RCS Anti-Surge, High Power Thick Film Chip Resistors

Product Overview

Rev. 2021-12-17

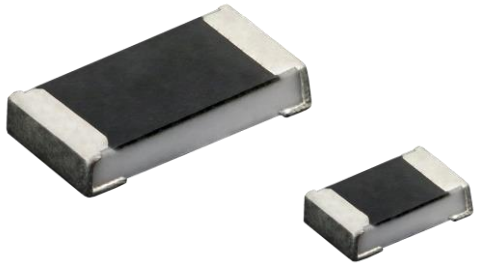
Introduction

Purpose

- Introduction of the Vishay RCS Anti-Surge, High Power Thick Film Chip Resistor Series

Objectives

- Discuss features
- Present construction
- Compare performance to standard thick film chip resistors
- Discuss potential cost savings / circuit miniaturization using RCS series
- Show potential applications



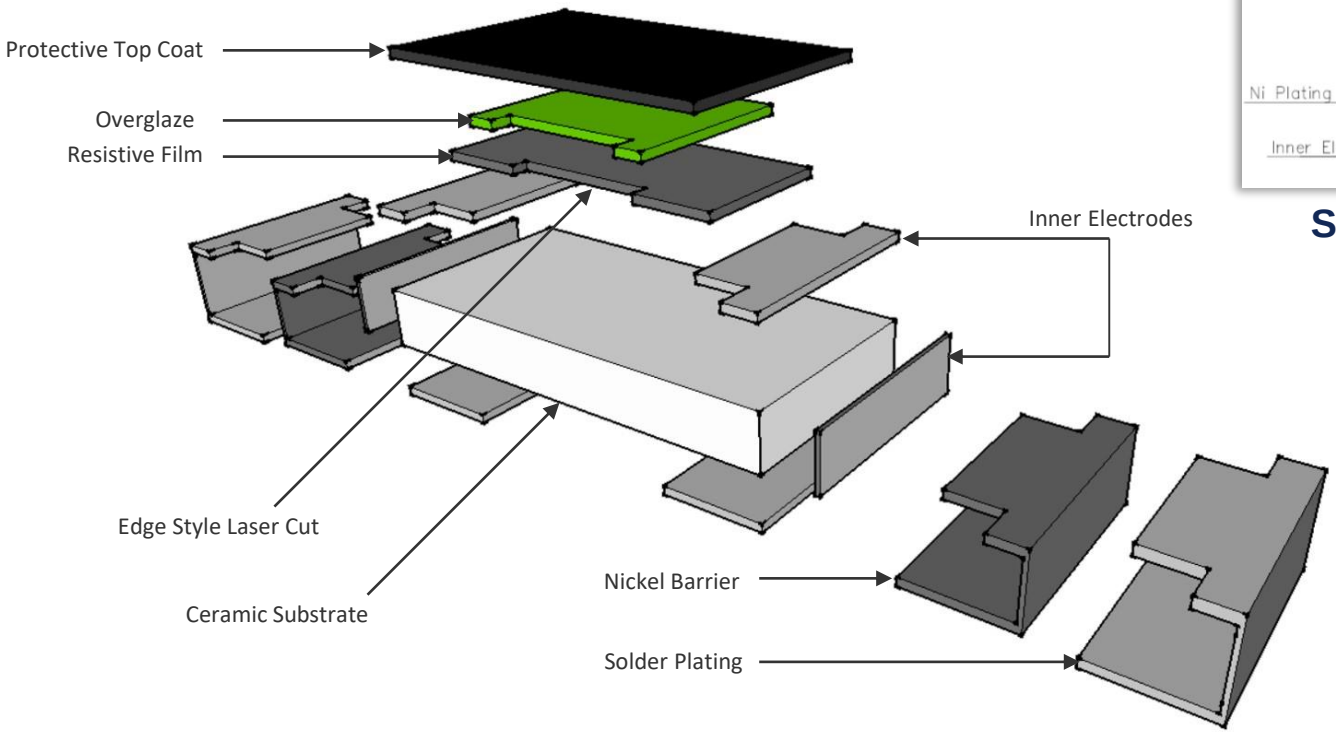
Welcome to the Vishay RCS Anti-Surge High Power Thick Film Chip Resistor Series product overview.
This presentation will provide an overview of the RCS thick film chip resistor series.
First, Features and Construction of the product series will be discussed.
Then comparisons of performance with standard thick film chip resistors will be made.
Finally, we will discuss how RCS series parts can be used to reduce the cost of your design.

