

SERIES BNC 75 Ω COAXIAL MINIATURE CONNECTORS

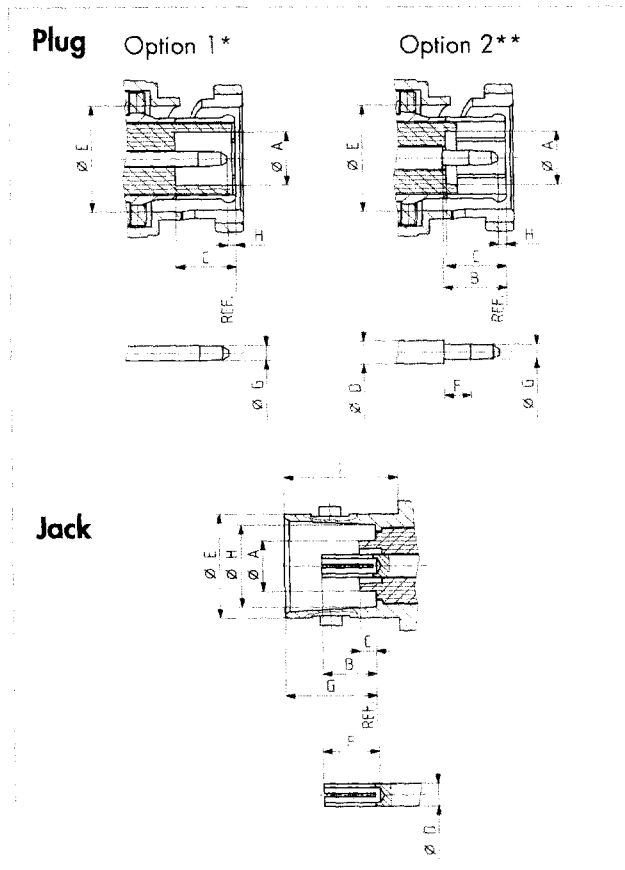
Description

SUHNER BNC Series featuring a two stud bayonet coupling mechanism which is particularly useful for frequently coupled and uncoupled RF connections. Within the internationally standardized BNC mating face dimensions a perfect 75Ω characteristic impedance cannot be realized. However, at frequencies up to 1 GHz the small impedance deviation is negligible for any application. A typical VSWR of 1.15 at 1 GHz is achieved.

Compatibility

All 75Ω BNC connectors and 50Ω connectors are intermateable without any restrictions.

Interface Dimensions



Contents

Page

Description	221
Interface Dimensions	221
Interface Dimensions in mm / inches	221
Standards	221
Technical Data	222
Cable Connectors for Semi-Rigid Cables ...	223
Cable Connectors for Flexible Cables	223
Receptacles with Solder End	231
PCB Connectors	233
Adaptors Within-Series	234
Protective Caps and Shorts	236
Terminations	237

Interface Dimensions in mm / inches

	Plug		Jack	
	min.	max.	min.	max.
A	4.83/.190	—	—	4.72/.186
B	5.33/.210	5.84/.230	4.72/.186	5.23/.206
C	5.28/.208	5.79/.228	1.50/.059 nom.	
D	2.06/.081	2.21/.087	2.06/.081	2.21/.087
E	9.78/.385	9.91/.390	9.60/.378	9.70/.382
F	1.98/.078	—	4.95/.195	—
G	1.32/.052	1.37/.054	8.31/.327	8.51/.335
H	0.08/.003	—	8.10/.319	8.15/.321
I	—	—	10.52/.414	—

* Option 1: with soldered centre contact mainly

** Option 2: with crimped centre contact mainly

Standards

Interface dimensions conform to
IEC 169-8
MIL-STD-348A/301
CECC 22120
BS 9210 N 0004

Technical Data

ELECTRICAL DATA	REQUIREMENTS
Impedance	75 Ω
Frequency range	DC ... 1 GHz (see also Appendix page 436)
RF-leakage (measured at 1 GHz)	≥ 55 dB
Dielectric withstanding voltage (at sea level)	1.5 kV rms, 50 Hz
Working voltage (at sea level)	≤ 500 V rms, 50 Hz
Insulation resistance	≥ 5 · 10 ³ MΩ
Contact resistance	
– centre contact	≤ 1.5 mΩ
– outer contact	≤ 1 mΩ

MECHANICAL DATA	REQUIREMENTS
Coupling nut torque	7 Ncm ... 28 Ncm / 0.6 in.-lbs ... 2.5 in.-lbs
Coupling nut retention force	≥ 450 N / 101.2 lbs
contact captivation	≥ 27 N / 6.1 lbs
Cable retention force ¹⁾	see pages 36 – 41
Durability (matings)	≥ 500

1) value considers maximum load of the cables without irreversible variations of specifications.

ENVIRONMENTAL DATA	TEST CONDITIONS
Temperature range	– 65°C ... + 165°C / – 85°F ... + 329°F
Climatic category acc. to IEC	55/155/21
Thermal shock	MIL-STD-202, Method 107, Condition B
Moisture resistance	MIL-STD-202, Method 106
Corrosion	Saltspray test acc. to MIL-STD-202, Method 101, Condition B
Vibration	MIL-STD-202, Method 204, Condition B
Shock	MIL-STD-202, Method 213, Condition G

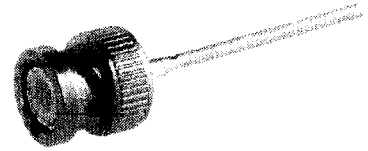
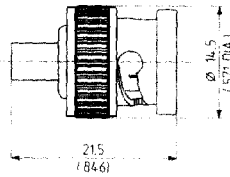
MATERIAL DATA			
CONNECTOR PART	STANDARDS	MATERIAL	SURFACE/PLATING
Bodies	QQ-B-626	brass	SUCOPLATE [®]
Pin contact			gold plated
Socket contact	QQ-C-530	beryllium-copper, hardened	gold plated
Crimp ferrules	SUHNER [®] specification	copper	SUCOPLATE [®]
Insulators	ASTM-D-1457, BS 4271 Grade B	PTFE	
Gaskets	ASTM-M-E 1418 PS 1	silicone rubber	

Some connectors may have a specification that differs from the above mentioned data.

