



Deutsch Bus & Microwave



AlpenHighPerformance

Flexible Microwave Assemblies

- DC to 65 GHz
- The Lowest Insertion Loss
- Very high velocity of signal propagation
- Very low weight

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Deutsch Bus & Microwave distinguishes itself by designing and manufacturing in house the cable, the connectors and the cable/connector junction. This engineered integration makes ALPEN HighPerformance assemblies unique. Assemblies are specially designed by highly qualified Compagnie Deutsch engineers for applications where the demand is a minimum attenuation with a minimum VSWR. This results in microwave cable assemblies meeting all of your needs for top quality and high-precision reproducibility.

Electrical parameters

Alpen HighPerformance series offers 40% less insertion loss than ALPEN SuperDynamic cables of the same diameters, an excellent VSWR and a high stability of the electrical performances.

Shielding effectiveness

Alpen HighPerformance RF Shielding is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables)

Quality

Alpen HighPerformance is always supplied as a complete, tested microwave cable assembly with defined and guaranteed radio-frequency and mechanical values

Composition

Alpen HighPerformance standard assembly consists of the following items if no additional specifications are provided :

- Microwave cable specified
- Connectors specified
- Marking sleeve with serial number
- RF Test protocol showing insertion and return loss
- Ruggedizations on demand

Part-number	A24	A40	A50	A81	A150
Operating frequency (GHz)	65	40	26,5	18	8
Diameter (mm)	2,3	3,6	5,2	7,9	16,3
Attenuation (dB/m) / (dB/ft)	5,83 / 1,78	2,1 / 0,64	1,29 / 0,39	0,65 / 0,20	0,20 / 0,06
Power CW (W at 5GHz)	45	206	300	640	1500
Velocity (%)	83	83	83	83	85

Alpen HighPerformance cable assemblies meet the requirements specified within this page

■ Conductor

Standard conductors are silver-coated copper wire per ASTM-B-298. Silver coating is 40 microinches minimum per MIL-C-17.

■ Dielectric core

The dielectric core is tape-wrapped, expanded polytetrafluoroethylene (ePTFE) conforming to the requirements of MIL-C-17, Type F-6.

■ Electrical shield

The inner shield is helically wrapped, silver coated flat copper conforming to IPC-FC-221. Silver coating is 40 microinches minimum per MIL-C-17.

■ Mechanical shield

The outer shield is braided, silver coated round copper wire per ASTM-B-298. Silver coating is 40 microinches minimum per MIL-C-17. Outer shield coverage is 90% minimum as determined by MIL-C-17.

■ Jacket

The jacket is extruded fluorinated ethylene propylene (FEP), conforming to MIL-C-17, type X, tinted purple.

■ Connectors

Connector type is as specified. Materials and finishes conform to the requirements of MIL-PRF-39012, when applicable.

■ Gaskets and O-rings

All connector gaskets and O-rings are made at silicone per ZZ-R-765 or MIL-R-25988.

■ Solder

All solder used during assembly are Type SN63, SN96, or other alloys per J-STD-006 as the application requires.

Extensive tests were conducted conforming to standards and ALPENHighPerformance assemblies successfully passed the following tests :

Mechanical tests

Mechanical shock, half-sine	MIL-STD-810	Method 516
Mechanical shock, saw-tooth	MIL-STD-810	Method 516
Vibration, sine	MIL-STD-202	Method 204, Condition G
Vibration, random	MIL-STD-810	Method 514
Gunfire vibration	MIL-STD-810	Method 519
Acceleration	MIL-STD-810	Method 513, Procedure I

Environmental tests

Crack resistance	MIL-C-17	4.8.17
Cold bend	MIL-C-17	4.8.19
Abrasion life	MIL-T-81490 / MIL-C-17	4.7.19, Procedure II / 4.8.33
Thermal shock	MIL-STD-202	Method 107, Condition B1
Humidity	MIL-STD-202	Method 103, Procedure I, III
Salt mist	MIL-STD-810	Method 509, Procedure I
Sand and dust	MIL-C-87104	4.6.4.4
Flame propagation	MIL-C-87104 / MIL-C-17	4.6.4.8 / 4.8.25
Smoke index	MIL-C-17	4.8.29
Fungus resistance	MIL-STD-810	Method 508

Electrical tests

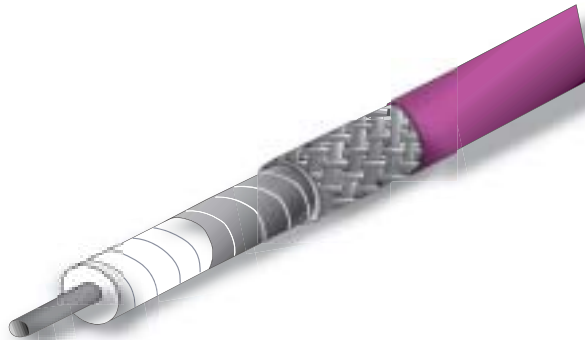
Screening effectiveness	MIL-T-81490	4.7.8
Corona extinction	MIL-C-87104	4.6.2.4
Continuity	MIL-C-17	4.8.2
Isolation resistance	MIL-C-17	4.8.4
High voltage test	IEC 966-1	9.10
Peak power	MIL-T-81490	4.7.13
C.W. power	MIL-T-81490	4.7.13, Procedure I
Phase stability Vs. Flexures *	In accordance with Compagnie Deutsch standards	
Phase stability Vs. T°	In accordance with Compagnie Deutsch standards	
Insertion loss stability Vs. Flexures *	In accordance with Compagnie Deutsch standards	
Insertion loss stability Vs. T°	In accordance with Compagnie Deutsch standards	

