Corso di Misure a Microonde

Cavi coassiali

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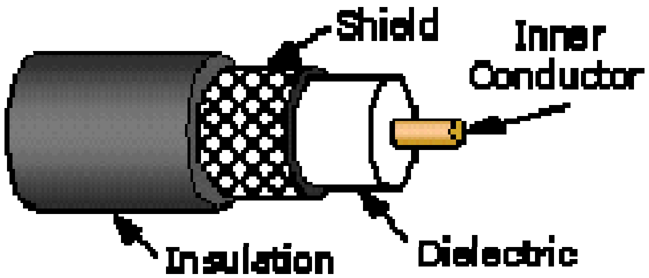
Sommario

- Tipi di cavi
- Caratteristiche principali
- Standard
- Come scegliere?
- Esempi di strutture reali
- Esempi di informazioni fornite dai costruttori

Tipi di cavi

Tipi di cavi

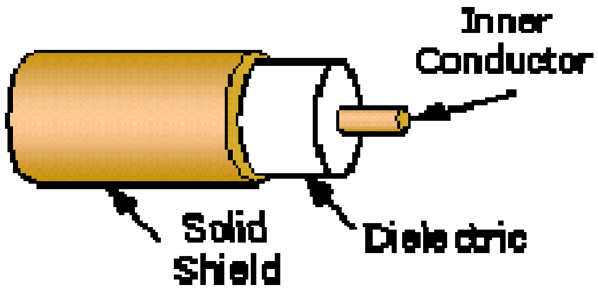
flessibili



Il conduttore esterno è costituito da una maglia metallica che gli conferisce flessibilità.

L'isolamento verso il mondo esterno non è totale e l'attenuazione del conduttore a maglia è superiore a quella di un conduttore continuo.

(semi)rigidi



Il conduttore esterno è costituito da una conduttore continuo che può essere curvato entro certi limiti e un numero limitato di volte.

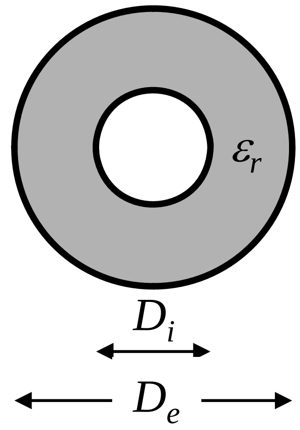
L'isolamento verso il mondo esterno è totale e l'attenuazione è generalmente inferiore a quella di un cavo flessibile di pari dimensioni e materiali.

Materiale isolante

Dielectric Type	Time Delay (ns/ft)	Propagation Velocity (% of c)
Solid Polyethylene (PE)	1.54	65.9
Foam Polyethylene (FE)	1.27	80.0
Foam Polystyrene (FS)	1.12	91.0
Air Space Polyethylene (ASP)	1.15-1.21	84-88
Solid Teflon (ST)	1.46	69.4
Air Space Teflon (AST)	1.13-1.20	85-90

Impedenza caratteristica

$$Z_0 = \frac{\eta_0}{2\pi\sqrt{\varepsilon_r}} \ln\frac{D_e}{D_i} = \frac{60}{\sqrt{\varepsilon_r}} \ln\frac{D_e}{D_i} \quad \Omega$$



La frequenza di taglio del primo modo superiore risulta:

$$f_c \cong \frac{7.5}{(D_e + D_i)\sqrt{\varepsilon_r}} \quad \text{GHz}$$

Attenuazione

$$\alpha_{conductors} = \alpha_c = \frac{11.39}{Z} * \sqrt{f} * \left| \frac{\sqrt{\rho_{rd}}}{d} + \frac{\sqrt{\rho_{rD}}}{D} \right| \quad \frac{dB}{m}$$

$$\alpha_{dielectric} = \alpha_{diel} = 90.96 * f * \sqrt{\varepsilon_r} * \tan(\delta) \quad \frac{dB}{m}$$

d = outside diameter of inner conductor in mm

D = inside diameter of outer conductor in mm

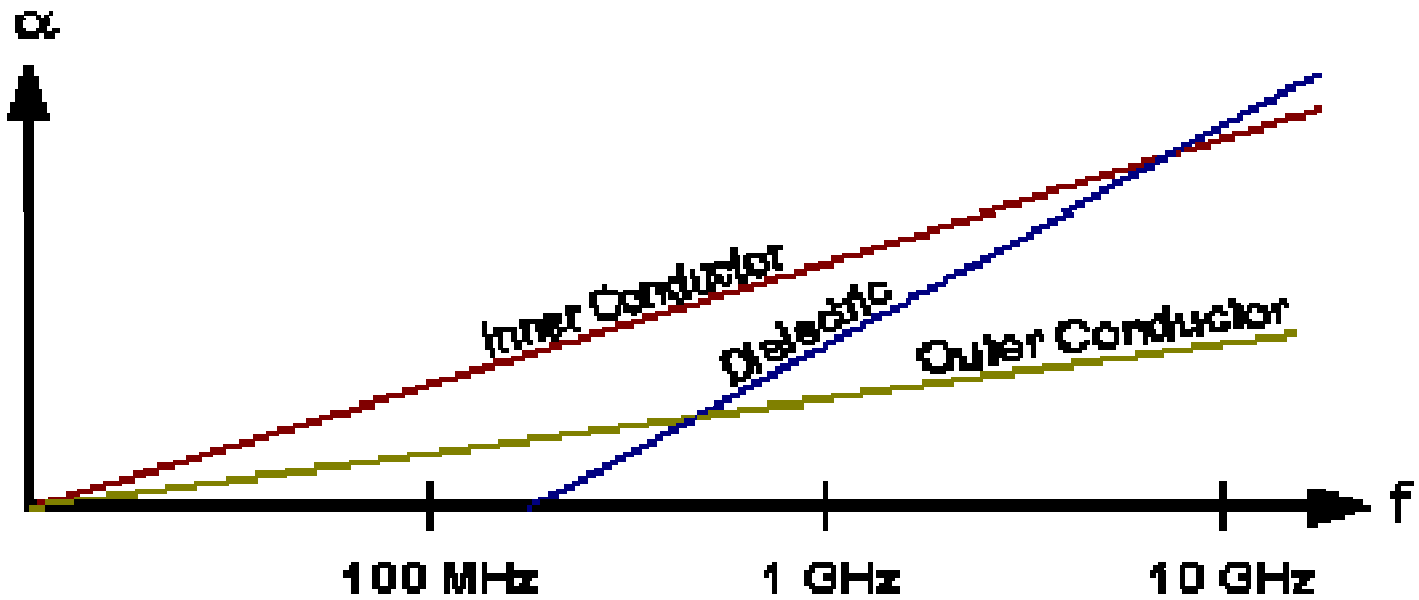
er = relative dielectric constant

f = frequency in GHz

ρ_{rd} = inner conductor material resistivity relative to copper

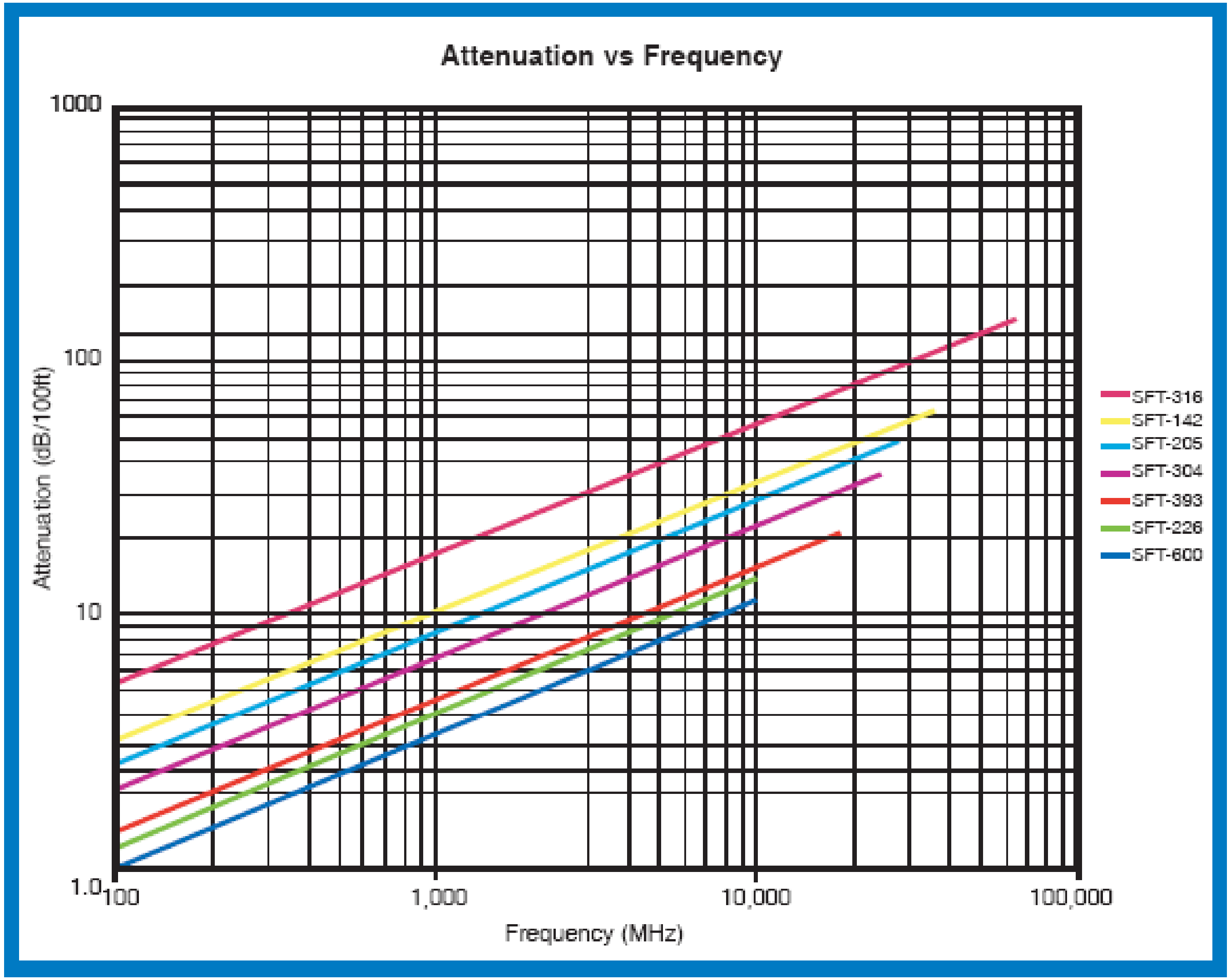
ρ_{rD} = outer conductor material resistivity relative to copper

