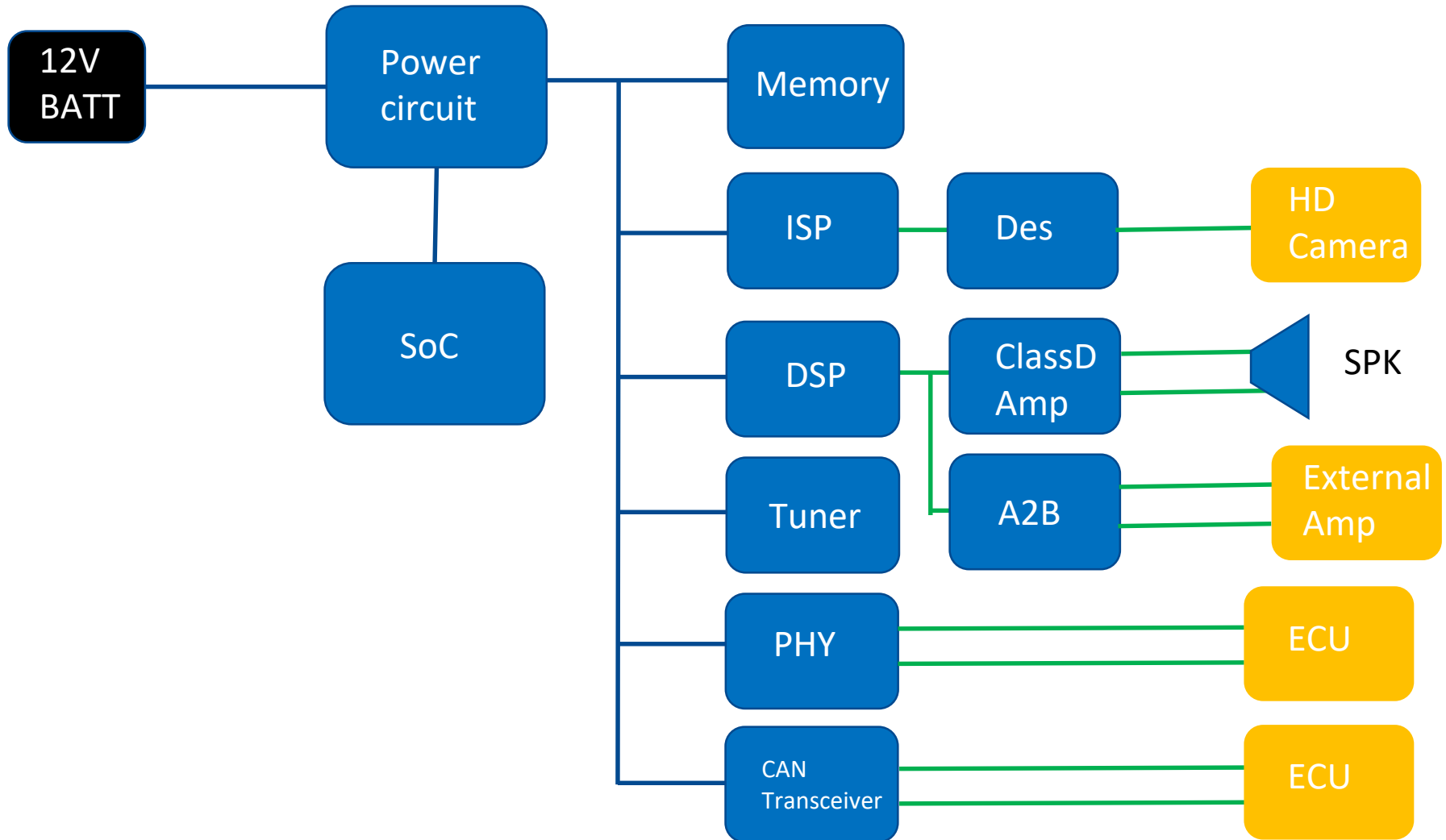


Bourns Solution in T-Box & IVI/ADAS

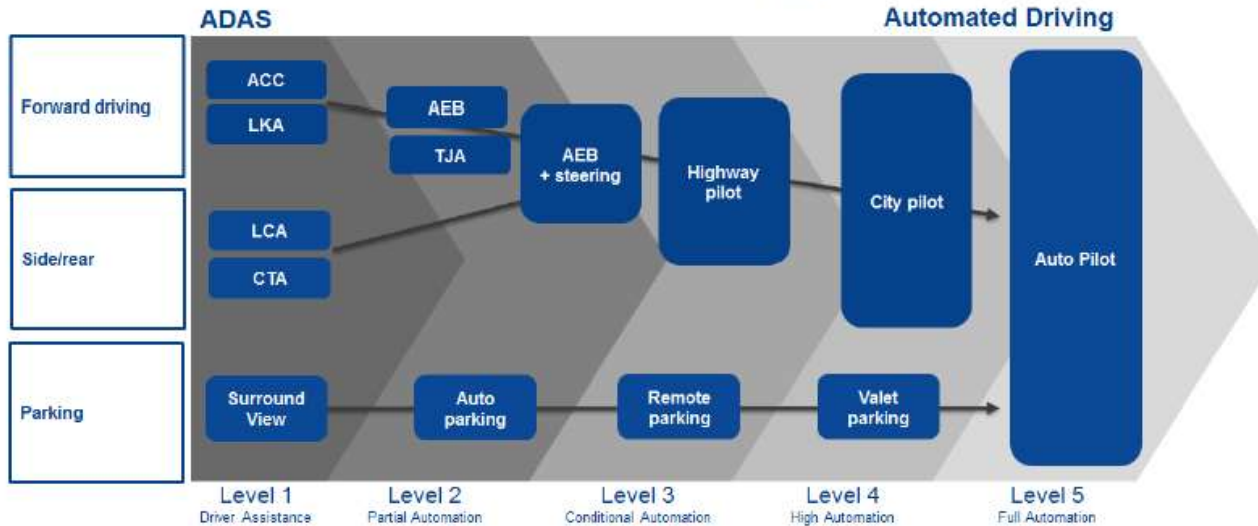
BOURNS®

IVI System Overview

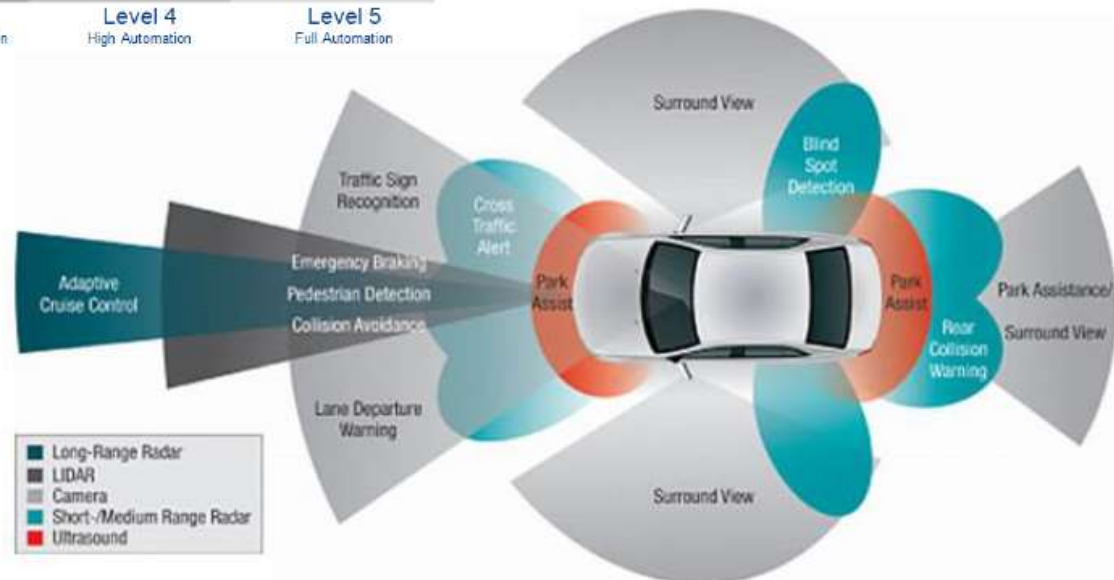


ADAS (Advanced Driver Assistance Systems)

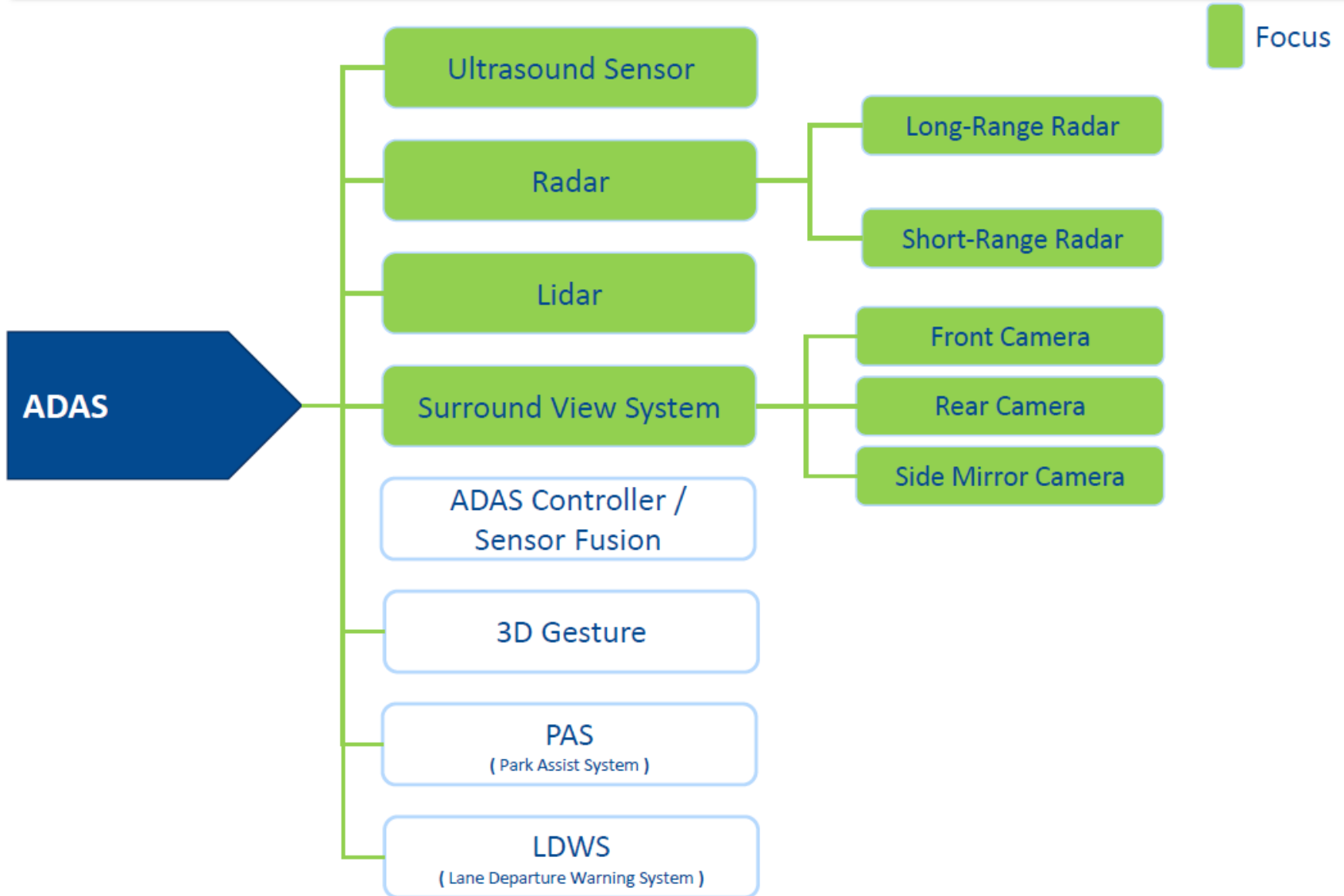
The way to Automatic Driving (AD) ...



