Zener Diode Silicon Epitaxial Planar

MSZ series

1. Applications

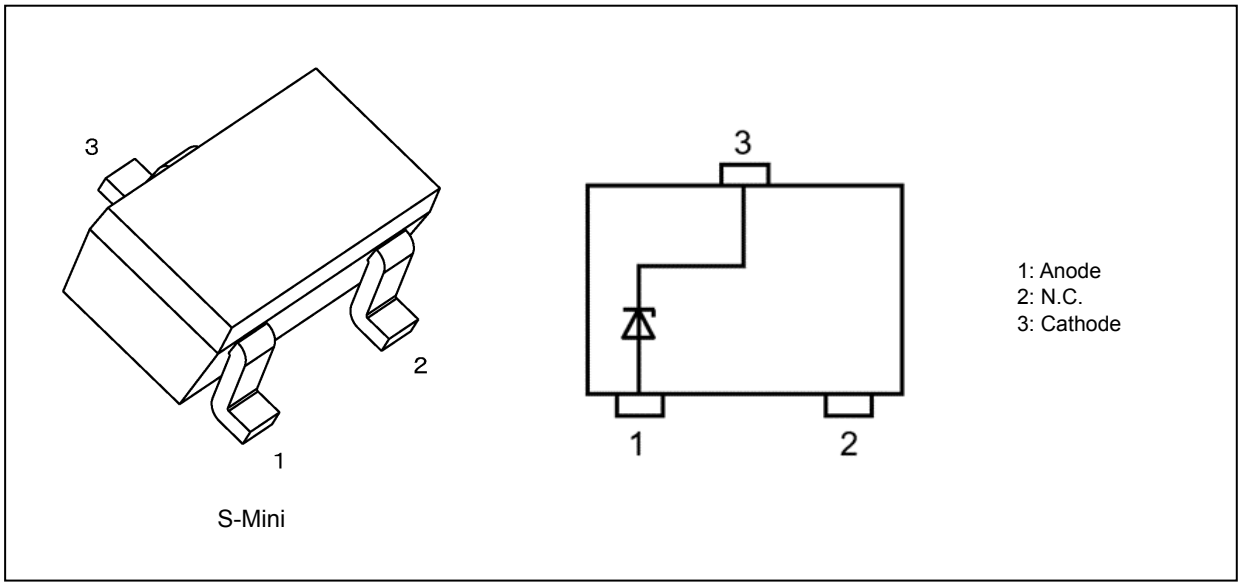
(1) Voltage surge protection

2. Features

(1) Small package

(2) The typical voltage of VZ is accorded to E24 series.

3. Packaging and Internal Circuit



4. Absolute Maximum Ratings 1 (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Rating	Unit
Power dissipation	P_D		200	mW
		(Note 1)	600	
Junction temperature	T_j		150	°C
Storage temperature	T_{stg}		-55 to 150	

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Mounted on a glass epoxy circuit board of 25.4 mm × 25.4 mm × 1.6 mm, Cu pad: 645 mm^2

Start of commercial production
2020-07

5. Absolute Maximum Ratings 2 (Note) (Unless otherwise specified, T_a = 25 °C)

Type No.	Electrostatic discharge voltage (Contact, Air) V_{ESD}(kV) (Note 1)	Peak pulse power P_{PK}(W) (Note 2)	Peak pulse current I_{PP}(A) (Note 2)
MSZ5V6	±30	155	12.0
MSZ6V2	±30	175	11.0
MSZ6V8	±30	180	10.0
MSZ7V5	±30	190	9.5
MSZ8V2	±30	200	8.5
MSZ9V1	±30	200	8.0
MSZ10V	±30	200	7.5
MSZ11V	±30	200	7.25
MSZ12V	±30	200	7.0
MSZ13V	±30	200	6.5
MSZ15V	±30	200	5.6
MSZ16V	±30	200	5.5
MSZ18V	±30	200	5.1
MSZ20V	±30	200	5.0
MSZ22V	±30	200	4.75
MSZ24V	±30	200	4.5
MSZ27V	±20	200	4.1
MSZ30V	±20	200	4.0
MSZ33V	±17	200	3.5
MSZ36V	±12	200	3.0

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note1: According to IEC61000-4-2.