δ = loss angle



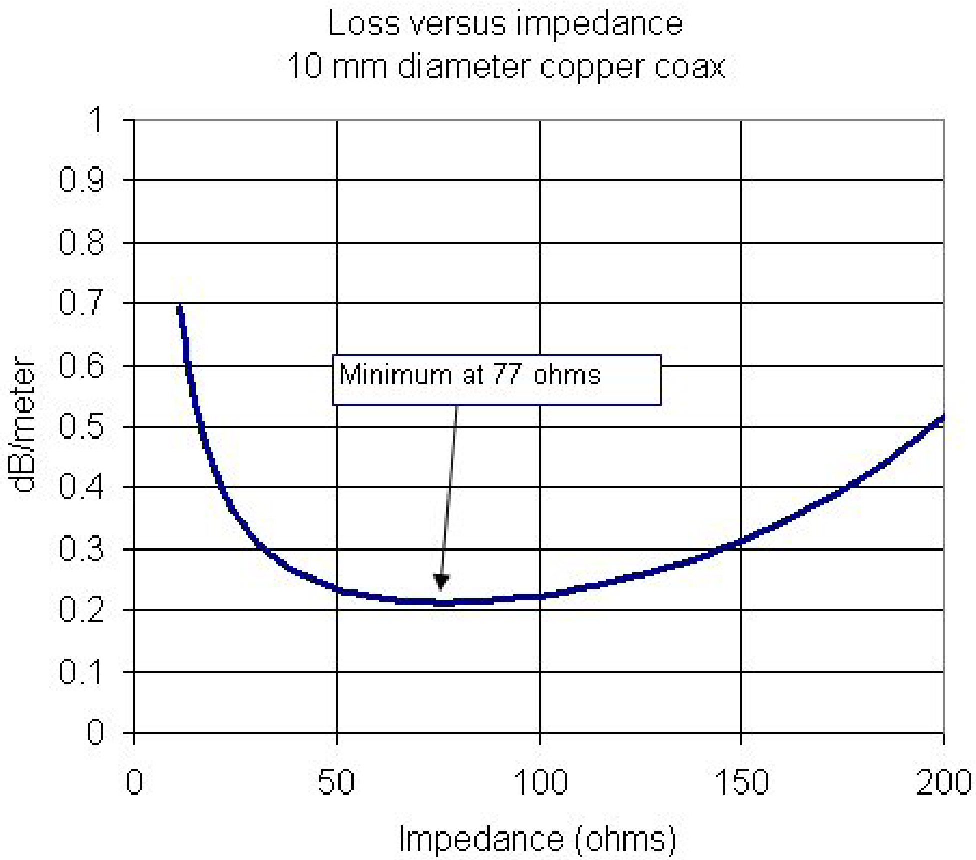
Attenuazione: esempio pratico

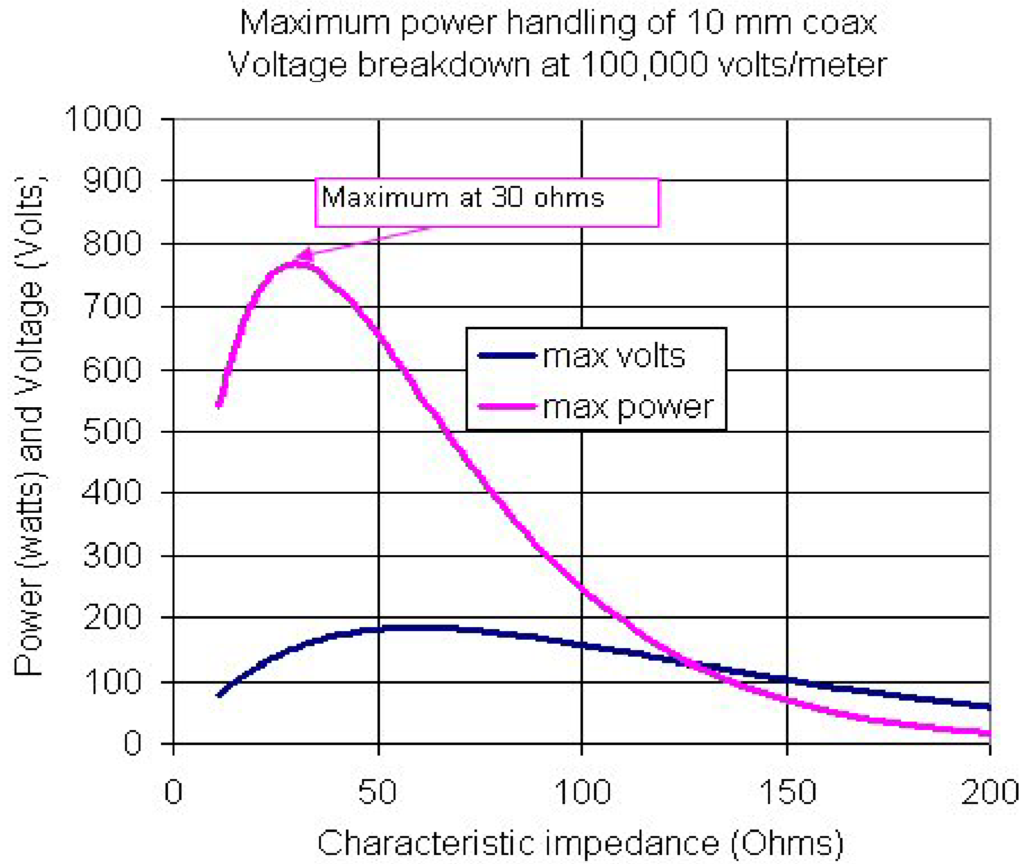
SFT Attenuation -vs- Frequency



Perché 50Ω di impedenza caratteristica?

Standardizzato intorno al 1930, rappresenta un buon compromesso tra perdite e potenza massima trasmissibile (per cavo in aria): è una via di mezzo tra la media aritmetica (53.3 Ω) e quella geometrica (48 Ω) tra 30 Ω (massima potenza) e 77 Ω (perdite minime)





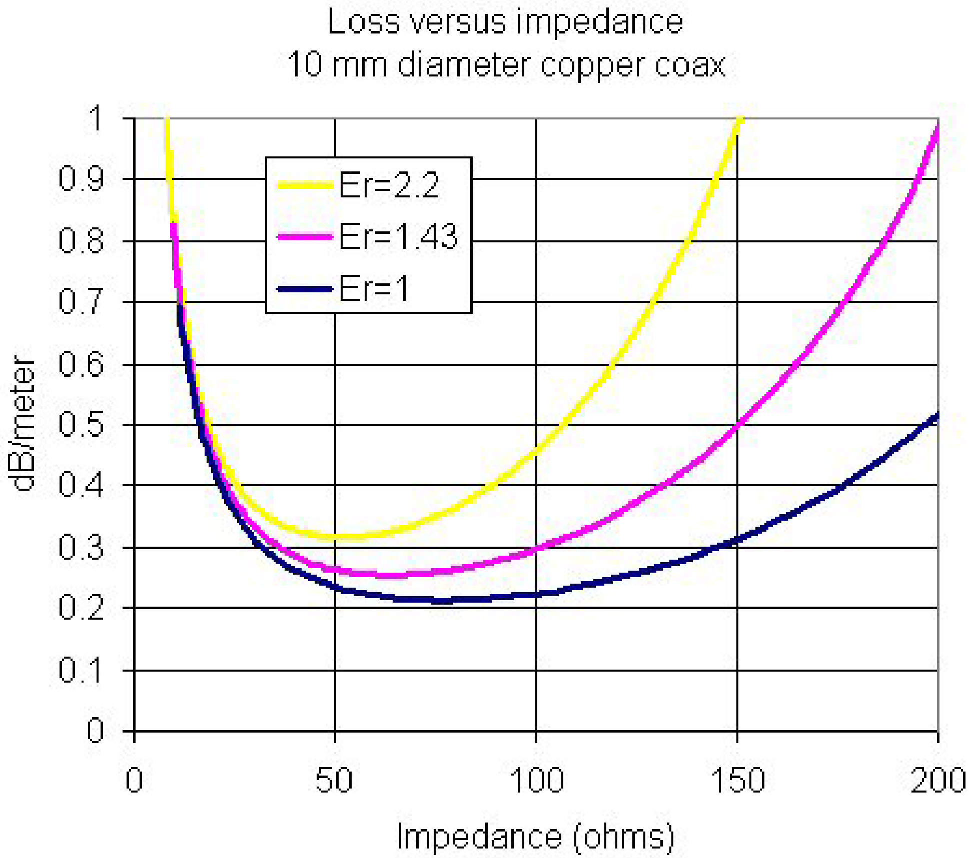
Cavo in aria, diametro conduttore esterno 10 mm, f = 10 GHz.

