

MICROWAVE COMPONENTS

# SMT couplers



ISO 9001 APPROVED



The Radial SMT coupler range, now includes the new mini type (5.1 mm wide). These products have been designed for wireless applications such as signal distribution, power amplifiers and low noise amplifiers.

They have been developed to incorporate Surface Mount Technology. Therefore, they are packaged in reel to allow the use of pick and place machines. Soldering operations can be achieved by reflow ovens.

SMT couplers are low profile. Their dimensions - 14.2 x 8.9 mm and 14.2 x 5.1- are standard ones so that their soldering pad is the same as most other SMT couplers on the market.

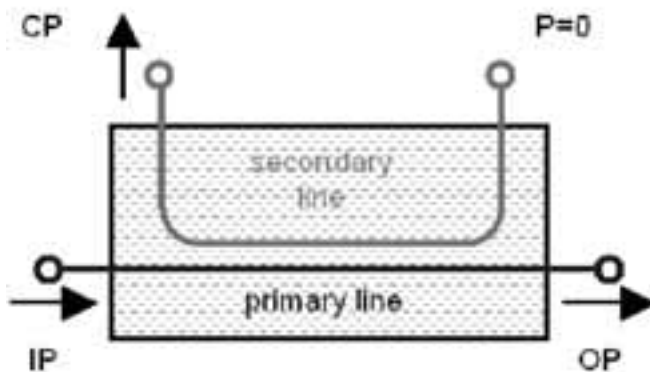
RADIAL SMT couplers feature small size metallized via holes which allow the following improvements :

- They avoid the risk of loss of electrical continuity during the component soldering onto the PCB.
- They improve V.S.W.R.

3, 6, 10 dB SMT couplers are already available for CDMA, GSM, PCS, DCS and WLL communication frequency bands.

### DEFINITION : WHAT IS A COUPLER ?

A coupler is a passive device, whose role is to separate or combine one signal from the main line relative to another. Two types of couplers are available : Directional and hybrid couplers



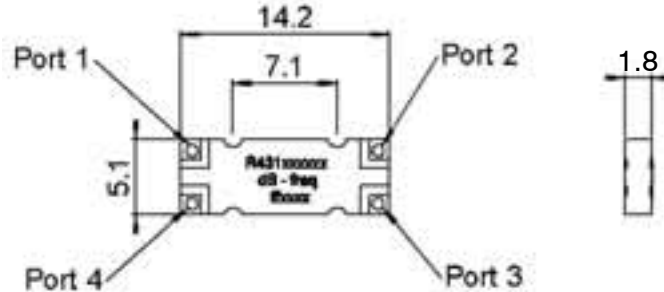
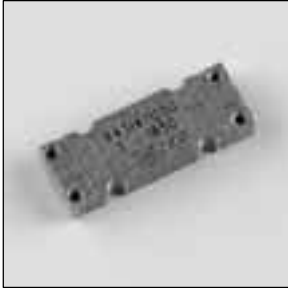
IP = Input Power  
 OP = Output Power  
 CP = Coupled Power

$$IP = OP + CP$$

### CHARACTERISTICS

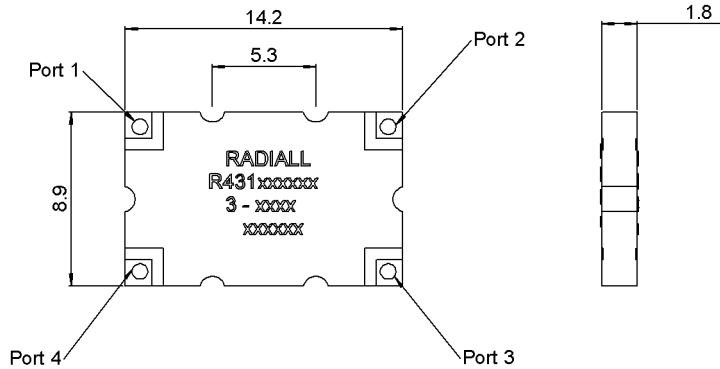
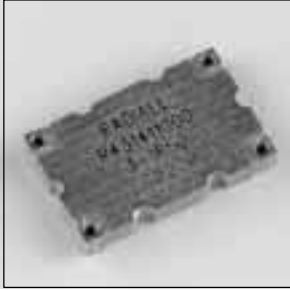
IMPEDANCE	50 Ω
TEMPERATURE RANGE	-55° / +85°C
SUBSTRATE MATERIAL	TEFLON
FINISH	Sn 60 Pb 40 - 8 μm plated holes
MATERIAL FLAMMABILITY RATING	UL 94 - V0

