BOURNS®

Power Resistor Solutions

Power Resistor Solutions

Types Available:
Power resistors, power shunt resistors

Function:
Surge, snubber resistors, voltage feedback

Power Range:
0.125 W to 100 W

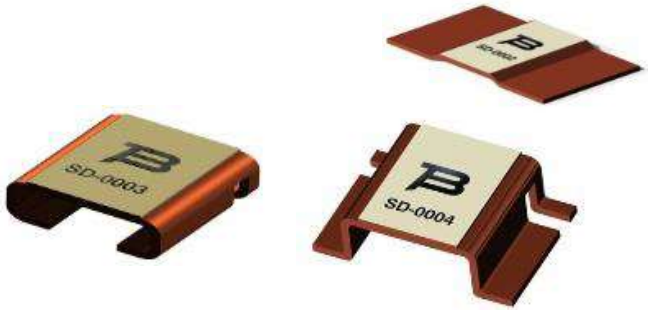
Resistor Materials:
Thick-film, metal alloys, wirewound

Formats:
Surface mount (chip and TO-220, DPAK), through- hole (TO-220), chassis mount, axial.

Temperature Coefficient:
As low as ±15 PPM/° C

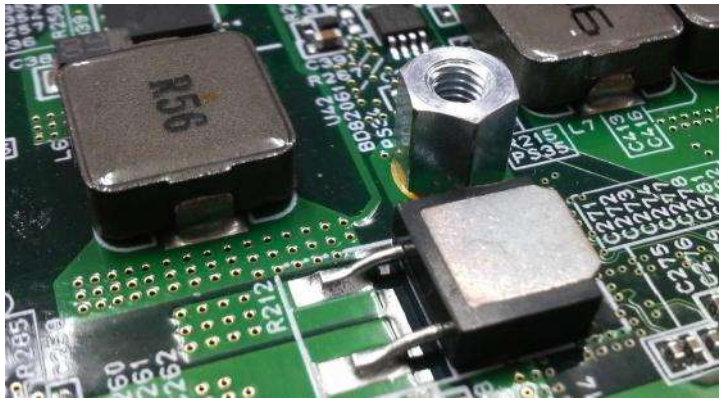
Resistance Range:
From 0.2 mΩ to 100 KΩ

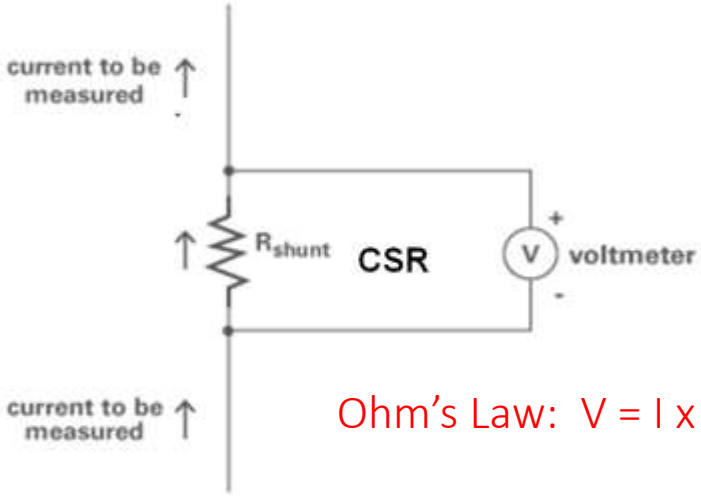
Applications:
Bourns® power resistors are used in power supplies, motor drives and electricity meters in telecom equipment, industrial equipment and automotive electronics.



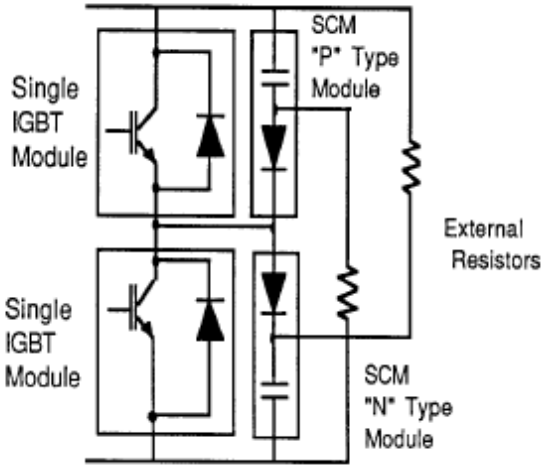
New product focus – High Power PWR series

- **Function of PWR**
  - Current Sense
    - For Ohmic Values less than 1 Ohm
    - Voltage Feedback
  - Current Limiting
    - For Ohmic Values between 1 Ohm and 15K
    - Dummy load
    - Relay Driver
    - R C D Snubber
    - Pulse Generator
    - Battery Charging