Various test

Interface dimension	MIL-C-39012	4.6.4
Torque	MIL-C-39012	4.6.3
Tensile strenght	MIL-T-81490	4.7.17
Crush resistance	MIL-T-81490	4.7.18
Torsion	MIL-T-81490	4.6.3.3

* Phase and insertion loss stability Vs flexures :

Four measurements are made, first with the assembly relaxed (in a straight position) ; then with the assembly wrapped 360° clockwise on the mandrel (static bending radius of the cable) to provide a large bend angle, then with the assembly wrapped 360° counterclockwise on the mandrel to stimulate a reserve bend phone, and finally, again in the relaxed position.



Cable design

Centre conductor	: Silver Plated Copper Wire (SPC)
Dielectric	: Expanded Polytetrafluoroethylene (ePTFE) hellically wrapped
Electrical Shield	: Helically Wrapped, Overlapped, Silver-Plated Copper Foil
Mechanical Shield	: Braided Round Wire
Jacket	: Fluorinated ethylene-propylene (FEP)

General data

Outside diameter	: 2,3 mm	0,09 inch
Weight	: 13 g/m	0,009 Lb/Ft
Temperature range	: - 65° C to + 165° C	- 85° F to + 329° F

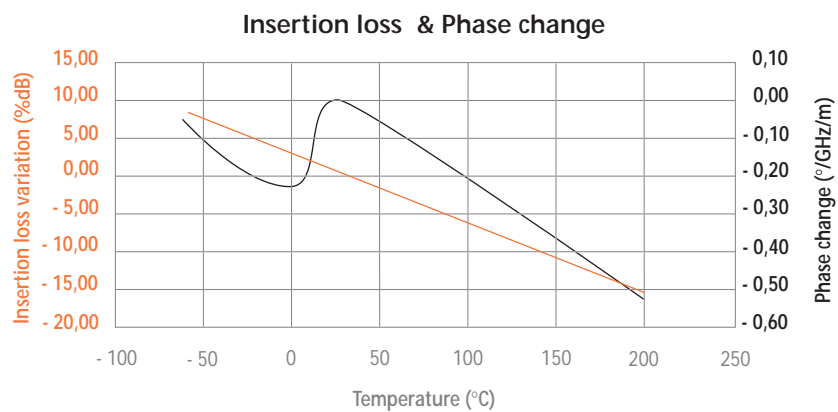
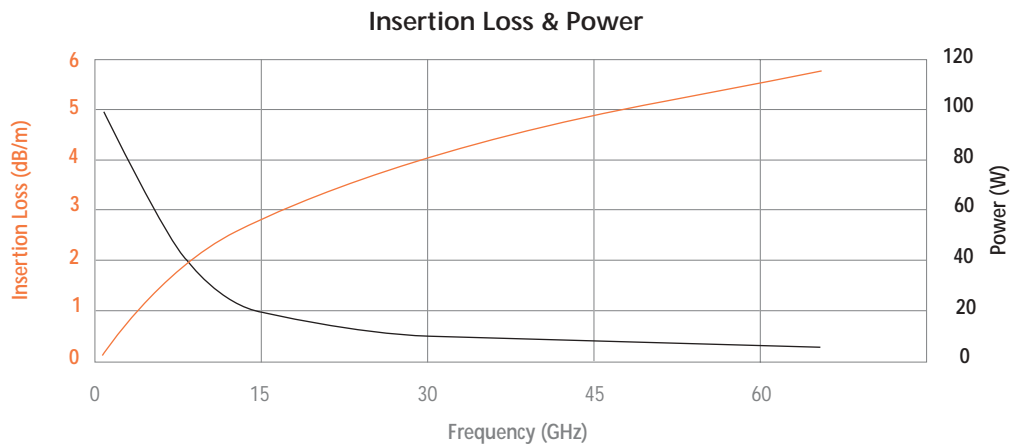
Mechanical & environmental data

Static bending radius	: 15 mm	0,6 inch
Dynamic bending radius	: 20 mm	0,8 inch
Crush resistance	: 50 kg	110 Lb
Number of flexures	: 1000	1000

