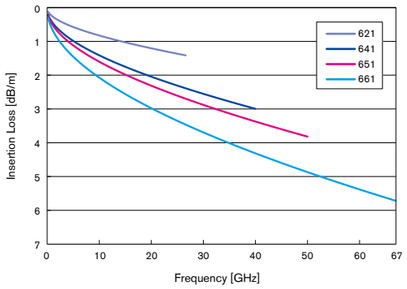
6 Series Highly Precise Skew Match Type

Highly precise skew match cable assembly with less than 1psec skew between the two cabls for measurement of digital transmission. (Continuous operating temperature range : -30 to +85°C)
Low insertion loss, suitable for measurement of the high-precision differential transmission signal.
4 type cables are available depends on maximum frequency (26.5GHz, 40GHz, 50GHz and 67GHz).

6 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.

621	**Typical Insertion Loss** (0.0077×f [GHz] +0.2304×$\sqrt{f}$ [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0077×f [GHz] +0.2304×$\sqrt{f}$ [GHz] +0.02) ×1.12×L [m]
641	**Typical Insertion Loss** (0.0095×f [GHz] +0.41×$\sqrt{f}$ [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0095×f [GHz] +0.41×$\sqrt{f}$ [GHz] +0.02) ×1.12×L [m]
651	**Typical Insertion Loss** (0.0095×f [GHz] +0.47×$\sqrt{f}$ [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0095×f [GHz] +0.47×$\sqrt{f}$ [GHz] +0.02) ×1.12×L [m]
661	**Typical Insertion Loss** (0.0095×f [GHz] +0.6148×$\sqrt{f}$ [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0095×f [GHz] +0.6148×$\sqrt{f}$ [GHz] +0.02) ×1.12×L [m]

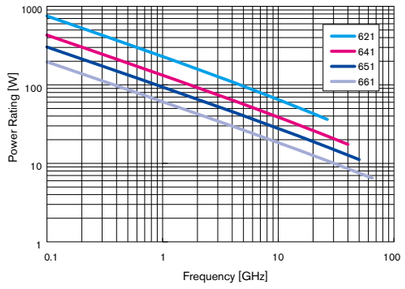
	621	641	651	661
18.5 GHz	1.2 dB/m	1.8 dB/m	2.1 dB/m	2.9 dB/m
Maximum Frequency	1.4 dB/m	3.0 dB/m	3.8 dB/m	5.6 dB/m

Power rating

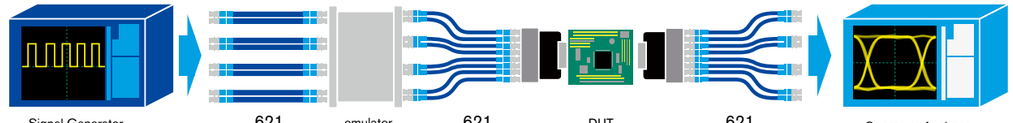
The diagram to the right shows the relationship between frequency and power rating.
The values are calculated at 25 °C and at sea level.
The power rating will need to be corrected for different ambient temperatures and altitude.
Power ratings may decrease, depending on the connector selected.

* The above figures are measured values for reference only.

Power Rating of 6 Series at Sea Level



Connection Example of 6 Series



Major Applications

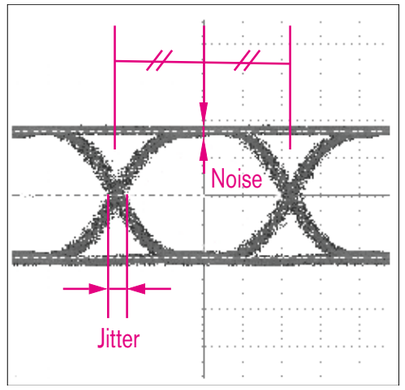
- Complince and evaluation of the USB, HDMI etc.
- BERT measurement, Jitter measurement.