Cable Connectors for Semi-Rigid Cables

straight plugs

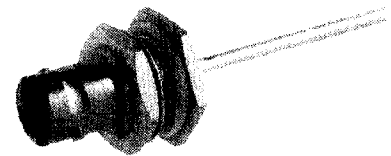
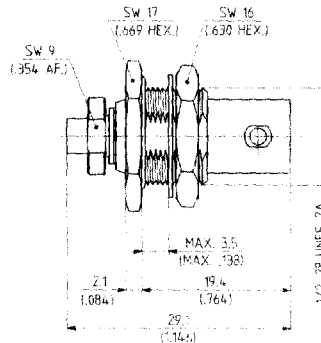
- > cable entry soldered
- > centre contact soldered



SUHNER TYPE	Ident. no.	Cable group (example)	Assembly instruction	Weight	Notes
11 BNC-75-3-26	• 642405	Y6 (EZ 141-75)	9106	9.0 g/.315 oz.	

bulkhead jacks

- > cable entry soldered
- > with panel seal
- > suitable for insulated mounting
- > insulating washers see page 425

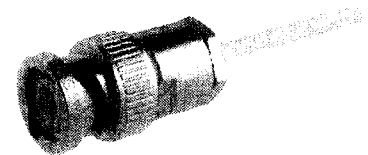
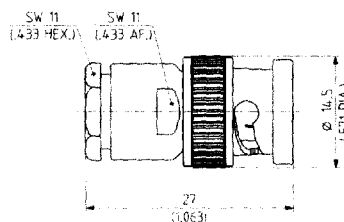


SUHNER TYPE	Ident. no.	Cable group (example)	Assembly instruction	Mounting hole	Weight	Notes
24 BNC-75-3-11	• 642697	Y6 (EZ 141-75)	9005	ML 4	17.0 g/.595 oz.	

Cable Connectors for Flexible Cables

straight plugs

- > cable entry clamp
- > centre contact soldered



SUHNER TYPE	Ident. no.	Cable group (example)	Assembly instruction	Weight	Notes
11 BNC-75-2-1	• 543768	U5 (RG 187 A/U)	3005	18.0 g/.630 oz.	
11 BNC-75-2-12	• 544277	U6 (S 02133)	3005	18.0 g/.630 oz.	

- centre contact captivated

- > cable entry clamp
- > centre contact soldered

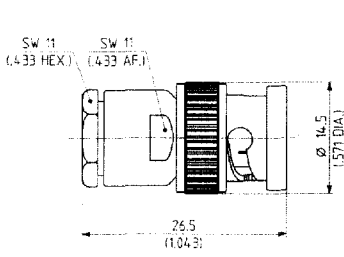


Fig. 1

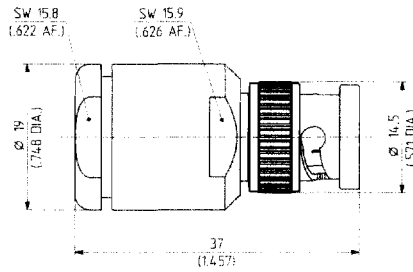
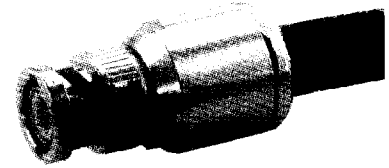


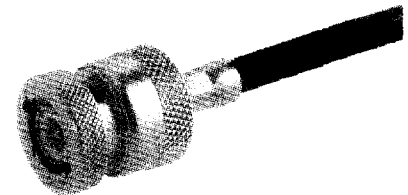
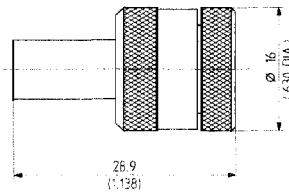
Fig. 2



SUHNER TYPE	Ident. no.	Cable group (example)		Assembly instruction	Weight	Fig.	Notes
11 BNC-75-3-11	● 540711	U14 (G 03233 D)		3005	16.0 g/ .560 oz.	1	
11 BNC-75-4-2	540755	U15 (RG 59 B/U)		3004	16.0 g/ .560 oz.	1	
11 BNC-75-4-3	● 540758	U15 (RG 59 B/U)		3005	16.0 g/ .560 oz.	1	
11 BNC-75-4-5	● 540763	U18 (G 04233 D)		3005	16.0 g/ .560 oz.	1	
11 BNC-75-5-2	● 540794	U21 (G 05273-5)		3005	14.5 g/ .508 oz.	1	
11 BNC-75-7-1	● 540806	U37 (RG 216/U)		3008	37.0 g/ 1.29 oz.	2	
11 BNC-75-7-2	● 540808	U35 (RG 11 A/U)		3008	37.0 g/ 1.29 oz.	2	

straight plug with screw-locking device

- > SUHNER® full crimp
- > taper sleeves see page 423
- > bayonet coupling can be screw locked



SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Weight	Notes
11 BNC-75-4-16	● 540780	U16 (RG 59 B/U)	2 C	3015	17.0 g/ .595 oz.	

- centre contact captivated

straight plugs

- > SUHNER® full crimp
- > taper sleeves see page 423

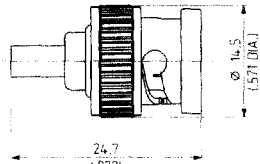
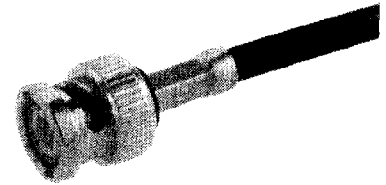


Fig. 1

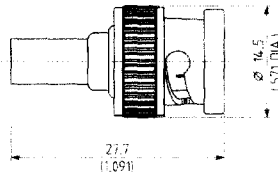


Fig. 2

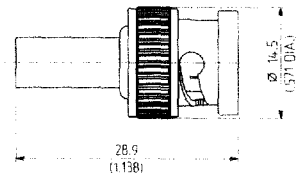


Fig. 3

SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Weight	Fig.	Notes
11 BNC-75-2-15	• 641685	U5 (RG 187 A/U)	1 A	9068	10.0 g/.350 oz.	1	
11 BNC-75-2-21	• 644358	R6 (G02133D-05)	1/4.95	27001	10.0 g/.350 oz.	2	
11 BNC-75-3-8	• 540707	U12 (G 03233)	2 B	3015	10.5 g/.368 oz.	3	
11 BNC-75-3-9	• 540709	U14 (G 03233 D)	2 B	3015	10.5 g/.368 oz.	3	
11 BNC-75-4-4	• 540761	U16 (RG 59 B/U)	2 C	3015	11.0 g/.385 oz.	3	
11 BNC-75-4-6	• 540765	U18 (G 04233 D)	2 C	3015	11.0 g/.385 oz.	3	
11 BNC-75-4-30	• 544636	U17 (S 04233)	2 C	3015	11.0 g/.385 oz.	3	
11 BNC-75-5-6	• 540799	U24 (G 05133 D)	*	3015	11.0 g/.385 oz.	3	* 76 Z-0-5-21
11 BNC-75-5-7	• 540800	U21 (G 05273-5)	*	3015	11.0 g/.385 oz.	3	* 76 Z-0-5-21