### 3dB HYBRID MINI SMT COUPLERS POWER 60 W



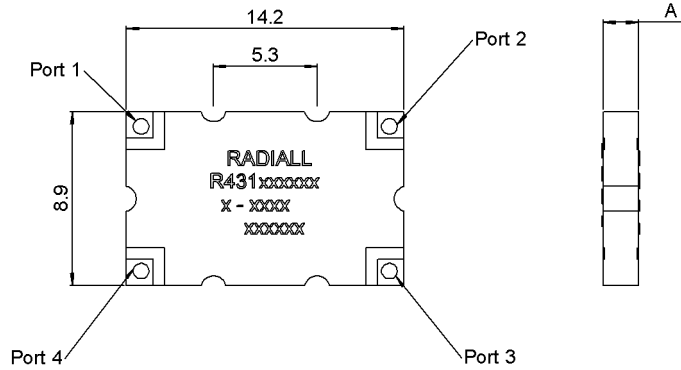
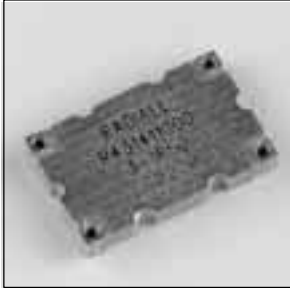
Part number	Packaging	Frequency (MHz)		Isolation (dB)	VSWR max	IL (dB)	Amp. balance (dB)	Phase balance (Degrees°)	Power (W)
R431 411 201	1000p reel	Specified band Extended band	1700 - 2000 1500 - 2200	$\geq 23$ $\geq 20$	$\leq 1.17$ $\leq 1.20$	$\leq 0.2$ $\leq 0.2$	+/-0.20 +/-0.35	+/- 2° +/- 3°	60
R431 411 203	3000p reel								
R431 411 205	100p reel								
R431 411 205W	unit								
R431 611 201	1000p reel	Specified band Extended band	1900 - 2200 1700 - 2400	$\geq 23$ $\geq 20$	$\leq 1.17$ $\leq 1.20$	$\leq 0.2$ $\leq 0.2$	+/-0.20 +/-0.35	+/- 2° +/- 3°	60
R431 611 203	3000p reel								
R431 611 205	100p reel								
R431 611 205W	unit								
R431 111 241	1000p reel	Specified band Extended band	2300 - 2700 2000 - 3000	$\geq 22$ $\geq 19$	$\leq 1.18$ $\leq 1.23$	$\leq 0.2$ $\leq 0.2$	+/-0.20 +/-0.40	+/- 3° +/- 4°	60
R431 111 243	2000p reel								
R431 111 245	100p reel								
R431 111 245W	unit								
R431 211 241	1000p reel	Specified band Extended band	3300 - 3700 3000 - 4000	$\geq 22$ $\geq 18$	$\leq 1.19$ $\leq 1.25$	$\leq 0.2$ $\leq 0.4$	+/-0.20 +/-0.40	+/- 4° +/- 5°	60
R431 211 243	3000p reel								
R431 211 245	100p reel								
R431 211 245W	unit								

