

Transient Voltage Suppressors (TVS)

SM8Z Series for Automotive Electronic Protection

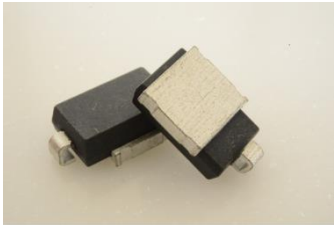
Working Voltage: 10 to 43 V Peak Pulse Power: 6600 Watt

Introduction

With the vigorous growth of the automotive market, more the advanced automotive electronics and systems are gradually being installed into automotive systems. The regulations on automotive electronics are strict more and more, including the ISO 26262 [1] related to the functional safety of vehicles, AEC-Q101 [2] specification related to reliability, TS-16949 [3] specification related to product quality, and the ISO 7637 [4] specification related to electromagnetic compatibility issues. All regulations are kept updated in order to ensure the functional safety of vehicles.

Among them, in terms of electromagnetic compatibility issues for vehicle protection components, the specification of load dump surge used to be based on ISO 7637-2 pulse 5a. However, the International Organization for Standardization had pronounced and replaced the ISO 7637-2 pulse 5a with the new specification, ISO 16750-2 pulse 5a [5], since 2010. The purpose is to provide better protection components by more stringent conditions of load dump surge test. The document of “Transient Voltage Suppressors (TVS) for the Automotive Electronics Protection”[6] introduces the TVS diode characteristic, the automotive electronics applications, the causes of load dump and the specifications of ISO 7637-2. And, we analyze the capability of TVS-SM8Z products withstanding load dump surge. For this report, we further evaluate the capability of TVS-SM8Z products by ISO 16750-2 pulse 5a specifications.

Materials

Part Number	VB(V)@IT=5mA	IR(uA)@VR	VR(V)	Sampling	Appearance
SM8Z18A	20.0~22.1	10	18	5	
SM8Z24A	26.7~29.5		24		
SM8Z28A	31.1~34.4		28		
SM8Z30A	33.3~36.8		30		
SM8Z33A	36.7~40.6		33		
SM8Z43A	47.8~52.8		43		

Instrument

EMTEST-LD 200N^[7]



Figure 1、LD 200N

Test condition

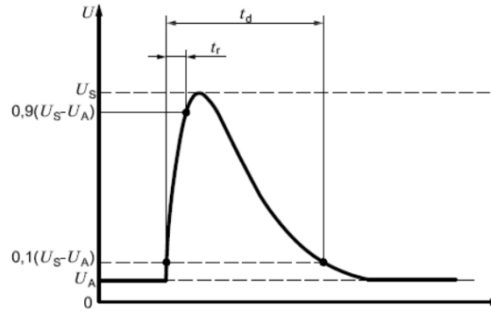
Load Dump Test		
Specification	12V-system	24V-system
Us (V)	87	174
Ua (V)	14	27
tr/td (ms)	10/400	10/350
Ri (Ω)	2→1	5→4
Pulse	10	
Interval (sec)	60	

Specification comparison: ISO 7637-2 5a and ISO 16750-2 5a

The following table is to compare the differences between ISO 16750-2 5a and ISO 7637-2 5a:

Load Dump Test				
Specification	12V-system		24V-system	
	ISO 7637-2 5a	ISO 16750-2 5a	ISO 7637-2 5a	ISO 16750-2 5a
Us (V)	65 ≤ Us ≤ 87		123 ≤ Us ≤ 174	
Ua (V)	14		27	
Tr (ms)	10		10	
td (ms)	400		350	
Ri (Ω)	0.5 ≤ Ri ≤ 4		1 ≤ Ri ≤ 8	
Pulse (#)	1	10	1	10
Interval (sec)	-	60	-	60

Table 1、The comparison between ISO 7637-2 5a and ISO 16750-2 5a specifications.



