BOURNS®

BMS Protect Solution

Overview

- Founded in 1947, Bourns, Inc. is a leading provider of components and solutions for Motion Control, Circuit Protection and Circuit Conditioning
- Privately held company headquartered in Riverside, California
- Approximately 5,300 employees with 14 worldwide manufacturing centers for electronic products
- All manufacturing centers are ISO 9001 and/or TS16949 certified

15 Acquisitions since 2000

Joslyn GDT Division
March 2001

Microelectronic Modules Corporation
December 2003

RUF Automotive Group
December 2004

J.W. Miller Magnetics Business
May 2006

pPTCs of Therm-O-Disc
July 2006

TBUs of Fultec Semiconductor
October 2008

Jensen Devices' GDTs
June 2012

Power Innovations, Ltd.
May 2000

Telecom Protection Products from TI
January 2003

MMC's Switch Power Products
February 2004

Tyco/Meggitt's Fuel Cards
February 2005

Automotive Controls Division of SSI
June 2006

Protection Products from Emerson
January 2008

Protection Products of Corning
June 2009

Komatsulite
December 2014

Global Manufacturing

ISO 9001, ISO 14001 and ISO/TS 16949 certified.

Major Customers

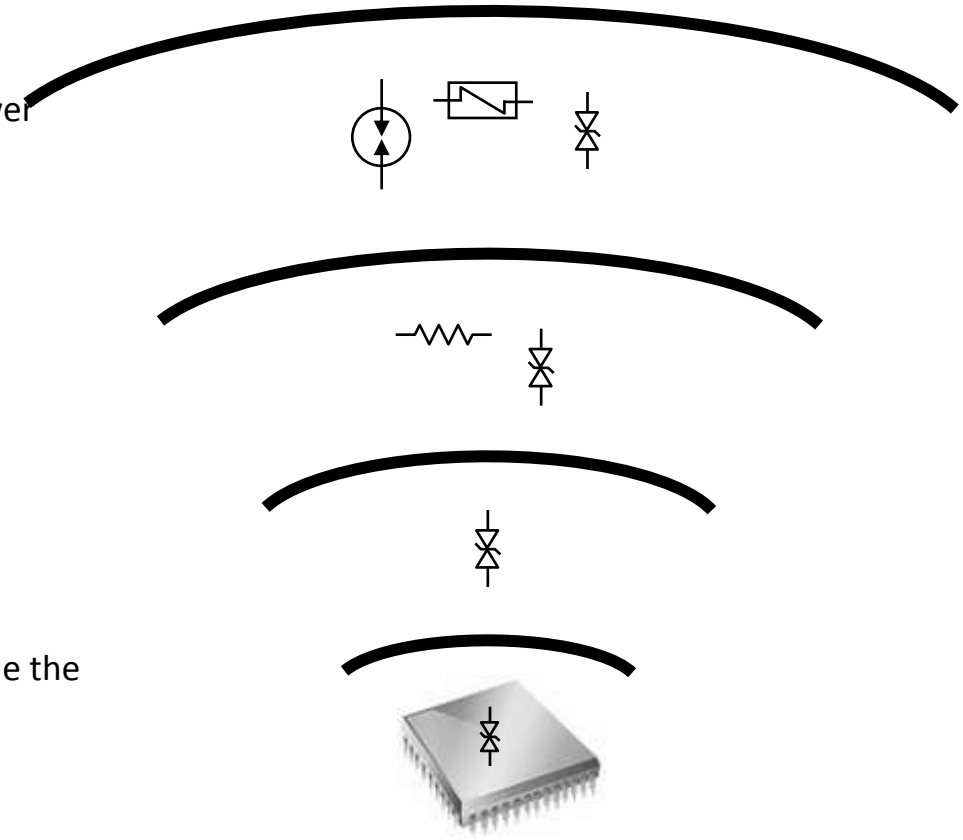
Customer	OEM Customer
GM Chassis & GM Powertrain	General Motors (GM)
Ford	Ford
Continental	Chrysler, VW, Audi, BMW
ZFLS	GM, VW, BMW
Hyundai Mobis	Hyundai, Kia
American Axle	GM
TRW	GM, Ford
Timken	Chrysler, GM, Ford
Delphi	GM
Pierburg	Opel, Fiat
Bosch	Honda, GM, Opel, Fiat, DCX, Nissan, Volvo

Customer	OEM Customer
Magneti Marelli	Opel, Fiat, PSA, Audi, Harley Davidson
Arvin Meritor	Various Heavy Truck
Knorr Bremse	Various Heavy Truck
Valeo	Mercedes
Mando	GM
Williams Controls	Volvo, Hyundai, CAT
Visteon	Ford, Jaguar, Mazda
Borg Warner	Ford, DCX
Dura	GM, Chrysler
Hella	GM, Ford, Audi, Nissan, Kia
ASMO	Nissan, HY, Toyota, VW

Levels of Protection

- The TBU solution provides a higher level of protection

- High Energy Surge Protection
  - Provides resistibility against lightning and power induced faults
- Moderate Energy Surge Protection
  - Typically need to add components to increase energy resistibility
- Low Energy Surge Protection
  - Basic ESD protection if IC structures are not adequate
- Protected IC
  - Sometimes contains sufficient protection inside the chip for low energy surges

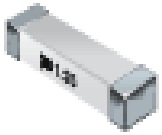


Bourns® Protection Device

Multifuse®

CPTC

Telefuse™



SinglFuse™

Over Current Protection

Over Voltage Protection

Magnetics

LSP

TCO

LPM

TBU™

TCS™

MOV

GDT

TISP®

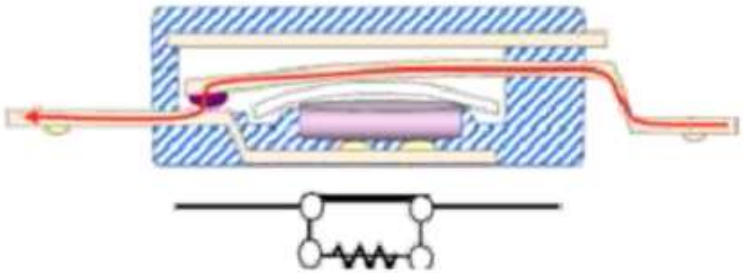
TVS

Chip Guard®

Komatsulite

- The mini-breaker – What is it?
- A bi-metal switch and a PTC
- Closed state is the normal state

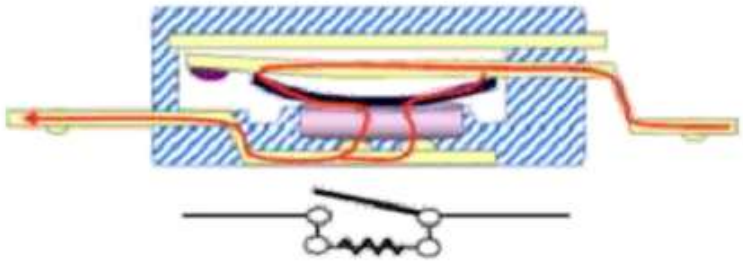
Closed State



Minimal resistance:

saves battery life
reduces recharge time
allows large current draws

Open State



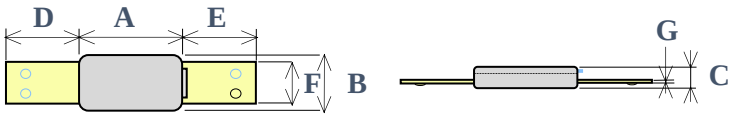
The PTC function:

keeps the bi-metal switch open
provides power for essential device functionality

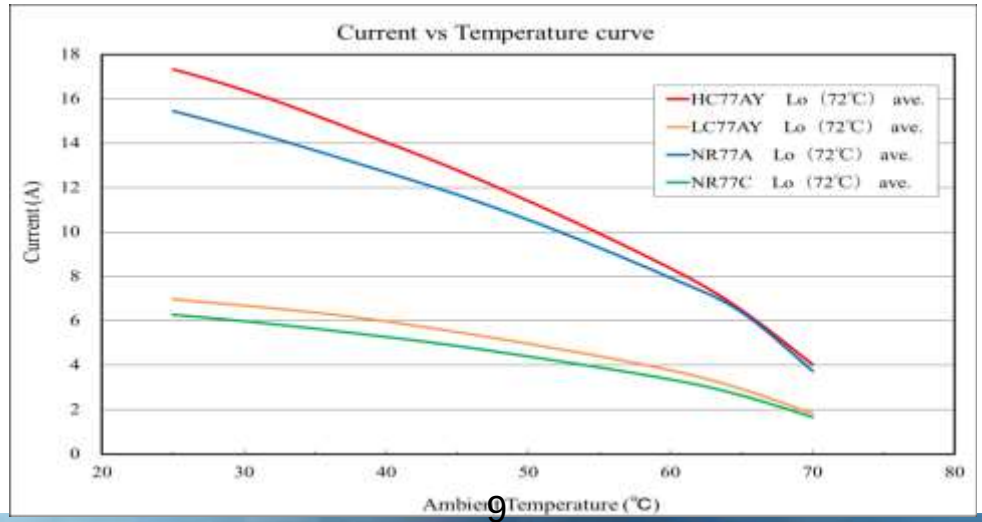
TCO Line Up

New

Item	LC Series		HC Series		NR Series				KCA Series	
Type	—		—		C		A		A	
Trip Temperature (±5℃)	LC72AY-☐	72℃	HC72AY-☐	72℃	NR72C☐☐	72℃	NR72A☐☐	72℃	KCA72A☐☐	72℃
	LC77AY-☐	77℃	HC77AY-☐	77℃	NR77C☐☐	77℃	NR77A☐☐	77℃	KCA77A☐☐	77℃
	LC82AY-☐	82℃	HC82AY-☐	82℃	NR82C☐☐	82℃	NR82A☐☐	82℃	KCA82A☐☐	82℃
	LC85AY-☐	85℃	HC85AY-☐	85℃	NR85C☐☐	85℃	NR85A☐☐	85℃	KCA85A☐☐	85℃
	—		HC90AY-☐	90℃	—		—		—	
Contact Rating	DC9V/12A 6,000cyc.		DC9V/25A 6,000cyc.		DC12V/12A 6,000cyc.		DC12V/25A 6,000cyc.		DC12V/25A 6,000cyc.	
Max. Voltage	DC28V/5A 100cyc.		DC28V/25A 100cyc.		DC28V/12A 100cyc.		DC28V/25A 100cyc.		DC28V/25A 100cyc.	
Self Hold Min. Volt.	2V (at 25℃)		3V (at 25℃)		2V (at 25℃)		2V (at 25℃)		2V (at 25℃)	
Max. Leak Current	150mA (at 25℃)		200mA (at 25℃)		150mA (at 25℃)		200mA (at 25℃)		200mA (at 25℃)	
Resistance	10±5mΩ (7～9mΩ)		5mΩ Max.(1.5～2.7mΩ)		15mΩ Max(7～11mΩ)		5mΩ Max.(1.7～3.5mΩ)		5mΩ Max.(1.7～3.5mΩ)	
Approved	UL, cUL, TUV		UL, cUL, TUV		UL, cUL, TUV		UL, cUL, TUV		Planning for UL, TUV	

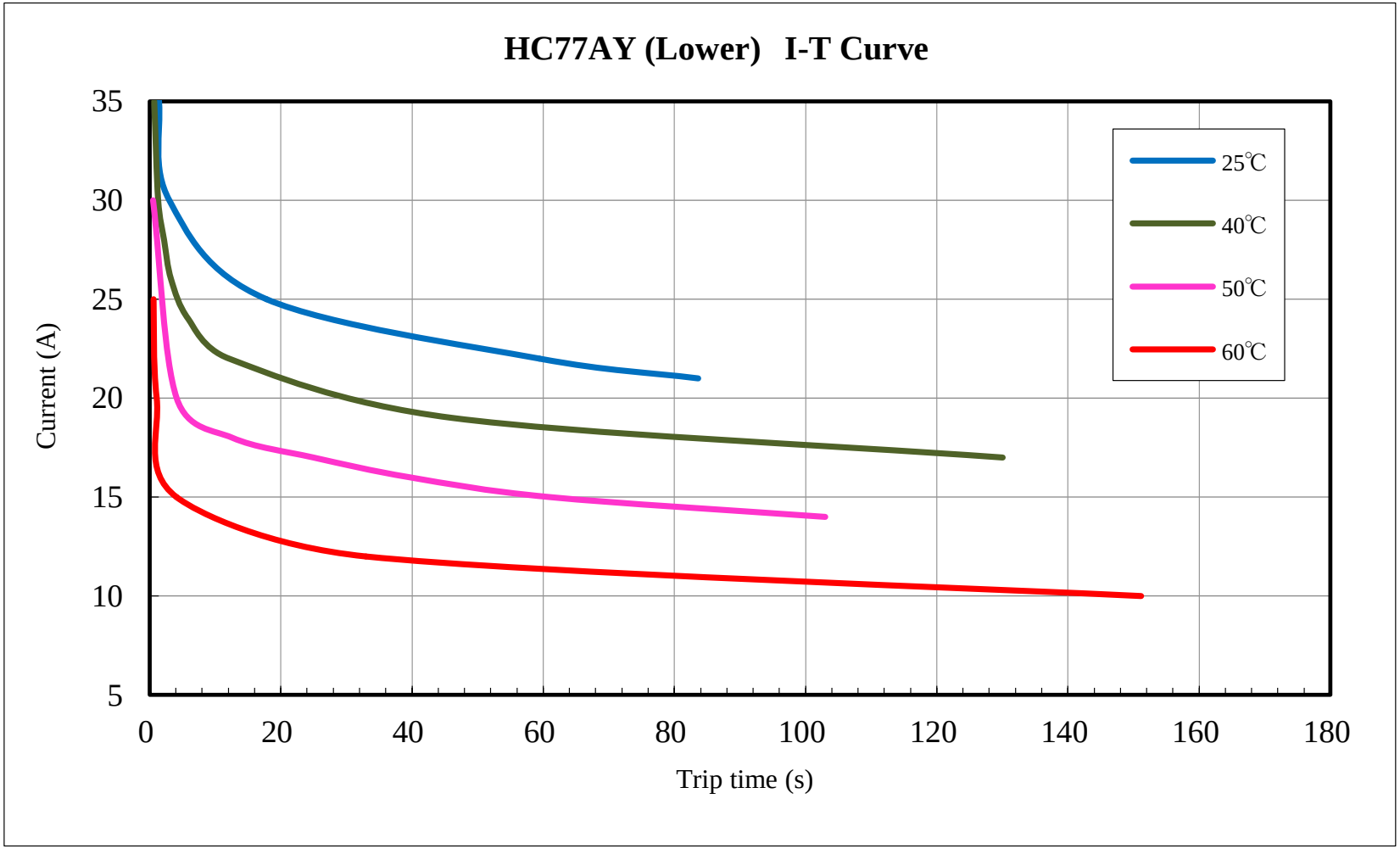


	A	B	C	D&E	F	G
LC☐☐AY-1	5.8 ±0.1	3.75 ±0.1	1.15 max.	2.7 ±0.1	2.5 ±0.1	0.1 ±0.01
LC☐☐AY-1T			1.05 max.			
HC☐☐AY-1			1.15 max			
NR☐☐☐10	4.8 ±0.1	2.8 ±0.1	0.94 max	3.2 ±0.1	2.0 ±0.1	
KCA☐☐☐10	5.4 ±0.1	3.2 ±0.1	0.94 max	2.9 ±0.1	2.3 ±0.1	



BOURNS®

Current vs. Trip time

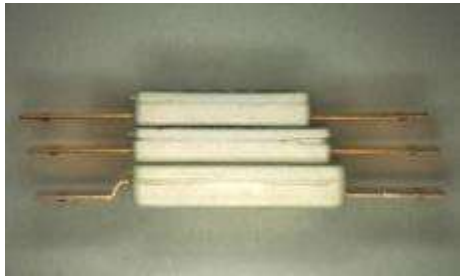
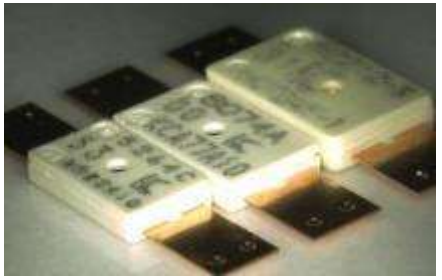


Case of Trip temp. : Trip time is almost same as case of high current (less than 1 s)

Size Comparison for NR, KCA and LC & HC

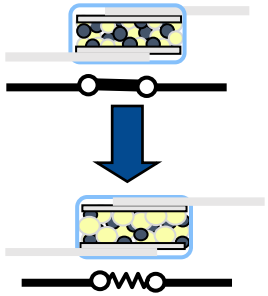
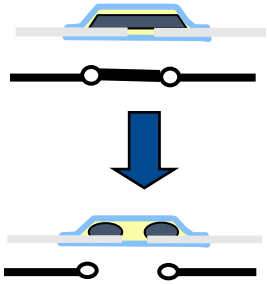
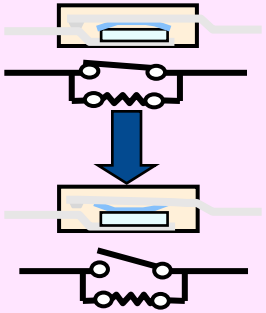
- NR body size/volume is 50% smaller than LC&HC TCO.
- KCA body size/volume is 35% smaller than LC&HC TCO.