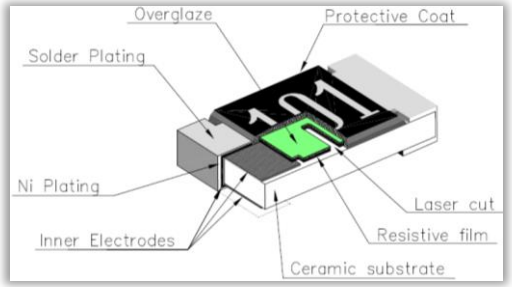
Main Features of the RCS series

- Package sizes: 0402, 0603, 0805, and 1206
- Higher power dissipation: 0.2W, 0.25W, 0.4W, and 0.5W
- 2 to 3 times the power ratings of standard thick film resistors
- Resistance range: 1Ω to 10MΩ
- Tolerance & TCR: ±0.5%, ±1% or ±5% & ±100ppm/°C or ±200ppm/°C
- Excellent surge/pulse capability
- AEC-Q200 qualified
- RoHS compliant
- Jumpers with enhanced maximum current ($I_{max.}$) up to 5A also available

The Vishay RCS series is a thick film chip resistor series available in the most commonly used chip resistor sizes: 0402, 0603, 0805, and 1206. Compared to standard thick film chip resistors, RCS series parts have higher surge capabilities and higher power dissipation capabilities, 2 to 3 times the power dissipation of standard thick film chip resistors. The 1206 case size is rated for 0.5W. RCS series parts are available with tolerance ±5%, ±1%, or ±0.5%. Most commonly used is ±1% or ±5%. Many industries, including automotive, demand AEC-Q200 qualified resistors and Vishay's RCS series meets this standard. The series is offered with a broad resistance range from 1 ohm to 10Mohms. Additionally, Jumper versions of RCS series parts with enhanced maximum current capability, up to 5A for the 1206 case size, are available.