Key
 t time
 U test voltage
 t_d duration of pulse
 t_r rising slope
 U_A supply voltage for generator in operation (see ISO 16750-1)
 U_S supply voltage

Figure 2 、 ISO 16750-2 pulse 5a [5]

Results

【12V-System】

Test conditions : 10/400ms, $U_S=87V$, $U_A=14V$, 10 pulses, interval=60 sec, Sampling=5 pcs

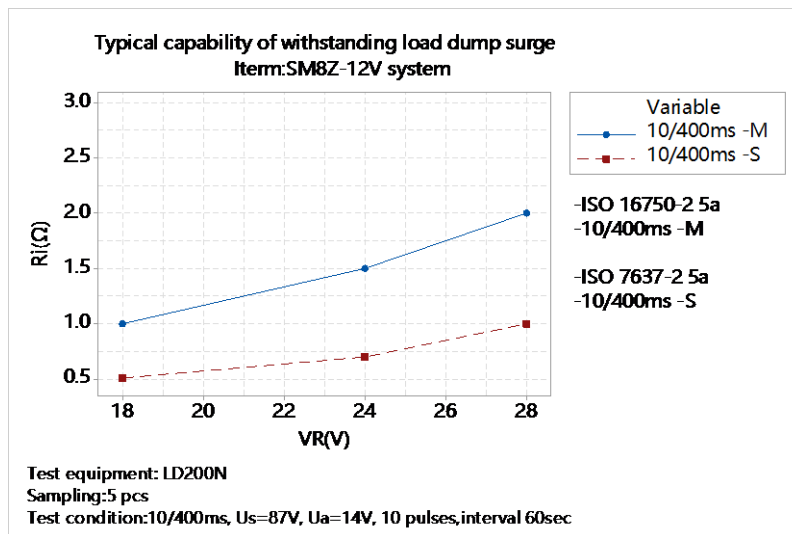


Figure 3 、 The testing result of load dump surge in SM8Z 12V-system products.

The figure 4 showing the clamping voltage of 12V-system products is 36.4V after load dump test.

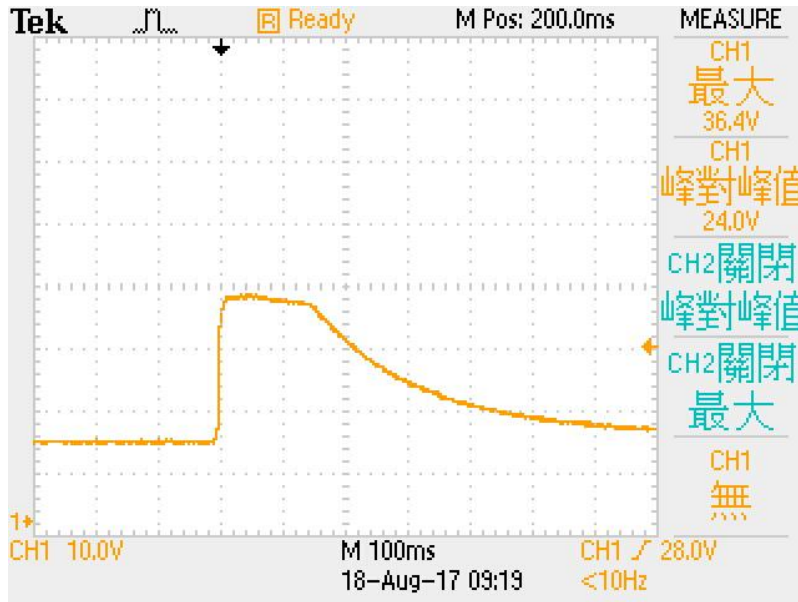


Figure 4 、 The clamping voltage of 12V-system products.(scale:10V/division)

【24V-system】

Test conditions : 10/350ms, Us=174V, Ua=28V, 10 pulses, interval=60 sec, Sampling=5 pcs

