Stackpole Electronics, Inc.

Resistive Product Solutions

Features:

- 0201 to 1225 sizes available
- Power ratings to 3W
- Low inductance < 2nH typically
- Non-standard resistance values available
- 0815, 2010 and 2512 sizes available with narrow terminations (CSRN)
- 100% RoHS compliant and lead free without exemption
- Halogen free
- REACH compliant



Electrical Specifications - CSR								
Type/Code	Power Rating (W) @ 70°C	Dielectric Withstanding	TCR (ppm/°C)	Ohmic Range (Ω				
		Voltage (V)	4000	1%	2%, 5%			
			± 1000	0.1 - (
CSR0201	0.05	200	± 600	0.15 -				
			± 300	0.51	1 - 1			
CSR0402	0.125	200	± 200	0.051	1 - 1			
CSR0603	0.125	200	± 300	0.02	! - 1			
CSR0805	0.25	200	± 200	0.02	! - 1			
CSR1206	0.5	200	± 100 (1)	0.01	- 1			
	0.5	200	± 600	0.01 -	0.02			
0004040			± 400	0.0205 -	0.0511			
CSR1210			± 300	0.0523 - 0.0976				
			± 200	0.1	- 1			
CSR2010	1	200	± 100 (1)	0.01	- 1			
CSR2512	2	200	± 200	0.01	- 1			
			± 300	-	0.001 - 0.004			
CSR0830	2	200	± 200	0.0051	- 0.01			
			± 150	0.0102	- 0.348			
			± 300	0.003 -	0.0049			
0054005			± 200	0.0051	- 0.02			
CSR1225	3	200	± 150	0.0205 -	0.0301			
			± 100	0.0332				

⁽¹⁾ Contact Stackpole for TCR below 50 mohm

	Electrical Specifications – CSRN (Narrow Termination)							
Type/Code	Power Rating (W) @ 70°C	Dielectric Withstanding	TCR (ppm/°C)	Ohmic Range (Ω) and Tolerance				
,,	@ 70°C	Voltage (V)		1%, 2%, 5%				
CSRN2010	1	200	± 250	0.01 - 1				
CSRN0815	4	200	± 300	0.01 - 0.0196				
CSKINUOIS	I	200	± 150	0.02 - 0.499				
CSRN2512 ^(*)	2	200	± 200	0.01 - 1				

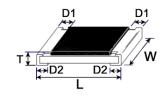
^(*) AEC-Q200 Qualified

Electrical Specifications – CSR-HP								
Type/Code	Power Rating (W) @ 70°C	Dielectric Withstanding	TCR (ppm/°C)	Ohmic Range (Ω) and Tolerance				
	@ 70°C	Voltage (V)		1%, 2%, 5%				
			± 400	0.051 - 0.1				
CSR0603HP	0.2	200	± 300	0.102 - 0.499				
			± 200	0.51 - 1				

Electrical Specifications – CSR-HP (cont.)								
Type/Code	Power Rating (W) @ 70°C Dielectric Withstanding		TCR (ppm/°C)	Ohmic Range (Ω) and Tolerance				
	@ 70 C	Voltage (V)		1%, 2%, 5%				
		000	± 600	0.01 - 0.02				
CSR1210HP	0.75		± 400	0.0205 - 0.0499				
GSK1210HP	0.75	200	± 300	0.051 - 0.091				
			± 200	0.1 - 1				

Please refer to the High-Power Resistor Application Note (page 8) for more information on designing and implementing high power resistor types.

Mechanical Specifications - CSR

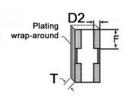


Type/Code	Weight (g) (1000 pieces)	L Body Length	W Body Width	T Body Height	D1 Top Termination	D2 Bottom Termination	Unit
CSR0201	0.18	0.024 ± 0.001 0.60 ± 0.03	0.012 ± 0.001 0.30 ± 0.03	0.009 ± 0.002 0.23 ± 0.05	0.005 ± 0.002 0.12 ± 0.05	0.006 ± 0.002 0.15 ± 0.05	inches mm
CSR0402	0.7	0.039 ± 0.002 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	1.99	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	5.3	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	8.82	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	15.5	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
CSR2010	27.03	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
CSR2512	53.08	0.252 ± 0.008 6.40 ± 0.20	0.126 ± 0.008 3.20 ± 0.20	0.020 ± 0.006 0.50 ± 0.15	0.024 ± 0.012 0.60 ± 0.30	0.079 ± 0.010 2.00 ± 0.25	inches mm
CSR0830	35.71	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