### 3dB HYBRID SMT COUPLERS POWER 40 and 100 W



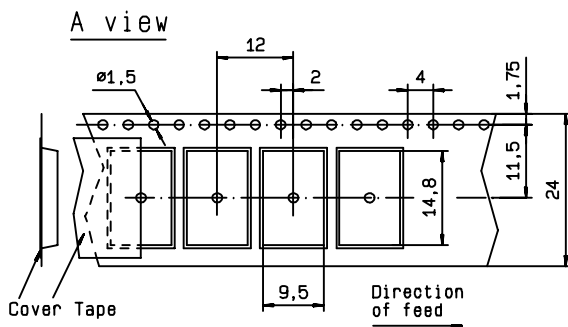
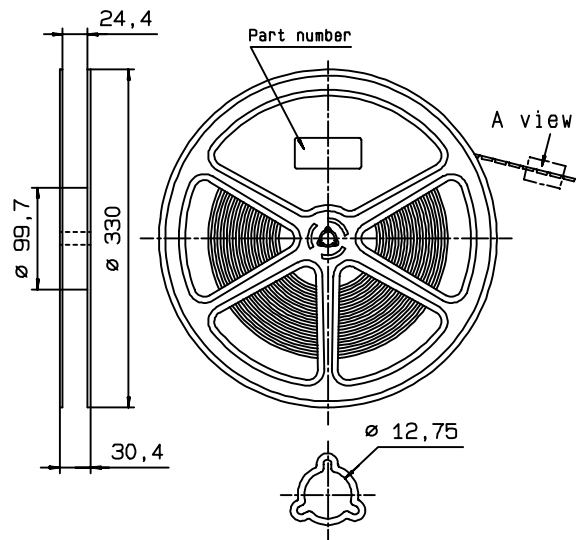
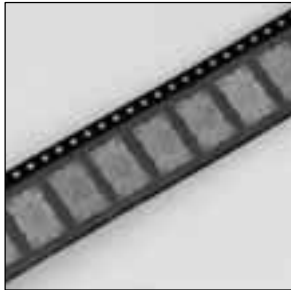
Part number	Packaging	Frequency (MHz)		Isolation (dB)	VSWR max	IL (dB)	Amp. balance (dB)	Phase balance (Degrees°)	Power (W)
R431 211 001	1000p reel	Specified band Extended band	815 - 960	$\geq 22$	$\leq 1.18$	$\leq 0.23$	+/-0.3	+/- 3°	100
R431 211 002	2000p reel		800 - 1200	$\geq 21$	$\leq 1.20$	$\leq 0.23$	+/-0.4		
R431 211 005	100p reel								
R431 211 005W	unit								
R431 411 001	1000p reel	Specified band Extended band	1700 - 2000	$\geq 23$	$\leq 1.18$	$\leq 0.23$	+/-0.3	+/- 3°	100
R431 411 002	2000p reel		1500 - 2200	$\geq 20$	$\leq 1.20$	$\leq 0.23$	+/-0.4	+/- 3°	
R431 411 005	100p reel								
R431 411 005W	unit								
R431 511 001	1000p reel	Specified band Extended band	1700 - 1800	$\geq 23$	$\leq 1.18$	$\leq 0.23$	+/-0.3	+/- 3°	100
R431 511 002	2000p reel		1500 - 1900	$\geq 20$	$\leq 1.20$	$\leq 0.23$	+/-0.5	+/- 4°	
R431 511 005	100p reel								
R431 511 005W	unit								
R431 611 001	1000p reel	Specified band Extended band	2000 - 2500	$\geq 20$	$\leq 1.25$	$\leq 0.35$	+/-0.4	+/- 5°	40
R431 611 002	2000p reel		1800 - 2700	$\geq 18$	$\leq 1.25$	$\leq 0.35$	+/-0.5	+/- 5°	
R431 611 005	100p reel								
R431 611 005W	unit								

### DIRECTIONAL SMT COUPLERS POWER 60 W

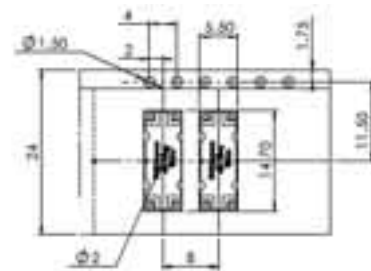


Mean coupling (dB)	Part number	Packaging	Frequency (MHz)		VSWR max	IL (dB) (Exclud. coupling loss)	Frequency sensitivity (dB)	Directivity (dB)	A (mm)
6 +/- 1	R431 412 001	1000p reel	Specified band Extended band	1700 - 2000 1500 - 2200	≤ 1.20 ≤ 1.25	≤ 0.3 ≤ 0.3	+/- 0.2 +/- 0.3	≥ 20 ≥ 20	2.1
	R431 412 002	2000p reel							
	R431 412 005	100p reel							
	R431 412 005W	unit							
6 +/- 1.5	R431 612 001	1000p reel	Specified band Extended band	2000 - 2500 1800 - 2700	≤ 1.20 ≤ 1.25	≤ 0.3 ≤ 0.3	+/- 0.2 +/- 0.3	≥ 17 ≥ 17	2.1
	R431 612 002	2000p reel							
	R431 612 005	100p reel							
	R431 612 005W	unit							
10 +/- 1.5	R431 413 001	1000p reel	Specified band Extended band	1700 - 2000 1500 - 2200	≤ 1.18 ≤ 1.20	≤ 0.25 ≤ 0.25	+/- 0.2 +/- 0.3	≥ 20 ≥ 20	1.8
	R431 413 002	2000p reel							
	R431 413 005	100p reel							
	R431 413 005W	unit							
10 +/- 1.5	R431 613 001	1000p reel	Specified band Extended band	2000 - 2500 1800 - 2700	≤ 1.20 ≤ 1.25	≤ 0.3 ≤ 0.3	+/- 0.2 +/- 0.3	≥ 17 ≥ 17	1.8
	R431 613 002	2000p reel							
	R431 613 005	100p reel							
	R431 613 005W	unit							

## REEL PACKAGING



Packaging size for standard coupler (14.2 x 8.9)

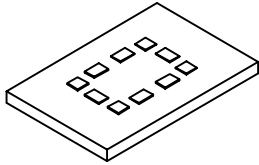


Packaging size for mini coupler (14.2 x 5.1)

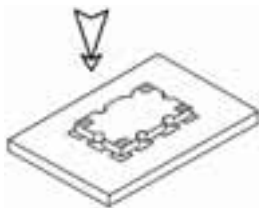
## PACKAGING TYPE

Quantity per reel	100 pièces	1000 pièces	2000 pièces	3000 pièces
Standard type (14.2 x 8.9)	X	X	X	-
Mini type (14.2 x 5.1)	X	X	-	X