(Reference) Eye Pattern and Junkosha's Method of Calculating Degree of Eye Pattern

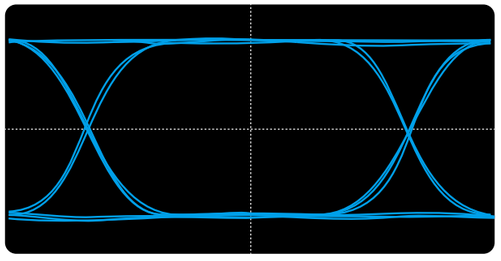
To measure pulse wave transmission characteristics, an experimental tool called "eye pattern" is observed. Upon balanced transmission, skew (variability of propagation delay time) between the signal cables will become one of the cause of deterioration of the jitter. Taking above into consideration, 6 series are designed and manufactured.

$$\text{Degree of Horizonal Eye Opening (\%)} = 100 \times \left(\frac{\frac{1}{\text{bit rate}} - \text{jitter}}{\frac{1}{\text{bit rate}}} \right)$$

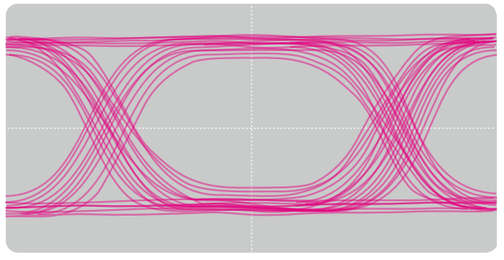
$$\text{Degree of Vertial Eye Opening (\%)} = 100 \times \left(\frac{\text{Amplitude of Input Signals} - 2 \times \text{Noise}}{\text{Amplitude of Input Signals}} \right)$$



6 Series



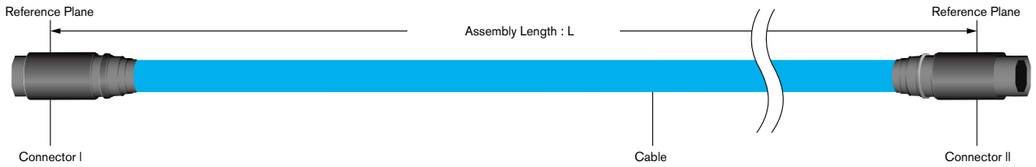
Conventional Product



* The above figures are measured values for reference only.

6 Series

Placing Orders



Catalog No.

MWX621 - 01000 DFS DMS /PAIR

Example 1

Cable: MWX621

Assembly Length: 1000 mm

Connector I : 3.5 mm (f) Straight

Connector II : 3.5 mm (m) Straight

Pair Product

Note 1) 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.
Note 2) We supply MWX6 series one pair of two cables.
Upon ordering, you are requested to inform us the catalogue number and set quantity.

Delivery

6 Series will be shipped within 11 business days after receiving your order.
*L/T might be changed on your order Qty.

Option

In the event that you would like to change quantity of one set, please feel free to contact us.

Remarks

Skew of 6 series between the two cables is standardized less than 1 psec upon shipment.
Bending or pulling the cable with strong force or other impact may cause the skew to go out of alignment
Please be careful upon handling them with great care.

Connector Codes

Connector				Cable			
				621	641	651	661
Type			Maximum Operating Frequency	26.5 GHz	40.0 GHz	50.0 GHz	67.0 GHz
N	(m)	Straight	18.0 GHz	NMS	NMS		
N	(f)	Straight	18.0 GHz	NFS			
SMA	(m)	Straight	18.5 GHz	AMS	AMS		
3.5 mm	(m)	Straight	26.5 GHz	DMS			DMS
3.5 mm	(f)	Straight	26.5 GHz	DFS			
2.92 mm	(m)	Straight	40.0 GHz		KMS	KMS	KMS
2.92 mm	(f)	Straight	40.0 GHz		KFS	KFS	
2.4 mm	(m)	Straight	50.0 GHz			LMS	LMS
2.4 mm	(f)	Straight	50.0 GHz			LFS	
1.85 mm	(m)	Straight	67.0 GHz				VMS
1.85 mm	(f)	Straight	67.0 GHz				VFS

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.