Electrical data

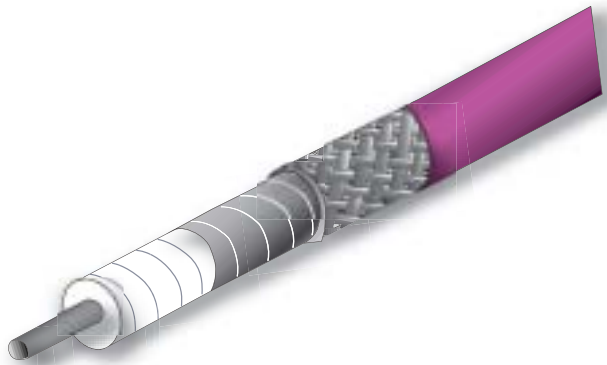
Impedance	: $50 \pm 2 \Omega$
Max. operating frequency	: 65 GHz
Capacitance	: 82 pF/m

Velocity of signal propagation	: 82%
Shielding effectiveness	: 85 dB/m



Suitable connectors

Connectors	V	SMA
Max. frequency (GHz)	65	26,5
Max. VSWR	1,23	1,14
Max. insertion loss (dB)	0,32	0,13



Cable design

Centre conductor	: Silver Plated Copper Wire (SPC)
Dielectric	: Expanded Polytetrafluoroethylene (ePTFE) hellically wrapped
Electrical Shield	: Silver-Plated Copper tape
Mechanical Shield	: Silver-Plaited braid
Jacket	: Fluorinated ethylene-propylene (FEP)

General data

Outside diameter	: 3,9 mm	0,15 inch
Weight	: 28 g/m	0,019 Lb/Ft
Temperature range	: - 65° C to + 165° C	- 85° F to + 329° F

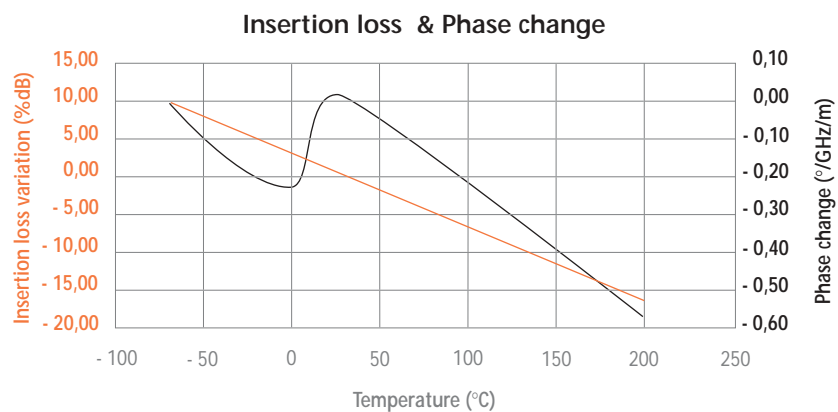
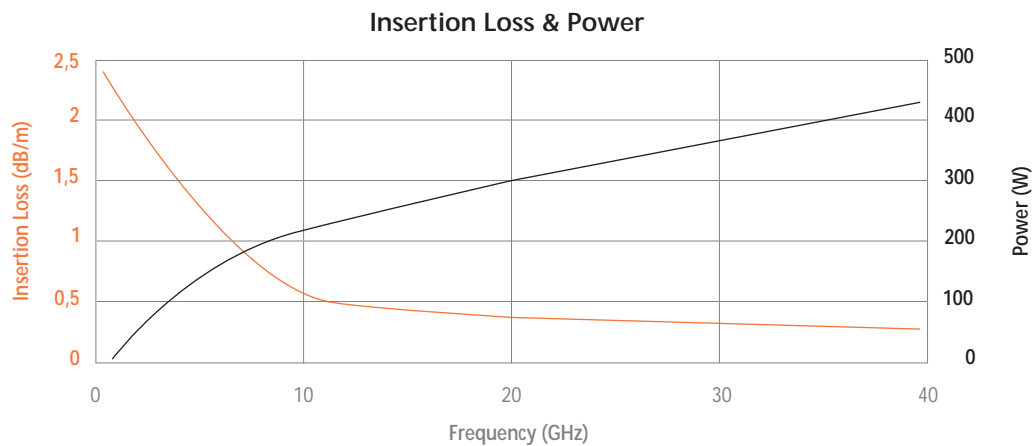
Mechanical & environmental data

Static bending radius	: 25 mm	1,0 inch
Dynamic bending radius	: 70 mm	2,7 inches
Crush resistance	: 60 kg	132 lb
Number of flexures	: 1000	1000

Electrical data

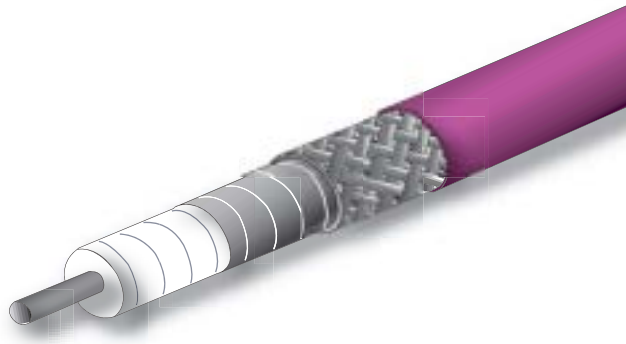
Impedance : $50 \pm 2 \Omega$
 Max. operating frequency : 40 GHz
 Capacitance : 73 pF/m

