



# Bourns® Resistive Products

## Diverse Requirements Drive Innovations to Pulse Resistors



CR Series



CRT/CRL Series



PWR Series



PWR4412



PWR220

### Introduction

Countless circuits depend on the protection provided by one of the most fundamental types of passive components: the resistor. As the size of electronic products shrink, resistors must offer higher current densities and higher pulse ratings necessary to meet specific requirements for protection, including those characterized by EN 61000. With one of the industry's leading lines of innovative current sense, shunt, and pulse withstanding resistors, Bourns is able to provide a solution that meets the requirements of a broad range of applications. For fast acting high voltage transient applications, Bourns® CRM chip resistors offer a different solution than the Metal Electrode Leadless Face (MELF) resistors typically used. In inrush current limiting applications, Bourns® PWR resistors provide designers the ability to follow trends that provide cost and space savings. These two applications will be explored, and a glimpse will be provided into features Bourns has designed into other resistive products that set the company apart from other manufacturers, such as higher power and better materials.



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## Resistors for Fast Acting High Voltage Transients

Electronic circuits connected to power lines or signal lines must be capable of withstanding a wide range of surges. A surge can be induced onto a circuit board by changes in the power distribution system such as capacitor banks switching, noise from semiconductor devices, and coupling or decoupling of heavy inductive loads. Atmospheric conditions like lightning storms can induce transients into a power distribution system or signaling network as well. EN 61000 defines standards for measuring the magnitude of certain transients. As shown in table 1, the transient is classified by a level based on its strength and shape, such as a 1.2/50  $\mu$ s pulse, and is tested to withstand the given open circuit voltage.

Level	Open Circuit Test Voltage
1	0.5 kV
2	1.0 kV
3	2.0 kV
4	4.0 kV

Resistors may be expected to withstand high voltages if they are used to measure voltage in metering circuits or rectifiers in power supplies. Traditionally, cylindrical shaped resistors such as MELF types are preferred for such purposes because they have proven more robust than standard rectangular chip resistors. The cylindrical surface provides a larger surface area of resistive material, thus allowing for higher power ratings and higher pulse resistance than standard chip resistors.

### Pulse Resistant Chip Resistors

Advances in resistive film technology combined with improved trimming techniques have made it possible to offer chip resistors with continuous power ratings and pulse resistances to match those of cylindrical resistors. Bourns® CRM series resistor is designed to withstand high pulses, though the capability does not require a taller package or any additional board real estate. It has the same dimensions as any standard chip resistor with the additional benefits of pulse ability, high power rating, and good surge capability. This part is rated for 2 W of continuous power and has a wide resistance range for sensing current and limiting inrush current in applications such as stepper motors drives and power supplies. It is commonly used in parallel with a Metal Oxide Varistor (MOV). Comparing Bourns® model CRM0805 resistor, for example, with an existing MELF resistor in table 2 shows there is no difference in key electrical specifications.



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Model	Peak Pulse (kV)	Power (W)	Length (mm)	Width (mm)	Termination length (mm)
MELF type	1	0.25	2.2	1.1	0.4
Bourns® CRM0805	1	0.25	2	1.2	0.4

The benefits of specifying a Bourns® CRM series thick film chip resistor include greater reliability in assembly and lower cost. MELF resistors have yield issues in assembly due to rolling during board mount, and the more economical Bourns® CRM chip resistor’s flat chip package has no such yield issues. The pulse characteristics of Bourns® CRM series can be summarized in figure 1. Based on the EN 61000 levels in table 1, all of the sizes qualify for levels one to three, and the larger two qualify for all four levels.

