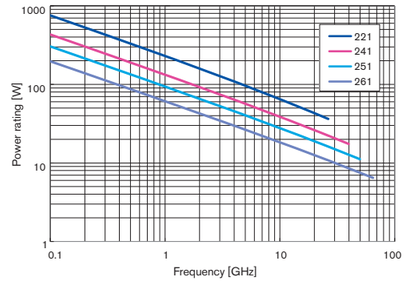
Simple Criteria for Cable Selection	
Insertion Loss	The larger the cable outer diameter, the lower the insertion loss.
Frequency Range	The smaller the cable, the higher mode frequency.
Power Rating	The larger the cable outer diameter, the higher the power rating.
Flexibility	The smaller the cable, the 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 2 Series at Sea Level

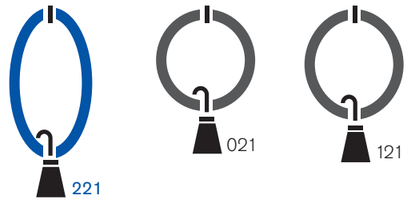


Flexibility Data

Test cable : 221, 021, 121

Test Condition Temperature : 24°C Test load : 454g Diameter of bar : ϕ16mm

Test Method A test cable measuring 1,000 mm in length was formed into a circle with an internal diameter of 300mm. Both ends were overlapped andsecured with tape measuring 50 mm in width. The circularly formed test cable was then suspended, with the overlapping end section at the top and a weight positioned at the bottom. Circularity was measured after five seconds. (Circularity is expressed as the ratio a/b.)



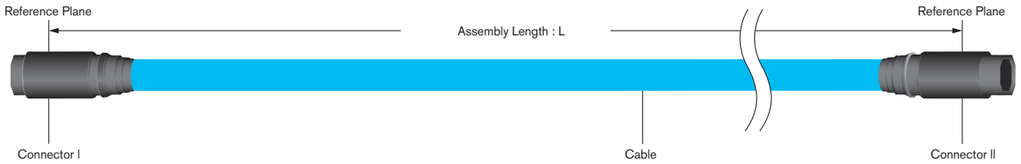
Test Result

Test Cable	Sample 1	Sample 2	Sample 3	Average
221	1,887	2,049	2,011	1,982
021	1,532	1,404	1,482	1,473
121	1,552	1,564	1,595	1,570

* The above figures are measured values for reference only.

2 Series

Placing Orders



Example 1

Cable : MWX221

Assembly Length : 1000 mm

Connector I : 3.5 mm (m) Straight

Connector II : 3.5 mm (m) Straight

Catalog No.

MWX221 - 01000 DMS DMS

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.

Example 2

Cable : MWX241

Assembly Length : 2000 mm

Connector I : 2.92 mm (m) Straight

Connector II : 2.92 mm (m) Straight

Armored : Armored-Type

Catalog No.

MWX241 - 02000 KMS KMS /B

Armored-type cables will have a" /B" appended to the connector combination code.

Example 3

Cable : MWX221

Assembly Length : 1000 mm

Connector I : SMA (m) Straight

Connector II : SMA (m) Straight

Armored : Light weight Armored-Type

Catalog No.

MWX221 - 01000 AMS AMS /A

Lightweight armored-type cables will have a" /A" appended to the connector combination code.

- 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

2 series will be shipped within 10 business days after received order.

* Leadtime may be effected by larger order volume.