Velocity of signal propagation : 85 %
 Shielding effectiveness : 95 dB/m



Suitable connectors

Connectors	K	AP2,4	AP 3,5	SMA	TNCP	NP
Max. frequency (GHz)	40	40	26,5	26,5	18	18
Max. VSWR	1,16	1,18	1,16	1,14	1,17	1,17
Max. insertion loss (dB)	0,19	0,23	0,13	0,13	0,13	0,13



Cable design

Centre conductor	: Silver Plated Copper Wire (SPC)
Dielectric	: Expanded Polytetrafluoroethylene (ePTFE) hellically wrapped
Electrical Shield	: Silver-Plated Copper tape
Mechanical Shield	: Silver-Plaited braid
Jacket	: Fluorinated ethylene-propylene (FEP)

General data

Outside diameter	: 5,2 mm	0,20 inch
Weight	: 62 g/m	0,042 Lb/Ft
Temperature range	: - 65° C to + 165° C	- 85° F to + 329° F

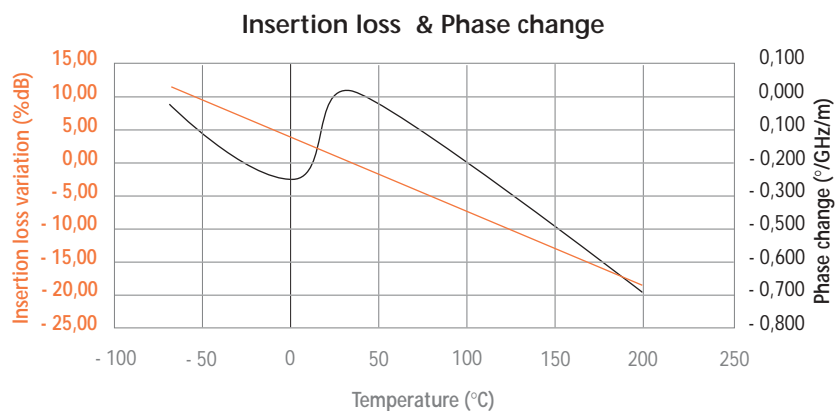
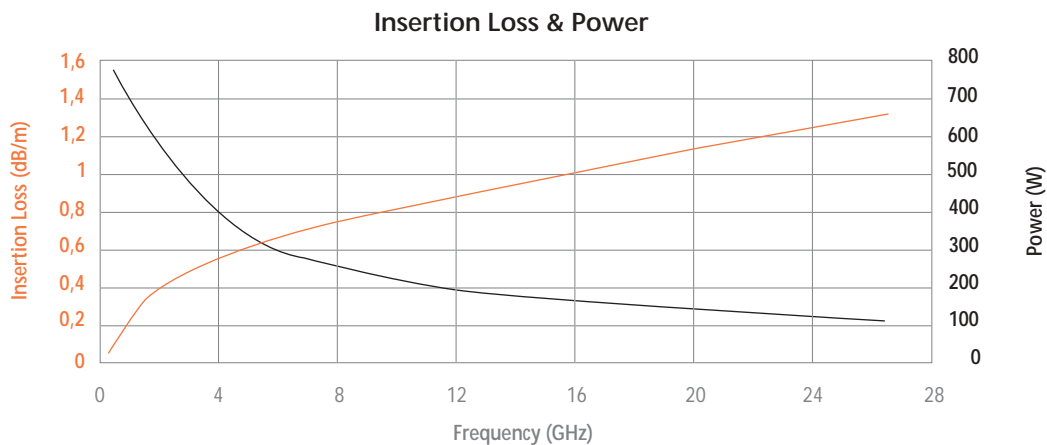
Mechanical & environmental data

Static bending radius	: 35 mm	1,4 inches
Dynamic bending radius	: 90 mm	3,5 inches
Crush resistance	: 70 kg	154 Lb
Number of flexures	: 1000	1000

Electrical data

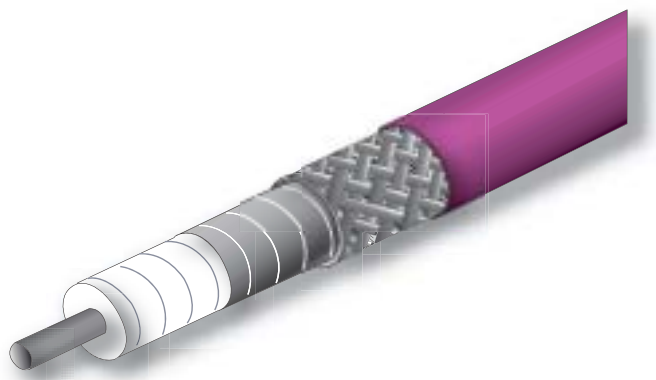
Impedance : $50 \pm 2 \Omega$
 Max. operating frequency : 26,5 GHz
 Capacitance : 79 pF/m

Velocity of signal propagation : 85 %
 Shielding effectiveness : 100 dB/m



Suitable connectors

Connectors	AP 3,5	SMA	TNCP	NP
Max. frequency (GHz)	26,5	26,5	18	18
Max. VSWR	1,16	1,14	1,17	1,17
Max. insertion loss (dB)	0,13	0,13	0,13	0,13



