Non-Magnetic Connectors

RADIALL
The next conneXion

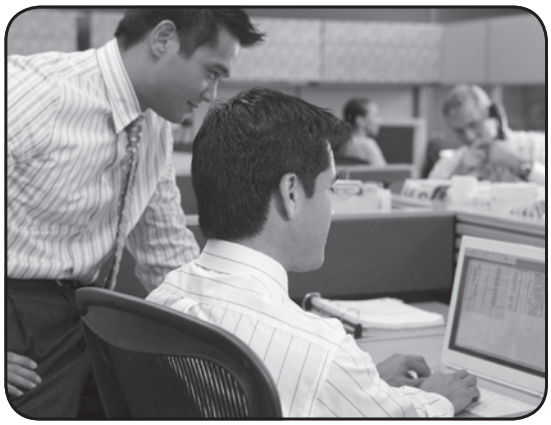
CONTENTS

Radiall . . . The Best Choice for Non-Magnetic Connectivity Solutions

We Know Your Market

We offer a range of non-magnetic RF connectors and cable assemblies for medical and space applications.

Why Radiall Is Your Best Choice



- Collaboration: We work closely with your engineers to understand your business, your technical needs, and your budgetary issues.
- High Performance, Competitively Priced Products: Our connectivity solutions give you the best combination of performance and value.
- Wide Product Range: We manage our product lines through the entire lifecycle, in order to offer you a wide selection of standard products at an affordable price.
- Global Presence: We're everywhere you need us, with worldwide sales, engineering support, R&D in North America, Europe, and Asia, and manufacturing facilities strategically located in the United States, Mexico, France, India, and China to provide on-demand cable assemblies.
- Responsive Support and Service: From the design stage, planning to post-installation support, we're with you at every step, whether you need sales support or engineering expertise.
- Warranty: We stand behind our products.

Certifications and Environmental

Radiall is ISO 9001:2008 certified and dedicated to continuous improvement programs that have resulted in also being AS9100, TS16949, and ISO 14001 certified. In addition, Radiall is committed to investing in its people, future technologies, and the environment, such as being RoHS (Restriction of Hazardous Substances) and REACH (Registration, Evaluation, Authorization and Restriction of Chemical Substances) compliant.

The Best Manufacturing and Process Technologies

Our dedication to innovation and continuous improvement in leading-edge products means we excel in the techniques to create them:

- High precision machining: metal stamping, milling, turning, and cutting
- Molding, polishing
- Laser, ultrasonic, and vapor soldering
- Plating and plastic metallization
- Automatic assembly
- Characterization
- Test and measurement
- Cable and PTFE wrapping
- Thin- and thick-film processes

NON-MAGNETIC CONNECTOR FAMILIES

Radiall offers a growing range of non-magnetic connectors for medical, space, and other applications that includes MMCX, MCX, SMP, and SMB interfaces. To guarantee an exceptional non-magnetism level and repeatability, each non-magnetic connector is manufactured through a strictly controlled production process according to our quality assurance procedures.

For space applications, such as satellites used for scientific exploration, we offer an extensive range of SMA products, fully ESA qualified, meeting the residual magnetism required by the ESCC 3402 generic specification and the ESCC 3402/001, 002, and 003 detail specifications. Connectors are made of beryllium copper, with gold plating and copper underplating.

NEW NON-MAGNETIC MCX SERIES

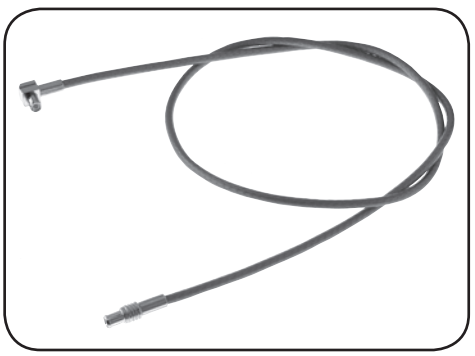
Radiall has expanded our range of non-magnetic connectors with the non-magnetic MCX series. These connectors meet the need for smaller interconnections in space-limited MRI equipment, such as those for head, shoulder, or foot. With more reliable connections through superior performance, the reinforced connection system eliminates the risk of perturbation in image quality.

