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Why Aren't Many Resistors UL Rated?

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Electronics in various types of applications and markets will occasionally require a UL rating. UL recognition for a component can range from the flammability level, to a complex set of tests designed to demonstrate whether the part will fail without creating fire, explosion, significant heat, or other detrimental or dangerous results. When seeking resistors for such applications, our customers frequently ask, why aren't there more UL-rated resistors available?

This article discusses the cost factors that influence whether resistors carry a UL rating, explaining the challenges to resistor manufacturers of qualifying families of parts. It also explains how fusible, failsafe resistors offer an alternative to UL-rated components. But first, let's look at why UL-rated resistors are considered for applications requiring a UL rating and where they fit in the two approaches to obtaining a UL listing for the customer's end product. We'll also try to clarify when a UL-rated resistor is warranted.

UL Specifications And The Qualification Process

Currently there are many UL specifications pertaining to various electronic circuits. Among the applications for UL resistors are audio/video equipment, household appliances, and motor drives, to name a few.

A UL rating (or UL listing) means the device or component has met safety and sustainability standards and has been proven to have little to no risk of fire or electrical shock under a specified set of conditions. This rating assures protection of the user or operator of the end product. UL tests commonly consist of stress tests which overload a component and check for excessive heat generated, fire or explosion, or the eruption of molten material from the part during the overload (Fig. 1).

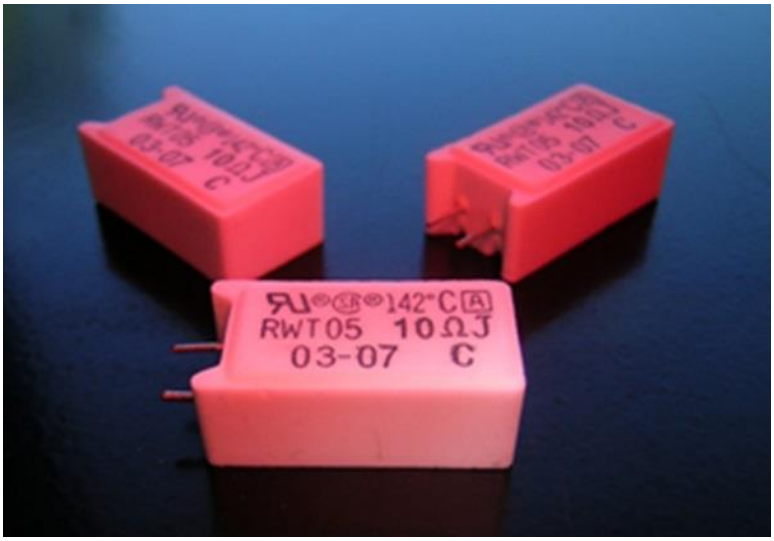

Fig. 1. These thermally protected, flameproof wirewounds are UL rated.

Typically, products such as electronic devices, appliances, power supplies, machinery, etc. can obtain a UL listing in one of two ways; they can obtain the UL qualification for the end product as a unit, or they can obtain one by using only UL-rated components to build the end product.

While many materials, hardware, and components can be found with a UL rating, the same is not normally the case for all passive components. For most UL-rated electronics, it typically makes more sense to seek UL qualification for the entire circuit, module, or completed unit.

However, there are downsides to entire circuit or full unit qualification including the cost of building up samples of the full circuit or module, which can be high depending on the cost and complexity of the electronics and assembly involved. In addition, in the case of a failure during qualification, another round of units will need to be built, further increasing costs. Clearly, seeking UL certification for a single component would be less expensive and complex in this scenario.

UL Qualification Of Resistors

UL resistor qualification, however, has its own set of significant challenges. For applications with a very limited range in power rating requirements and resistance values, it can make economic sense to qualify a resistor. But if the application requires multiple power ratings, a wide range of values, or has evolving design and functionality requirements, seeking UL approval can cause costs to increase exponentially.