- > SUHNER® full crimp
- > taper sleeves see page 423

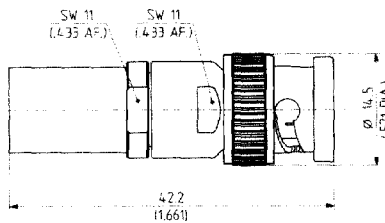
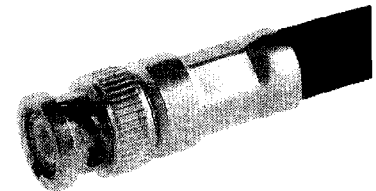


Fig. 1

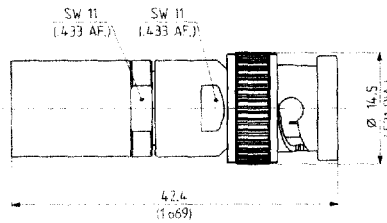


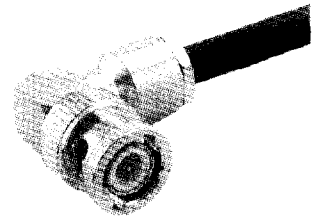
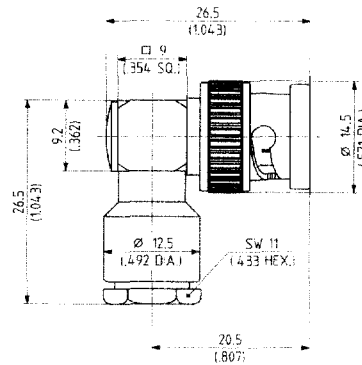
Fig. 2

SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Weight	fig.	Notes
11 BNC-75-6-2	• 540802	U26 (G 06133-6)	*	9030	20.0 g/.700 oz.	1	* 76 Z-0-6-21
11 BNC-75-7-5	• 540811	U34 (RG 11 A/U)	2 D	9120	20.0 g/.700 oz.	2	
11 BNC-75-7-6	• 543960	U36 (RG 216/U)	2 D	9120	20.0 g/.700 oz.	2	

- centre contact captivated

right angle plug

> cable entry clamp



SUHNER TYPE	Ident. no.	Cable group (example)	Assembly instruction	Weight	Notes
16 BNC-75-4-2	● 540836	U15 (RG 59 B/U)	3024	24.0 g/ .840 oz.	

> cable entry crimp

> centre contact soldered

> taper sleeves see page 423

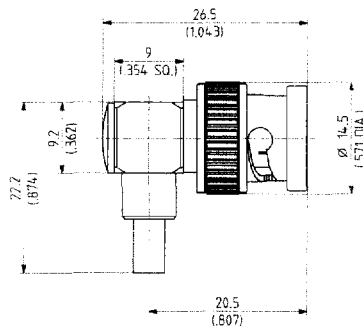


Fig. 1

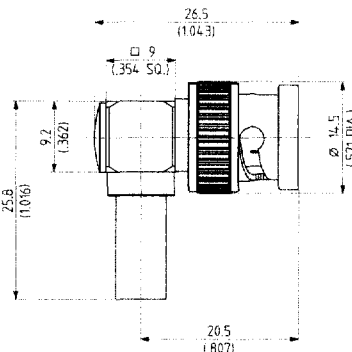
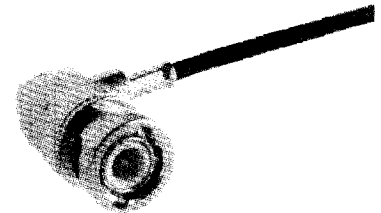


Fig. 2



SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Weight	Fig.	Notes
16 BNC-75-2-3	● 540820	U5 (RG 187 A/U)	A	3079	17.0 g/ .595 oz.	1	
16 BNC-75-3-3	● 543780	U12 (G 03233)	B	3058	17.5 g/ .613 oz.	2	
16 BNC-75-3-4	● 543781	U14 (G 03233 D)	B	3058	17.5 g/ .613 oz.	2	
16 BNC-75-4-4	● 540840	U16 (RG 59 B/U)	C	3058	17.5 g/ .613 oz.	2	
16 BNC-75-4-5	● 540842	U18 (G 04233 D)	C	3058	17.5 g/ .613 oz.	2	

● centre contact captivated

straight jacks

- > SUHNER® full crimp
- > taper sleeves see page 423

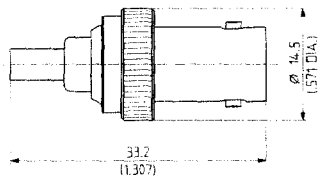


Fig. 1

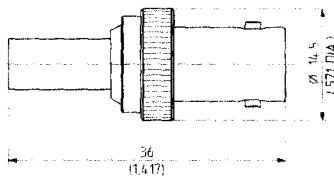
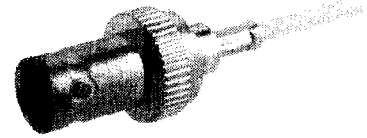


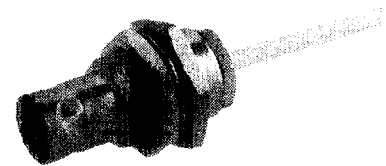
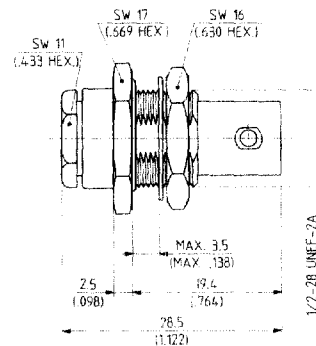
Fig. 2



SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Weight	Fig.	Notes
21 BNC-75-2-5	● 641780	U5 (RG 187 A/U)	1 A	9068	13.5 g/.473 oz.	1	
21 BNC-75-3-4	● 540859	U12 (G 03233)	2B	3015	14.0 g/.490 oz.	2	
21 BNC-75-3-5	● 540861	U14 (G 03233 D)	2B	3015	14.0 g/.490 oz.	2	
21 BNC-75-4-4	● 540872	U16 (RG 59 B/U)	2C	3015	14.0 g/.490 oz.	2	
21 BNC-75-4-5	● 540874	U18 (G 04233 D)	2C	3015	14.0 g/.490 oz.	2	

straight bulkhead jacks

- > cable entry clamp
- > centre contact soldered
- > with panel seal
- > suitable for insulated mounting
- > insulating washers see page 425



SUHNER TYPE	Ident. no.	Cable group (example)	Assembly instruction	Mounting hole	Weight	Notes
24 BNC-75-2-1	● 540909	U5 (RG 187 A/U)	3005	ML 4	21.5 g/.753 oz.	
24 BNC-75-4-2	● 540928	U15 (RG 59 B/U)	3005	ML 4	19.0 g/.665 oz.	