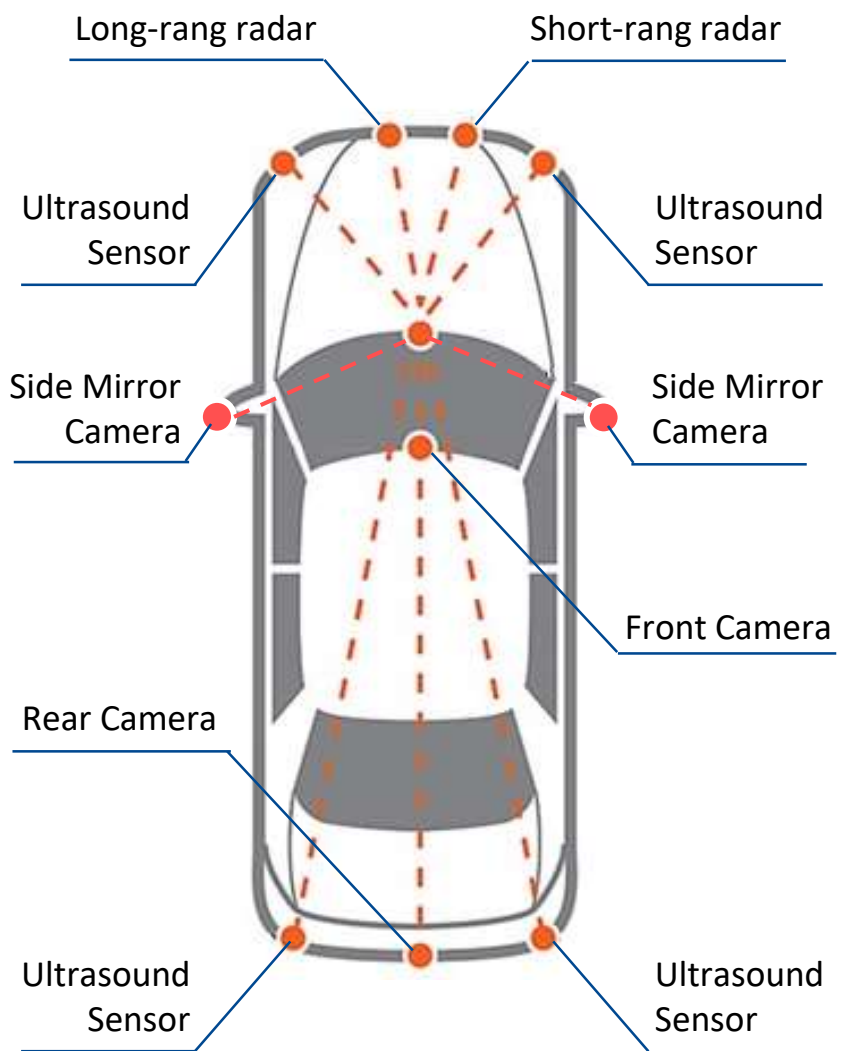
- ACC** Automatic Cruise Control
- LKA** Lane Keep Assist
- LCA** Lane Change Assist
- CTA** Cross Traffic Alert
- TJA** Traffic Jam Assist
- AEB** Automatic Emergency Braking



ADAS (Advanced Driver Assistance Systems)



ADAS (Advanced Driver Assistance Systems)



Current ADAS Major Devices

LDWS (Lane Departure Warning System)

PAS (Park Assist System)



3D Gesture



Radar

- Long-Rang Radar
- Short-Rang Radar
- Ultrasound Sensor



Camera Module

- Front Camera
- Side Mirror Camera
- Rear Camera



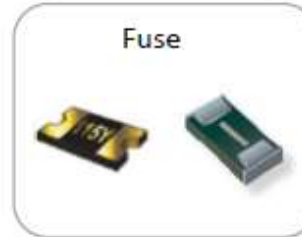
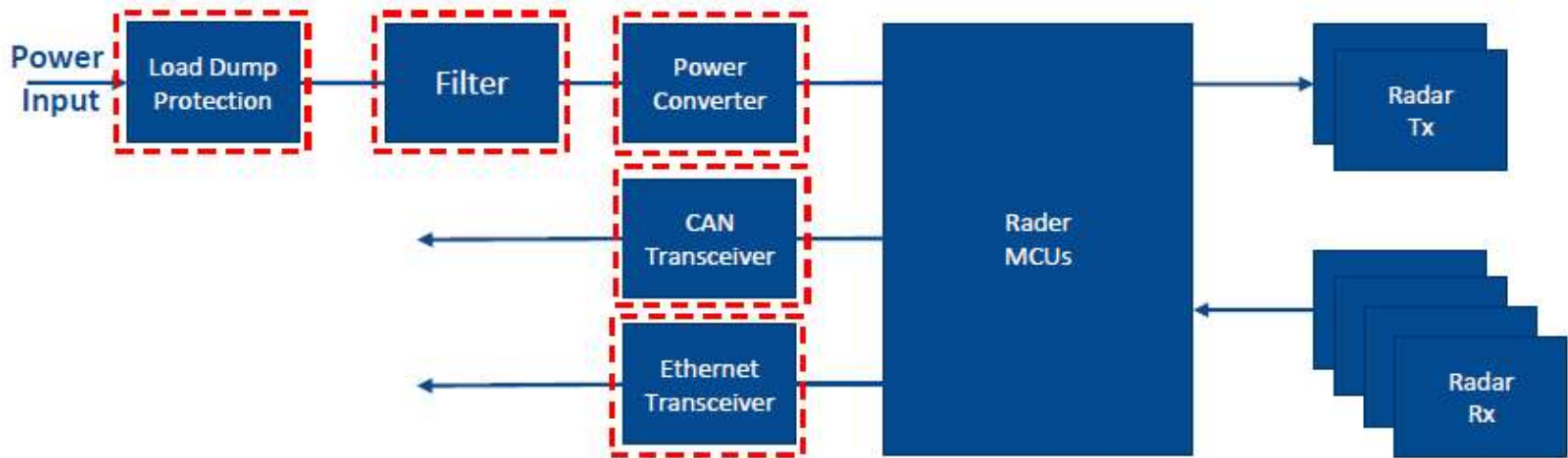
Communication

- LIN
- CAN Bus
- Ethernet

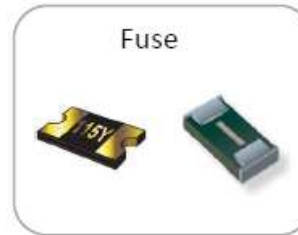
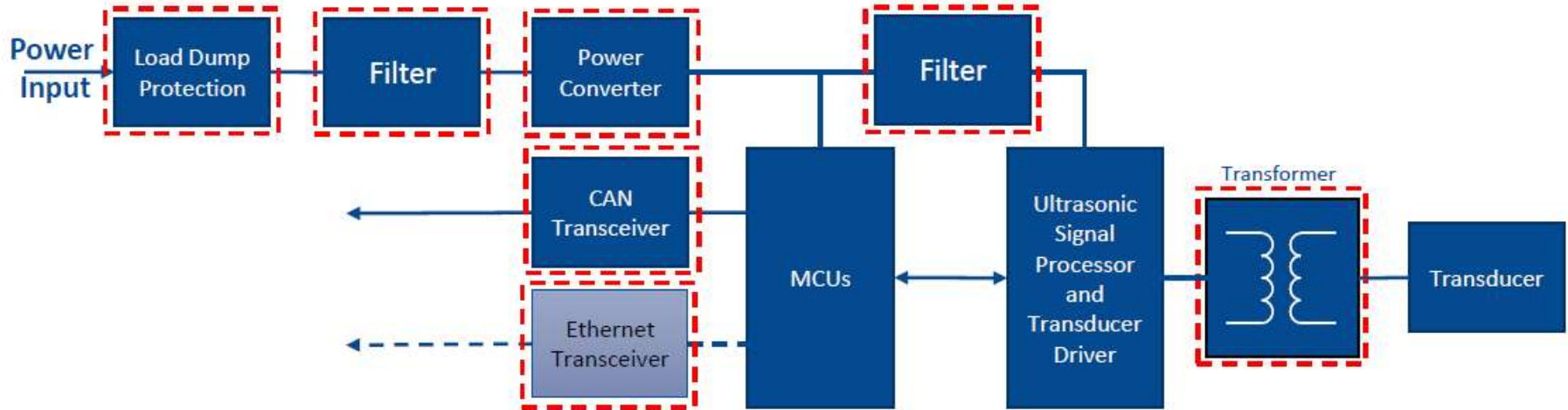
Potential Business

- Power Inductor
- Common-Mode Choke (CMC)
- TVS Diode
- MF

Radar

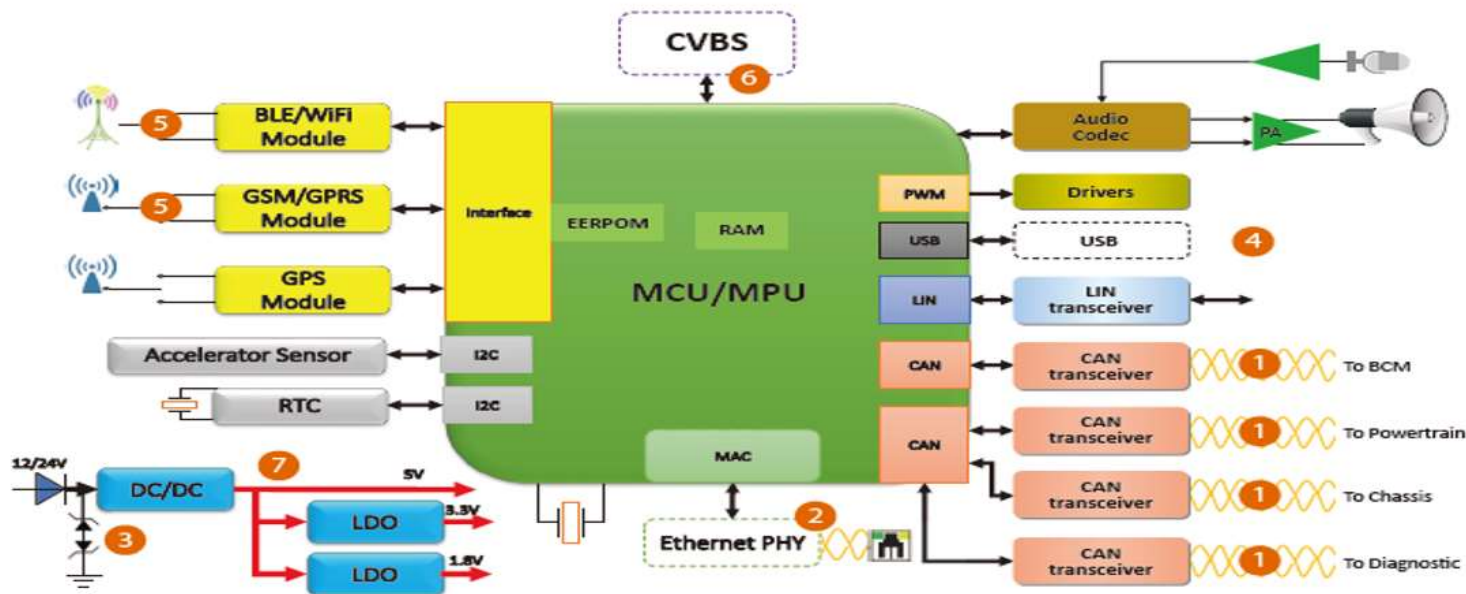


Automotive Ultrasound Sensor



T-Box应用保护解决方案

Telematics BOX, 简称车载T-Box或者T-Box车载终端, 可实现对车辆的运行数据、位置数据进行管理, 提供包含定位功能、车辆状态、电机数据、BMS工作状态、充电状态、状态报警等等。



1 CANbus通信保护: CMC + TVS

CMC: SRF4530A-510Y
TVS: CDSOT23-T24-CAN-Q

2 Ethernet通信保护: Transformer + TVS

Transformer: SM13072APEL
CMC: SRF3225TAB-201Y, SRF4530A-
TVS: CDNBS08-SLVU2.8-4, CDNBS08-SLVU2.8-8, CDSOT23-SRV05-4

3 纯负载TVS

7kW TVS: SM8SF33CA-Q
TVS: SMAJ-Q, SMBJ-Q, SMCJ-Q

4 USB 保护: PTC+TVS

PTC: MF-NSMF-150-2, MF-NSMF075-2
TVS: CD143A-SR05, CDSOD323-T05C, CG0603MLC-05LE

5 RF天线保护

TVS: CDDFN2-T5.0C

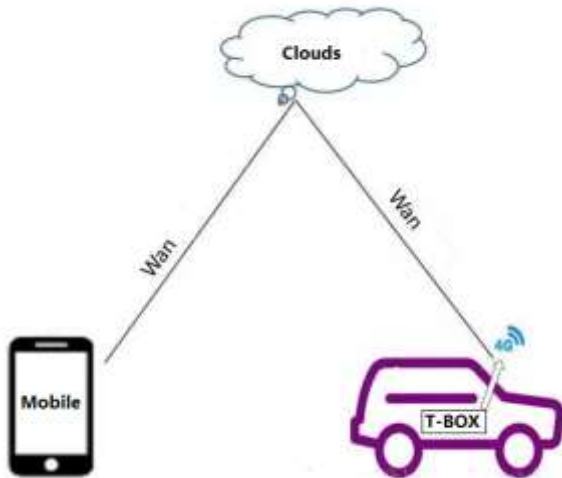
6 CVBS接口保护: GDT + TBU

GDT: 2031-23T-SM
TBU: R3777-TBU, TBU-DB055-100-Q

7 功率电感

Inductors: Bourns可以提供一系列车规级包含定制化功率电感

TBU- robust protection of T-BOX



Situation

T-BOX (telematics box) is a node of car networking, it is used for communication between clouds system to mobile APP to realize vehicle information displaying and controlling of mobile APP

- CVBS (complicated video broadcast signal) is a standard interface in T-Box;
- CVBS ports always be damaged in field due to user faulty operation or ports loosening;
- Previous solution is only TVS in parallel, it's too weak to protect well, there is high failure rate.

Solution

TBU –Robust solution

Bourns provides TBU (transient blocking unit) solution, which withstand inrush current and short circuit within a microsecond.