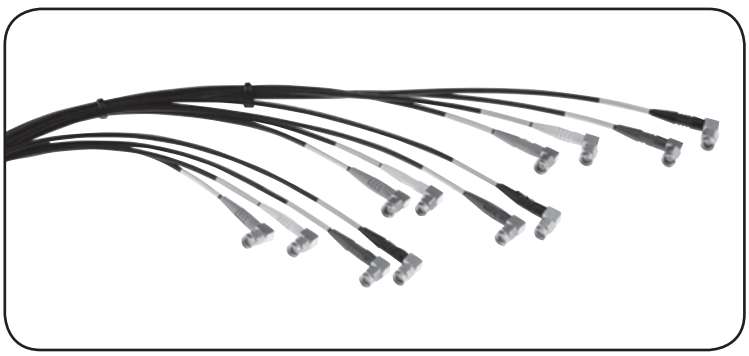
The non-magnetic MCX family also includes a new full-detent cable version, which has been tested in high-vibration conditions, that eliminates intermittent connections. It complies with MIL-STD-202, Method 204, Condition D for vibration testing.

Non-magnetic MCX connectors are available in a wide range of configurations for:

- Board-to-board connections
- Cable-to-board connections
- Cable-to-cable connections

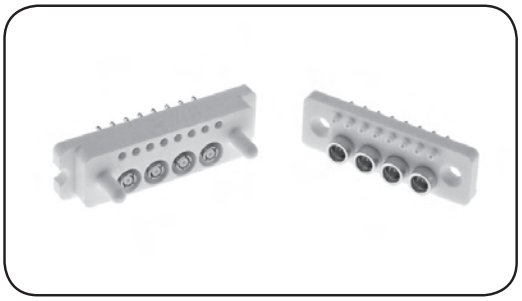
NON-MAGNETIC CABLE ASSEMBLIES

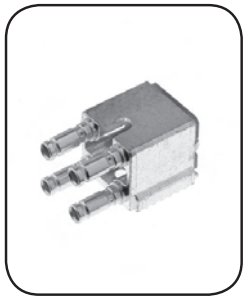


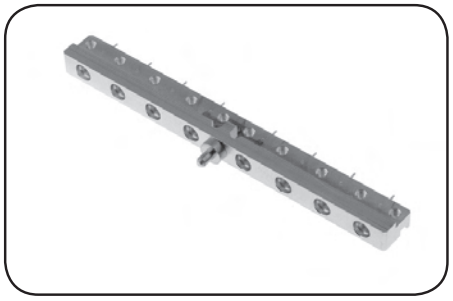


Radiall offers non-magnetic cable assemblies that provide a totally non-magnetic solution to reduce the risk of perturbation while working inside the B_0 magnetic field. Non-magnetic cables are available in RG/316, RG/178 flexible or .085" and .141" semi-rigid styles.

INTRODUCTION







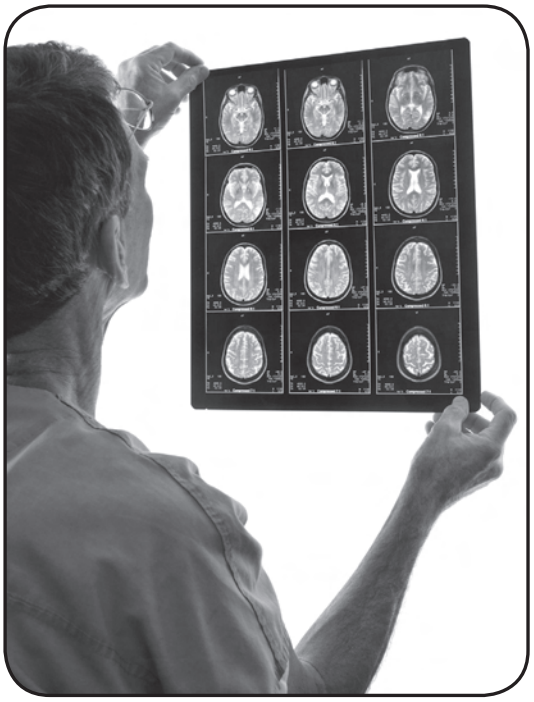
CUSTOM PRODUCTS

We are continually developing new non-magnetic products, including high-density, multiposition configurations.

Multi-port connectors: We offer a wide variety of solutions for high-density coaxial contacts based on the standard SMP, Coaxipack 2, SMB and SMA ranges with additional multiple DC contacts. Our expertise and extensive knowledge in RF coaxial connector and cable assembly technology allows us to offer superior technical project support including those projects that need new coaxial connections developed. Multi-port connectors offer the advantage of having only one connector instead of several separate connectors to mate and unmate.