Perché 75Ω di impedenza caratteristica?

Per uso commerciale (bassa potenza), l'impedenza caratteristica standard è tipicamente 75 Ω. Sembrerebbe naturale poiché abbiamo visto che un'impedenza di 77 Ω minimizza le perdite. Ma non è così! Se il cavo non è in aria, il valore di Z_0 che minimizza le perdite cambia con ε_r e, nel caso tipico di $\varepsilon_r \cong 1.5$, il valore ottimo sarebbe intorno ai 60 Ω.

Allora perché 75 Ω?

Il conduttore centrale di cavi a basso costo è spesso realizzato in acciaio e ricoperto in rame. Poiché impedenze caratteristiche basse richiedono conduttori interni di sezione maggiore, la scelta dei 75 Ω è probabilmente stata un buon compromesso fra basse perdite e flessibilità del cavo.



Standard

Type (/U)	MIL-W-17	$Z_0(\Omega)$	Dielectric Type	Capacitance (pF/ft)	O.D. (in.)	dB/100 ft @400 MHz	Vmax (rms)	Shield
RG-4		50.0	PE	30.8	0.226	11.7	1,900	Braid
RG-5		52.5	PE	28.5	0.332	7.0	3,000	Braid
RG-5A/B		50.0	PE	30.8	0.328	6.5	3,000	Braid
RG-6	/2-RG6	76.0	PE	20.0	0.332	7.4	2,700	Braid
RG-6A	/2-RG6	75.0	PE	20.6	0.332	6.5	2,700	Braid
RG-8		52.0	PE	29.6	0.405	6.0	4,000	Braid
RG-8A		52.0	PE	29.6	0.405	6.0	5,000	Braid
RG-9		51.0	PE	30.2	0.420	5.9	4,000	Braid
RG-9A		51.0	PE	30.2	0.420	6.1	4,000	Braid
RG-9B		50.0	PE	30.8	0.420	6.1	5,000	Braid
RG-10		52.0	PE	29.6	0.463	6.0	4,000	Braid
RG-10A		52.0	PE	29.6	0.463	6.0	5,000	Braid
RG-11	/6-RG11	75.0	PE	20.6	0.405	5.7	4,000	Braid
RG-11A	/6-RG11	75.0	PE	20.6	0.405	5.2	5,000	Braid
RG-12	/6-RG12	75.0	PE	20.6	0.463	5.7	4,000	Braid
RG-12A	/6-RG12	75.0	PE	20.6	0.463	5.2	5,000	Braid
RG-17A		52.0	PE	29.6	0.870	2.8	11,000	Braid
RG-22	/15-RG22	95.0	PE	16.3	0.405	10.5	1,000	Braid
RG-22A/B	/15-RG22	95.0	PE	16.3	0.420	10.5	1,000	Braid
RG-23/A	/16-RG23	125.0	PE	12.0	0.650	5.2	3,000	Braid
RG-24/A	/16-RG24	125.0	PE	12.0	0.708	5.2	3,000	Braid
RG-34	/24-RG34	71.0	PE	21.7	0.625	5.3	5,200	Braid
RG-34A	/24-RG34	75.0	PE	20.6	0.630	5.3	6,500	Braid
RG-35	/64-RG35	71.0	PE	21.7	0.928	2.8	10,000	Braid
RG-35A/B	/64-RG35	75.0	PE	20.6	0.928	2.8	10,000	Braid
RG-55B		53.5	PE	28.8	0.200	11.7	1,900	Braid
RG-58	/28-RG58	53.5	PE	28.8	0.195	11.7	1,900	Braid
RG-58A	/28-RG58	52.0	PE	29.6	0.195	13.2	1,900	Braid
RG-58B		53.5	PE	28.8	0.195	14.0	1,900	Braid
RG-58C	/28-RG58	50.0	PE	30.8	0.195	14.0	1,900	Braid
RG-59/A	/29-RG59	73.0	PE	21.1	0.242	10.5	2,300	Braid
RG-59B	/29-RG59	75.0	PE	20.6	0.242	9.0	2,300	Braid

Standard

Type (/U)	MIL-W-17	$Z_0 (\Omega)$	Dielectric Type	Capacitance (pF/ft)	O.D. (in.)	dB/100 ft @400 MHz	Vmax (rms)	Shield
RG-62/A/B	/30-RG62	93.0	ASP	13.5	0.242	8.0	750	Braid
RG-63/A/B	/31-RG63	125.0	ASP	10.0	0.405	5.5	1,000	Braid
RG-65/A	/34-RG65	950.0	ASP	44.0	0.405	16 @5MHz	1,000	Braid
RG-71/A/B	/90-RG71	93.0	ASP	13.5	0.245	8.0	750	Braid
RG-79/A/B	/31-RG79	125.0	ASP	10.0	0.436	5.5	1,000	Braid
RG-83		35.0	PE	44.0	0.405	9.0	2,000	Braid
RG-88		48.0		50.0	0.515	0.7 @1MHz	10,000	Braid
RG-108/A	/45-RG108	78.0	PE	19.7	0.235	2.8 @10MHz	1,000	Braid
RG-111/A	/15-RG111	95.0	PE	16.3	0.478	10.5	1,000	Braid
RG-114/A	/47-RG114	185.0	ASP	6.5	0.405	8.5	1,000	Braid
RG-119	/52-RG119	50.0	ST	29.4	0.465	3.8	6,000	Braid
RG-120	/52-RG120	50.0	ST	29.4	0.523	3.8	6,000	Braid
RG-122	/54-RG122	50.0	PE	30.8	0.160	18.0	1,900	Braid
RG-130	/56-RG130	95.0	PE	17.0	0.625	8.8	3,000	Braid
RG-131	/56-RG131	95.0	PE	17.0	0.683	8.8	3,000	Braid
RG-133/A	/100-RG133	95.0	PE	16.3	0.405	5.7	4,000	Braid
RG-141/A		50.0	ST	29.4	0.190	9.0	1,900	Braid
RG-142/A/B	/60-RG142	50.0	ST	29.4	0.195	9.0	1,900	Braid
RG-144	/62-RG144	75.0	ST	19.5	0.410	4.5	5,000	Braid
RG-164	/64-RG164	75.0	PE	20.6	0.870	2.8	10,000	Braid
RG-165	/65-RG165	50.0	ST	29.4	0.410	5.0	5,000	Braid
RG-166	/65-RG166	50.0	ST	29.4	0.460	5.0	5,000	Braid
RG-177	/67-RG177	50.0	PE	30.8	0.895	2.8	11,000	Braid
RG-178/A/B	/93-RG178	50.0	ST	29.4	0.072	29.0	1,000	Braid
RG-179	/94-RG179	70.0	ST	20.9	0.100	21.0	1,200	Braid
RG-179A/B	/94-RG179	75.0	ST	19.5	0.100	21.0	1,200	Braid
RG-180	/95-RG180	93.0	ST	15.4	0.140	17.0	1,500	Braid
RG-180A/B	/95-RG180	95.0	ST	15.4	0.140	17.0	1,500	Braid
RG-210	/97-RG210	93.0	ASP	13.5	0.242	8.0	750	Braid
RG-211/A	/72-RG211	50.0	ST	29.4	0.730	2.3	7,000	Braid
RG-212	/73-RG212	50.0	PE	29.4	0.332	6.5	3,000	Braid
RG-213	/74-RG213	50.0	PE	30.8	0.405	5.5	5,000	Braid