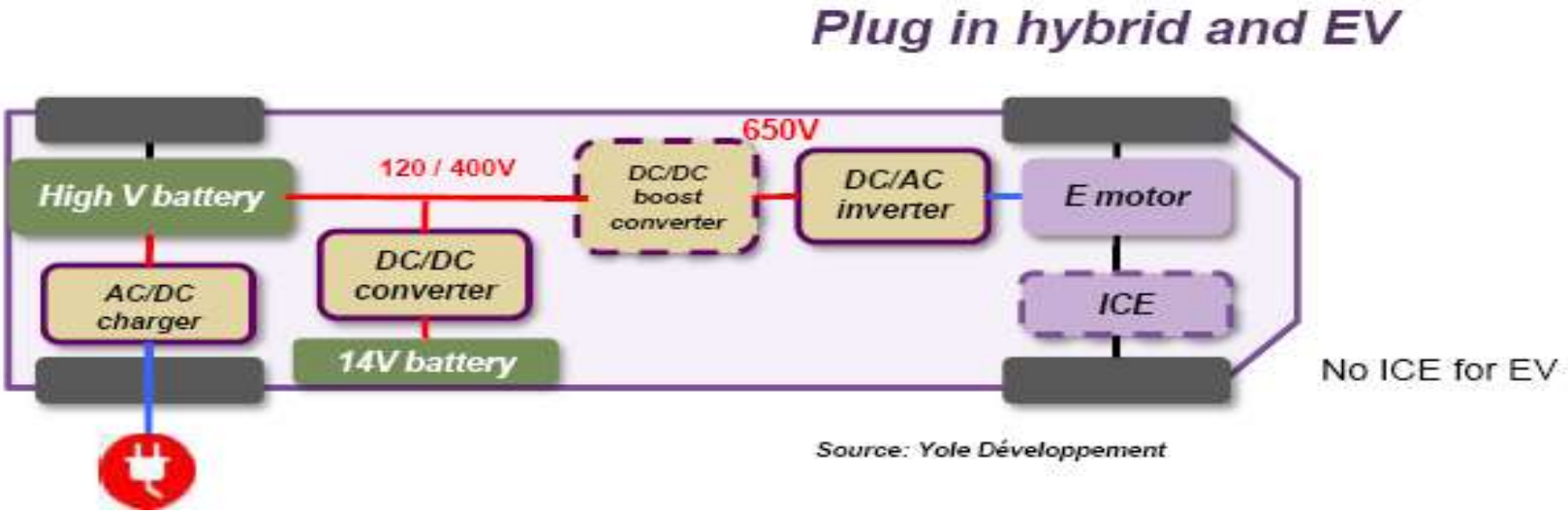
Ohm's Law: V = I x R



Limiting the overshoot caused by switching IGBTs on and off is achieved by Snubber circuits.

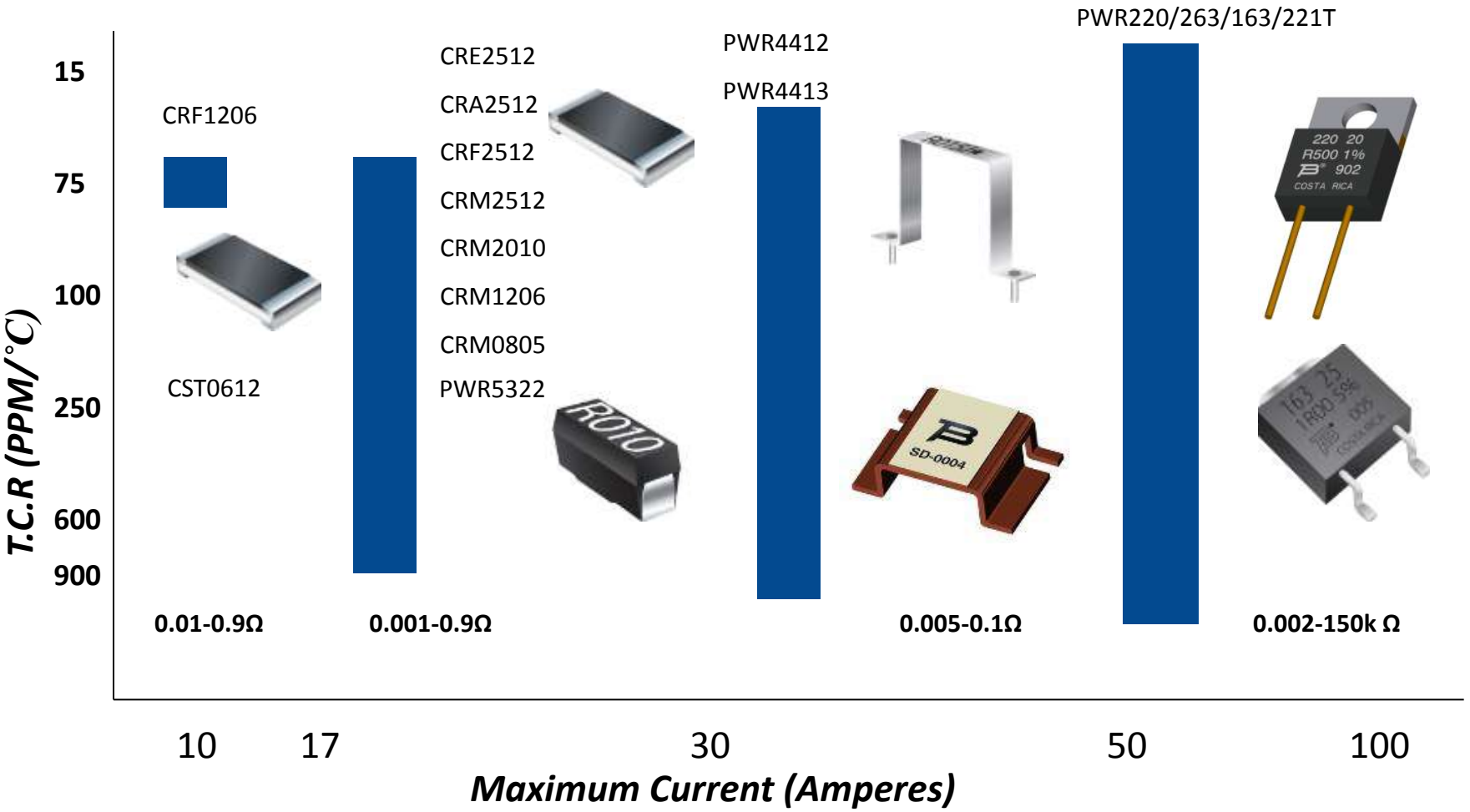
New product focus – High Power PWR series

- **Focus application**
  - Automotive
    - Plug in Hybrids, Full Electric Vehicles
    - DC/DC, Converter, Inverter Drive for E Motor, Battery Charger (RCD Snubbers, Current Sense)
  - Standard Industrial & Telecom
    - Network Storage, Industrial Lighting, Network Switches, Test Equipment, Industrial Electric Motor Drives, Audio Amplifiers
    - (Rectifiers, DC/DC Converter, Inverter Supply (RCD Snubbers)



Fix Resistor products

Diagram



Bourns Current Sense Resistors

- Maximum Current Capability of 50 Amps
- SMD, Open Frame, TO220 Housings
- TCRs as low as 15 PPM available
- Operating Temperaturs as high as 325˚C
- For information on Design Kits, Datasheets, Application Notes please visit www.bourns.com