NR KCA LC/HC

	1. Size	2. Thickness (Max)	3. Weight
NR	12.63 ㎟	0.94 mm	43 mg
Contribution	✔50% downsize	✔0.21mm reduction	✔45% cut
KCA	16.24 ㎟	0.94 mm	53 mg
Contribution	✔35% downsize	✔0.21mm reduction	✔32% cut
Conventional (LC&HC)	25.01 ㎟	1.15 mm	78 mg

Matrix of Protectors for Li Rechargeable Batteries

	Polymer PTC	Thermal Fuse	Breaker
Structure & Circuit Schematic			
Temperature Choice	OK	Good	Excellent
Thickness	Excellent	Excellent	Good
In line trip temp inspection	No	No	100%
Re-sett	Yes, but not stable after over time.	No, because one time only	Yes, with stable impedance at 1.5-2.7mΩ for HC
Resistance	OK	Good	Excellent
Overheat & current	Over current	Over heat	Hybrid
Allowable Voltage	OK	Good	Good
Current Leakage	OK	Excellent	Good

TCO Roadmap

As of 2015/Apr./14

~2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016

LC series
72-85℃
Size:
5.8X 3.75X 1.15
In mass production

LC 1T
Low profile type
t=1.05mm Max
In mass production

HC series
High capacity type
6A~11A/60℃
Size:
5.8X 3.75X 1.15
In mass production

Technology
-High Capacity

Technology
-Low profile

NR-C series
The smallest TCO
Low capacity type
Size:
4.8X 2.8X 0.94
In mass production

NR-A series
The smallest TCO
High capacity type
In mass production

TCO sub Assy
(TCO + Ni tab attached by welding)

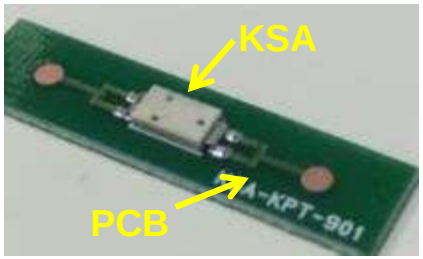
TCO = Thermal Cut Off
= TCO

Technology
-Corrosion free
-Low profile

KCA series
The smallest TCO
in corrosion free
2015/Jun. MP
Size:
5.4X 3.2X 0.94

Technology
-Nickel welding
-Auto inspection

TCO sub assy
Ni-tab sub assembly
2015/Nov. MP



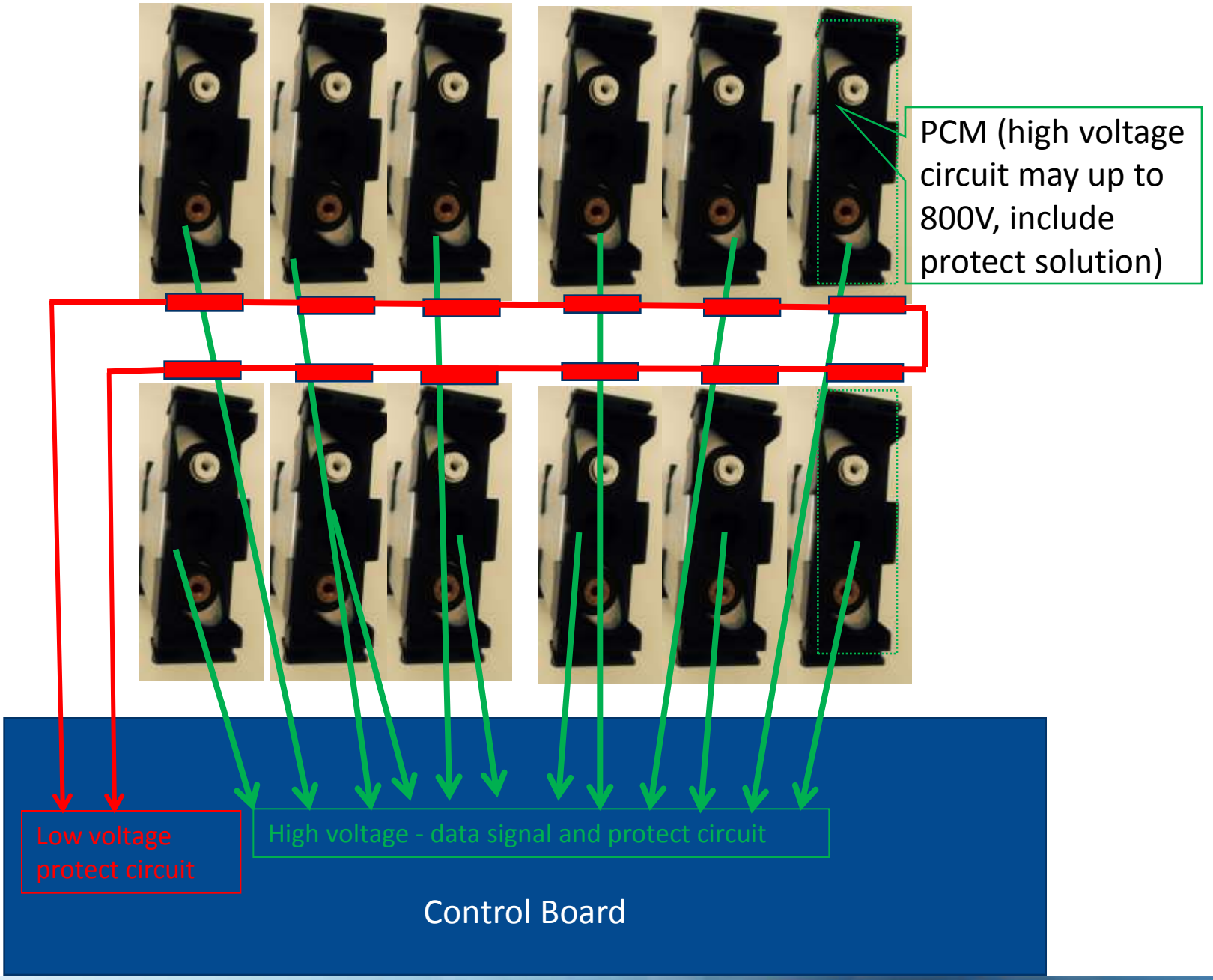
KSA TCO
(SMD TCO)

2016/Jan. MP

Technology
-Heat resistance
-Reflow soldering 3 times

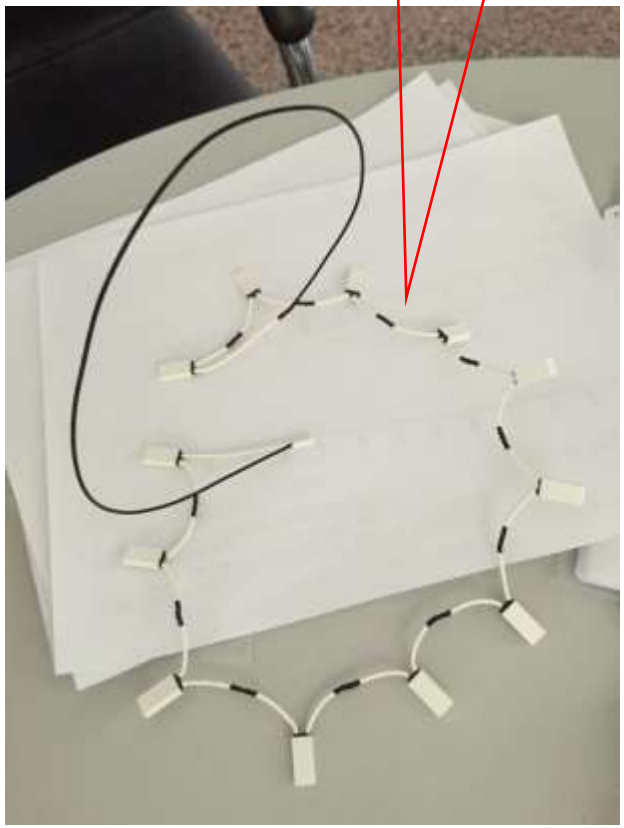
KSA series
(SMD type)
Surface Mount Device

Example of the TCO assemble in the Li-ion Battery


PCM (high voltage circuit may up to 800V, include protect solution)
Low voltage protect circuit
High voltage - data signal and protect circuit
Control Board

Breaker

Low voltage protect module with breakers



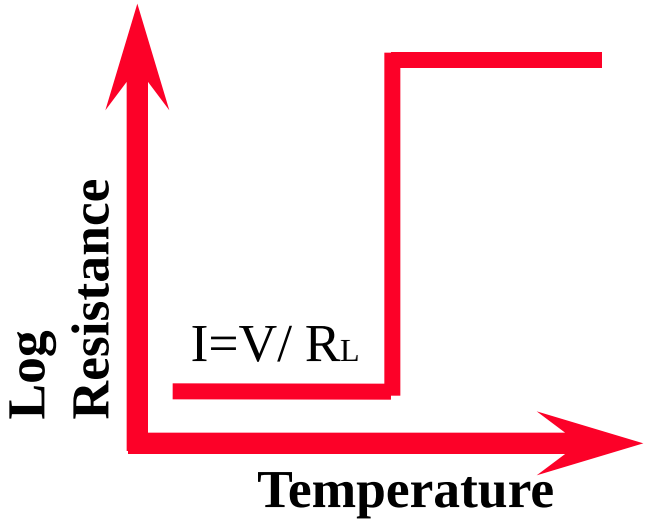
Battery cell

Multifuse® PTC Resettable Fuses
Standard Devices

- Polymer PTC resettable fuses for:
  - Over current Protection
  - Over temperature Protection
- 6 to 90 V operating voltages
- Hold currents from 50 mA to 11.0 A
- AEC-Q200-Rev C
- Agency approval - UL, CSA & TÜV
- High temperature polymers available with operating temperatures between –40° C to +125° C
- Built in TS-16949 facility
- RoHS compliant standard & halogen free upon request
- Designed to protect a wide range of cabin & under the hood electronics

Multifuse devices – What do they do?

- Protect a load from a fault condition and will "reset" once the fault has cleared and power is cycled
- They protect a load by changing from a low resistance phase to a high resistance phase
- Made from a Conductive Polymer - exhibits a Positive Temperature Coefficient (PTC) effect.



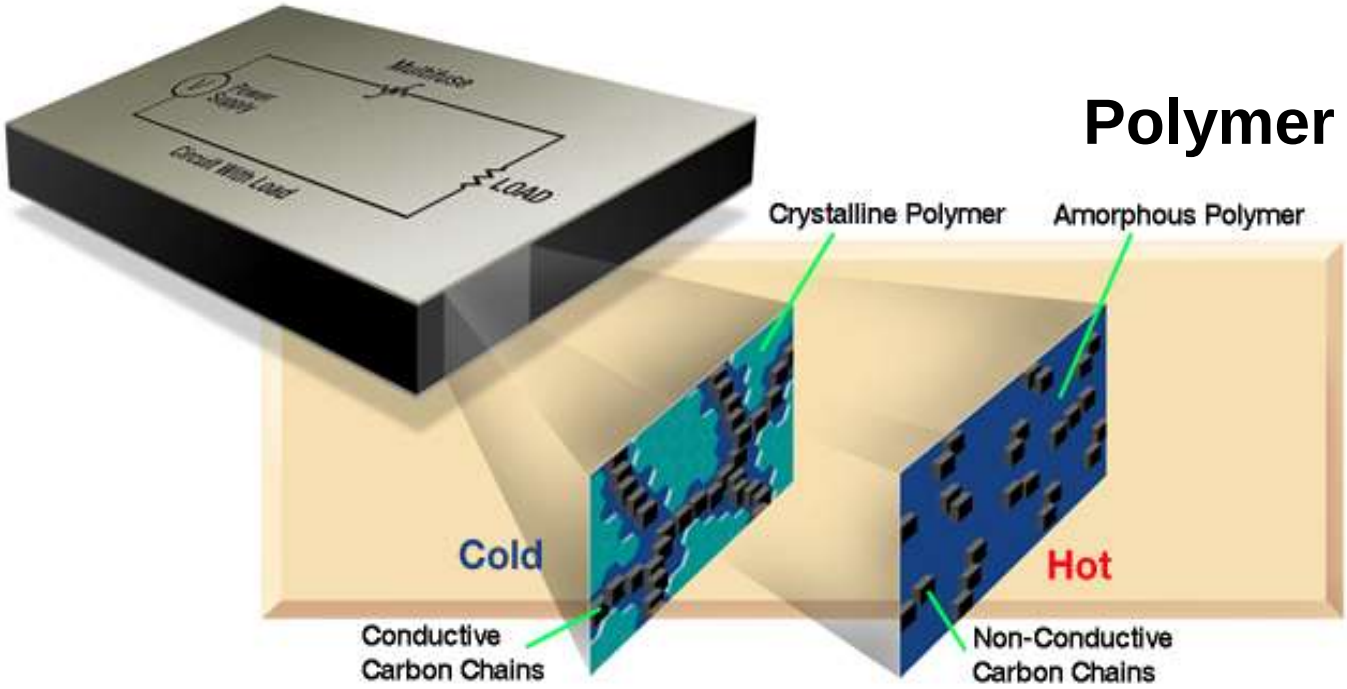
Multifuse devices – How do they work?

Working Current

- Many conductive paths
- Very low resistance

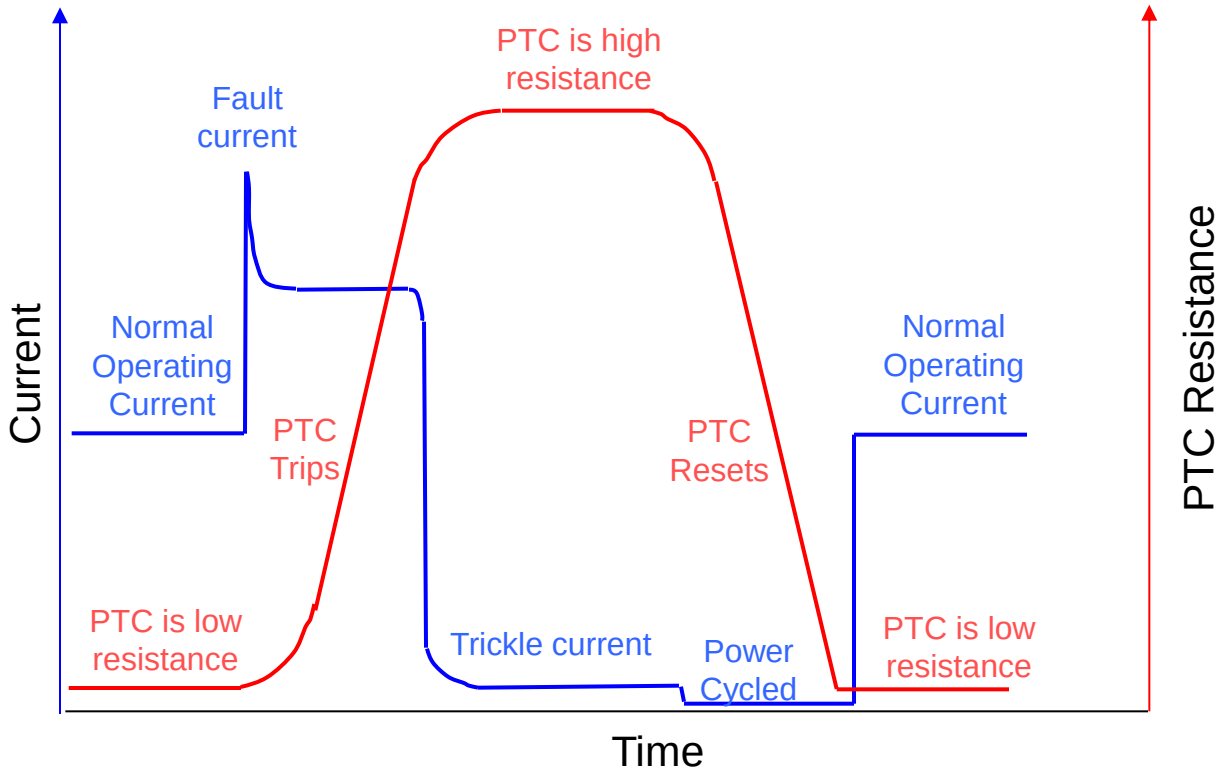
Fault Current

- Device heats - I^2R
- Fewer conductive paths
- Very high resistance



Polymer PTC

Multifuse® - Circuit Protection Method

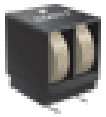


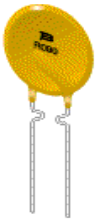
Multifuse® Product Range

MF-SM Series
MF-SM/250 Series
MF-SMHT Series
MF-LSMF Series
MF-SMDF Series
MF-MSMF Series
MF-USMF Series
MF-NSMF Series
MF-PSMF Series
MF-FSMF Series
MF-ASMF Series