6 Series

Features

- High Precise Skew Matching
- Days to Ship: 11 Business Days
- RoHS Compliant

Property

	621	641	651	661
Maximum Operating Frequency	26.5 GHz	40.0 GHz	50.0 GHz	67.0 GHz
Characteristic Impedance (Typical)	50 ±1Ω	50 ±1Ω	50 ±1Ω	50 ±1Ω
Propagation Delay (Typical)	4.4 ns/m	4.35 ns/m	4.36 ns/m	4.38 ns/m
VSWR ((Typical)	1.33	1.43	1.43	1.43
Typical Insertion Loss	1.4 dB/m(26.5GHz)	3.0 dB/m(40.0GHz)	3.8 dB/m(50.0GHz)	5.6 dB/m(67.0GHz)
Skew (Between Pair Cables)	1 ps	1 ps	1 ps	1 ps
Phase Deviation (Between Pair Cables : @1 GHz)	0.3°	0.3°	0.3°	0.3°
Cable Outer Diameter	6.0 mm	4.1 mm	3.7 mm	2.6 mm
Cable Mass (Typical)	64 g/m	35 g/m	29 g/m	17 g/m
Continuous Operating Temperature Range	-30~+85 °C	-30~+85 °C	-30~+85 °C	-30~+85 °C
Applicable Connector	SMA(m) 3.5 mm(m), 3.5 mm(f)	2.92 mm(m), 2.92 mm(f)	2.4 mm(m), 2.4 mm(f) 2.92 mm(m), 2.92 mm(f)	1.85 mm(m), 1.85 mm(f)
Assembly Length	200~1,500 mm	200~1,500 mm	200~1,500 mm	200~1,500 mm
Typical Insertion Loss	1.4 dB/m (26.5 GHz)	3.0 dB/m (40.0 GHz)	3.8 dB/m (50.0 GHz)	5.6 dB/m (67.0 GHz)

Order Form Example

Please provide the following information when placing an order.

Example MWX621

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

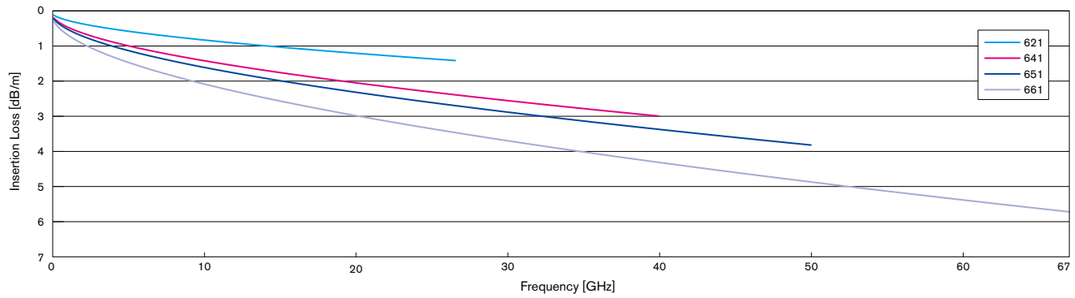
Catalog No.
MWX621-01000DFSDMS/PAIR
a b c d

* We supply 6 series one pair of two cables.
* See P.6-4 “Connector Codes”

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

Technical Data

6 Series Typical Insertion Loss

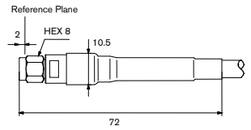


621	**Typical Insertion Loss** (0.0077×f [GHz] +0.2304×√f [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0077×f [GHz] +0.2304×√f [GHz] +0.02) ×1.12×L [m]
641	**Typical Insertion Loss** (0.0095×f [GHz] +0.41×√f [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0095×f [GHz] +0.41×√f [GHz] +0.02) ×1.12×L [m]
651	**Typical Insertion Loss** (0.0095×f [GHz] +0.47×√f [GHz] +0.02) ×L [m]	**Maximum Insertion Loss** (0.0095×f [GHz] +0.47×√f [GHz] +0.02) ×1.12×L [m]
661	**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]

Connector

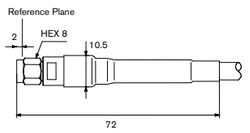
621

SMA (m) Straight (Code : AMS)



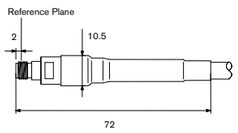
Maximum Operating Frequency : 18.5 GHz /
Mass : 11g

3.5 mm (m) Straight (Code : DMS)



Maximum Operating Frequency : 26.5GHz /
Mass : 11g

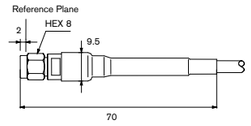
3.5 mm (f) Straight (Code : DFS)



Maximum Operating Frequency : 26.5 GHz /
Mass : 10g

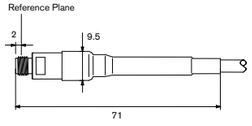
641

2.92 mm (m) Straight (Code : KMS)