Thick Film Chip Resistors

For current sensing

CRL Series - Low Value Chip Resistors

	CRL0603	CRL0805	CRL1206	CRL2010	CRL2512
Resistance range	0.1~9.1Ω	0.05~9.1Ω	0.02~9.1Ω	0.02~9.1Ω	0.02~9.1Ω
Power rating	0,1 W	0,125 W	0,25 W	0,5 W	1 W
TCR	0.05 Ω to 9.10 Ω ±200 ppm/°C 0.03 Ω to 0.04 Ω ±400 ppm/°C 0.01 Ω to 0.02 Ω ±600 ppm/°C				
Tolerance	±1 %, ± 5 %				
Working temperature	-55 to +125°C				

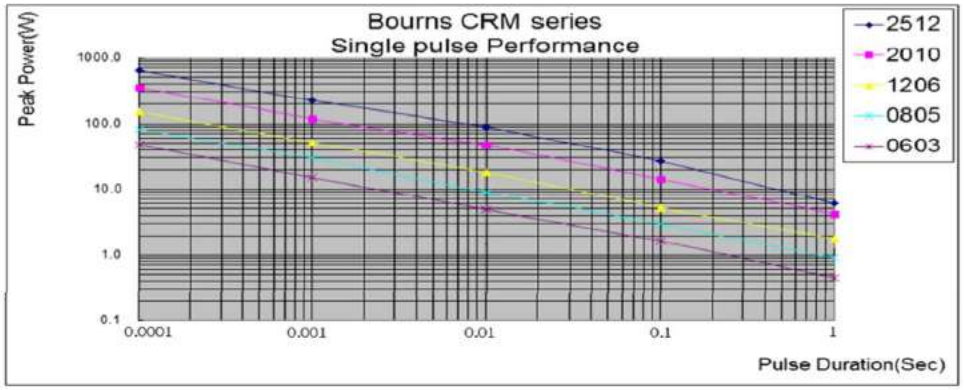
Thick Film Chip Resistors

For current sensing

CRM Series - chip resistors with high power ratings

	CRM0805	CRM1206	CRM2010	CRM2512
Resistance range	47 mohm to 1 Mohm			110 mohm to 1Mohm
Power rating	0,25 W	0,5 W	1 W	2 W
TCR	±100 ppm/°C ±200 ppm/°C			
Tolerance	±1 %, ±5 %			
Working temperature	-55 to +155°C			

- Strong pulse performance
- Power supplies
- Stepper motor drives
- Current limiting
- Snubber



BOURNS®

High Power Current Sense Chip Resistors

Model	Power (W)	Resistor	Resistance Range	Tolerance	TCR (PPM/°C)	Application	
CRA2010	**1.5**	**Special Alloy**	0.01 ohms to 0.100 ohms	1% ,5%	±75 ppm	Power supplies, Stepper motor drives	
CRA2512	**3**	**Special Alloy**	0.01 ohms to 0.100 ohms	1% ,5%	±75 ppm	Power supplies, Stepper motor drives	
CRF2512	**(2W) 0.100 to 0.010** **(1W) 0.015 to 0.040**	**Thin Film**	0.015 ohms to 0.040 ohms/ 0.003 ohms to 0.010 ohms/ 0.001 ohms to 0.002 ohms	1% ,5%	±75 ppm ±100 ppm ±275 ppm	Power supplies, Stepper motor drives	
CRM0805/CRM1206/CRM1206/CRM2010/CRM2512	**0.25/0.5/1/2**	**Thick Film**	.047 ohm to 1 megohm	1% ,5%	±100 ppm ±150 ppm ±200 ppm	Power supplies, Stepper motor drives	

Low & High Value Chip Resistors (CRL&CRH)

Model	Power (W)	Resistance Range	Tolerance	TCR (PPM/°C)	Application	
CRL0805	**0.125**	0.05 ohms to 9.1 ohms	1% & 5%	±200 ppm/±400 ppm	Portable devices, medical device	
CRL0603	**0.1**	0.10 ohms to 9.1 ohms	1% & 5%	±200 ppm	Portable devices, medical device	
CRL1206	**0.25**	0.02 ohms to 9.1 ohms	1% & 5%	±200 ppm/±600 ppm	Portable devices, medical device	
CRL2010/CRL 2512	**0.5/1**	0.02 ohms to 9.1 ohms	1% & 5%	±200 ppm/±600 ppm	Portable devices, medical device	
CRH0805	**0.125**	1.02 mega ohms to10 mega ohms	1%	±200 ppm	X-Ray devices	
CRH1206	**0.250**	1.02 mega ohms to10 mega ohms	1%	±200 ppm	X-Ray devices	

Ultra-Tight Tolerance Precision Chip Resistors

(Thin Thin Film)

Model	Power (W)	Resistor	Resistance Range	Tolerance	TCR (PPM/°C)	Application	
CRT0402	**0.0625**	**Thin Film**	50 ohms to 100K ohms	0.01% to 1%	± 5 ppm to ± 50 ppm	Hand hold devices, servers	
CRT0603	**0.100**	**Thin Film**	4.7 ohms to 402 ohms	0.01% to 1%	± 5 ppm to ± 50 ppm	Oil and gas meters	
CRT0805	**0.125**	**Thin Film**	1 ohms to 1 mega ohms	0.01% to 1%	± 5 ppm to ± 50 ppm	Hand hold devices, servers, Oil and gas meters	
CRT1206	**0.125**	**Thin Film**	1 ohms to 2 mega ohms	0.01% to 1%	± 5 ppm to ± 50 ppm	Process Control Computer	

Thin film v.s. Thick film

Thin Film

- Cost higher
- Sputtering resistive layer
- Homogeneous film
- Highly stable materials
- HF stable, low noise
- Low TCR (±25ppm)
- Narrow tolerance (±0.1% ~ ±1%)

Thick Film

- Cost low
- Printing & firing resistive layer
- Material with standard performance
- Higher noise
- Standard TCR
- (±100 ~ ±200ppm)
- Standard tolerance
- (±1% ~ ±5%)