Connector Codes

Connector			2 Series										
			221	221/B	221/A	241/B	241/A	241	251/B	251	261/B	261/A	261
Type		Maximum Operating Frequency	26.5 GHz			40.0 GHz			50.0 GHz		67.0 GHz		
SMA	(m) Right Angle	10.0 GHz											
SMP	(f) Right Angle	12.0 GHz											
SMP	(f) Straight	12.0 GHz											
4.3-10	(m) Straight	12.0 GHz	FMS	FMS	FMS								
TNC	(m) Straight	15.0 GHz											
N	(m) Straight	18.0 GHz	NMS	NMS	NMS	NMS	NMS	NMS					
N	(m) Lightweight	18.0 GHz											
N	(m) Torque Canceller	18.0 GHz											
N	(m) Swept	18.0 GHz	NMW										
N	(f) Straight	18.0 GHz	NFS	NFS	NFS								
SMA	(m) Right Angle H	18.0 GHz	AMH										
SMA	(m) Straight	18.5 GHz	AMS	AMS	AMS	AMS	AMS	AMS					
SMA	(m) Lightweight	18.5 GHz											
SMA	(m) Torque Canceller	18.5 GHz											
SMA	(m) Swept	18.5 GHz	AMW										
SMA	(f) Straight	18.5 GHz											
SSMA	(m) Straight	18.5 GHz											
3.5 mm	(m) Straight	26.5 GHz	DMS	DMS	DMS								DMS
3.5 mm	(m) Torque Canceller	26.5 GHz											
3.5 mm	(m) Multi-Lock	26.5 GHz											
3.5 mm	(m) Swept	26.5 GHz	DMW										
3.5 mm	(f) Straight	26.5 GHz	DFS	DFS	DFS								
3.5 mm	(f) Torque Canceller	26.5 GHz											
2.92 mm	(m) Straight	40.0 GHz				KMS	KMS	KMS	KMS	KMS			KMS
2.92 mm	(m) Swept	40.0 GHz						KMW*					
2.92 mm	(f) Straight	40.0 GHz				KFS	KFS	KFS	KFS	KFS			
SMPM	(f) Right Angle	40.0 GHz											
2.4 mm	(m) Straight	50.0 GHz							LMS	LMS			LMS
2.4 mm	(m) Swept	50.0 GHz											
2.4 mm	(f) Straight	50.0 GHz							LFS	LFS			
2.4 mm	(f) NMD	50.0 GHz											
1.85 mm	(m) Straight	67.0 GHz									VMS	VMS	VMS
1.85 mm	(m) Swept	67.0 GHz											
1.85 mm	(f) Straight	67.0 GHz									VFS	VFS	VFS
1.85 mm	(f) NMD	67.0 GHz											
SMPM	(f) Straight	67.0 GHz											
1.85 mm	(m) Straight	70.0 GHz											
1.85 mm	(f) Straight	70.0 GHz											
SMPS	(f) Straight	100.0 GHz											
1.0 mm	(m) Safety-Lock	110.0 GHz											
1.0 mm	(f) Straight	110.0 GHz											
1.0 mm	(m) Straight	110.0 GHz											
1.0 mm	(f) Straight	110.0 GHz											
1.0 mm	(m) Safety-Lock	120.0 GHz											
1.0 mm	(m) Straight	120.0 GHz											
1.0 mm	(f) Straight	120.0 GHz											
1.0 mm	(m) Safety-Lock	130.0 GHz											
1.0 mm	(f) Straight	130.0 GHz											
0.8 mm	(m) Safety-Lock	145.0 GHz											
0.8 mm	(f) Straight	145.0 GHz											

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.

2 Series Flexible Cable Assemblies for Measuring Instruments

221

Features

- Phase Stability: Static Bending
- Cable Flexibility
- Maximum Operating Frequency: 26.5 GHz
- Temperature Range: -30 to 85°C
- 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)	4.4 ns/m
Velocity of Propagation (Typical)	76 %
Higher mode frequency (Typical)	27.5 GHz
VSWR (Typical)	1.33
Maximum Frequency Insertion Loss (26.5 GHz)	1.4 dB/m

Mechanical Properties	Standard Type	Armored Type	Lightweight Armored Type (for Fixed Wiring)
Cable Outer Diameter	6.0 mm	12.5 mm	11mm
Minimum Bending Radius (Inner Side)	20 mm	20 mm	30 mm
Cable Mass (Typical)	64 g/m	212 g/m	160 g/m
Continuous Operating Temperature Range	-30~+85 °C	-30~+85 °C	-30~+85 °C
Armored Side Pressure	-	196 N/cm	196 N/cm
Assembly Length	200~5,000 mm	700~5,000 mm	500~5,000 mm

Order Form Example

Please provide the following information when placing an order.

* See P. 2-4 "Connector Codes"

Example 1
MWX221
Assembly Length: 1000mm
Connector Ⅰ : SMA (m) Straight
Connector Ⅱ : 3.5mm (m) Straight
Catalog No.
MWX221-01000AMSDMS
a b c

Example 2
MWX221 Armored type
Assembly Length: 1500mm
Connector Ⅰ : N (m) Straight
Connector Ⅱ : N (m) Straight
Catalog No.
MWX221-01500NMSNMS/B
a b c d

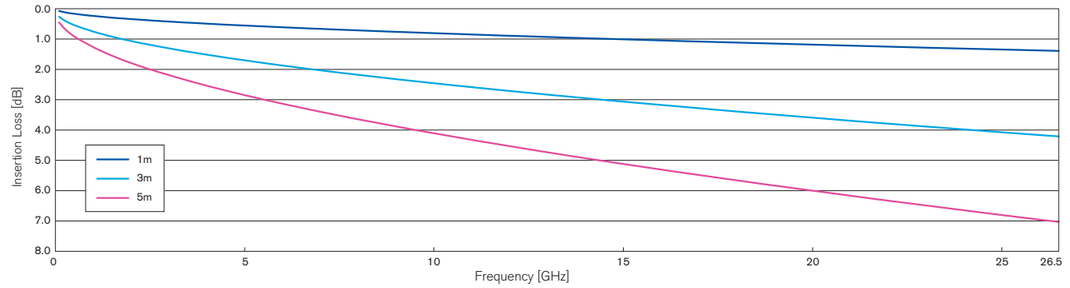
Example 3
MWX221 Lightweight Armored Type
Assembly Length: 1000mm
Connector Ⅰ : SMA (m) Straight
Connector Ⅱ : SMA (m) Straight
Catalog No.
MWX221-01000AMSAMS/A
a b c d

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

Option ● We can deliver products with matched phases for customers who require this characteristic.