Standard

Type (/U)	MIL-W-17	$Z_0 (\Omega)$	Dielectric Type	Capacitance (pF/ft)	O.D. (in.)	dB/100 ft @400 MHz	Vmax (rms)	Shield
RG-214	/75-RG214	50.0	PE	30.8	0.425	5.5	5,000	Braid
RG-215	/74-RG215	50.0	PE	30.8	0.463	5.5	5,000	Braid
RG-216	/77-RG216	75.0	PE	20.6	0.425	5.2	5,000	Braid
RG-217	/78-RG217	50.0	PE	30.8	0.545	4.3	7,000	Braid
RG-218	/79-RG218	50.0	PE	30.8	0.870	2.5	11,000	Braid
RG-219	/79-RG219	50.0	PE	30.8	0.928	2.5	11,000	Braid
RG-223	/84-RG223	50.0	PE	19.8	0.211	8.8	1,900	Dbl Braid
RG-302	/110-RG302	75.0	ST	19.5	0.201	8.0	2,300	Braid
RG-303	/111-RG303	50.0	ST	29.4	0.170	9.0	1,900	Braid
RG-304	/112-RG304	50.0	ST	29.4	0.280	6.0	3,000	Braid
RG-307/A	/116-RG307	75.0	80	16.9	0.270	7.5	1,000	Braid
RG-316	/113-RG316	50.0	ST	29.4	0.102	20.0	1,200	Braid
RG-391	/126-RG391	72.0		23.0	0.405	15.0	5,000	Braid
RG-392	/126-RG392	72.0		23.0	0.475	15.0	5,000	Braid
RG-393	/127-RG393	50.0	ST	29.4	0.390	5.0	5,000	Braid
RG-400	/128-RG400	50.0	ST	29.4	0.195	9.6	1,900	Braid
RG-401	/129-RG401	50.0	ST	29.4	0.250	4.6	3,000	Cu. S-R
RG-402	/130-RG402	50.0	ST	29.4	0.141	7.2	2,500	Cu. S-R
RG-403	/131-RG403	50.0	ST	29.4	0.116	29.0	2,500	Braid
RG-405	/133-RG405	50.0	ST	29.4	0.086	13.0	1,500	Cu. S-R
9914 (Belden)		50.0		26.0	0.405	10.0	------	

Come scegliere?

I parametri da considerare sono molteplici:

Electrical	Mechanical	Environmental
Frequency Range	Length	Operating temp range
Attenuation (loss)	Flexibility (bend moment)	Operating altitude
Return loss (VSWR)	Flex Life	Moisture resistance
Passive IM	Bend radius	UV resistance
Shielding (isolation)	Outer Jacket or armor	
RF Stability (with temp or flex)	Connector series	
Phase length	Attachment method	
Power handling	Mating life cycle	
Impedance		

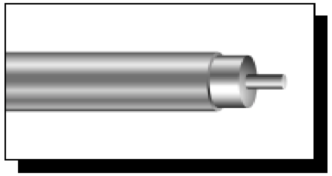
Esempio di struttura reale

TIMES FIBER COMMUNICATIONS, INC.®
1-800-677-2288

TFC SEMIFLEX CABLE SERIES **T10-TX10**

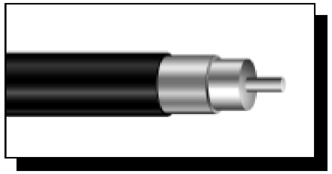
UNJACKETED

Application: Recommended for aerial installations in a non-corrosive environment, unjacketed semiflex cable features bonding of the center conductor to the dielectric and dielectric to the outer conductor. This bonding prevents moisture ingress and facilitates connectorization since it leaves no harmful residue.



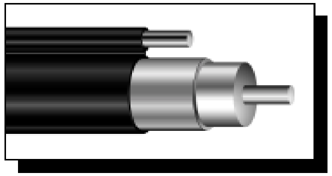
JACKETED

Application: For aerial applications in urban and coastal environments, Jacketed semiflex cable is recommended where highly corrosive conditions may exist. This cable features a triple bonding of the center conductor to the dielectric, dielectric to the outer conductor and outer conductor to the jacket and is designed to withstand more abrasion and mechanical abuse than an unjacketed version. With an extra thick jacket, this cable will withstand more abrasion and mechanical abuse than the standard jacketed burial cable.



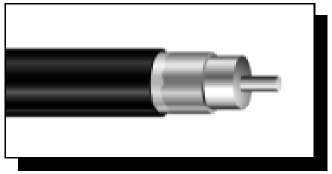
MESSENGERED

Application: Messengered semiflex cable is recommended for aerial feeder installations where strand installation is not practical. T10412 and T10500 semiflex cable is designed with a strong, integral, galvanized solid steel wire which supports the cable in aerial installations. TX10625 and TX10565 semiflex cable features a jacketed galvanized stranded steel wire which also acts as a support, relieving the cable from undue tension. Resting ladders on messengered cable is not recommended.



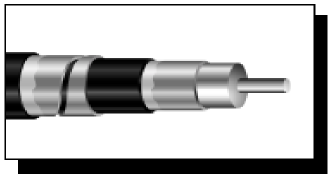
JACKETED BURIAL

Application: Jacketed Burial semiflex cable is recommended for underground applications in conduit or direct burial installations. This version features a cold flowing, self-healing flooding compound for underground applications, providing an additional layer of corrosion protection. For aerial applications, non-dripping flooding compound is used which also serves as an additional layer of corrosion protection.

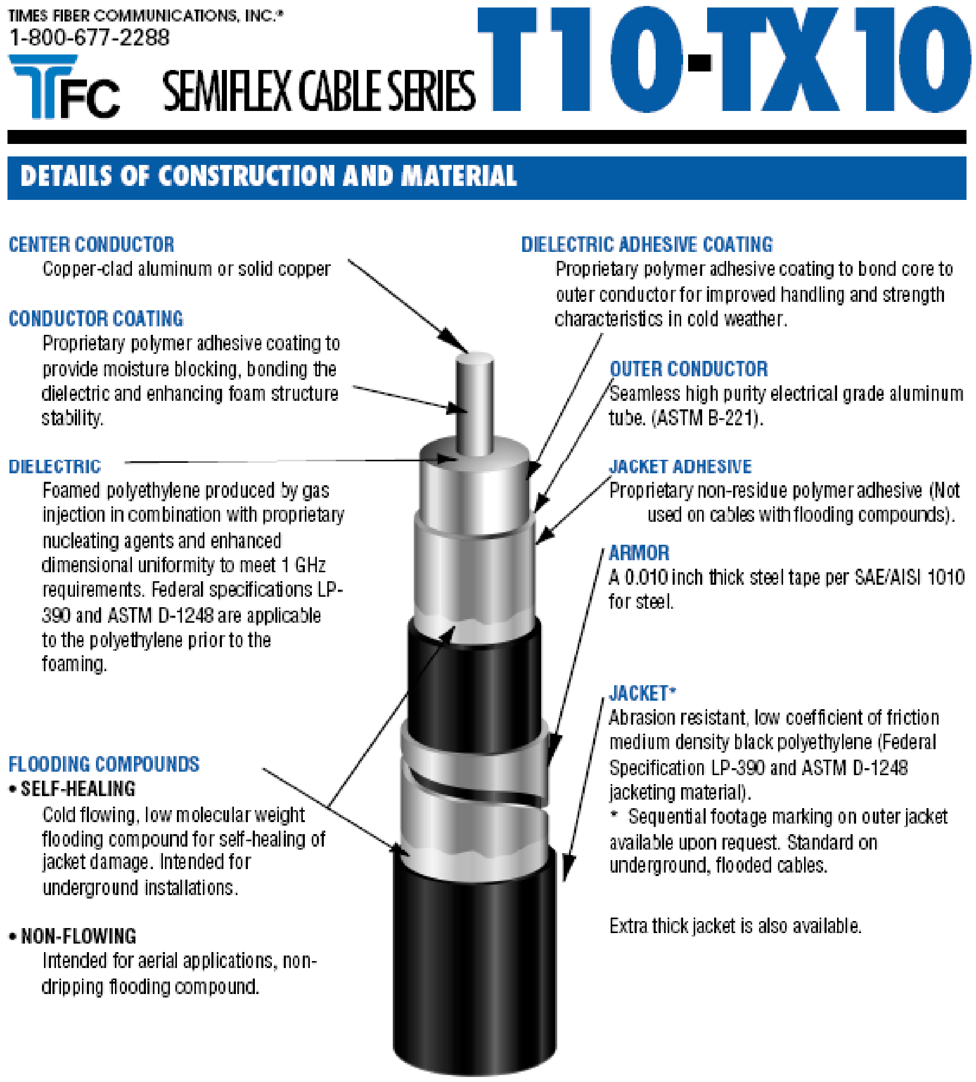


ARMORED

Application: Where cable is exposed to extensive mechanical abuse and rodent attack, armored semiflex cable is recommended. Used for direct burial applications, Armored semiflex cable features a flooded steel tape and jacket which are layered over the standard flooded jacketed cable to increase mechanical strength.



