POWER DUMMY LOADS / TERMINATIONS

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POWER DUMMY LOADS

Alumina power loads

ALUMINA POWER LOADS

Introduction

TEMEX proposes a new line of power load ranging from 3 to 100 W. The carrier substrate is alumina and the design allows an advantageous alternative against the traditional BeO substrate up to 100 W, without its environmental inconvenience.

Standard range of loads - Alumina substrate

- Power loads are manufactured using a resistive thick film technology on alumina substrate
- Silver-Palladium metallization for connection pads
- Impedance: 50 Ω ± 5 % (DC)
- Metallization on the bottom face for grounding and better thermal contact

Overview

Nearly all microwave circuits require the transmission of electric power to a resistance that evacuates the power in the form of heat either as a part of their operation cycle or as a security system. To produce these kind of resistances, three materials have traditionally been used : Al2O3, BeO and AlN.

Unfortunately, OSHA lists BeO dust as a hazardous substance and a probable carcinogen in humans. So, all equipments using BeO ceramic parts must have a warning sticker on their cover; therefore, when the equipment has run its lifetime and is removed from service, BeO must be removed and disposed of properly.

This leaves low cost, traditionally medium performance Al2O3 and high cost AlN available for use. But TEMEX met the challenge and designed a line of components from Al2O3 which draws the maximum out of this material for most microwave applications which typically operate under 100 watts, and matched or improved on BeO performance as a bonus.

Our strengths

Low cost, non toxic substrate material
VSWR of 1.05:1 typical with our resistive thick film technology on Al2O3 substrate
Patents on a metallized hole which reduces or eliminates the capacitance effect
Prices lower than AlN terminations

Key things to remember

100 Watt BeO free load $1: who said environmental friendly products had to be expensive?
TEMEX, an ISO14001 company which protects both
environment and your applications !

ALUMINA POWER LOAD FAMILIES

Standard version: electrical and physical characteristics

Power PN (W)	Power PM (W)	L (mm)	l (mm)	e (mm)	L (")	W (")	t (")	VSWR	Fo Range (MHz)	Reference	Remark
5	5	1.520	1.240	0.380	0.060	0.049	0.015	1.05	0 to 6000	1128 0A	
10	10	2.800	1.300	0.380	0.110	0.051	0.015	1.05	0 to 4000	1061 0A	
10	10	2.800	1.300	0.380	0.110	0.051	0.015	1.05 1.10	0 to 3000 3000 to 4000	1061 0B	
10	10	2.800	1.300	0.380	0.110	0.051	0.015	1.05 1.10	0 to 2000 2000 to 4000	1061 0C	
15	20	3.000	1.500	0.635	0.118	0.059	0.025	1.10 1.20	0 to 3500 3500 to 5000	1160 0A	
25	30	5.000	1.900	0.635	0.197	0.075	0.025	1.05 1.10 1.20	0 to 2000 2000 to 2500 2500 to 3000	1159 0A	
25	30	5.000	1.900	0.635	0.197	0.075	0.025	1.05 1.10 1.20	0 to 1500 1500 to 2000 2000 to 3000	1159 0B	
25	30	5.000	1.900	0.635	0.197	0.075	0.025	1.05 1.10 1.20	0 to 1000 1000 to 2000 2000 to 3000	1159 0C	
30	40	5.300	3.000	1.000	0.209	0.118	0.039	1.05	0 to 2000	1132 0A	
30	40	5.300	3.000	1.000	0.209	0.118	0.039	1.05 1.10	0 to 1500 1500 to 2000	1132 0B	
40	50	6.300	6.300	1.000	0.248	0.248	0.039	1.05	0 to 3500	1126 0A	
40	50	6.300	6.300	1.000	0.248	0.248	0.039	1.05 1.10	0 to 3000 3000 to 3500	1126 0E	
40	50	6.300	6.300	1.000	0.248	0.248	0.039			1131 0A	customized*
50	70	6.300	6.300	0.635	0.248	0.248	0.025	1.05	900 and 1800	1070 0A	
50	70	6.300	6.300	0.635	0.248	0.248	0.025	1.10 1.05	900 1800	1070 0B	
50	70	6.300	6.300	0.635	0.248	0.248	0.025	1.05 1.10	900 1800	1070 0C	
50	70	6.300	6.300	0.635	0.248	0.248	0.025	1.10	900 and 1800	1070 0D	
50	70	6.300	6.300	0.635	0.248	0.248	0.025			1130 0A	customized*
60	80	9.400	6.300	1.000	0.370	0.248	0.039	1.05	900 and 1800	1121 0A	w test pad
60	80	9.400	6.300	1.000	0.370	0.248	0.039	1.10 1.05	900 1800	1121 0B	w test pad
60	80	9.400	6.300	1.000	0.370	0.248	0.039	1.05 1.10	900 1800	1121 0C	w test pad
60	80	9.400	6.300	1.000	0.370	0.248	0.039	1.10	900 and 1800	1121 0D	w test pad
70	100	8.400	6.300	1.000	0.331	0.248	0.039	1.05	900 and 1800	1129 0A	