NON-MAGNETIC RF CONNECTORS FOR MEDICAL

Non-magnetic coaxial connectors are used primarily inside MRI and other medical imaging equipment. Magnetic resonance imaging produces high-resolution cross-sectional images of the inside of the human body by exploiting radio frequency (RF) pulses. MRI technology has seen tremendous improvements in recent years with continued advances in technology, a small part of which is due to coaxial non-magnetic connectors.



MRI medical equipment consists of a large magnet or electromagnet to create an intense and homogenous magnetic field (0.3 to 7 T) that surrounds the patient, “gradient coils” to position the area under analysis, and two high-frequency coils. One coil transmits RF pulses of 20 to 300 MHz to excite the atomic nucleus in the area under analysis. The other coil receives a signal that constitutes the image after excitation. The output is sent to a computer for processing and display.

The quality of the picture depends mainly on the homogeneity of the magnetic field and on the signal-to-noise ratio. To avoid any interference in the field homogeneity, coaxial connectors and cables located in the magnetic field to connect the coils should be transparent relative to the field, which means their relative permittivity μ_r should be equal to 1.

High-quality non-magnetic connectors have extremely low magnetic susceptibility so that they are not magnetized by the fields created in the equipment.

RADIALL NON-MAGNETIC CONNECTORS

Radiall connectors are specified for coils because they are manufactured with materials especially adapted to non-magnetism (with relative permittivity μr close to 1). Each rod of raw material is selected based on a direct measurement with a vibrant magnetometer, with the highest quality of surface plating such as BBR (Bright Bronze Radiall), GBR (Golden Bronze Radiall) or NPGR (gold plated over a non-magnetic nickel phosphorous).

Our non-magnetic connectors have a susceptibility of around 10^{-5}, as opposed to 10^{-2} for standard connectors made of brass/nickel materials. As a result, our non-magnetic connectors are transparent to the magnetic field, which means no field distortion, a higher SNR, and higher quality images.

Performance of Radiall non-magnetic RF connectors

Table of distortion comparison

	Distortion at 10 mm $\Delta H/H_{ext}$ with B_0=1.5 Tesla	Magnetic susceptibility χ
Radiall non-magnetic connector	$\leq 5.10^{-7}$	$\approx 10^{-5}$
Standard non-magnetic connector	$\approx 10^{-5}$	$\approx 10^{-3}$
Brass/nickel connector	$\approx 10^{-4}$	$\approx 10^{-2}$

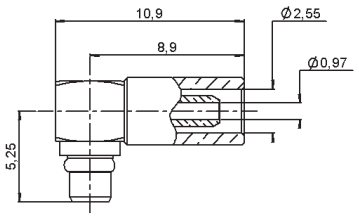
The relative distortion of a magnetic field of 1.5 T, generated by Radiall non-magnetic connectors is only 5.10^{-7} maximum, at a distance of 10 mm from the surface of the connector. Furthermore, they meet the electrical and mechanical characteristics required for any reliable coaxial connector. In addition, these connectors are extremely durable for medical applications.

Manufacturing

Manufacturing a Radiall non-magnetic connector involves a special “clean room” environment where all precautions are taken to avoid any contact with ferromagnetic materials during the machining and cleaning process. Radiall follows strict manufacturing guidelines through a quality assurance plan whose documented rules are enforced throughout the production line. This quality assurance procedure guarantees the highest level of non-magnetism and repeatability for all Radiall non-magnetic connectors.

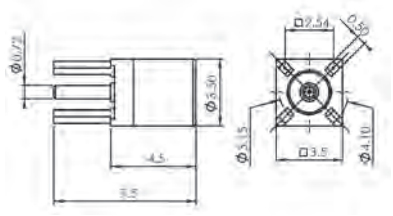
MMCX PLUG AND PCB RECEPTACLE

RIGHT-ANGLE PLUG CRIMP TYPE FOR FLEXIBLE CABLE



Cable type	Cable group dia.	Part number	Captive center contact	Body material	Finish
RG-178 Non-magnetic cable	2/50/S	R110 170 147	Yes	Non-magnetic bronze	BBR

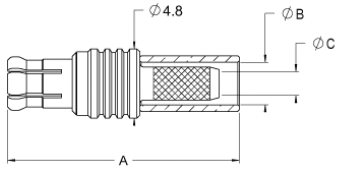
STRAIGHT PCB RECEPTACLE



Part number	Captive center contact	Panel drilling	Body material
R110 426 107	Yes	P01	Non-magnetic bronze