Surface Mount Type

Custom Type





MF-R Series
MF-RX Series
MF-RX/250 Series
MF-RX/600 Series
MF-RHT Series
MF-RG Series
MF-SD/250

Radial Lead Type

MF-LS Series
MF-SVS Series
MF-VS Series
MF-LL Series

Strap Type

HT – high temperature material (-40 ºC ~ 125 ºC) critical for many automotive applications

Representative Multifuse® Customers

Logos and trademarks are the property of the companies below

Quality System Certificate

- QS9000/ISO9001, certified by UL
- TL9000/ISO9001, certified by UL
- TS16949, certified by UL

Agency Approval Matrix

Safety Test Item

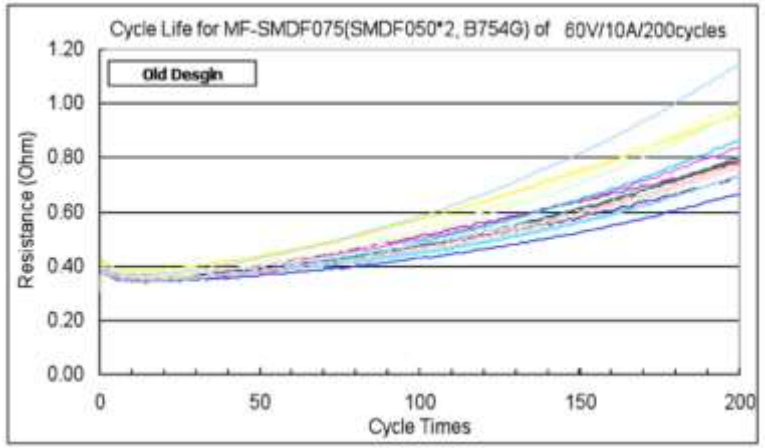
		Aging\ Trip Endurance	H-C-Humid /Humidity	Overload	Endurance (Trip cycle Life)	Cold Operation Cycling	Thermal Runway	High Temp. Storage Aging	I-Hold --> I-Trip	Thermal Condition	Temp. Stress	Insulation Testing
UL 1434	Test Conditions	1000 hrs @ Vmax & Itrip (Trip State for 1000 hrs)	24 hrs @ Tss, 168 hrs @ 40°C & 95% RH, 8 hrs @ 0°C	50 Cycles of 120%Imax & Vmax	6000 cycles of 250%Itrip & Vmax	1000 cycles of Vmax &Itrip @ 0°C	2 minutes of 200%Vmax	N/A	N/A	N/A	N/A	N/A
	Samples	3	3	3	3	3	3	N/A	N/A	N/A	N/A	N/A
	Pass / Fail Criteria	<20% shift in trip temp.	<20% shift in trip temp.	<20% shift in trip temp.	<20% shift in trip temp.	<20% shift in trip temp.	<20% shift in trip temp.	N/A	N/A	N/A	N/A	N/A
CA - 3A	Test Conditions	4 hrs @ Vmax, 4 hrs @ 120%Vmax, 64 hrs @ Vmax	168 hrs @ 40°C & 95% RH	Accepts UL data	Accepts UL data	Accepts UL data	Accepts UL data	300 hrs @ Ttrip + 30°C	Hold @ I-hold within 30 min. Trip @ I-trip within 15 min.	N/A	N/A	N/A
	Samples	6	6	Accepts UL data	Accepts UL data	Accepts UL data	Accepts UL data	6	6	N/A	N/A	N/A
	Pass / Fail Criteria	R-T drift, PTC effect	R-T drift, PTC effect	Accepts UL data	Accepts UL data	Accepts UL data	Accepts UL data	R-T drift, PTC effect	I-hold: no trip I-trip: trip	N/A	N/A	N/A
EN60730	Test Conditions	Accepts UL data	Accepts CSA data	N/A	Accepts UL data	Accepts UL data	Accepts UL data	N/A	N/A	1000 hrs @ 85°C	24 hrs @ -10°C, 4 hrs @ 60°C	500 Vdc@devices rated <50V, or 1000 Vdc @ devices rated >50V
	Samples	Accepts UL data	Accepts CSA data	N/A	Accepts UL data	Accepts UL data	Accepts UL data	N/A	N/A	6	6	6
	Pass / Fail Criteria	Accepts UL data	Accepts CSA data	N/A	Accepts UL data	Accepts UL data	Accepts UL data	N/A	N/A	R-T drift, PTC effect	R-T drift, PTC effect	R-T drift, PTC effect

Bourns Test Lab is UL TCP Certified

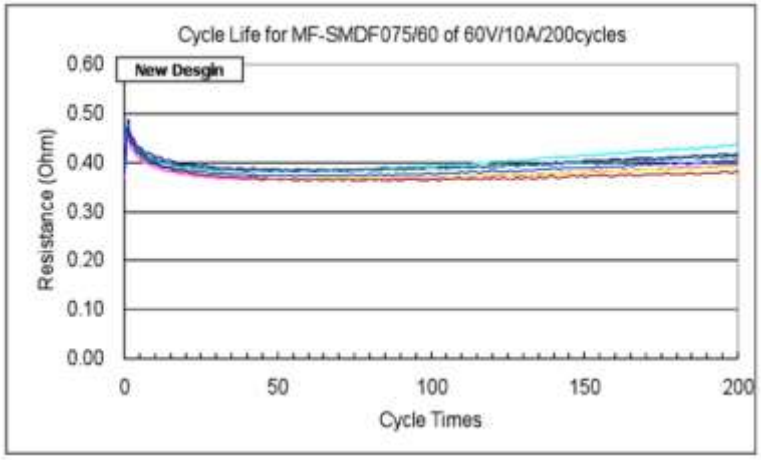
Next Generation Technology: *FreeXpansion®*
PTC Resettable Fuse

- Improved resistance stability
- Greater reliability
- Higher voltage capability
- Higher current capability
- Smaller footprints
  - 0805 size
  - 0603 size

Conventional PTC

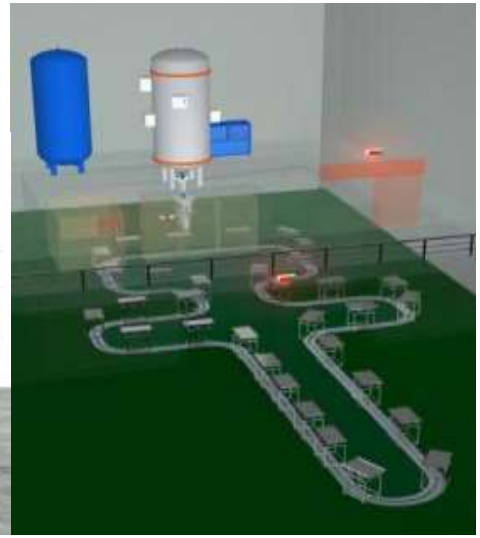


FreeXpansion® PTC



E-Beam facility

- Bringing e-beaming in house, in a new purpose built facility (multi million dollar investment)
- Advantages:
  - Helps reduce lead times by up to 1 week
  - Gives Bourns more control over its costs
  - Allows for tighter resistance tolerances which is critical in telecom, motor & battery applications
  - Reduce the amount of e-beam cycles (many products have 2 e-beam cycles)
  - Helps develop higher voltage materials
  - Faster development times



Typical Charge Profile for a Li-ion Battery Cell

(single-cell, 3.6-4.2V typ)

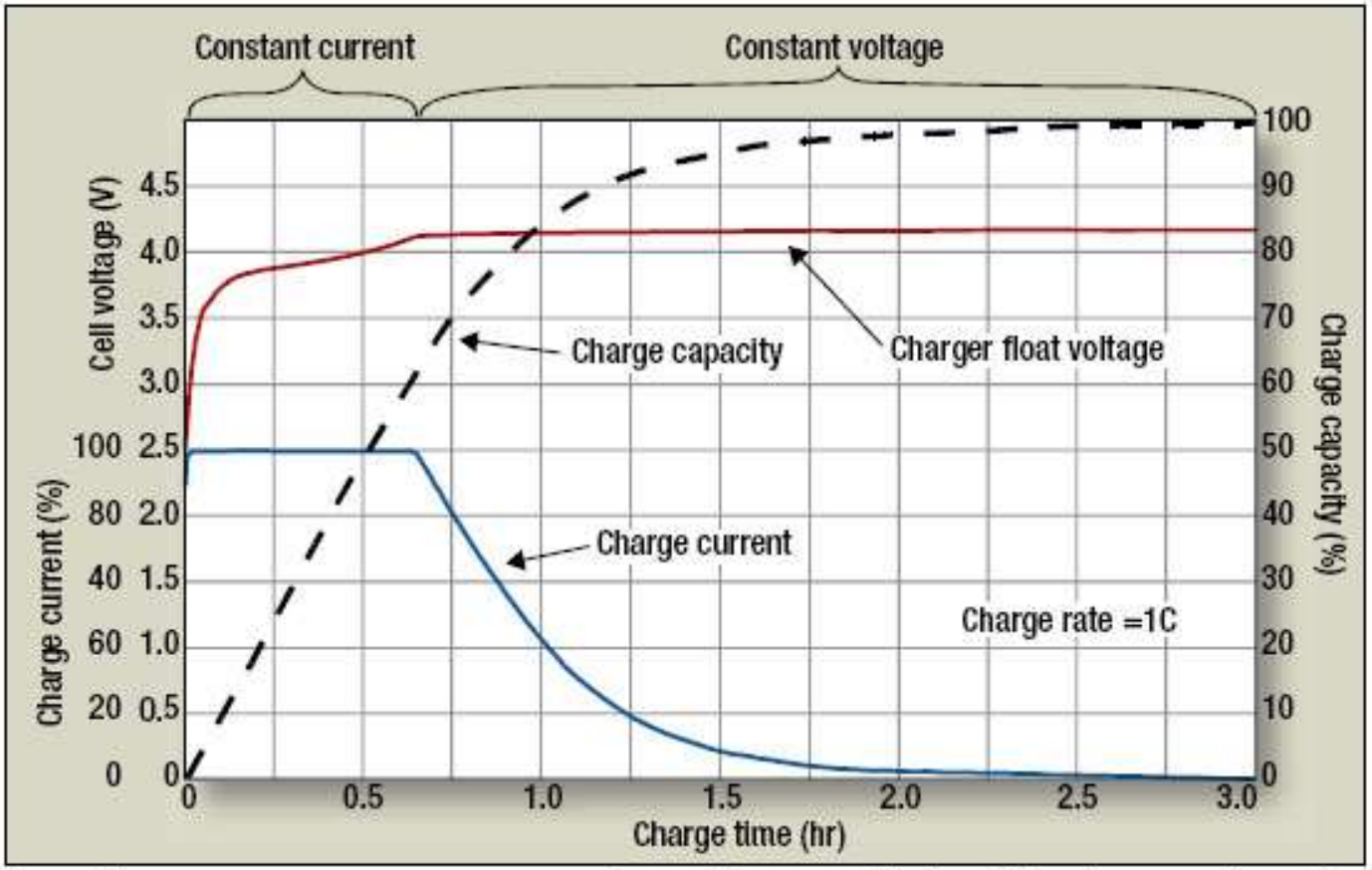
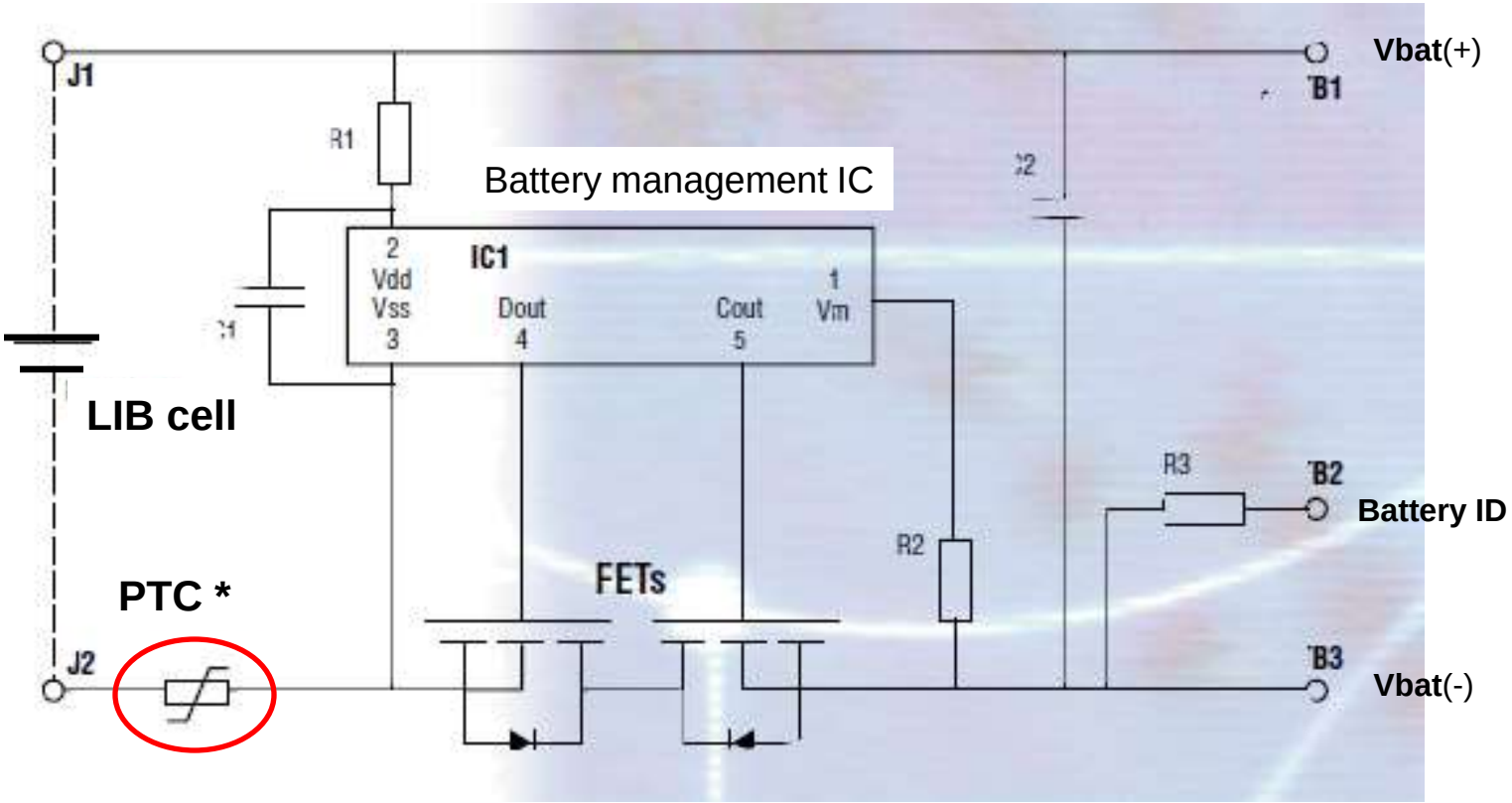


Fig. 1. *The constant-current, constant-voltage charge profile for a Li-ion battery depends on the charge current, cell voltage and charge capacity.*

Typical Protection Circuit for Li-ion Battery Packs

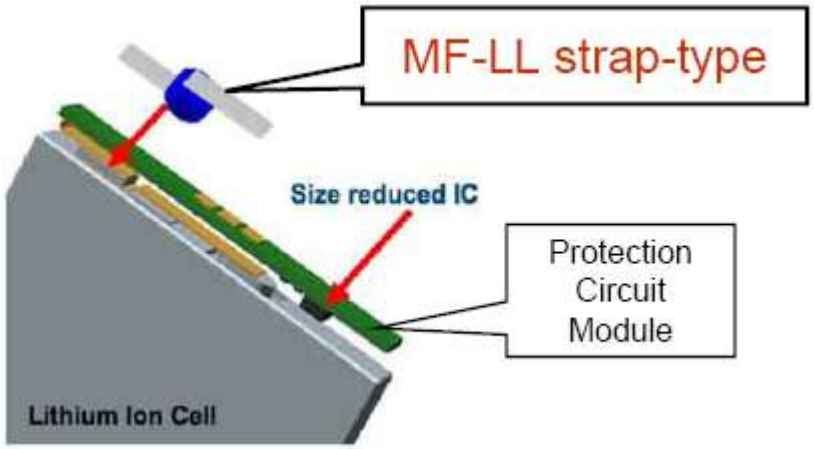
(single-cell, 3.6V typ)