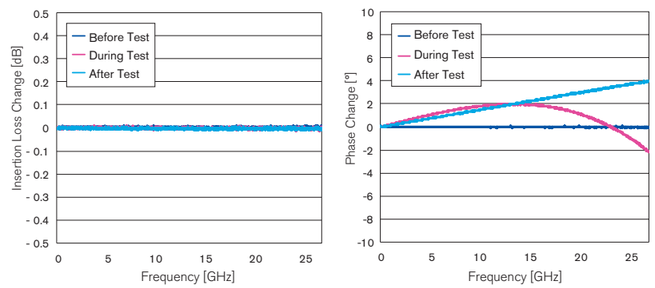
Technical Data

Cable Typical Insertion Loss



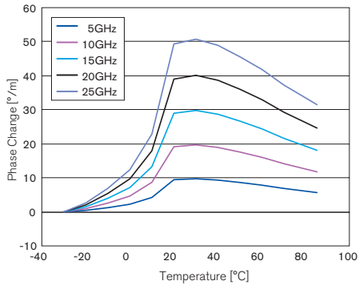
Typical Insertion Loss $(0.0077\times f\,[GHz]+0.2304\times\sqrt{f\,[GHz]}+0.02)\times L\,[m]$ **Maximum Insertion Loss** $(0.0077\times f\,[GHz]+0.2304\times\sqrt{f\,[GHz]}+0.02)\times 1.12\times L\,[m]$

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



* The cable was wrapped 360° around ø60mm mandrel.

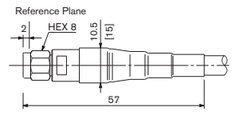
221 Phase Change vs. Temperature



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

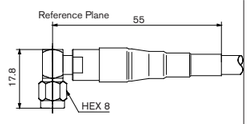
Connector

SMA (m) Straight (Code : AMS)



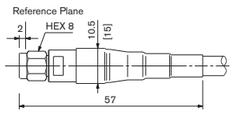
Maximum Operating Frequency : 18.5GHz / Mass : 10g

SMA (m) Right Angle (Code : AMH)



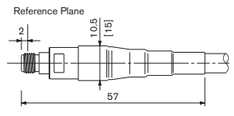
Maximum Operating Frequency : 18.0GHz / Mass : 10g

3.5mm (m) Straight (Code : DMS)



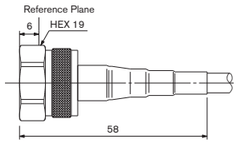
Maximum Operating Frequency : 26.5GHz / Mass : 11g

3.5mm (f) Straight (Code : DFS)



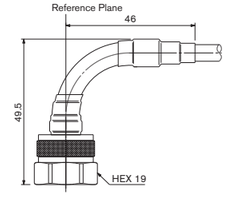
Maximum Operating Frequency : 26.5 GHz / Mass : 10g

N (m) Straight (Code : NMS)



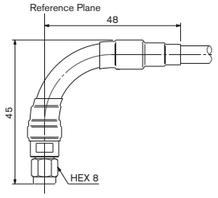
Maximum Operating Frequency : 18.0GHz / Mass : 38g

N (m) Swept (Code : NMW)



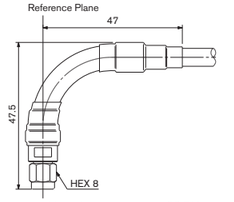
Maximum Operating Frequency : 18.0GHz / Mass : 46g

SMA (m) Swept (Code : AMW)



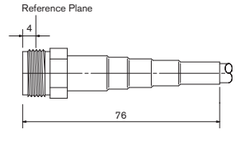
Maximum Operating Frequency : 18.5GHz / Mass : 17g

3.5mm (m) Swept (Code : DMW)



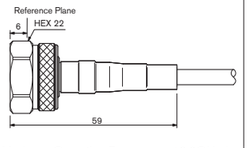
Maximum Operating Frequency : 26.5GHz / Mass : 18g

N (f) Straight (Code : NFS)



Maximum Operating Frequency : 18.0GHz / Mass : 26g

4.3-10 (m) Straight (Code : FMS)



Maximum Operating Frequency : 12.0GHz / Mass : 51g

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

* Swept and right angle are not available to armored type.
* Please see P.2-13 about "customer-specified swept and right angle connectors".
* [ ] : Armored type size.