MCX PLUG

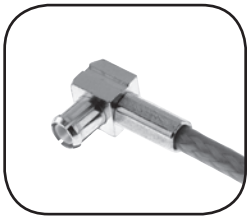
STRAIGHT PLUG CRIMP TYPE FOR FLEXIBLE CABLE

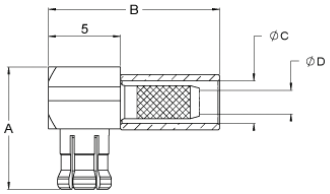


Cable type	Cable group dia.	Part number	Dimensions (mm)			Note	Finish
			A	B	C		
RG-178	2/50/S	R113 081 097	16.1	2.55	1.1	—	BBR
RG-316	2.6/50/S	R113 082 097	16.1	2.95	1.65	—	
RG-316	2.6/50/S	R299 122 097	16.1	2.95	1.65	Full detent	

PRODUCT SPECIFICATION: please refer to the standard range

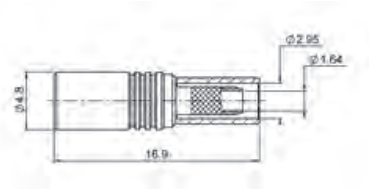
RIGHT-ANGLE PLUG CRIMP TYPE FOR FLEXIBLE CABLE





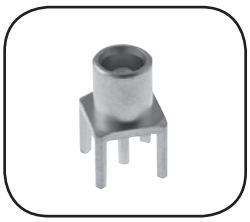
Cable type	Cable group dia.	Part number	Dimensions (mm)				Note	Finish
			A	B	C	D		
RG-178	2/50/S	R113 181 097	8.6	11.9	2.55	1.1	–	BBR
RG-316	2.6/50/S	R113 182 097	8.6	11.9	2.95	1.65	–	
RG-316	2.6/50/S	R299 122 087	8.6	11.9	2.95	1.65	Full detent	

STRAIGHT JACK CRIMP TYPE FOR FLEXIBLE CABLE



Cable type	Cable group dia.	Part number	Finish
RG-316	2.6/50/S	R113 240 097	BBR

STRAIGHT PCB RECEPTACLE



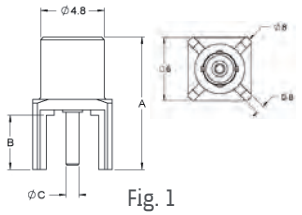


Fig. 1

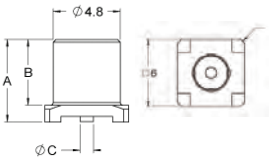


Fig. 2

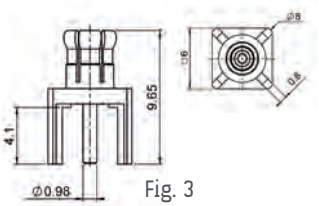
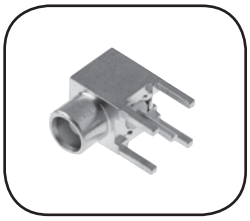
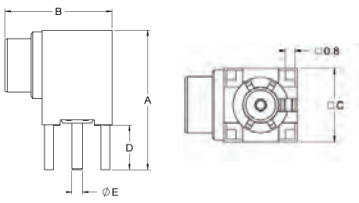


Fig. 3

Part number	Figure	Dimensions (mm)			Panel drilling	Termination	Finish	Type
		A	B	C				
R113 426 097	1	10	4.1	0.98	P01	Solder legs	GBR	Female
R113 424 097	2	5.9	4.7	0.96	--	SMT		Female
R113 425 097	3	9.65	4.1	0.98	P01	Solder legs		Male

RIGHT-ANGLE PCB RECEPTACLE





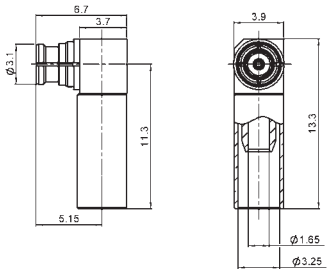
Part number	Panel drilling	Termination style	Finish	Type
R113 665 097	P01	Solder legs	GBR	Female

PRODUCT SPECIFICATION: please refer to the standard range

To download data sheets and assembly instructions, visit **www.radiall.com** & enter the part number in the Search box.
Bold part numbers represent products typically in stock & available for immediate shipment.
See page 8 and 9 for packaging information.