	Mechanical Specifications – CSRN (Narrow Termination)									
Type/Code	Weight (g) (1000 pieces)	L Body Length	W Body Width	T Body Height	D1 Top Termination	D2 Bottom Termination	Unit			
CSRN0815	19.96	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			
CSRN2010	27.03	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			
CSRN2512	53.08	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			

Mechanical Specifications - CSR1225





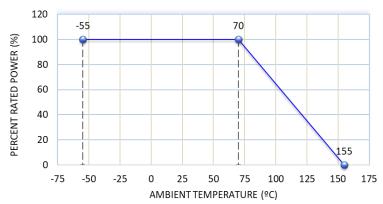
Type/Code	Weight (g) (1000 pieces)	L	W	Т	D1	D2	F	Unit
CSR1225	64.88	0.126 ± 0.006 3.20 ± 0.15	0.254 ± 0.006 6.45 ± 0.15	0.035 ± 0.006 0.90 ± 0.15	0.024 ± 0.012 0.60 ± 0.30	0.031 ± 0.010 0.80 ± 0.25	0.090 ± 0.005 2.29 ± 0.13	inches mm

	Performance Characteristics						
Test	Test Method	Test Specification	Typical	Test Condition			
High Temperature Exposure	MIL-STD-202 Method 108	1% Tol: (± 1% + 0.05Ω) 2%, 5% Tol: (± 1.5% + 0.1Ω)	≤ 0.5%	1000 hours at T = 155°C. Unpowered. Measurement at 24 ± 4 hours after test conclusion.			
Short Time	JIS-C-5201-1 4.13	$\pm (0.5\% + 0.05\Omega)$	≤ 0.25%				
Overload	IEC 60115-1 4.13	\pm (1% + 0.05Ω) For high power rating	≤ 0.5%	RCV (rated current) * 2.5 for 5 seconds.			
Temperature Cycling	JESD22 Method JA-104	1% Tol: (± 0.5% + 0.05Ω) 2%, 5% Tol: (± 1.5% + 0.1Ω)	≤ 0.5%	1000 Cycles (-55°C to +125°C) Measurement at 24 ± 4 hours after test conclusion. 30 minuntes maximum dwell time at each temperature extreme. 1 minute maximum transition time.			
Biased Humidity	MIL-STD-202 Method 103	1% Tol: (± 1% + 0.1Ω) 2%, 5% Tol: (± 2% + 0.1Ω)	≤ 0.5%	1000 hours 85°C / 85% RH. Note: Specified conditions: 10% of operating power. Measurement at 24 ± 4 hours after test conclusion.			
Operational Life	MIL-STD-202 Method 108	1% Tol: (± 1% + 0.1Ω) 2%, 5% Tol: (±2% + 0.1Ω)	≤ 0.5%	Condition D Steady State TA = 125°C at rated power. Measurement at 24 ± 4 hours after test conclusion.			
External Visual	MIL-STD 883 Method 2009	-	Pass	Electrical test not required. Inspect device construction, marking and workmanship.			
Physical Dimensions	JESD22 Method JB-100	-	Pass	Verify physical dimensions to the applicable device detail specification. Note: User(s) and supplier specification, electrical test not required.			
Resistance to Solvents	MIL-STD 202 Method 215	Marking unsmeared	Pass	Note: Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.			
Mechanical Shock	MIL-STD 202 Method 213	1% Tol: (± 0.25% + 0.05Ω) 2%, 5% Tol: (± 1% + 0.05Ω)	≤ 0.5%	Figure 1 of Method 213. Condition C.			
Vibration	MIL-STD 202 Method 204	1% Tol: (± 0.5% + 0.05Ω) 2%, 5% Tol: (±1% + 0.05Ω)	≤ 0.5%	5g's for 20 minuntes, 12 cycles each of 3 orientations. Note: Use 8" X 5" 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 - 2000Hz.			
Resistance to Soldering Heat	MIL-STD 202 Method 210	1% Tol: (± 0.5% +0.05Ω) 2%, 5% Tol: (± 1% + 0.05Ω)	≤ 0.5%	Condition B no pre-heat of samples. Note: Single wave solder - Procedure 2 for SMD.			
ESD	AEC-Q200-002		Pass	With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of \pm 500V, \pm 1kV, \pm 2kV, \pm 4kV, \pm 8kV. The electrometer reading shall be within \pm 10% for voltages from 500V to \leq 8kV.			
Solderability	J-STD-002	> 95% Coverage		Electrical test not required. Magnification 50 times. Conditions: SMD: a) Method B, 4 hours @ 155°C dry heat @ 235°C. b) Method B @ 215°C category 3. c) Method D category 3 at 260°C.			