- centre contact captivated

- > SUHNER® full crimp
- > with panel seal
- > suitable for insulated mounting
- > insulating washers see page 425
- > taper sleeves see page 423

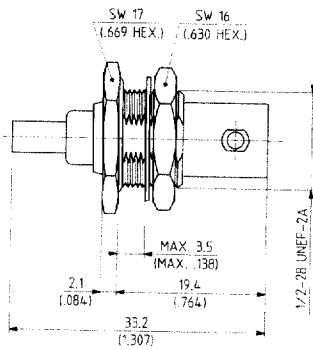


Fig. 1

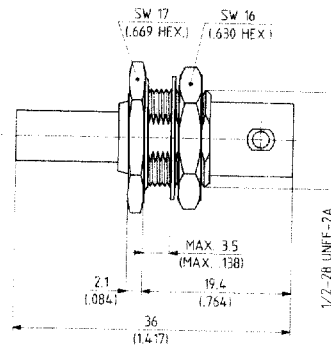
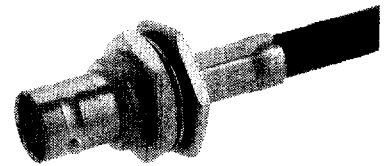


Fig. 2



SUHNER TYPE	Ident. no	Cable group (example)	Crimp insert	Assembly instruction	Mounting hole	Weight	Fig.
24 BNC-75-2-6	● 641786	U5 (RG 187 A/U)	1 A	9068	ML 4	17.0 g/ .595 oz.	1
24 BNC-75-3-4	● 540917	U12 (G 03233)	2 B	3015	ML 4	17.5 g/ .613 oz.	2
24 BNC-75-3-5	● 540920	U14 (G 03233 D)	2 B	3015	ML 4	17.5 g/ .613 oz.	2
24 BNC-75-4-3	● 540930	U16 (RG 59 B/U)	2C	3015	ML 4	18.0 g/ .630 oz.	2
24 BNC-75-4-4	● 540932	U18 (G 04233 D)	2C	3015	ML 4	18.0 g/ .630 oz.	2
24 BNC-75-4-15	● 641769	U17 (S 04233)	2C	3015	ML 4	18.0 g/ .630 oz.	2
24 BNC-75-5-3	● 540942	U24 (G 05133 D)	*	3015	ML 4	18.0 g/ .630 oz.	2

*76 Z-0-5-21

- centre contact captivated

straight panel jacks

- > cable entry clamp
- > centre contact soldered
- > fastening screws see page 424

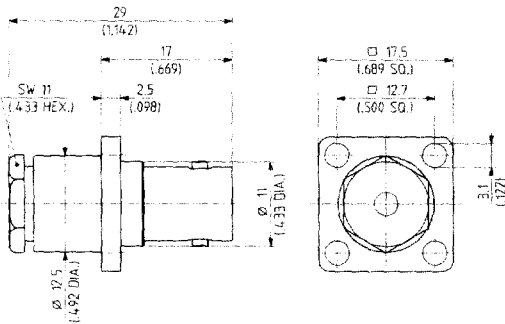
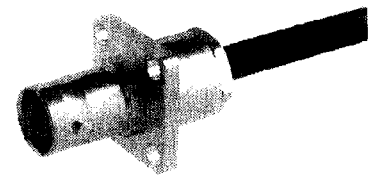


Fig. 1

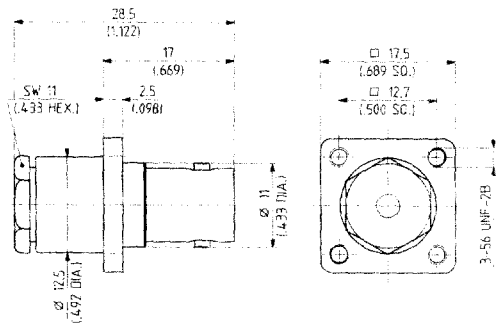
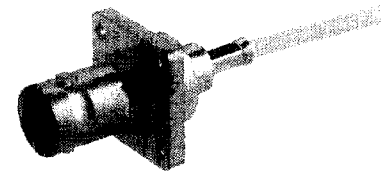


Fig. 2

SUHNER TYPE	Ident. no.	Cable group (example)	Assembly instruction	Mounting hole	Weight	Fig.
25 BNC-75-2-1	● 540947	U5 (RG 187 A/U)	3005	ML 8	19.5 g/.682 oz.	1
25 BNC-75-4-2	● 540975	U15 (RG 59 B/U)	3005	ML 8	18.0 g/.630 oz.	2 *

* mounting also possible with screws ISO M 2.5

- > SUHNER® full crimp
- > fastening screws see page 424
- > taper sleeves see page 423