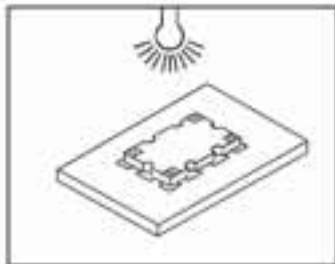
### 1 Solder cream deposition



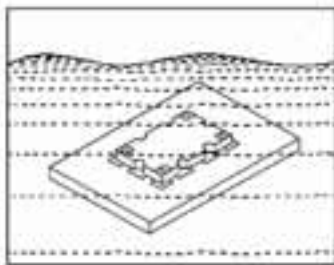
### 2 Placement of the coupler



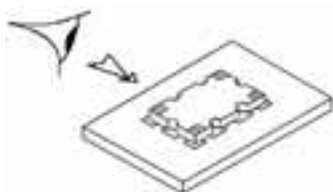
### 3 Soldering



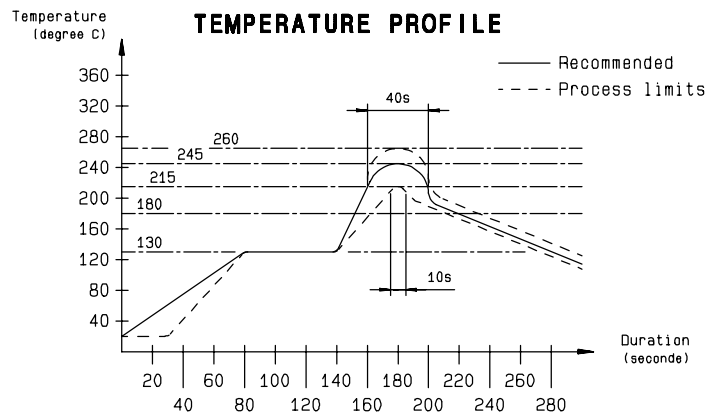
### 4 Cleaning of the PCB



### 5 Quality check



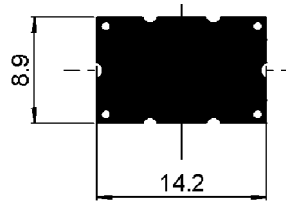
- 1.1 RADIALL recommends using a solder cream Sn 63 - Pb 35 - Ag 2 type" no clean - low residue" (5% solid residue of flux quantity) that will permit the elimination of the cleaning operation step after soldering. When using a conventional solder cream with high level of flux solid residue, it is important to incorporate a good cleaning operation step in the fifteen minutes after soldering.
- 1.2 The substrate must have Sn 60 - Pb 40 protection. Please optically verify that the edges of the zones are clean, without contaminates and that the PCB zoned areas have not oxydated.
- 1.3 Solder cream may be applied on the board with screen printing or dispenser techniques. For either method, the paste solder must be coated to appropriate thickness and shapes to achieve good solder wetting and adequate insulation.
- 1.4 The design of the mounting pads and the stencilling area are given in the applicable note, for a thickness of the silk-screen printing of 150  $\mu$ m.
- 2.1 Couplers components require precise positioning on their soldering pads; typically  $\pm 0.25$  mm.
- 2.2 Place the coupler onto the PCB with automatic pick and place equipment. Various types of suction can be used .
- 2.3 RADIALL does not recommend using adhesive agents on the component or on the PCB .
- 3.1 Please follow RADIALL's recommended temperature profile.
- 3.2 This profile can be used with Infra - red reflow, Vapor phase soldering and Forced air convection.



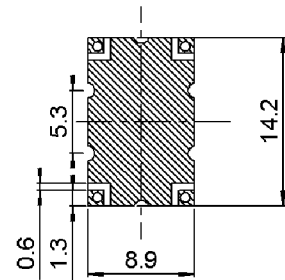
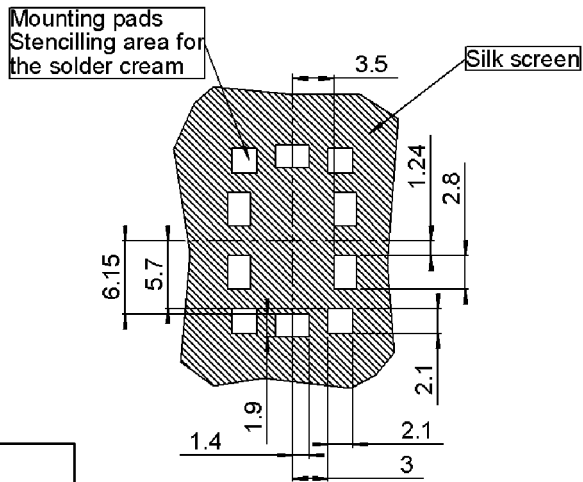
- 4.1 When using a conventional solder cream with high level of residue, please clean the PCB with a substitute product, similar to CFC, that complies to the International Environment Agency rules. It is important to do the cleaning operation step less than fifteen minutes after reflow .
- 4.2 RADIALL recommends using ultrasonic waves or vapor phase process .
- 5.1 Verify by visual inspection that component is centred on the mounting pads.
- 5.2 Solder joints : verify by visual inspection that the formation of meniscus on the pads and inside the hole are proper, and have a capilarity amount upper the third of the height .