	Performance Characteristics (cont.)								
Test	Test Method	Test Specification	Typical	Test Condition					
Electrical Characterization	User Spec		Pass	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.					
Flammability	UL-94	No ignition of tissue or scorching of pine board.	Pass	V - 0 or V - 1 are acceptable. Electrical test not required.					
Board Flex	AEC-Q200-005	1% Tol: (± 1% + 0.05Ω) 2%, 5% Tol: (± 1% + 0.05Ω)	≤ 0.5%	60 second minimum holding time.					
Terminal Strength (SMD)	AEC-Q200-006	No breakage	Pass						
Flame Retardance	AEC-Q200-001	No flame	Pass						
Voltage Proof	JIS-C-5201-1 4.7 IEC-60115-1 4.7	No breakdown or flashover	Pass	1.42 times Max. Operating Voltage for 1 minute. 0201: 50V; 0402: 100V; 0603: 150V; 0805: 300V 1206, 1210, 2010, 2512, 0830, 1225, 0815: 400V					

Operating temperature range is -55°C to +155°C

Power Derating Curve:



Recommended Pad Layouts - CSR

Type/Code	а	b	С	Unit
CSR0201	0.010	0.012	0.016 ± 0.008	inches
C3R0201	0.25	0.30	0.40 ± 0.20	mm
CSR0402	0.020	0.020	0.024 ± 0.008	inches
C3R0402	0.50	0.50	0.60 ± 0.20	mm
CSR0603	0.031	0.039	0.035 ± 0.008	inches
C3K0003	0.80	1.00	0.90 ± 0.20	mm
CSR0805	0.039	0.039	0.053 ± 0.008	inches
C3R0003	1.00	1.00	1.35 ± 0.20	mm
CSR1206	0.079	0.045	0.067 ± 0.008	inches
C3K1206	2.00	1.15	1.70 ± 0.20	mm
CSR1210	0.079	0.045	0.098 ± 0.008	inches
CSR1210	2.00	1.15	2.50 ± 0.20	mm

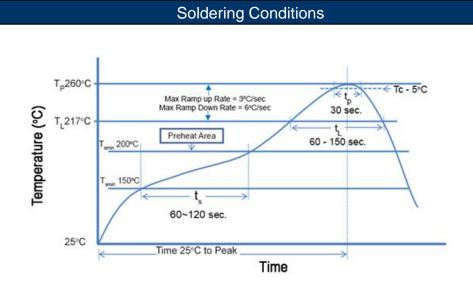
Stackpole Electronics, Inc. Resistive Product Solutions

Thick Film Current Sensing Resistor

Resistive Product Solution

	Recommended Pad Layouts – CSR (cont.)									
Type/Code	а	b	С	Unit						
CSR0830	0.039	0.071	0.299 ± 0.008	inches						
C3K0830	1.00	1.80	7.60 ± 0.20	mm						
CSR2010	0.142	0.055	0.098 ± 0.008	inches						
CSR2010	3.60	1.40	2.50 ± 0.20	mm						
CSR2512	0.193	0.063	0.126 ± 0.008	inches						
C3R2512	4.90	1.60	3.20 ± 0.20	mm						
CSR1225	0.047	0.079	0.276 ± 0.008	inches						
CSK1223	1.20	2.00	7.00 ± 0.20	mm						