Construction of RCS Series

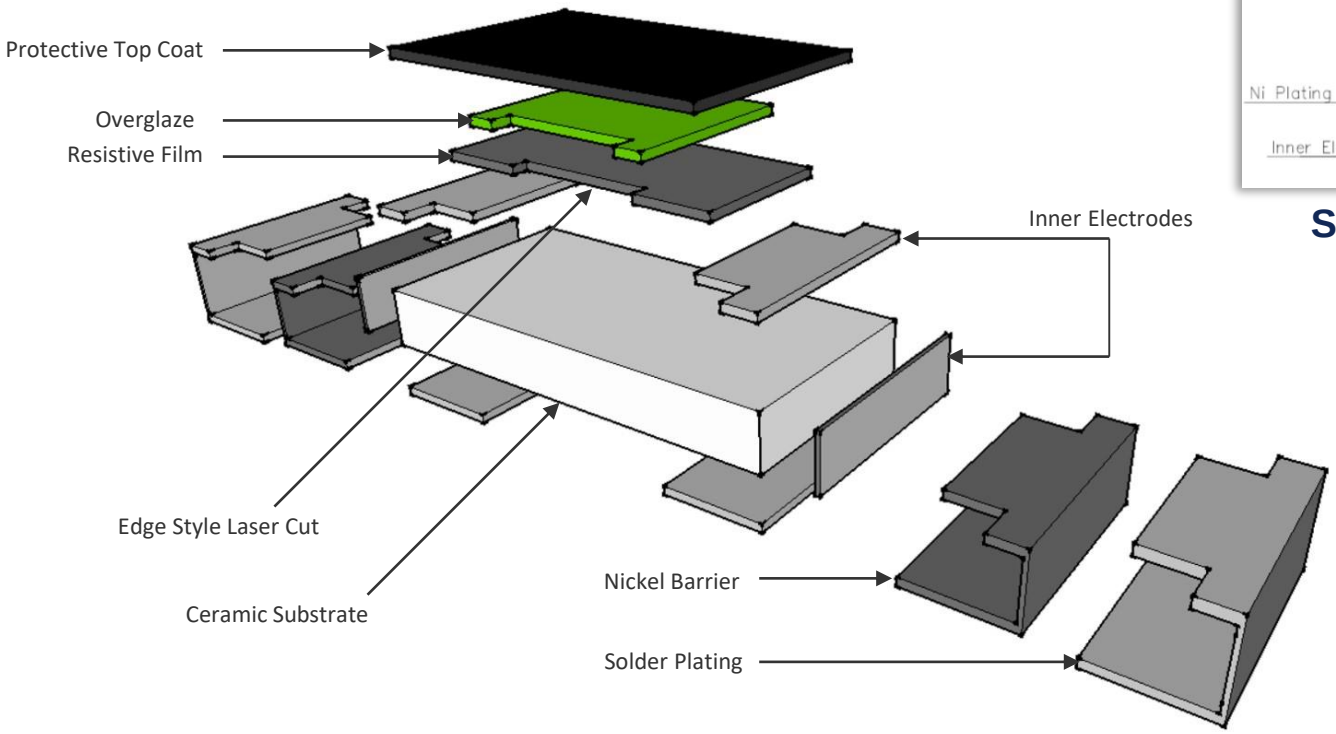


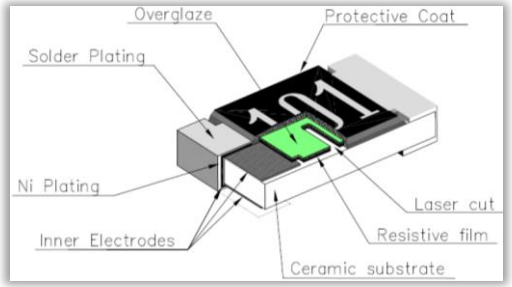


Standard thick film construction, for comparison.

The construction of RCS series parts is similar to that of standard thick film chip resistors in many regards, but there is a difference which greatly impacts performance. We'll start with what the product types have in common. Both standard thick film and RCS series parts are built upon a ceramic substrate chip. At the ends of the chip there is what is known as wrap-around termination, with inner electrodes, covered by a nickel barrier, and with a solder plating. Upon the ceramic chip substrate, making an electrical connection between the part terminals is a thick film Ruthenium Oxide resistive element. This resistive element is trimmed to achieve the desired final resistance value. Above the thick film resistive element is an overglaze layer and a protective top coat.

Construction of RCS Series

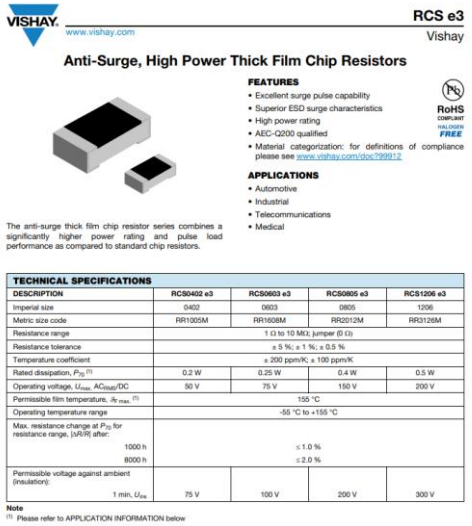




Standard thick film construction, for comparison.

