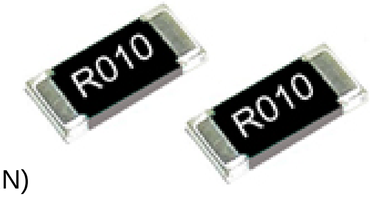
CSR/CSRN Series

Thick Film Current Sensing Resistor

Stackpole Electronics, Inc.
Resistive Product Solutions

Features:

- 0402 to 2512 & 1225 sizes available
- Power ratings to 3W
- Low inductance – less than 0.2nH typically
- RoHS compliant
- Non-standard resistance values available
- 0815, 2010 and 2512 sizes available with narrow terminations (CSRN)



Electrical Specifications

Type / Code	Power Rating (Watts) @ 70ºC	Dielectric Withstanding Voltage	Resistance Temperature Coefficient	Ohmic Range (Ω) and Tolerance	
				1%	2%, 5%
CSR0402	0.125W	200V	±200 ppm/ºC	0.05 - 1	
CSR0603	0.125W	200V	±300 ppm/ºC	0.02 - 1	
CSR0805	0.25W	200V	±200 ppm/ºC	0.02 - 1	
CSR1206	0.5W	200V	±100 ppm/ºC(1)	0.01 - 1	
CSR1210	0.5W	200V	±600 ppm/ºC	0.01 - 0.02	
			±400 ppm/ºC	0.021 - 0.05	
			±300 ppm/ºC	0.051 - 0.099	
			±200 ppm/ºC	0.1 - 1	
CSRN0815	1W	200V	±300 ppm/ºC	0.01 - 0.019	
			±150 ppm/ºC	0.02 - 0.5	
CSR0830	2W	200V	±300 ppm/ºC	-	0.001 - 0.004
			±200 ppm/ºC	0.005 - 0.01	
			±150 ppm/ºC	0.011 - 0.35	
CSR2010	1W	200V	±100 ppm/ºC(1)	0.01 - 1	
CSRN2010	1W	200V	±250 ppm/ºC	0.01 - 1	
CSR2512	2W	200V	±200 ppm/ºC	0.01 - 1	
CSRN2512	2W	200V	±200 ppm/ºC	0.01 - 1	
CSR1225	3W	200V	±300 ppm/ºC	0.003 - 0.005	
			±200 ppm/ºC	0.006 - 0.02	
			±150 ppm/ºC	0.021 - 0.03	
			±100 ppm/ºC	0.033 - 8	

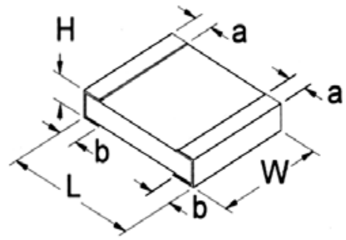
(1) Contact Factory for TCR below 50mOhm

Electrical Specifications – High Power

Type / Code	Power Rating (Watts) @ 70ºC	Dielectric Withstanding Voltage	Resistance Temperature Coefficient	Ohmic Range (Ω) and Tolerance
				1%, 2%, 5%
CSR0603…-HP	0.2W	200V	±400 ppm/ºC	0.051 - 0.1
			±300 ppm/ºC	0.102 - 0.5
			±200 ppm/ºC	0.51 - 1
CSR1210…-HP	0.75W	200V	±600 ppm/ºC	0.01 - 0.02
			±400 ppm/ºC	0.021 - 0.05
			±300 ppm/ºC	0.051 - 0.091
			±200 ppm/ºC	0.1 - 1

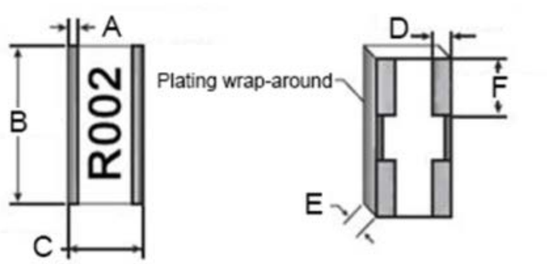
Please refer to the High Power Resistor Application Note (page 6) for more information on designing and implementing high power resistor types.