TBU-CA065-050-WH

- Fast response, less than 1us.
- Long life cycles
- Improve customer product quality

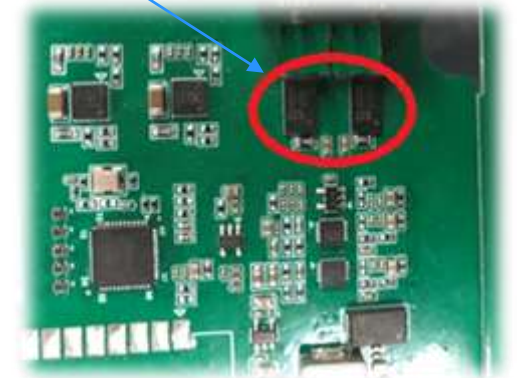


4G T-BOX

Benefit

Stable and safe in long term and harsh environment

- TBU-CA065-050-WH is approved by YAXON, typical T-BOX customer base in China,
- Significant opportunity to drive this solution into T-BOX accounts,



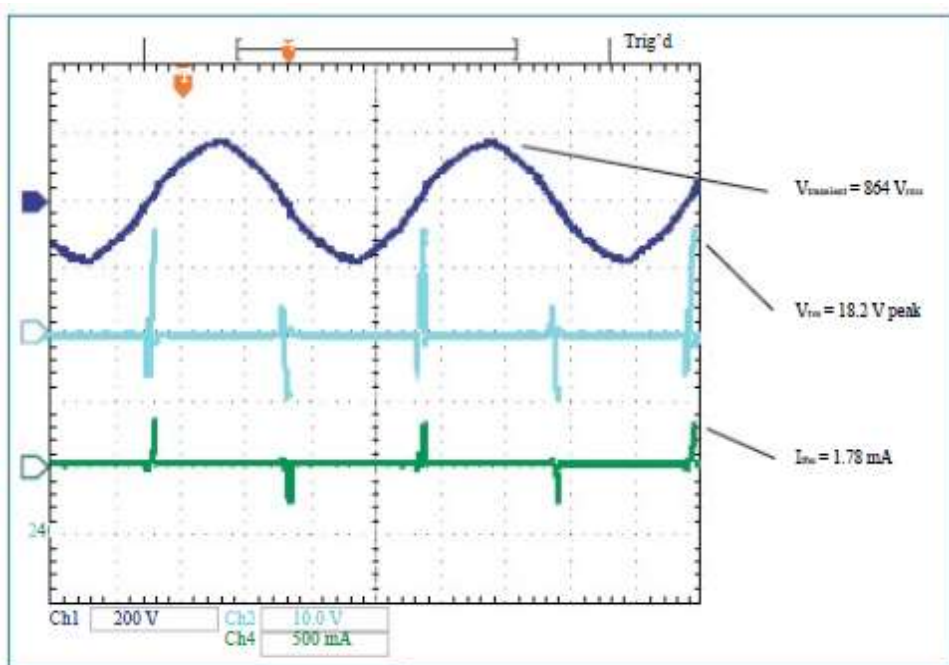


图7 1.2/50us 浪涌测试

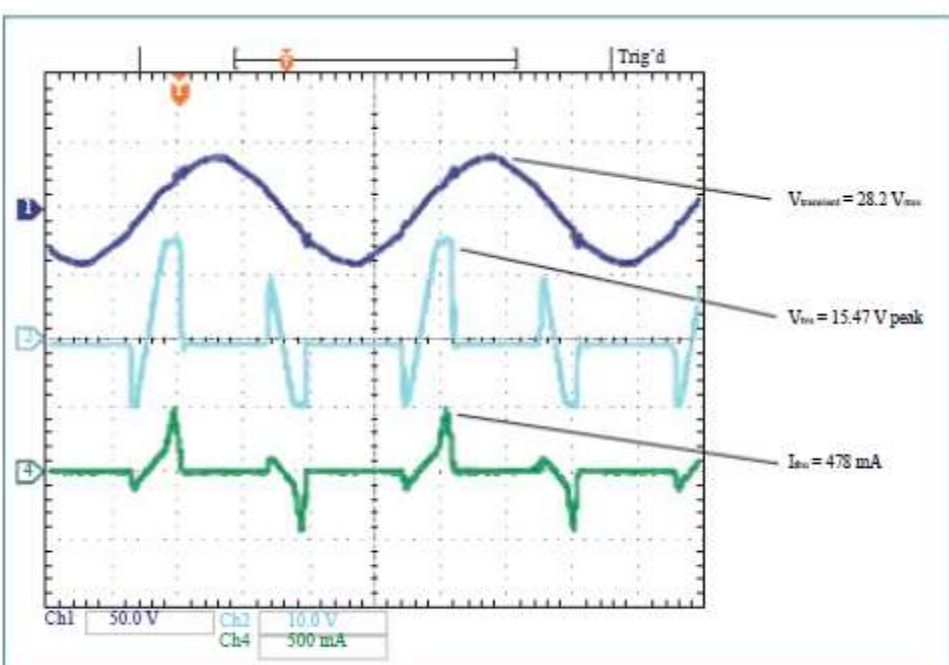


图4 28Vrms 电力线串扰

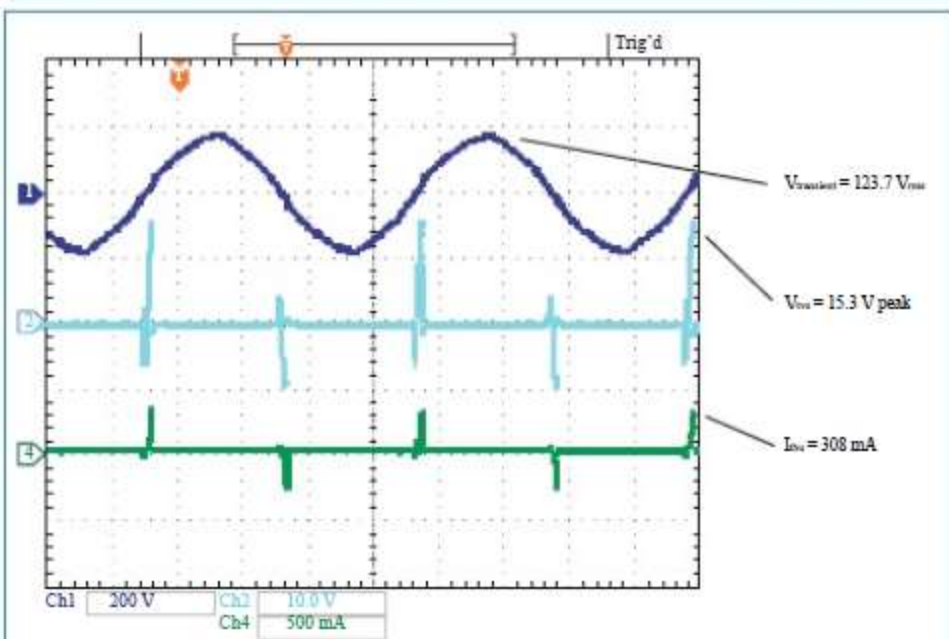


图5 120Vrms 串扰

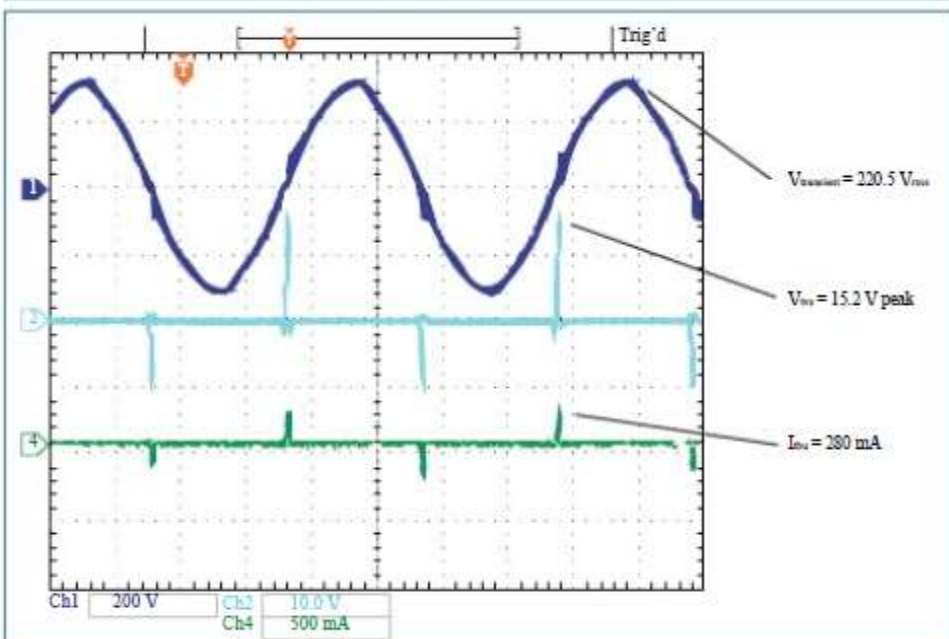
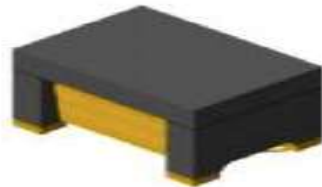
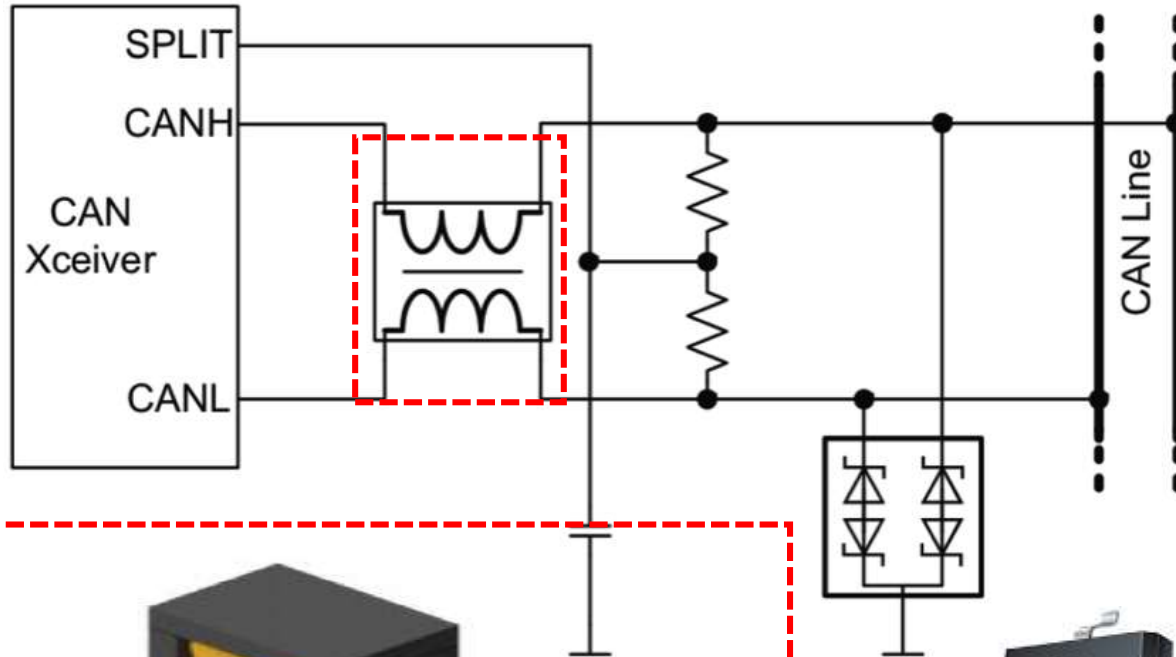


图6 220Vrms 串扰

Communication Technology Inside Car

Technology	Speed(bps)	PHY Chip	Main Applications	Bourns Parts
CAN /LIN/ FlexRay (Controller Area Network In Car)	20K~10 M	N/A	-Powertrain -Chassis/Body Electronics	SRF4530A Common Mode Chokes (CMC)
A2B (Automotive Audio Bus)	~50M	Analog Devices -AD2401/2402/2410	-Infotainment	SRF4530A Common Mode Chokes (CMC)
MOST: (Media Oriented Transport)	25M 50M 150M	Microchip/SMSC -OS81082, OS81092	-Cameras -Video	Ethernet Transformers: -SM13072APEL/SM13074AL -PT61018AAPEL
LVDS: (Low voltage differential signaling)	3G	N/A	-Camera -Video	N/A
Ethernet AVB(Audio Video Bridging for Real Time)	100M 1000M	Microchip/SMSC -LAN89303/LAN88730 Microchip -KSZ8041/51,LAN7800 -KSZ9031RNXUB-VAO KSZ8864/73/95xMLLU Marvell-88E1119R, 88E1510, -Realtek	-Diagnose Port -Video and Audio -Dashboard Display -ADAS	Ethernet Transformers: -SM13072APEL/SM13074AL -PT61018AAPEL -SM41126AEL(Chip LAN Module) -GIGA (TBA)
Single Twisted Pair Ethernet: (100Base-T1, PoDL, 1000Base-T1)	100M 1000M	Broadcom BCM89810 NXP TJA1100 Marvell 88Q2112	-Camera & ADAS -Sensors -All Comms. Networks - Future Car Backbone	CMC and Inductors: – 100Mbps CMC (SRF4530AB-201Y) - PoDL CMC(TBA) – 1000Mbps (TBA)
HD Base-T Automotive	6G	Valens VA6000 with STmicro	-ADAS -HD Head Unit/HD-Displaying - HD Infotainment	Ethernet Transformers: - 10G Transformer -1000Mbps CMC (TBA)

