



Power Dissipation in N-way Power Divider

Introduction

Florida RF Labs 2-, 3- and 4-way power dividers are Wilkinson style power dividers. A quarter wave line and a termination resistor between the output legs characterize a Wilkinson power divider. The Florida RF Labs power dividers dissipate 35 Watts of input power with a 1.40:1 mismatch at the output of the device. The devices are capable of operation with an output mismatch up to 2:1 with an input power of 9 Watts. The reduction in power handling occurs because, as the mismatch increases, the balance between the output legs is disturbed. The termination resistor experiences current when the output legs are not matched which raises the temperature of the internal resistor and limits its ability to dissipate power safely. The termination resistor is capable of dissipating full power at 85° C base temperature and derates to 0 Watts at 150° C base temperature.

Wilkinson Power Dividers

The termination resistor in a Wilkinson power divider creates balance between the output legs in order for the designed power split and isolation to occur between the output legs. The termination resistor also determines the power rating the device. To determine the size or needed power rating of the termination resistor for a given input power the following formulas are used:

$$\begin{aligned} \text{Given: } P_{in} &= 35 \text{ Watts} \\ VSWR &= 1.40:1 \text{ max} \end{aligned}$$

Calculate reflection coefficient:

$$\Gamma_V = \frac{VSWR - 1}{VSWR + 1} \quad (1) \quad \text{Voltage Reflection Coefficient}$$

$$\Gamma_V = \frac{1.40 - 1}{1.40 + 1} = 0.16$$

Power reflected from the mismatch:

$$\Gamma_P = \Gamma^2 \quad (2) \quad \text{Power Reflection Coefficient}$$

$$\Gamma_P = (0.16)^2 = 0.026$$

Total power reflected due to mismatch:

$$P_{dissipated} = \Gamma^2 * P_{in} \quad (3) \quad \text{Power dissipated in the termination resistor}$$

$$P_{dissipated} = 0.16^2 * 35 = 910 \text{ mW}$$