PWR263/220

- TO-263/TO-220 Package
- 20/25/30 Watts of Power (at 25C)
- Thickfilm Resistor element mounted on a metal Backplane and over moulded in Black Epoxy
- ROHS Compliant
- Lead Free Reflow Soldering Compatible
- Non Inductive
- Excellent Pulse Power Characteristics
- Resistor Electrically Isolated from Backplane
- TCR of 100PPM/˚C

Bourns Advantage

- Competitive price
  - Bourns can offer cost reductions to customers if they switch from a competitor to Bourns
  - Bournsquote will give out special pricing when requested to support sales
- 4 week lead-time min.
- Excellent quality (manufactured by TESA)
- Capacity: Max. 30K/wk
- Sample availability
- Modifications available
  - Special resistance value (3 weeks to do customization!)
  - Additional configurations

Friendly technical and sales staff

- Available through major distributors

New product focus – High Power PWR series

- **Automotive capabilities**
  - Costa Rica plant is TS16949 certified
  - AEC approved products
  - PPAP capability
  - Factory audits facilitated
  - Specialized testing available
  - Assembled parts (with wire)

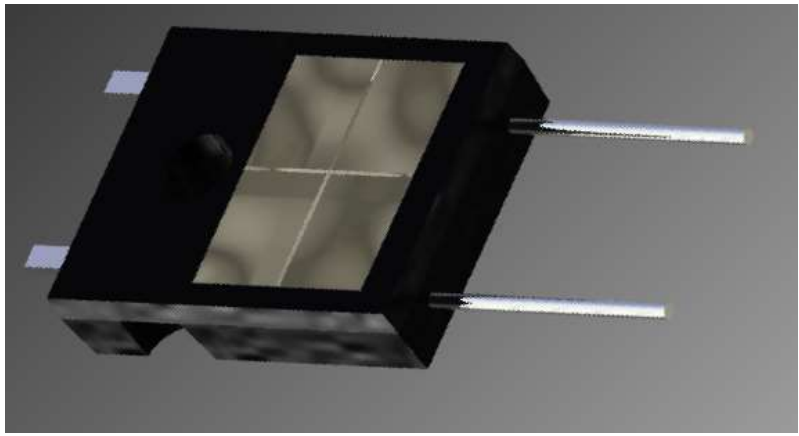
Model	Format	Features
PWR163 PWR263S-20 PWR263S-35	SMD DPAK 	Resistance Range 0.02 ohms-130Kohms Tolerances: 1 %, 5 % TCR ±100 ppm/°C Power: 20, 30, 35, ***50W*** , **70W, 100W** Superior Surge Performance Withstands high Temperatures Tested to 2000 hrs vs 1000 hrs standard (Therefore higher MTBF)
PWR220T-20 PWR220T-35 PWR221T-30 ***PWR221T-50***	Through-Hole TO220	
PWR247-70 ***PWR247-100***	***TO247*** ***Q1 2015*** 	

- **Cross reference**

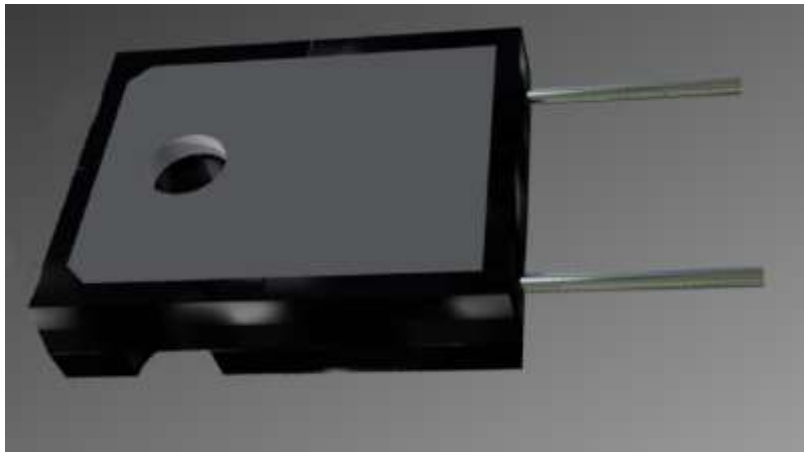
	BOURNS	VISHAY	CADDOCK	BI
DPAK	PWR163		MP725	
D2PAK	PWR263	D2TO		SMHP
TO-220	PWR220T	RTO	MP820/MP850	MHP
TO-220	PWR221T	LTO30	MP930	

New Products

- PWR 247, 100W TO-247 Package
- Two packaging options
  - Bare ceramic back
    - No metal backplate
    - Popular configuration in the market
    - No backplate attachment operation
    - Ceramic 0.040” limits heat conduction to the heatsink
    - Difficult to mold, requires pin extension to hold the element in position, difficult to index for auto placement.
    - Exposed pin ends