## STANDARD SMT COUPLERS

Video shadow of coupler



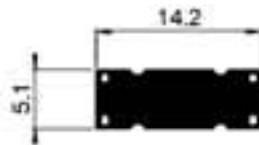
Soldering pattern



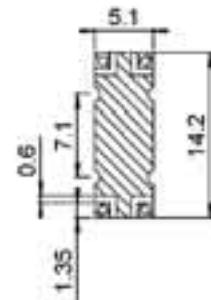
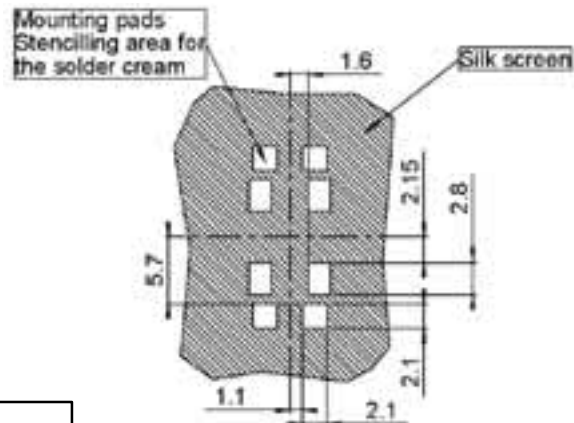
Thickness of the silk screen printing: 0.150 mm