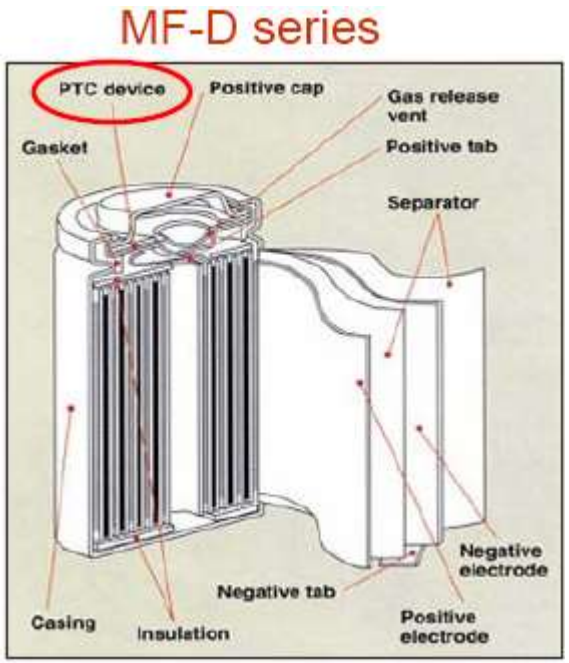
- PTC is mainly for **Over-Temperature Protection** of the Li-ion cell.
- PTC needs to be mounted to have thermal link with the cell.
- OCP and OVP as well as charge management provided by IC/FETS

Battery Pack Protection-Typical Examples

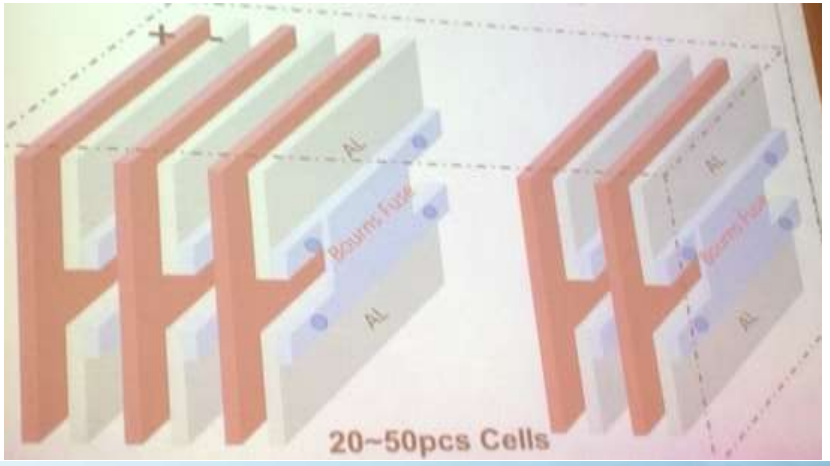
- **PTC in a flat-pack Li-ion Battery**



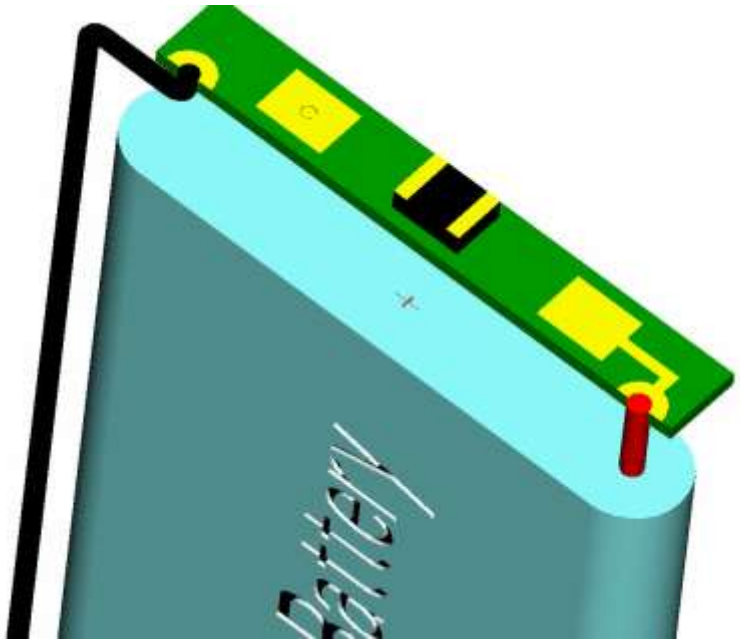
- **PTC in a cylindrical Li-ion Battery**



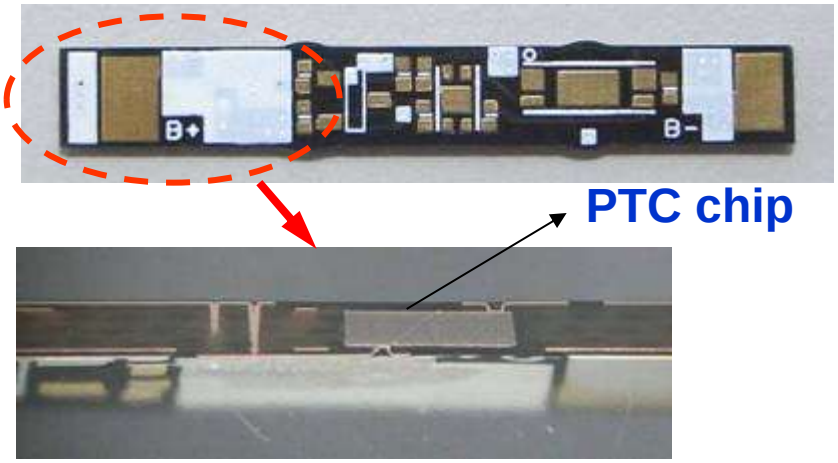
- **Battery cell electrode structure with PTC**

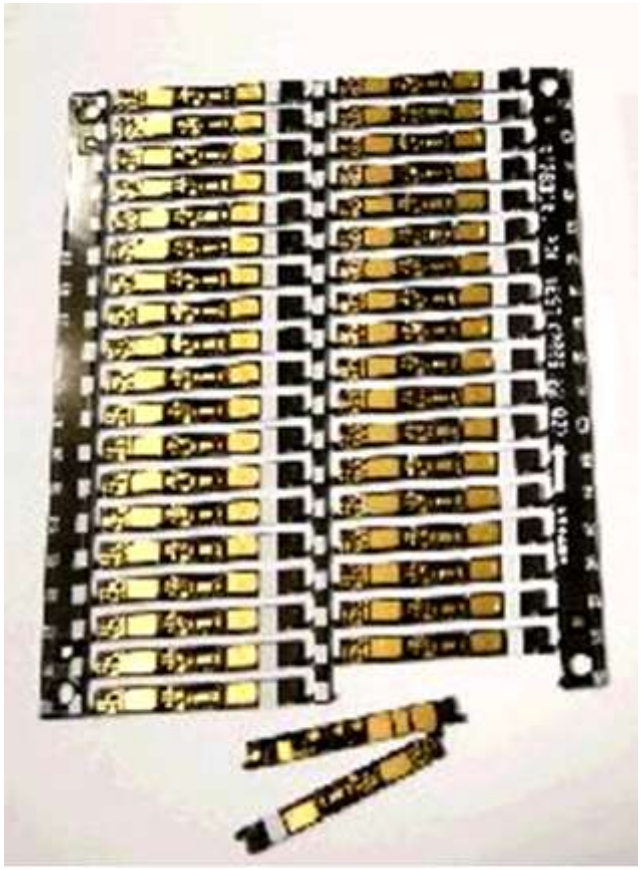


Embedded design for Battery Packs

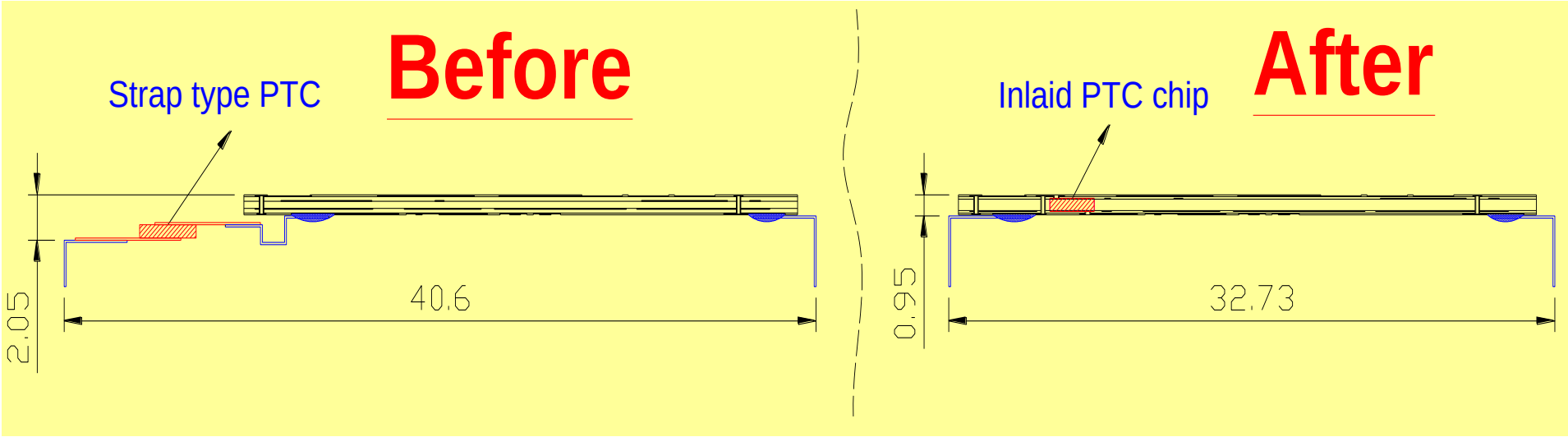


Embedded design for Battery Packs





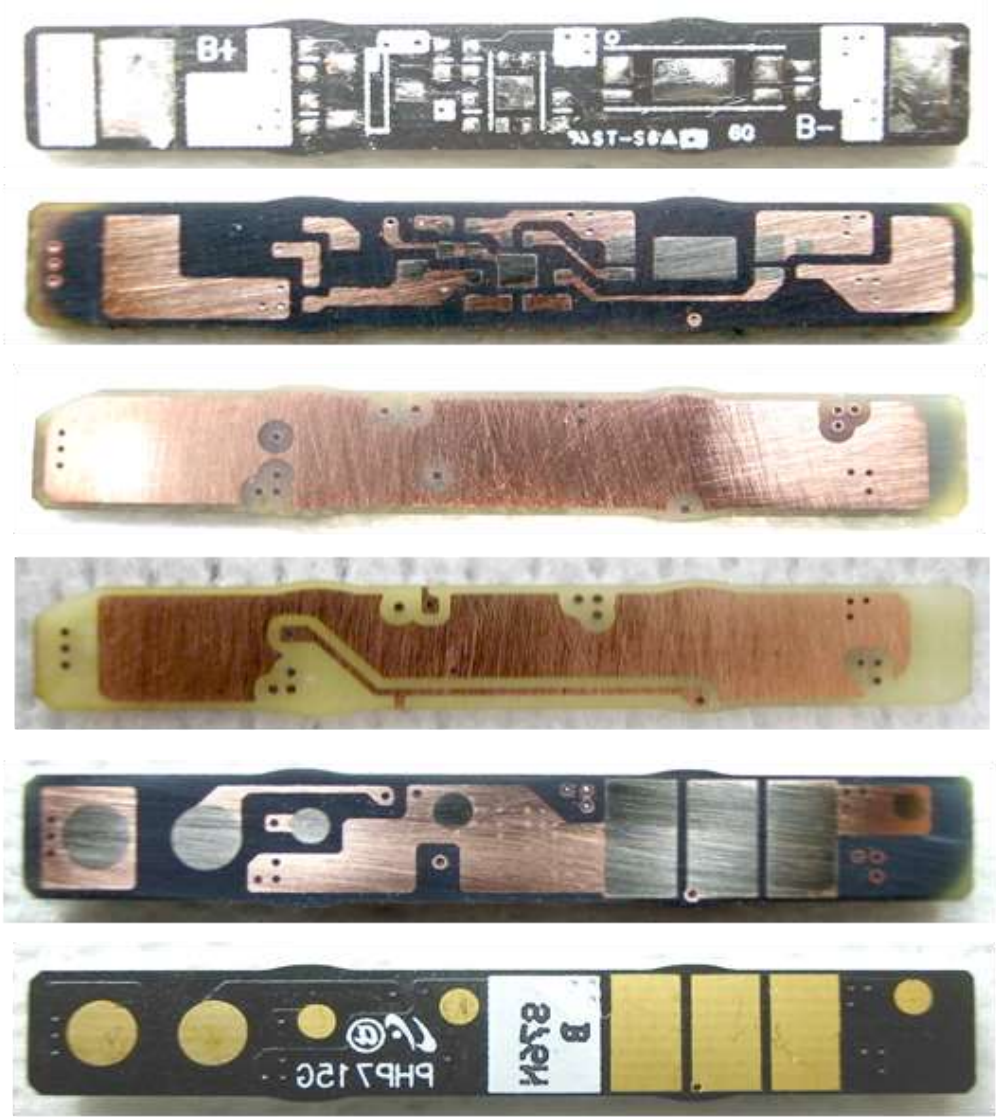
PCM Space saving embedded design



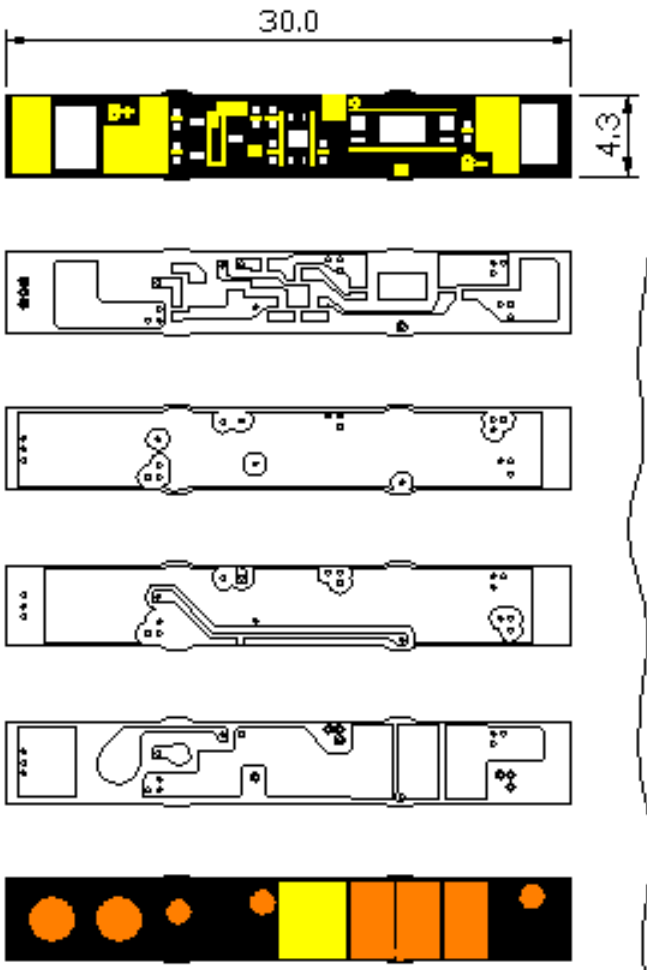
What can be saved?