Note2: according to IEC61000-4-5 (tp = 8 / 20 μs)

6. Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

	Zener Voltage V_Z (V)				Dinamic Impedance Z_Z (Ω)		Dynamic Resistance R_{DYN} (Ω) (Note 1)	Clamp Voltage V_C (V) (Note 1) (Note 2)	Total Capacit-ance C_t (pF) (Note 3)	Reverse Current I_R (μA)	
Type No.	Min	Typ.	Max	Test Current I_Z (mA)	Max	Test Current I_Z (mA)	Typ.	Typ.	Typ.	Max	Test Voltage V_R (V)
MSZ5V6	5.3	5.6	6.0	5	30	5	0.16	9.0	125	1	3.5
MSZ6V2	5.8	6.2	6.6	5	30	5	0.21	10.0	105	2.5	5.0
MSZ6V8	6.4	6.8	7.2	5	30	5	0.27	13.0	88	1.5	5.5
MSZ7V5	7.0	7.5	7.9	5	30	5	0.32	14.0	78	0.1	6.0
MSZ8V2	7.7	8.2	8.7	5	30	5	0.37	16.5	67	0.1	7.0
MSZ9V1	8.5	9.1	9.6	5	30	5	0.44	17.0	62	0.1	7.5
MSZ10V	9.4	10.0	10.6	5	30	5	0.52	19.0	60	0.1	8.0
MSZ11V	10.4	11.0	11.6	5	30	5	0.60	24.0	48	0.1	9.0
MSZ12V	11.4	12.0	12.6	5	30	5	0.70	26.0	44	0.1	10.0
MSZ13V	12.4	13.0	14.1	5	30	5	0.80	27.0	42	0.1	11.0
MSZ15V	13.8	15.0	15.6	5	30	5	0.60	24.0	36	0.1	12.0
MSZ16V	15.3	16.0	17.1	5	35	5	0.50	27.0	35	0.1	14.0
MSZ18V	16.8	18.0	19.1	5	45	5	0.40	28.5	31	0.1	16.0
MSZ20V	18.8	20.0	21.2	5	70	5	0.35	30.5	29	0.1	17.6
MSZ22V	20.8	22.0	23.3	5	70	5	0.40	32.0	27	0.1	18.0
MSZ24V	22.8	24.0	25.6	5	70	5	0.60	36.5	26	0.1	19.0
MSZ27V	25.1	27.0	28.9	2	70	2	0.90	45.0	23	0.1	23.0
MSZ30V	28.0	30.0	32.0	2	100	2	1.25	47.5	21	0.1	27.0
MSZ33V	31.0	33.0	35.0	2	100	2	1.80	57.0	19	0.1	30.0
MSZ36V	34.0	36.0	38.0	2	100	2	2.60	63.0	18	0.1	32.5

Note1: TLP parameters: Z0 = 50 Ω, t_p = 100 ns, t_r = 300 ps, averaging window: t1 = 30 ns to t2 = 60 ns, extraction of dynamic resistance using least squares fit of TLP characteristics between I_{TLP1} = 16 A and I_{TLP2} = 30 A.

Note2: I_{TLP} = 16 A

Note3: V_R = 0 V, f = 1 MHz

7. Marking List

Type No.	Marking	Type No.	Marking	Type No.	Marking
MSZ5V6	ZLL	MSZ11V	ZM3	MSZ22V	ZMA
MSZ6V2	ZLM	MSZ12V	ZM4	MSZ24V	ZMB
MSZ6V8	ZLN	MSZ13V	ZM5	MSZ27V	ZMC
MSZ7V5	ZLP	MSZ15V	ZM6	MSZ30V	ZMD
MSZ8V2	ZLQ	MSZ16V	ZM7	MSZ33V	ZME
MSZ9V1	ZLR	MSZ18V	ZM8	MSZ36V	ZMF
MSZ10V	ZM2	MSZ20V	ZM9	—	—

8. Marking

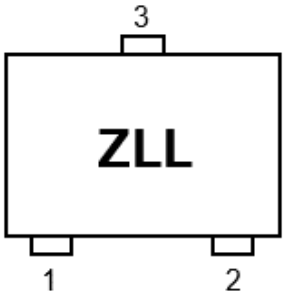


Fig. 8.1 MSZ5V6

9. Land Pattern Dimensions (for reference only)

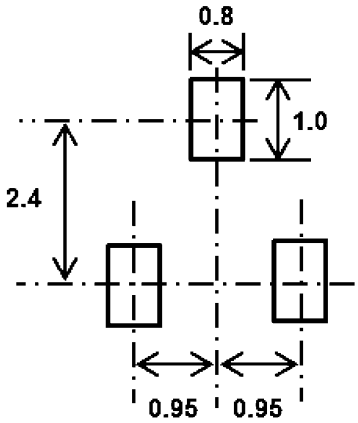


Fig. 9.1 Land Pattern Dimensions (for reference only) (Unit: mm)

