TERMINATIONS / DUMMY LOADS

A termination is a one-port device with an impedance that matches the characteristic impedance of a given transmission line. It is attached to a certain terminal or port of a device to absorb the power transmitted to that terminal or to establish a reference impedance at that terminal. Important parameters of a termination are its VSWR and power handling capacity. In a receiver, terminations are usually placed at various unconnected ports of components such as hybrid and power dividers to keep the VSWR of the signal path low. It is extremely important that the isolated port in a directional coupler and the unused port of a power divider (i.e., only three ports of a four-way power divider are used) be properly terminated. All of the design considerations of directional couplers and power dividers are based on the fact that all ports are terminated with matched loads. If an unused port is not properly terminated, then the isolation between the output ports will be reduced which may severely degrade the performance of the receiver.

A termination is the terminology used to refer to a low power, single terminal device intended to terminate a transmission line. Similar devices designed to accommodate high power are generally termed dummy loads.

TERMINATIONS:

Terminations are employed to terminate unconnected ports on devices when measurements are being performed. They are useful as dummy antennas and as terminal loads for impedance measurements of transmission devices such as filters and attenuators.

The resistive elements in most terminations are especially fabricated for use at microwave frequencies. Two types are commonly employed: (1) resistive film elements, and (2) molded resistive tapers. The resistive film is very thin compared to the skin depth and normally very short relative to wavelength at the highest operating frequency. The molded taper consists of a dissipative material evenly dispersed in a properly cured dielectric medium. Both forms of resistive elements provide compact, rugged terminations suitable for the most severe environmental conditions with laboratory stability and accuracy.

Terminations should be properly matched to the characteristic impedance of a transmission line. The termination characteristics of primary concern are:

a. operating frequency range
b. average power handling capability
c. operating temperature range
d. VSWR
e. size
f. weight

Many microwave systems employ directional couplers which require terminations on at least one port, and most have various modes of operation or test where terminations are needed on certain terminals.

A matched termination of a generalized transmission line is ideally represented by an infinite length of that line having small, but non-zero loss per unit length so that all incident energy is absorbed and none is reflected.

Standard mismatches are useful as standards of reflection in calibrating reflectometer setups and other impedance measuring equipment. They are also used during testing to simulate specific mismatches which would be encountered on the terminals of components once the component is installed in the actual system. The following table shows common mismatches with the impedance that can provide the mismatch.

Common Mismatches (Z_O = 50 Ω)		
Ratio	Z_L (higher)	Z_L (lower)
1.0 : 1	50 Ω (matched)	50 Ω (matched)
1.25 : 1	62.5 Ω	40 Ω
1.50 : 1	75 Ω	33.3 Ω
2.00 : 1	100 Ω	25 Ω

DUMMY LOADS

A dummy load is a high power one port device intended to terminate a transmission line. They are primarily employed to test high power microwave systems at full power capacity. Low power coaxial loads are generally termed terminations and typically handle one watt or less.

Most radars or communications systems have a dummy load integrated into them to provide a non-radiating or EMCON mode of operation, or for testing (maintenance).

Three types of dissipative material are frequently employed in dummy loads: (1) lossy plastic, (2) refractory, and (3) water.

The lossy plastic consists of particles of lossy material suspended in plastic medium. This material may be designed to provide various attenuations per unit length but is limited as to operating temperature. It is employed primarily for low power applications.

The refractory material is a rugged substance that may be operated at temperatures up to 1600°F. It is virtually incapable of being machined by ordinary means but is often fabricated through diamond wheel grinding processes. Otherwise material must be fired in finished form. Such material is employed in most high power applications.

The dissipative properties of water are also employed for dummy load applications. Energy from the guide is coupled through a leaky wall to the water which flows alongside the main guide. Water loads are employed for extremely high power and calorimetric applications.

While dummy loads can operate over full waveguide bands, generally a more economical unit can be manufactured for use over narrower frequency ranges.

The power rating of a dummy load is a complex function dependent upon many parameters, including average and peak power, guide pressure, external temperature, guide size, air flow, and availability of auxiliary coolant. The average and peak powers are interrelated in that the peak power capacity is a function of the operating temperature which in turn is a function of the average power.