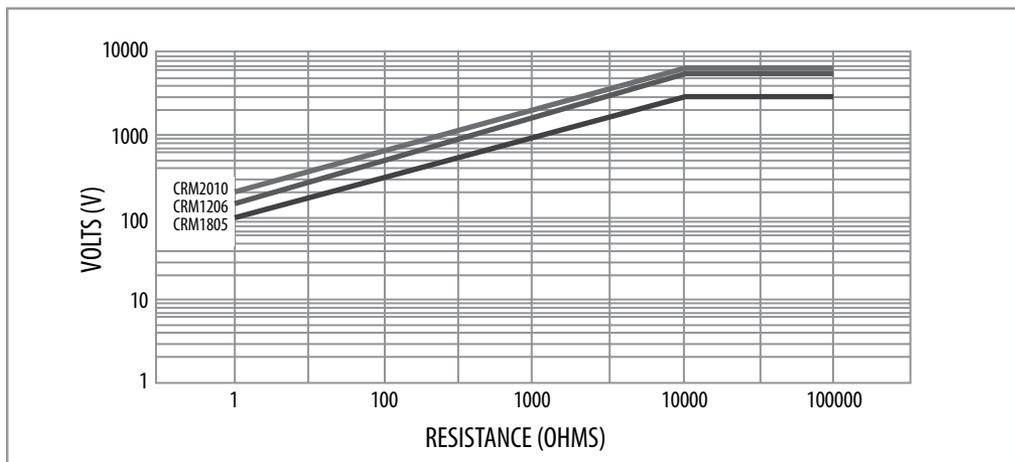


Figure 1 | Bourns® CRM Pulse Characteristics

Bourns® CRM2512-FT is a variation of the part adapted to telecommunications applications. It is tested to 1.5 kV with a 10/700 μs waveform and can withstand 600 V per ITU K.20, K.21, and K.45 specifications. Bourns® CRM2512-FT resistor is used in ADSL and VDSL ports and with metallic ended line test chips.



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## Resistors for Inrush Current Limiting

Another area in which Bourns® pulse resistors offer advantages to traditional circuit design is inrush current limiting. Here, a resistor has to withstand a sudden inrush of current from an alternating current (AC) mains supply. As shown in figure 2, a wirewound resistor used in series with a fuse protects the power supply from short circuit conditions and from surges above the specification.

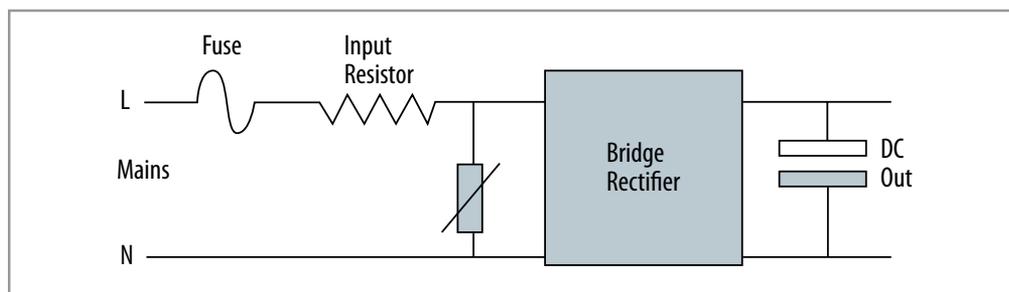


Figure 2 | Typical Inrush Current Limiting Circuit

An observable trend in inrush current limiting circuits is to move away from the separate fuse and resistor configuration to a single component, as shown in figure 3. Bourns recently released a resistor designed with both functions of a current limiting fuse combined into one. Bourns® PWR4522 is a newer wirewound axial leaded fusible power resistor with a UL-rated flame-resistant coating. This resistor was designed to fuse safely at sixteen times the rated power in no more than 45 seconds. It fuses safely in less than one second when 220/240 mains voltage is applied. Using an integrated resistor provides the board designer both space and cost savings.