10. Characteristics Curves

10.1. MSZ series Characteristics Curves(Note)

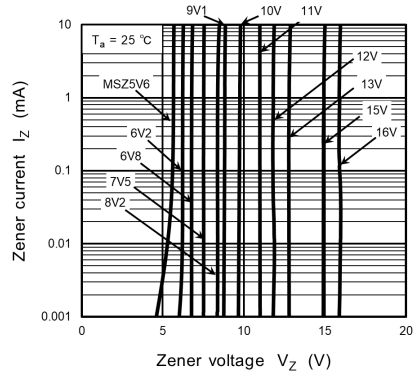


Fig. 10.1.1 I_Z - V_Z(1)

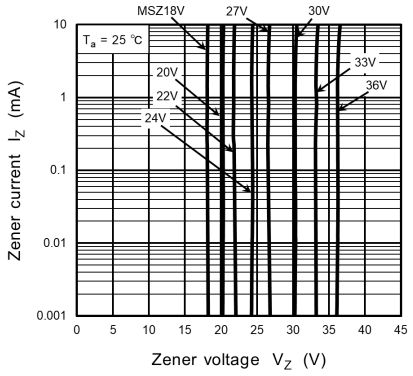


Fig. 10.1.2 I_Z - V_Z(2)

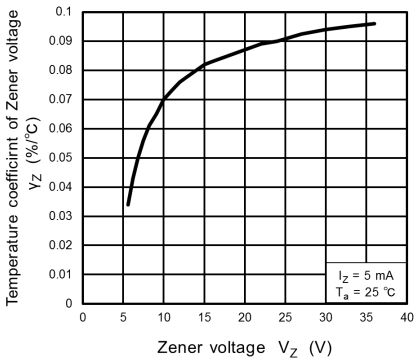


Fig. 10.1.3 γ_Z - V_Z

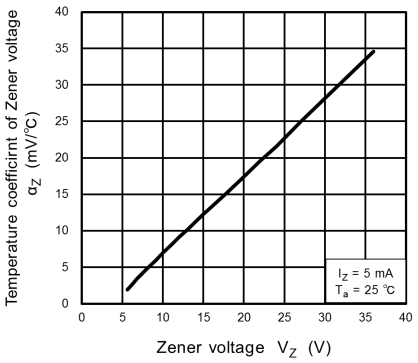


Fig. 10.1.4 α_Z - V_Z

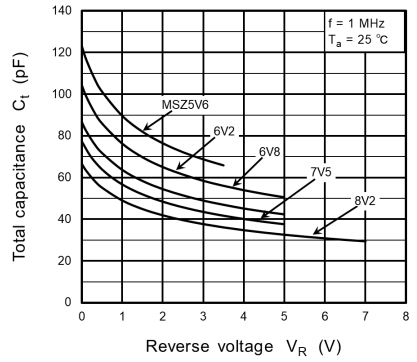


Fig. 10.1.5 C_t - V_R (1)

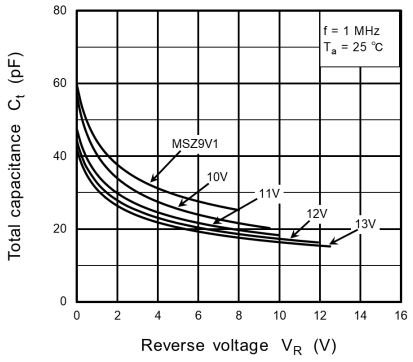


Fig. 10.1.6 C_t - V_R (2)

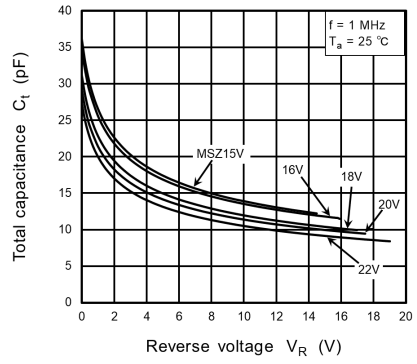


Fig. 10.1.7 C_t - V_R (3)