Mechanical Specifications



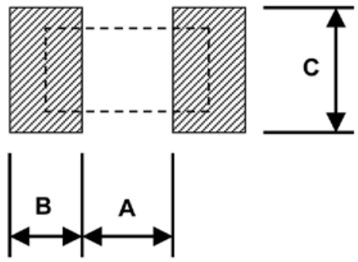
Type / Code	L Body Length	W Body Width	H Body Height	a Top Termination	b Bottom Termination	Unit
CSR0402	0.039 ± 0.002 1.00 ± 0.05	0.020 ± 0.002 0.50 ± 0.05	0.013 ± 0.004 0.32 ± 0.10	0.010 ± 0.004 0.25 ± 0.10	0.008 ± 0.004 0.20 ± 0.10	inches mm
CSR0603	0.063 ± 0.004 1.60 ± 0.10	0.031 ± 0.004 0.80 ± 0.10	0.018 ± 0.004 0.45 ± 0.10	0.012 ± 0.008 0.30 ± 0.20	0.012 ± 0.008 0.30 ± 0.20	inches mm
CSR0805	0.079 ± 0.006 2.00 ± 0.15	0.049 ± 0.006 1.25 ± 0.15	0.022 ± 0.004 0.55 ± 0.10	0.012 ± 0.008 0.30 ± 0.20	0.016 ± 0.010 0.40 ± 0.25	inches mm
CSR1206	0.120 ± 0.006 3.05 ± 0.15	0.061 ± 0.006 1.55 ± 0.15	0.022 ± 0.004 0.55 ± 0.10	0.020 ± 0.012 0.50 ± 0.30	0.016 ± 0.010 0.40 ± 0.25	inches mm
CSR1210	0.122 ± 0.004 3.10 ± 0.10	0.102 ± 0.006 2.60 ± 0.15	0.022 ± 0.004 0.55 ± 0.10	0.020 ± 0.012 0.50 ± 0.30	0.020 ± 0.010 0.50 ± 0.25	inches mm
CSRN0815	0.079 ± 0.008 2.00 ± 0.20	0.148 ± 0.008 3.75 ± 0.20	0.024 ± 0.004 0.60 ± 0.10	0.016 ± 0.008 0.40 ± 0.20	0.016 ± 0.008 0.40 ± 0.20	inches mm
CSR0830	0.079 ± 0.008 2.00 ± 0.20	0.295 ± 0.012 7.50 ± 0.30	0.024 ± 0.004 0.60 ± 0.10	0.016 ± 0.008 0.40 ± 0.20	0.016 ± 0.008 0.40 ± 0.20	inches mm
CSR2010	0.197 ± 0.008 5.00 ± 0.20	0.100 ± 0.008 2.54 ± 0.20	0.020 ± 0.006 0.50 ± 0.15	0.068 ± 0.006 1.72 ± 0.15	0.067 ± 0.006 1.70 ± 0.15	inches mm
CSRN2010	0.197 ± 0.008 5.00 ± 0.20	0.096 ± 0.006 2.45 ± 0.15	0.024 ± 0.006 0.60 ± 0.15	0.024 ± 0.012 0.60 ± 0.30	0.020 ± 0.010 0.50 ± 0.25	inches mm
CSR2512	0.252 ± 0.008 6.40 ± 0.20	0.126 ± 0.008 3.20 ± 0.20	0.020 ± 0.006 0.50 ± 0.15	0.075 ± 0.006 1.90 ± 0.15	0.075 ± 0.006 1.90 ± 0.15	inches mm
CSRN2512	0.250 ± 0.008 6.35 ± 0.20	0.124 ± 0.006 3.15 ± 0.15	0.024 ± 0.004 0.60 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	0.022 ± 0.010 0.55 ± 0.25	inches mm
CSR1225	0.122 ± 0.006 3.10 ± 0.15	0.248 ± 0.006 6.30 ± 0.15	0.035 ± 0.006 0.90 ± 0.15	0.024 ± 0.012 0.60 ± 0.30	0.031 ± 0.010 0.80 ± 0.25	inches mm