One key challenge is that resistors are available in 24 different resistance values in a single 5% tolerance decade (such as 10 Ω to 100 Ω, 100 Ω to 1 k Ω and so on). If the application requires 1% tolerance resistors, the number of possible values per decade balloons to 96 each. So, unless the resistance range is significantly limited, this would require UL testing for a huge number of resistance values, and this assumes only one power rating or size is necessary. If several sizes are needed, then multiply that number of values by the number of power ratings that may be needed.

It is easy to see how the costs for such qualification would skyrocket. UL qualification for a just a handful of values in a single size can range from $10K to $20K. Once UL approval is granted, there are additional yearly costs for administrative fees and quarterly verification testing that can be several thousands of dollars as well. There must be significant market demand for the UL-rated product to justify these ongoing costs. For most resistor manufacturers, the market demand simply is not large enough to sustain UL approval.

Failsafe Components

Non-UL-rated failsafe components are a good solution for applications and end products that require a measure of safety short of UL certification. Many types of failsafe resistors are built to withstand the testing requirements of UL or their design can be adjusted to do so. They can provide a fusing response to overloads without risk of fire, spark or explosion, or molten metal erupting from the part.

Fusible film resistors provide a low level and reliable fusing action to protect low-power electronics. For higher-power requirements such as motor protection, fusible wirewounds can be tailored to provide both surge current withstanding and failsafe fusing under excessive overloads. Finally, thermally protected wirewounds are available to provide the ultimate assurance that temperatures will not exceed the required levels (Fig. 2).

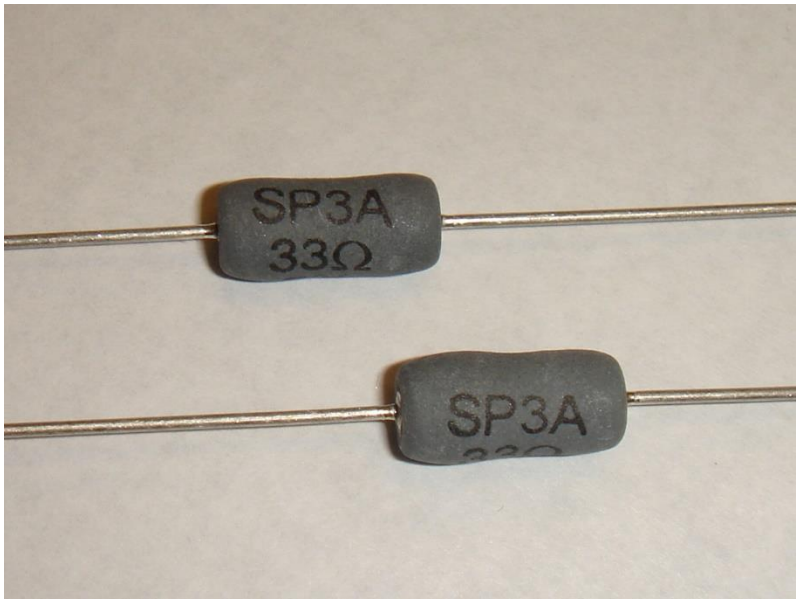

Fig. 2. Examples of non-UL rated fusible, failsafe wirewound resistors. These types of resistors offer a measure of safety short of UL certification.

Summary

UL certification can provide assurance for the end user that the product rated is safe from a variety of dangerous situations. Gaining UL recognition can be achieved by either qualification of the end unit, or using only UL-listed components, materials, and packaging for the product. In cases where the end product may be extremely expensive to build for the UL qualification test, and if all components and materials are available in UL-rated versions, it may be more beneficial to do that.

However, for most electronics, it is difficult to find UL-rated components. For passive components, with generally lower average selling prices, the costs of attaining and then maintaining UL recognition are typically much greater than the market will support.

About the Author

Kory Schroeder currently serves as the director of Marketing and Engineering at Stackpole Electronics. His experience includes applications engineering for film capacitors with American Shizuki, product management, applications engineering, and field applications engineering with Vishay Intertechnology in their resistor division. Kory graduated from the University of Nebraska—Lincoln with a bachelor's degree in electrical engineering.

For further reading on power supply-related safety and compliance issues, see How2Power's special section on Power Supply Safety and Compliance.