1. Two spot-welding operations of strap type PTC
2. Saved package space

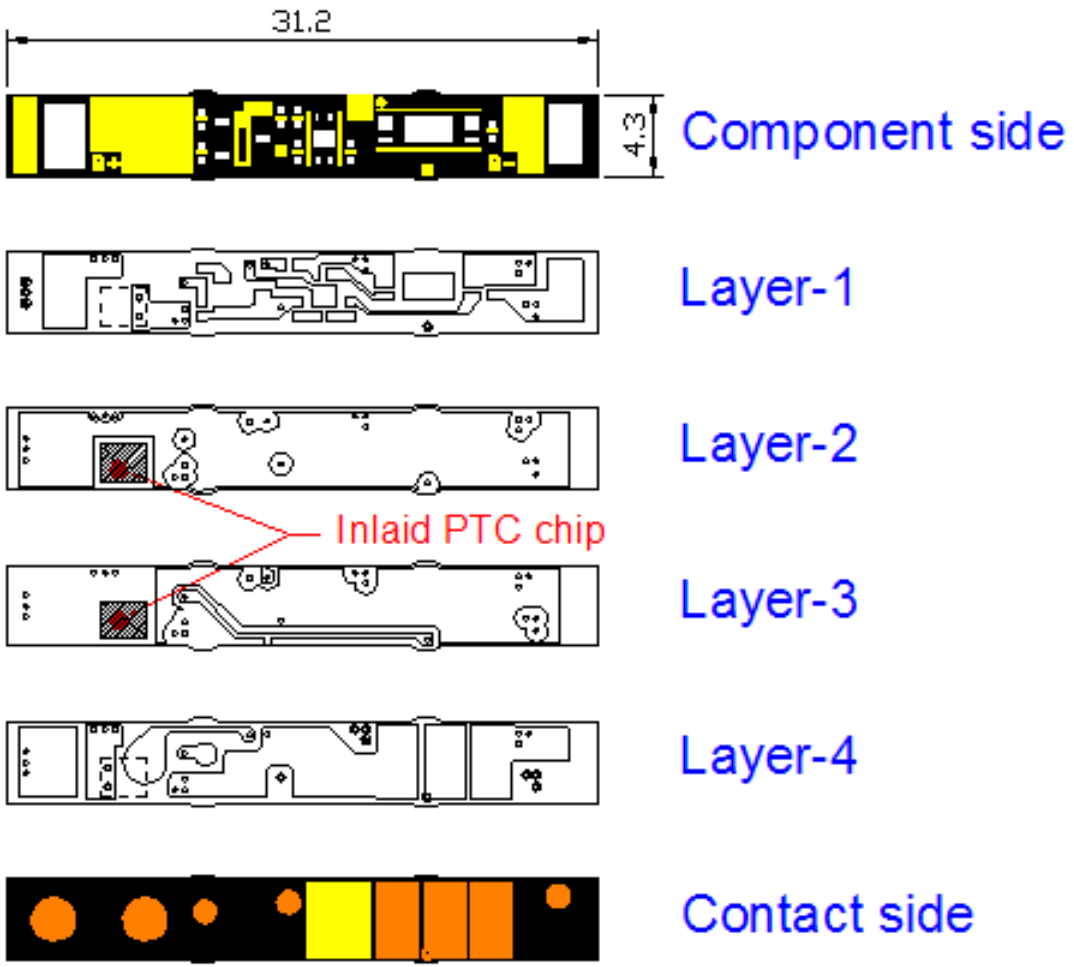
Test Example of Battery PCM (before inlaying PTC)



Original design



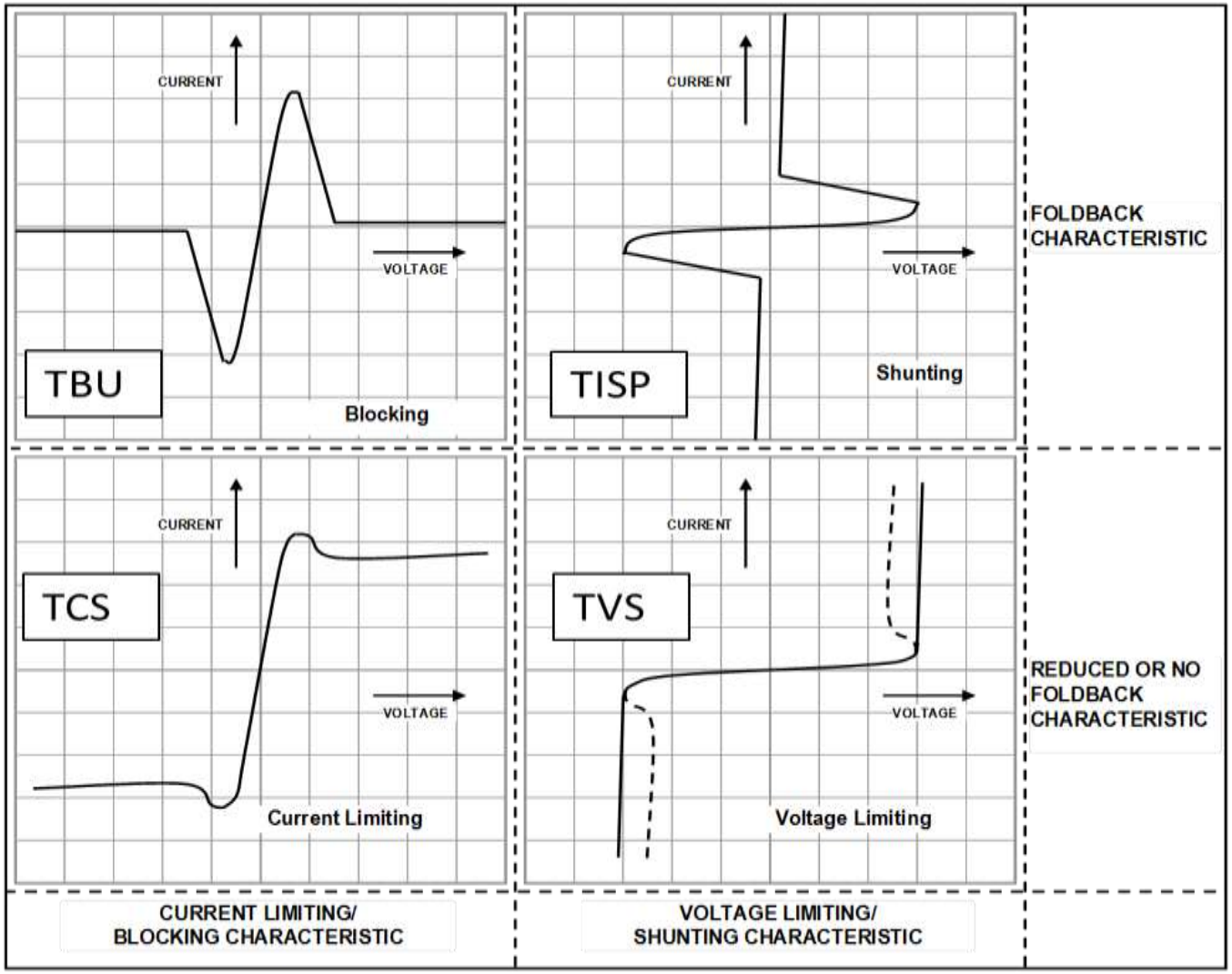
Bourns inlaid PTC design



Bourns Automotive Approved PPTCs

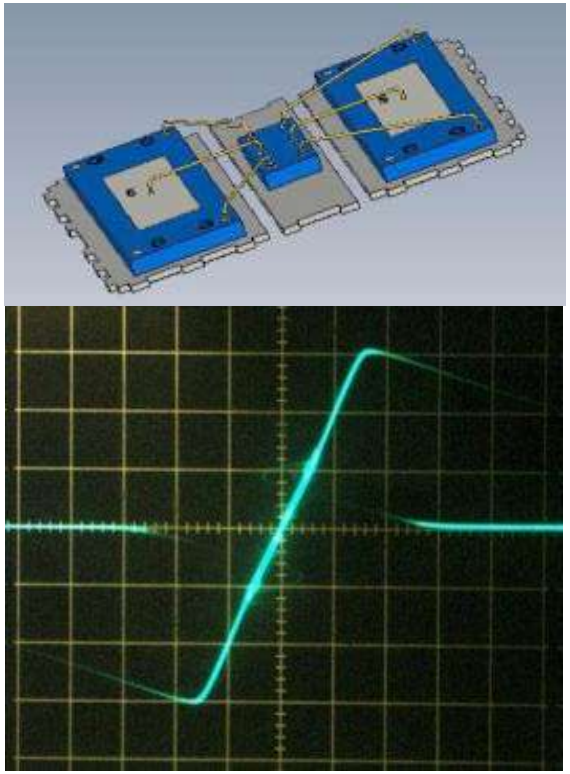
Series	Max Operating Temperature (°C)	Voltage (V)	Current (A)	R1Max (Ω)	Nominal Trip Current (A) at 23C	Time to Trip at 23C (S)	Trip Current at 23C at Time to Trip (A)	Format
MF-RHT	125	16	0.7~13	0.01~0.8	1.4~24	4~13	3.5~60	Radial
MF-SMHT	125	16	1.36~1.6	0.15~0.33	2.72~3.2	10	8	2920 & 3425 package
MF-PSHT	125	16	0.1	7.5	0.6	1.5	2.5	0805 Package
MF-RG	85	16	3~5	0.034~0.0975	5.1~8.5	1-2	15-25	Radial
MF-R	85	60	0.05~11	0.014~22	0.1-22	5-20	0.5-40	Radial
MF-SM	85	6-60	0.3~3	0.048~4.8	0.6-6	3-35	1.5-8	2920 & 3425 package
MF-LSMF	85	6-33	1.85~3.0	0.075~0.15	3.7-5.2	2.5-20	8	2920 package
MF-MSMF	85	6-60	0.1~2.6	0.08~15	0.3-5.2	0.06-5	0.5-8	1812 Package
MF-NSMF	85	6-30	0.12~2	0.085~8.5	0.29-4	0.1-1	1-8	1206 Package

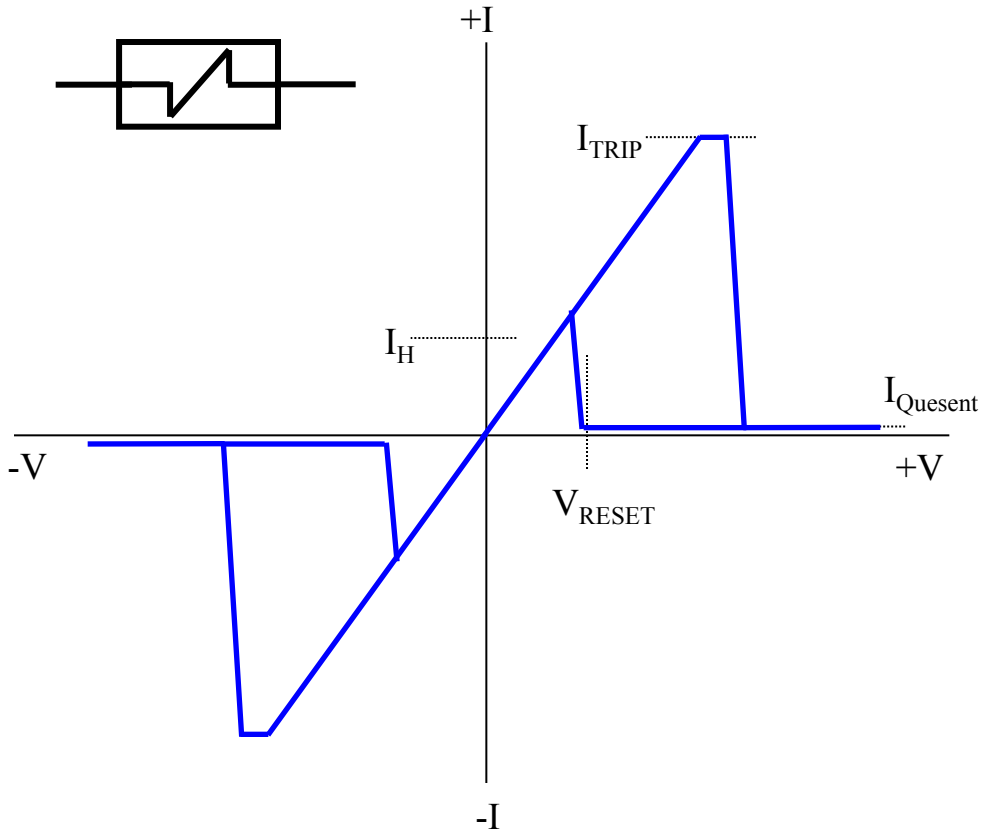
General Characteristics of the Device Types



I-V Characteristic of a TBU™ device

- Below trigger threshold, TBU device acts like a resistor
- Above trigger threshold, TBU acts like a ~1mA current source



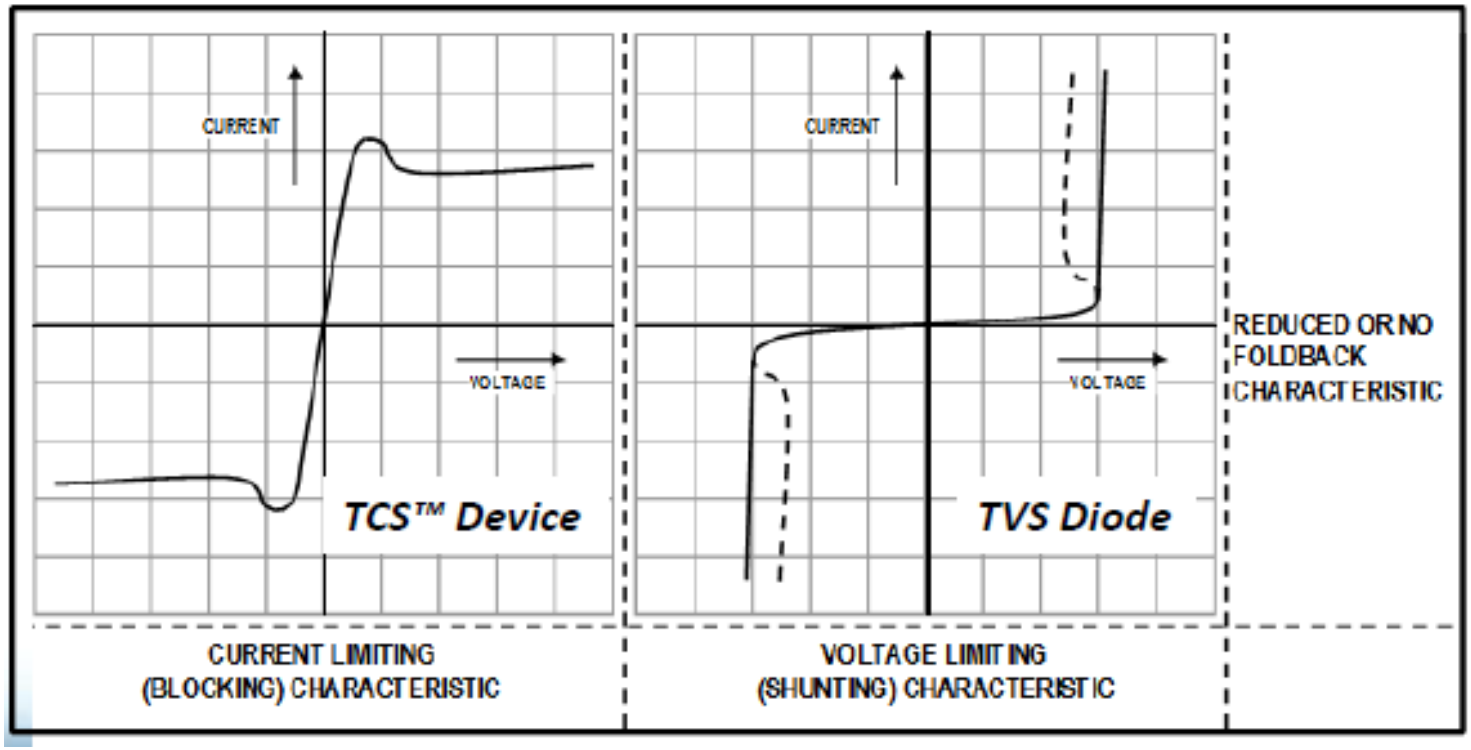


Operating temperature range: -40 to +125° C

What Makes Bourns® TCS™ Products Innovative?