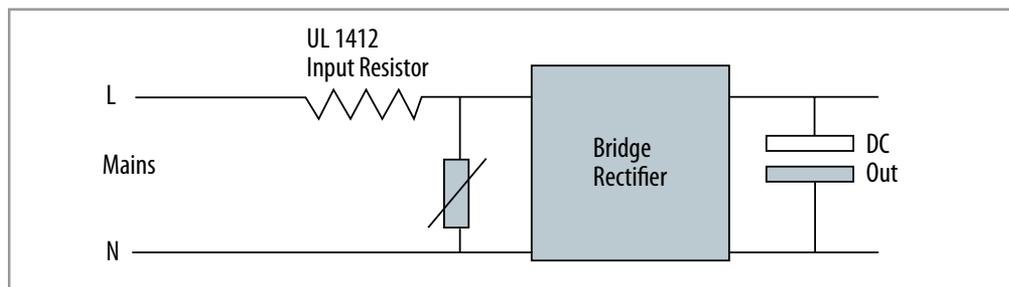


Figure 3 | Integrated Inrush Current Circuit

Consumer and industrial applications requiring the integration of a current limiting and surge-resistant resistor with a fail-safe mains fuse can take advantage of Bourns® PWR4522. Common applications include white goods, inverters, lighting, and metering. Additional resistors in Bourns® PWR series include Bourns® PWR5322, a 1 ohm resistor that can withstand 600 A with an 8/20  $\mu$ s waveform. Frequently used for lightning protection in telecommunications and industrial environments, it withstands surges per IEC 6000-4-5 for simulated lightning-induced surges. Bourns® PWR5322 resistor is suitable for applications with large surges or where there is inrush current such as medical applications, audio, base stations, and telecommunications.



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## Competitive Advantages of Bourns Features

Bourns offers numerous series of resistors with features that provide competitive advantages in pulse and surge circuits. Bourns® CRA2512 resistor uses high-quality copper alloy that improves the performance of the device. It allows for operation at higher frequencies and gives the resistor better power characteristics. These resistors typically are used in power supplies and stepper motor drives, and Bourns® CRF resistor is chosen where resistance values down to 0.001 ohm are required. Bourns® PWR221T-30 resistor has a sealed thermoplastic housing that was designed to be placed on its white alumina ceramic back for contact with a heat sink to dissipate power. This allows for greater strength during surges or sudden bursts of energy. These resistors are ideal for current limiting, current measurement, and capacitor discharge circuits in industrial and telecom applications such as test and measurement equipment, motor drives, rectifiers, and power supplies.

Superior surge performance, greater temperature capability, and high MTBF are advantages of Bourns® PWR163, PWR263, and PWR220 series. Bourns® PWR220-S is one of two resistors offering the performance provided with Manganin Foil technology. This part is superior in terms of TCR, resistance drift over time, and current capabilities compared to other technologies. Bourns® PWR263 series offers excellent pulse power characteristics and its stable resistance only begins to change slightly in higher frequency areas. Bourns® PWR263 resistor frequently is used in battery chargers, high frequency switching, and torque controllers.

Available as a bent metal through-hole resistor, Bourns® PWR4412 and Bourns® PWR4413 have high current capability and low inductance. The special metal alloy welded to leads of tinned copper makes Bourns® PWR4412 resistor quite rugged. Bourns® PWR4412 resistor was designed for current shunt and current sensing applications such as power supplies, motor drives, and many other applications. Bourns® PWR4413 resistor is similar to Bourns® PWR4412 resistor, and it boasts a high overload capability, low inductance, wide operating temperature range, and high power rating. Typical applications include rectifiers, inverter drives, and switching power supplies.



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## Continued Innovation

As power levels increase and telecommunications and automation applications grow, there will be continued demand for smaller high precision resistors that allow for rapid, high yield production. As illustrated in the examples of their application in pulse and inrush current limiting applications, the main differences in the resistors Bourns offers are size, power rating, and pulse handling. Customization is possible in many cases per the requirements of the application. Pulse and performance characteristics are tested at a facility that allows higher power and higher temperature capabilities to be tested compared to the classic models used in the past. Bourns is able to perform specific testing for customers upon request. As a leader in the development of resistive products for decades, Bourns offers a mature and ever-expanding line-up of top quality resistors to meet the needs of current and next-generation designs. To meet high power and surge conditions, a designer can trust Bourns® current, pulse, and surge resistors while focusing engineering resources on the rest of the design with peace of mind.

For further technical support and for more information on Bourns® Resistive Products, please visit

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