Esempio di struttura reale



Esempio di struttura reale

TIMES FIBER COMMUNICATIONS, INC.®
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TFC

412 SERIES SEMIFLEX CABLE T10

PHYSICAL SPECIFICATIONS

NOMINAL DIMENSIONS	UNJACKETED*		JACKETED		EXTRA THICK JACKET		MESSENGERED		JACKETED BURIAL		EXTRA THICK JACKETED BURIAL		ARMORED	
	inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)
Conductor	0.088	(2.24)	0.088	(2.24)	0.088	(2.24)	0.088	(2.24)	0.088	(2.24)	0.088	(2.24)	0.088	(2.24)
Dielectric	0.362	(9.19)	0.362	(9.19)	0.362	(9.19)	0.362	(9.19)	0.362	(9.19)	0.362	(9.19)	0.362	(9.19)
Outer Conductor Thickness	0.025	(0.64)	0.025	(0.64)	0.025	(0.64)	0.025	(0.64)	0.025	(0.64)	0.025	(0.64)	0.025	(0.64)
Outer Conductor Diameter	0.412	(10.5)	0.412	(10.5)	0.412	(10.5)	0.412	(10.5)	0.412	(10.5)	0.412	(10.5)	0.412	(10.5)
First Jacket	—	—	0.470	(11.9)	0.542	(13.8)	0.480	(12.2)	0.480	(12.2)	0.552	(14.0)	0.480	(12.2)
Messenger	—	—	—	—	—	—	0.109	(2.77)	—	—	—	—	—	—
Armor	—	—	—	—	—	—	—	—	—	—	—	—	0.500	(12.7)
Second Jacket	—	—	—	—	—	—	—	—	—	—	—	—	0.600	(15.2)
Nominal Weight (lb/1000 ft) (kg/km)	58	(86)	75	(112)	98	(146)	126	(188)	78	(116)	102	(152)	159	(237)
Nominal Weight (per reel) lb (kg)	252	(114)	301	(137)	372	(169)	479	(217)	310	(141)	382	(173)	577	(262)
Nominal Length (per reel) feet (m)	3000	(914)	3000	(914)	3000	(914)	3000	(914)	3000	(914)	3000	(914)	3000	(914)
Maximum Pull Force lbf (N)	250	(1112)	250	(1112)	250	(1112)	900	(4003)	250	(1112)	250	(1112)	250	(1112)
Minimum Bend Radius in (mm)	3.0	(76)	2.5	(64)	2.5	(64)	3.0	(76)	3.0	(76)	3.0	(76)	8.4	(213)
Messenger Break Strength lbf (N)	—	—	—	—	—	—	1800	(8007)	—	—	—	—	—	—
Reel Size (inches) (Flange x Width)[1]	36 x 22		36 x 22		36 x 22		42 x 22		36 x 22		36 x 22		42 x 22	
Reel Size (centimeters) (Flange x Width)[1]	91 x 56		91 x 56		91 x 56		107 x 56		91 x 56		91 x 56		107 x 56	

* All T10 Unjacketed Cable is available rated per NEC Article 820 - CATV (UL).

[1] Width = outside flange to outside flange

ELECTRICAL SPECIFICATIONS

Nominal DC Resistance @ 68°F (20°C)	Ohms per 1000	
Copper-Clad Aluminum Center Conductor	feet	meters
Center Conductor	2.06	6.76
Outer Conductor	0.44	1.44
Loop	2.50	8.20
Nominal Capacitance	15.6 pF/ft (51.2 pF/m)	
Impedance	75 ± 2 Ohms	
Velocity of Propagation	87% nominal	

MAXIMUM ATTENUATION @ 68°F (20°C)

Frequency MHz	dB per 100 feet	dB per 100 meters
5	0.20	0.66
55	0.68	2.24
211	1.35	4.44
250	1.49	4.89
270	1.55	5.09
300	1.64	5.38
330	1.73	5.66
350	1.78	5.84
400	1.91	6.27
450	2.03	6.66
500	2.15	7.05
550	2.26	7.41
600	2.37	7.78
750	2.68	8.79
870	2.90	9.52
1000	3.13	10.27

Attenuation increases with increasing temperature and decreases with decreasing temperature at the rate of 0.1% / °F (0.18% / °C)

Specifiche fornite dai costruttori

High Power Cable Properties

	RG-177	RG-217	RG-218	RG-220 Single Shield	RG-220 Double Shield	RG-220 Triple Shield	RG-220 FERMI	RG-393	AA-5885	AA-9021 HP-226	AA-9083 HP-600	AA-9104 HP-700
Attenuation: dB/100ft (/100m) @												
13.56 MHz	0.29 (0.950)	0.48 (1.590)	0.27 (0.890)	0.20 (0.660)	0.20 (0.660)	0.20 (0.660)	0.19 (0.620)	0.72 (2.361)	0.41 (1.345)	0.56 (1.825)	0.37 (1.223)	0.25 (0.825)
50 MHz	0.59 (1.92)	0.96 (3.15)	0.55 (1.81)	0.42 (1.37)	0.42 (1.37)	0.42 (1.37)	0.39 (1.29)	1.41 (4.63)	0.79 (2.60)	1.10 (3.60)	0.74 (2.44)	0.49 (1.60)
100 MHz	0.87 (2.8)	1.40 (4.6)	0.82 (2.7)	0.63 (2.1)	0.63 (2.1)	0.63 (2.1)	0.59 (1.9)	2.03 (6.7)	1.12 (3.7)	1.58 (5.2)	1.09 (3.6)	0.69 (2.3)
1000 MHz	3.60 (11.8)	5.28 (17.3)	3.44 (11.3)	2.84 (9.3)	0.63 (2.1)	0.63 (2.1)	2.74 (9.0)	7.24 (23.8)	3.67 (12.0)	5.81 (19.1)	4.24 (13.9)	2.31 (7.5)
1500 MHz	4.76 (15.6)	6.81 (22.3)	4.56 (15.0)	3.83 (12.6)	0.63 (2.1)	0.63 (2.1)	3.70 (12.1)	9.20 (30.2)	4.54 (14.9)	7.44 (24.4)	5.51 (18.1)	2.88 (9.4)
K1	0.07400 (0.24279)	0.12700 (0.41669)	0.06900 (0.22639)	0.05000 (0.16405)	0.05000 (0.16405)	0.05000 (0.16405)	0.04667 (0.15312)	0.19100 (0.62667)	0.11070 (0.36321)	0.14676 (0.48152)	0.09693 (0.31803)	0.06767 (0.22203)
K2	0.00126 (0.00413)	0.00126 (0.00413)	0.00126 (0.00413)	0.00126 (0.00413)	0.00126 (0.00413)	0.00126 (0.00413)	0.00126 (0.00413)	0.00120 (0.00394)	0.00017 (0.00056)	0.00117 (0.00384)	0.00117 (0.00384)	0.00017 (0.00056)
CW Power (kW) @												
13.56 MHz	10	5	11	16	16	16	17	12	14	18	30	45
50 MHz	4.9	2.3	5.3	7.8	7.8	7.8	8.3	6.4	7.4	9.3	14.8	23.2
100 MHz	3.3	1.6	3.6	5.2	5.2	5.2	5.5	4.4	5.2	6.4	10.1	16.3
1000 MHz	0.8	0.4	0.8	1.1	1.1	1.1	1.2	1.2	1.6	1.7	2.6	4.9
1500 MHz	0.6	0.3	0.6	0.8	0.8	0.8	0.9	1.0	1.3	1.3	2.0	3.9
Peak Power (kW)	22,000	6,000	22,000	39,000	39,000	39,000	39,000	2,200	22	6,000	9,000	62
DC Voltage (kV)	95	50	95	125	125	125	125	30	3	50	62	5
DC Resistance ohms/1000ft (/km):												
center conductor	0.273 (0.896)	0.923 (3.028)	0.273 (0.896)	0.153 (0.502)	0.153 (0.502)	0.153 (0.502)	0.153 (0.502)	1.550 (5.086)	0.643 (2.110)	0.860 (2.822)	0.760 (2.494)	0.410 (1.345)
outer conductor	0.303 (0.994)	0.600 (1.969)	0.347 (1.139)	0.270 (0.886)	0.136 (0.446)	0.091 (0.299)	0.227 (0.745)	1.310 (4.298)	1.140 (3.740)	0.890 (2.920)	0.850 (2.789)	0.249 (0.817)
~ Equivalent AWG:												
center conductor	4	10	4	2	2	2	2	12	8	9	9	6
outer conductor	5	8	5	4	1	0	4	11	10.5	9	9	4
Impedance (ohms)	50	50	50	50	50	50	50	50	50	50	50	50
Capacitance pF/ft (/m)	30.8 (101.1)	30.8 (101.1)	30.8 (101.1)	30.8 (101.1)	30.8 (101.1)	30.8 (101.1)	30.8 (101.1)	29.3 (96.1)	25.0 (82.0)	28.6 (93.8)	28.6 (93.8)	24.8 (81.4)
Velocity of Propagation (%)	65.9	65.9	65.9	65.9	65.9	65.9	65.9	69.5	80	71	71	82
Dielectric Constant	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.07	1.56	1.98	1.98	1.49
Jacket Material	PVC	PVC	PVC	PVC	PVC	PVC	PVC	FEP	FEP	FEP	FEP	ALKP/NMX
Jacket Dimensions: Inches (mm)	0.895 (22.7)	0.545 (13.8)	0.870 (22.1)	1.120 (28.4)	1.165 (29.6)	1.200 (30.5)	1.180 (30.0)	0.390 (9.9)	0.485 (12.3)	0.485 (12.3)	0.590 (15.0)	0.688 (17.5)
Operating Temp Range: °F (°C)	-40° to +176° (-40° to +80°)							-67° to +392° (-55° to +200°)	-67° to +392° (-55° to +200°)			-85° to +482° (-65° to +250°)
Bend Radius: Inches (mm)	9 (229)	5.5 (140)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	4 (102)	5 (127)	5 (127)	6 (152)	6 (152)
Weight: lbs/ft (kg/m)	0.47 (0.70)	0.23 (0.34)	0.46 (0.69)	0.82 (1.22)	0.89 (1.33)	1.05 (1.56)	0.82 (1.22)	0.17 (0.25)	0.24 (0.35)	0.24 (0.35)	0.33 (0.48)	0.40 (0.60)