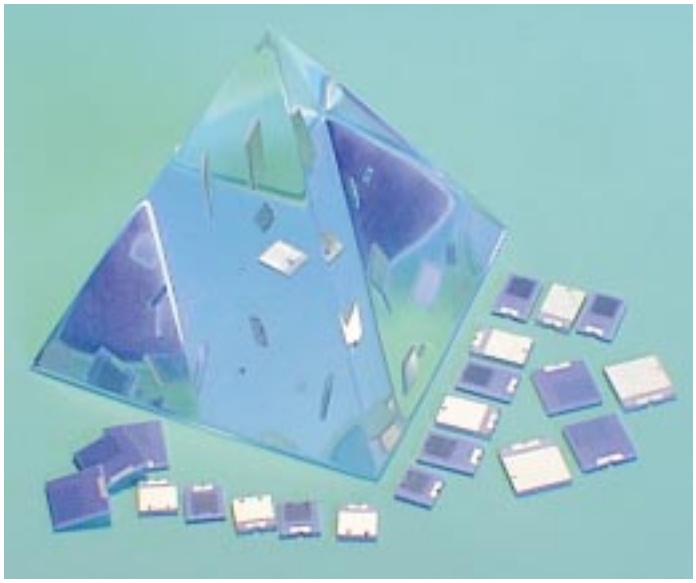
***Customized parts: Include capacitive elements to match particular specifications.**

ALUMINA POWER LOAD FAMILIES

New SMD power termination versions

New SMD power termination versions

Our patent pending design using a non hazardous material was just the first step. With a power range up to 100 Watts, a purely resistive effect at the nominal frequency - i.e. no capacitive effect, so no specific pattern with the microstrip line - and a typical VSWR of 1.05, our product line was just missing an SMD capability.



And the TEMEX power terminations are not missing this capability any longer! We are proud to announce that we are now able to propose SMD versions up to 40 Watts. These loads are especially designed for mass-production equipments where soldering is done in one reflow pass.

Power P_N (W)	Power P_M (W)	L (mm)	l (mm)	e (mm)	L (")	W (")	t (")	VSWR	Fo range (MHz)	Reference
10	10	5.000	2.400	1.000	0.197	0.094	0.039	1.20	0 to 2000	1168 0A
15	20	6.200	6.200	1.000	0.244	0.244	0.039	1.20	0 to 2000	1169 0A
25	30	9.400	6.200	1.000	0.370	0.244	0.039	1.20	0 to 2000	1170 0A
30	40	9.400	9.400	1.000	0.370	0.370	0.039	1.20	0 to 2000	1171 0A

Parts can be delivered worldwide from stocks.