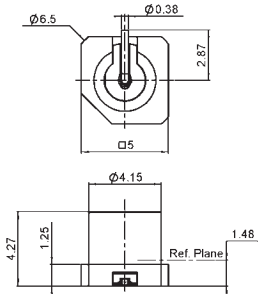
SMP PLUG AND RECEPTACLE

RIGHT-ANGLE PLUG CRIMP TYPE FOR FLEXIBLE CABLE



Cable type	Cable group dia.	Part number	Captive center contact	Body material	Finish
RG-179 non-magnetic cable	2.6/50/S	R222 900 357	Yes	Non-magnetic bronze	BBR

STRAIGHT SMT RECEPTACLE

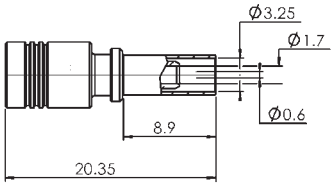


Part number	Retention	Captive center contact	Body material	Finish
R222 941 324	Limited detent	Yes	Non-magnetic bronze	Gold over copper

PRODUCT SPECIFICATION: please refer to the standard range

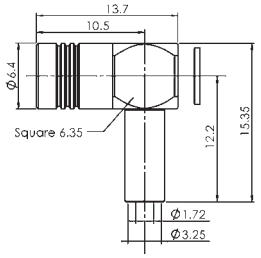
See page 8 and 9 for packaging information.

STRAIGHT PLUG FULL CRIMP TYPE FOR FLEXIBLE CABLE



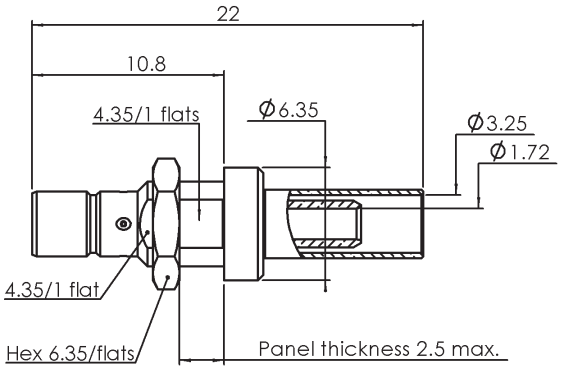
Cable type	Cable group dia.	Part number	Captive center contact	Body material	Finish
RG-179, RG-316 non-magnetic cable	2.6/50+75/S	R114 082 107	Yes	Non-magnetic bronze	BBR

RIGHT-ANGLE PLUG CRIMP TYPE FOR FLEXIBLE CABLE



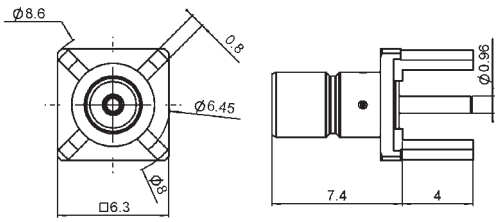
Cable type	Cable group dia.	Part number	Captive center contact	Body material	Finish
RG-179, RG-316 non-magnetic cable	2.6/50+75/S	R114 186 197	Yes	Non-magnetic bronze	BBR

STRAIGHT BULKHEAD JACK CRIMP TYPE FOR FLEXIBLE CABLE



Cable type	Cable group dia.	Part number	Captive center contact	Panel drilling	Body material	Finish
RG-316 non-magnetic cable	2.6/50+75/S	R114 313 197	Yes	P02	Non-magnetic bronze	BBR

STRAIGHT MALE RECEPTACLE FOR PCB



PRODUCT SPECIFICATION: please refer to the standard range
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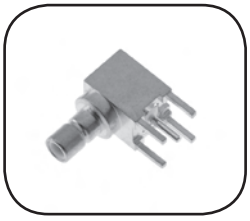
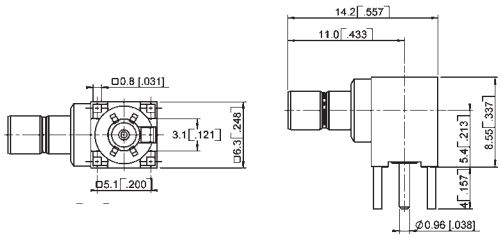
SMB RECEPTACLE

RIGHT-ANGLE RECEPTACLE FOR PCB, SOLDER LEGS

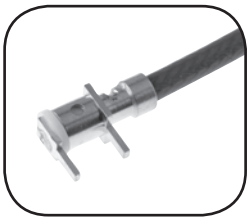


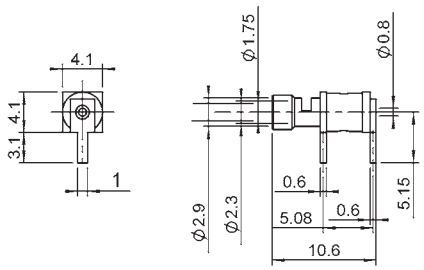


Part number	Captive center contact	Body material	Finish
R114 665 107	Yes	Non-magnetic bronze	GBR