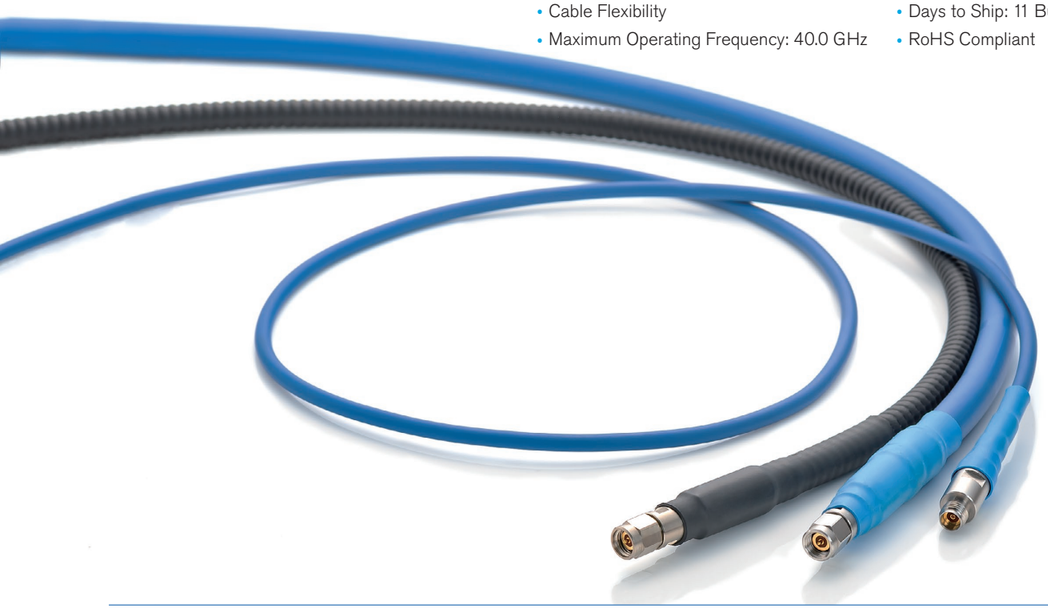
* The above figures are measured values for reference only.

2 Series Flexible Cable Assemblies for Measuring Instruments

241

Features

- Phase Stability: Static Bending
- Cable Flexibility
- Maximum Operating Frequency: 40.0 GHz
- Temperature Range: -30 to 85°C
- Days to Ship: 11 Business Days
- RoHS Compliant



Property

Electrical Properties	
Maximum Operating Frequency	40.0 GHz
Characteristic Impedance (Typical)	50±1 Ω
Capacitance (Typical)	88 pF/m
Propagation Delay (Typical)	4.35 ns/m
Velocity of Propagation (Typical)	77 %
Higher Mode Frequency (Typical)	40.5 GHz
VSWR (Typical)	1.43
Maximum frequency Insertion Loss (40.0 GHz)	3.0 dB/m

Mechanical Properties	Standard Type	Non-Armored Type Custom-Made	Lightweight Armored Type (for Fixed Wiring)
Cable Outer Diameter	9.5 mm	4.1 mm	8 mm
Minimum Bending Radius (Inner Side)	20 mm	20 mm	20 mm
Cable Mass (Typical)	137 g/m	35 g/m	98 g/m
Continuous Operating Temperature Range	-30~+85 °C	-30~+85 °C	-30~+85 °C
Armored Side Pressure	196 N/cm	-	196N/cm
Assembly Length	700~5,000 mm	200~5,000 mm	500~5,000 mm

* Take care when handling the non-armored type product because its outer diameter of the cable is thin.

Order Form Example

Please provide the following information when placing an order.

* See P. 2-4 "Connector Codes"

Example 1
MWX241 Armored Type (Standard)
Assembly Length: 1000mm
Connector I : 2.92mm (m) Straight
Connector II : 2.92mm (m) Straight
Catalog No.
MWX241-01000KMSKMS/B
a b c d

Example 2
MWX241 Non-Armored Type
* The individual specification is required.