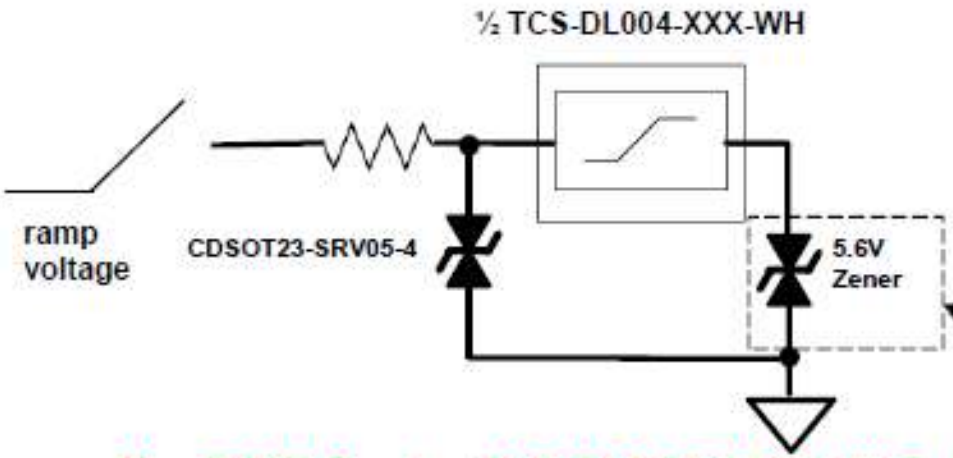
Current vs. Voltage Plot

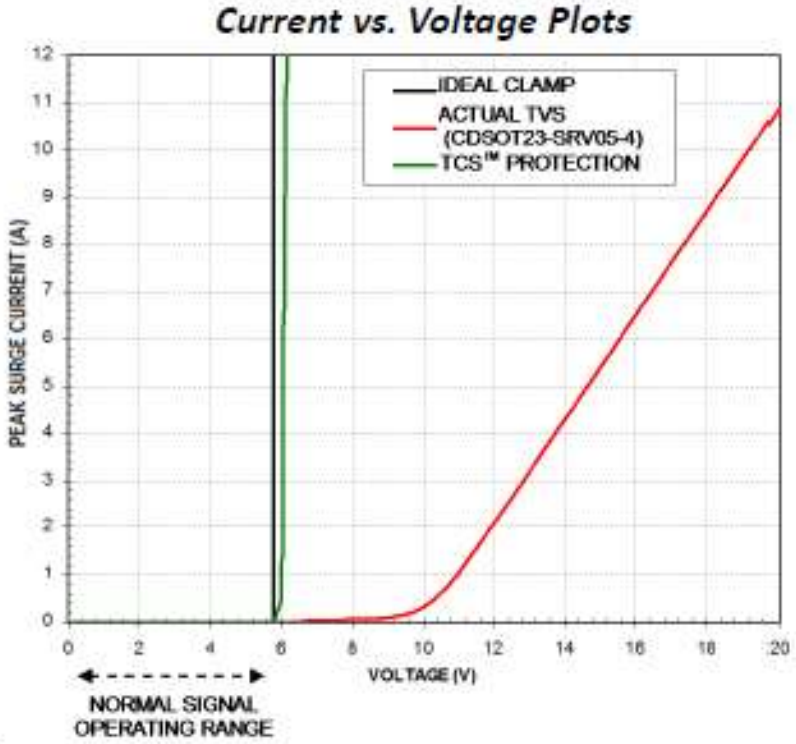
- *A TCS™ product is a bidirectional device which has a general I-V curve as shown below. The I-V curve for a TVS diode is also shown for comparison. Note that a TCS™ device limits current while a TVS diode limits voltage.*



Using a TCS™ to Create an "Ideal Clamp Diode"

- *Black Line – Ideal "Brick Wall" Diode*
- *Red Line – CDSOT23-SRV05-4 TVS diode*
- *Green Line – Close to "Ideal Response" using: TVS Diode, TCS™, Zener Diode to represent a devices ESD protection*





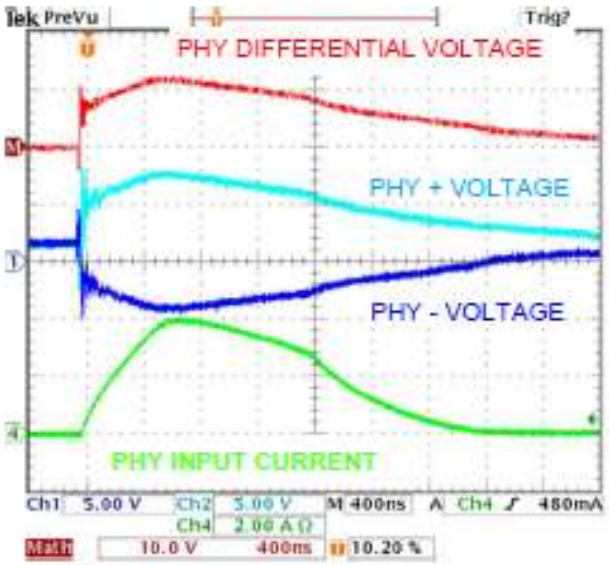
The TCS™ Device TCS-DL004-250-WH Behaves Like an "Ideal Clamp" When Compared to a TVS Diode (CDSOT23-SRV05-4)

Bourns® TCS™ Product Applications

GbE Signal Line Application: 1.2/50, 8/20 µs CW Surge Test (800 V/100 A)

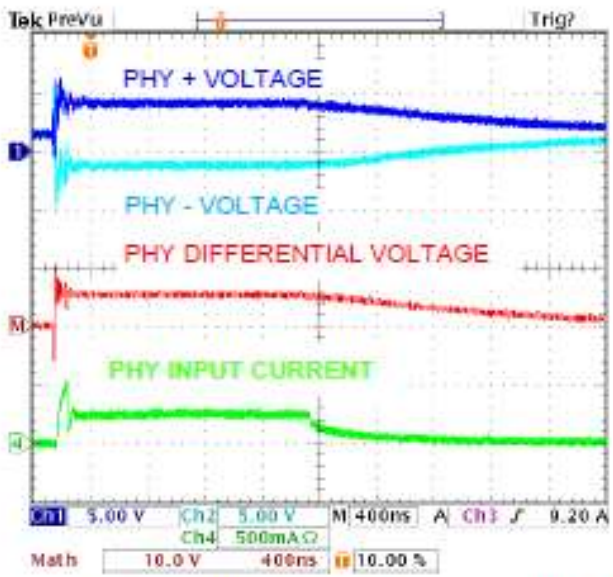
Protecting a Typical Ethernet Port with a TCS-DL004-250-WH

With TVS Diode Only



PHY sees: Peak Voltage: >12 V
Peak Current: 4 A
Energy: ~ 50 µJ

With TCS™ Device and TVS Diode

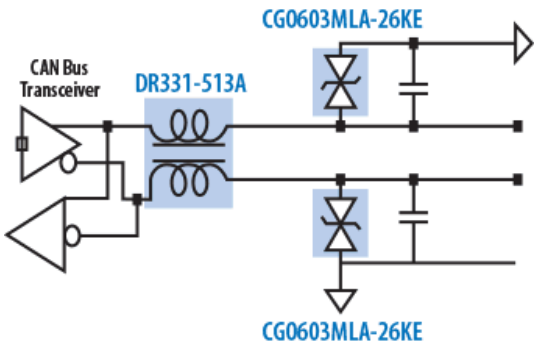


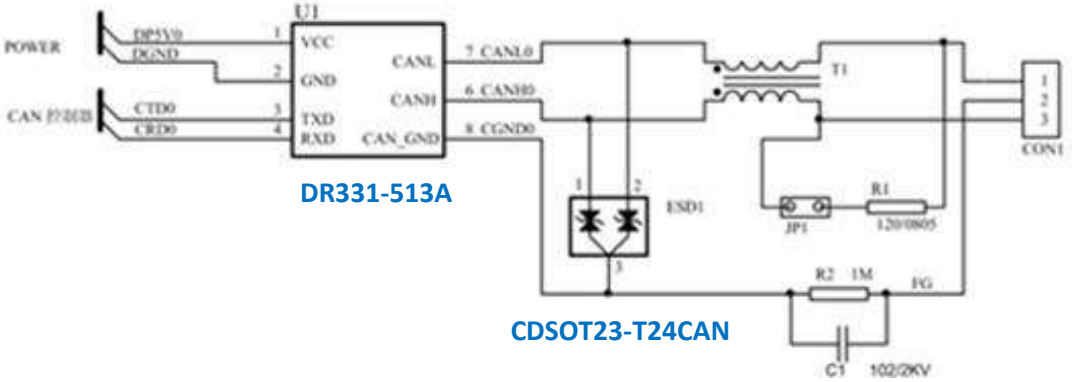
PHY sees: Peak Voltage: <6 V after initial peak
Peak Current: <300 mA after initial peak
Energy: ~ 3 µJ

TCS™ Device reduces PHY stress by more than 90 %

Canbus Connectivity Applications

- Solution: CDSOT23-T24CA(NUP2105)+ DR331 (Common choke)
- Reduce Stress on CANbus Phy
- Transients clamped by Automotive Approved ESD or TVS Array
- See the app note on DR331 at:
  http://www.ti.com/lit/an/slla271/slla271.pdf





Outside World

Primary Protection

Overcurrent Protection

Secondary Protection

Tertiary Protection

Integrated Circuit

STANDARDS

5

Primary
（GDT/OSP）

4

PTC
Multifuse®

SinglFuse™
Telefuse®

TBU™

Line Feed
Resistor

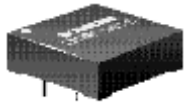
3

TISP®

Fast GDT

3

Transformers



Inductors

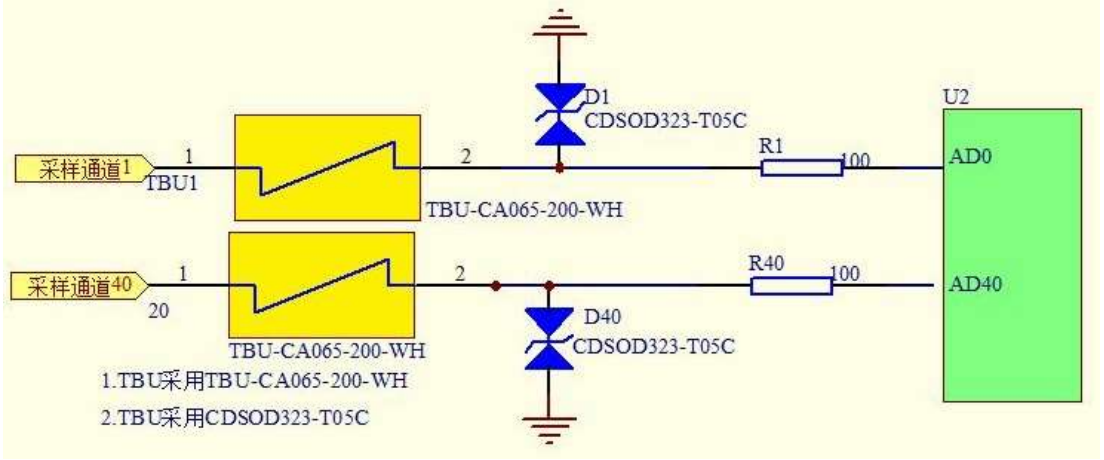
1

TVS Diodes

Chipguard™

TCS

A/C Battery Management for New Energy Car



- ✓ High-reliability automotive BMS
- ✓ Concern response time and potential risk
- ✓ Concern higher operation temperature range

New design for LiFePO4 BMS

Original design for LFP BMS

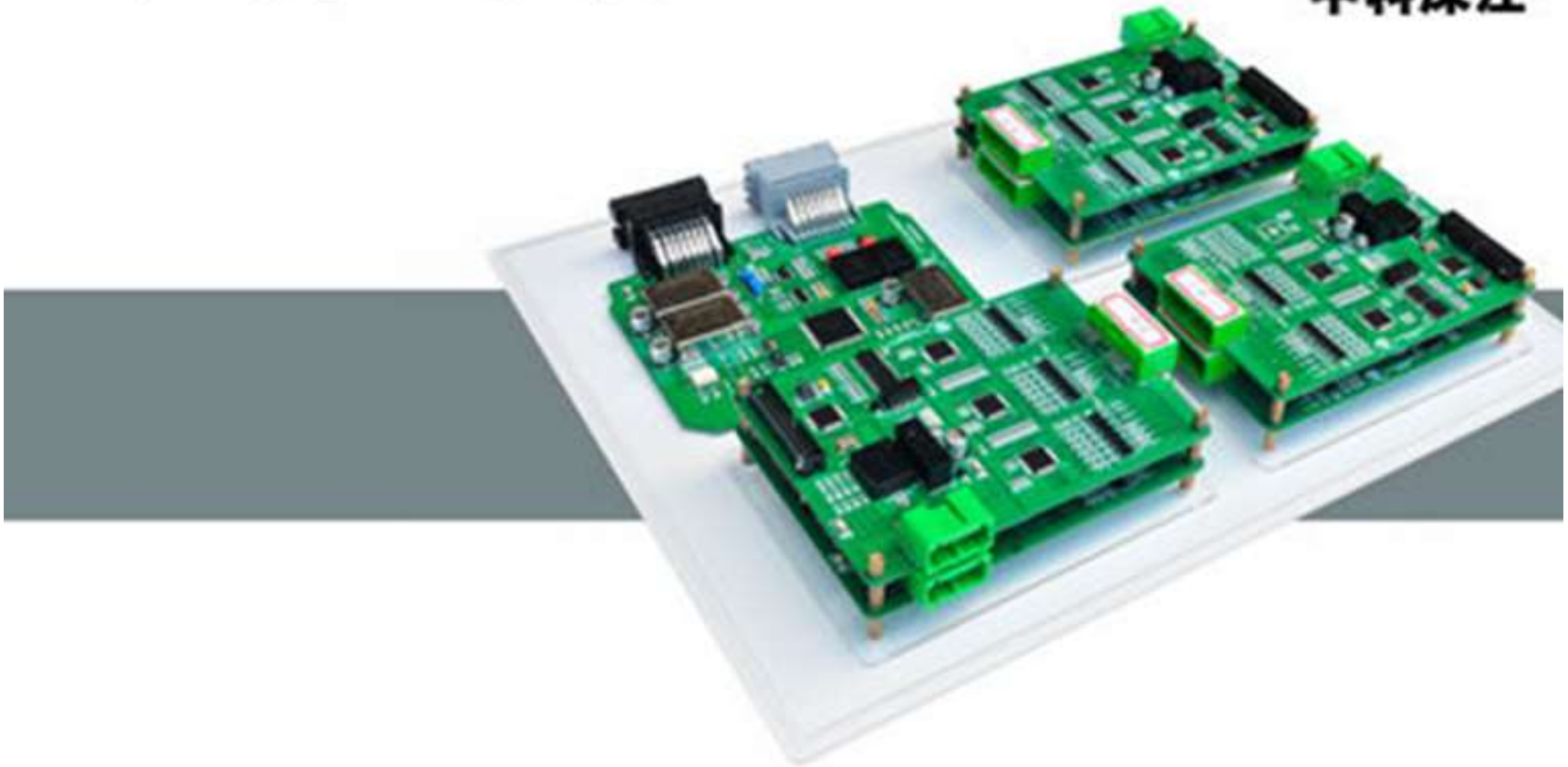
New design for LFP BMS

3266 design in BMS

3223 design in BMS

电池管理系统

UCAS
中科深江



Bourns® Inductors

J.W.Miller MAGNETICS
A Bourns Company

- Through-hole
  - Standard
    - Axial Series
    - Radial Series
  - High Current
    - Axial Series
    - Radial Series
    - Toroid Series
    - Common Mode Series
- SMD
  - Dual Chokes (CMC)
    - CMC
      - SRF Series
    - Signal Line
      - Sector W. Bifilar W.
        - DR331 DR221
  - Chip Inductors
    - Multilayer
      - Ferrite
        - Standard CS Series
      - Ceramic
        - Standard CI Series
    - Wirewound
      - Open CW Series
      - Sealed CM Series
  - Power Chokes – *Focus Products*
    - Non-Shielded
      - SDR Series
    - Semi-Shielded
      - SRN Series
    - Shielded
      - SRR Series SRU Series
    - High Current
      - SRP Series

Power Inductors – Overview

Semi-Shielded Power Inductors – SRN Models

- Features: Semi-shielded, reduced radiation
- Available Models: 15
- Footprint Range: 3 x 3 to 10 x 10 mm
- Height Range: 1 to 6 mm
- Inductance Range: 0.5 to 470 uH
- Rated Current Range: 0.28 to 10 A

Shielded High Current Inductors – SRP Models

- Features: Iron powder core, low radiation, high saturation current, up to 60 A
- Available Models: 19
- Footprint Range: 4.8 x 4 to 14 x 14 mm
- Height Range: 1.2 to 7 mm
- Inductance Range: 0.1 to 47 uH
- Rated Current Range: 1.5 to 55 A

Common Mode Chokes – Power

- 7100, 7300, 7400, 7500, 8100
- PM3700, SRF0703, SRF1260, SRF1280
- Power conversion application
- High perm. toroid or UU core, close magnetic loop construction to maximize CM impedance
- Available Models: 9
- Inductance Range: 0.2 – 50mH
- Rated Current Range: 0.27 – 20A
- Frequency Range: 10K – 50MHz
- Size Range: 0.75-1.7” (L) x 0.43-0.9” (W) x 0.6-1.2” (H)

Bourns® Inductors for Automotive Buck Converters and EMI Filtering

- SRP7030 2.2 µH I peak 12 Amps
- Small Form Factor (7.8 x 7.0 mm)
- AEC-Q200 Test Reports Available

- **SRP Series**
  - High Current Shielded Inductors
  - 0.1 – 10 µH
  - Up to 50 A
  - Operating Temperature Up to 150 ° C

Inductive Components - Automotive

Recommended Products

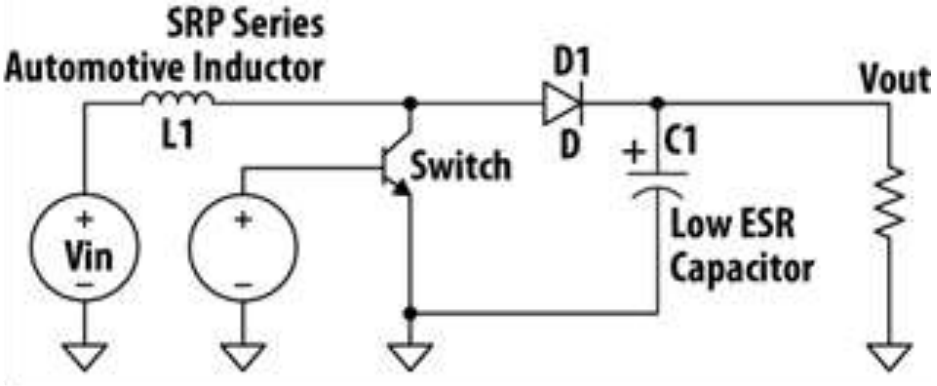
High Current Power Inductors SRP Series

These series are produced in the factory with ISO/TS16949 certificate available or in process; for many models there is the PAPP level 3 available.