CABLE TERMINALS

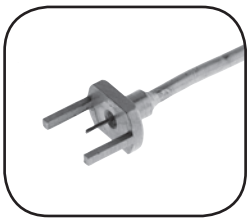
RIGHT-ANGLE TERMINAL SOLDER TYPE FOR FLEXIBLE CABLES

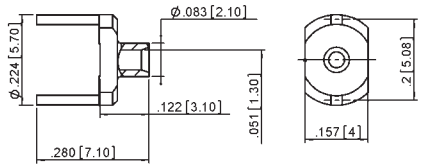




Cable group	Cable group dia.	Part number	Panel drilling	Body material	Finish
RG-174, RG-316, RD-316, RG-179, RD-179	2.6/50+75	R280 220 027	P05	Non-magnetic bronze	GBR

STRAIGHT TERMINAL SOLDER TYPE FOR SEMI-RIGID CABLES





Cable group	Cable group dia.	Part number	Panel drilling	Body material	Finish
RG-174, RG-316, RD-316, RG-179, RD-179	.047	R280 287 107	P06	Non-magnetic bronze	GBR

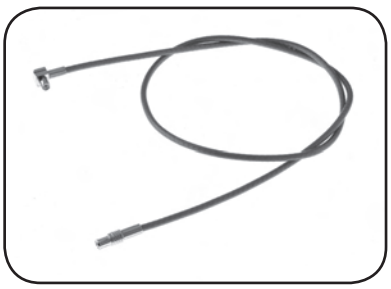
PRODUCT SPECIFICATION: please refer to the standard range

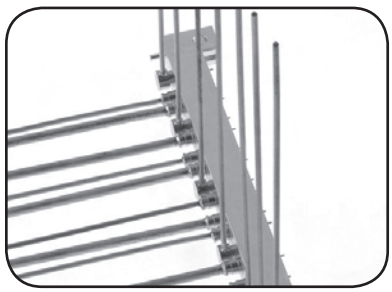
See page 8 and 9 for packaging information.

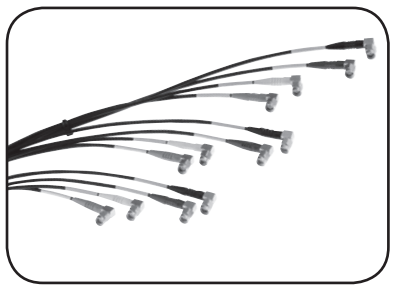
NON-MAGNETIC CABLE ASSEMBLIES

Radiall also offers a standard range of non-magnetic cable assemblies fit to work within the B_0 magnetic field. The cables are not sold separately.

In order to meet our customer's specific project requirements, Radiall provides worldwide technical support.



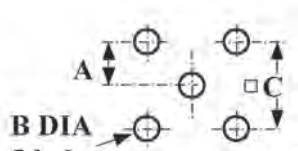




Cable type	Cable group dia.	Part number
RG-178 non-magnetic	2/50/S	C291 140 087
RG-316 non-magnetic	2.6/50/S	C291 170 079
RG-400 non-magnetic	5/50/S	C291 324 079
.085" semi-rigid	.085	C291 851 001
.141" semi-rigid	.141	C291 861 061

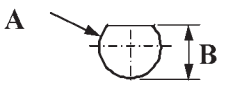
PANEL DRILLING

P01



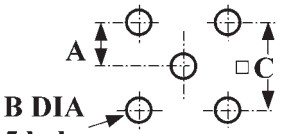
	mm	
	Maxi	mini
A	1.29	1.25
B	0.85	0.75
C	2.56	2.52

P02



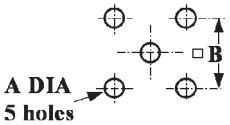
	mm	
	Maxi	mini
A	5	4.9
B	4.58	4.46

P03



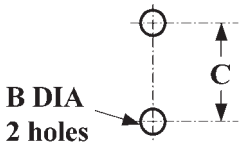
	mm	
	Maxi	mini
A	2.59	2.49
B	1.40	1.30
C	5.16	5.00

