

Power design for automotive PCB board – V.1

Specification:

Input (Automotive)

- Voltage – 12V [Min 10V / Max 14V (Full charge) / On Load 18V (Observed)]

Output

- Voltage - 5V
- Current - 2A (Continuous Current)

Points to consider:

1. Reverse polarity Protection
2. TVS diode [Transient Voltage Suppression]
3. External fuse (2A Blow fuse / NTC PTC)
4. Isolation
5. Power supply Filter

1)

a) TI IC [here](#)

b) **Diode Protection**

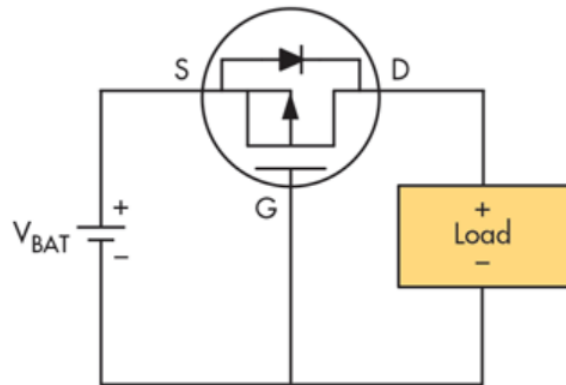


Eg . SK16 Schottky Diode with Reverse Voltage 60V and Forward Rectified Current 1A [Used in infoTrack]

Issue – Power loss [Heat Dissipation] and forward voltage drop - **Need to Test it**

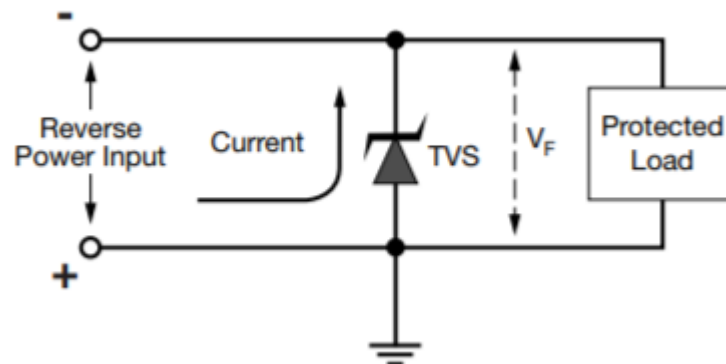
c) MOSFET Protection

Low $R_{ds(on)}$ will generate less heat.

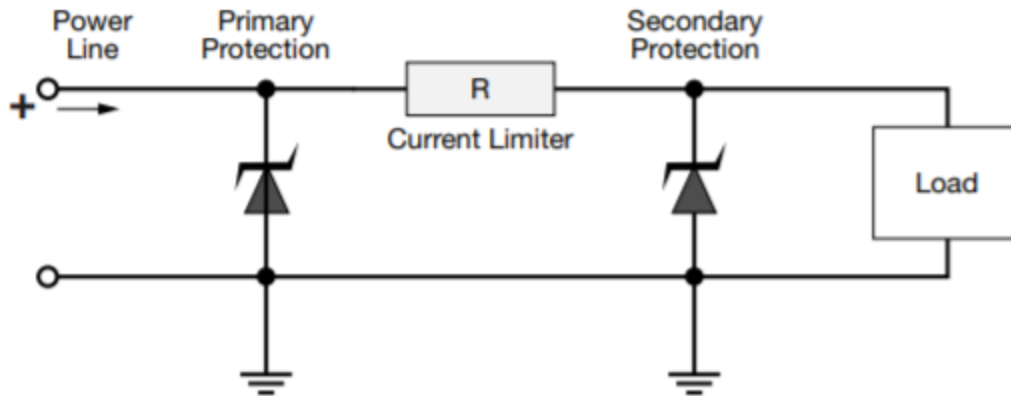


2) TVS

Reverse Bias Status- Standard TVS working model



Voltage and Current protection (Recommended for 24V system eg Trucks and Buses)



Diode Parameter for 12V system:

Parameter	12V system	24V system
U_s	65v to 87V	123V to 174V

Can procure VISHAY or Little Fuse TVS

diode for 12V battery.

Definition-

- **Load dump** means the disconnection of a powered load. It can cause 2 problems:

1. Failure of supply to equipment or customers
2. Large voltage spikes from the inductive generator(s)

In automotive electronics, it refers to the disconnection of the vehicle battery from the alternator while the battery is being charged. Due to such a disconnection of the battery, other loads connected to the alternator see a surge in power line.