Cable design

Centre conductor	: Silver Plated Copper Wire (SPC)
Dielectric	: Expanded Polytetrafluoroethylene (ePTFE) hellically wrapped
Electrical Shield	: Silver-Plated Copper tape
Mechanical Shield	: Silver-Plaited braid
Jacket	: Fluorinated ethylene-propylene (FEP)

General data

Outside diameter	: 7,9 mm	0,31 inch
Weight	: 120 g/m	0,081 Lb/Ft
Temperature range	: - 65° C to + 165° C	- 85° F to + 239° F

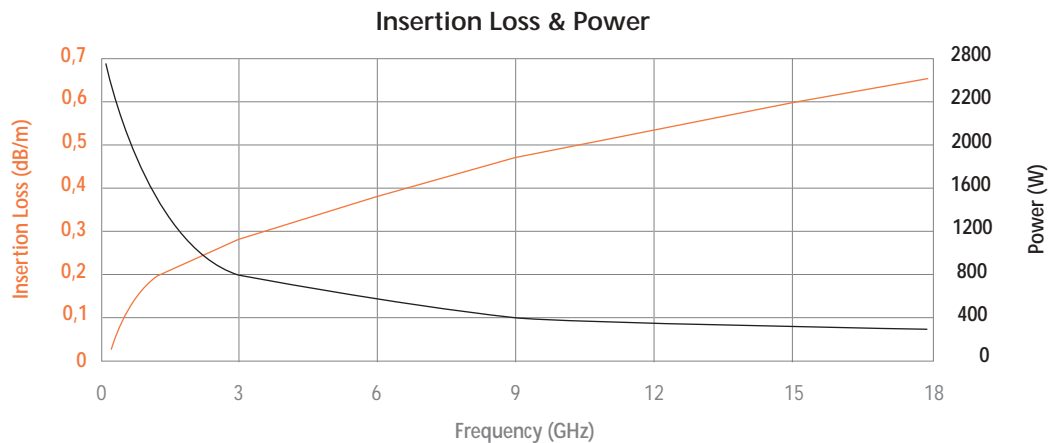
Mechanical & environmental data

Static bending radius	: 80 mm	7,1 inches
Dynamic bending radius	: 120 mm	4,7 inches
Crush resistance	: 80 kg	176 Lb
Number of flexures	: 1000	1000

Electrical data

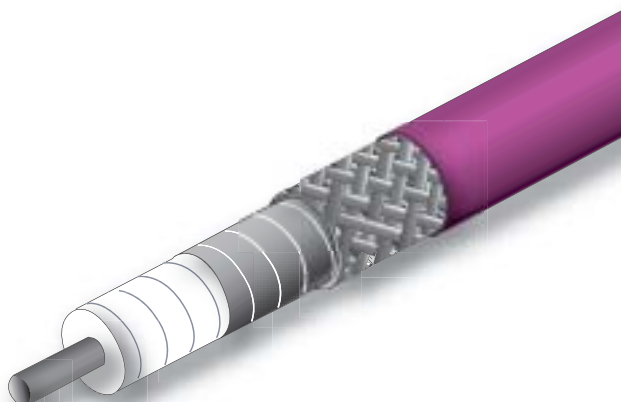
Impedance : $50 \pm 2 \Omega$
 Max. operating frequency : 18 GHz
 Capacitance : 79 pF/m

Velocity of signal propagation : 85 %
 Shielding effectiveness : 105 dB/m



Suitable connectors

Connectors	SMA	TNCP	NP	HN	7/16
Max. frequency (GHz)	18	18	18	5	2
Max. VSWR	1,12	1,17	1,17	1,13	1,12
Max. insertion loss (dB)	0,11	0,13	0,13	0,1	0,06



Cable design

Centre conductor	: Silver Plated Copper Wire (SPC)
Dielectric	: Expanded Polytetrafluoroethylene (ePTFE) helically wrapped
Electrical Shield	: Silver-Plated Copper tape
Mechanical Shield	: Silver-Plated braid
Jacket	: Fluorinated ethylene-propylene (FEP)

General data

Outside diameter	: 16,3 mm	0,64 inch
Weight	: 425 g/m	0,286 Lb/Ft
Temperature range	: - 65° C to + 165° C	- 85° F to + 329° F