BNC 75

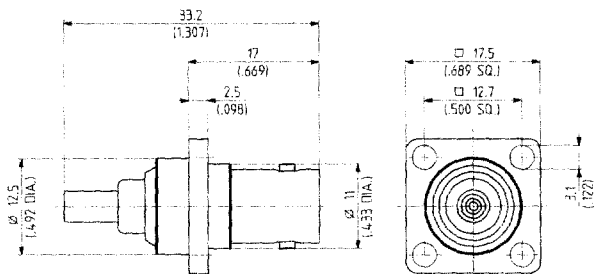


Fig. 1

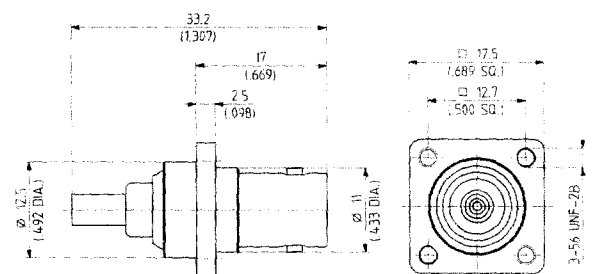


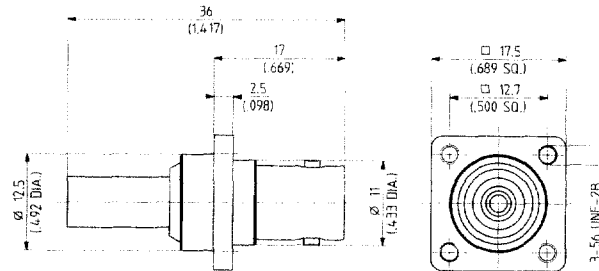
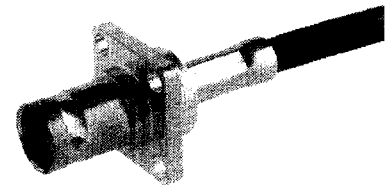
Fig. 2

SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Mounting hole	Weight	Fig.
25 BNC-75-2-7	● 641790	U5 (RG 187 A/U)	1 A	9068	ML 8	16.5 g/.578 oz.	1
25 BNC-75-2-8	● 641791	U5 (RG 187 A/U)	1 A	9068	ML 8	16.5 g/.578 oz.	2 *

* mounting also possible with screws ISO M 2.5

- centre contact captivated

- > SUHNER® full crimp
- > fastening screws see page 424
- > taper sleeves see page 423



SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Mounting hole	Weight	Notes
25 BNC-75-3-7	● 540959	U14 (G 03233 D)	2 B	3015	ML 8	17.0 g/.595 oz.	*

* mounting also possible with screws ISO M 2.5

- > SUHNER® full crimp
- > fastening screws see page 424
- > taper sleeves see page 423

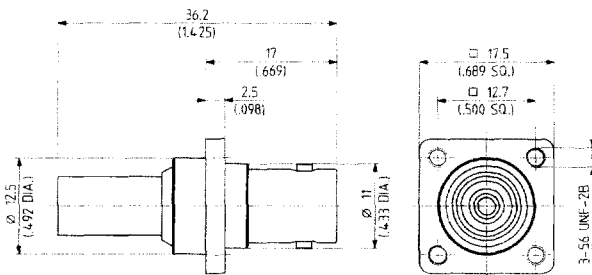
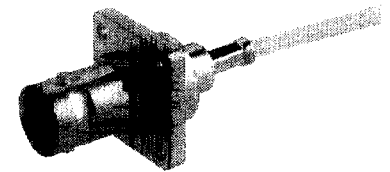


Fig. 1

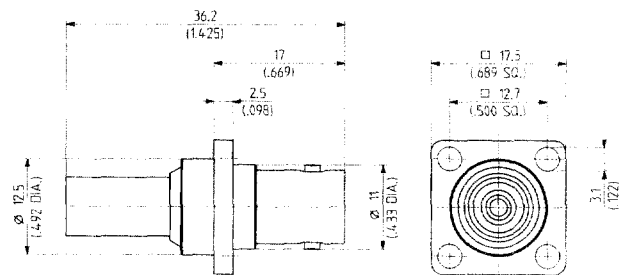


Fig. 2

SUHNER TYPE	Ident. no.	Cable group (example)	Crimp insert	Assembly instruction	Mounting hole	Weight	Fig.
25 BNC-75-4-8	● 540982	U16 (RG 59 B/U)	2 C	3015	ML 8	17.0 g/.595 oz.	1 *
25 BNC-75-4-9	● 540984	U16 (RG 59 B/U)	2 C	3015	ML 8	17.0 g/.595 oz.	2

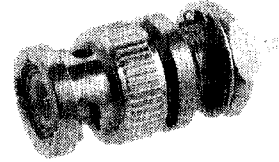
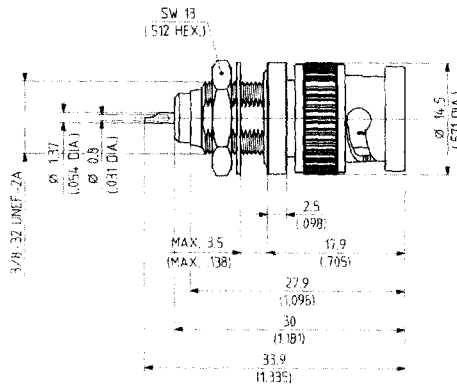
* mounting also possible with screws ISO M 2.5

- centre contact captivated

Receptacles with Solder End

receptacle, male

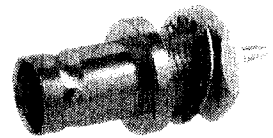
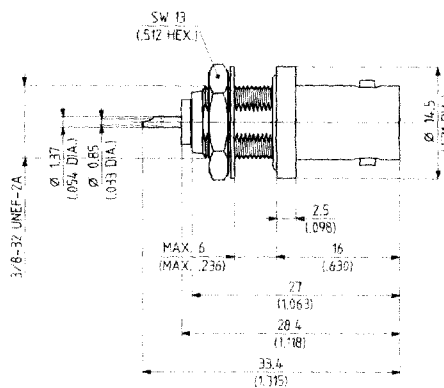
- > bulkhead mounted
- > with panel seal
- > solder tags see page 426
- > insulating washers see page 425



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
12 BNC-75-0-1	• 540814	ML 2	16.5 g/ .578 oz.	suitable for insulated mounting

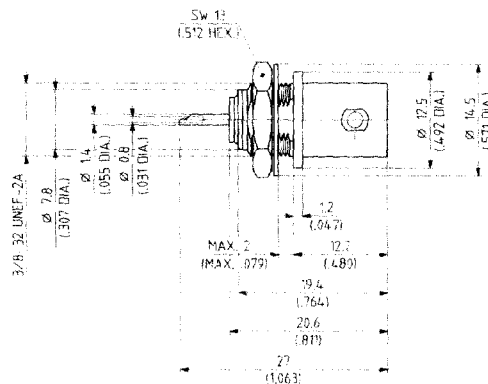
receptacles, female

- > bulkhead mounted
- > with panel seal
- > solder tags see page 426
- > insulating washers see page 425



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
22 BNC-75-0-1	• 540883	ML 1	11.5 g/ .403 oz.	suitable for insulated mounting