P04



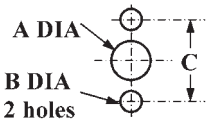
	mm		inch	
	Maxi	mini	Maxi	mini
A	1.4	1.3	.055	.051
B	5.16	5.00	.203	.197

P05



	mm	
	Maxi	mini
B	1.5	1.4
C	5.13	5.03

P06



	mm		inch	
	Maxi	mini	Maxi	mini
A	1.1	1.05	.043	.041
B	1.1	1.05	.043	.041
C	5.16	5.00	.203	.197

PRODUCT SPECIFICATION: please refer to the standard range

To download data sheets and assembly instructions, visit **www.radiall.com** & enter the part number in the Search box.
Bold part numbers represent products typically in stock & available for immediate shipment.
See page 8 and 9 for packaging information.

NOTES

Cable designation	Cable Group ∅ / Ω	Imp. Ω	Cable dimensions mm (inch)					Radiall cable if applicable	
			Core type	Core ∅	Insulator ∅	Screen	Outer ∅	P/N	Remark
RG 174 A/U	2.6 / 50 S	50	7 x 0.16	0.48 (.019)	1.52 (.060)	S	2.79 (.110)	C291 150 000	PVC jacket
RG 178 B/U	2 / 50 S	50	7 x 0.1	0.30 (.012)	0.84 (.033)	S	1.78 (.070)	C291 145 007	FEP jacket
RG 178 B/U	2 / 50 S	50	7 x 0.1	0.30 (.012)	0.84 (.033)	S	1.83 (.072)	C291 145 060	PVC jacket
RG 178 non m.	2 / 50 S	50	7 x 0.1	0.29 (.011)	0.84 (.033)	S	1.80 (.071)	C291 140 087	non magnetic / FEP jacket
RG 179 B/U	2.6 / 75 S	75	7 x 0.1	0.30 (.012)	1.60 (.063)	S	2.54 (.010)	C291 210 007	FEP jacket
RG 187 A/U	2.6 / 75 S	75	7 x 0.1	0.30 (.012)	1.60 (.063)	S	2.79 (.110)	C291 211 006	PTFE jacket
RG 188 A/U	2.6 / 50 S	50	7 x 0.17	0.51 (.020)	1.52 (.060)	S	2.79 (.110)	C291 160 006	PTFE jacket
RG 196 A/U	2 / 50 S	50	7 x 0.1	0.30 (.012)	0.86 (.034)	S	2.03 (.080)	C291 110 006	PTFE jacket
RG 212 /U	8 / 50 D	50	solid	1.41 (.056)	4.70 (.185)	D	8.43 (.331)	na	
RG 213 /U	10 / 50 S	50	7 x 0.75	2.26 (.089)	7.24 (.285)	S	10.30 (.406)	C291 510 000	PVC jacket
RG 214 /U	11 / 50 D	50	7 x 0.75	2.25 (.089)	7.24 (.285)	D	10.80 (.425)	C291 600 000	PVC jacket
RG 215	10 / 50 S	50	7 x 0.75	2.25 (.089)	7.25 (.285)	S	10.29 (.405)	na	
RG 216 /U	11 / 75 D	75	7 x 0.4	1.21 (.048)	7.24 (.285)	D	10.80 (.425)	C291 610 000	PVC jacket
RG 217 /U	14 / 50 D	50	solid	2.69 (.106)	9.40 (.370)	D	13.84 (.545)	C291 620 000	PVC jacket
RG 218 /U	22 / 50 S	50	solid	4.95 (.195)	17.27 (.680)	S	22.10 (.870)	C291 630 000	PVC jacket
RG 223 /U	5 / 50 D	50	solid	0.89 (.035)	2.95 (.116)	D	5.38 (.212)	C291 330 000	PVC jacket
RG 225 /U	11 / 50 D	50	7 x 0.8	2.38 (.094)	7.24 (.285)	D	10.90 (.429)	C291 605 007	glass fiber jacket
RG 303 /U	5 / 50 S	50	solid	0.94 (.037)	2.95 (.116)	S	4.32 (.170)	na	
RG 316 /U	2.6 / 50 S	50	7 x 0.17	0.53 (.021)	1.52 (.060)	S	2.49 (.098)	C291 170 007	FEP jacket
RD 316	2.6 / 50 D	50	7 x 0.17	0.53 (.021)	1.52 (.060)	D	2.80 (.110)	C291 185 067	FEP jacket
RG 393	10 / 50 D	50	7 x 0.81	2.39 (.094)	7.24 (.285)	D	9.91 (.390)	C291 511 007	FEP jacket
RG 400	5 / 50 / D	50	19 x 0.19	0.98 (.039)	2.95 (.116)	D	4.95 (.195)	C291 324 007	FEP jacket
Flexible cable BT approved									
RD 179	2.6 / 75 D	75	7 x 0.10	0.30 (.012)	1.6 (.063)	D	3.07 (.121)	C291 230 080	LSOH jacket
BT 3002	3.6 / 75 D	75	solid	0.31 (.012)	1.95 (.077)	D	3.55 (.140)	C291 246 046	FEP jacket
