

CSS/CSSH Series

Ultra Precision Current Sensing Chip Resistor

Stackpole Electronics, Inc.

Resistive Product Solutions

Features:

- High power metal alloy current sense resistor
- Very low inductance (0.5nH to 5nH)
- High temperature performance up to 225°C; for operation up to 275°C, contact factory
- Excellent frequency response
- Low thermal EMF (<1μV/C)
- Proprietary processing technique produces extremely low resistance values
- All the CSS package sizes and the CSSH2512 package size are qualified to AEC-Q200
- RoHS compliant / lead-free



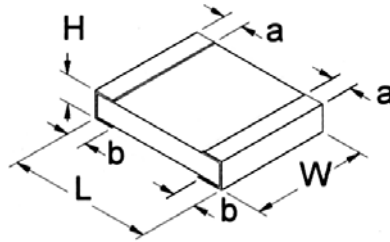
Electrical Specifications

Type / Code	Maximum Power Rating (Watts)	Maximum Rating Current (A)	Maximum Overload Current (A)	TCR (ppm/°C)	Ohmic Range (Ω) and Tolerance	
					0.5%	1%, 2%, 5%
CSS0603 ^(*)	0.33	8.1	16.2	±50 ppm/°C	-	0.005, 0.01, 0.015
CSS0805 ^(*)	0.5	12.9	25.8	±50 ppm/°C	-	0.005, 0.01, 0.015
CSS1206 ^(*)	1	31.62	63.25	±50 ppm/°C ±25 ppm/°C ±15 ppm/°C	- 0.007 - 0.015 0.016 - 0.05	0.001 - 0.004 0.005 - 0.015 0.016 - 0.05
CSS2010 ^(*)	1	31.62	63.25	±50 ppm/°C ±25 ppm/°C ±15 ppm/°C	- - 0.007 - 0.1	0.001 - 0.003 0.004 - 0.006 0.007 - 0.1
CSS2512 ^(*)	2	63.25	141.42	±50 ppm/°C ±25 ppm/°C ±15 ppm/°C	- - 0.007 - 0.075	0.0005 - 0.003 0.004 - 0.006 0.007 - 0.075
CSSH2512 ^(*)	3	77.46	134.16	±50 ppm/°C ±25 ppm/°C	- 0.007 - 0.01	0.0005 - 0.0025 0.003 - 0.01
CSS2725 ^(*)	4	126.49	252.95	±50 ppm/°C	-	0.00025 - 0.003
CSS2728 ^(*)	3	27.39	47.43	±25 ppm/°C ±15 ppm/°C	0.004 - 0.007 0.008 - 0.1	0.004 - 0.007 0.008 - 0.1
CSSH2728	4	31.62	63.25	±25 ppm/°C ±15 ppm/°C	0.004 - 0.007 0.008 - 0.05	0.004 - 0.007 0.008 - 0.05
CSS4527 ^(*)	5	100	173	±50 ppm/°C	0.007 - 0.12	0.0005 - 0.12

(*) Qualified to AEC-Q200

Please refer to the High Power Resistor Application Note (page 5) for more information on designing and implementing high power resistor types.