Nominal power definition

The power indicated in the chart is the nominal load power P_N. Its value is defined with the following formulae:

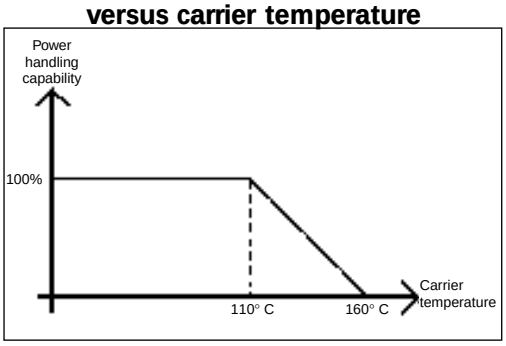
$$P_N = 0.6 \times P_R \text{ and } P_M = 0.8 \times P_R$$

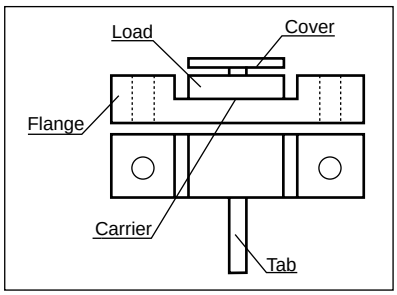
where P_R and P_M are respectively the breaking and maximum working power. Thus even if our loads can work without any problem at the PM power, we have decided to defined them for the P_N rating to improve their reliability.

General overview

Our alumina power terminations are designed to handle 100% of the nominal power with a carrier temperature up to 110° C as shown on this diagram.

Derating power versus carrier temperature

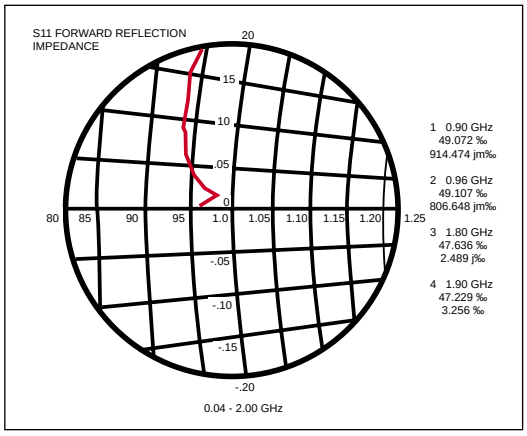


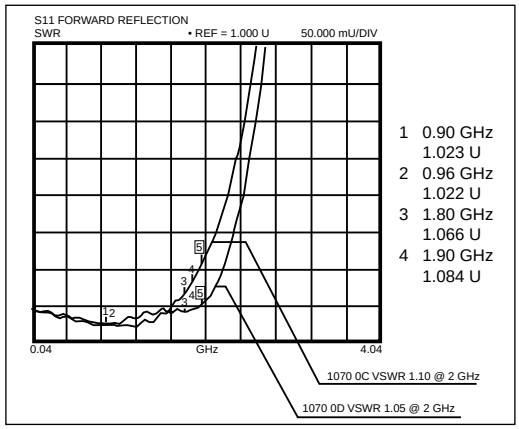


In addition to the load itself, we can provide tab, flange or cover options.

Examples of Smith charts and VSWR graphs are given below:

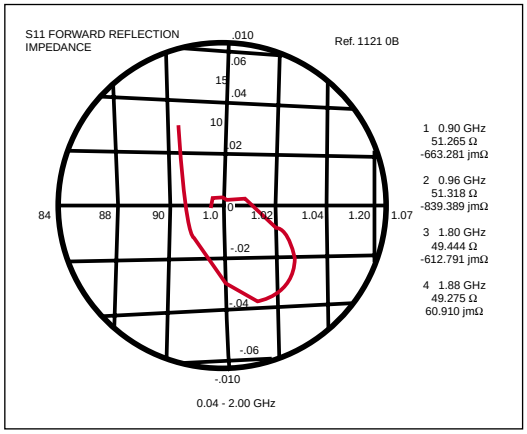
• 50W alumina load reference 1070

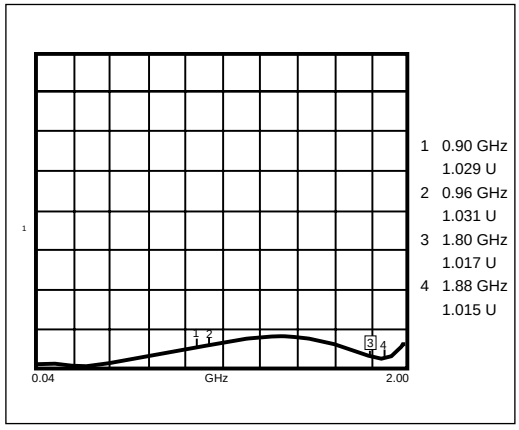




At the operating frequency, the load is inductive with a VSWR ratio of 1.05:1

• 60W alumina load reference 1121





At the operating frequency point, the load is capacitive with a VSWR ratio of 1.02:1

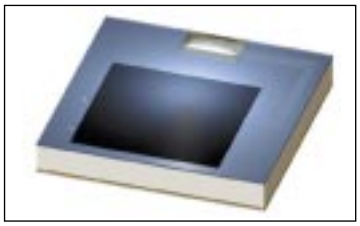
BASIC ALUMINA POWER LOAD

Technical notes

TECHNICAL NOTES

Overview

Purpose of a termination is to dissipate the reflected energy in order to protect the microwave source. So, according to the application, designers know what is the maximal power the termination will have to handle. Then, surface of the termination will depend on both the nominal power and the thermal conductivity coefficient of the material used.



Thermal conductivity of common materials is given hereafter:

BeO :	200W/mK
AlN :	150W/mK
Al2O3 :	25W/mK

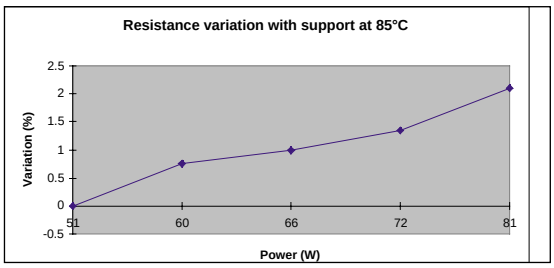
It means that for the same size resistor film and power dissipation, the Al2O3 resistive film will run hotter than the BeO one. Therefore, to avoid running the Al2O3 resistor film above its maximum, either the power rating must be lower than the BeO or the termination surface bigger. Due to its high thermal conductivity, BeO material dominates the market and is used in nearly all the power terminations.

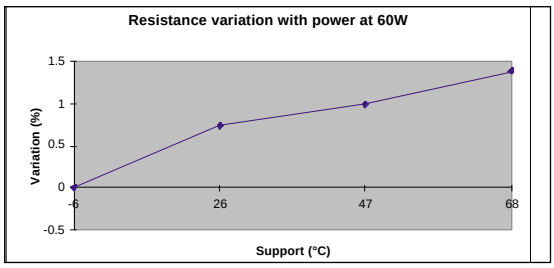
However, as BeO dust has been stated as a hazardous substance, power load manufacturers have had to develop a new range of products. According to its thermal conductivity, which is close from the BeO one, the new power loads are made from AlN. But the cost of such a part, for a given power, is three times higher!

TEMEX then decided to look for another solution. Today, we are proud to provide an innovative design using Al2O3, with better VSWR performances and at a similar cost than the BeO one. Our products are perfectly matched as capacitance is compensated by inductance elements integrated onto the load itself (patent pending).

Resistance variation

The power load resistance value is affected by both handled power and support temperature. In our alumina terminations, from low power to nominal power, the variations are very low, allowing us to meet very tough specifications.