BT 2002	5 / 75 D	75	7 x 0.20	0.60 (.024)	2.5 (.098)	D	5.1 (.200)	C291 333 080	FEP jacket
Semi rigid cables MIL-C-17 standard									
RG 401 /U	.250"	50	solid	1.63 (.064)	5.31 (.209)	--	6.35 (.250)	C291 870 001	copper tubing
RG 401 alu	.250"	50	solid	1.63 (.064)	5.31 (.209)	--	6.35 (.250)	C291 874 187	tinned alu tubing
RG 402 /U	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	3.58 (.141)	C291 860 001	copper tubing
RG 402 tin	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	3.58 (.141)	C291 862 005	tinned copper tubing
RG 402 silver	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	3.58 (.141)	C291 861 066	silvered copper tubing
RG 402 alu	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	3.58 (.141)	C291 864 187	tinned alu tubing
RG 402 non m.	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	3.58 (.141)	C291 861 061	non magnetic / copper tubing
RG 405 /U	.085"	50	solid	0.51 (.020)	1.68 (.066)	--	2.20 (.087)	C291 850 001	copper tubing
RG 405 tin	.085"	50	solid	0.51 (.020)	1.68 (.066)	--	2.20 (.087)	C291 850 005	tinned copper tubing
RG 405 alu	.085"	50	solid	0.51 (.020)	1.68 (.066)	--	2.20 (.087)	C291 844 187	tinned alu tubing
RG 405 non m.	.085"	50	solid	0.51 (.020)	1.68 (.066)	--	2.20 (.087)	C291 851 001	non magnetic / copper tubing
.047"	.047"	50	solid	0.29 (.011)	0.94 (.037)	--	1.19 (.047)	C291 855 001	copper tubing
.047" tin	.047"	50	solid	0.29 (.011)	0.94 (.037)	--	1.19 (.047)	C291 855 065	tinned copper tubing
Hand-formable cable									
Hand-formable	.085"	50	solid	0.51 (.020)	1.63 (.064)	--	2.21 (.087)	C291 844 065	tin soaked braid
Hand-formable	.141"	50	solid	0.92 (.036)	2.95 (.116)	--	3.50 (.138)	C291 864 065	tin soaked braid
Hand-formable	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	4.05 (.159)	C291 866 378	FEP jacket
Hand-formable	.141"	50	solid	0.92 (.036)	2.98 (.117)	--	4.50 (.177)	C291 866 270	LSZH jacket
Corrugated cables (with helical or ringed/annular copper tube)									
Flexible	1/4"	50	solid	2.38 (.094)	6.40 (.252)	--	8.70 (.343)	na	ringed/annular tube
Flexible	1/2"	50	solid	4.80 (.189)	11.6 (.457)	--	16.35 (.644)	C291 972 085	ringed/annular tube
Flexible	7/8"	50	solid	9.13 (.359)	22.5 (.866)	--	27.7 (1.091)	na	ringed/annular tube
Flexible	1 1/4"	50	solid	12.7 (.500)	32.5 (1.28)	--	39.5 (1.55)	na	ringed/annular tube
Flexible	1 5/8"	50	solid	17.3 (.681)	43.5 (1.71)	--	50.5 (1.99)	na	ringed/annular tube
Super flexible	1/4"	50	solid	1.90 (.075)	4.70 (.185)	--	7.40 (.291)	C291 993 080	helical tube
Super flexible	3/8"	50	solid	2.60 (.102)	6.30 (.248)	--	10.8 (.425)	C291 996 070	helical tube
Super flexible	1/2"	50	solid	3.60 (.142)	8.70 (.343)	--	13.2 (.520)	C291 994 080	helical tube
Super flexible	7/8"	50	tube	9.04 (.356)	23.62 (.930)	--	27.48 (1.082)	C291 996 580	helical tube

Note: S = single braid. D = dual braid. For more information about cables manufactured by Radiall, please consult our online catalog.

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