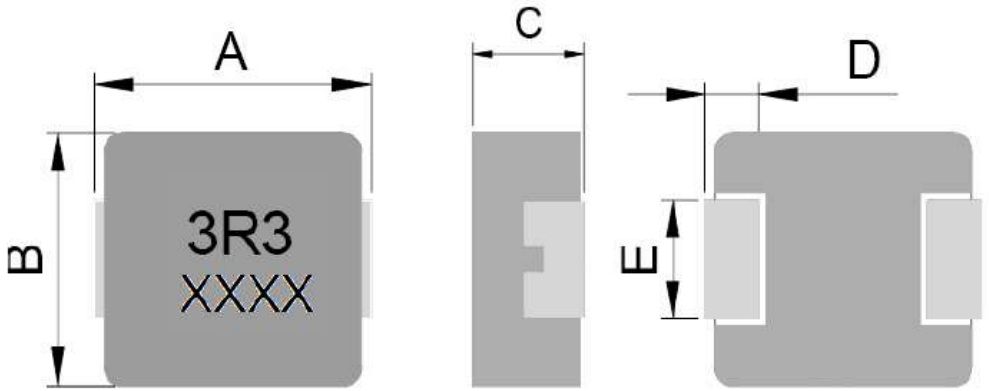
PART NO.	Inductance L0 (uH) ±20% @0A	Rdc (mΩ) typ. @25℃	Rdc (mΩ) max. @25℃	Irms(A) typ.	Isat(A) typ.
SRP1265-1R0M	1.0	1.7	2.3	30	48
SRP1265-3R3M	3.3	5.7	6.8	18	30

- 100% Drop in for Vishay IHLP5050

Bourns Inductor in Start Stop DC DC Converter

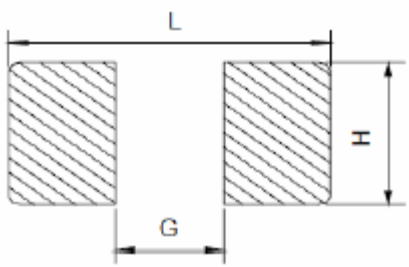


Basic Functional Diagram of
DC DC Boost Converter



Chip Size:mm

A: 13.5±0.5
B:12.5±0.3
C:6.2±0.3
D:2.3±0.3
E:4.7±0.3
G: 8.0
H: 5.0
L: 14.2



Bourns Automotive Approved Inductors

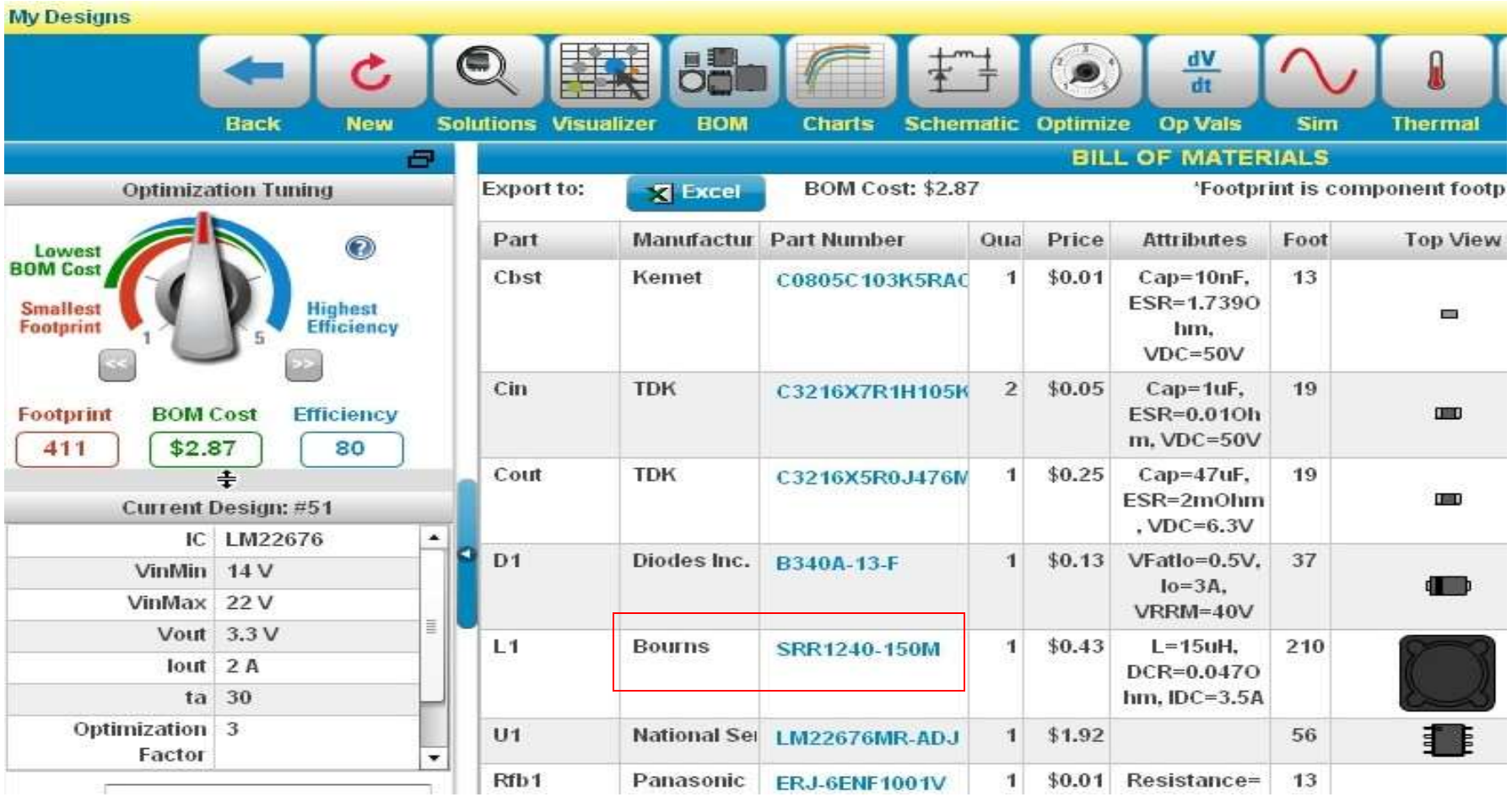
Series	Standard Model	Inductor Value Range(uH)	Max Current Range(A)	Saturation Current Range (A)	Diameter or LxW mm	Core	Shielded
SRF0703A	SRF0703	34.1~608.2	2.66~0.65	PLM	7.6x7.6	Ferrite (Drum)	Y
SRF0905A	SRF0905	10-6500	1.6~0.3	PLM	9.2x6	Ferrite (Toroid)	Y
SRF1260A	SRF1260	0.47~1000	17.6~0.57	33~0.7	12.5x12.5	Ferrite (Drum)	Y
SRF1280A	SRF1280	1.67~4020	8.94~0.307	PLM	12.5x12.5	Ferrite (Drum)	Y
SDE0604A	SDR0604	1.2-120	5.~0.75	6.0-0.6	5.8	Ferrite (Drum)	N
SDE1006A	SDE1006	1.2~820	7.2~0.45	7.2~0.45	9	Ferrite (Drum)	N
SDR1307A	SDR1307	1.5~1000	9.5~0.65	20~1.0	13	Ferrite (Drum)	N
SRR0735A	SRR0735	10~680	2.1~0.21	1.85~0.22	7.3x7.3	Ferrite (Drum)	Y
SRR0745A	SRR7045	10~1000	2.1~0.2	2.5~0.24	7.3x7.3	Ferrite (Drum)	Y
SRR1210A	SRR1210	1.0~1000	2.19~0.58	16.5~0.7	12x12	Ferrite (Drum)	Y
SRR1260A	SRR1260	1~1000	9.4~0.68	10~0.6	12.5x12.5	Ferrite (Drum)	Y
SRR1280A	SRR1280	4.7~1000	8.2~0.68	8.8~0.8	12.5x12.5	Ferrite (Drum)	Y
SRU1028A	SRU1028	1-150	7~0.7	8.0~0.65	10x10	Ferrite (Drum)	Y
SRU1038A	SRU1038A	1.5~330	7.2~055	7.0~0.55	10x10	Ferrite (Drum)	Y
SRU1048A	SRU1048	1.5~330	7~0.65	7.2~0.52	10x10	Ferrite (Drum)	Y
SRU3028A	SRU3028	10~33	0.72~0.47	0.86~0.48	3.3x3.5	Ferrite (Drum)	Y
SRU5028A	SRU5028	1.2~100	3.5~0.47	3.4~0.42	5.2x5.2	Ferrite (Drum)	Y
SRU6025A	SRU6025	1.2~220	4.0~0.42	3.2~0.24	6.2x6.5	Ferrite (Drum)	Y
SRU8028A	SRU8028A	2.5~100	4.5~0.75	4.2~0.7	8x8	Ferrite (Drum)	Y

Sales Tools - Designer Kits

- SMD Non-Shielded, Semi-Shielded, Shielded and High Current Inductors

Inductors ➔ Bourns Part-number Selection

TI - WEBENCH



Power Resistor Solutions

Types Available:
Power resistors, power shunt resistors

Function:
Surge, snubber resistors, voltage feedback

Power Range:
0.125 W to 100 W

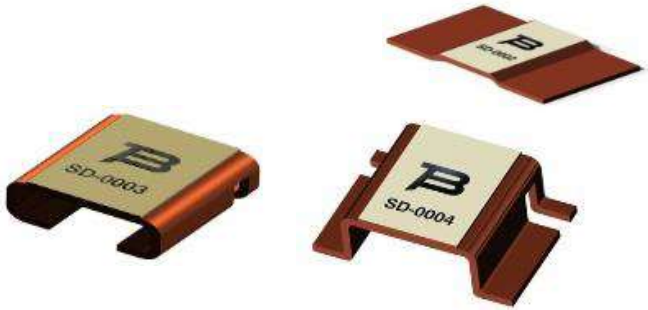
Resistor Materials:
Thick-film, metal alloys, wirewound

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

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

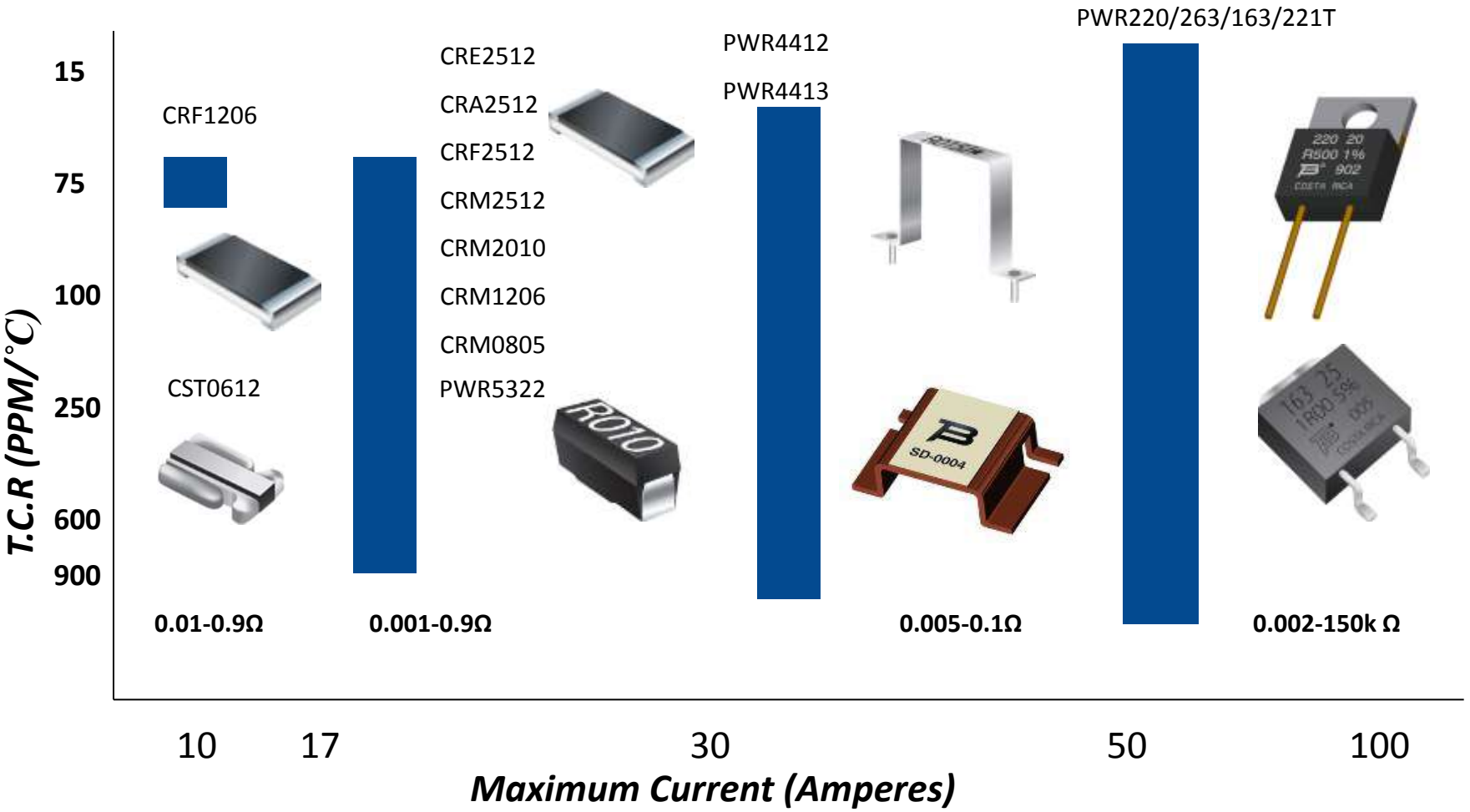
Resistance Range:
From 0.2 mΩ to 100 KΩ

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



Fix Resistor products

Diagram



Current Sense Resistors Matrix(Focus Products)

Model	Image	Size (mm)	Terminals	Min Resistance Available (Ohm)	Power Rating (W)	TCR (PPM/C)	Resistance Tolerance (%)	Maximum Temperature ©	Maximum Current
CRE2512		6.45 x 3.35	2	0.001	3	+/-75	+/-1	170	55
CRA2512		6.45 x 3.35	2	0.01	3	+/-75	+/-1	170	17
CRF0805		2x1.25	2	0.005	0.5	+/-100	+/-1	170	10
CRF1206		3.2x1.65	2	0.001	1	+/-275	+/-1	170	32
CST0612		1.65x3.05	4	0.0005	1	+/- 200	+/- 1	170	45
CSS2H-5930		15 x 7.75	2	0.001	10	+/-50	+/-1	170	100
CSS2H-3920		10 x 5.2	2	0.001	8	+/-50	+/-1	170	89
CSS2H-2512		6.35 x 3.05	2	0.0005	6	+/-50	+/-1	170	110

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/CRM 1206/CRM1206/ CRM2010/CRM 2512	**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	