The major difference in construction which allows for enhanced pulse and power dissipation performance is the manner in which the resistive element is trimmed. While a standard thick film chip resistor usually utilizes a simple quick “I” or “L” style cut into the resistive element to achieve the final resistance value, RCS series parts are trimmed using an Edge Style Laser cut. By trimming only the edge of the resistive element of RCS series parts, current density of any single spot on the resistor is reduced compared to the more broadly made I-cut or L-cut trimming style used for standard thick film chip resistors, where a hot spot may occur at the end of the I-cut or L-cut laser trim when the part is subjected to very high pulse conditions. Overall, this allows the component to have what is known as a larger “active resistive area”.

Enhanced Power Rating



VISHAY
www.vishay.com
RCS e3
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Anti-Surge, High Power Thick Film Chip Resistors

FEATURES
- Excellent surge pulse capability
- Superior ESD surge characteristics
- High power rating
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT HALOGEN FREE

APPLICATIONS
- Automotive
- Industrial
- Telecommunications
- Medical

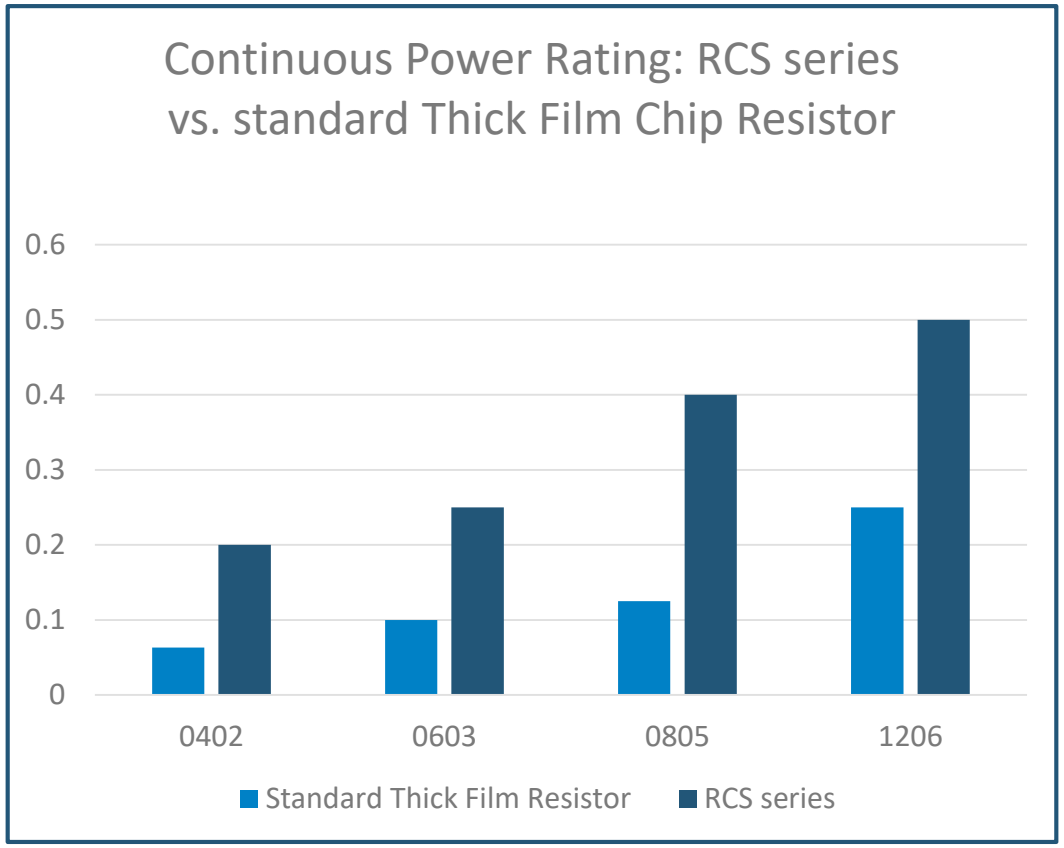
The anti-surge thick film chip resistor series combines a significantly higher power rating and pulse load performance as compared to standard chip resistors.