CANBUS/CANFD



Common Mode Choke (CMC)

- **SRF4530A-510Y** : Size 4530
Competitor : PE-1812ACC510STS (Pulse)
ACT45B-510-2P-TL(TDK)
- **SRF3225TA-510Y** : Size 3225
Competitor : ACT1210-510-2P (TDK)

ESD Protection

- **CGA0603**
- **CDSOT23-T24CAN-Q**



CDSOT23-T24CAN-Q

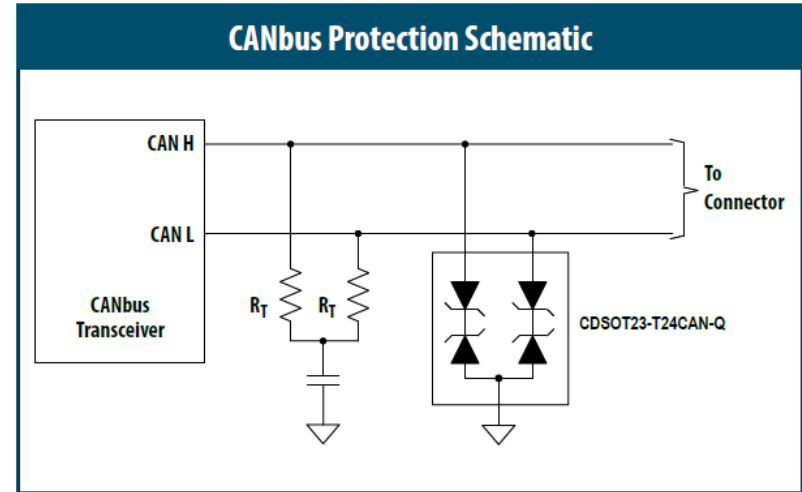


Features

- IEC 61000-4-2 30 kV ESD
- IEC 61000-4-5 (Level 1, CWG 1.2/50) 500 V Surge
- V_{BR} 26.2V compatible with transceivers with internal circuitry for 24V power supply miswiring

Applications

- High Speed CANbus
- On-board diagnostics
- LED headlamp control
- BMS



Absolute Maximum Ratings (@ T_A = 25 °C Unless Otherwise Noted)

Rating	Symbol	Value	Unit
Repetitive Peak Off-state Voltage	V _{DRM}	24	V
Non-Repetitive Peak Impulse Current, 8/20 μs Waveform	I _{PPSM}	8	A
Non-Repetitive Peak Impulse Current, 1.2/50 μs Waveform	I _{PPSM}	6	A
ESD (IEC 61000-4-2 Contact)		30	kV
Junction Temperature	T _J	-40 to +150	°C
Storage Temperature	T _{stg}	-55 to +150	°C



CDSOT23-T24CAN-Q



CDSOT23-T24CAN-Q Sales Guide

CDSOT23-T24CAN Specifications

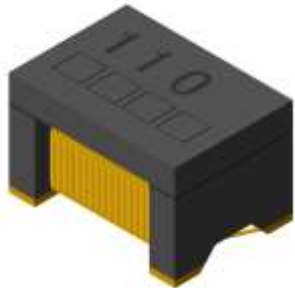
Comparison to Devices with a Similar Surge Rating

Parameter	Units	Bourns	OnSemi	Littelfuse
		CDSOT23-T24CAN	NUP2105L	SM24CANB
V_{DRM}	V	24	24	24
I_{PPSM} (8/20 μ s Current Waveform)	A	8	8	10
ESD (Contact)	kV	30	30	30
V_{BR} min. @ $I_{BR} = 1$ mA	V	26.2	26.2	26.7
V_{BR} max. @ $I_{BR} = 1$ mA	V	32	32	Not Specified (NS)
I_R max.	μ A	0.1	0.1	0.1
Typical V_C @ I_{PPSM}	V	40	44 max.	50 max.
C (Line to GND), typical	pF	22	30 max.	30

Comparison to Devices with a Lower Surge Rating

Parameter	Units	Bourns	STM			Littelfuse	NXP		ProTek
		CDSOT23-T24CAN	ESDCAN24-2BLY	ESDCAN01-2BLY	ESDCAN03-2BLY	SM24CANA	PESD1CAN	PESD2CAN	PESD2CAN
V_{DRM}	V	24	24	24	24	24	24	24	24
I_{PPSM}	A	8	5.5	5.5	3.7	3	3	5	4
ESD (Contact)	kV	30	30	30	30	24	23	30	8
V_{BR} min. @ $I_{BR} = 1$ mA	V	26.2	27	25	26.5	26.7	25.4	26.2	25.4 @ 4 mA
V_{BR} max. @ $I_{BR} = 1$ mA	V	32	32	30	NS	NS	30.3	30.3	NS
I_R max.	μ A	0.1	0.1	0.1	0.01	1	0.01	0.01	0.05
Typical V_C @ I_{PPSM}	V	40	43 max. @ 5 A	40 max. @ 5 A	41 max. @ 3 A	50 max.	50 max.	41 max.	60 max.
C (Line to GND), typical	pF	22	30 max.	30 max.	3	11	9.3	25	11

Common Mode Line Filter SRF4530A



- **Feature :**
Ferrite Core Common Mode Filter
- **Application :**
Automotive CAN bus
- **Size :** 4.5×3.2×3.2 mm

SRF3225TAC



- **Feature :**
Ferrite Core Common Mode Filter
- **Application :**
Automotive CAN bus
- **Size :** 3.2×2.5×2.5 mm

****Both are AECQ 200 Compliant**

CANBUS Parameter comparison (51uH)

4530 size

Bourns SRF4530A-510Y	TDK ACT45B-510-2P	Murata DLW43SH510XK2
Temperature 150C	Temperature 150C	Temperature 125C
Rated current 230mA	Rated current 200mA	Rated current 230mA
Cost Low	Cost High	Cost Mid

3225 size

Bourns SRF3225TAC-510Y	TDK ACT1210-510-2P	Murata DLW432SH510XK2
Temperature 150C	Temperature 150C	Temperature 125C
Rated current 200mA	Rated current 200mA	Rated current 200mA
Cost Low	Cost High	Cost Mid

CANFD Parameter comparison (100uH)

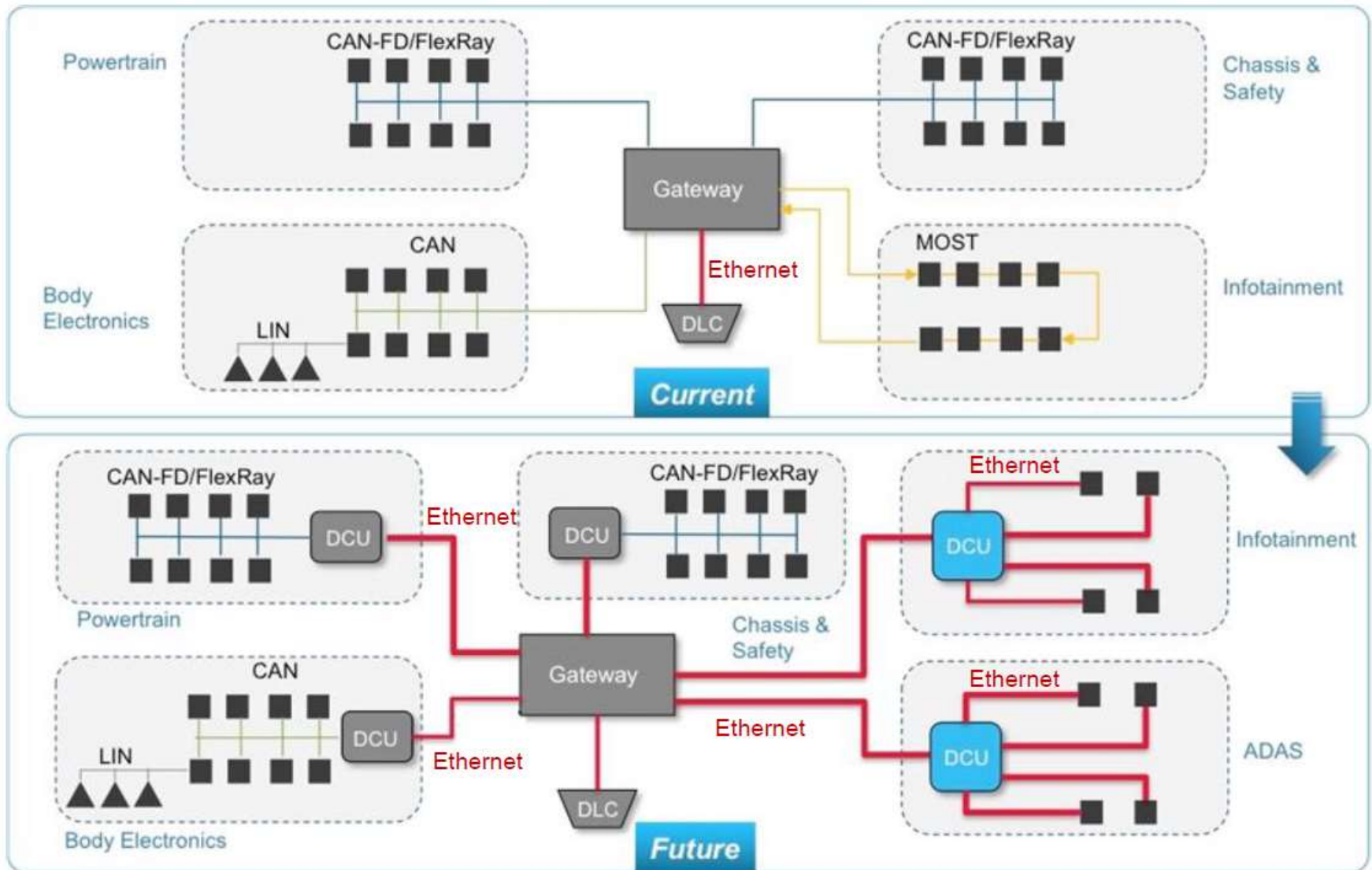
4530 size

Bourns SRF4530A-101Y	TDK ACT45B-101-2P	Murata DLW43SH101XK2
Temperature 150C	Temperature 150C	Temperature 125C
Rated current 200mA	Rated current 150mA	Rated current 200mA
Cost Low	Cost High	Cost Mid

3225 size

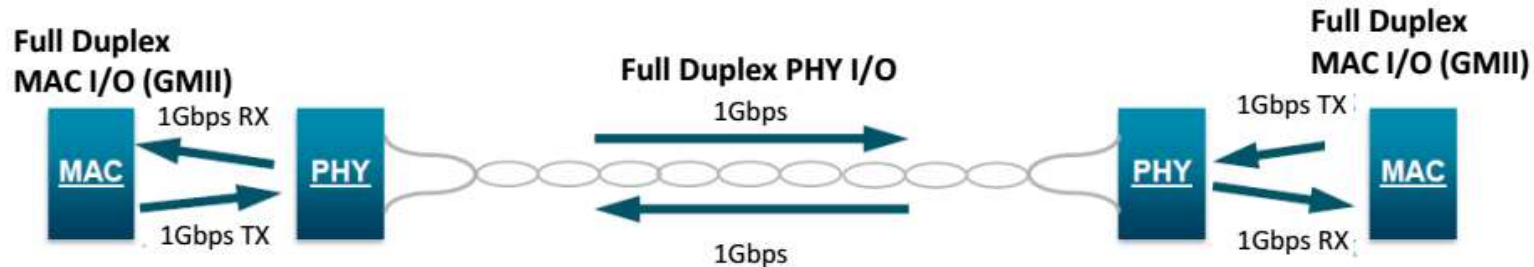
Bourns SRF3225TAC-101Y	TDK ACT1210-101-2P	Murata DLW432SH101XK2
Temperature 150C	Temperature 150C	Temperature 125C
Rated current 150mA	Rated current 150mA	Rated current 150mA
Cost Low	Cost High	Cost Mid