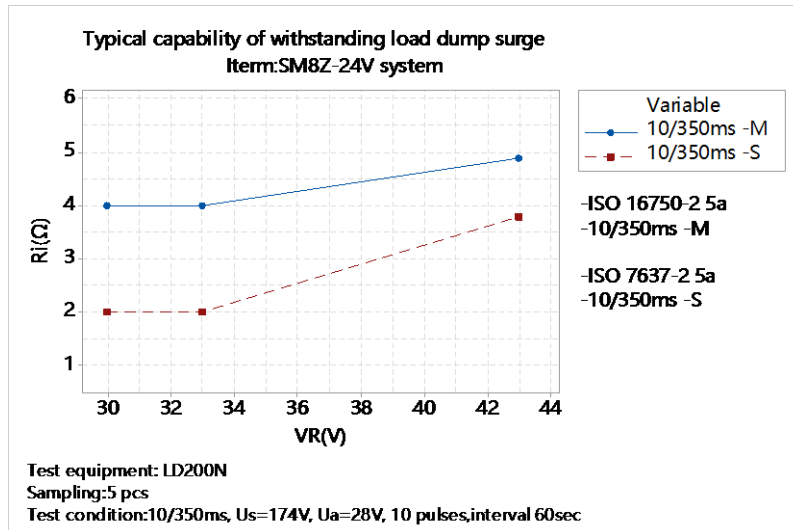


Figure 5 、 The testing result of load dump surge in SM8Z 24V-system products.

The figure 6 showing the clamping voltage of 24V-system products is 45.6V after load dump test.

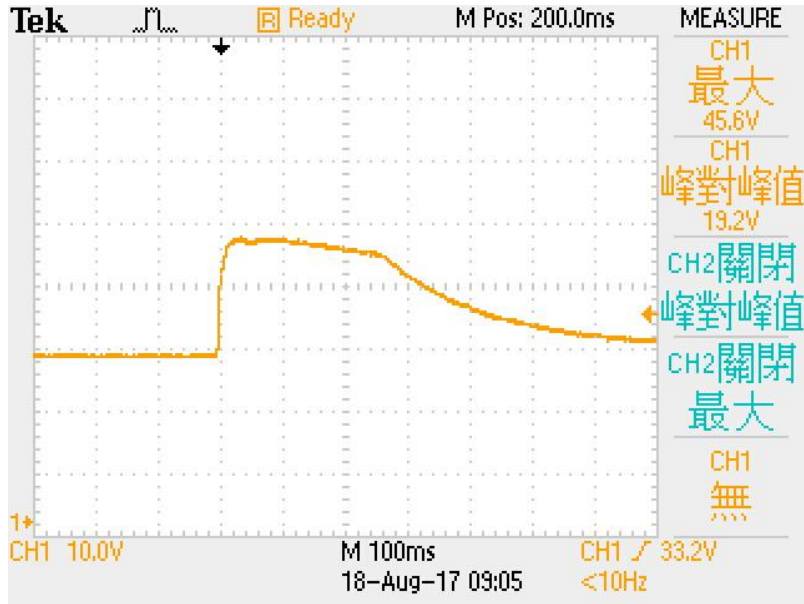


Figure 6 · The clamping voltage of 24V-system products.(Scale:10V/division)

Conclusion:

Due to the rapid growth of the automotive market, the demand for automotive electronics has gradually increased. Coupled with the increase in the precision of automotive electronic components, the tolerance for withstanding current noise is smaller. As the result, the requirements for protection products will be improved. The specification for load dump protection has been changed from ISO 7637-2 pulse 5a to ISO 16750-2 pulse 5a. It specifies the more stringent conditions to test products in order to improve the protection of automotive systems.

The TVS-SM8Z series with high reliability have passed the AEC- Q101 specification. The products not only can pass the test of ISO 7637-2 5a but also can show the excellent protection performance to ensure the function of vehicle system under ISO 16750-2 5a specification.

References

1. ISO 26262, Functional Safety Draft International Standard for Road Vehicles: Background, Status, and Overview.
2. AEC-Q101-Rev-D1: Failure mechanism based stress test qualification for discrete semiconductors in automotive applications, *Automotive Electronics Council, Component Technical Committee*.
3. TS-16949, Automotive Quality Management.
4. ISO 7637-2: [Road vehicles -- Environmental conditions and testing for electrical and electronic equipment -- Part 2: Electrical loads](#).
5. ISO 16750-2: [Road vehicles -- Environmental conditions and testing for electrical and electronic equipment -- Part 2: Electrical loads](#).
6. Transient Voltage Suppressors (TVS) for Automotive Electronic Protection, William Yang.
7. EMTEST LD200N: <http://www.emtest.com/zh/home.php>.
8. ANOVA-KA series:
<http://www.anova-semi.com/i/assets/file/product/79df8f5258aa415fc6baecc739095239.pdf>

For more information contact:

Anova Technologies, Co., LTD.