CSR1225 Bottom Termination Specifications



Type / Code	A	B	C	D	E	F	Unit
CSR1225	0.020 ± 0.005 0.51 ± 0.13	0.250 ± 0.005 6.35 ± 0.13	0.125 ± 0.005 3.18 ± 0.13	0.032 ± 0.005 0.81 ± 0.13	0.030 ± 0.005 0.76 ± 0.13	0.090 ± 0.005 2.29 ± 0.13	inches mm

Solder Pad Dimensions



Type / Code	A	B	C	Unit
CSR0402	0.020 0.50	0.020 0.50	0.024 ± 0.008 0.60 ± 0.20	inches mm
CSR0603	0.031 0.80	0.039 1.00	0.035 ± 0.008 0.90 ± 0.20	inches mm
CSR0805	0.039 1.00	0.039 1.00	0.053 ± 0.008 1.35 ± 0.20	inches mm
CSR1206	0.079 2.00	0.045 1.15	0.067 ± 0.008 1.70 ± 0.20	inches mm
CSR1210	0.079 2.00	0.045 1.15	0.098 ± 0.008 2.50 ± 0.20	inches mm
CSRN0815	0.039 1.00	0.071 1.80	0.154 ± 0.008 3.90 ± 0.20	inches mm
CSR0830	0.039 1.00	0.071 1.80	0.299 ± 0.008 7.60 ± 0.20	inches mm
CSR2010	0.142 3.60	0.055 1.40	0.098 ± 0.008 2.50 ± 0.20	inches mm
CSRN2010	0.142 3.60	0.055 1.40	0.098 ± 0.008 2.50 ± 0.20	inches mm
CSR2512	0.193 4.90	0.063 1.60	0.122 ± 0.008 3.10 ± 0.20	inches mm
CSRN2512	0.193 4.90	0.063 1.60	0.122 ± 0.008 3.10 ± 0.20	inches mm
CSR1225	0.047 1.20	0.079 2.00	0.276 ± 0.008 7.00 ± 0.20	inches mm

Performance Characteristics

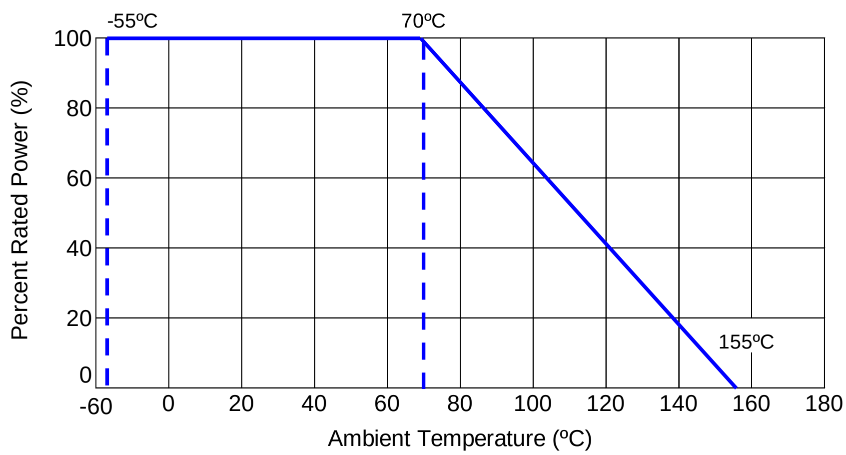
Test	Test Specification	Test Conditions	Test Limits	Typical
High Temperature Exposure	MIL-STD-202 Method 108	1000 hrs. @ T=155°C. Unpowered. Measurement at 24 ± 4 hours after test conclusion.	1% Tol: (±1.0% +0.05Ω) 2%, 5% Tol:(±1.5% +0.10Ω)	≤ 0.5%
Temperature Cycling	JESD22 Method JA-104	1000 Cycles (-55°C to +125°C) Measurement at 24 ± 4 hours after test conclusion. 30 min maximum dwell time at each temperature extreme. 1 min. maximum transition time.	1% Tol: (±0.5% +0.05Ω) 2%, 5% Tol:(±1.5% +0.10Ω)	≤ 0.5%
Biased Humidity	MIL-STD-202 Method 103	1000 hours 85°C/85% RH. Note: Specified conditions: 10% of operating power. Measurement at 24 ± 4 hours after test conclusion.	1% Tol: (±1.00% +0.10Ω) 2%, 5% Tol:(±2.00% +0.10Ω)	≤ 0.5%
Operational Life	MIL-STD-202 Method 108	Condition D Steady State T_A=125°C at rated power. Measurement at 24 ± 4 hours after test conclusion.	1% Tol: (±1.00% +0.10Ω) 2%, 5% Tol:(±2.00% +0.10Ω)	≤ 0.5%
External Visual	MIL-STD 883 Method 2009	Electrical test not required. Inspect device construction, marking and workmanship	--	Pass
Physical Dimensions	JESD22 Method JB-100	Verify physical dimensions to the applicable device detail specification. Note: User(s) and Suppliers spec. Electrical test not required.	--	Pass