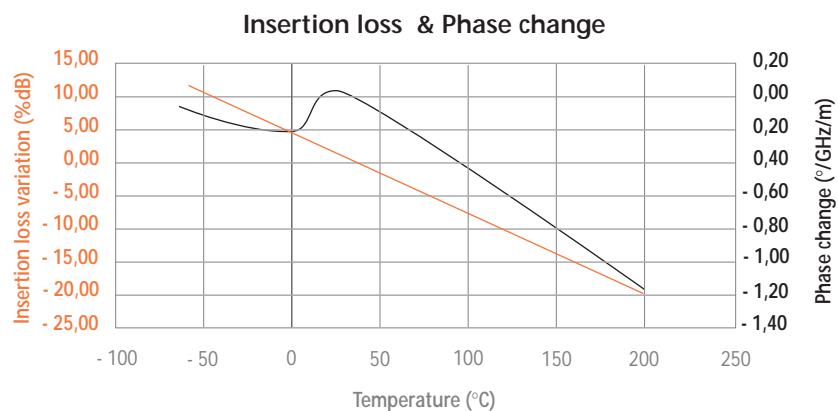
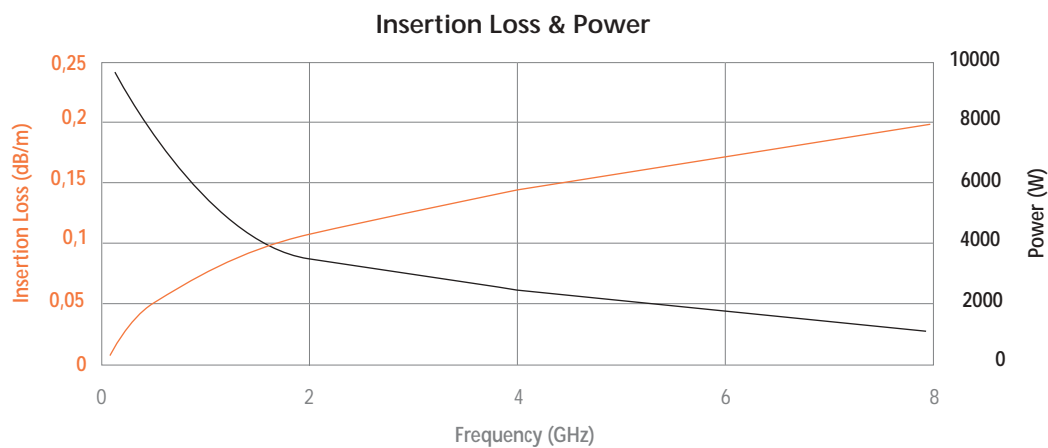
Mechanical & environmental data

Static bending radius	: 180 mm	7,1 inches
Dynamic bending radius	: 250 mm	9,7 inches
Crush resistance	: 150 kg	331 Lb
Number of flexures	: 1000	1000

Electrical data

Impedance : $50 \pm 2 \Omega$
 Max. operating frequency : 8 GHz
 Capacitance : 77 pF/m

Velocity of signal propagation : 86 %
 Shielding effectiveness : 125 dB/m



Suitable connectors

Connectors	TNCP	NP
Max. Frequency (GHz)	8	8
Max. VSWR	1,12	1,12
Max. insertion loss (dB)	0,09	0,09

Steel Coil and PUR



temperature range	: - 55° C to + 110° C
Crush resistance	: 350 Kg / 772 Pound
Min. bending radius	: min. cable bending radius

Steel coil (round wire) and polyurethane pur jacket. Up to 110°C, this ruggedization offers excellent protection against **compression, abrasion** and other mechanical forces acting upon the cable.

Typical applications

- Radars
- Shipboards
- External applications

Stainless steel



temperature range	: - 65° C to + 165° C
Crush resistance	: 350 Kg / 772 Pound
Min. bending radius	: min. cable bending radius

Flexible hose of stainless steel. This ruggedization protects the cable against **compression, abrasion, mechanical injuries, open fire and hot objects** (soldering irons for example). The continuous temperature is limited by the cable to +165°C, and in the immediate proximity of the connectors to the maximum connector temperature.

Typical applications

- Radars
- Industrial environments

Stainless steel and PUR



temperature range	: - 55° C to + 110° C
Crush resistance	: 200 Kg / 441 Pound
Min. bending radius	: min. cable bending radius

Flexible hose of stainless steel and polyurethane (PUR) jacket. Up to 110° C, this ruggedization offers excellent protection against compression, tension, abrasive and other mechanical forces acting upon the cable.

Typical applications

- Protected line replaceable units (LRU).
- Radars

We involve ourselves in the design of your “cable system”, Compagnie Deutsch Microwave Assemblies are ready to meet the challenge of your system. From initial concept stage to prototype development to field testing, Compagnie Deutsch engineers are available to assist reducing your system risk.

The information from this list will aid in specifying the most appropriate Compagnie Deutsch Microwave assembly. Please be prepared with the following information when calling.

Electrical characteristics

- Characteristic impedence
- Frequency range
- Max insertion loss
- Max VSWR
- RF leakage
- Power handling
- Peak power
- Velocity of signal propagation
- Operating voltage
- Others : Phase matching, electrical length...

Mechanical characteristics

- Length of assembly
- Max diameter
- Min bending radius
- Flexures (type and numbers)
- Others : Max weight, pull strength, crush resistance...