Further Inner Vehicle Network



1000Base-T1 Ethernet – Single Pair

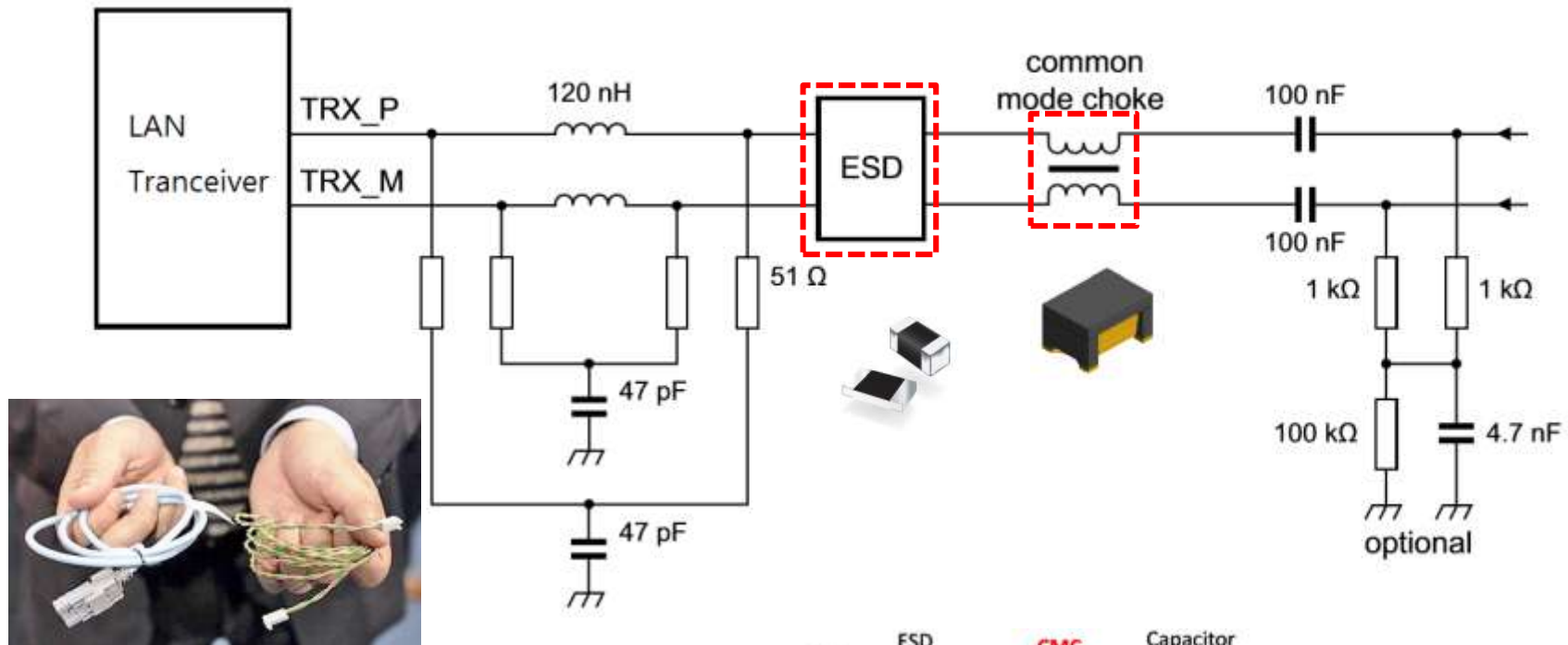
- Demand by high resolution camera and LCD display
- **A** – Common Mode Choke,
 - ✓ (1812 foot print)



Applications:

- ADAS (Advanced Driver Assist)
 - ✓ Basic visual systems will stay with 100 Mbps Ethernet
 - ✓ Gigabit Ethernet needed for image processing & HD
 - ✓ Image fidelity is critical for object recognition
- IVI (In-vehicle Infotainment)
 - ✓ Most bandwidth intensive in-vehicle application
 - ✓ Gigabit Ethernet first used to connect infotainment modules
 - ✓ Video panels link adoption will depend on total cost of solution
- Body Electronics
 - ✓ 100 Mb/s technology used to connect inside domains
 - ✓ Gigabit Ethernet will connect the major control domains

100Base-T1 Ethernet – Single Pair Broad-Reach

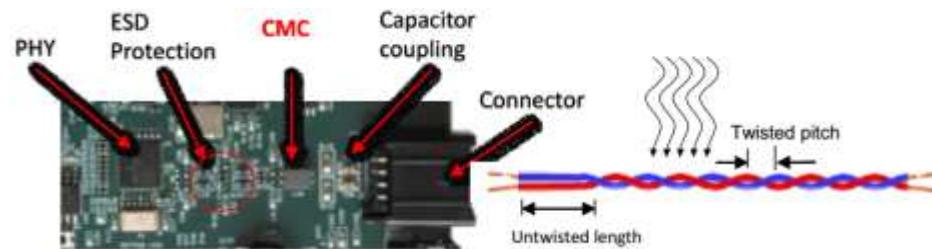


Common Mode Choke (CMC)

- **SRF4530AB-201Y** : Size 4530
Competitor : ACT45L-201-2P (TDK)
DLW43MH201XK2 (Murata)
AE2002-201 (Pulse)



- **SRF3225TABR-210Y** : Size 3225
Competitor : ACT1210L-210-2P (TDK)

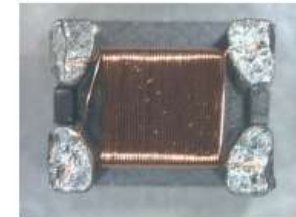
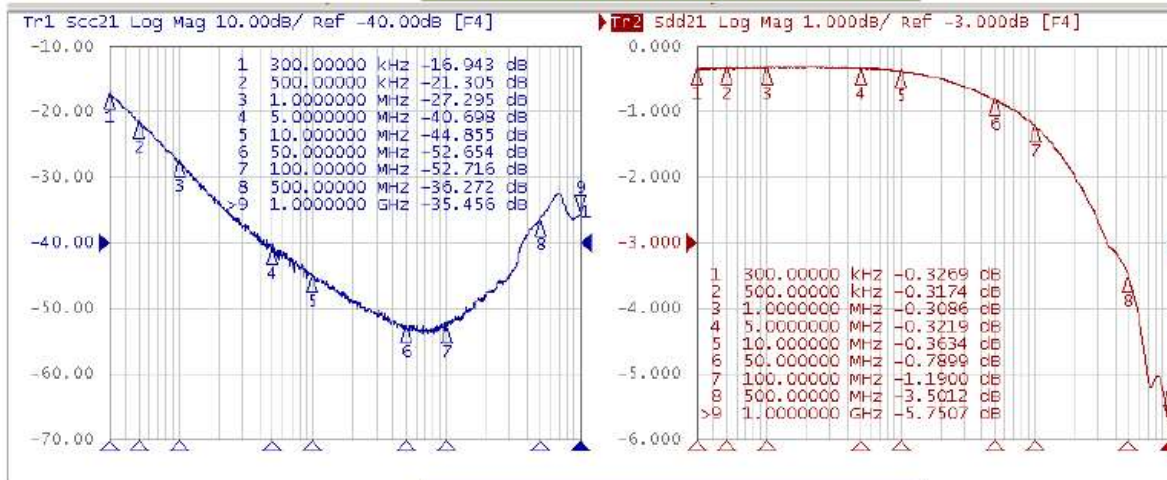


ESD Protection

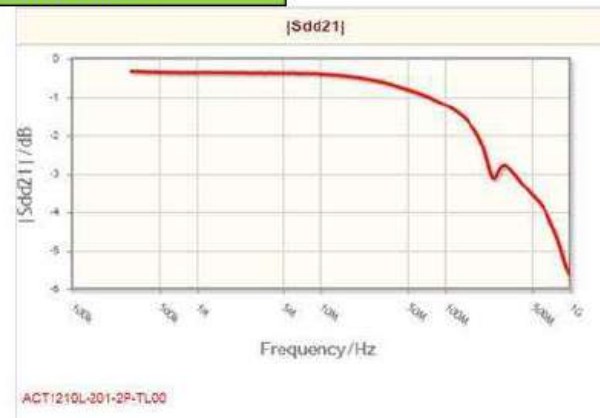
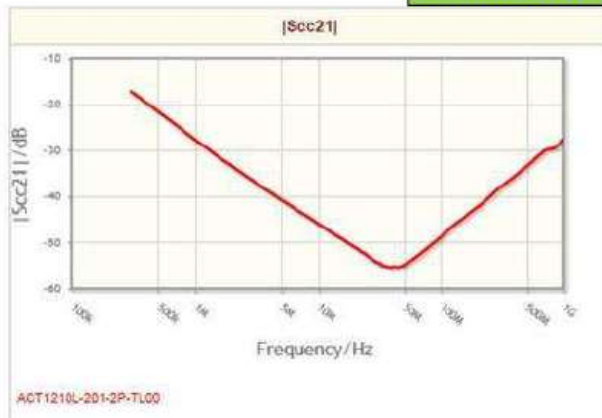
- **CGA0603**

S-Parameter & Winding Outline Comparing Between Bourns SRF3225TAB-201Y and TDK ACT1210L-201-2P-TL00

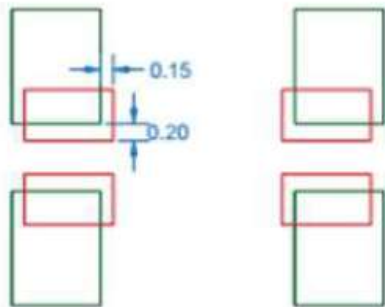
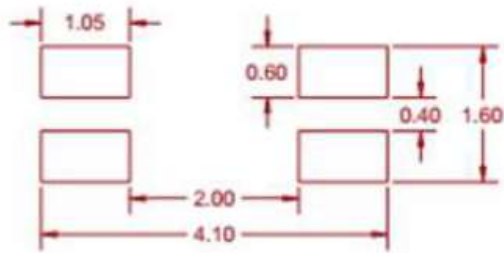
Bourns SRF3225TAB-201Y



TDK ACT1210L-201-2P-TL00

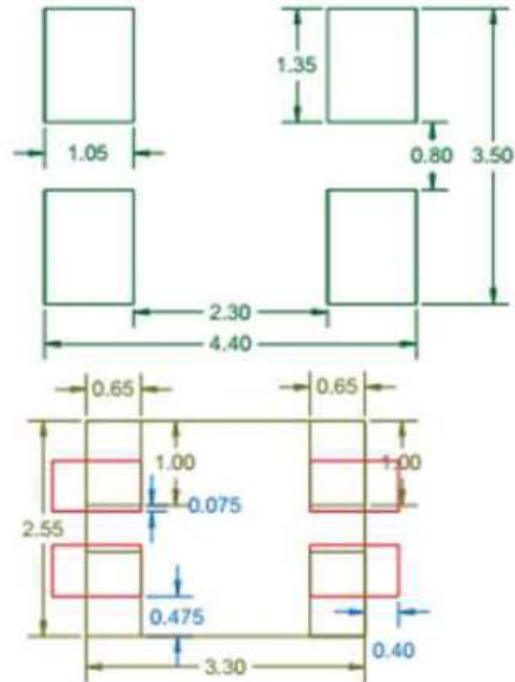


Foot-Print and PCB Pattern Recommended *Comparing Between Bourns SRF3225TAB-201Y and TDK ACT1210L-201-2P-TL00*



TDK ACT1210L-201-2P
Recommended PCB Pattern

Bourns SRF3225TAB-201Y
Recommended PCB Pattern



Unit: mm

Bourns SRF3225TAB-201Y
DR TOP VIEW

USB

CMCC for both USB2.0 & USB3.0 (90ohm @ 100MHz)



(Common Mode Choke)

Electrical Specifications @ 25 °C

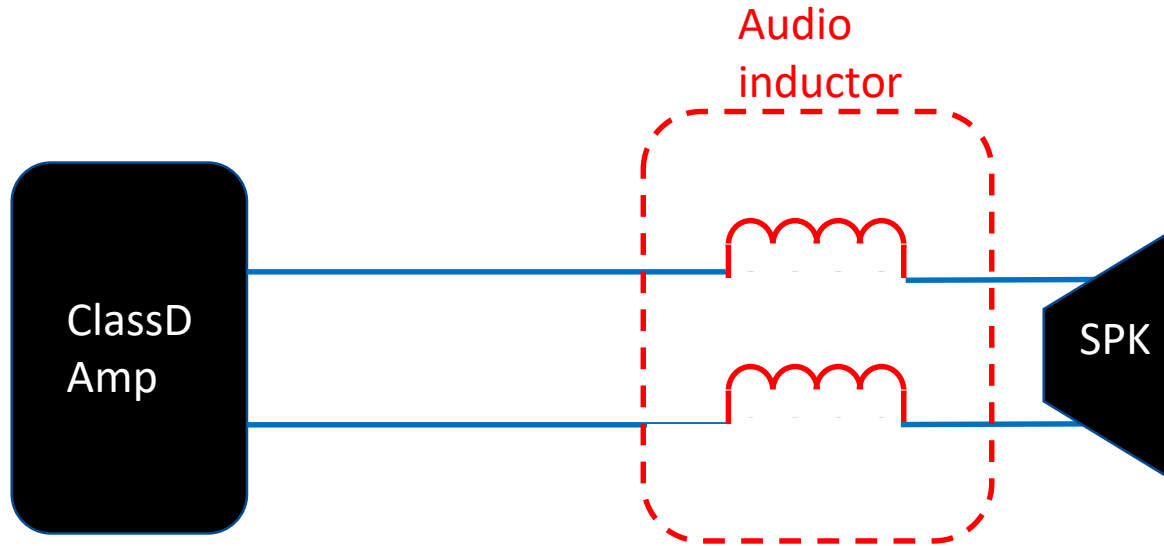
Bourns Part Number	Impedance @ 100 MHz / 1 V		DCR Typ. (Ω)	DCR Max. (Ω)	I _{rms} (mA)
	Z (Ω)	Tolerance (%)			
SRF2012A-670YA	67	± 25	0.15	0.25	400
SRF2012A-900YA	90	± 25	0.16	0.30	400
SRF2012A-121YA	120	± 25	0.20	0.30	400
SRF2012A-161YA	160	± 25	0.25	0.35	350
SRF2012A-181YA	180	± 25	0.25	0.35	350
SRF2012A-201YA	200	± 25	0.30	0.40	300
SRF2012A-221YA	220	± 25	0.30	0.40	300
SRF2012A-261YA	260	± 25	0.35	0.40	300
SRF2012A-361YA	360	± 25	0.45	0.50	300

*90ohm@100MHz was common used for USB2.0 & USB3.0's EMI filter.

