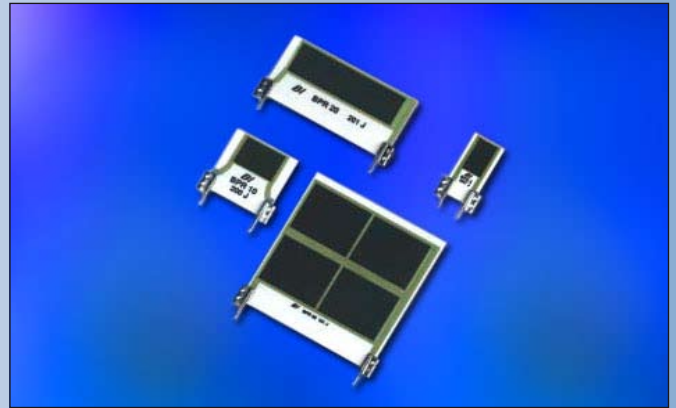
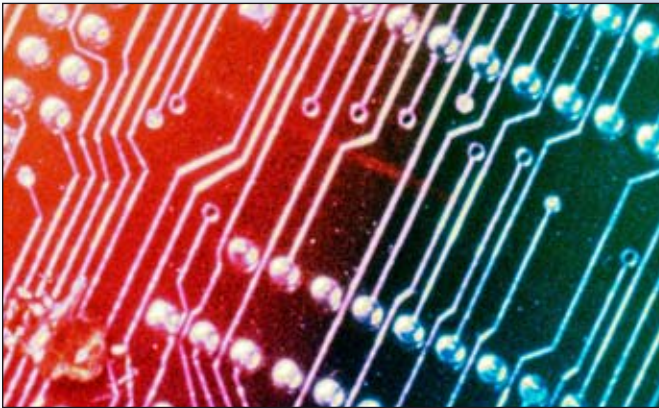


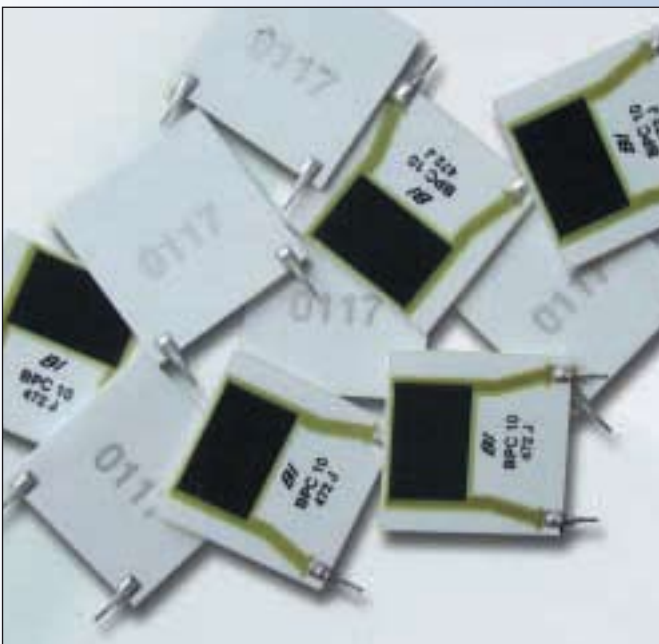
PLANAR SURGE RESISTORS - Application Note



Non-inductive Planar Thick Film Power Resistors

Thick-film on ceramic offers a highly compact resistor technology for surge and overload applications. This Application Note illustrates some of the many applications, which range from PSU inrush

suppression to high voltage laser supply current limiting, and the TT electronics products which meet their high surge requirements.



Features

- Planar thick film
- Low inductance
- High frequency operation
- Vertical mount
- Low board level temperature
- 20x rated power surge

Applications

- Switching Power Supplies
- Snubbers
- Inrush Current Suppression
- Current Limiters

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1. Inrush current suppression

The planar resistor may be used to limit inrush current when a power supply is switched on. Figure 1 shows a typical PFC circuit in which two BPC10 resistors in series function in an inrush current suppression circuit which operates principally at switch-on.