Environmental

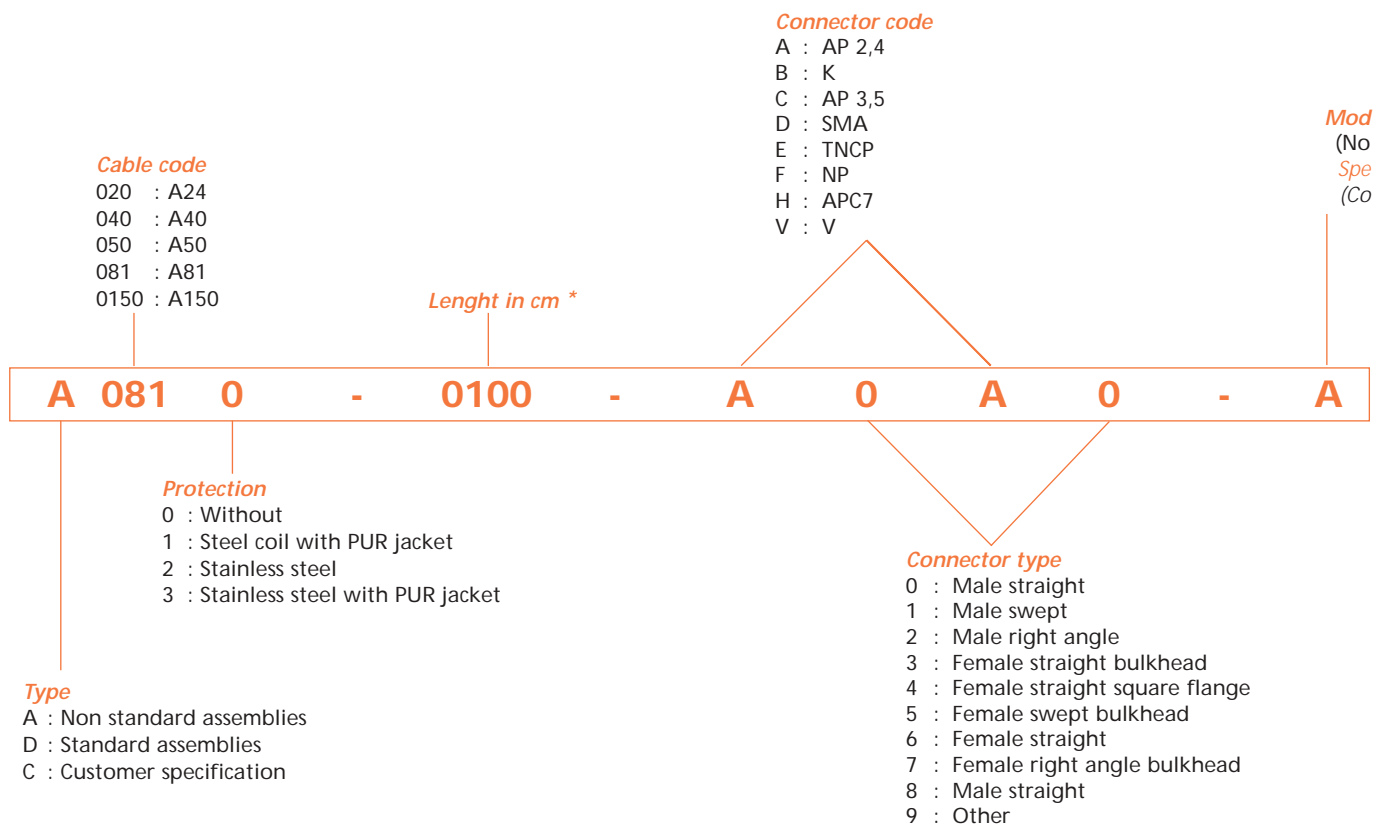
- Temperature range
- Humidity
- Salt spray
- Gas
- Altitude

Connector interface

- End A
- End B

Other items to consider

- Phase with temperature and/or flexures
- Insertion loss with temperature and/or flexures
- Wiring restrictions
- Routing restrictions



* Specifying Assembly Length

Length is measured using the connector reference plane of straight pin connectors, the pin centre line of right angle connectors, and the physical end of straight socket connectors.

Compagnie Deutsch offers you a competent one-stop-shop service from the very beginning of your design-in phase. You are receiving flexible microwave assemblies optimally tailored to your specific needs. Take advantage of our vast experience in the design and development of flexible microwave assemblies by using our comprehensive and matching connector and cable range

Benefits

- Excellent VSWR values, given through optimized matched cables and connector combination
- Individual and competent consulting service and support, starting from the design-in phase to the qualification, approval, production and after sales service
- Our products, service and experience covers applications for the following markets: Space, Defence, Test & Measurement and Industrial and Telecom
- we offer flexible and complete customer solutions, in close co-operation with our in-house connector and cable R&D, production, assembly shop and test laboratory.

Skills

At Compagnie Deutsch, we have a tradition of innovation and high technology, a spirit of research combined with a continuous improvement.

We use powerful design tools to respond quickly to the needs of our customers.

Thanks to the advanced integration of our processes, we master the development of our products and final assembly to ensure good quality.

Employees and know-how are always at the heart of the company : efficiency through dialogue and team spirit, continuous improvement of competencies , recognition of everyone's contribution.

Total quality

A total quality program, based upon a continuous improvement project, is set up to constantly optimize and improve resources and possibilities of the Group. The Compagnie Deutsch Group established its reputation upon the quality and the reliability of its products.

