APPLICATION NOTES

Internet Copy Rev 0

IMPEDANCE MATCHING PADS

Overview

Impedance matching pads are used to match different impedances. Let's say you are connecting a 75W cable to 50W test equipment, factors such as the length of the transmission line on either side of the connection (with respect to the signal rise and fall times), shift in impedances, reflections due to the mismatch, may degrade your signal. To avoid this problem, a matching pad can be added to the connecting junction.

Figure 1: Broadwave Impedance Matching Pad

Types of matching pads

The two main types of circuitry used for impedance matching are transformers and resistive matching pads. The differences for both types are stated below.

Transformer matching pads

- Used mainly in AC coupled application, where no meaningful DC content exists.
- Such wideband applications include audio and video.
- Generally has a lesser loss than the resistive types.
- Does not work at DC.

Resistive matching pads

- Used in wideband application, insuring good impedance translation.
- Passive elements only.
- Works from DC onwards.

Resistive matching pads explored

Some of the common resistive matching pad configurations include Pi (Figure 2), T (Figure 3) and L (Figure 4) matching pads. Resistive matching pads can be designed for greater or equal to the minimum loss, but not lesser than the minimum loss. For example, a 75W to 50W matching pad will have a minimum loss of 5.7 dB.

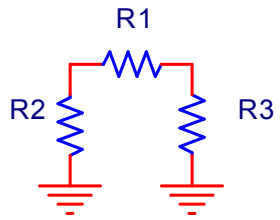

Figure 2: Pi matching pad

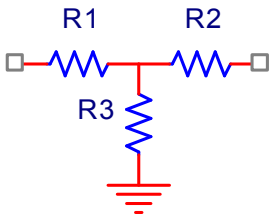

Figure 3: T matching pad

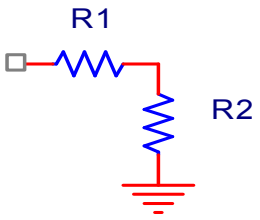

Figure 4: L matching pad

IMPEDANCE MATCHING PADS

Terms and Definitions

When choosing a matching pads, here are some key parameters you need to consider.

Frequency range: This is application specific.

VSWR: Voltage Standing Wave Ratio (VSWR) is the ratio of maximum and minimum voltage at a given point along a transmission line. VSWR is a good measure of power transfer efficiency. A low VSWR (i.e. closer to unity with little or no reflections) means more power is delivered from the source to the load, while a high VSWR (i.e. much greater than 1 with lots of reflection within unit) has less power delivered to the load.

Insertion loss: Insertion loss is defined as the decrease in the transmitted signal power due to the insertion of a device (the matching pad) in a transmission line. It is usually expressed in decibels (dB).

Mismatch loss: Mismatch loss is the measure of how much transmitted power is attenuated due to reflection caused due to a mismatch of impedances in the transmission line.

Calculations

Given below are formulae and calculation for a resistive matching pad (Figure 5). It is assumed Zo > ZL for the following calculations)

Zo – Source Impedance

ZL – Load Impedance

G – Reflection coffecient

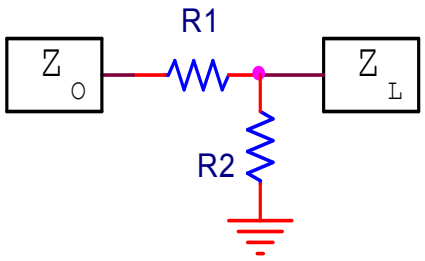

Figure 5: Resistive matching pad

$|G| = |(ZL - Zo)/(ZL + Zo)|$

Mismatch Loss = $-10\log(1- |G|^2)$

Power Loss = $10 \log(Pd/Ps)$

$= 10 \log(ZL/Zo) + 20 \log (Zo / (2Zo- (\mathbf{sqrt((Zo- ZL^2)/(Zo-ZL))} // ZL)))$

(Where Pd is Power dissipated and Ps is power available from the source. // denotes parallel addition of impedances)

Note: All the calculations are based on the resistors placement in Figure 5. If your pad is other way around (mirror image), changes the values accordingly

Things to consider

When choosing impedance matching pads for your application, a few main things to consider would be the VSWR and insertion loss of the pad. Resistive matching pads have an inherent loss that need to be taken into account during measurement. If you are using the most commonly used 75-50W (or 50-75Wmatching pad, the fact that its insertion loss is inherently 5.7dB has to be taken into account, especially when it is used as part of a 50W measurement system.

Applications

- Test stations.
- Any system where different impedances need to be matched,

IMPEDANCE MATCHING PADS

Broadwave Technologies Impedance Matching Pads

Given below are some of the general specifications of some of Broadwaves's impedance matching pads. Standard 50-75 W and 75-50 W are available. Special pads for different impedances are available upon request. For more detailed information, specifications or to view entire catalog, please visit our website. If you are unable to find something to your specifications, feel free to contact us.

Impedance Matching Pads (Part no: 25X-XXX-XXX)	
Connector Types	SMA, N, TNC, BNC, F. Other
Impedance *	Typically 50W/75W units
Input Power (Average)	Up to 1W
Frequency Range	DC to 3 Ghz

Note: * Different impedance values are available upon request. Contact us for more information.

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