Tel: +886-426819555 ext.50

E-mail: annalee@anova-semi.com



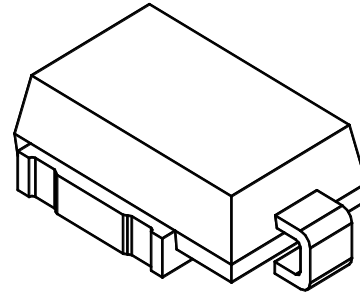
Working Voltage: 10 to 43 V

Peak Pulse Power: 6600 W

Surface Mount Transient Voltage Suppressors

Features

- Optimized glass passivated chip
- $T_J = 175\text{ }^\circ\text{C}$ capability suitable for high reliability and automotive requirement
- 6600 W peak pulse power capability with a 10/1000 μs waveform, repetitive rate (duty cycle):0.01 %
- Meet ISO 7637-2 5a/5b and ISO 16750 load dump test (varied by test condition)
- AEC-Q101 qualified
- Low leakage current
- Low forward voltage drop
- Uni-directional polarity
- Excellent clamping capability
- Very fast response time
- RoHS compliant



DO-218AB

Mechanical Data

- Case: DO-218AB
- Molding compound: UL94V-0 flammability
- Polarity: Heatsink is anode

Maximum Ratings($T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak power dissipation with a 10/1000 μs waveform ⁽¹⁾	P_{PP}	6600	W
Peak power dissipation with a 10/10,000 μs waveform	P_{PP}	5200	W
Peak pulse current with a 10/1000 μs waveform ⁽¹⁾	I_{PP}	See Next Table	A
Power dissipation on infinite heatsink at $T_L = 25\text{ }^\circ\text{C}$	P_D	8.0	W
Peak forward surge current 8.3 ms single half sine-wave	I_{FSM}	700	A
Operating junction and storage temperature range	T_J, T_{STG}	- 55 to +175	$^\circ\text{C}$

Note:

(1)Non-repetitive current pulse per Fig.2 and derated above $T_A=25\text{ }^\circ\text{C}$ per Fig.1

Ratings and Characteristics Curves ($T_A=25^\circ\text{C}$ unless otherwise noted)

