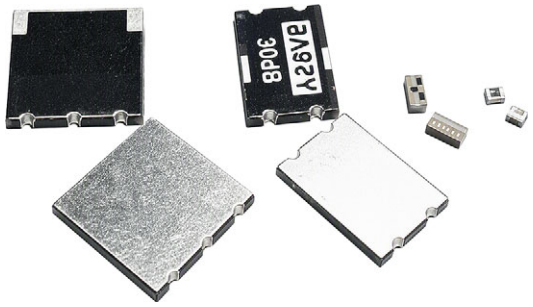
High Power Attenuator Performance Over Frequency

By Vishay Barry

Tuning, physical layout, power handling and design account for the performance of an attenuator. The combination of these factors enable circuit designers the ability to adjust power levels in the operation of their RF and Microwave circuit designs.

For thick film attenuator design, the resistors that make up the attenuator circuit are laser trimmed while monitoring the resistance values. This measurement is done at DC and may differ from the value needed at the desired frequency of operation.



For many attenuator designs the circuit is laid out as a PI network (Fig. 1.) with two shunt resistors connected by a series resistor. As attenuation values are increased the amount of power dissipated (as a percentage of input power) in these resistors shifts from the series resistor to the input shunt resistor. This power shift is reflected in most designs and with the design change, the slope of the attenuator (attenuation vs. frequency) is different for low, mid and high attenuation values.

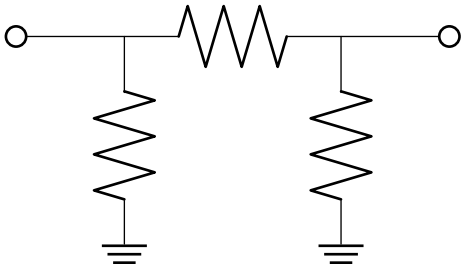


Fig. 1 - PI Attenuator Circuit

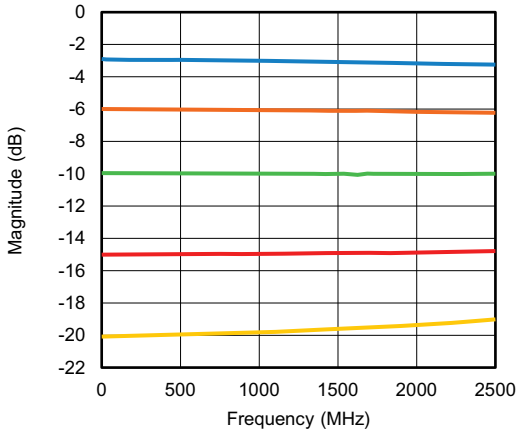


Fig. 2 - Typical Attenuator Frequency Response

Fig. 2 shows how the typical attenuation response changes as the attenuation value increases. Design layout will affect these slopes and power handling is usually the controlling element. For limited frequency applications where the attenuation value needs to be at a certain value, the DC attenuation is shifted to get the desired attenuation value.

Custom attenuators may affect the slope more than the standard catalog attenuators. For high attenuation values RF leakage across the chip is usually the limiting factor in the slope performance.

TECHNICAL NOTE

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Typical designs will have the following characteristics:

CHARACTERICTICS										
ATTENUATION VALUE (dB)	FREQUENCY OF OPERATION (DB)			RELATIVE SLOPE OVER FREQUENCY	ATTENUATION VALUE (dB)	FREQUENCY OF OPERATION (DB)			RELATIVE SLOPE OVER FREQUENCY	LESS ATTENUATION
	LOW	MID	HIGH			LOW	MID	HIGH		
1	1.1	1.2	1.3		11	11.0	11.0	11.0		·
2	2.1	2.2	2.3		12	12.0	12.0	12.0		•
3	3.1	3.2	3.3		13	13.0	12.9	12.9		•
4	4.1	4.2	4.3		14	14.0	13.9	13.9		•
5	5.1	5.1	5.2		15	15.0	14.9	14.8		•
6	6.0	6.1	6.2		16	16.0	15.9	15.8		•
7	7.0	7.1	7.1		17	17.0	16.9	16.7		•
8	8.0	8.1	8.1		18	18.0	17.9	17.6		•
9	9.0	9.0	9.0		19	19.0	18.9	18.6		•
10	10.0	10.0	10.0		20	20.0	19.9	19.6		•
										MORE ATTENUATION

TECHNICAL NOTE