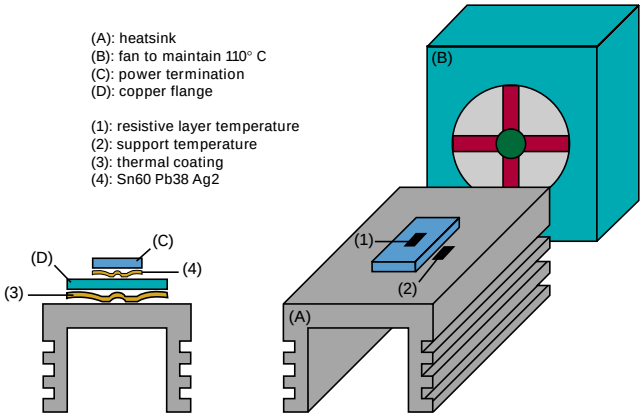




MEASUREMENT METHODS

1- Maximum power P_M measurement

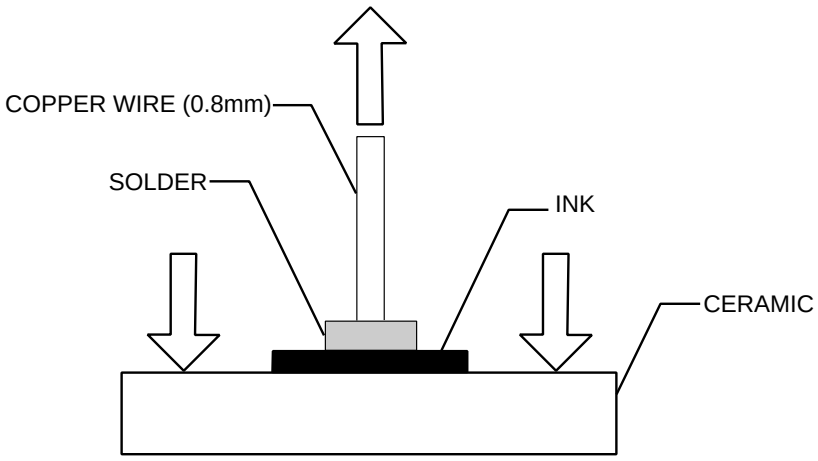
The maximum power P_M is the last measurement done before the destructive power PR is reached. We consider that the destructive power is reached when the load resistance value exhibits non-



reversible modification of more than one percent over R_{IN}.
To achieve this measurement, we must maintain the support temperature (2) at a value lower than 110° C. For information, the layer temperature (1) can increase to values up to 300° C or more.

Equipment: power supply (up to 100W), voltmeter, ampermeter, thermometer and specific bench.

2- Silver layer adherence measurement



The following system allows us to measure the maximum perpendicular strength we can apply on the soldering before wrecking. The copper wire is soldered to the ink layer using a hotplate at 80° C, a SnPbAg (62/36/2) solder and a medium active flow.
It should be noticed than a parallel pull test is also conducted, based on a similar principle.

BASIC ALUMINA POWER LOAD

Measurement methods

Equipment: balance and specific bench.

3- VSWR measurement

We are doing a final control on every manufactured batch regarding the VSWR parameter. Our sampling quantity is based on NFX06-022 specification, level II.

Equipment: network analyzer, specific probes.

Process characteristics

Solder must be SnPbAg (62/36/2) with a medium active flow like ALPHA611,

Maximum hotplate temperature is 100° C,

Soldering iron temperature is around 235° C.

It should be noticed that two soldering iron temperatures are available. The low temperature is 235° C (low soldering temperature) and it is used in normal conditions to connect a standard wire to the power termination. If the customer requires a tab, the process is then splitted:

- First stage is to solder the tab to the load at a high temperature of 300° C (high soldering temperature),
- Second stage is to solder the tab to the isolator strip at a low temperature of 235° C (low soldering temperature), thus preventing the tab to unsolder.

A medium active flow might attack the surface oxides to allow a good soldering quality, but also should not corrode the de-oxidized metal (silver).

The protective layer is a dielectric 850° C or a glass 650° C one. Our metallization is done with a thick film silver layer or equivalent.

One could also braze using SnPb (63/37) with a reflow soldering process. We can then deliver loads with Ag (10) + Ni + SnPb (90/10) to be brazed.