- > bulkhead mounted
- > solder tags see page 426
- > insulating washers see page 425



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
22 BNC-75-0-4	• 540889	ML 2	8.0 g/ .280 oz.	suitable for insulated mounting

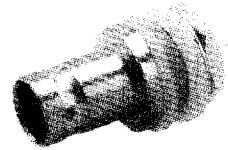
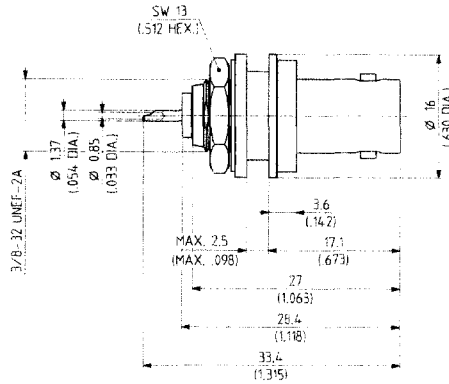
• centre contact captivated

cable groups see pages 36

assembly tools see page 403

mounting holes see page 441

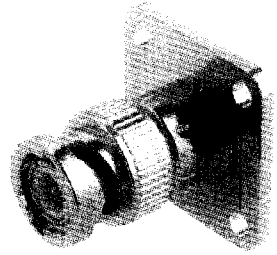
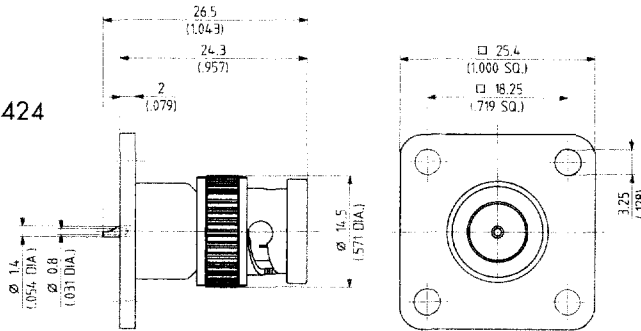
- > bulkhead mounted
- > solder tags see page 426
- > suitable for insulated mounting



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
22 BNC-75-0-2	• 540891	ML 102	12.0 g/.420 oz.	insulated mounting / equipped with insulating washers 77 Z-0-0-2 (not protected against rotation)

receptacle, male

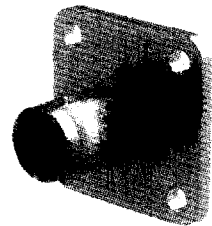
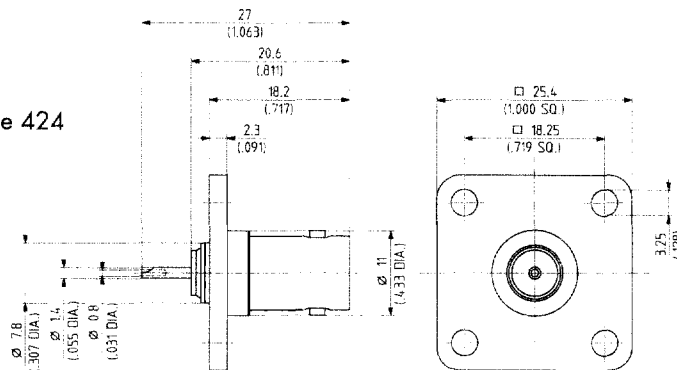
- > panel mounted
- > fastening screws see page 424



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
13 BNC-75-0-2	• 540817	ML 5	21.0 g/.735 oz.	suitable for SUCOBOX® applications, see page 428

receptacles, female

- > panel mounted
- > fastening screws see page 424



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
23 BNC-75-0-7	• 540900	ML 5	17.0 g/.595 oz.	suitable for SUCOBOX® applications, see page 428

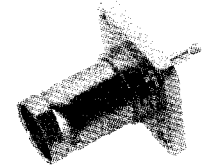
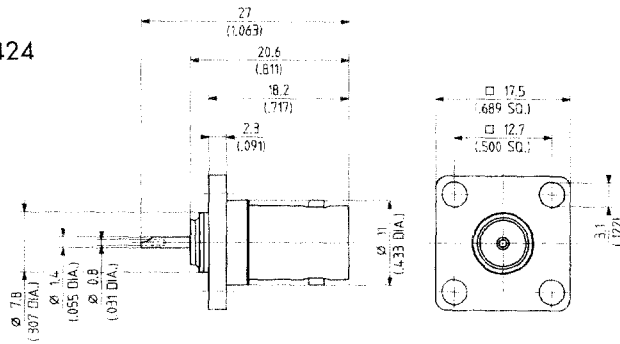
• centre contact captivated

cable groups see page 36

assembly tools see page 403

mounting holes see page 441

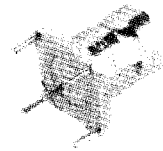
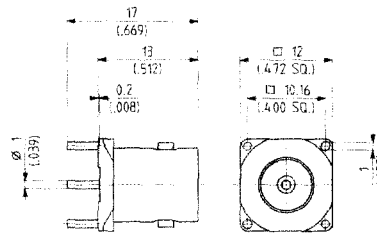
- > panel mounted
- > fastening screws see page 424



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
23 BNC-75-0-10	• 540906	ML 6	11.0 g/.385 oz.	

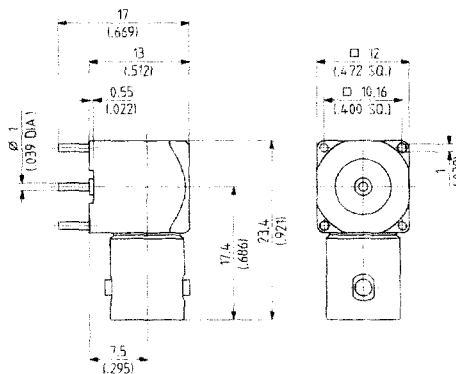
PCB Connectors

straight PCB jack



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
82 BNC-75-0-2	643586	ML 49	5.49 g/.189 oz.	

right angle PCB jack



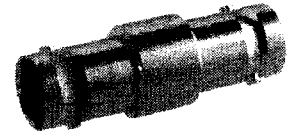
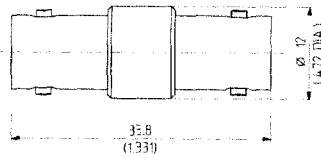
SUHNER TYPE	Ident. no.	Mounting hole	Weight	Notes
85 BNC-75-0-1	641623	ML 49	15.5 g/.543 oz.	