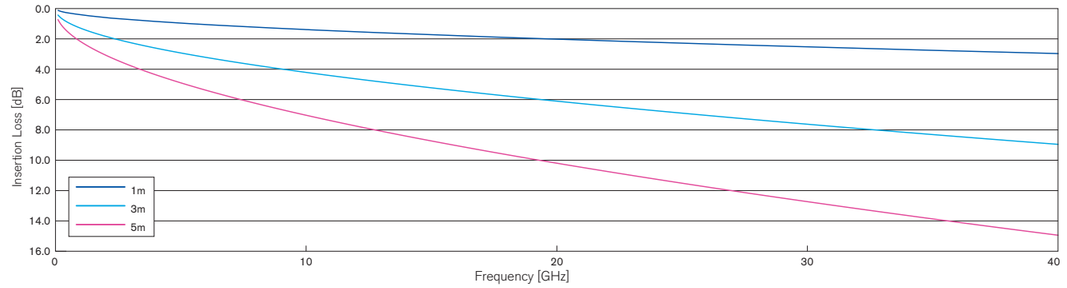
Example 3
MWX241 Lightweight Armored Type
Assembly Length: 1000mm
Connector I : 2.92mm (m) Straight
Connector II : 2.92mm (m) Straight
Catalog No.
MWX241-01000KMSKMS/A
a b c d

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

Option
- We can deliver products with matched phases for customers who require this characteristic.

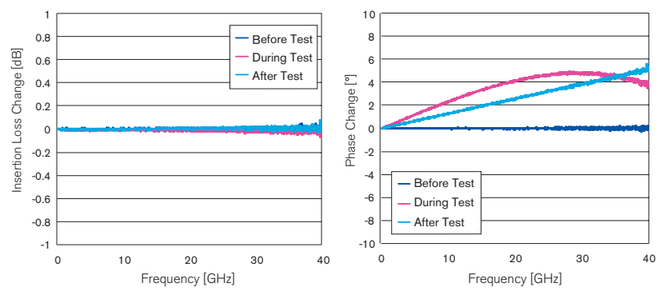
Technical Data

Cable Typical Insertion Loss



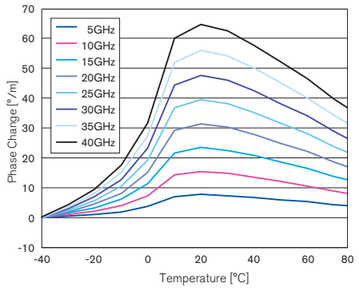
Typical Insertion Loss (0.0095×f [GHz]+0.41×√f [GHz]+0.02)×L [m] **Maximum Insertion Loss** (0.0095×f [GHz]+0.41×√f [GHz]+0.02)×1.12×L [m]

Static Bending Data (Insertion Loss, Phase) Bending Radius : 20 mm



* The cable was wrapped 360° around ø40mm mandrel.

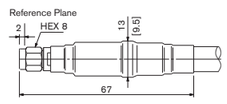
241 Phase Change vs. Temperature



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

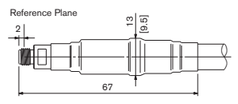
Connector

2.92mm (m) Straight (Code : KMS)



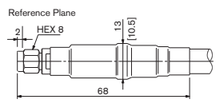
Maximum Operating Frequency : 40.0 GHz / Mass : 10g

2.92mm (f) Straight (Code : KFS)



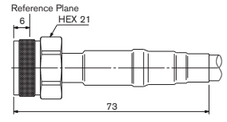
Maximum Operating Frequency : 40.0 GHz / Mass : 10g

SMA (m) Straight (Code : AMS)



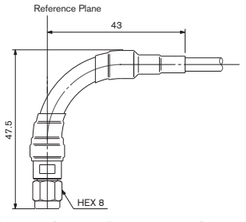
Maximum Operating Frequency : 18.5 GHz / Mass : 12g

N (m) Straight (Code : NMS)



Maximum Operating Frequency : 18.0 GHz / Mass : 42g

2.92mm (m) swept (custom-made)



Maximum Operating Frequency : 40.0 GHz / Mass : 17g

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

* Swept and right angle are not available to armored type.
* Please see P.2-13 about "customer-specified swept and right angle connectors".
* [ ] : Non-armored type size.

* The above figures are measured values for reference only.

2 Series Flexible Cable Assemblies for Measuring Instruments

251

Features

- Phase Stability: Static Bending
- Cable Flexibility
- Maximum Operating Frequency: 50.0 GHz
- Temperature Range: -30 to 85°C
- Days to Ship: 11 Business Days
- RoHS Compliant

Property

Electrical Properties	
Maximum Operating Frequency	50.0 GHz
Characteristic Impedance (Typical)	50±1 Ω
Capacitance (Typical)	88 pF/m
Propagation Delay (Typical)	4.36 ns/m
Velocity of Propagation (Typical)	77 %
Higher Mode Frequency (Typical)	50.3 GHz
VSWR (Typical)	1.43
Maximum Frequency Insertion Loss (50.0 GHz)	3.8 dB/m

Mechanical Properties	Standard Type	Non-Armored Type Custom-Made
Cable Outer Diameter	9.5 mm	3.7 mm
Minimum Bending Radius (Inner Side)	20 mm	6 mm
Cable Mass (Typical)	129 g/m	29 g/m
Continuous Operating Temperature Range	-30~+85 °C	-30~+85 °C
Armored Side Pressure	196 N/cm	-
Assembly Length	700~1,500 mm	200~1,500 mm

* Take care when handling the non-armored type product because its outer diameter of the cable is thin.