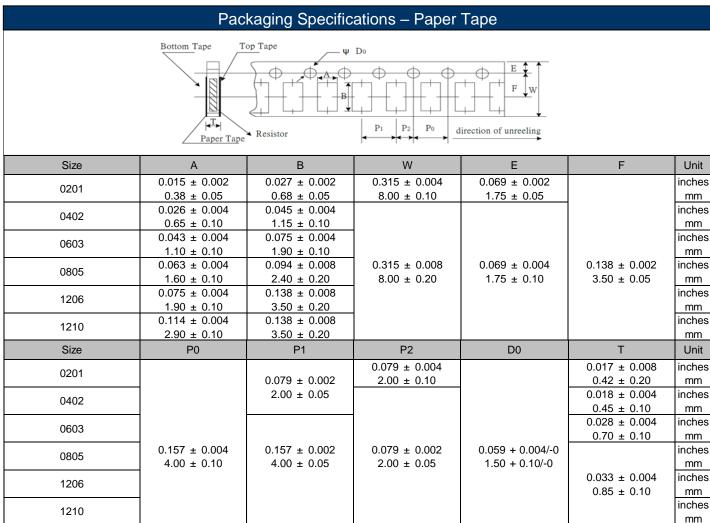
Recommended Pad Layouts - CSRN								
Type/Code	a	b	С	Unit				
CSRN0815	0.039	0.071	0.154 ± 0.008	inches				
CSKNOOTS	1.00	1.80	3.90 ± 0.20	mm				
CSRN2010	0.142	0.055	0.098 ± 0.008	inches				
CSRN2010	3.60	1.40	2.50 ± 0.20	mm				
CSRN2512	0.193	0.063	0.126 ± 0.008	inches				
CSRN2512	4.90	1.60	3.20 ± 0.20	mm				

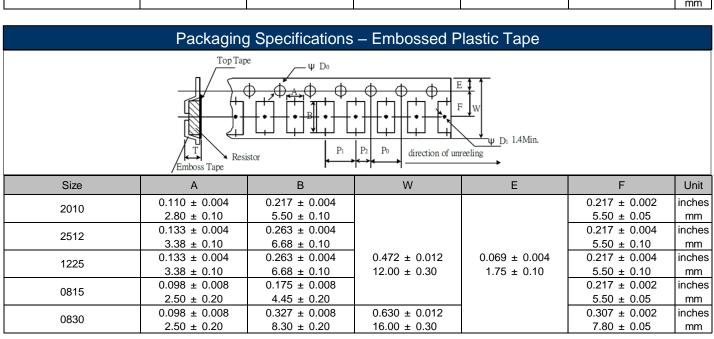


Profile Feature	Pb-Free Assembly		
Preheat			
Min. Temperature (Tsmin)	150°C		
Max. Temperture (Tsmax)	200°C		
Prehating time (ts) from (Tsmin to Tsmax)	60-120 seconds		
Ramp-up Rate (T _L to T _P)	3°C/second max.		
Liquidous Temperature (T _L)	217°C		
Time (t_L) maintained above T_L	60-150 seconds		
Min. Peak Temperature (Tp min)	235°C		
Max. Peak Temperature (Tp max)	260°C		
Time (tp) within 5°C of the specified classification temperature (Tc)	30 seconds max.		
Ramp-down rate (T _P to T _L)	6°C/second max.		
Time 25°C to peak temperature	8 minutes max.		

Reel Specifications

Size	А	В	С	W	Т	Unit
0201						inches
						mm inches
0402						mm
2000						inches
0603				0.374 ± 0.004	0.453 ± 0.039	mm
0805				9.50 ± 0.10	11.50 ± 1.00	inches
0000						mm
1206						inches
	7.008 ± 0.039	2.362 ± 0.039	0.531 ± 0.028			mm inches
1210	178.00 ± 1.00	60.00 ± 1.00	13.50 ± 0.70			mm
	170.00 ± 1.00	00.00 ± 1.00	10.00 ± 0.70			inches
2010						mm
2512						inches
2312				0.531 ± 0.039	0.610 ± 0.039	mm
1225				13.50 ± 1.00	15.50 ± 1.00	inches
						mm
0815						inches
				0.689 ± 0.039	0.768 ± 0.039	inches
0830				17.50 ± 1.00	19.50 ± 1.00	mm