Performance Characteristics

Test	Test Specification	Test Conditions	Test Limits	Typical
Resistance to Solvents	MIL-STD 202 Method 215	Note: Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.	Marking unsmeared	Pass
Mechanical Shock	MIL-STD 202 Method 213	Figure 1 of Method 213. Condition C.	1% Tol: (±0.25% +0.05Ω) 2%, 5% Tol:(±1.00% +0.05Ω)	≤ 0.5%
Vibration	MIL-STD 202 Method 204	5 g's for 20 min., 12 cycles each of 3 orientations. Note: Use 8"X5" PCB 0.031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 - 2000 Hz.	1% Tol: (±0.50% +0.05Ω) 2%, 5% Tol:(±1.00% +0.05Ω)	≤ 0.5%
Resistance to Soldering Heat	MIL-STD 202 Method 210	Condition B no pre-heat of samples. Note: Single wave solder - Procedure 2 for SMD.	1% Tol: (±0.50% +0.05Ω) 2%, 5% Tol:(±1.00% +0.05Ω)	≤ 0.5%
ESD	AEC-Q200-002	With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of ±500 V, ±1kV, ±2kV, ±4kV, ±8kV. The electrometer reading shall be within ±10% for voltages from 500 V to ≤ 8 kV.	--	Pass
Solderability	J-STD-002	Electrical test not required. Magnification 50X. Conditions: SMD: a) Method B, 4 hrs @ 155°C dry heat @ 235°C. b) Method B @ 215°C category 3. c) Method D category 3 @ 260°C.	> 95% Coverage	Pass
Electrical Characterization	User Spec	Parametrically test per lot and sample size requirements, summary to show Min, Max, Mean and Standard Deviation at room as well as Min and Max operating temperatures.	--	Pass
Flammability	UL-94	V-0 or V-1 are acceptable. Electrical test not required.	No ignition of tissue or scorching of pine board.	Pass
Board Flex	AEC-Q200-005	60 second minimum holding time.	1% Tol: (±1.00% +0.05Ω) 2%, 5% Tol:(±1.00% +0.05Ω)	≤ 0.5%
Terminal Strength (SMD)	AEC-Q200-006		None broken	Pass
Flame Retardance	AEC-Q200-001		No flame	Pass

Operating Temperature Range: -55ºC to +155ºC

Power Derating Curve:



How to Order

1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
C	S	R	1	2	0	6	F	T	1	0	L	0	-	H	P

Product Series

Product Series	
CSR	Standard
CSRN	Narrow Terminations

Size / Power

Size	Power
0402	0.125W
0603	0.125W
0805	0.25W
1206	0.5W
1210	0.5W
0815	1W
0830	2W
2010	1W
2512	2W
1225	3W

Tolerance

Code	Tol
F	1%
G	2%
J	5%

Packaging

Code	Description	Size	Quantity
T	7" Reel Paper Tape	0402	10,000
		0603, 0805, 1206, 1210	5,000
	7" Reel Plastic Tape	2010, 2512	4,000
		0815, 0830, 1225	2,000
K	7" Reel Paper Tape	0402	1,000
		0603, 0805, 1206, 1210	1,000
	7" Reel Plastic Tape	2010, 2512	1,000
		0815, 0830, 1225	1,000

Resistance Value

Four characters with the multiplier used as the decimal holder. "L" used as multiplier of 10^{-3} for any value under 0.1 ohm