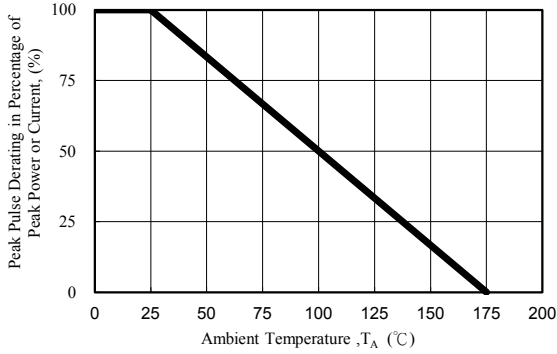


Fig. 1 - Pulse Derating Curve

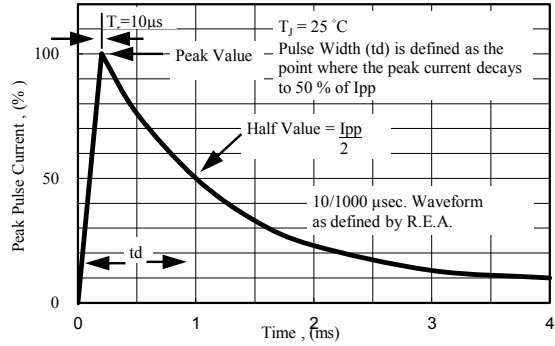


Fig. 2 - Pulse Waveform

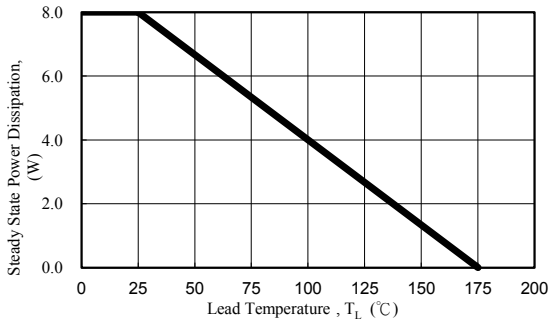


Fig. 3 - Steady State Power Derating Curve

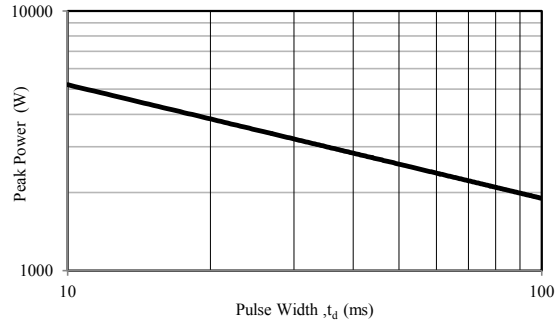
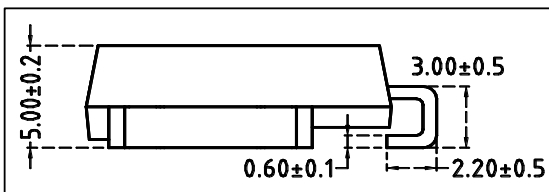
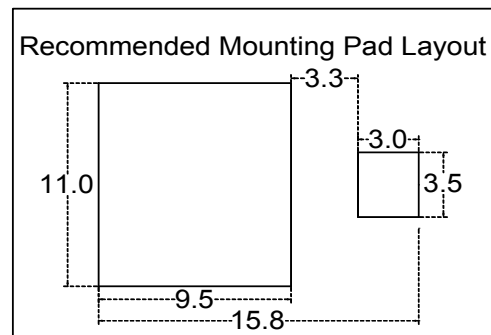
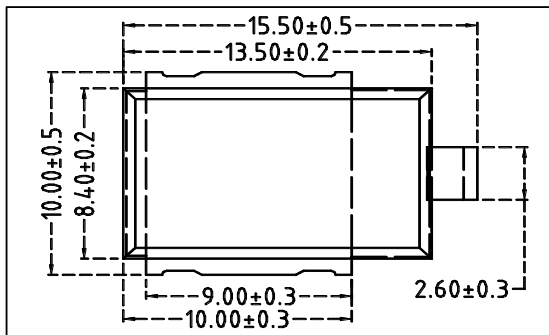
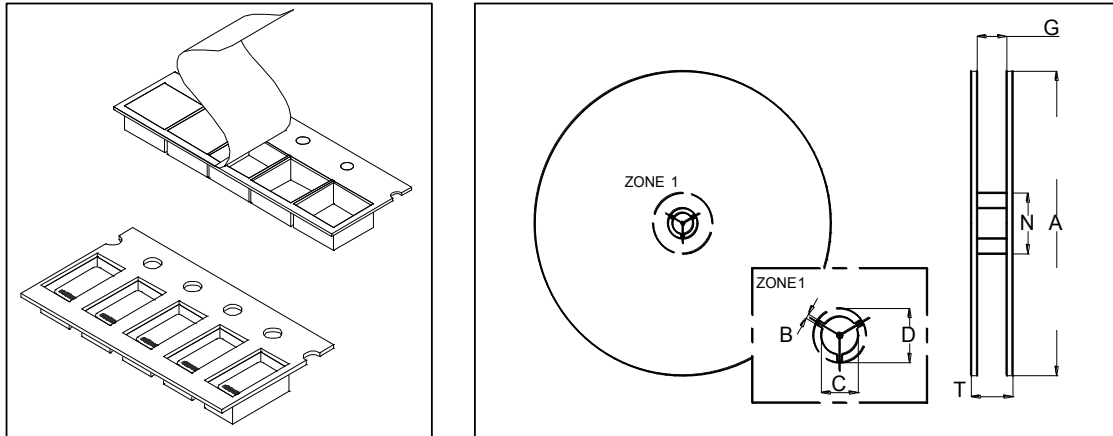


Fig. 4 - Peak Pulse Power Rating Curve

Package Outline Dimensions (millimeters)



Surface Mount Tape and Reel Packaging



Dimensions in Millimeters (inches)