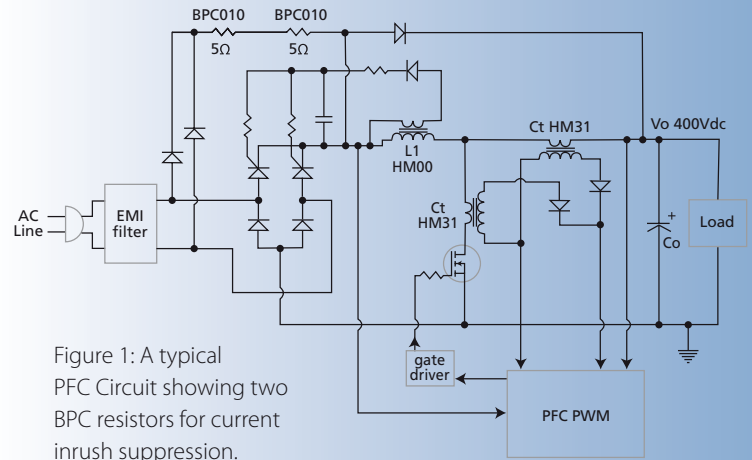


Figure 1: A typical PFC Circuit showing two BPC resistors for current inrush suppression.

2. Snubber circuits and Start-up Circuits

The planar resistor may be used in series with a capacitor in a snubber circuit to filter spikes in the rising and falling edges of square waves. In Figure 2 BPC3 500Ω is used. Figure 2 also includes a start-up circuit that provides 18 Volts to the PWM while the power supply is turning on. In this case a 50kΩ, BPC5 is utilised.

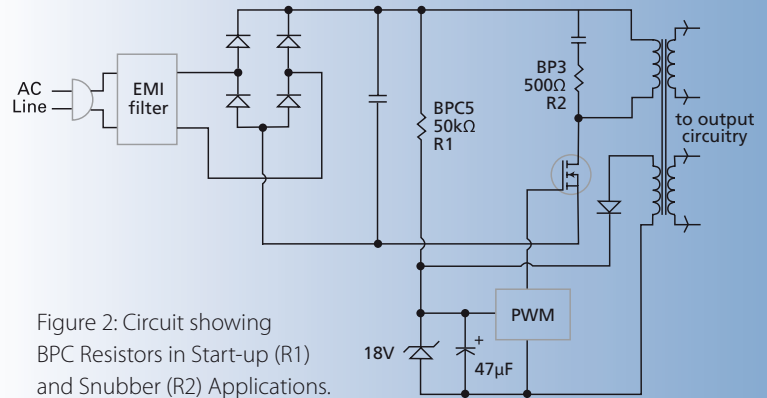


Figure 2: Circuit showing BPC Resistors in Start-up (R1) and Snubber (R2) Applications.

3. Inrush current limiting

This resistor limits the amount of current allowed to surge into the system at turnon. Power resistors in this circuit must be able to withstand a 20x nominal surge for 8msec. This is typically a 15Ω, 7-10 watt, 10% resistor. A typical location of this resistor is shown in Figure 3. This resistor carries the main current load.

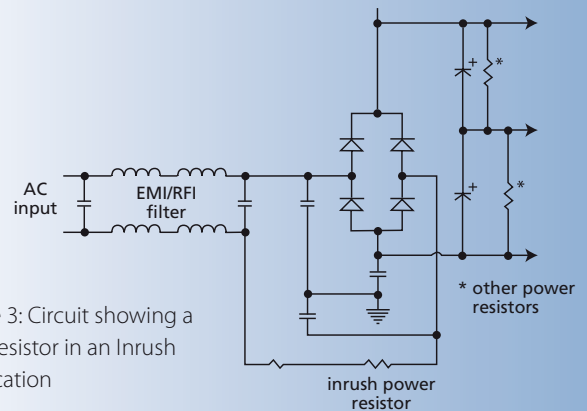


Figure 3: Circuit showing a BPC Resistor in an Inrush Application

4. Other Snubber Circuits

In these applications the power resistor bleeds current of the magnetics to prevent inductive spikes. This resistor will experience voltage spikes at 2x the switchmode switching frequency. This is typically a 500Ω to 1kΩ, 3W to 5W, 2% to 5% resistor. Circuit configurations are found in Figure 4.