0.051 ohm = 51L0
0.35 ohm = R350
1 ohm = 1R00

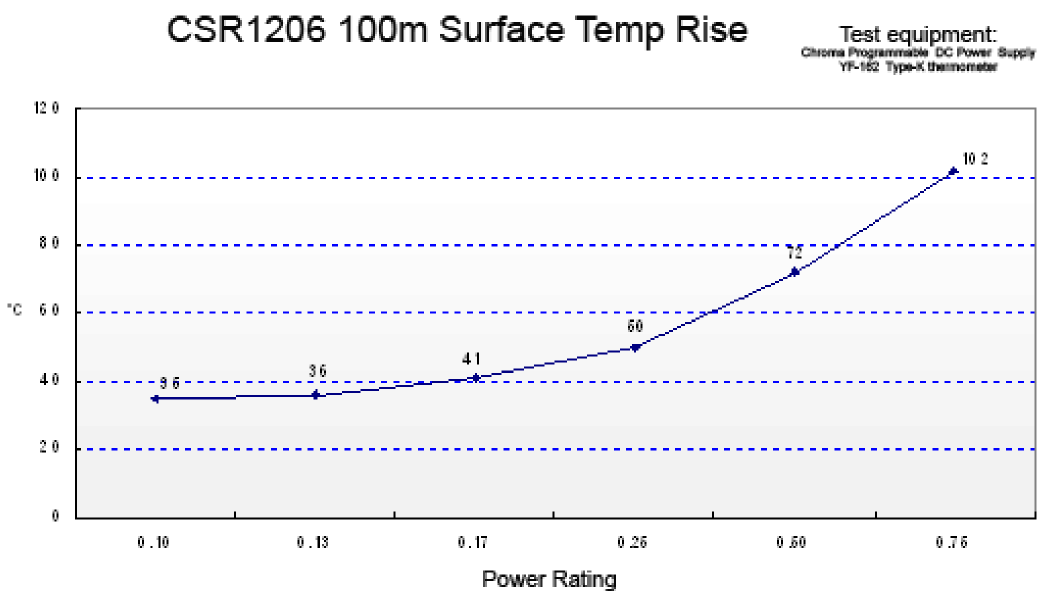
Special

Code	Description
HP	High Power

High Power Chip Resistors and Thermal Management

Stackpole has developed several surface mount resistor series in addition to our current sense resistors, which have had higher power ratings than standard resistor chips. This has caused some uncertainty and even confusion by users as to how to reliably use these resistors at the higher power ratings in their designs.

The data sheets for the RHC, RMCP, RNCP, CSR, CSRN, CSRF, CSS, and CSSH state that the rated power assumes an ambient temperature of no more than 100 degrees C for the CSS / CSSH series and 70 degrees C for all other high power resistor series. In addition, IPC and UL best practices dictate that the combined temperature on any resistor due to power dissipated and ambient air shall be no more than 105C. At first glance this wouldn't seem too difficult, however the graph below shows typical heat rise for the CSR ½ 100 milliohm at full rated power. The heat rise for the RMCP and RNCP would be similar. The RHC with its unique materials, design, and processes would have less heat rise and therefore would be easier to implement for any given customer.



The 102 degrees C heat rise shown here would indicate there will be additional thermal reduction techniques needed to keep this part under 105C total hot spot temperature if this part is to be used at 0.75 watts of power. However, this same part at the usual power rating for this size would have a heat rise of around 72 degrees C. This additional heat rise may be dealt with using wider conductor traces, larger solder pads and land patterns under the solder mask, heavier copper in the conductors, vias through PCB, air movement, and heat sinks, among many other techniques. Because of the variety of methods customers can use to lower the effective heat rise of the circuit, resistor manufacturers simply specify power ratings with the limitations on ambient air temperature and total hot spot temperatures and leave the details of how to best accomplish this to the design engineers. Design guidelines for products in various market segments can vary widely so it would be unnecessarily constraining for a resistor manufacturer to recommend the use of any of these methods over another.

Note: The final resistance value can be affected by the board layout and assembly process, especially the size of the mounting pads and the amount of solder used. This is especially notable for resistance values ≤ 50 mΩ. This should be taken into account when designing.