TECHNICAL SPECIFICATIONS

DESCRIPTION	RCS0402 e3	RCS0603 e3	RCS0805 e3	RCS1206 e3
Imperial size	0402	0603	0805	1206
Metric size code	RR1005M	RR1608M	RR2012M	RR3126M
Resistance range	1 Ω to 10 MΩ; jumper (0 Ω)			
Resistance tolerance	± 5 %; ± 1 %; ± 0.5 %			
Temperature coefficient	± 200 ppm/K; ± 100 ppm/K			
Rated dissipation, P_{70} (1)	0.2 W	0.25 W	0.4 W	0.5 W
Operating voltage, $U_{max.}$ AC$_{(rms)}$/DC	50 V	75 V	150 V	200 V
Permissible film temperature, $\vartheta_{F\,max.}$ (1)	155 °C			
Operating temperature range	-55 °C to +155 °C			
Max. resistance change at P_{70} for resistance range, [ΔR/R] after:				
1000 h	≤ 1.0 %			
8000 h	≤ 2.0 %			
Permissible voltage against ambient (insulation):				
1 min, U_{ins}	75 V	100 V	200 V	300 V

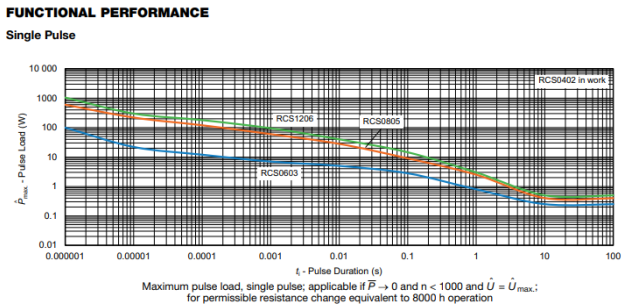
Note
(1) Please refer to APPLICATION INFORMATION below

Size	Standard Thick Film Resistor (W)	RCS series (W)
0402	0.063	0.2
0603	0.1	0.25
0805	0.125	0.4
1206	0.25	0.5



