Stackpole Electronics, Inc.
*Resistive Product Solutions*

Technical Article

# Resistors in Industrial Applications

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This application highlight will discuss industrial applications for resistors. Industrial applications have a wide variety of conditions and electrical requirements which may require with performance beyond what typical thick film chip resistors can achieve. This application highlight will discuss some of the typical building blocks used in industrial electronics and the resistors that are needed for robust and reliable designs.

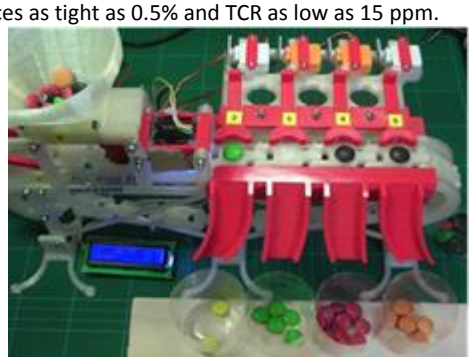
**Bridge Rectifier Input Protection**

Typical industrial applications such as motion / motor control, HVAC systems, UPS systems, and information outputs begin with rectifying the high voltage AC input into a DC voltage with a bridge rectifier. The input to this bridge rectifier is typically protected by either a pulse withstanding film chip resistor or fusible wirewound in combination with and MOV. The intent is to smooth out and limit the energy of normal input voltage noise and surges, but to fuse open if continuous or extreme overload is encountered. The RPC series is ideal for lower voltages due to the fusible nature of film resistors and excellent pulse withstanding for a film chip resistor.

The WWF fusible wirewounds can be a great choice for higher voltages and higher energy requirements and can have the pulse withstanding and fusing action tailored to fit the specific electrical operating conditions. MOV's are typically used when the surges at the bridge input include voltages which would damage the rectifier. Stackpole's RV series offers a wide range of input voltage protection and a range of energy handling capability.

**DC to DC Conversion**

The next step in the power supply process for industrial electronics is to change the rectified DC voltage from the rectifier in the previous stage down to a usable level for the other electronic modules. Virtually every industrial machine or circuit design requires some level of DC to DC conversion. DC to DC converters will most often utilize a current sense resistor to control the output power lever from this electronics stage. The current sense resistor requirements range from relatively high resistances such as 1 ohm or more, to fractions of a milliohm for high current or high power electronics. Stackpole has a wide range of current sense resistors to cover all the needs from the thick film based CSR/CSRN offering a wide range of sizes and values in a cost effective product, to the HCS high current shunts designed for high current handling up to 223 amps, to the CSS/CSSH ultra precision current sense resistors offering tolerances as tight as 0.5% and TCR as low as 15 ppm.



Automated sorting equipment, user interface, temperature / displacement / flow monitoring and transmission, and valve control require digital signal processing after converting the analog signal from the equipment to a digital equivalent. DSP requires high speed and accuracy along with small size. Stackpole's RNCS and RTAN series both provide excellent stability and environmental reliability with precision tolerances as tight as 0.05% and low TCR down to 10 ppm.

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**Digital, Analog and User Interface Signal Input and Output Protection**

Whether the signal is coming from a user interface or from another section of the equipment, this signal and the associated circuitry is typically at very low levels of voltage and current. Depending on the speed of the signals, the interface, and the potential sources and levels of electrical overstress, protection for these signal inputs and outputs of varying degrees are needed. If the signal is high speed and the interface is a port such as USB or HDMI, the ESD series from Stackpole can be an ideal solution for ESD and low energy type overvoltage events. If the signals are not high speed, multilayer varistors such as Stackpole's ZV or ZVL offer a wide range of voltage protection and can handle higher levels of current and energy than the ESD series.

**Buck / Boost Converters**

UPS systems, valve and motor controls, and LED drivers typically utilize a buck / boost converter to allow for the supply of different output voltages to different parts of the electronics to optimize the components used in each stage. Buck / boost converters will occasionally require current sense resistors, but normally they are relatively high in resistance value ranging from around 0.5 ohm up to 3 ohm. Because of the range of output voltages and currents associated with buck / boost converters, large case size chip resistors such as 2010 and 2512 are needed. For these requirements, the RMCF general purpose chip resistor is adequate and provides a cost effective solution.

Industrial applications cover a wide range of applications, equipment, and end uses. These applications and end uses have requirements beyond standard small size chip resistor. Stackpole offers a broad range of products to meet the specific requirements of our customers. Please contact Stackpole to learn more about our resistor offering for industrial applications.