## MINI SMT COUPLERS

Video shadow of coupler

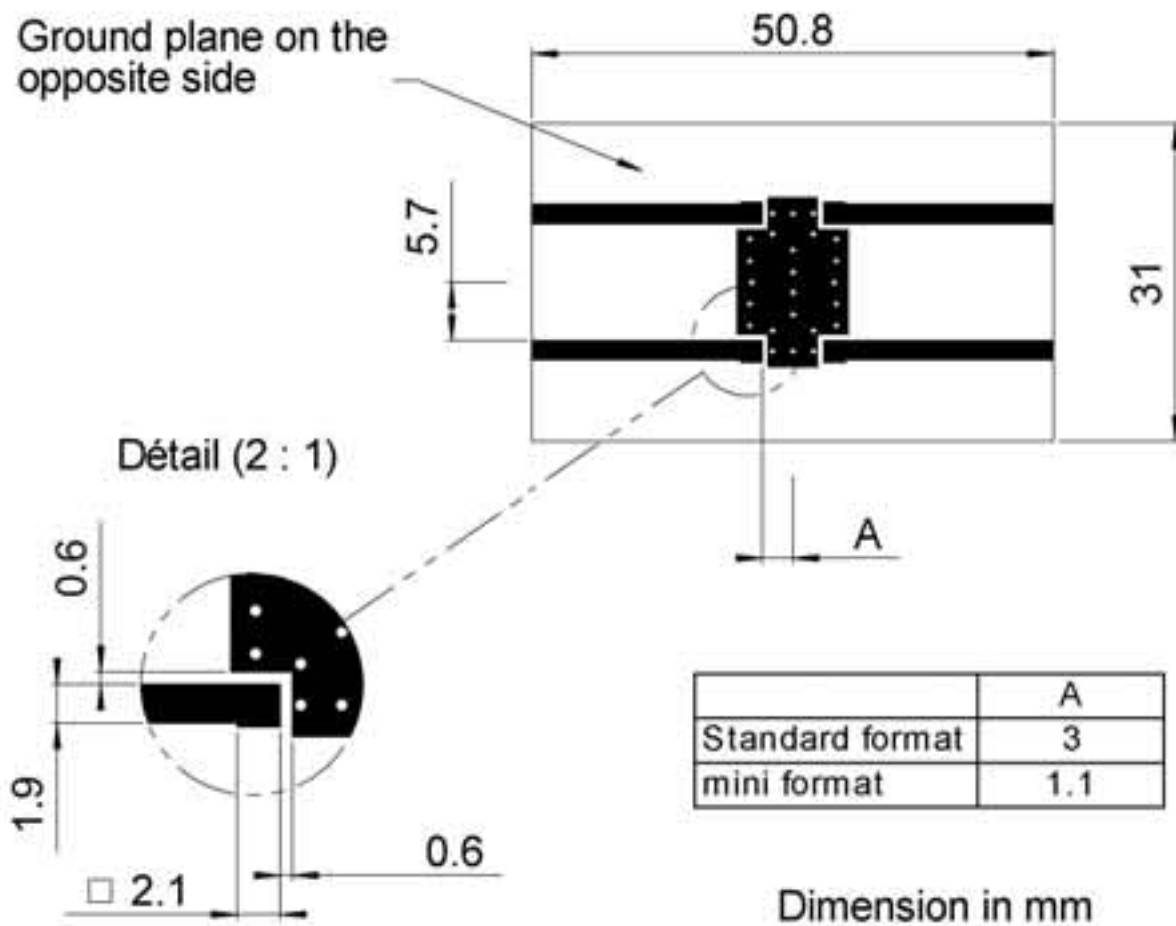


Soldering pattern



Thickness of the silk screen printing: 0.150 mm





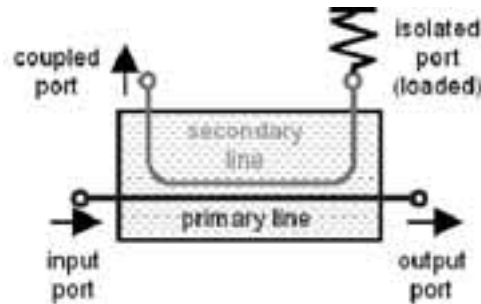
Nota: The substrate is RO4003 - thickness 1.6 mm  
Cu double side 0.035 mm

## DIRECTIONAL COUPLERS

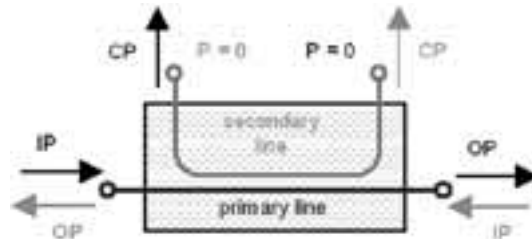
A directional coupler is a passive transmission-line component to be inserted between two lines in order to transfer one part of the input power from one line to the other.

Two juxtaposed transmission lines and the associated coupling structure allow the transfer of RF energy from the "primary" (main) line to the "secondary" (coupled) line.

A unidirectional coupler is a directional coupler that can transfer a coupled power into the secondary line in one direction only.



Whereas a bidirectional coupler can transfer a coupled power into the secondary line in each of the two directions of propagation in the primary line



## HYBRID COUPLERS

A hybrid coupler is a non-directional coupler that can be used in two different ways : either as a power divider (input power split between output and coupled powers) or as a power combiner (input power 1 and input power 2 lead to one output power).

a) divider :  
 IP to OP  
       ↘ CP

b) combiner :  
 IP 1 ↘ to OP  
 IP 2 ↗

Hybrid couplers are also called quadrature or 90° couplers since there is a 90° difference in phase between the output signal and the coupled output signal. These are 3dB couplers.

## PRIMARY LINE

The primary line is the main line, that receives the main flow of RF energy into the transmission line.

## SECONDARY LINE

The secondary line is the line that is coupled to the primary line.

## COUPLING FACTOR

Coupling factor of directional couplers is determined by obtaining the midpoint between maximum and minimum coupling over the specified frequency band.

Coupling factor of unidirectional couplers is determined as a ratio expressed in dB, of the power available at the output of the secondary line to the power input to the primary line (the output end of the primary line being properly terminated).

Coupling factor of bidirectional couplers is determined separately for each secondary lines.

$$\text{Coupling factor (dB)} = -10\log (CP/ IP)$$

## VSWR

It is the impedance discontinuity when the coupler is inserted into a matching line and all ports are terminated with a matching load.

## FREQUENCY SENSITIVITY

The frequency sensitivity, also called Coupling variation, of directional couplers is determined over the specified frequency range.

The frequency sensitivity of unidirectional couplers is the difference between the maximum and the minimum coupling over the specified frequency range. It is a positive number or a zero.

The frequency sensitivity of bidirectional couplers is determined separately for each secondary line.

## INSERTION LOSS

Insertion loss for a directional coupler is the difference in the power level received at the load before and after insertion of the primary line of the coupler in a transmission line.

$$\text{Insertion loss (dB)} = -10 \log (OP / IP)$$

In an ideal coupler without any heat dissipation, insertion loss would be :

$$\text{Insertion loss (dB)} = -10 \log (1 - CP / IP)$$

Insertion loss for a hybrid coupler is determined by subtracting the nominal value of the divider (3 dB) from the measured average coupling value. The average coupling of the device is determined by the swept frequency technique over the specified frequency range. It is the average of the measured coupling between the input and each output port.