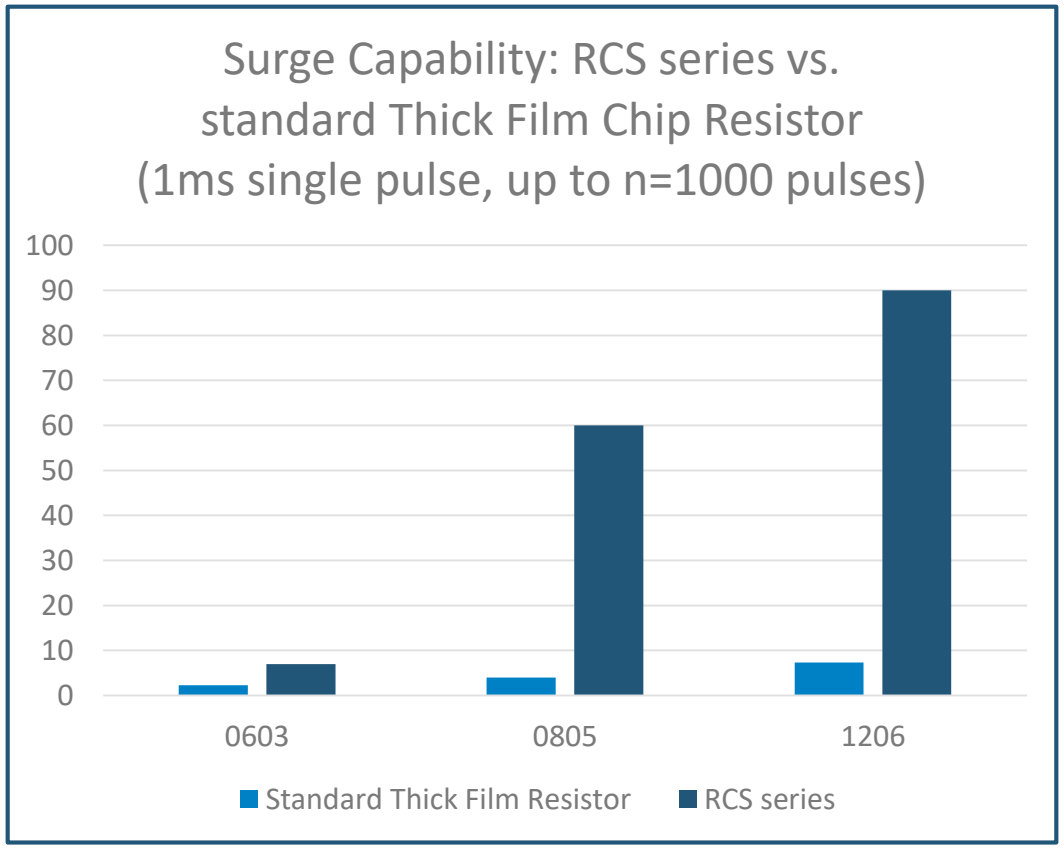
Next, let's compare continuous power dissipation ratings of RCS series parts with those of standard thick film resistors. As shown in the table and chart above, RCS series parts are specified to withstand continuous power dissipation of two or more times that allowed for standard thick film chip resistors of the same size. For example, while a standard 0603 size thick film chip resistor may only dissipate 0.1W, the RCS0603 can handle up to 0.25W. And while a standard 0805 size thick film chip resistor may only dissipate 0.125W, the RCS0805 can handle up to 0.4W. If even more power dissipation is needed, Vishay's CRCW-HP resistor series is a potential solution.

Enhanced Pulse Capabilties



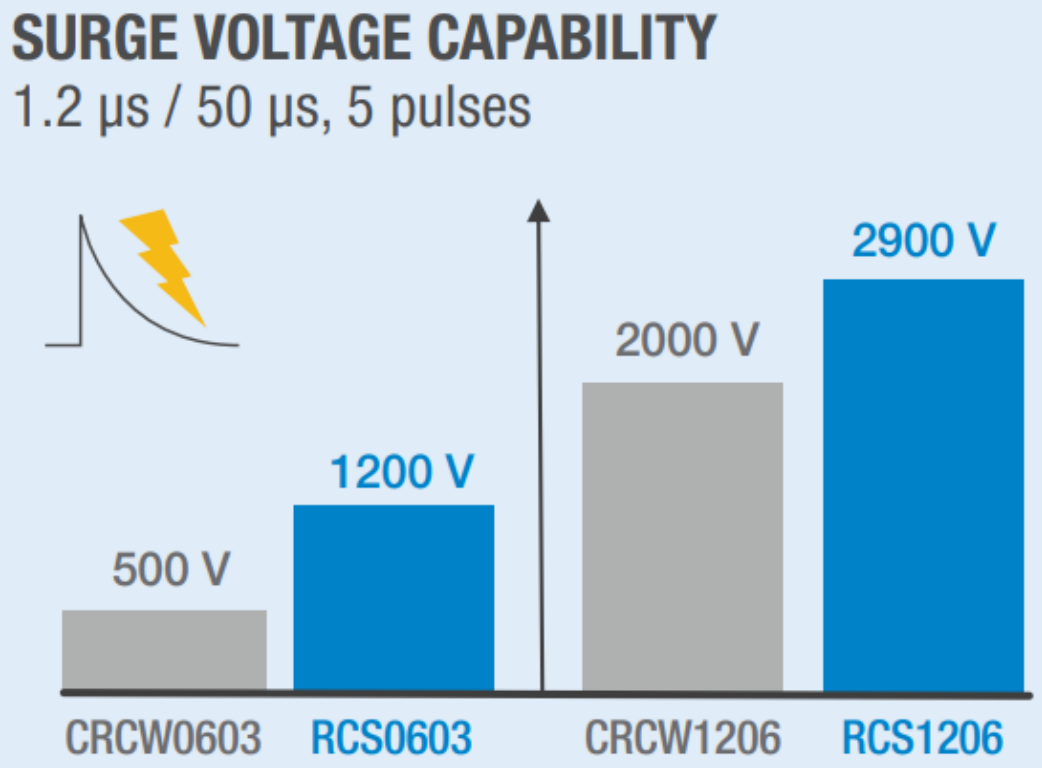
Size	Standard Thick Film Resistor (W)	RCS series (W)
0603	2.3	7
0805	4	60
1206	7.3	90