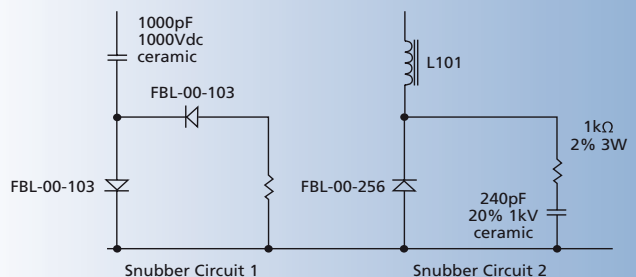


Figure 4: Snubber circuits found in power supplies

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5. Biasing (Current conditioning)

These resistors do not experience surges or spikes. This is a steady state application. In these applications the resistor values vary considerably from 200Ω to 20kΩ, 3W to 5W, 2% to 5%. An example is shown in Figure 5.

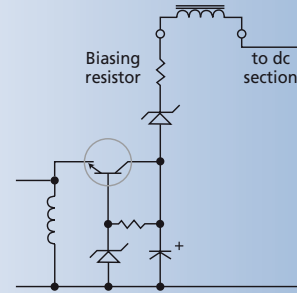


Figure 5: Circuit from a high-current power supply which uses a BPC resistor for Biasing

6. Preloading (1)

This resistor experiences a steady state condition. The typical resistor is 3Ω to 1kΩ with 10% tolerance. The preloading is usually a function of the circuit. An example is shown in Figure 6.

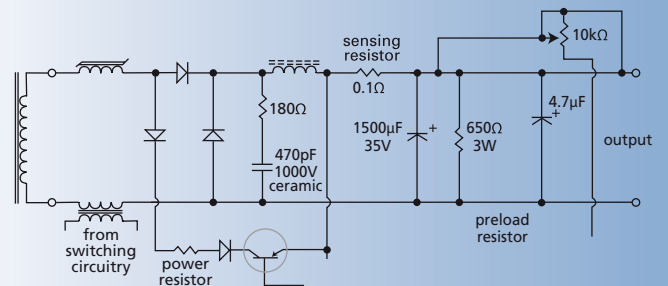


Figure 6: Part of proprietary power supply showing two power resistors

7. Current Limiting

Planar resistors have uses as current limiters in high-voltage power supplies. An example of a high voltage power supply, which is used to drive a laser, is shown in Figure 7 where BPC5 is used for current limiting.

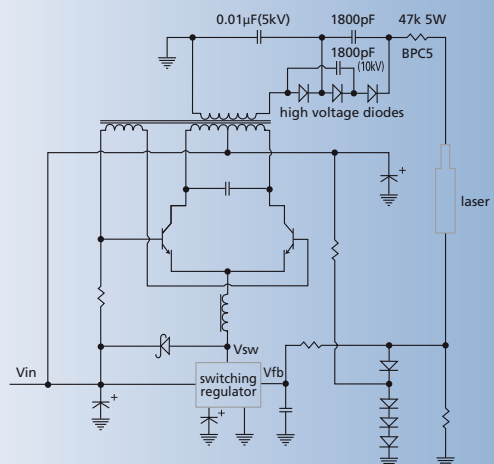


Figure 7: Laser power supply showing a BPC5 for current limiting

PLANAR SURGE RESISTORS - Application Note

8. Preloading (2)

Another example of preloading is in a Battery Charger circuit as shown in Figure 8 where a resistor is used as a dummy load to prevent overcharging the battery.