Audio line

*SRP series as the discreted solution, please contact with FAE for detail technical support.

Audio inductor

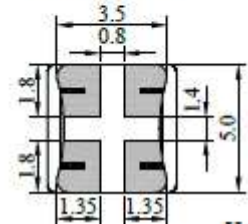


- **Feature :**
Dual coil with excellent magnetic coupling.
- **Application :**
Filter for Class-D Amplifier
- **Size :**
 - ◆ 12x9.6x11.3mm (**SRF1010DA**)
 - ◆ 5x5x2.5mm (**SRF0502-501Y**)



(Plated Dimensions)

Unit : m/m ref.



Audio line

CMCC for A2B

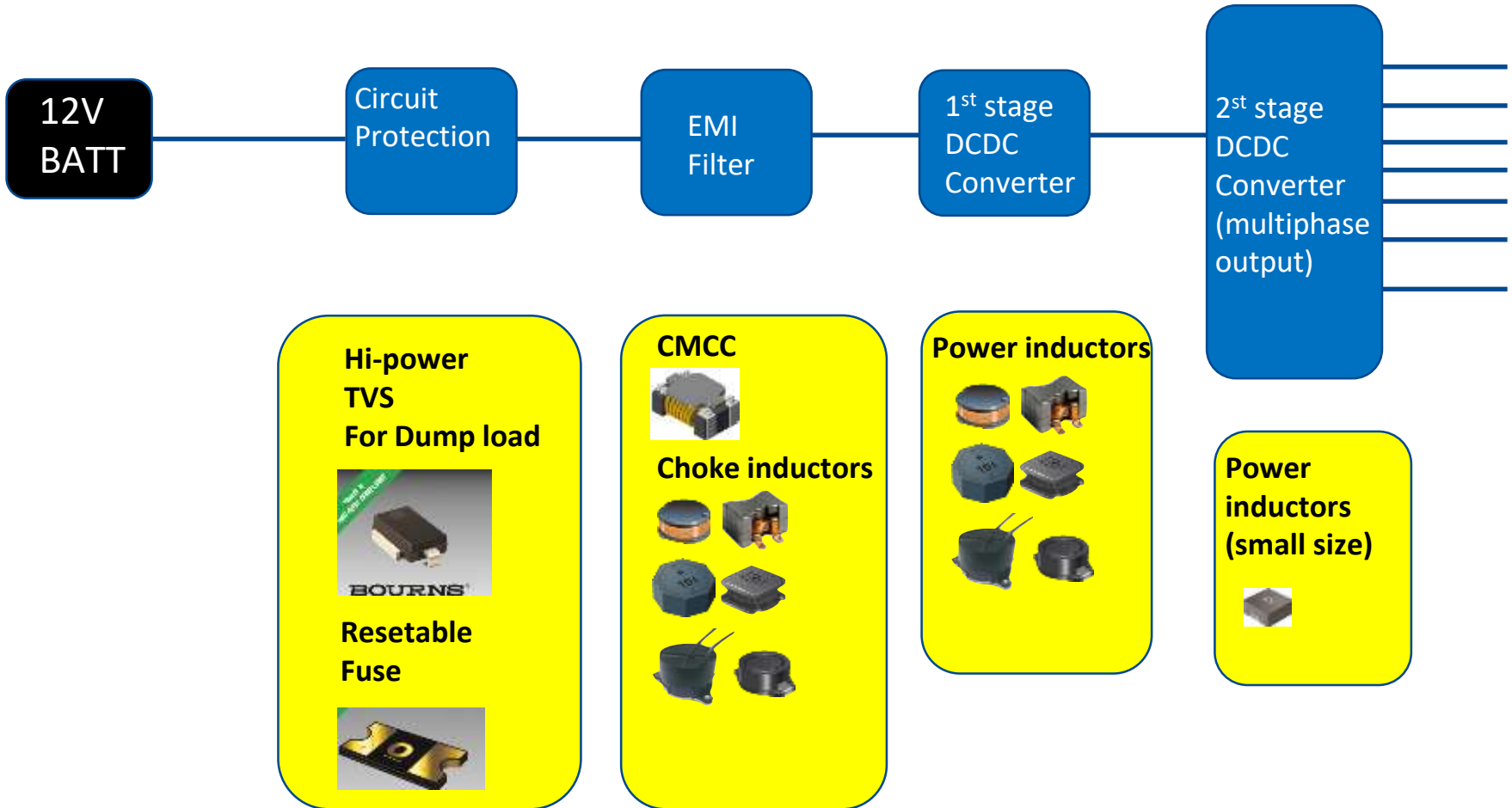


V. ELECTRICAL CHARACTERISTICS :

Part No.	Inductance (μH) @100kHz/0.1V	DCR (Ω) max.	Rated Current (mA) max.	Rated voltage (Vdc) max.	IR (M Ω) min.	Impedance (Ω) [10MHz]	
SRF3225TABR-101Y	100+50/-30%	1.5	150	80	10	1800 min.	3750 typ.
SRF3225TABR-201Y	200+30/-10%	5.5	70	80	10	5000 min.	9500 typ.

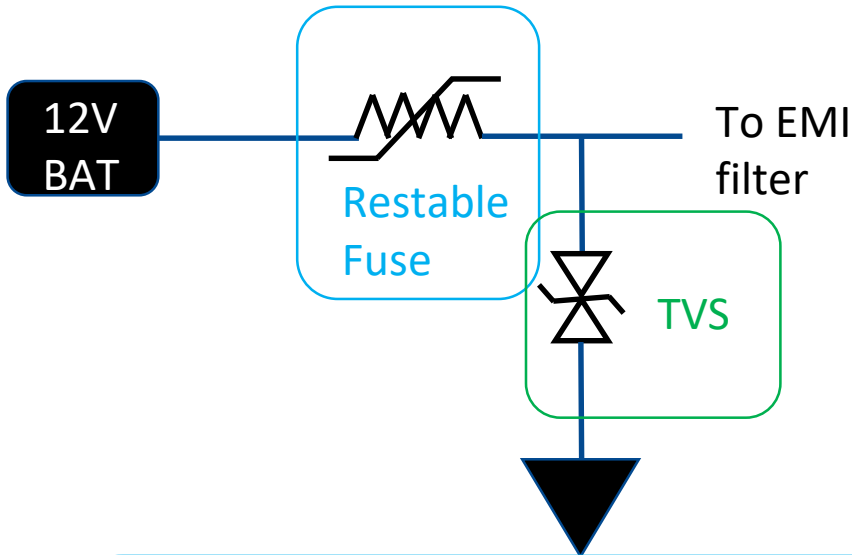
*We can also promote SRF3225AB-101Y (customized part) if our standard part does not work well for the noise suppression.

Power circuit



Power circuit

Circuit protection:



Features

- High power ratings
- Compliant with AEC-Q200 Rev-C- Stress Test Qualification for Passive Components in Automotive Applications
- Low profile
- Compatible with Pb and Pb-free solder reflow profiles
- RoHS compliant* and halogen free**
- Surface mount packaging for automated assembly
- Agency recognition: **UL** **AEC-Q200**
- Standard 7555 mm (2920 mils) footprint

MF-LSMF Series - PTC Resettable Fuses

Electrical Characteristics

Model***	V max. Volts	I max. Amps	I _{hold}		I _{trip}		Resistance		Max. Time To Trip		Tripped Power Dissipation Watts at 23 °C Typ.
			Amps at 23 °C		Ohms at 23 °C		Amps at 23 °C		Seconds at 23 °C		
			Hold	Trip	R _{Min}	R _{1Max}	Amps	Seconds	Amps	Seconds	
MF-LSMF185/33X	33.0	40	1.85	3.70	0.045	0.150	8.0	2.50	1.5		
MF-LSMF260X	24.0	20	2.60	5.20	0.020	0.075	8.0	5.00	1.5		
MF-LSMF300X	6.0	40	3.00	5.00	0.015	0.048	8.0	20.00	1.5		
MF-LSMF300/24X	24.0	20	3.00	5.20	0.020	0.075	8.0	5.00	1.5		
MF-LSMF400/12X****	12.0	20	4.00	8.00	0.005	0.050	8.0	15.00	1.5		

*** Features Multifuse® Free Expansion Design™ for MF-LSMF Series
**** UL approval pending



Features

- Maximum Peak Power Dissipation: 6000 watts
- Meets ISO7637-2 / ISO16750-2 Surge specification (varies by test condition)
- RoHS compliant*
- AEC-Q101 compliant**

Applications

- High peak power applications (up to rated limits)
- High temperature applications (up to rated limits)
- Clamping diode
- Load switching and lighting

SM8S-Q Transient Voltage Suppressor Diode Series

General Information

Bourns offers Transient Voltage Suppressor Diodes for surge and ESD protection applications, in compact chip package DO-218 size format. The Transient Voltage Suppressor series offers a choice of Working Peak Reverse Voltage from 16 V up to 43 V. Typical fast response times are less than 1.0 picosecond from 0 V to Breakdown Voltage.

Absolute Maximum Ratings (@ T_A = 25 °C Unless Otherwise Noted)

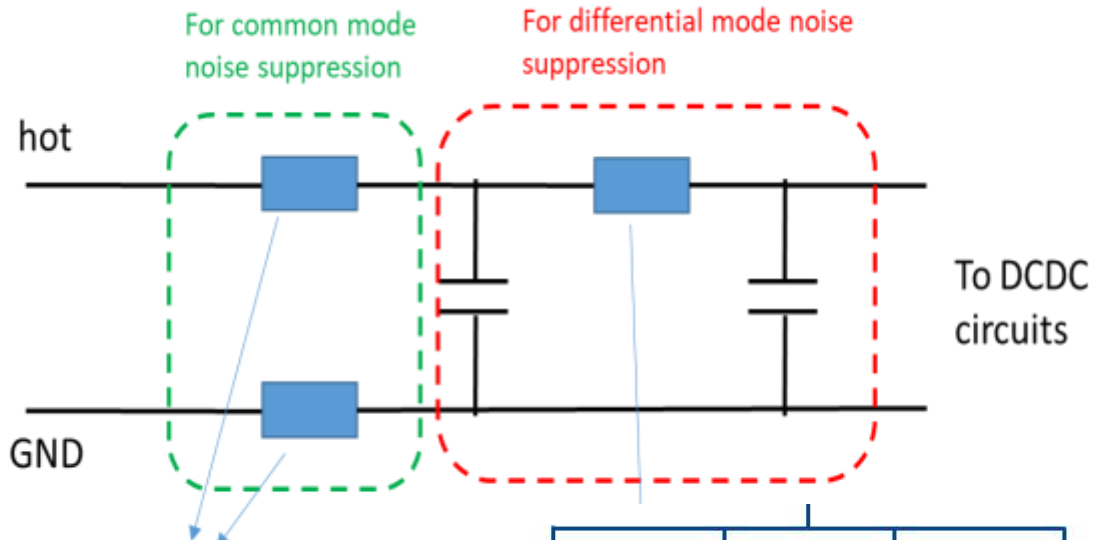
Parameter	Symbol	Value	Unit
Maximum Peak Pulse Power Dissipation (10/1000 μs)	P _{PK}	6000	W
Maximum Peak Pulse Power Dissipation (10/10000 μs)	P _{PK}	5200	W
Power Dissipation with Infinite Heatsink (T _C = 25 °C)	P _D	∅	W
Operating Temperature Range	T _J	-55 to +175	°C
Storage Temperature Range	T _{STG}	-55 to +175	°C

Electrical Characteristics (@ T_A = 25 °C Unless Otherwise Noted)

Unidirectional Device	Bidirectional Device	Breakdown Voltage V _{BR} (Volts)			Working Peak Reverse Voltage V _{RWM} (V)	Maximum Reverse Leakage @ V _{RWM} I _R (μA)	Maximum Reverse Voltage @ I _{RSM} V _{RSM} (V)	Maximum Reverse Surge Current I _{RSM} (A)
		Min.	Max.	@ I _F (mA)				
Part No.	Part No.	Min.	Max.	@ I _F (mA)	V _{RWM} (V)	I _R (μA)	V _{RSM} (V)	I _{RSM} (A)
SM8S16A	SM8S16CA	17.80	19.70	5	16.0	10	26.0	254.0

Power circuit

EMI filter:



1. CMCC for power line:

7.0x6.0x3.5 (**SRF7038A**) ACM70V

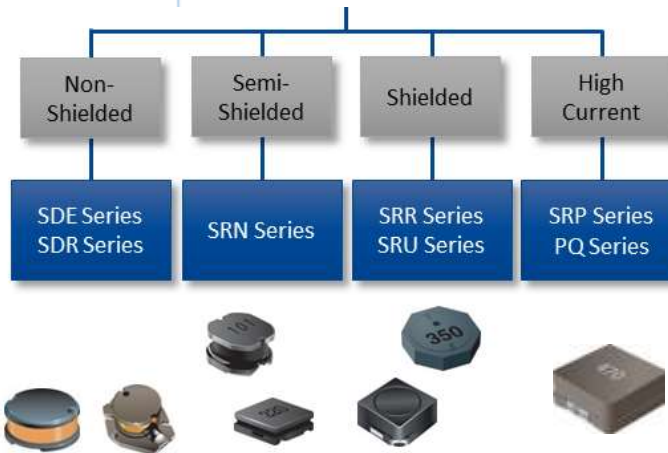
9.0x6.5x4.5 (**SRF9045A**) ACM90V

12.5x11.0x6.5 (**SRF1206A**) ACM12V



2. Choke inductor for power line:





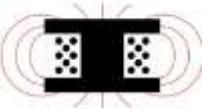

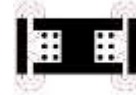

2.5x2.0x1.2 (**SRP2512A**)*



*For solution2, please contact with FAE for more detail technical support.