## ISOLATION

Isolation is measured between any selected input port and the adjacent isolated port, opposite ports being terminated with matched loads.

$$\text{Isolation (dB)} = -10 \log (P3 / IP)$$

## DIRECTIVITY

Directivity of a directional coupler is defined over the specified frequency range.

Directivity of a unidirectional coupler is the ratio of the available power at the output of the secondary line for the two directions of transmission, at equal power levels of the primary line, the secondary line being terminated in a matched detector.

$$\text{Directivity (dB)} = -10 \log (P3 / CP)$$

For directional couplers, directivity = isolation - coupling

## AMPLITUDE BALANCE (for hybrid couplers only)

The amplitude balance is the difference between the amplitude of the signal at the output port and the amplitude of the signal at the coupled port, the 4th port being terminated with matched load, within the specified frequency range.

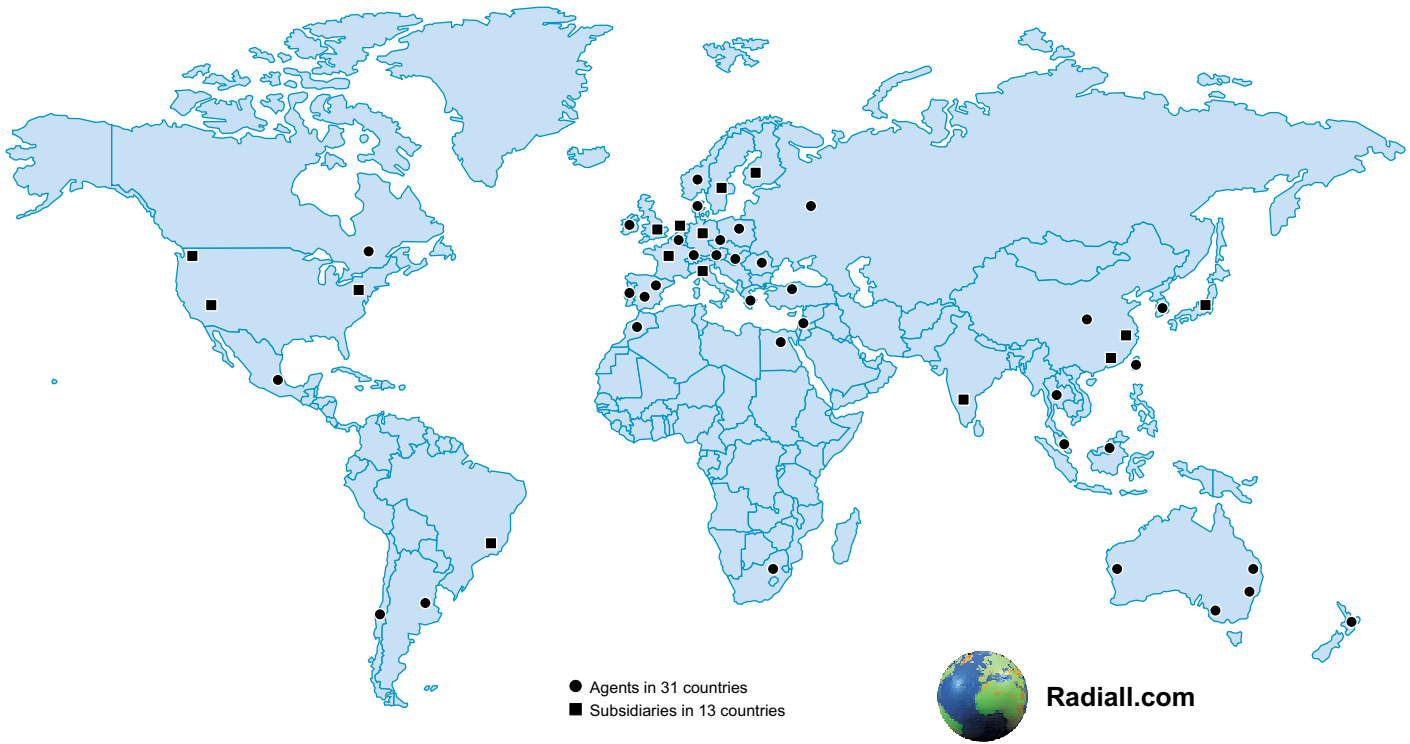
If it is too low, it means that too much power exists from one port than from the other.

## PHASE BALANCE (for hybrid couplers only)

The phase balance is the comparison between the phase of the output signal and the phase of the coupled signal.