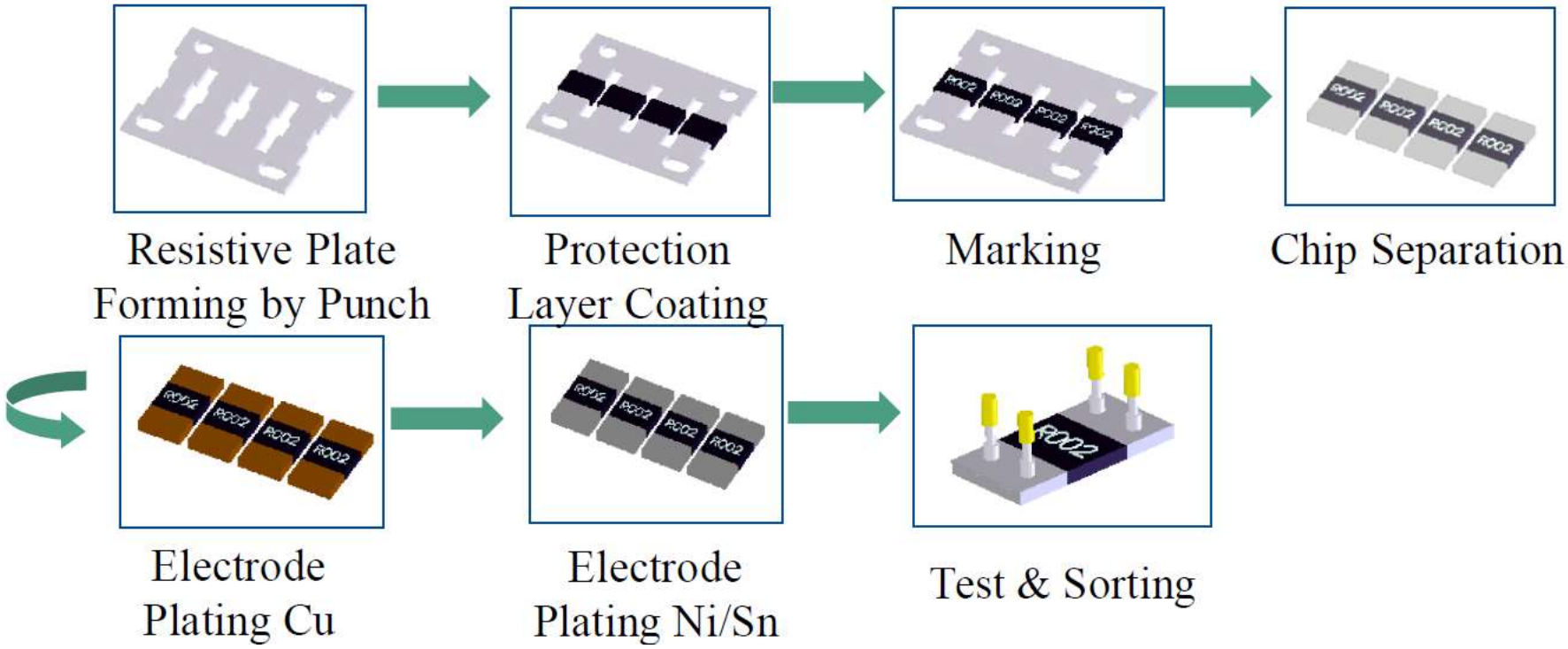


  - Heatsink Back
    - Metal backplate covering most of the area
    - Requires back plate attachment operation
    - 0.025” ceramic allows for better heat conduction to heatsink
    - Hole in the backplate allows for easy indexing in the mold.
    - More expensive



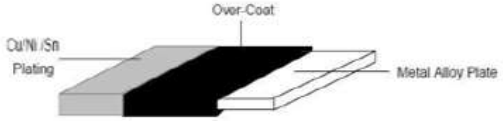
Metal Alloy Chip Resistors

For current sensing



Metal Alloy Chip Resistors

For current sensing



Feature

- Low ohmic
- High Power
- Low Thermal EMF
- Low TCR

	CRF0805	CRF1206	CRF2512	CRA2512	CRE2512
Construction	Mn/CU alloy			Mn/CU alloy	Mn/CU alloy
Resistance range	5 to 20mohms	1 to 30 mohms	1 to 50mohms	10 to 100 mohms	1 to 9 mohms
Power rating	0,5 W	1 W	1 W, 2 W	3 W	2 W, 3 W
TCR	±100 ppm/°C	(0.001 Ω) ±275 ppm/°C (0.002 to 0.010 Ω) ±100 ppm/°C (>0.010 Ω) ± 75 ppm/°C		±75ppm	±75ppm
Tolerance	±1%, ±5%			±1%, ±5%	±1%
Working temperature	-55 to +170°C				

BOURNS®

Metal Alloy Chip Resistors CRE 2512

- General purpose SMD current sense resistor from 1mOhm to 10mOHm, 2 & 3W
- Inductance less than 5 nH
- Low **EMF** due to the Mn/Cu metal alloy plate

↘

Thermal EMF (Electro Motive Force):

- Dissimilar metals, in contact with each other, produce a small voltage.
- This voltage is variable with temperature and is therefore called a “Thermal EMF”
- Its unit is shown as µV/℃ .

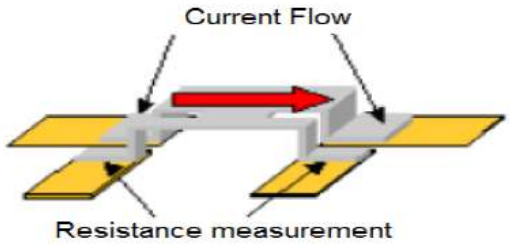
When ΔT=10℃ between metal foil and Cu pad.

Metal strip alloy	Thermal EMF(µV/℃)	Induced Voltage Drop (mV)	Induced Current (mA)
Ni/Cu	-40	0,4	0,04
Mn/Cu (CRE serie)	-1	0,01	0,001

Voltage drop due from low EMF of Mn/Cu (CRE serie) is much smaller than Ni/Cu resistors

4-Teminal Current Sense Resistor

CST- series



new

Application: Consumer (graphic cards), Industrial electronics

Competitive Advantage: less hot spots due to trimming by grinding

Market Benefit: Low cost method to monitor the current in a circuit and translate the amount of current into a voltage that can be easily measured and monitored