	AA-9007 MT-650	LMR®-400-LLPL®	LMR®-500-LLPL®	LMR®-600-LLPL®	LMR®-900-LLPL®	LMR®-1200-LLPL®	FBT-400	FBT-500	FBT-600	LMR®-600	LMR®-900	LMR®-1200	
Attenuation: dB/100ft (/100m) @													Attenuation: dB/100ft (/100m) @
13.56 MHz	0.31 (1.024)	0.48 (1.567)	0.37 (1.218)	0.30 (0.990)	0.21 (0.699)	0.16 (0.512)	0.48 (1.567)	0.37 (1.218)	0.30 (0.990)	0.28 (0.924)	0.19 (0.633)	0.14 (0.459)	13.56 MHz
50 MHz	0.60 (1.98)	0.92 (3.02)	0.72 (2.35)	0.58 (1.91)	0.41 (1.36)	0.30 (1.00)	0.92 (3.02)	0.72 (2.35)	0.58 (1.91)	0.55 (1.80)	0.37 (1.23)	0.27 (0.89)	50 MHz
100 MHz	0.86 (2.8)	1.31 (4.3)	1.02 (3.3)	0.83 (2.7)	0.59 (1.9)	0.44 (1.4)	1.31 (4.3)	1.02 (3.3)	0.83 (2.7)	0.78 (2.6)	0.53 (1.8)	0.39 (1.3)	100 MHz
1000 MHz	2.84 (9.3)	4.23 (13.9)	3.32 (10.9)	2.72 (8.9)	1.99 (6.5)	1.50 (4.9)	4.23 (13.9)	3.32 (10.9)	2.72 (8.9)	2.65 (8.7)	1.80 (5.9)	1.34 (4.4)	1000 MHz
1500 MHz	3.53 (11.6)	5.23 (17.1)	4.11 (13.5)	3.38 (11.1)	2.49 (8.2)	1.89 (6.2)	5.23 (17.1)	4.11 (13.5)	3.38 (11.1)	3.32 (10.9)	2.25 (7.4)	1.69 (5.5)	1500 MHz
K1	0.08410 (0.27593)	0.12914 (0.42371)	0.10026 (0.32895)	0.08139 (0.26704)	0.05722 (0.18774)	0.04172 (0.13688)	0.12914 (0.42371)	0.10026 (0.32895)	0.08139 (0.26704)	0.07555 (0.24788)	0.05177 (0.16986)	0.03737 (0.12261)	K1
K2	0.00018 (0.00059)	0.00015 (0.00048)	0.00015 (0.00048)	0.00015 (0.00048)	0.00018 (0.00059)	0.00018 (0.00059)	0.00015 (0.00048)	0.00015 (0.00048)	0.00015 (0.00048)	0.00026 (0.00085)	0.00016 (0.00052)	0.00016 (0.00052)	K2
CW Power (kW) @													CW Power (kW) @
13.56 MHz	33	5	7	10	20	35	9	13	17	8	13	19	13.56 MHz
50 MHz	16.8	2.6	3.9	5.4	10.2	18.0	4.5	6.5	8.8	4.2	6.9	9.7	50 MHz
100 MHz	11.8	1.8	2.7	3.8	7.1	12.6	3.2	4.6	6.2	3.0	4.8	6.8	100 MHz
1000 MHz	3.6	0.6	0.8	1.1	2.1	3.6	1.0	1.4	1.9	0.9	1.4	2.0	1000 MHz
1500 MHz	2.9	0.5	0.7	0.9	1.7	2.9	0.8	1.1	1.5	0.7	1.1	1.6	1500 MHz
Peak Power (kW)	40	16	22	40	82	90	16	22	40	40	62	90	Peak Power (kW)
DC Voltage (kV)	4	2.5	3	4	5	9	2.5	3	4	4	5	6	DC Voltage (kV
DC Resistance ohms/1000ft (/km):													DC Resistance: ohms/1000ft (/km):
center conductor	0.656 (2.152)	1.800 (5.906)	1.090 (3.576)	0.730 (2.395)	0.730 (2.395)	0.730 (2.395)	1.800 (5.906)	1.090 (3.576)	0.730 (2.395)	0.530 (1.739)	0.540 (1.772)	0.320 (1.050)	center conductor
outer conductor	0.697 (2.287)	1.650 (5.414)	1.270 (4.167)	1.200 (3.937)	1.200 (3.937)	1.200 (3.937)	1.650 (5.414)	1.270 (4.167)	1.200 (3.937)	1.200 (3.937)	0.550 (1.805)	0.370 (1.214)	outer conductor
~ Equivalent AWG:													~ Equivalent AWG:
center conductor	8	12.5	10.5	9	9	9	12.5	10.5	9	7	7	6	center conductor
outer conductor	8	12	11	11	11	11	12	11	11	11	7	6	outer conductor
Impedance (ohms)	50	50	50	50	50	50	50	50	50	50	50	50	Impedance (ohms)
Capacitance pF/ft (/m)	25.4 (83.3)	26.7 (87.6)	26.7 (87.6)	26.7 (87.6)	26.7 (87.6)	26.7 (87.6)	26.7 (87.5)	26.7 (87.6)	26.7 (87.6)	23.4 (76.8)	23.4 (76.8)	23.1 (75.8)	Capacitance pF/ft (/m)
Velocity of Propagation (%)	78	76	76	76	76	76	76	76	76	87	87	88	Velocity of Propagation (%)
Dielectric Constant	1.64	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.32	1.32	1.29	Dielectric Constant
Jacket Material	FEP/NMX	FRPVC	FRPVC	FRPVC	FRPVC	FRPVC	FEP	FEP	FEP	PE	PE	PE	Jacket Material
Jacket Dimensions: Inches (mm)	0.650 (16.5)	0.405 (10.3)	0.500 (12.7)	0.590 (15.0)	0.870 (22.1)	1.200 (30.5)	0.370 (9.40)	0.465 (11.8)	0.565 (14.4)	0.590 (15.0)	0.870 (22.1)	1.120 (28.4)	Jacket Dimensions: Inches (mm)
Operating Temp Range: °F (°C)	-67° to +392° (-55° to +200°)	+23° to +167° (-5° to +75°)					-67° to +302° (-55° to +150°)			-40° to +175° (-40° to +85°)			Operating Temp Range: °F (°C)
Bend Radius: Inches (mm)	4 (102)	2 (51)	2.5 (64)	3 (76)	4.5 (114)	6 (152)	2 (51)	2.5 (64)	6 (152)	1.5 (38)	3 (76)	6.5 (165)	Bend Radius: Inches (mm)
Weight: lbs/ft (kg/m)	0.36 (0.54)	0.11 (0.17)	0.19 (0.29)	0.24 (0.36)	0.62 (0.92)	0.70 (1.04)	0.10 (0.15)	0.17 (0.25)	0.21 (0.31)	0.13 (0.20)	0.27 (0.40)	0.45 (0.67)	Weight: lbs/ft (kg/m)

Loss at other Frequencies = [K1 x $\sqrt{F}$] + [K2 x F] F = Frequency in MHz

Notes:

1) power based on 1:1 vswr, sea level, +40°C ambient
2) shields in parallel for Rdc
3) power values are approximations, generally conservative and based on the cable's heat transfer properties
4) BC = bare copper
   TC = tinned copper
   SC = silver plated copper
   ALT = aluminum tape
   PE = solid polyethylene
   PTFE = solid polytetrafluoroethylene
   LDTFE = low density PTFE
   TTFE = taped polytetrafluoroethylene
   FPE = foam polyethylene
   PVC = polyvinyl chloride
   FEP = fluorinated ethylene propylene
   FRPVC = fire retardant PVC
   PE = polyethylene
   ALKP = aluminum-kapton tapes
   FEP/NMX = braided nomex over FEP
5) ~ = Equivalent (copper) AWG based on DC Resistance