## COUPLING FACTORS

Coupling factor	Power	Output power (Input = 100W)	Coupled power (Input = 100W)	Coupling loss	Coupler
3 dB	1/2	50W	50W	3 dB	Hybrid
6 dB	1/4	75W	25W	1.25	Directional
10 dB	1/10	90W	10W	0.46	
20 dB	1/100	99W	1W	0.05 dB	
30 dB	1/1000	99.9W	0.1W	0.005 dB	



**Radiall.com**

**RADIALL WORLDWIDE LOCATIONS**

**EUROPE**

**France - RADIALL HEADQUARTERS**  
101, Rue Ph. Hoffmann - 93116 ROSNY sous BOIS (Paris)  
Tel. : +33 1 49 35 35 35 Fax : +33 1 48 54 63 63  
E-Mail : info@radiall.com

**Finland - RADIALL FIN**  
Pilot Business Park - Lentokatu 2 - FIN-90460 OULUNSALO  
Tel. : +358 852 70 130 Fax : +358 852 70 105  
E-Mail : info@radiall.fi

**Germany - RADIALL G.m.b.H.**  
CarlZeiss Str. 10 Postfach 200143 - D63307 RÖDERMARK (Frankfurt)  
Tel. : +49 60 74 91 07 0 Fax : +49 60 74 91 07 70  
E-Mail : info@radiall.de  
Regional offices : Munich

**Italy - RADIALL Elettronica S.R.L.**  
Via Concordia, 5 - I20090 ASSAGO MILANO  
Tel. : +39 02 48 85 121 Fax : +39 02 48 84 30 18  
E-Mail : radiall@tin.it  
Regional office : Roma

**Netherlands - RADIALL B.V.**  
Postbus 64 - 3870 CB HOEVELAKEN  
Tel. : +31 33 253 40 09 Fax : +31 33 253 45 12  
E-Mail : info@radiall.nl

**Sweden - RADIALL A.B.**  
Sjöängsvägen 2 - SE-192 72 SOLLENTUNA (Stockholm)  
Tel. : +46 844 434 10 Fax : +46 875 449 16  
E-Mail : info@radiall.se

**U.K. - RADIALL Ltd**  
10, Perivale Industrial Park, Horsenden Lane south  
PERIVALE Middlesex UB6 7RL (London)  
Tel. : +44 208 991 7700 Fax : +44 208 991 7769  
E-Mail : info@radiall.co.uk

**AMERICA**

**USA - RADIALL, INC.**  
*RF Coaxial connectors, Microwave devices & Fiber optic connectors*  
300 Long Beach Blvd - STRATFORD Connecticut 06615  
Tel. : +1 203 380 9800 Fax : +1 888 387 0001  
E-Mail : sales@radiallusa.com

**USA - RADIALL LARSEN Antenna Technologies, INC**  
*Antennas*  
3611 NE 112<sup>th</sup> Avenue - VANCOUVER, Washington 98682  
Tel. : +1 360 944 7551 Fax : +1 360 944 7556  
E-Mail : info@radiallarsen.com

**USA - RADIALL JERRIK, INC.**  
*Mill/Aerospace Markets*  
102 West Julie Drive - TEMPE, Arizona 85283 (Phoenix)  
Tel. : +1 480 730 5700 Fax : +1 480 730 5800  
E-Mail : sales@radialljerrick.com

**Brasil - RADIALL do Brasil**  
Largo do Machado, 54 sala 706 - Catete  
22221-020 RIO DE JANEIRO  
Tel. : +55 21 2558 05 76 Fax : +55 21 2245 97 63  
E-Mail : hubertm@radiall.com.br

**ASIA**

**China - SHANGHAI RADIALL Electronic Co., Ltd**  
N° 390 Yong He Road 200072 - SHANGHAI  
Tel. : +86 21 66 52 37 88 Fax : +86 21 66 52 11 77  
E-Mail : radialls@online.sh.cn

**Japan - NIHON RADIALL KK**  
1-3-10, Higashi nihonbashi, Chuokku, TOKYO 103-0004  
Tel. : +81 3 3866 23 90 Fax : +81 3 3866 23 91  
E-Mail : emiko@radiall.co.jp

**HongKong - RADIALL Electronics Ltd**  
Elite Industrial Centre, Room 212, 2/F  
N° 883 Cheung Sha Wan Road - KOWLOON HONG KONG  
Tel. : +852 29 59 38 33 Fax : +852 29 59 26 36  
E-Mail : info@radiall.com.hk

**India - RADIALL PROTECTRON**  
25 D, II Phase, Peenya Industrial Area - BANGALORE 560058  
Tel. : +91 80 83 95 271 Fax : +91 80 83 97 228  
E-Mail : radiall@vsnl.com



**REPRESENTED IN**

Africa	Israël	South Africa
Australia	Middle East	South Korea
Belgium	Poland	Switzerland
Greece	Spain	Turkey

For the above countries, please contact the local agent or RADIALL HEADQUARTERS at export@radiall.fr

January 2003 Edition

D1 M 431 CE



This information is intended as a guide only. To ensure a continuing policy of product improvement, Radiall reserves the right to modify its specifications without prior notification.

©Registered Trade Mark

Printed in France