- centre contact captivated

Adaptors Within-Series

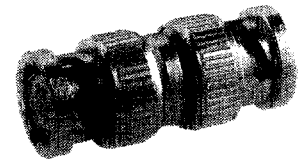
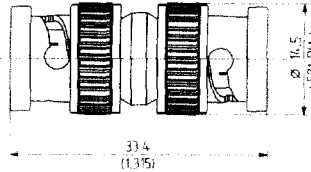
straight adaptors

> jack to jack



SUHNER TYPE	Ident. no.	Weight	Notes
31 BNC-75-0-1	• 541003	13.0 g / .455 oz.	

> plug to plug



SUHNER TYPE	Ident. no.	Weight	Notes
32 BNC-75-0-1	• 541016	20.0 g / .700 oz.	

> jack to jack
> bulkhead mounted

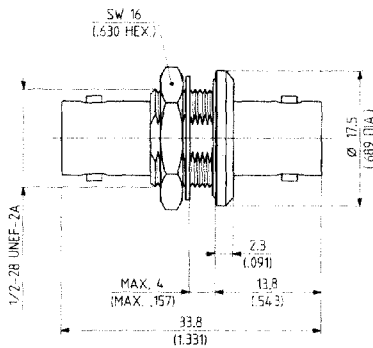


Fig. 1

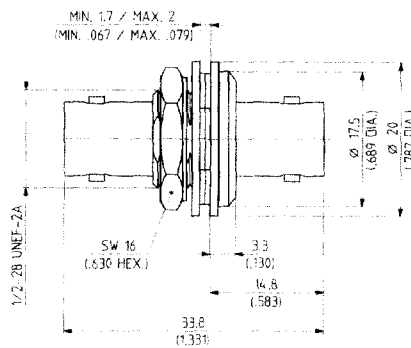
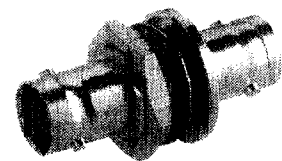


Fig. 2



SUHNER TYPE	Ident. no.	Mounting hole	Weight	Fig.	Notes
34 BNC-75-0-1	• 541040	ML 4	18.0 g / .630 oz.	1	with panel seal
34 BNC-75-0-2	• 541042	ML 22	18.5 g / .648 oz.	2	for insulated mounting / equipped with insulating washers 77 Z-0-0-12 (protected against rotation)

• centre contact captivated

- > jack to jack
- > panel mounted
- > fastening screws see page 424

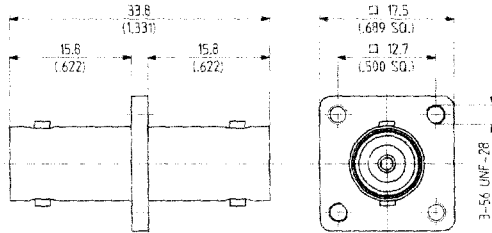
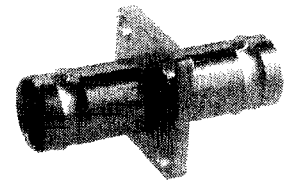


Fig. 1

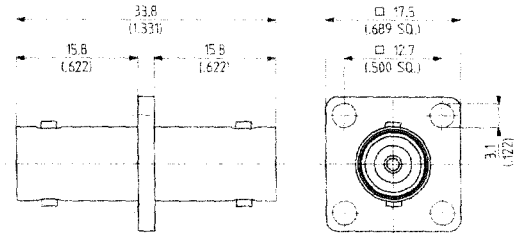
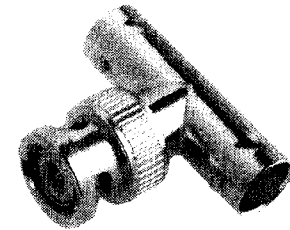
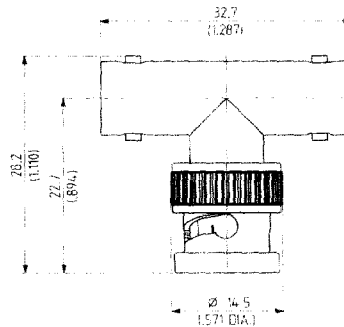


Fig. 2

SUHNER TYPE	Ident. no.	Mounting hole	Weight	Fig.	Notes
37 BNC-75-0-1	• 541045	ML 10	14.0 g / .490 oz.	1	mounting also possible with screws ISO M 2.5
37 BNC-75-0-2	• 541047	ML 10	13.5 g / .473 oz.	2	

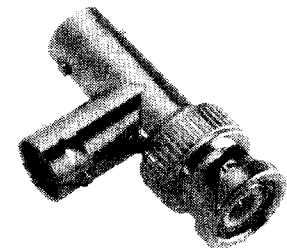
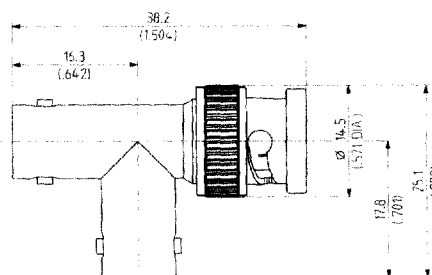
T-adaptors

- > 2 jacks, 1 plug



SUHNER TYPE	Ident. no.	Weight	Notes
43 BNC-75-0-1	• 541049	19.0 g / .665 oz.	

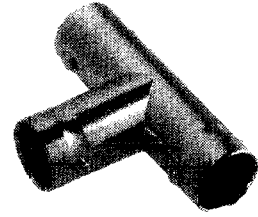
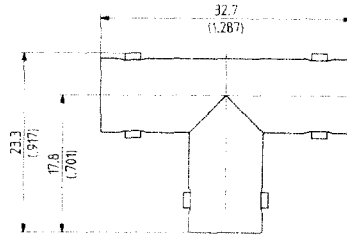
- > 2 jacks, 1 plug



SUHNER TYPE	Ident. no.	Weight	Notes
45 BNC-75-0-1	• 541050	18.5 g / .648 oz.	