Power circuit

Power inductors

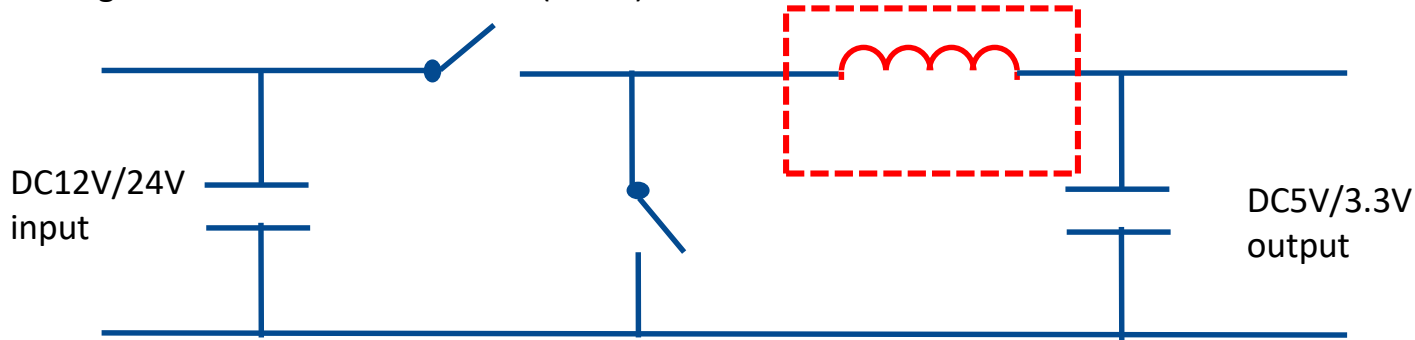
Inductor Model	SDE / SDR Non-shielded	SRN Semi-shielded	SRR / SRU Shielded	SRP / PQ High Current Shielded
Appearance				
Construction				<ul style="list-style-type: none"> • Molding - SRP • Ferrite - PQ 
Features	<ul style="list-style-type: none"> • Ferrite core • Low cost • High saturation current 	<ul style="list-style-type: none"> • Ferrite core • Semi-Shielded with epoxy resin • Lower radiation than non-shielded • Lower cost than shielded 	<ul style="list-style-type: none"> • Ferrite core • Shielded • Low radiation • Low DCR 	<ul style="list-style-type: none"> • Carbonyl / Alloy powder core -SRP • Ferrite - PQ • Shielded • Low radiation • Low DCR • High rated current
Models Available	26	25	71	46
Footprint	3x3 to 22x22 mm	2x2 to 10x10 mm	3x3 to 18x18 mm	2x2 to 23x22 / 28x28 mm
Height	2.7 to 7 mm	0.8 to 6 mm	0.9 to 8.5 mm	1 to 7 / 19mm
Inductance	0.8 to 15,000 μ H	0.33 to 680 μ H	0.47 to 15,000 μ H	0.1 to 100 μ H
Rated Current	0.02 to 16 A	0.20 to 12 A	0.02 to 20 A	1.0 to 70 A / >100 A

Power circuit

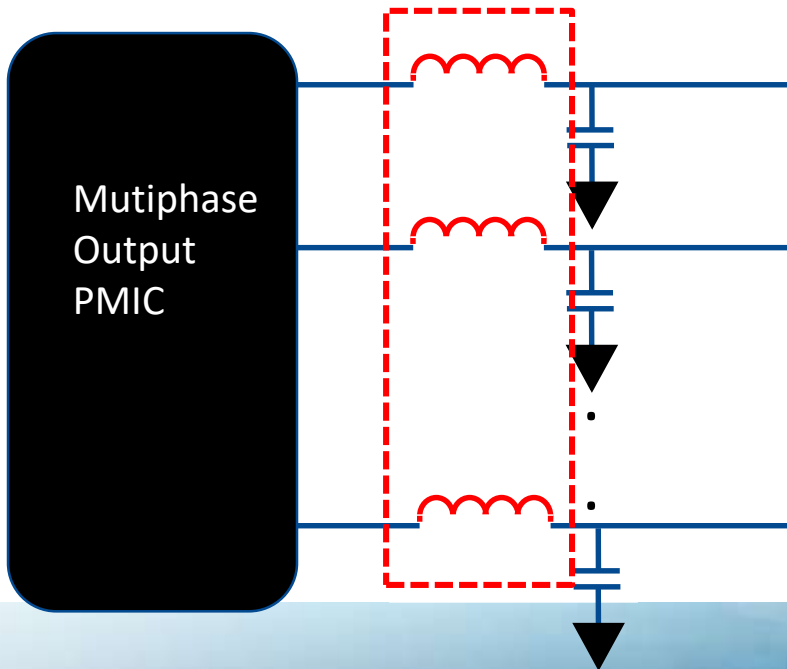
Power inductors

Eg. Distriected DCDC converter (BUCK)

We can suggest the best solution based on your request



Eg. Mutiphase output PMIC based on TI's J6 platform



Eg. SRP2512A-1R0M 9pcs per set
(1uH/3A requested)

Internet of Vehicle

SM8S-xx(C)A-Q

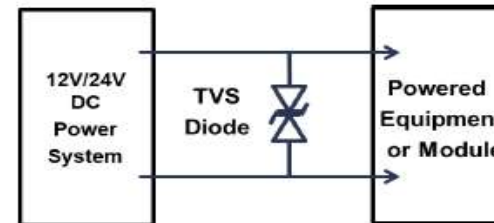


Features

- Standoff Voltage: 16~ 43
- Power Dissipation: 6600 watts (10/1000 us)
- Maximum Peak Pulse Current: 254~ 95A (10/1000 μ s)
- Meets ISO7637-2 / ISO16750-2 surge specification

Applications



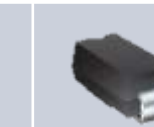





- Load dump protection - DC power supply protection against voltage transients induced by inductive load switching, lighting, etc.



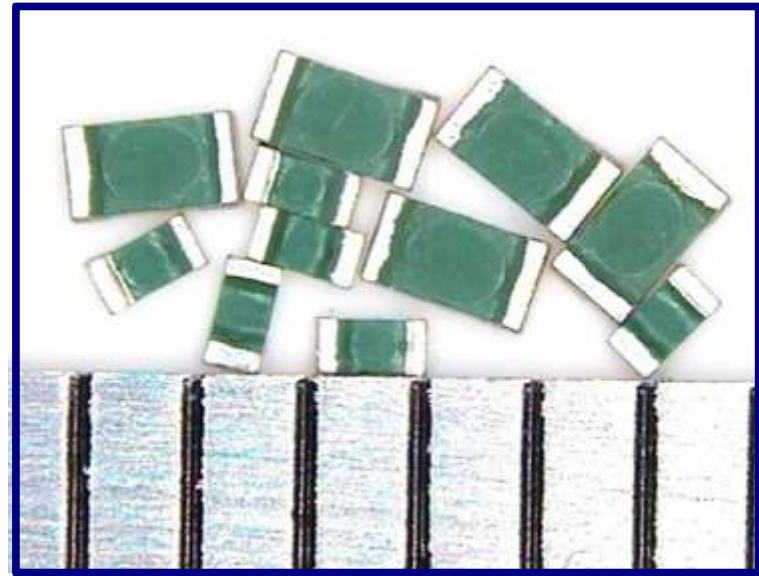
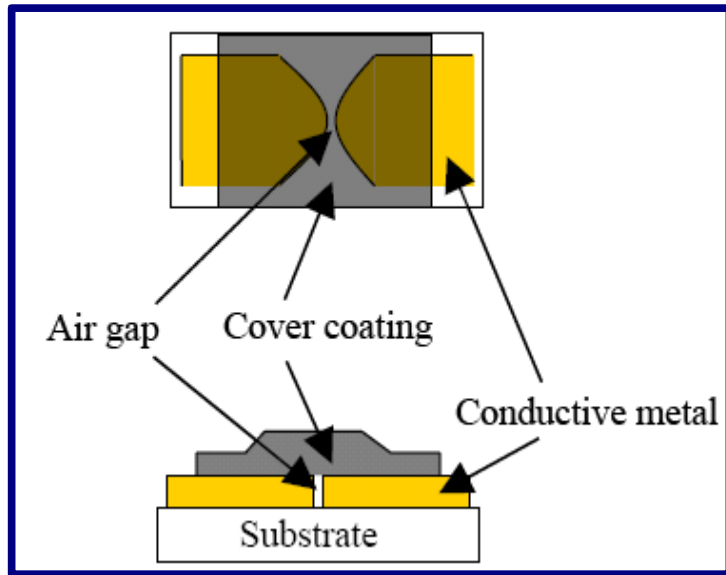
Cross Reference

Vishay	V_{RWM} (Typ)	I_{PP} (10/1000 μ s)	Power Peak Pulse	Package
SM5S33AHE3_A/I	33V	68A	3600W (3.6kW)	 DO-218AB
SM6S33AHE3_A/I	33V	86A	4600W (4.6kW)	
SM8S33AHE3_A/I	33V	124A	6600W (6.6kW)	

Automotive TVS Diode

	CDSOT23-T24CAN-Q	CDSOD323-TxxC-DSL-Q	SMAJ-Q	SMBJ-Q	SMCJ-Q	SMLJ-Q	5.0SMDJ-Q	SM8SF33CA-Q
Package								
Package Type	SOT-23	SOD323	DO-214AC (SMA)	DO-214AA (SMB)	DO-214AB (SMC)	DO-214AB (SMC)	DO-214AB (SMC)	0.41" x 0.32"
Peak Pulse Power (Watt) (10/1000 µs)	-	-	400	600	1500	3000	5000	7000
Peak Pulse Current (A) (10/1000 µs)	8 (8/20µs)	11 / 6 (8/20µs)	20.1 ~ 4.3	30.2 ~ 6.5	75.4 ~ 16.1	150.6 ~ 32	252 ~ 72.1	132
Stand-Off Voltage (V)	24	12 / 24	12 ~ 58	12 ~ 58	12 ~ 58	12 ~ 58	12 ~ 43	33
Breakdown Voltage (V)	26.2	13.3 / 26.7	13.3 ~ 64.4	13.3 ~ 64.4	13.3 ~ 64.4	13.3 ~ 64.4	13.3 ~ 47.8	36.7

ChipGuard[®] ESD Suppressor Product *Using Air Gap*



- Air Gap technology fabricated in surface mount devices (SMD, 0603 / 0402 chip type)
- Designed by air space discharge technology; provides bidirectional protection

Bourns Automotive Approved ESD Protectors

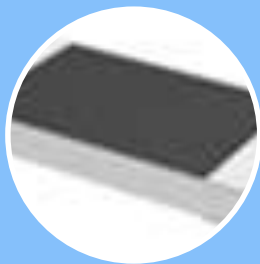
Part Number	Working Voltage (V)	ESD Rating	BreakDown Voltage	Capacitance	Clamping Voltage(V)
CG0603MLC-05E	5	8KV Contact, 15KV Air	250V	0.5pF	25
CG0603MLC-12E	12	8KV Contact, 15KV Air	250V	0.5pF	25
CGA0402MLC-05E	5	8KV Contact, 15KV Air	300V	0.2pF	30
CGA0402MLC-12E	12	8KV Contact, 15KV Air	300V	0.2pF	30
CGA0402MLC-24E	24	8KV Contact, 15KV Air	300V	0.2pF	30
CGA0603MLC-05E	5	8KV Contact, 15KV Air	300V	0.2pF	30
CGA0603MLC-12E	12	8KV Contact, 15KV Air	300V	0.2pF	30
CGA0603MLC-24E	24	8KV Contact, 15KV Air	300V	0.05pF	30