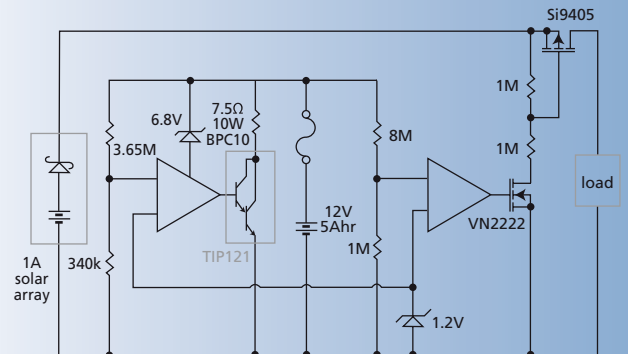


Figure 8: Shunt battery charger which uses a BPC10

Advantages of TT electronics Planar Surge Resistors

- **Planar Thick Film Cermet Resistor - Very low inductance for high frequency operation.**
- **20x Rated power surge capability.**
- **Low operating temperature at board surface means high temperature solder is not required.**
- **Large surface area to thickness ratio - maximises power dissipation, minimises hot spots.**
- **Vertical mounting. Power is dissipated above the circuit board. Enhances board cooling due to natural convection flow.**
- **Minimises required board area. Uses only a third board area versus a typical wirewound resistor.**
- **BPR is ideal for high shock & vibration environments.**
- **BPC offers thermal isolation between resistor element and PCB, and so ideal for slow overloads.**
- **PWP gives a minimum height solution, and is characterised for fast surges.**

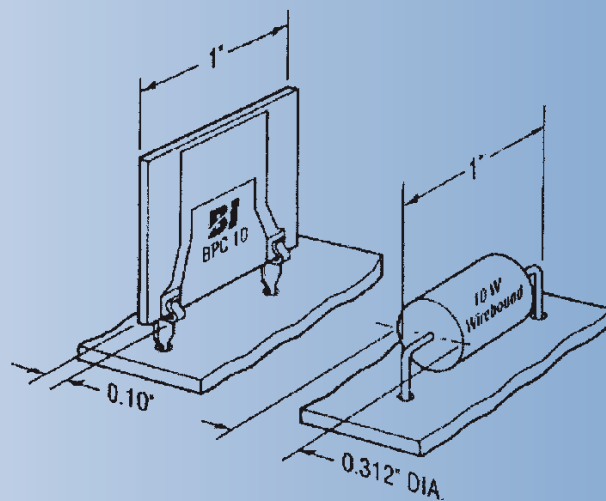
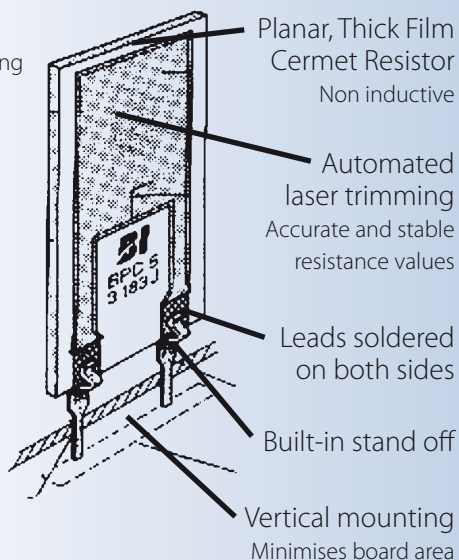
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Planar Resistor Format

Vertical mounting
Enhances board cooling
due to natural
convection airflow

Large surface
Maximises power
dissipation and
minimises hot spot

Low operating
temperature
Maximises power
dissipation and
minimises hot spot



	BPC	BPR	PWP
Power Rating (W)	3 - 10	3 - 50	0.4 - 2
Surge Rating (J) 8ms duration	0.6 - 1.6	0.6 - 8	6 - 70
Value Range	OR1 - 200K	OR1 - 200K	100R - 200K
Technology	Thick film	Thick film	Thick film
Format	Through hole	Through hole	Through hole
Package	Planar radial	Planar radial	Planar radial
Features	Small footprint	Vibration resistant	Low (6.35mm) profile

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