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SFT™ Specifications

Physical & Mechanical Specifications

	SFT-316		SFT-142		SFT-205		SFT-304		SFT-393		SFT-226		SFT-600	
Dimensions	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
Center Conductor	0.0226	(0.57)	0.0403	(1.02)	0.0508	(1.29)	0.062	(1.57)	0.096	(2.44)	0.131	(3.33)	0.163	(4.14)
Dielectric	0.068	(1.73)	0.121	(3.07)	0.154	(3.91)	0.185	(4.70)	0.285	(7.24)	0.370	(9.40)	0.455	(11.56)
Inner Shield	0.078	(1.98)	0.131	(3.33)	0.164	(4.17)	0.195	(4.95)	0.295	(7.49)	0.380	(9.65)	0.465	(11.81)
Interlayer	0.083	(1.85)	0.136	(3.48)	0.169	(4.29)	0.200	(5.08)	0.300	(7.62)	0.385	(9.78)	0.470	(11.94)
Outer Shield	0.096	(2.44)	0.158	(4.01)	0.187	(4.75)	0.227	(5.77)	0.319	(8.10)	0.399	(10.14)	0.499	(12.67)
Jacket	0.120	(3.05)	0.180	(4.57)	0.205	(5.21)	0.250	(6.35)	0.390	(9.91)	0.485	(12.32)	0.565	(14.35)
Bend Radius: minimum	0.500	(12.7)	0.750	(19.1)	1.000	(25.4)	1.250	(31.8)	2.000	(50.8)	2.500	(63.5)	3.000	(76.2)
Weight	0.018 lbs/ft	(0.03 kG/m)	0.036 lbs/ft	(0.05 kG/m)	0.042 lbs/ft	(0.06 kG/m)	0.067 lbs/ft	(0.10 kG/m)	0.126 lbs/ft	(0.19 kG/m)	0.235 lbs/ft	(0.35 kG/m)	0.265 lbs/ft	(0.39 kG/m)
Temperature Range	-67°/+392°F (-55°/+200°C)						-67°/+392°F (-55°/+200°C)							

Electrical Specifications

	SFT-316		SFT-142		SFT-205		SFT-304		SFT-393		SFT-226		SFT-600	
Impedance	50 ohms		50 ohms		50 ohms		50 ohms		50 ohms		50 ohms		50 ohms	
Velocity of Propagation	76 %		76 %		76 %		76 %		76 %		76 %		76 %	
Dielectric Constant	1.73		1.73		1.73		1.73		1.73		1.73		1.73	
Shielding Effectiveness	>100 dB		>100 dB		>100 dB		>100 dB		>100 dB		>100 dB		>100 dB	
Time Delay	1.34 nS/ft	(4.39 nS/m)	1.34 nS/ft	(4.39 nS/m)	1.34 nS/ft	(4.39 nS/m)	1.34 nS/ft	(4.39 nS/m)	1.34 nS/ft	(4.39 nS/m)	1.34 nS/ft	(4.39 nS/m)	1.34 nS/ft	(4.39 nS/m)
Capacitance	26.7 pF/ft	(87.7 pF/m)	26.7 pF/ft	(87.7 pF/m)	26.7 pF/ft	(87.7 pF/m)	26.7 pF/ft	(87.7 pF/m)	26.7 pF/ft	(87.7 pF/m)	26.7 pF/ft	(87.7 pF/m)	26.7 pF/ft	(87.7 pF/m)
Inductance	0.067 uH/ft	(0.22 uH/m)	0.067 uH/ft	(0.22 uH/m)	0.067 uH/ft	(0.22 uH/m)	0.067 uH/ft	(0.22 uH/m)	0.067 uH/ft	(0.22 uH/m)	0.067 uH/ft	(0.22 uH/m)	0.067 uH/ft	(0.22 uH/m)
Cutoff Frequency	63 GHz		35 GHz		28 GHz		23 GHz		15 GHz		11 GHz		9.2 GHz	
Voltage Withstand	500 DC		1000 DC		1500 DC		2000 DC		2500 DC		3000 DC		4000 DC	
Peak Power	0.6 kW		2.5 kW		5.6 kW		10 kW		16 kW		22 kW		40 kW	
DC Resistance - ohms	ohms/1000ft	(ohms/km)	ohms/1000ft	(ohms/km)	ohms/1000ft	(ohms/km)	ohms/1000ft	(ohms/km)	ohms/1000ft	(ohms/km)	ohms/1000ft	(ohms/km)	ohms/1000ft	(ohms/km)
Inner Conductor	20.3	(66.6)	6.39	(21.0)	4.02	(13.2)	2.70	(8.9)	1.13	(3.7)	0.63	(2.1)	0.52	(1.7)
Outer Conductor	5.54	(18.2)	3.10	(10.2)	2.43	(8.0)	2.02	(6.6)	1.3	(4.3)	1.04	(3.4)	0.8	(2.6)

Attenuation & Power Handling — Attenuation (+25°C Ambient) & Power Handling (+40°C Ambient; Sea Level; VSWR 1:1)

Frequency (MHz)	SFT-316 dB/100ft	dB/100m	kW	SFT-142 dB/100ft	dB/100m	kW	SFT-205 dB/100ft	dB/100m	kW	SFT-304 dB/100ft	dB/100m	kW	SFT-393 dB/100ft	dB/100m	kW	SFT-226 dB/100ft	dB/100m	kW	SFT-600 dB/100ft	dB/100m	kW
13.56	2.0	7	4.044	1.2	3.8	5.040	1.0	3.2	6.648	0.8	2.5	9.057	0.5	1.7	16.417	0.5	1.5	20.571	0.4	1.2	26.138
30	3.0	10	2.713	1.7	5.7	3.382	1.4	4.7	4.461	1.1	3.8	6.076	0.7	2.5	11.007	0.7	2.2	13.788	0.6	1.8	17.512
100	5.5	18	1.478	3.2	10.4	1.843	2.6	8.6	2.431	2.1	6.9	3.310	1.4	4.5	5.987	1.2	4.1	7.496	1.0	3.4	9.509
150	7	22	1.203	3.9	12.8	1.501	3.2	10.6	1.980	2.6	8.5	2.695	1.7	5.6	4.871	1.5	5.0	6.097	1.3	4.2	7.731
400	11	36	0.730	6.4	20.9	0.912	5.3	17.4	1.202	4.2	13.9	1.635	2.8	9.2	2.948	2.5	8.2	3.686	2.1	6.9	4.665
900	17	55	0.481	9.6	31.6	0.601	8.0	26.2	0.792	6.4	21.0	1.077	4.2	13.9	1.936	3.8	12.5	2.418	3.2	10.5	3.052
1000	18	58	0.455	10.2	33.3	0.569	8.4	27.7	0.750	6.8	22.2	1.020	4.5	14.7	1.832	4.0	13.2	2.288	3.4	11.1	2.887
1500	22	71	0.368	12.5	41.0	0.461	10.4	34.0	0.608	8.3	27.3	0.826	5.5	18.2	1.480	5.0	16.4	1.846	4.2	13.8	2.326
2000	25	82	0.316	14.5	47.4	0.397	12.0	39.5	0.523	9.7	31.7	0.710	6.4	21.1	1.270	5.8	19.1	1.584	4.9	16.1	1.992
3000	31	101	0.255	17.8	58.4	0.320	14.8	48.7	0.422	11.9	39.2	0.573	8.0	26.2	1.022	7.2	23.7	1.272	6.1	20.0	1.597
4000	36	117	0.219	20.7	67.8	0.275	17.2	56.5	0.362	13.9	45.5	0.491	9.3	30.6	0.874	8.4	27.6	1.087	7.1	23.4	1.362
5000	40	131	0.194	23.2	76.1	0.244	19.4	63.5	0.321	15.6	51.2	0.435	10.5	34.5	0.773	9.5	31.2	0.961	8.1	26.5	1.202
6000	44	144	0.175	25.5	83.7	0.221	21.3	69.9	0.291	17.2	56.4	0.394	11.6	38.1	0.698	10.5	34.5	0.868	8.9	29.3	1.084
8000	51	167	0.149	29.6	97.3	0.189	24.8	81.3	0.249	20.1	65.8	0.336	13.6	44.6	0.594	12.3	40.5	0.738	10.5	34.5	0.919
10000	57	187	0.132	33.3	109.4	0.167	27.9	91.5	0.220	22.6	74.2	0.297	15.4	50.5	0.524	14.0	45.9	0.649			
12000	63	205	0.119	36.7	120.4	0.151	30.7	100.9	0.198	25.0	81.9	0.268	17.1	55.9	0.471						
13500	67	218	0.111	39.1	128.2	0.141	32.8	107.5	0.186	26.6	87.3	0.251	18.2	59.8	0.440						
15000	70	231	0.105	41.3	135.6	0.133	34.7	113.7	0.175	28.2	92.5	0.236	19.3	63.5	0.414						
18000	77	253	0.094	45.5	149.4	0.120	38.3	125.5	0.157	31.2	102.2	0.213									
24000	90	295	0.079	53.2	174.5	0.101	44.8	146.8	0.133	36.6	119.9	0.180									
28000	97	319	0.072	57.8	189.7	0.092	48.7	159.8	0.122												
35000	110	359	0.063	65.3	214.2	0.081															
63000	150	492	0.043																		
Attenuation at Frequency	(A=K1 √FMHz + K2 FMHz)									(A=K1 √FMHz + K2 FMHz)											
K1	0.551680			0.315330			0.260980			0.208100			0.135930			0.121830			0.101373		
K2	0.000180			0.000180			0.000180			0.000180			0.000180			0.000180			0.000180		

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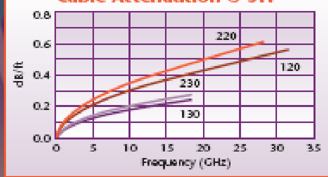
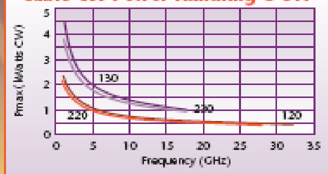
GrooveTube® Low Loss Cables – Series 1 & 2

Lowest Loss – EMC Lab • Low Loss System Connections

Cable Attenuation @ STP



Cable CW Power Handling @ STP



Series 1 & 2 Cable Construction

Inner Conductor	Solid Ag-plated Cu (120 & 130) Stranded Ag-plated Cu (220 & 230)
Dielectric	PTFE
Outer Conductor	Cu GrooveTube®
Outer Jacket	Neoprene over Braid-F (130 & 230) Polyolefin-C (120 & 220) (Other jackets available upon request.)