Order Form Example

Please provide the following information when placing an order.

Example 1
MWX251 Armored Type (Standard)

Assembly Length: 1000mm
Connector Ⅰ : 2.4mm (m) Straight
Connector Ⅱ : 2.4mm (m) Straight

Catalog No.
MWX251-01000LMSLMS/B
a b c d

Example 2
MWX251 Non-Armored Type

* The individual specification is required.

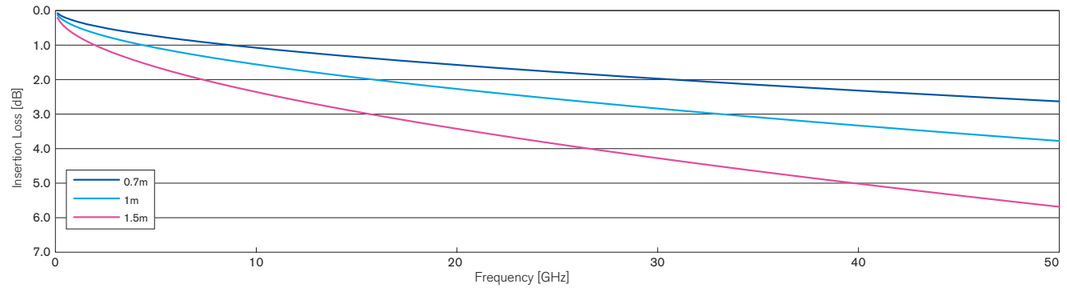
* See P. 2-4 "Connector Codes"

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

Option
- We can deliver products with matched phases for customers who require this characteristic.

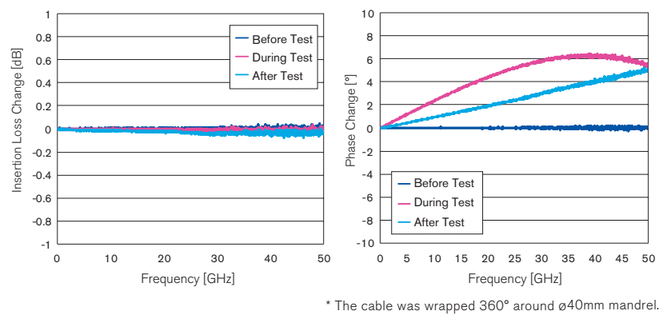
Technical Data

Cable Typical Insertion Loss



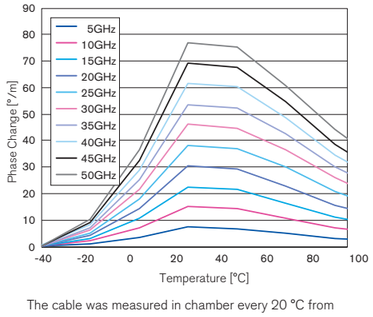
Typical Insertion Loss $(0.0095\times f\,[GHz]+0.47\times\sqrt{f\,[GHz]}+0.02)\times L\,[m]$ **Maximum Insertion Loss** $(0.0095\times f\,[GHz]+0.47\times\sqrt{f\,[GHz]}+0.02)\times 1.12\times L\,[m]$

Static Bending Data (Insertion Loss, Phase) Bending Radius: 20 mm



* The cable was wrapped 360° around ø40mm mandrel.

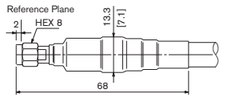
251 Phase Change vs. Temperature



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

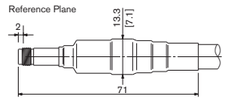
Connector

2.4mm (m) Straight (Code : LMS)



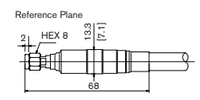
Maximum Operating Frequency : 50.0 GHz / Mass : 13g

2.4mm (f) Straight (Code : LFS)



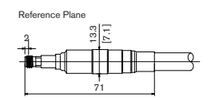
Maximum Operating Frequency : 50.0 GHz / Mass : 13g

2.92mm (m) Straight (Code : KMS)



Maximum Operating Frequency : 40.0 GHz / Mass : 13g

2.92mm (f) Straight (Code : KFS)



Maximum Operating Frequency : 40.0 GHz / Mass : 13g

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

* [ ] : Non-armored type size.