- **Breakdown voltage(V_{BR}):** This is a threshold. If the voltage that is being monitored reaches this value, the TVS will turn on (decreasing its resistance) and driving to GND the overvoltage detected.
- **Clamping voltage:** When the breakdown voltage is reached, the TVS goes to its on state and it will try to clamp the voltage to this value (clamping voltage). While the TVS is trying to do this, it will be responsible of absorbing (drive to GND) all the current that is generated due to the difference of voltages
- **Maximum Peak Pulse Current:** This is the maximum current capacity that the TVS can drive before failing due to excessive heat dissipation.

- **“Dark current”** refers to current consumed by various load devices which use battery power even after the vehicle has been powered off.

3) External fuse (2A Blow fuse / NTC PTC)

- Automotive Standard Fuse - 2A
- PPTC (Polymeric Positive Temperature Coefficient) - 2A

4) Isolation

Reference Link - [here](#)

Forum Link [here](#)

5) Power supply Filter - Reduce the level of switching noise or ripple from a DC-DC converter

Fig.1 DC-DC output noise filtering

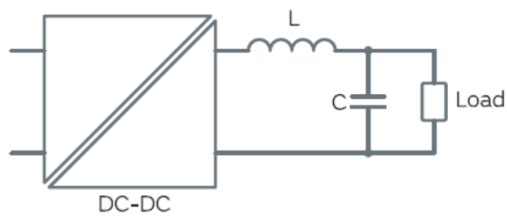


Fig.3 Input noise filter to avoid instability

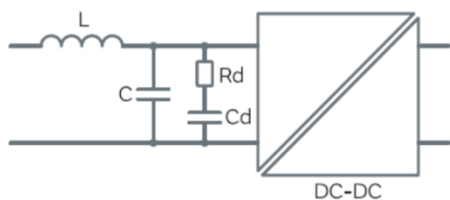
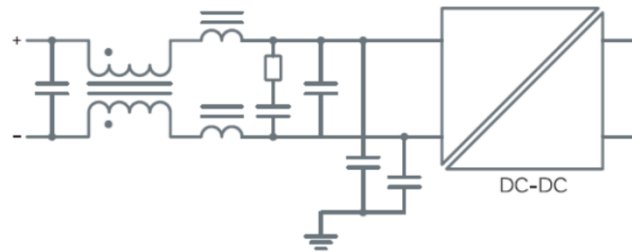
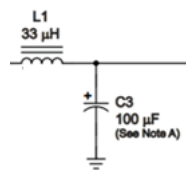


Fig.4 Comprehensive DC-DC input noise filter



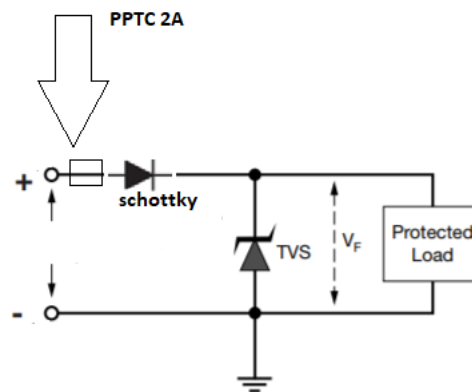
Note:

We have LC filter at output of BUCK converter.



[The inductor and the capacitor both are used to store and release energy during each switching cycle]

Conclusion:



Note: We will add 2A automotive external fuse.

Testing:

- 1) Selection of TVS diode with clamping voltage of 40V for 12V system and 60V in 24V system.
- 2) Selection of DC – DC Regulator (LDO/Buck)- [Test Pass](#)
- 3) Schottky Diode- SS16- [Test Pass](#)
- 4) Complete Testing

Note:

TVS Diode specification- SMBJ24 A - Testing

Part Number	Reverse Standoff V	Breakdown Voltage		Test Current	Max. Reverse Leakage	Max. Clamping Voltage	Peak Pulse Current
1	VRWM(V)	Min (V)	Max (V)	IT(mA)	IR (μA)	VC (V)	(A)
SMBJ24 A	24	26.7	30.7	1	5	38.9	15.4

Schottky Diode- SS16 – Testing Done

1	Maximum Recurrent Peak Reverse Voltage	60V
2	Maximum RMS Voltage	42V
3	Maximum DC Blocking Voltage	60V
4	Maximum Average Forward Rectified Current @ TA = 75C	1A
5	Peak Forward Surge Current 8.3 ms single half sine-wave	25A
6	Maximum DC Reverse Current at Rated @ TA = 25C DC Blocking Voltage @ TA = 100C	0.5A 1A

Requirement :

DC-DC Buck converter with

- Low IQ (<100 μA)
- Low Noise
- Low EMI (Electromagnetic Interference)
- High Load Dump Voltage
- Continuous 1A / 2A current output with High switching frequency
- Output voltage range
- Over-current protection