

Optimized Low-Clamping FlatSuppressX™ TVS Diode for 48 V Automotive Applications, ISO 21780 Compliant

Overview

For 48 V automotive power rails, TVS diodes are used to clamp transient overvoltage events. Under ISO 21780 test conditions, the rail may be subjected to both sustained overvoltage and short-duration surge events, including load-dump-type transients.

Additionally, abrupt MOSFET turn-off in combination with wiring harness inductance can generate voltage spikes that may exceed the device's limits. To ensure reliable operation, either the power converter or front-end IC must tolerate these overvoltage conditions, or a pre-regulator or active protection circuit should be implemented.

The TP5.0SMD-FL (5 kW) and TP1KSMB-FL (1 kW) FlatSuppressX™ TVS diode series are designed to protect 48 V automotive power rails from transient overvoltage events. These devices provide low and well-controlled clamping behavior and are characterized to support ISO 21780-defined test conditions.



Features

- FlatSuppressX™ TVS provides superior surge protection, maintaining a flat and lower clamping voltage through its advanced foldback I-V characteristics
- 5 kW surge capability in SMC package (TP5.0SMD-FL) and 1kW surge capability with SMB package (TP1KSMB-FL)
- AEC-Q101-qualified, PPAP capable and in compliance with ISO 21780

Benefits

- The advance FlatSuppressX™ TVS offers a near-constant and low clamping profile under fast transient and high-energy overvoltage conditions while avoiding the latch-up risk
- It allows designers to implement lower voltage-rated components like MOSFET or power IC and reduce the total system BOM costs.

Table 1. Clamping comparison between conventional 5 kW TVS and FlatSuppressX™ TVS TP5.0SMD-FL

Other Automotive 5 kW SMCTVS	Reverse Stand off Voltage V_R (V)	Breakdown Voltage $V_{BR} @ I_T$ (V)		Maximum Clamping Voltage $V_C @ I_{PP}$ (V)	Maximum Peak Pulse Current I_{PP} (A)	Test Current I_T (mA)
		Min	Max			
xxxSMD60CAxx	60	66.70	73.70	96.8	51.7	1
xxxSMD64CAxx	64	71.10	78.60	103.0	48.6	1
Part Number (FlatSuppressX™ TVS)	Reverse Stand off Voltage V_R (V)	Breakdown Voltage $V_{BR} @ I_T$ (V)		Maximum Clamping Voltage $V_C @ I_{PP}$ (V)	Maximum Peak Pulse Current I_{PP} (A)	Test Current I_T (mA)
		Min	Max			
TP5.0SMD60CA-FL	60	66.70	73.70	78.6	77.7	1
TP5.0SMD60CA-FL	64	71.10	78.60	81.4	80.5	1

The TP5.0SMD-FL Series provides up to 5000 W peak pulse power capability in a DO-214AB (SMC) package. At the same time, the TP1KSMB-FL Series delivers 1000 W in a compact DO-214AA (SMB) package. By combining high surge capability with ultra-low clamping voltage, the TP5.0SMD-FL and TP1KSMB-FL Series help engineers design more robust, efficient, and cost-effective automotive electronics platforms.

Figure 1. Target Applications

- Automotive 48 V systems (ISO 21780 compliant)
- Battery Disconnect Units (BDUs)
- Zone Control Units (ZCUs)
- Electric Power Steering (EPS) systems
- DC/DC converters and power distribution networks

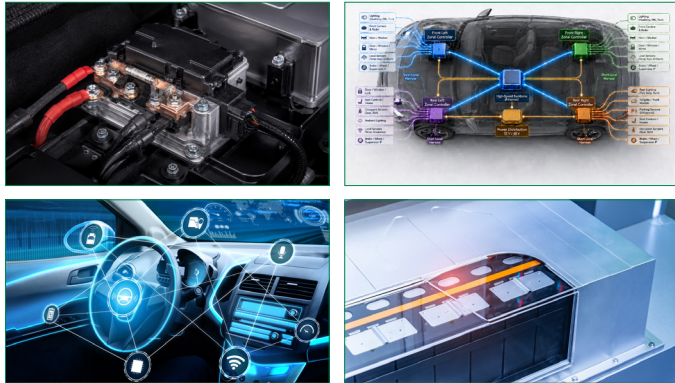


Figure 2. FlatSuppressXTM TVS Diode Transients Clamping Waveform

FlatSuppressXTM devices leverage an advanced foldback/snapback I-V characteristic to tightly control transient response while avoiding latch-up risk. This approach enables the use of lower voltage-rated components, improving design flexibility and cost efficiency.

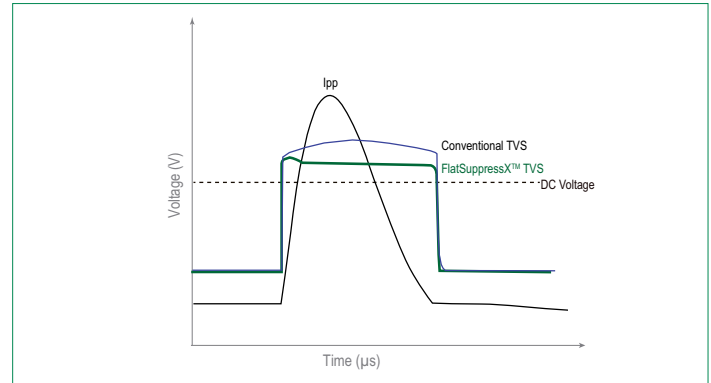
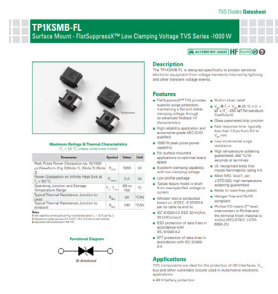
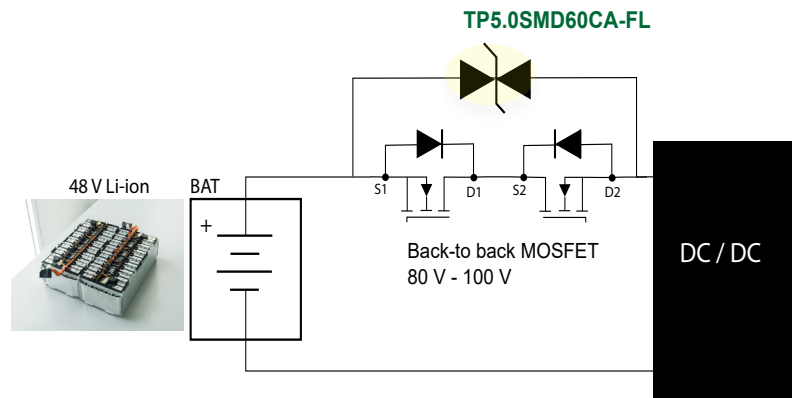


Figure 3. 48 V Battery Disconnect Unit (BDU) Application Example

In this example, instead of using 3 conventional TPSMD-18CA TVS, only 1 TP5.0SMD60CA-FL TVS is applied for this 48 V battery disconnect unit protection. This approach also allows designers to use a lower voltage MOSFET instead of a higher-voltage alternative, reducing component costs, saving valuable PCB space and simplifying the circuit design.



For more information about [TP5.0SMD-FL](#) and [TP1KSMB-FL](#), please reference the product datasheet on Littelfuse.com.