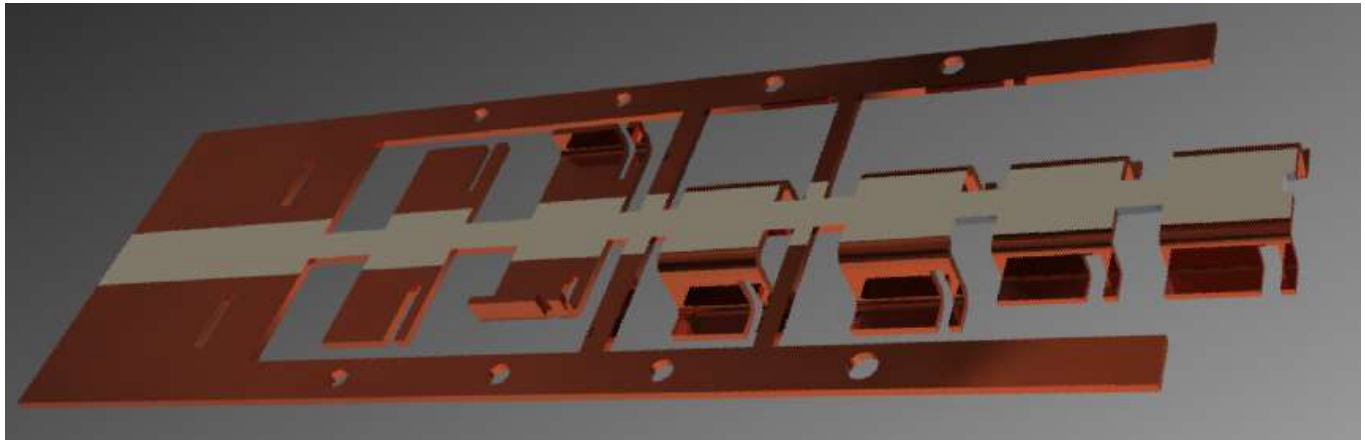
Features

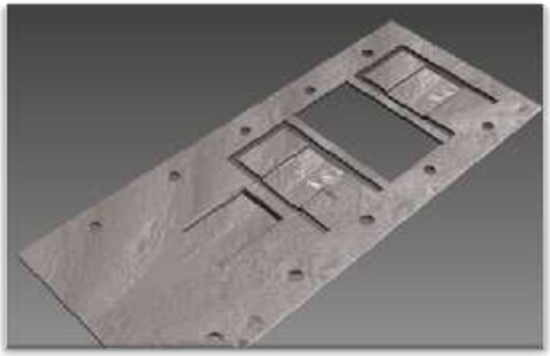
Type	CST0612
Power Rating	1/2 W&1W
Resistance Value	0.5mΩ ~ 5mΩ
Operation Temperature Range	-55℃~+170℃
Temperature Coefficient of Resistance	± 200ppm/°C (0.5mΩ≦R≦3mΩ)
	± 150ppm/°C (3 mΩ≦R≦5mΩ)
Tolerance	±1% , ±2% , ±5%
Insulation Resistance	Over 100MΩ
Maximum Working Voltage(V)	$(P*R)^{1/2}$

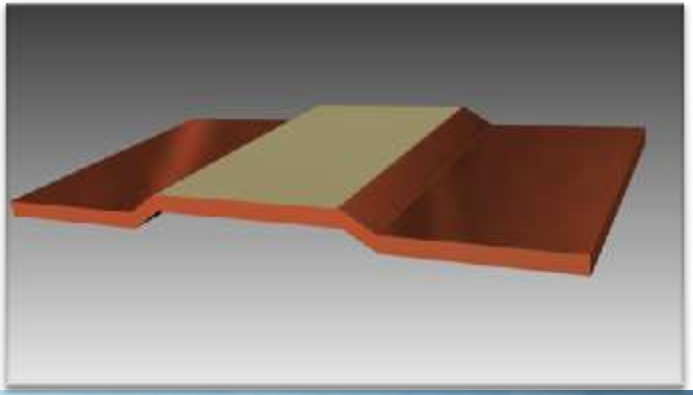
Note*:1 Watts with total solder pad and trace size of $300mm^2$

SHUNTS

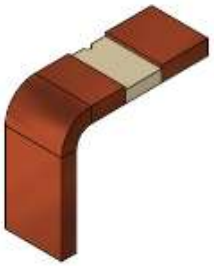
- Very low Resistance values
- Made out of Electron Bean welded resistive element to copper sheets
- Die forming out of the metal sheet







Isabellenhutte products

PRODUCT DESCRITION: CURRENT SENSOR SHUNT **CSS**				REV: C
MARKET REFERENCE **ISABELLENHUETTE [ISA]**	PRODUCT OUT LINE: DRAWING:			STYLE:
BVE/ BVS/ BVT [2 TERMINALS]	**SD-0005** 	**SD-0006** 	**SD-0007** 	**H**
BVB/ BRS [4 TERMINALS]	**SD-0003** 			**C**
BVR [4 TERMINALS]	SD-0004 			**J**
BVH [THROUHOLE]	SD- 			**N**
LEAR	**SD-0008** 			**L**

ISABELLENHUETTE [ISA]

BOURNS STYLE

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVE	2-termimal-resistors with large connectors for high performance.	5930	10 W	1 %	0.0002 Ω	0.002 Ω	50 ppm/K

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVS	2-terminal-resistors made of composite material	3920	12 W	1 %	0.0002 Ω	0.005 Ω	50 ppm/K

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVT	2-terminal-resistors made of composite material.	2512	3 W	1 %	0.0003 Ω	0.0068 Ω	50 ppm/K

H

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVB	4-terminal-resistors made of composite material. Perfectly suitable for the use on DBC or ceramic. Space-saving design.	2725	12 W	1 %	0.0002 Ω	0.005 Ω	20 ppm/K

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BRS		BRS	2-terminal-resistors made of composite material. Perfectly suitable for the use on DBC or ceramic. Space-saving design.	3812	2 W	1 %	0.002 Ω	0.010 Ω	100 ppm/K

C

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVH	Heavy copper connectors	3820	5 W	3 %	0.0003 Ω	0.002 Ω	300 ppm/K

N

Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVR	4-terminal-resistors made of composite material. Perfectly suitable for the use on DBC.	4026	5 W	1 %	0.0002 Ω	0.003 Ω	20 ppm/K

J

PART NUMBER:

CSS2H-2512-L500F

MODEL:
CSS = CURRENT SENSOR SHUNT

PIN COUNT:
2 or 4

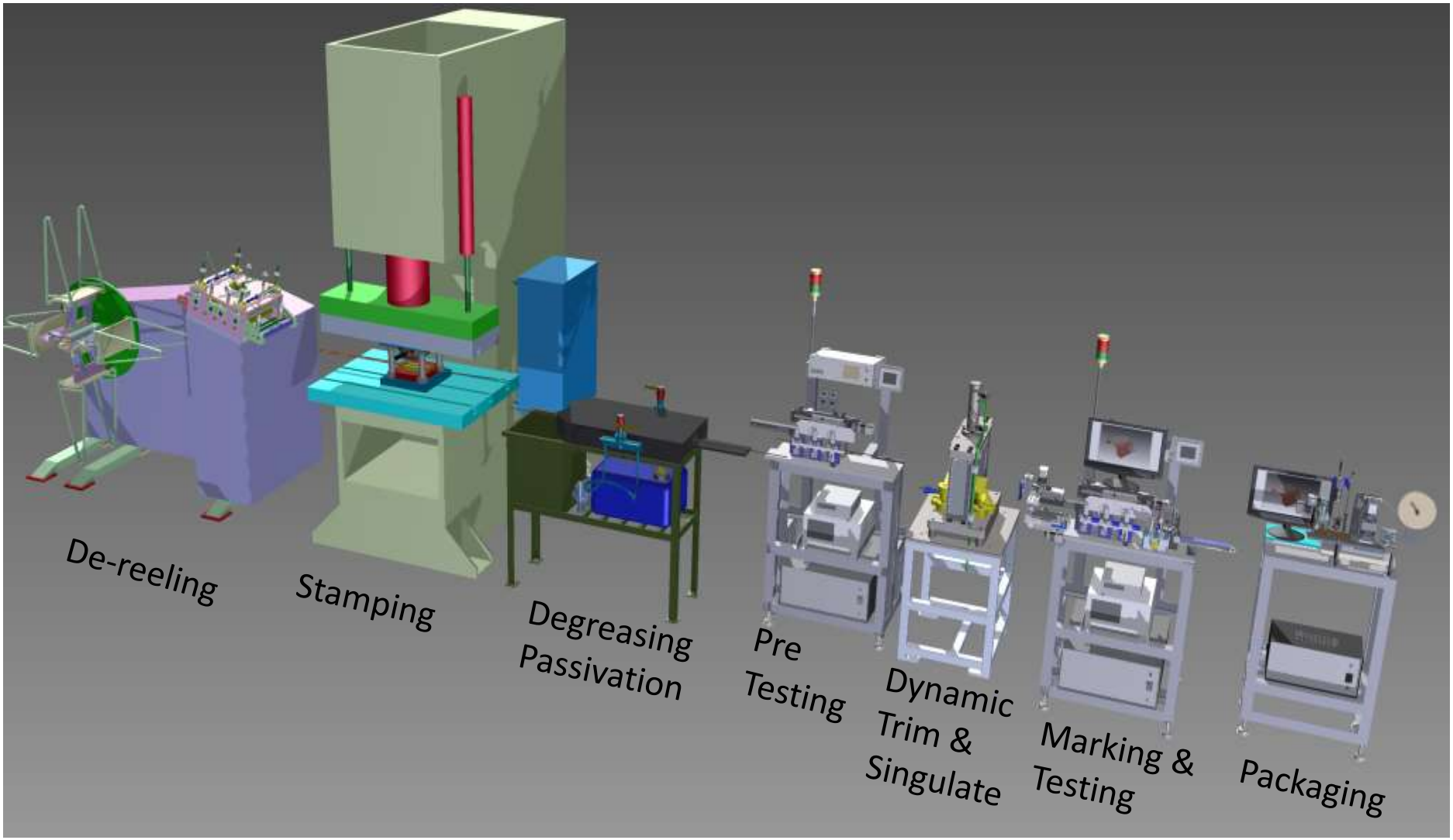
STYLE:
C,H,J [N,L]

SIZE:
L x W (INCH THOU)

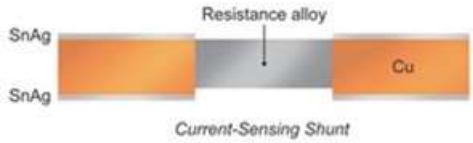
RESISTANCE:
(milliohms)
“L” represents decimal point

ABSOLUTE TOLERANCE:
F = 1%
J = 5%

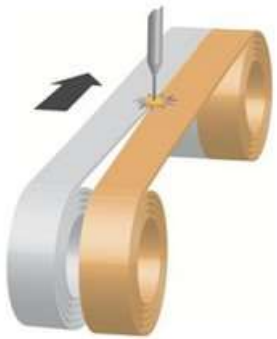
Shunt Production Line

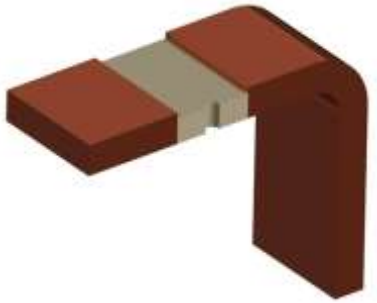


Production Considerations



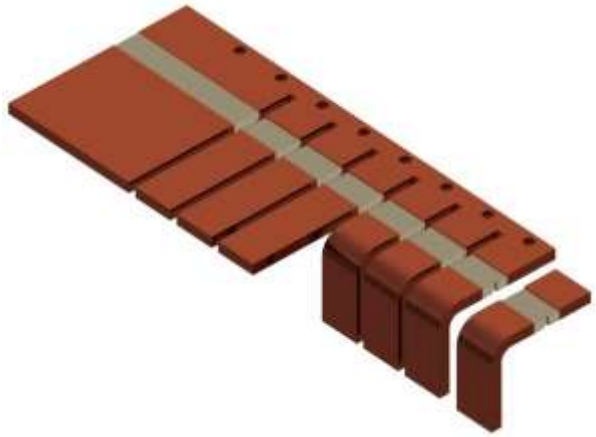
- Every new model requires its own specific raw material
- To make 1 new model, requires to buy ~20lbs of material, this produced ~3k pcs @ $2700 per part
- Therefore we will not be doing a general release of every part number





Product Release

1. Release specific customer project, Delta (Lear)
2. Release individual part numbers first :
   - Equivalent to ISA BVE 1mΩ & 2mΩ
   - Equivalent to ISA BVT 1mΩ & 2mΩ
   - Equivalent to ISA BVR 1mΩ & 2mΩ
3. Flesh out families with specific customer requests



Cross list [preliminary]