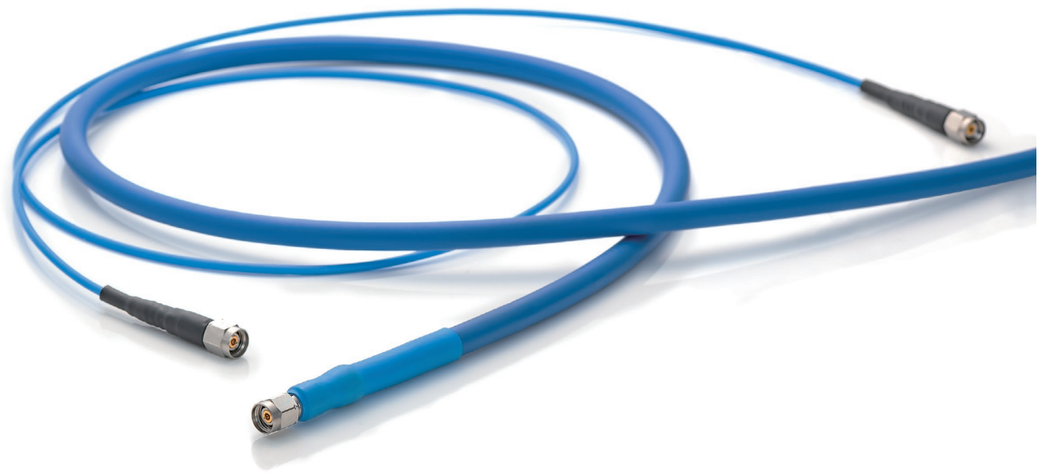
* The above figures are measured values for reference only.

2 Series Flexible Cable Assemblies for Measuring Instruments

261

Features

- Phase Stability: Static Bending
- Cable Flexibility
- Maximum Operating Frequency: 67.0 GHz
- Temperature Range: -30 to 85°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)	4.38 ns/m
Velocity of Propagation (Typical)	76 %
Higher Mode Frequency (Typical)	67.0 GHz
VSWR (Typical)	1.43
Maximum Frequency Insertion Loss (67.0 GHz)	5.6 dB/m

Mechanical Properties	Standard Type	Non-Armored Type Custom-Made
Cable Outer Diameter	7.7 mm	2.6 mm
Minimum Bending Radius (Inner Side)	20 mm	6 mm
Cable Mass (Typical)	90 g/m	17 g/m
Continuous Operating Temperature Range	-30~+85 °C	-30~+85 °C
Armored Side Pressure	196 N/cm	-
Assembly Length	700~1,500 mm	200~1,500 mm

* Take care when handling the non-armored type product because its outer diameter of the cable is thin.

Order Form Example

Please provide the following information when placing an order.

Example 1
MWX261 Armored Type (Standard)

Assembly Length: 1000mm
Connector I : 1.85 mm (m) Straight
Connector II : 1.85 mm (m) Straight

Catalog No.
MWX261-01000VMSVMS/B
a b c d

Example 2
MWX261 Non-Armored Type

* The individual specification is required.

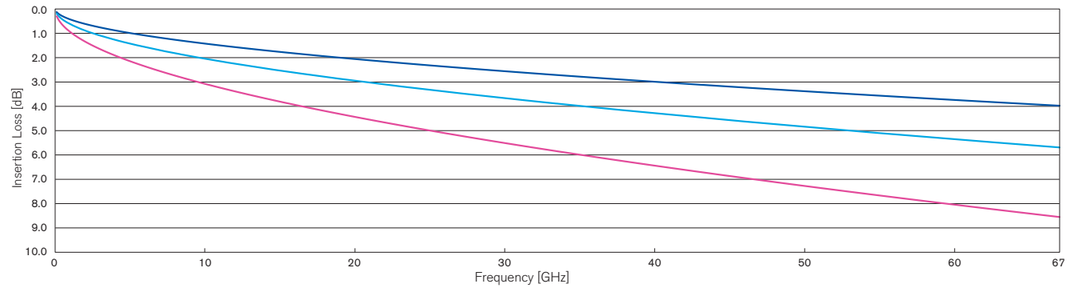
* See P. 2-4 "Connector Codes"

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

Option ● We can deliver products with matched phases for customers who require this characteristic.