Note: Considering Single Pulse capability chart included within product datasheet, where average power dissipated by resistor over time approaches 0, with up to n=1000 pulses and permissible resistance change equivalent to 8000 h operation specification.



Now, let's compare pulse capabilities. Shown here is a chart (right) which compares the specified maximum pulse power for RCS series parts versus standard thick film resistor. In this comparison, the single pulse capability chart (top left) found within the Vishay product datasheets, which allow for up to 1000 pulses, were used to make the comparison, considering pulse duration 1 millisecond. As shown, RCS series parts have much higher pulse capabilities compared to the standard thick film of the same size. The RCS0805 can withstand up to 60 watts for this duration compared to only 4 watts allowed for the standard 0805 size part (15 times as much) while the RCS1206 can withstand up to 90 watts compared to only 7.3 watts allowed for the standard 1206 size (12 times as much).

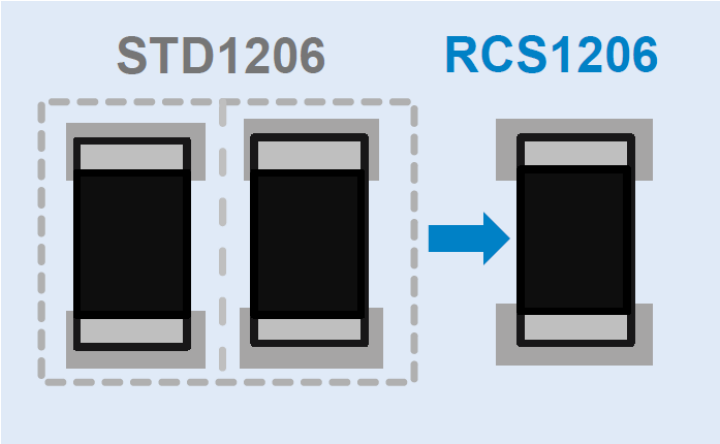
Enhanced Single Pulse High Voltage Overload (SPHVOL) Capabilities



Single Pulse High Voltage Overload capabilities of RCS series parts also perform favorably compared to more standard thick film chip resistors. As shown in the chart above, which is considering a 1.2µs/50µs test condition, the RCS0603 series/size will withstand up to a whopping 1200V compared to the maximum of 500V that a standard thick film chip resistor of the same size while using resistance value 100kΩ.

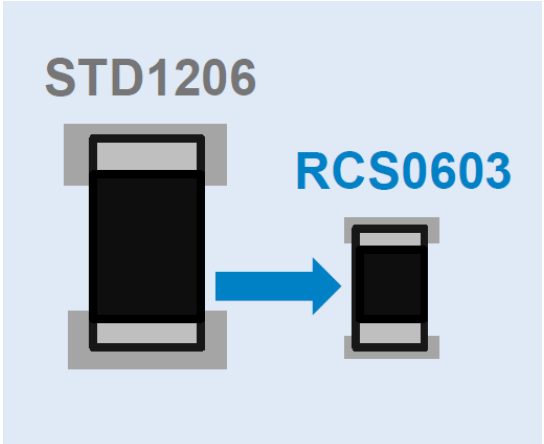
Cost Savings and reducing Circuit size

Reducing component count with RCS series resistors



- No reduction in performance capability
- Reduces pick and place costs
- Reduces total area of PCB that is occupied by resistors

