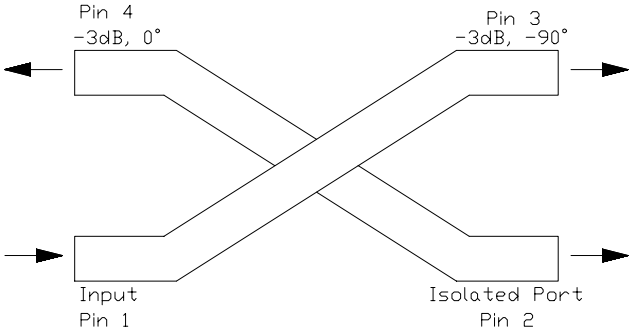
Hybrid Coupler Specification Definitions Application Note

VER8/1/00

A hybrid is a special case of a directional coupler in which the signals at the two output ports are equal and differ in phase by 90°. They are commonly used in amplifier systems where solid state power is insufficient due to individual amplifier limitations, power can be increased by using multiple amplifiers in a hybrid network. By cascading hybrids in a tree or a matrix divider/combiner configuration, more power can be transmitted as well as improving the efficiency of the transmission[1]. The following table is a reference guide to the definitions of the electrical parameters in the specification tables for these hybrid couplers.



Hybrid Schematic Drawing

Parameter	Definition	Mathematical Representation
VSWR	(Voltage Standing Wave Ratio) The impedance match of the device to the overall system. A VSWR of 1.0:1 is optimal[2].	VSWR = Vmax/Vmin Vmax = voltage maxima of a standing wave Vmin = voltage minima of a standing wave VSWR = (1 + ρ)/(1 - ρ)
Reflection Coefficient (ρ)	The ratio of the amplitude of the reflected wave to that of the incident wave.	ρ = (VSWR-1)/(VSWR+1)
Reflection Loss	Also referred to as mismatch loss and is the increase of the insertion loss due to a mismatch.	$-10\log(1-\rho^2)$ [dB]
Return Loss	The decibel difference between the power incident on a mismatched discontinuity and the power reflected from the discontinuity	-20log[(VSWR-1)/(VSWR+1)] = -20log(ρ) [dB]
Coupling	The decibel difference between the power at the coupled port and the input port.	-10log(Power at Pin 4/Power at Pin 1) [dB]
Coupling Loss	Loss to the main line due to coupled power[3].	-10log[1- (Power at Pin 4/Power at Pin 1)] [dB]
Insertion Loss	Power lost due to dielectric and conductor losses.	-10log[(Power at Pin 2/Power at Pin 1)+ (Power at Pin 3/Power at Pin 1)+ (Power at Pin 4/Power at Pin 1)] [dB]
Isolation	Power at the isolated port with respect to the input power.	-10log(Power at Pin 2/ Power at Pin 1) [dB]
Phase Balance	The phase variation between the difference of a hybrid's output ports (Pins 3&4) from quadrature (90°)	Phase of Pin 4 - Phase of Pin 3 + 90° [ang]

Notes:

1) For more information on the use of hybrids in amplifier systems, refer to Anaren's 1997 Catalog, pages 60-73 and Anaren White Paper #M1105-59 "Hybrid Matrix Amplifiers"
2) RF systems are usually matched to 50 ohms, the VSWR is the ratio of the match.
3) For example, a 3dB Hybrid has 50% of the input power to the coupled port and 50% is transmitted to the coupler's output, which corresponds to a coupling loss of 3.0dB.

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