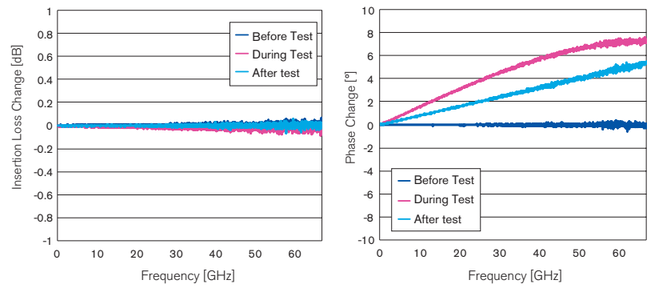
Technical Data

Cable Typical Insertion Loss



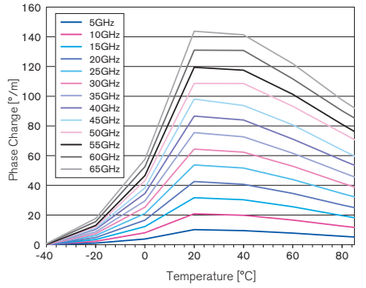
Typical Insertion Loss (0.0095×f [GHz]+0.6148×√f [GHz]+0.02)×L [m] **Maximum Insertion Loss** (0.0095×f [GHz]+0.6148×√f [GHz]+0.02)×1.12×L [m]

Static Bending Data (Insertion Loss, Phase) Bending Radius : 20 mm



* The cable was wrapped 360° around ø40mm mandrel.

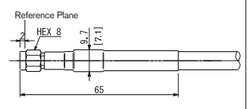
261 Phase Change vs. Temperature



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

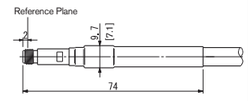
Connector

1.85mm (m) Straight (Code : VMS)



Maximum Operating Frequency : 67.0 GHz / Mass : 8g

1.85mm (f) Straight (Code : VFS)



Maximum Operating Frequency : 67.0 GHz / Mass : 8g

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

* [ ] : Non-armored type size.

* The above figures are measured values for reference only.

Series Common Properties

Connector Insertion Loss [dB/connector]

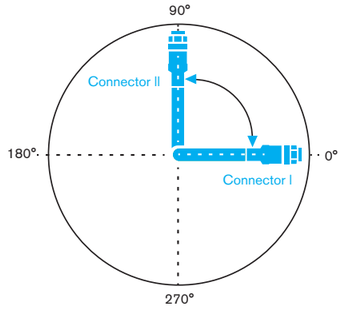
Connector Type	Connector Insertion Loss	Frequency [GHz]						
		1.0 GHz	10.0 GHz	18.5 GHz	26.5 GHz	40.0 GHz	50.0 GHz	67.0 GHz
SSMA (m) Straight	0.03√f	0.03	0.09	0.13	-	-	-	-
SMA (m) Straight	0.03√f	0.03	0.09	0.13	0.15	0.19	-	-
SMA (f) Straight	0.03√f	0.03	0.09	0.13	-	-	-	-
SMA (m) Right Angle	0.07√f	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 $I_2/I_1 \cdot V_2/V_1$	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

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].

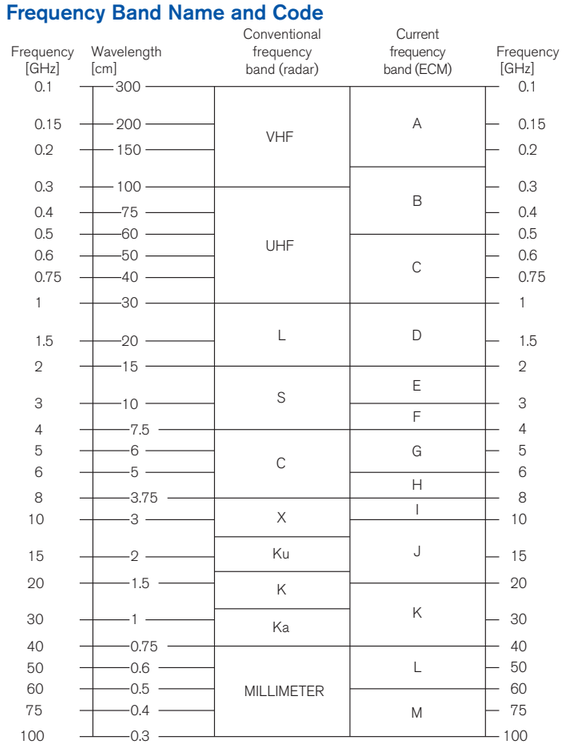
1. $VSWR = \frac{1+\rho}{1-\rho} = \frac{1+10^{-\frac{RL}{20}}}{1-10^{-\frac{RL}{20}}}$

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 $\alpha\ (dB) = -10\log(1-\rho^2) = -10\log\left(1-\left(\frac{VSWR-1}{VSWR+1}\right)^2\right)$

Frequency Band Name and Code



Relationship between frequency and wavelength
$f = \frac{c}{\lambda}$ where $c = 2.998 \times 10^8$[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 : εr=1, Dense PTFE : εr ≒ 2.1

* The above figures are measured values for reference only.