Standard Connectors

130 & 230: 7mm, 7-16, SMA, TNC, Type N

120 & 220: 2.4mm, 2.92mm, 3.5mm, 7mm, SMA, TNC, Type N

Other connectors available upon request.

Series 1 & 2 Typical Insertion Loss$_{dB}$ = (Attenuation)(Length) + 2(Connector Loss)

Frequency		Attenuation								Conn. Loss dB	SWR
		130		230		120		220			
GHz	Band	dB/ft	dB/m	dB/ft	dB/m	dB/ft	dB/m	dB/ft	dB/m		
0.045	VHF	0.01	0.04	0.01	0.05	0.02	0.07	0.02	0.08	0.01	1.02:1
0.512	UHF	0.04	0.13	0.05	0.15	0.07	0.23	0.08	0.26	0.02	1.04:1
0.900		0.05	0.17	0.06	0.21	0.09	0.30	0.11	0.35	0.02	
1.000	L	0.05	0.18	0.07	0.22	0.10	0.32	0.11	0.36	0.03	1.05:1
1.900		0.08	0.25	0.09	0.30	0.13	0.44	0.15	0.50	0.03	
2.000	S	0.08	0.26	0.09	0.31	0.14	0.45	0.16	0.51	0.04	
3.000		0.10	0.32	0.11	0.37	0.17	0.55	0.19	0.63	0.04	1.10:1
4.000	C	0.11	0.37	0.13	0.43	0.19	0.63	0.22	0.72	0.05	
5.000		0.13	0.41	0.14	0.47	0.21	0.70	0.24	0.80	0.06	
6.000		0.14	0.45	0.15	0.51	0.23	0.76	0.26	0.87	0.06	1.15:1
7.000		0.15	0.49	0.17	0.55	0.25	0.81	0.28	0.93	0.07	
8.000	X	0.16	0.53	0.18	0.59	0.27	0.87	0.32	1.06	0.07	
9.000		0.17	0.56	0.19	0.63	0.28	0.93	0.33	1.09	0.08	
10.000		0.18	0.60	0.20	0.66	0.30	0.98	0.34	1.13	0.08	1.20:1
12.000		0.20	0.66	0.22	0.73	0.33	1.09	0.38	1.24	0.09	
12.400		0.20	0.67	0.23	0.75	0.34	1.11	0.42	1.38	0.09	1.25:1
14.000	Ku	0.22	0.72	0.24	0.80	0.36	1.18	0.44	1.44	0.09	
15.000		0.23	0.74	0.25	0.83	0.37	1.23	0.45	1.48	0.10	
16.000		0.23	0.77	0.26	0.86	0.39	1.27	0.46	1.51	0.10	
18.000		0.25	0.82	0.28	0.91	0.41	1.36	0.47	1.55	0.11	
20.000	K					0.44	1.44	0.50	1.65	0.11	
22.000						0.46	1.52	0.55	1.80	0.12	1.30:1
24.000						0.49	1.59	0.56	1.82	0.12	
26.500						0.51	1.69	0.62	2.03	0.13	1.35:1
28.000	Ka					0.53	1.74			0.13	
30.000						0.55	1.81			0.14	
32.000						0.57	1.88			0.14	1.40:1

Series 1 & 2 Electrical Data

	130	230	120	220
Maximum Frequency	18.0 GHz	18.0 GHz	32.0 GHz	26.5 GHz
Impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal	50 Ω nominal
Propagation Velocity	80% nominal	80% nominal	80% nominal	80% nominal
Time Delay	1.21 ns/ft (3.97 ns/m)	1.21 ns/ft (3.97 ns/m)	1.27 ns/ft (4.17 ns/m)	1.27 ns/ft (4.17 ns/m)
Capacitance	26.7 pF/ft (87.6 pF/m)	26.7 pF/ft (87.6 pF/m)	26.7 pF/ft (87.6 pF/m)	26.7 pF/ft (87.6 pF/m)
Shielding Effectiveness	< -90 dB	< -90 dB	< -90 dB	< -90 dB
Dielectric Constant	1.43	1.43	1.57	1.57
Dielectric Withstdg. Voltage	15 kV at 60 Hz	15 kV at 60 Hz	10 kV at 60 Hz	10 kV at 60 Hz

Series 1 & 2 Mechanical Data

	130	230	120	220
Outer Conductor Diam.	0.307 in (7.8 mm)	0.307 in (7.8 mm)	0.207 in (5.3 mm)	0.207 in (5.3 mm)
Bend Radius	1.00 in (2.54 cm)	1.00 in (2.54 cm)	0.50 in (1.27 cm)	0.50 in (1.27 cm)
Operating Temp. Range	-76 to 347°F (-60 to +175°C)		-76 to 347°F (-60 to +175°C)	
Unjacketed Weight	0.08 lbs/ft (0.12 kg/m)	0.08 lbs/ft (0.12 kg/m)	0.04 lbs/ft (0.06 kg/m)	0.04 lbs/ft (0.06 kg/m)
Max. Assembly Length	25 ft (7.62 m)	25 ft (7.62 m)	25 ft (7.62 m)	25 ft (7.62 m)
Flex. Rating – Highest = 5.0	4.0	5.0	4.0	5.0

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High Performance VNA Test Cable – VN Series

Best Performance – R&D Lab • Highest Precision • Compare Price vs. OEMs

Available Connectors

1.85mm, 2.4mm, 2.92mm, 3.5mm, 7mm, SMA, TNC, Type N

VN Series Insertion Loss$_{dB}$

= (Attenuation)(Length) + 2(Connector Loss)

Frequency		Part No.	Attenuation		Conn. Loss dB	SWR
GHz	Band		dB/ft	dB/m		
0.512	UHF	VN4	0.08	0.27	0.02	1.04:1
0.900			0.11	0.36	0.02	1.05:1
1.000	L		0.12	0.39	0.02	
1.900			0.17	0.56	0.03	1.10:1
2.000	S		0.17	0.57	0.03	
3.000			0.22	0.73	0.04	
4.000	C		0.26	0.86	0.04	1.20:1
6.000		VN8	0.34	1.10	0.06	
8.000	X		0.40	1.31	0.07	1.25:1
10.000		VN18	0.46	1.50	0.08	
12.400			0.53	1.74	0.08	
14.000	Ku		0.58	1.89	0.09	1.30:1
18.000			0.69	2.26	0.11	
20.000	K	VN26	0.74	2.44	0.12	
22.000			0.79	2.61	0.13	
26.500			0.91	2.99	0.15	1.35:1
28.000	Ka	VN40	0.95	3.11	0.16	
30.000			1.00	3.27	0.17	1.40:1
32.000			1.05	3.43	0.18	
38.000			1.19	3.90	0.22	1.45:1
40.000			1.24	4.06	0.25	
50.000	mm	VN50	1.47	4.82	0.37	1.50:1

VN Series Electrical Data

Maximum Frequency	50 GHz
Impedance	50 Ω nominal
Propagation Velocity	69% nominal
Time Delay	1.47 ns/ft (4.82 ns/m)
Capacitance	29.0 pF/ft (95.1 pF/m)

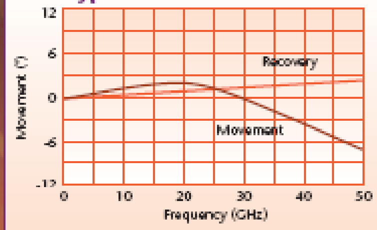
VN Series Mechanical Data

Jacketed Outer Diameter	0.625 in (15.88 mm)
Bend Radius	1.500 in (38.10 mm)
Operating Temperature Range	-76 to 250°F (-60 to +121°C)
Weight	0.175 lbs/ft (0.26 kg/m)
Flexibility Rating – Highest = 5.0	4.0

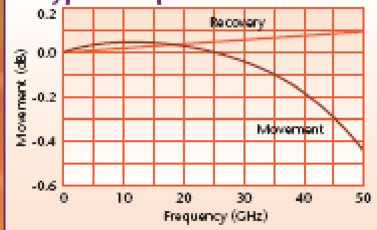
VN Series Cable Construction

Inner Conductor	Solid Ag-plated Cu
Dielectric	PTFE
Outer Conductor	Cu GrooveTube®
Ruggedization	Metal Braid over Metal Armor
Outer Jacket	PET Braid

Typical Phase vs. Flexure



Typical Amplitude vs. Flexure



Cable Attenuation @ STP