Mechanical Specifications



Type/Code	Maximum Power Rating (Watts)	Resistance Range (Ω)	L	W	H	a	b	Unit
CSS0603	0.33	0.005, 0.01, 0.015	0.063 ± 0.008 1.60 ± 0.20	0.031 ± 0.008 0.80 ± 0.20	0.012 ± 0.004 0.30 ± 0.10	0.012 ± 0.006 0.30 ± 0.15	0.012 ± 0.006 0.30 ± 0.15	inches mm
CSS0805	0.5	0.005, 0.01, 0.015	0.080 ± 0.008 2.03 ± 0.20	0.050 ± 0.008 1.27 ± 0.20	0.012 ± 0.004 0.30 ± 0.10	0.014 ± 0.008 0.35 ± 0.20	0.014 ± 0.008 0.35 ± 0.20	inches mm
CSS1206	1	0.001 - 0.05	0.126 ± 0.010 3.20 ± 0.25	0.063 ± 0.010 1.60 ± 0.25	0.025 ± 0.010 0.65 ± 0.25	0.020 ± 0.010 0.51 ± 0.25	0.020 ± 0.010 0.51 ± 0.25	inches mm
CSS2010	1	0.001 - 0.003	0.200 ± 0.010 5.08 ± 0.25	0.100 ± 0.010 2.54 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	0.051 ± 0.010 1.30 ± 0.25	0.051 ± 0.010 1.30 ± 0.25	inches mm
		0.0031 - 0.1	0.200 ± 0.010 5.08 ± 0.25	0.100 ± 0.010 2.54 ± 0.25	0.025 ± 0.010 0.65 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	inches mm
CSS2512	2	0.0005 - 0.004	0.246 ± 0.010 6.25 ± 0.25	0.130 ± 0.010 3.30 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	0.074 ± 0.010 1.88 ± 0.25	0.074 ± 0.010 1.88 ± 0.25	inches mm
		0.0041 - 0.075	0.246 ± 0.010 6.25 ± 0.25	0.130 ± 0.010 3.30 ± 0.25	0.025 ± 0.010 0.65 ± 0.25	0.044 ± 0.010 1.12 ± 0.25	0.044 ± 0.010 1.12 ± 0.25	inches mm
CSSH2512	3	0.0005	0.246 ± 0.010 6.25 ± 0.25	0.130 ± 0.010 3.30 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	0.074 ± 0.010 1.88 ± 0.25	0.074 ± 0.010 1.88 ± 0.25	inches mm
		0.0006 - 0.0029 0.0041 - 0.01	0.246 ± 0.010 6.25 ± 0.25	0.130 ± 0.010 3.30 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	0.044 ± 0.010 1.12 ± 0.25	0.044 ± 0.010 1.12 ± 0.25	inches mm
		0.003 - 0.004	0.246 ± 0.010 6.25 ± 0.25	0.130 ± 0.010 3.30 ± 0.25	0.031 ± 0.010 0.79 ± 0.25	0.066 ± 0.010 1.68 ± 0.25	0.066 ± 0.010 1.68 ± 0.25	inches mm
CSS2725	4	0.00025, 0.0005	0.268 ± 0.010 6.81 ± 0.25	0.254 ± 0.010 6.45 ± 0.25	0.039 ± 0.010 0.99 ± 0.25	0.085 ± 0.010 2.16 ± 0.25	0.085 ± 0.010 2.16 ± 0.25	inches mm
		0.001	0.268 ± 0.010 6.81 ± 0.25	0.254 ± 0.010 6.45 ± 0.25	0.043 ± 0.010 1.09 ± 0.25	0.085 ± 0.010 2.16 ± 0.25	0.085 ± 0.010 2.16 ± 0.25	inches mm
		0.0015	0.268 ± 0.010 6.81 ± 0.25	0.254 ± 0.010 6.45 ± 0.25	0.039 ± 0.010 0.99 ± 0.25	0.085 ± 0.010 2.16 ± 0.25	0.085 ± 0.010 2.16 ± 0.25	inches mm
		0.002	0.268 ± 0.010 6.81 ± 0.25	0.254 ± 0.010 6.45 ± 0.25	0.035 ± 0.010 0.89 ± 0.25	0.071 ± 0.010 1.80 ± 0.25	0.071 ± 0.010 1.80 ± 0.25	inches mm
		0.0025	0.268 ± 0.010 6.81 ± 0.25	0.254 ± 0.010 6.45 ± 0.25	0.035 ± 0.010 0.89 ± 0.25	0.065 ± 0.010 1.65 ± 0.25	0.065 ± 0.010 1.65 ± 0.25	inches mm
		0.003	0.268 ± 0.010 6.81 ± 0.25	0.254 ± 0.010 6.45 ± 0.25	0.035 ± 0.010 0.89 ± 0.25	0.051 ± 0.010 1.30 ± 0.25	0.051 ± 0.010 1.30 ± 0.25	inches mm
CSS2728	3	0.004 - 0.1	0.264 ± 0.010 6.71 ± 0.25	0.283 ± 0.010 7.19 ± 0.25	0.039 ± 0.010 0.99 ± 0.25	0.045 ± 0.010 1.14 ± 0.25	0.045 ± 0.010 1.14 ± 0.25	inches mm
CSSH2728	4	0.004 - 0.1	0.264 ± 0.010 6.71 ± 0.25	0.283 ± 0.010 7.19 ± 0.25	0.039 ± 0.010 0.99 ± 0.25	0.045 ± 0.010 1.14 ± 0.25	0.045 ± 0.010 1.14 ± 0.25	inches mm
CSS4527	5	0.0005 - 0.005	0.450 ± 0.010 11.43 ± 0.25	0.270 ± 0.010 6.85 ± 0.25	0.059 ± 0.010 1.50 ± 0.25	0.038 ± 0.010 0.97 ± 0.25	0.127 ± 0.010 3.22 ± 0.25	inches mm
		0.0051 - 0.1	0.450 ± 0.010 11.43 ± 0.25	0.270 ± 0.010 6.85 ± 0.25	0.059 ± 0.010 1.50 ± 0.25	0.038 ± 0.010 0.97 ± 0.25	0.071 ± 0.010 1.82 ± 0.25	inches mm

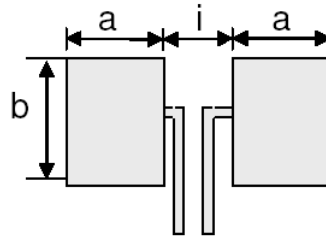
CSS/CSSH Series

Ultra Precision Current Sensing Chip Resistor

Stackpole Electronics, Inc.