- centre contact captivated

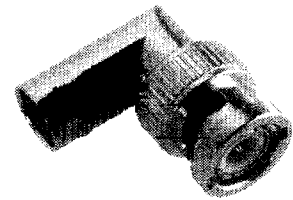
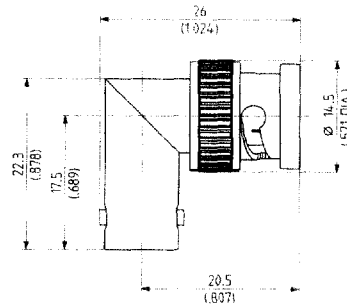
> 3 jacks



SUHNER TYPE	Ident. no.	Weight	Notes
46 BNC-75-0-1	• 541053	12.5 g/.438 oz.	

right angle adaptor

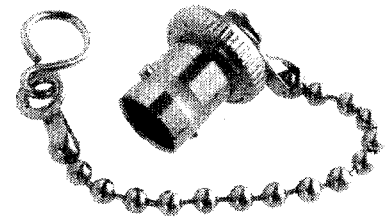
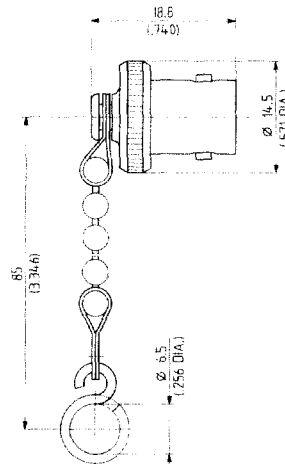
> plug to jack



SUHNER TYPE	Ident. no.	Weight	Notes
53 BNC-75-0-1	• 541055	16.5 g/.578 oz.	

Protective Caps and Shorts

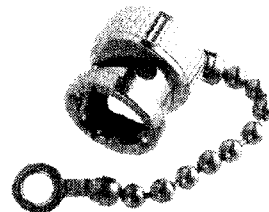
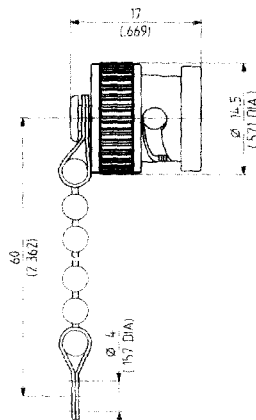
> protective cap for plugs



SUHNER TYPE	Ident. no.	MIL M	Weight	Notes
61 BNC-0-0-1	540660	39012/ 25-0008	9.0 g/.315 oz.	replaces CW 282/U

• centre contact captivated

> protective cap for jacks



SUHNER TYPE	Ident. no.	MIL M 39012/	Weight	Notes
62 BNC-0-0-1	540666	25-0006	8.5 g/.298 oz.	replaces CW 123/U

> protective caps for jacks

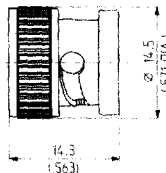
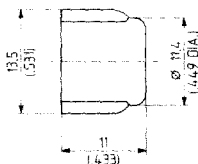


Fig. 1

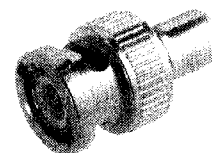
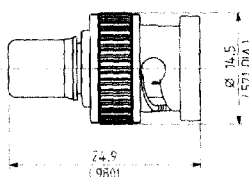
Fig. 2

SUHNER TYPE	Ident. no.	MIL M 39012/	Weight	Fig.	Notes
62 BNC-0-0-2	540667		0.4 g/.014 oz.	1	made of plastic
62 BNC-0-0-3	540669	25-0015	6.5 g/.228 oz.	2	replaces CW 155/U

Terminations

plug

0.5 Watt, DC – 1 GHz



SUHNER TYPE	Ident. no.	Impedance	VSWR 300 MHz	1 GHz	Power ¹⁾	Weight
65 BNC-75-0-7	650006	75Ω ± 1.5Ω	≤ 1.05	≤ 1.1	0.5 Watt	12.0 g/.420 oz.

1) at max. 30°C / 86°F ambient temperature, derated linearly to zero power at 130°C / 266°F

plugs

1 Watt, DC – 2 GHz

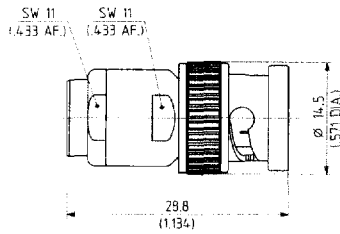


Fig. 1

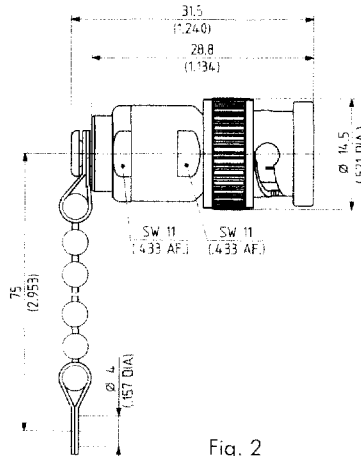
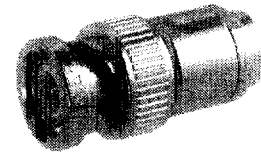


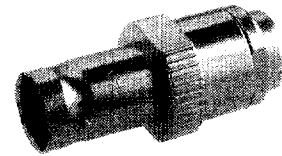
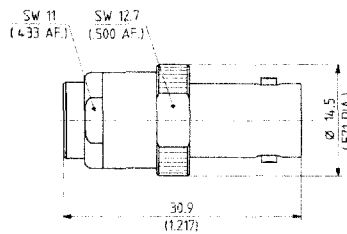
Fig. 2



SUHNER TYPE	Ident. no.	Impedance	VSWR			Power ¹⁾	Weight	Fig.
			1 GHz	1.5 GHz	2. GHz			
65 BNC-75-0-1	550055	75Ω ± 1.5Ω	≤ 1.1			1 Watt 800W peak ²⁾	14.0 g / .490 oz.	1
65 BNC-75-0-2	550058	75Ω ± 1.5Ω	≤ 1.1			1 Watt 800W peak ²⁾	16.0 g / .560 oz.	2

jack

1 Watt, DC – 2 GHz



SUHNER TYPE	Ident. no.	Impedance	VSWR			Power ¹⁾	Weight
			1 GHz	1.5 GHz	2. GHz		
65 BNC-75-0-31	550036	75Ω ± 1.5Ω	≤ 1.1			1 Watt 800W peak ²⁾	16.0 g / .560 oz.

1) at max. 30°C / 86°F ambient temperature, derated linearly to zero power at 130°C / 266°F

2) pulsed power with a duration of ≤ 10 ns, rise time ≥ 5 ns