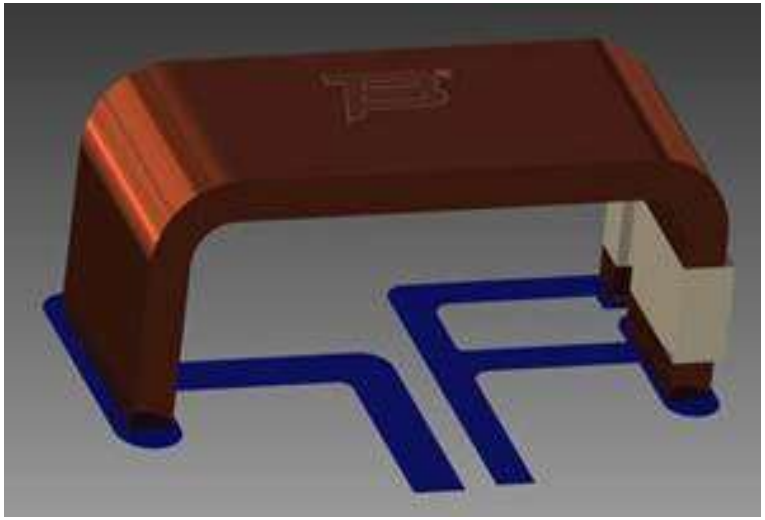
ISA P/N	BOURNS P/N	REFERENCE SKETCH	OUT LINE DWG
BVR-Z-R0005-1.0	**CSS4J-4026-L500F**	SD-0004	I-3995
BVT-Z-R0005-1.0	**CSS2H-2512-L500F**	SD-0005	I-3996
BVS - M - R0005 - 1.0	**CSS2H-3920-L500F**	SD-0006	I-3993
BVE-M-R0005-1.0	**CSS2H-5930-L500F**	SD-0007	I-3994
BVB - Z - R0005 - 1.0	**CSS4C-2725-L500F**	TBA	TBA
BVH-M-R0005-5.0	**CSS4N-3820-L500J**	TBA	TBA
BVN - Z - R0005 - 1.0	**CSS2C-1216-L500F**	TBA	TBA

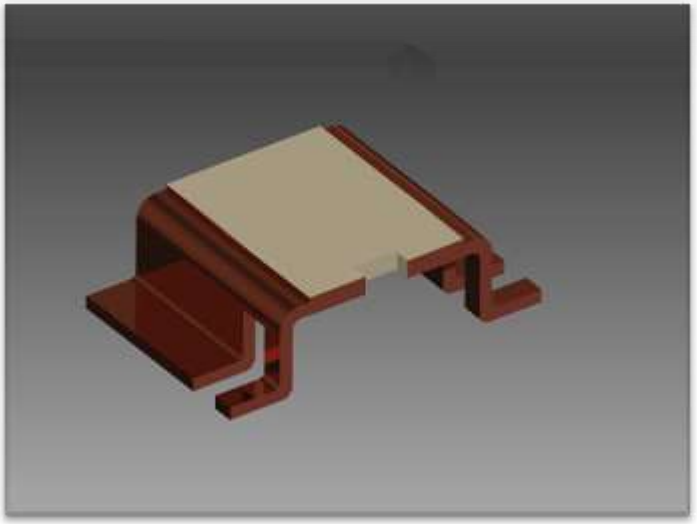
shunt: definition

an electrical conductor joining two points of a circuit, through which more or less of a current may be diverted.

"One indication is a shunt or a short circuit of a medium between the common control element and the devices."

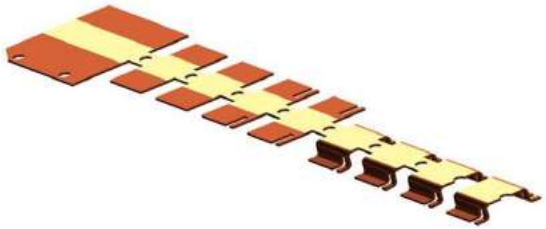
ISA BVR
VISHAY



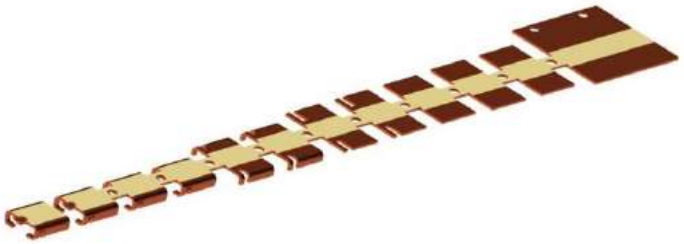


High Power – Welded Strip Shunts

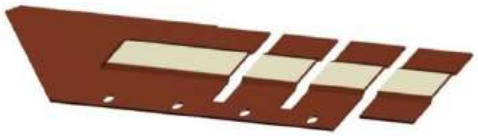
Size	7 mm
R range	0.2 – 3 mohms
Power rating	5W
TCR	<20 ppm
Tolerance	1%, 5%
Working Temperature	-55~170



Size	7 mm
R range	0.2 – 3 mohms
Power rating	5W
TCR	<20 ppm
Tolerance	1%, 5%
Working temperature	-55~170



Size	3 mm to 7 mm
R range	0.2m~2mohms
Power rating	4W~10W
TCR	<100ppm
Tolerance	0.5%, 1%
Working temperature	-55~170



High Power – Surface mounted

PWR 1913/2010/3014/4318
5312/2615/4525/6327

Features

- Power 1,5-3 W
- Resistance value 0,01-25k
- Low TCR 20-150 ppm
- Surge Protection
- High Pulse Power

Application:

- Power supplies
- Motor drives
- Electricity metering

High Power – Bare metal element

PWR4412, 4413, 4414

Features

- Power 1-5W
- Resistance value: 0,005 to 0,1 ohm
- Through hole & SMT
- Current Sense
- High Current, High Temperature

Applications

- Power supplies
- UPS
- Motor drivers

New Products

- Sulphur Proof — Continue to release more model
  - Thick film Chip resistors & arrays for sulphur environments
  - Already approved by large industrial & memory OEMs

- Current Sense
  - Low ohmic <1mOhm, 4 terminal device
  - Already approved by large consumer OEM

- High Voltage Chip resistors
  - Thick film chip resistors, 500V, 1206, 2010 & 2512 size

- Wirewound (non fusible)
  - Axial leaded, pulse withstand