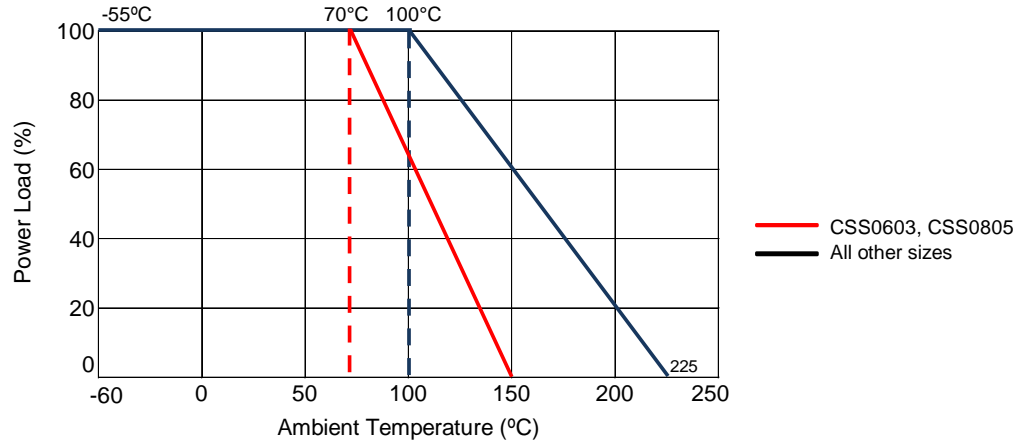
Resistive Product Solutions

Solder Pad Dimensions



Type/Code	Maximum Power Rating (Watts)	Resistance Range (Ω)	a	b	i	Unit
CSS0603	0.33	0.005, 0.01, 0.015	0.039 1.00	0.050 1.27	0.020 0.50	inches mm
CSS0805	0.5	0.005, 0.01, 0.015	0.071 1.80	0.086 2.18	0.026 0.66	inches mm
CSS1206	1	0.001 - 0.05	0.063 1.60	0.086 2.18	0.039 1.00	inches mm
CSS2010	1	0.001 - 0.003	0.114 2.89	0.115 2.92	0.048 1.22	inches mm
		0.0031 - 0.1	0.090 2.29	0.115 2.92	0.095 2.41	inches mm
CSS2512	2	0.0005 - 0.004	0.120 3.05	0.145 3.68	0.050 1.27	inches mm
		0.0041 - 0.075	0.083 2.11	0.145 3.68	0.125 3.18	inches mm
CSSH2512	3	0.0005	0.120 3.05	0.145 3.68	0.050 1.27	inches mm
		0.0006 - 0.0029	0.086	0.145	0.118	inches
		0.0041 - 0.01	2.19	3.68	3.00	mm
CSSH2512	3	0.003 - 0.004	0.110 2.79	0.145 3.68	0.071 1.80	inches mm
CSS2725	4	0.00025 - 0.003	0.125 3.18	0.270 6.86	0.052 1.32	inches mm
CSS2728	3	0.004 - 0.1	0.108 2.75	0.308 7.82	0.138 3.51	inches mm
CSSH2728	4	0.004 - 0.1	0.108 2.75	0.308 7.82	0.138 3.51	inches mm
CSS4527	5	0.0005 - 0.005	0.189 4.80	0.344 8.74	0.217 5.51	inches mm
		0.0051 - 0.12	0.134 3.40	0.344 8.74	0.327 8.31	inches mm

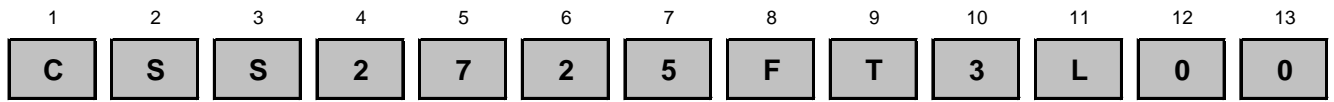
Power Derating Curve:



Performance Characteristics										
Test Item	Condition of Test	Test Method	Test Limits							
Temperature Coefficient of Resistance (TCR)	$TCR \text{ (ppm/}^\circ\text{C)} = \frac{(R2-R1)}{R1 (T2-T1)} \times 10^6$ R1: resistance of room temperature (T1) R2: resistance of 150°C (T2)	JIS C 5201-1 4.8	Per specification (refer to Electrical Specification table)							
Short Time Overload (rating power duration = 5 seconds)	The number of rated power are as follows:	JIS C 5201-1 4.13	$(\Delta R/R1) \leq \pm 0.5\%$							
	<table border="1"> <tr><td>CSS0603-0.33W: 4 times rated power</td></tr> <tr><td>CSS0805-0.5W: 4 times rated power</td></tr> <tr><td>CSS1206-1W: 4 times rated power</td></tr> <tr><td>CSS2010-1W: 4 times rated power</td></tr> <tr><td>CSS2512-2W: 5 times rated power</td></tr> <tr><td>CSSH2512-3W: 3 times rated power</td></tr> <tr><td>CSS2725-4W: 4 times rated power</td></tr> <tr><td>CSS2728-3W: 3 times rated power</td></tr> <tr><td>CSSH2728-4W: 4 times rated power</td></tr> <tr><td>CSS4527-5W: 3 times rated power</td></tr> </table>			CSS0603-0.33W: 4 times rated power	CSS0805-0.5W: 4 times rated power	CSS1206-1W: 4 times rated power	CSS2010-1W: 4 times rated power	CSS2512-2W: 5 times rated power	CSSH2512-3W: 3 times rated power	CSS2725-4W: 4 times rated power
CSS0603-0.33W: 4 times rated power										
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CSS2725-4W: 4 times rated power										
CSS2728-3W: 3 times rated power										
CSSH2728-4W: 4 times rated power										
CSS4527-5W: 3 times rated power										
Insulation Resistance	100±15V DC for 1 minute	JIS C 5201-1 4.6	$\geq 10^9 \Omega$							
Dielectric Withstanding Voltage	Applied 500V AC for 1 minute and limit surge current 50mA (max)	JIS C 5201-1 4.7	Without break down							

Operating Temperature Range for sizes 0603 and 0805: -55°C to +150°C. Contact factory for operation at higher temperatures.
 Operating Temperature Range for all other sizes: -55°C to +225°C. Contact factory for operation at higher temperatures.

How to Order



Product Series		Size	Power	Tolerance		Packaging			Resistance Value	
CSS	Metal Alloy			Code	Tol	Code	Description	Size	Quantity	Four characters with the multiplier used as the decimal holder. "L" used as multiplier of 10 ⁻³ for any value under 0.1 ohm. 0.00025 ohm = L250 0.004 ohm = 4L00 0.05 ohm = 50L0 0.12 ohm = R120
CSSH	High Power	0603	0.33W	D	0.5%	T	7" Reel - Plastic Tape	0603, 0805	5,000	
		0805	0.5W	F	1%			1206	4,000	
		1206	1W	G	2%			2010, 2512	2,000	
		2010	1W	J	5%			(H)2512		
		2512	2W					2725, 2728	1,000	
		(H)2512	3W					(H)2728		
		2725	4W					4527	500	
		2728	3W							
		(H)2728	4W							
		4527	5W							

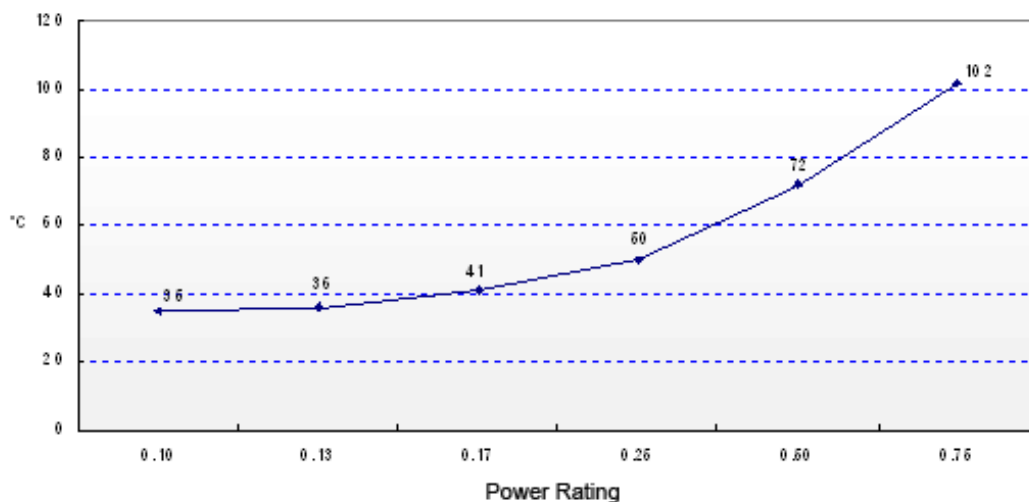
High Power Chip Resistors and Thermal Management

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.

CSR1206 100m Surface Temp Rise

Test equipment:
Chroma Programmable DC Power Supply
YF-162 Type-K thermometer



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 m Ω . This should be taken into account when designing.