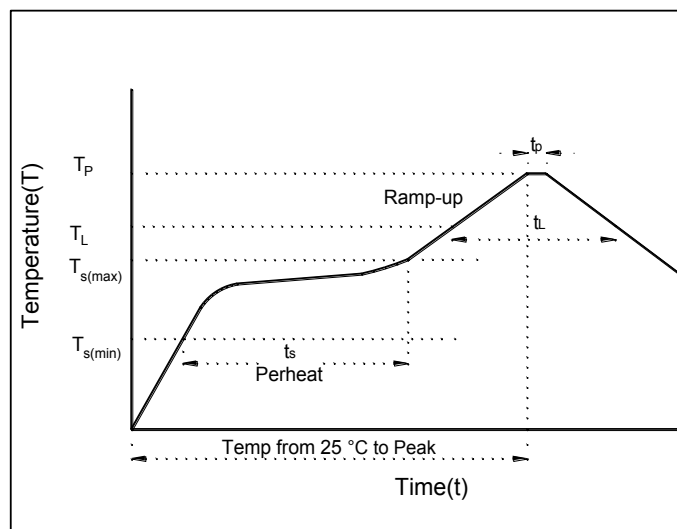
TAPE SIZE	A MAX.	B MIN.	C	D MIN.	N MIN.	G MAX.	T MAX.
24 mm (0.945)	330 ± 2.0 (13.0 ± 0.079) 178 ± 2.0 (7.0 ± 0.079)	1.5 (0.059)	13.5 ± 0.50 (0.53 ± 0.02)	20.2 (0.795)	50 (1.97)	26.4 (1.039)	30.4 (1.197)

Recommended Soldering Parameters

IR-Reflow Condition			
Pre Heat	Temp. min	150	°C
	Temp. max	200	°C
	Time(min to max)	60-180	sec
Ramp up rate (150-200°C)		<3	°C/sec

Reflow	Liquidus Temp.	>220	°C
	Peak Temp.	245	°C
	Time(Liq. to Peak)	60-150	sec
Ramp up rate (220-200°C)		<3	°C/sec
Time within actual peak temp.		10-30	sec

Ramp down Rate		<5	°C/sec
Time(25°C to Peak temp.)		<6	min
Do not exceed		280	°C



Electrical Characteristics($T_A=25^{\circ}\text{C}$ unless otherwise noted)

Part Number (Uni)	Breakdown Voltage V_{BR} @ I_T			Maximum Reverse Leakage I_R @ V_{RWM} (uA)	Maximum I_R @ V_{RWM} $T_J=175$ (uA)	Working Peak Reverse Voltage V_{RWM} (V)	Maximum Reverse Surge Current I_{PP} (A) ⁽¹⁾	Maximum Clamping Voltage V_C @ I_{PP} (V)
	Min (V)	Max (V)	I_T (mA)					
SM8Z10A	11.10	12.30	5.0	15	250	10	388.00	17.0
SM8Z11A	12.20	13.50	5.0	10	150	11	363.00	18.2
SM8Z12A	13.30	14.70	5.0	10	150	12	332.00	19.9
SM8Z13A	14.40	15.90	5.0	10	150	13	307.00	21.5
SM8Z14A	15.60	17.20	5.0	10	150	14	284.00	23.2
SM8Z15A	16.70	18.50	5.0	10	150	15	270.00	24.4
SM8Z16A	17.80	19.70	5.0	10	150	16	254.00	26.0
SM8Z17A	18.90	20.90	5.0	10	150	17	239.00	27.6
SM8Z18A	20.00	22.10	5.0	10	150	18	226.00	29.2
SM8Z20A	22.20	24.50	5.0	10	150	20	204.00	32.4
SM8Z22A	24.40	26.90	5.0	10	150	22	186.00	35.5
SM8Z24A	26.70	29.50	5.0	10	150	24	170.00	38.9
SM8Z26A	28.90	31.90	5.0	10	150	26	157.00	42.1
SM8Z28A	31.10	34.40	5.0	10	150	28	145.00	45.4
SM8Z30A	33.30	36.80	5.0	10	150	30	136.00	48.4
SM8Z33A	36.70	40.60	5.0	10	150	33	124.00	53.3
SM8Z36A	40.00	44.20	5.0	10	150	36	114.00	58.1
SM8Z40A	44.40	49.10	5.0	10	150	40	102.00	64.5
SM8Z43A	47.80	52.80	5.0	10	150	43	95.10	69.4

NOTE:

1. Surge current waveform is defined at 10/1000uS waveform

2. For all types maximum VF = 1.8 V at IF = 100 A measured on 8.3 ms single half sine-wave or equivalent square wave, duty cycle = 4 pulses per minute maximum