Bourns' current sensing resistor technologies



Thick film

10m~1Ω
0201~2512
up to 2W
100 – 400 ppm/°C
CR, CRL, CRM



Metal Foil

5~200mΩ
0402~2512
up to 2W
100 ppm/°C
CRG



Metal Strip

1~150mΩ
0402~2512
up to 3W
50 ppm/°C
CRE, CRA, CRF, CST



EB- welded Metal Strip

0.1~5mΩ
2512~ 5930 – 8515 (M)
up to 10-30 W
50 ppm/°C
CSS, CSM

Higher
Power
Quality
Price

Lower
Resistance
TCR



CSM2F8536-32



CSM2F-7036



BMS shunt with molding










CSM2F-8518

Bourns® Current Sense Resistors

Model	Photo	Type	Features / Applications	Power Ratings (W)	Size or Package	Tolerance (%)	Resistance Range (Ohms)	Temperature Coefficient (PPM/°C)
CRA		Metal Strip	High Power, Low Ohmic Low TCR, Low EMF, Current Sense, Input Amplifiers, AEC-Q200 Compliant	3	2512	1, 5	0.01 to 0.1	50
CRE		Metal Strip	High Power, Low Ohmic Low TCR, Low EMF, Current Sense, Input Amplifiers, AEC-Q200 Compliant	2, 3	2512	1	0.001 to 0.009	50
CRF		Metal Strip	High Power, Low Ohmic Low TCR, Low EMF, Current Sense, Input Amplifiers, AEC-Q200 Compliant	0.5 to 2	0805 to 2512	1, 5	0.001 to 0.05	50
CST		4-Terminal Metal Strip	High Power, Low Ohmic, Current Sense, Input Amplifiers, AEC-Q200 Compliant	1	0612	1	0.0005 to 0.002	100/200
CRL		Thick Film	Low Ohmic, Current Sense	0.1 to 1	0603 to 2512	1, 5	0.02 to 9.1	200/400/600
CRM (A)		Thick Film	High Power, High Pulse Rating Current/Voltage Sense, Power Supply, Snubber, A- Automotive, AEC-Q200 Compliant, Sulfur Resistant	0.125 to 2	0603 to 2512	1, 5	0.047 to 1M	100 to 250
CSS2H-2512		Metal Element	High Power, Low Ohmic, Low TCR, Low EMF, Current Sense, Battery Management, Power Supply, AEC-Q200 Compliant	2 to 6	2512	1, 5	0.0003 to 0.005	≤ 50
CSS2H-3920		Metal Element	High Power, Low Ohmic, Low TCR, Low EMF, Current Sense, Battery Management, Power Supply, AEC-Q200 Compliant	3 to 12	3920	1, 5	0.0002 to 0.005	≤ 50
CSS2H-5930		Metal Element	High Power, Low Ohmic, Low TCR, Low EMF, Current Sense, Battery Management, Power Supply, AEC-Q200 Compliant	4 to 15	5930	1, 5	0.0002 to 0.003	≤ 50
CSS4J-4026		4-Terminal Metal Element	High Power, Low Ohmic, Low TCR, Low EMF, Current Sense, Battery Management, Power Supply, AEC-Q200 Compliant	3 to 5	4026	1, 5	0.0002 to 0.005	≤ 50
CSM2F		Metal Element	High Power, Low Ohmic, Low TCR, Low EMF, Current Sense, Battery Management, Power Supply, AEC-Q200 Compliant	36 & 50	6918, 7036, 8515	5	50 μΩ & 100	50
PWR4412		Through-Hole Open Air Shunt	Current Sense, High Current, High Temperature	1, 3, 5	11.43 x 7.62 to 20.32 x 26 (mm)	1, 5	0.005 to 0.1	20

Current Sense Resistors for Automotive

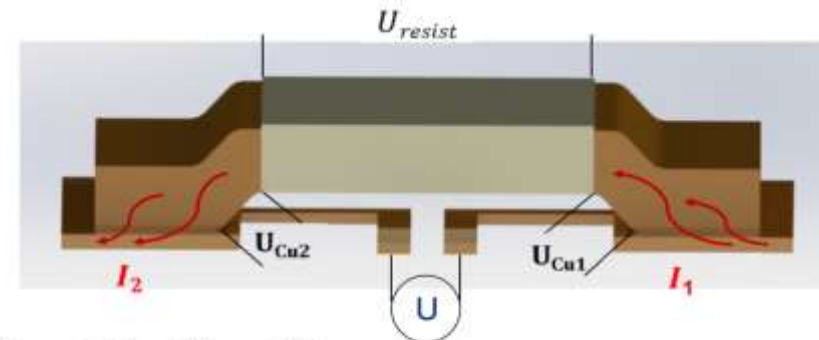
Resistor Family	Image	Maximum Current	Voltage Drop at Maximum Current
CST0612		44.7A	22.3mV
CRE2512		55.0A	50.0mV
CSS2H-2512		140A	42.4mV
CSS2H-3920		245A	49mV
CSS2H-5930		126.5A	63mV
CSS4J-4026R		100A	50mV
CSM2F-7036		1000A	50mV

- Custom Shapes also Available



- Applications

- Converters (eg 48 to 12V bidirectional)
- Battery Management Systems



$$U_{\text{sense}} = U_{\text{Cu1}} + U_{\text{resist}} + U_{\text{Cu2}}$$

- 铜端子引线电阻对测量结果影响极小
- 电路板信号采样布局实现四端子测量

Application overview

- Application of Circuit

Function	Product type	Resistance range	Rating Power	BOURNS Model
Over Current Protection (OCP)	Current Sensing Resistors (CSR)	1mΩ ~ 910mΩ	0.5W ~ 50W	CRA 2512 CRE 2512 CRF 0805/1206/2512 CRK 0612/1225/0815 CST 0612/1225 CRL 0402/.../2512 CSS 2512/..5930 CSM 6918/7036/8518
Over Voltage Protection (OVP)	Precision Resistor	1Ω ~ 1MΩ	0.01%/../0.5%	CRT, CRT-AS 0402/.../2512
Starting	Safety Certified High Voltage Resistor	100kΩ ~ 22MΩ	0.25W ~ 1W	CHV 0603/.../2512
Current Limiting	High Power Resistor	1Ω ~300Ω	0.25W ~ 2W	CRM 0603/.../2512
	Surge Resistor	1Ω ~300Ω	0.25W ~ 2W	CRS 0603/.../2512

Fixed Resistor Automotive portfolio



Metal Strip Chip



CRA Series
CRE Series
CRF Series



0805 – 2512
0,5 – 3W
1 – 100 mΩ



CST 0612 Series
(4 Terminal)

- AEC-Q200 qualified
- Battery control
- Capacitor discharging
- Climate controls
- Converters

High Power Thick Film



PWR163/263 Series
PWR220/221
/247Series



SMT DPAK/TO220
25 – 100 W
20 mΩ – 130 kΩ

- Current sensing
- Electric/hybrid vehicles
- Engine control units
- Multimedia
- Power steering
- Lighting
- Navigation

Thick Film Network



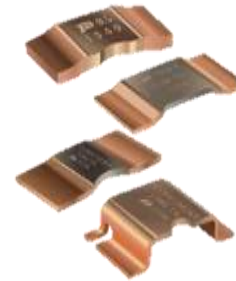
4800P Series
SMT, DIP
Medium Body

Anti Sulfur Thick Film Chip



CRM-A Series
CRS-A Series
0.125 – 2 W
0,05 mΩ to 1MΩ

EB-welded Metal Strip



CSS Series
2512, 3920, 5930
4026 (4 Terminal)
2 – 12 W
0,2 – 5 mΩ

Park Sensor Transformer



Features:

1. Good Transmission performance, without distortion
2. Small footprint and low profile design (7*7.8*7.8mm);
3. Magnetic shield design;
4. Big turn ratio;
5. Automatic production line;
6. Tape & reel packaging for SMT pick and place process ;

Application:

Park Sensor

Current customers:

Valeo

Potential customers:

Bosch, Hella



Type	Operation Voltage	Turns ratio	Current	Weight
EP6	12~24V	1:1~200	100mA Max.	3g

Antenna



Features:

This inductor is a stronger solution and performing very good electrical properties, and very good solution for PEPS, Keyless Go and Keyless entry systems;

Application:

1. Emitter antennas for automotive; PEPS.

Current customers:

No mass production

Potential customers:

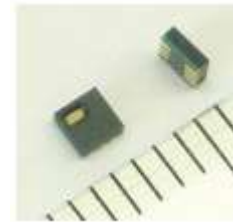
Marquardt, Lear, Delphi, Valeo

Type	Frequency	Inductance range	SRF	Size
Emitter antenna	20K~134KHz	100uH~500uH	>3MHz	Custom
TPMS	20K~134KHz	100uH~9mH	>0.4MHz	Custom

Humidity Sensing – BPS230 Bourns Humidity Sensor

Proven reliability with high performance components for Relative Humidity sensing in Consumer, Medical, and Industrial applications

- Accuracy: $\pm 3.0\%$ RH
- Operating Range: 0 to 100% RH
- Temperature range: -30°C to 100°C
- Supply Voltage Range: 1.62 – 5.5 VDC
- Output: Digital – I2C – Temperature and Relative Humidity
- Benefits: Reliability, low current



BOURNS

Features

- Low voltage operation
- Low current consumption
- Miniature SMD package size
- I²C communication protocol
- Established reliability
- RoHS compliant*

Applications

- Industrial:
- HVAC systems
 - Process monitoring
 - Packaging Automation
- Medical:
- Diagnostic equipment
 - Analysis equipment

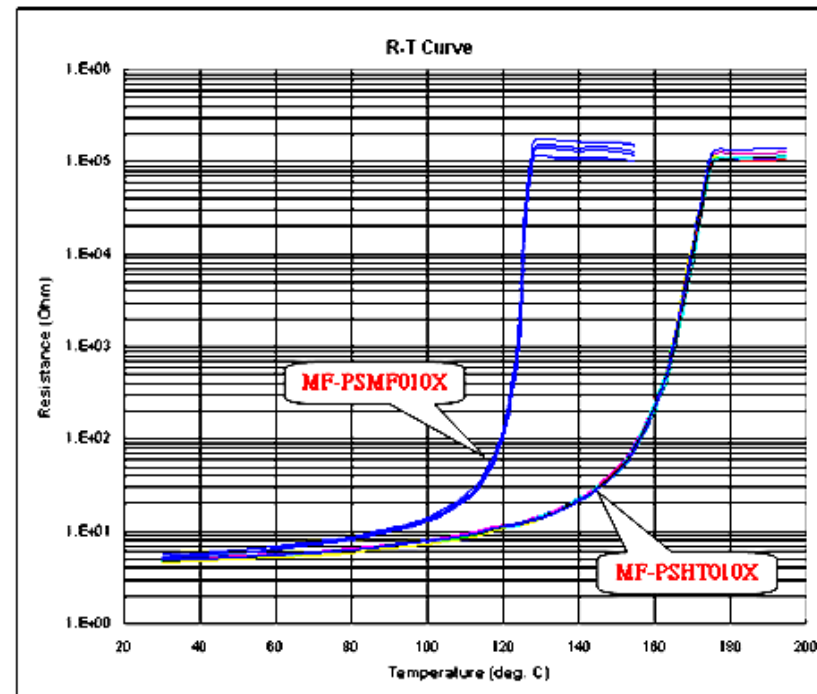
BPS230 Series – 2 mm Humidity Sensor

PTC in Rear view Cameras

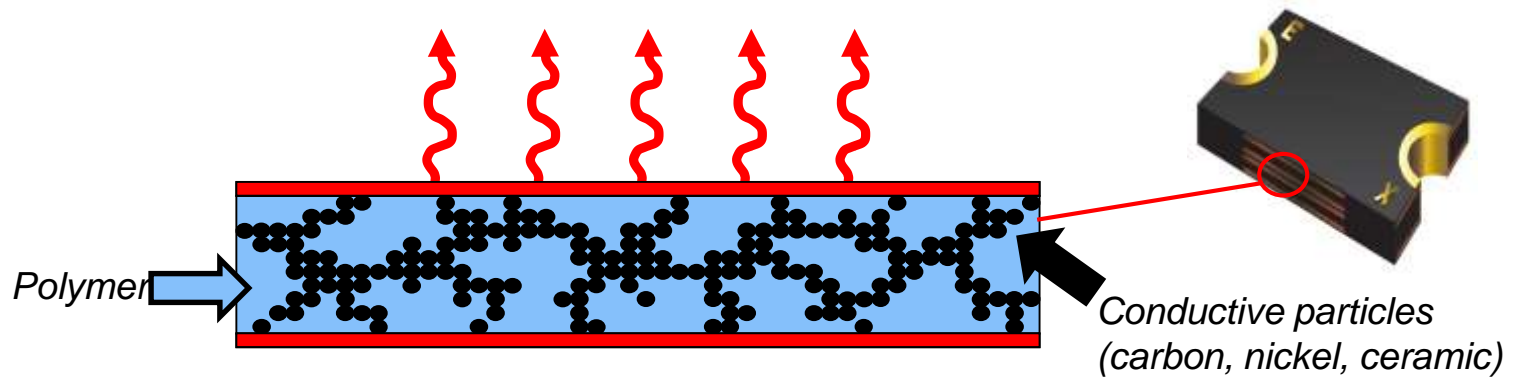
- Background :
 - Cameras using CMOS technology typically run very hot, 95 °C or 100°C
 - This rules out many standard PTCs (e.g. MF-PSMF010X),
- Solution :
 - NEW MF-PSHT010X
 - Use freeXpansion SMD design, 0805 size
 - Uses High temperature material
 - Operates up to 125°C



MF-PSHT010X & MF-PSMF010X R-T curve comparison



PTC Self-Regulating Heaters



Heats at the rate of I^2R – reaches thermal equilibrium in tripped state

- Traditional PTC use is as an overcurrent protection or overtemperature protection in electronic circuits
- Their material characteristics allow the device to react to overheating events, meaning the material is a self-regulating heater
- Ceramic PTCs have been used for self-regulating heating for years but polymer PTCs can also be used

Automotive Ceramic PTC Heaters



Thank you!

BOURNS®