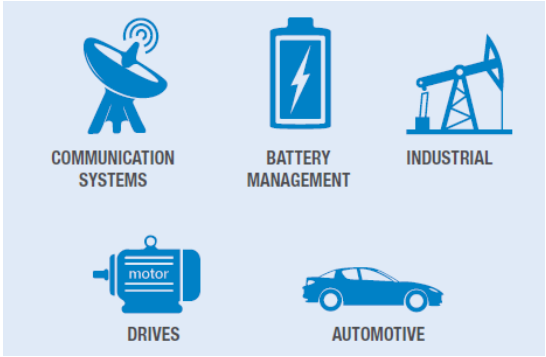
Replacing larger standard chip resistors with RCS series resistors



- Also reduces total area of PCB that is occupied by resistors

As RCS series resistors have enhanced power dissipation and pulse withstanding capabilities, they can be used to reduce component count, or to replace standard chip resistors with smaller RCS series parts. For example, two standard 1206 size chip resistors can be replaced with a single RCS1206 part while maintaining the necessary power dissipation and pulse capabilities. This type of component count reduction will reduce pick and place manufacturing costs. As another example, a single RCS0603 size resistor can replace a larger 1206 size standard chip resistor, reducing the area of expensive “real estate” of the circuit board occupied by the resistor. These are just a couple examples of using RCS series parts during circuit design; however, the possibilities are endless!

Applications



Any application where…

- Reduced component count is desirable.
- When reduced size of discrete components is needed.
- A high surge or high pulse chip resistor is needed.
- An overall reduction in cost of resistors while meeting certain performance criteria is needed.

ALTERNATIVE ENERGY
- Solar Inverter
- Power Meters

AMS
- Handset Radio
- Surveillance System

AUTOMOTIVE
- Climate Control Module
- LED Driver
- Powertrain
- Engine Control Unit
- Automotive Camera Module
- Door Latch
- Infotainment

COMPUTER
- HDD
- AC-DC Adapter
- Gaming
- RF repeater product

INDUSTRIAL
- DC-DC Converter
- Motor Control
- Electrical Circuit Breaker
- Amplifier

As the RCS series will allow for a circuit designer to reduce their component count, reduce resistor size, withstand higher pulse conditions, and reduce overall costs for resistors used in a design, the product series is used across the board in many market segments including alternative energy, AMS, automotive, computer, and industrial. RCS series parts are a great fit for a wide variety of applications including automotive modules, power electronics systems, industrial drives, AC-DC adapters, engine control units, DC-DC converters, or any application in which thick film chip resistors are used.

Summary

- Great option for smaller circuit boards and for reducing component count
- High power thick film chip resistor up to 0.5W with 1206 case size
- 2 to 3 times power rating compared to standard thick film resistors
- Excellent high pulse capability more than 10x better than standard parts
- Available in 0402 to 1206 sizes, 1Ω to 10MΩ, and as jumper (0Ω)
- Jumpers with enhanced maximum current ($I_{max.}$) up to 5A
- AEC-Q200 qualified
- RoHS compliant
- CRCW-HP is an option for even higher pulse/power requirements

That concludes this Product Overview focused on Vishay's RCS series. The enhanced construction of Vishay's RCS series allows for the parts to have power ratings that are 2 to 3 times that of standard thick film resistors, with high pulse capabilities more than 10 times better depending on the case size. Available with popular case sizes from size 0402 to 1206, and with a wide range of resistance values, from 1Ω to 10MΩ in addition to enhanced 0Ω jumpers, the RCS series is ideal for applications requiring AEC-Q200 qualified resistors.