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	

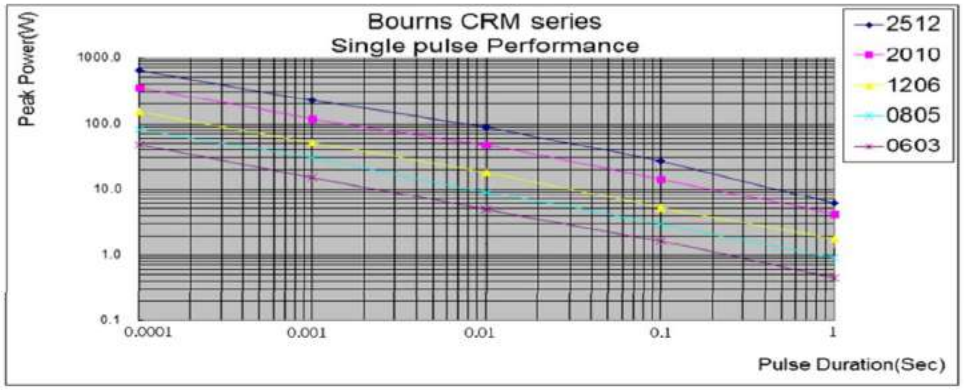
Thick Film Chip Resistors

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			

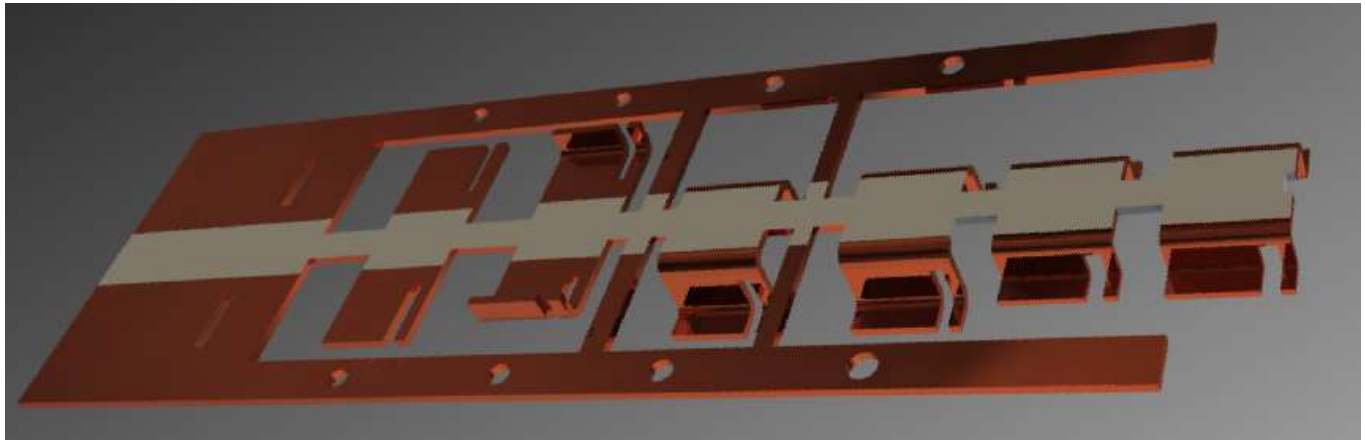
- Strong pulse performance
- Power supplies
- Stepper motor drives
- Current limiting
- Snubber

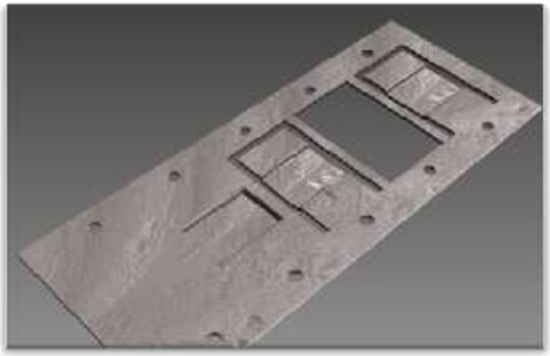


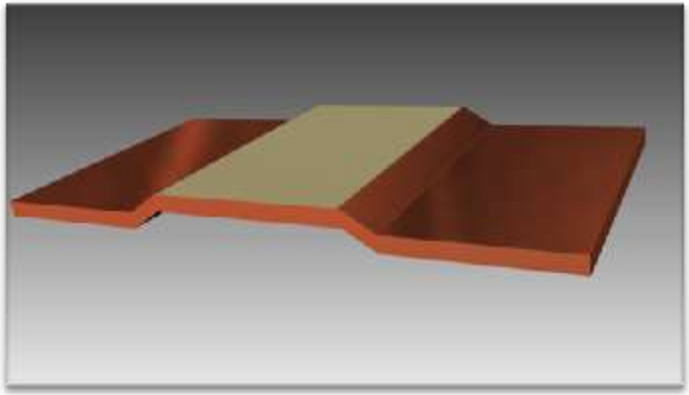
BOURNS®

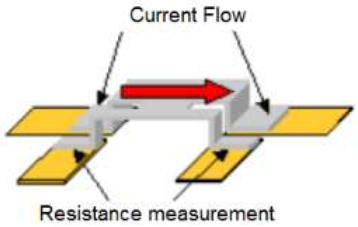
SHUNTS

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

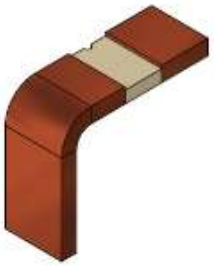








Isabellenhutte products

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

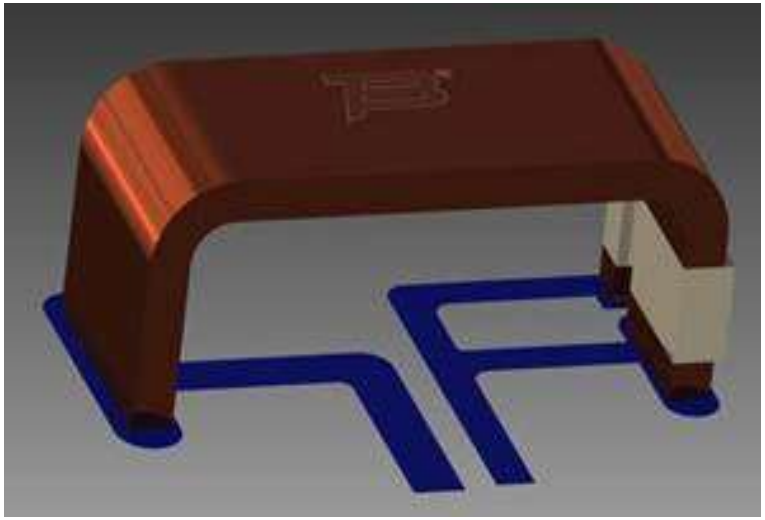
Type/ series	Picture	Type	Description	Connector style	Power	Tolerance	Resistance (min)	Resistance (max)	TC
BVx		BVH	Heavy copper connectors	3820	5 W	3 %	0.0003 Ω	0.002 Ω	300 ppm/K

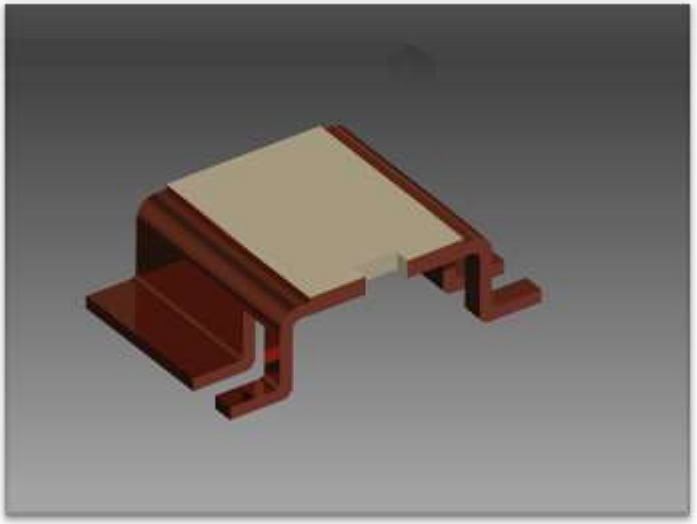
N

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

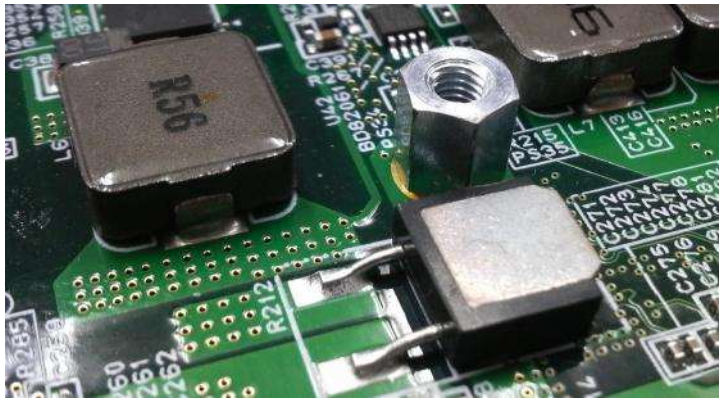
ISA BVR
VISHAY

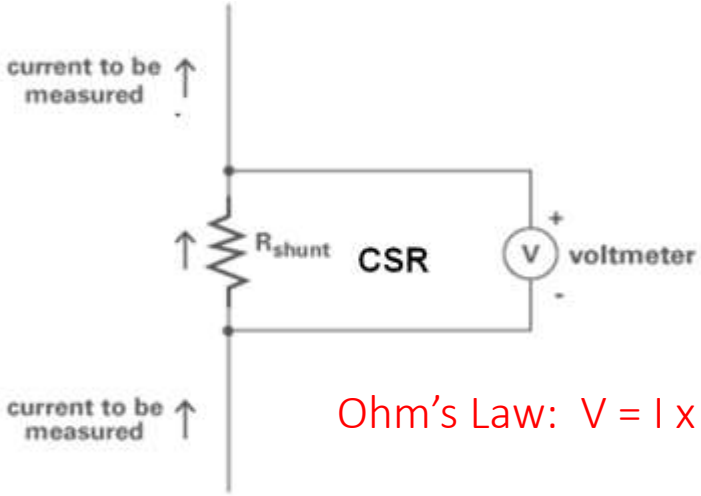




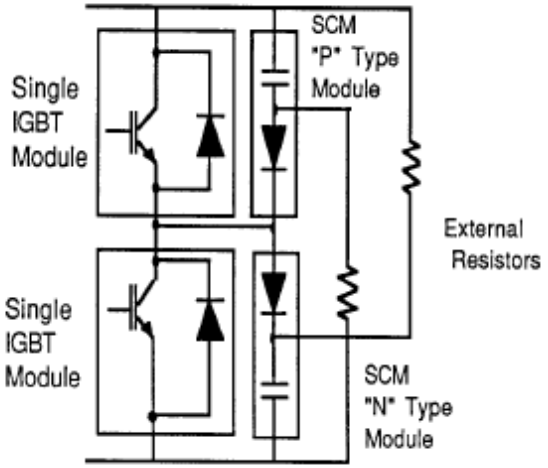
New product focus – High Power PWR series

- **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





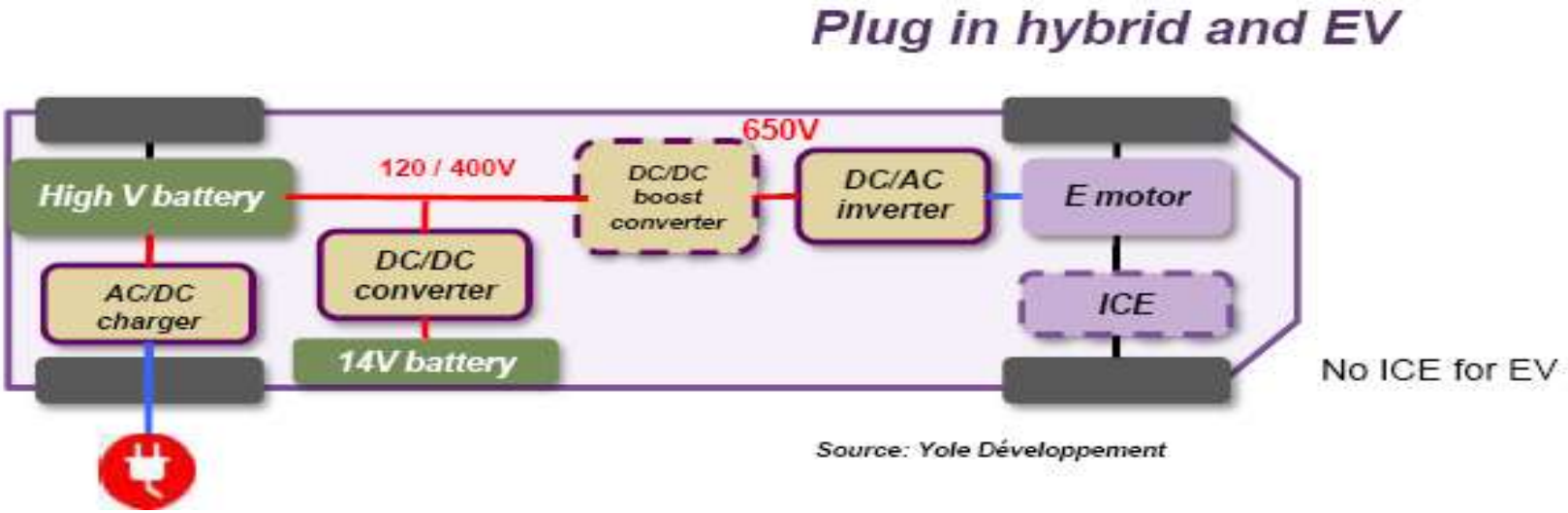
Ohm's Law: V = I x R



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)



New product focus – High Power PWR series

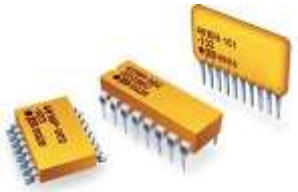
- **Automotive capabilities**
  - Costa Rica plant is TS16949 certified
  - AEC approved products
  - PPAP capability
  - Factory audits facilitated
  - Specialized testing available
  - Assembled parts (with wire)

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*** 	

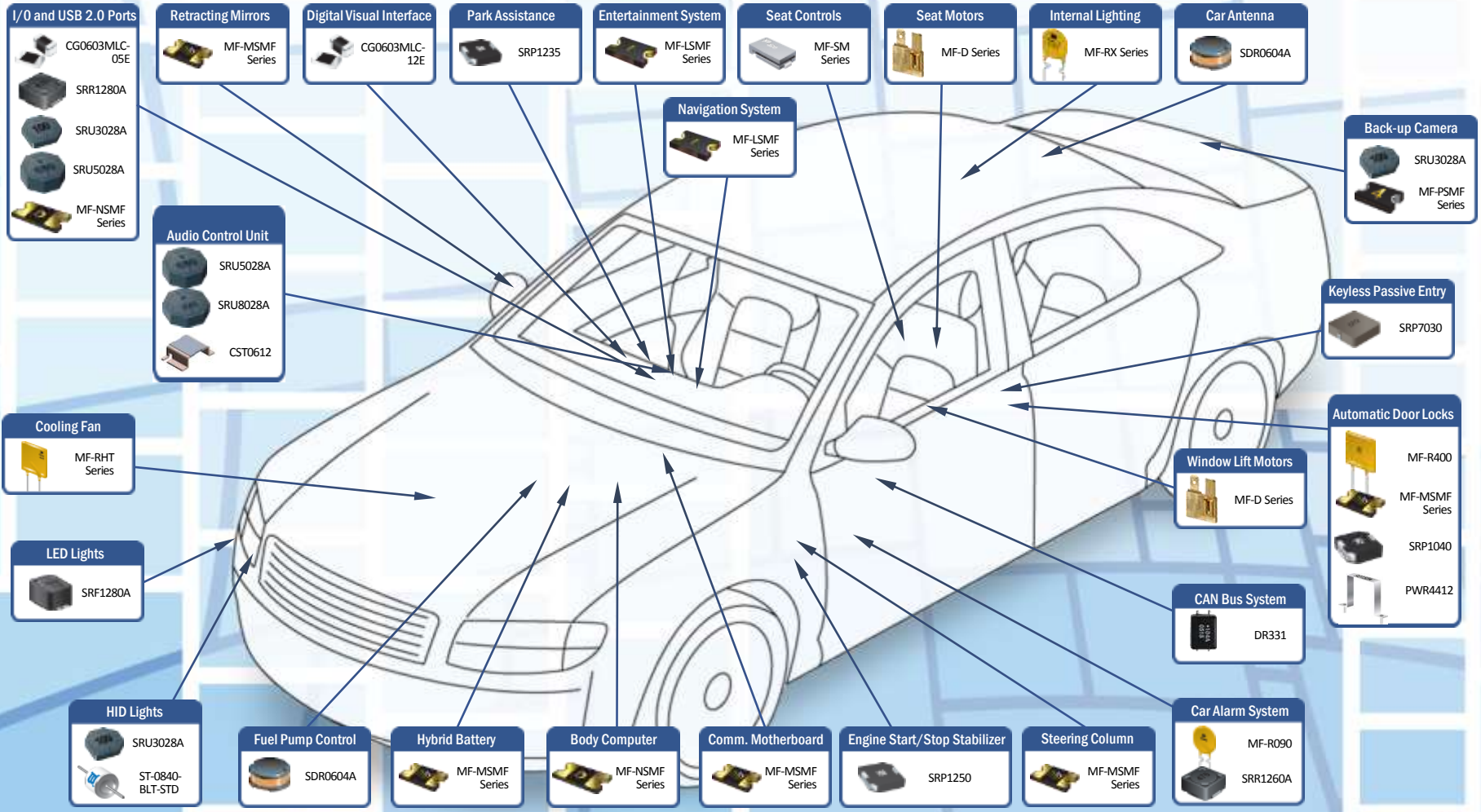
- **Cross reference**

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

Further Automotive Applications Made by BOURNS®

Resistor and RC Networks 	Switches 	Chip Resistors & Chip Arrays 	Power Resistor 	Inductors & Transformers 
Multifuse® Resettable Fuses 	GDT Gas Discharge Tubes 	ChipGuard® ESD Protection Solutions 	Power Semiconductor 	Commercial Panel Controls & Encoders 

Board Level Components for Automotive Applications



BOURNS®