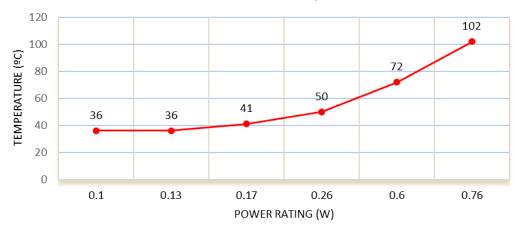
Packaging Specifications – Embossed Plastic Tape (cont.)							
Size	P0	P1	P2	D0	Т	Unit	
2010	0.157 ± 0.002 4.00 ± 0.05	0.157 ± 0.004 4.00 ± 0.10	0.079 ± 0.002 2.00 ± 0.05	0.059 + 0.004/-0 1.50 + 0.10, -0	0.039 ± 0.008 1.00 ± 0.20	inches mm	
2512	0.157 ± 0.004 4.00 ± 0.10			0.061 + 0.002/-0	0.057 ± 0.008	inches mm	
1225				1.55 + 0.05, -0	1.45 ± 0.20	inches mm	
0815	0.157 ± 0.002 4.00 ± 0.05			0.061 + 0.004/-0	0.047 ± 0.008	inches mm	
0830				1.55 + 0.10, -0	1.20 ± 0.20	inches mm	

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°C for the CSS / CSSH series and 70°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 105°C. At first glance this wouldn't seem too difficult, however the graph below shows typical heat rise for the CSR1206 100 milliohms 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 100mΩ Surface Temperature Rise



The 102°C heat rise shown here would indicate there will be additional thermal reduction techniques needed to keep this part under 105°C 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°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, via 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 $\leq 50 \text{ m}\Omega$. This should be taken into account when designing.

Stackpole Electronics, Inc.

Resistive Product Solutions

RoHS Compliance

Stackpole Electronics has joined the worldwide effort to reduce the amount of lead in electronic components and to meet the various regulatory requirements now prevalent, such as the European Union's directive regarding "Restrictions on Hazardous Substances" (RoHS 3). As part of this ongoing program, we periodically update this document with the status regarding the availability of our compliant components. All our standard part numbers are compliant to EU Directive 2011/65/EU of the European Parliament as amended by Directive (EU) 2015/863/EU as regards the list of restricted substances.

	RoHS Compliance Status						
Standard Product Series	Description	Package / Termination Type	Standard Series RoHS Compliant	Lead-Free Termination Composition	Lead-Free Mfg. Effective Date (Std Product Series)	Lead-Free Effective Date Code (YY/WW)	
CSR	Thick Film Current Sensing Surface Mount Chip Resistor	SMD	YES	100% Matte Sn over Ni	May-04	04/18	
CSRN	Thick Film Current Sensing Surface Mount Chip Resistor, Narrow	SMD	YES	100% Matte Sn over Ni	May-04	04/18	

"Conflict Metals" Commitment

We at Stackpole Electronics, Inc. are joined with our industry in opposing the use of metals mined in the "conflict region" of the eastern Democratic Republic of the Congo (DRC) in our products. Recognizing that the supply chain for metals used in the electronics industry is very complex, we work closely with our own suppliers to verify to the extent possible that the materials and products we supply do not contain metals sourced from this conflict region. As such, we are in compliance with the requirements of Dodd-Frank Act regarding Conflict Minerals.

Compliance to "REACH"

We certify that all passive components supplied by Stackpole Electronics, Inc. are SVHC (Substances of Very High Concern) free and compliant with the requirements of EU Directive 1907/2006/EC, "The Registration, Evaluation, Authorization and Restriction of Chemicals", otherwise referred to as REACH. Contact us for complete list of REACH Substance Candidate List.

Environmental Policy

It is the policy of Stackpole Electronics, Inc. (SEI) to protect the environment in all localities in which we operate. We continually strive to improve our effect on the environment. We observe all applicable laws and regulations regarding the protection of our environment and all requests related to the environment to which we have agreed. We are committed to the prevention of all forms of pollution.