To maintain this place on the market, the Group is certified :

EN 9100, ISO 9001, AQAP110 OTAN, MIL-STD-790, MIL-QPL, JAR 21,

ESA-SCC, FERROVIAIRE AQF2 (SNCF), AQFM2 (RATP), QUALIFAS, ISO TS 16946.

Guarantee of performances

Microwave and bus cable assemblies require a specific technological make-up, the aim being their perfect integration in systems, without deteriorating their performance.

Thanks to the mastering of design and manufacturing of cables and connectors, Deutsch Bus & Microwave can respond to the needs of its customers, offer an adapted service and guarantee performances of its products.

Excellence in service

Compagnie Deutsch has always been a precursor to improve the service to its customers. Deutsch Bus & Microwave propose services such as : on-site technical assistance, Electronic Data Interchange, short lead-time delivery of standard cable assemblies.

Worldwide presence

The key component to winning customer satisfaction and attaining profitable growth is fulfilling the customer's support expectations. Compagnie Deutsch has created a network of sales companies, distributors and authorized service centers which support our products around the world. In addition to our manufacturing locations, we have sales companies all around the world.

Look up your nearest Deutsch representative on our web site.
www.compagnie-deutsch.com

Constants & formulas

Symbols

μ	=	Permeability
ϵ	=	Dielectric Constant
c	=	Speed of light 2.9979×10^8 m/s
C	=	Capacitance
L	=	Inductance
L_E	=	Electrical length
Z_o	=	Characteristic Impedance
R_L	=	Return Loss
VSWR	=	Voltage Standing Wave Ratio
V_p	=	Phase Velocity
λ	=	Wavelength = $\frac{c}{f}$ (Free Space)
f	=	Frequency
Γ_L	=	Reflection Coefficient
ϵ_0	=	$\frac{1}{\mu_0 c^2} = 8.85 \times 10^{-12}$ F/m (Free Space)
μ_0	=	$4\pi \cdot 10^{-7}$ H/m (Free Space)
Z_0	=	$\sqrt{\frac{\mu_0}{\epsilon_0}} = 377 \Omega$ (Free Space)
ϵ_r	=	1.45 for ePTFE
	=	2.1 for solid PTFE (TEFLON®)
	=	$\frac{\epsilon}{\epsilon_0}$

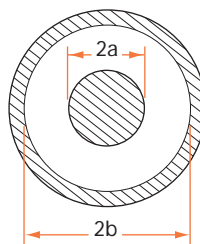
Formulas

Voltage standing Wave Ratio	$VSWR = \frac{1 + \Gamma_L }{1 - \Gamma_L } = \frac{E_{\max}}{E_{\min}} \quad \Gamma_L = \frac{VSWR-1}{VSWR+1}$
Insertion Loss	$I_L(\text{dB}) = P_{\text{in}}(\text{dBm}) - P_{\text{out}}(\text{dBm}) = 10 \log_{10} \frac{P_{\text{in}}}{P_{\text{out}}}$
Return Loss	$R_L(\text{dB}) = P_{\text{in}}(\text{dBm}) - P_{\text{refl}}(\text{dBm}) = 20 \log_{10} \left(\frac{1}{ \Gamma } \right)$
Reflection Coefficient	$ \Gamma ^2 = \frac{P_{\text{refl}}}{P_{\text{in}}}$

Conventional Coaxial Line

2a is the OD of the center conductor.

2b is the ID of the outer conductor.



Coaxial Line Characteristics

pF/m	=	Capacitance	$C = \frac{55.556 \epsilon_r}{\ln(b/a)}$
nH/m	=	Inductance	$L = 200 \ln(b/a)$
Ω	=	Characteristic Impedance	$Z_o = \frac{60}{\sqrt{\epsilon_r}} \ln(b/a) = \sqrt{\frac{L}{C}}$
m/s	=	Phase Velocity	$\frac{V_p}{V \epsilon_r} = \frac{3 \cdot 10^8}{\sqrt{LC}} = 1$
ns/m	=	Delay	$\tau_d = 3.33 \sqrt{\epsilon_r}$
dB/unit length	=	Dielectric Attenuation Constant	$\alpha_d = 27.3 \sqrt{\epsilon_r \frac{\tan \delta}{\lambda_0}}$
dB/unit length	=	Conductor Attenuation Constant s for silver = 6.17×10^7 mho/m	$\alpha_c = \frac{8.686}{Z_o} \sqrt{\left[\frac{\mu_0 f}{16\pi} \left(\frac{1}{a \sqrt{\sigma_a}} + \frac{1}{b \sqrt{\sigma_b}} \right) \right]}$
Unit of a or b	=	Cutoff Wavelength for TR_{11} mode	$\lambda_c \approx \pi \sqrt{\epsilon_r (a+b)}$

Weight and measurements

Millimeter	=	0,039370 Inch
Meter	=	3,280833 Feet 39,3700 Inches
Foot	=	0,3048006 Meter
Gram	=	0,00220462 Pound
Pound	=	0,453592 Kilogram
Ounce	=	28,349527 Grams



Connecteurs Electriques Deutsch
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