Maximum Operating Frequency : 40.0 GHz /
Mass : 8g

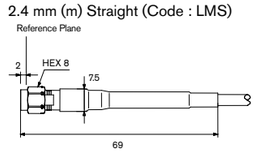
2.92 mm (f) Straight (Code : KFS)



Maximum Operating Frequency : 40.0 GHz /
Mass : 8g

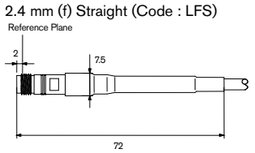
651

2.4 mm (m) Straight (Code : LMS)



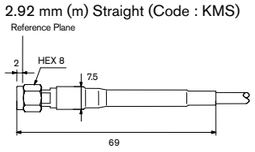
Maximum Operating Frequency : 50.0 GHz /
Mass : 5g

2.4 mm (f) Straight (Code : LFS)



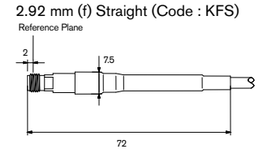
Maximum Operating Frequency : 50.0 GHz /
Mass : 5g

2.92 mm (m) Straight (Code : KMS)



Maximum Operating Frequency : 40.0 GHz /
Mass : 5g

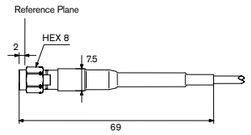
2.92 mm (f) Straight (Code : KFS)



Maximum Operating Frequency : 40.0 GHz /
Mass : 5g

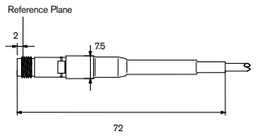
661

1.85 mm (m) Straight (Code : VMS)



Maximum Operating Frequency : 67.0 GHz /
Mass : 6g

1.85 mm (f) Straight (Code : VFS)



Maximum Operating Frequency : 67.0 GHz /
Mass : 6g

* The above figures are measured values for reference only.

Series Common Properties

Connector Insertion Loss [dB/connector]

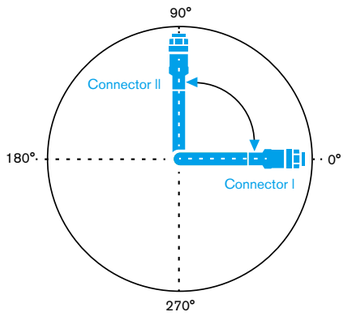
Connector Type	Connector Insertion Loss	Frequency [GHz]						
		1.0 GHz	10.0 GHz	18.5 GHz	26.5 GHz	40.0 GHz	50.0 GHz	67.0 GHz
SSMA (m) Straight	0.03√f	0.03	0.09	0.13	-	-	-	-
SMA (m) Straight	0.03√f	0.03	0.09	0.13	0.15	0.19	-	-
SMA (f) Straight	0.03√f	0.03	0.09	0.13	-	-	-	-
SMA (m) Right Angle	0.07√f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

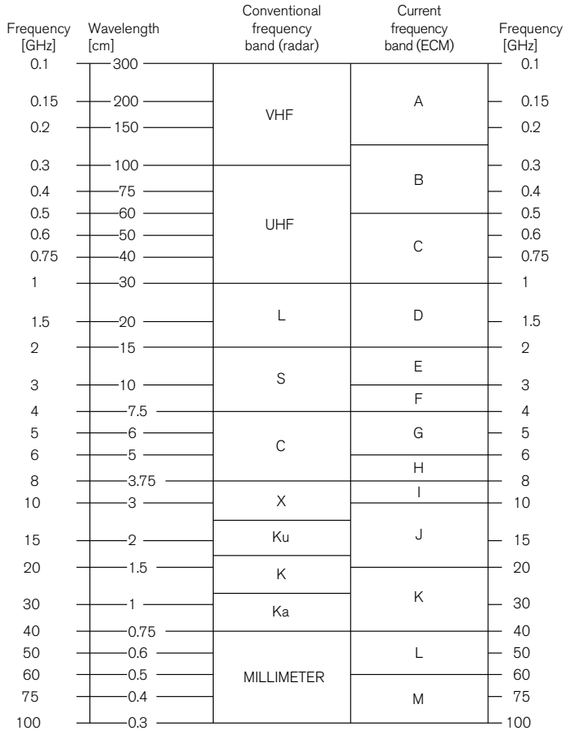
VSWR – Return Loss Conversion Table

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

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 : εr=1, Dense PTFE : εr ≒ 2.1

* The above figures are measured values for reference only.