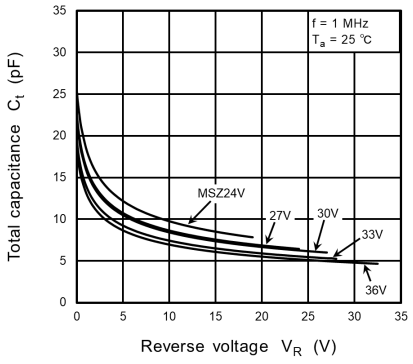


Fig. 10.1.8 C_t - V_R (4)

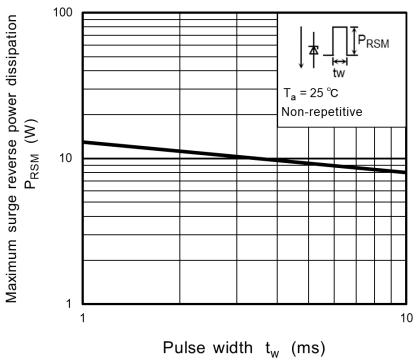


Fig. 10.1.9 P_{RSM} - t_w

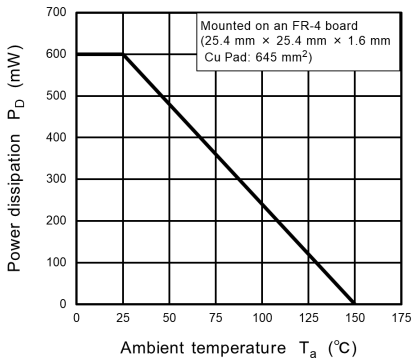


Fig. 10.1.10 P_D - T_a

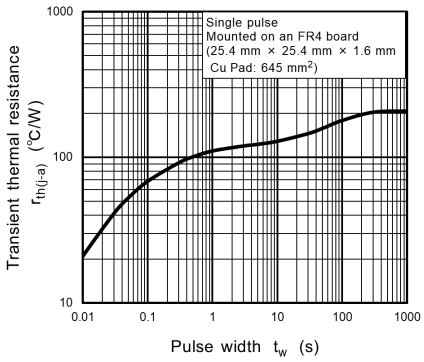


Fig. 10.1.11 $r_{th(j-a)}$ - t_w

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

10.2. MSZ5V6 Characteristics Curves(Note)

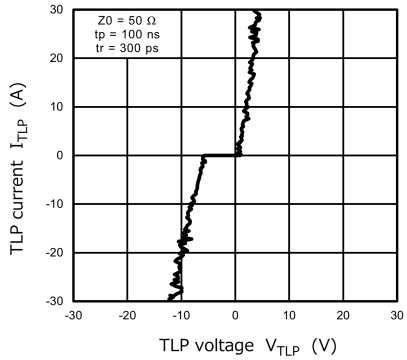


Fig. 10.2.1 I_{TLP} - V_{TLP}

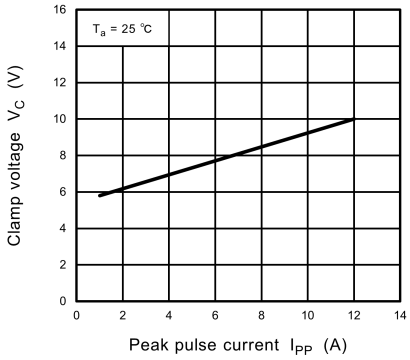


Fig. 10.2.2 V_C - I_{PP}

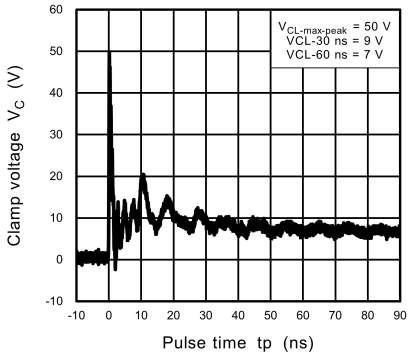


Fig. 10.2.3 IEC61000-4-2 Clamp Waveform +8 kV

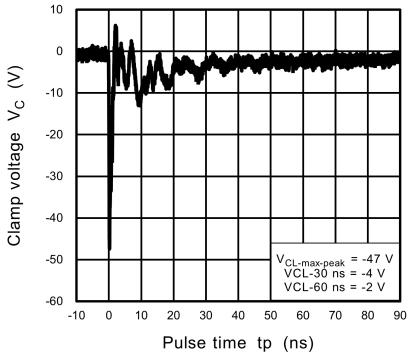


Fig. 10.2.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.3. MSZ6V2 Characteristics Curves(Note)

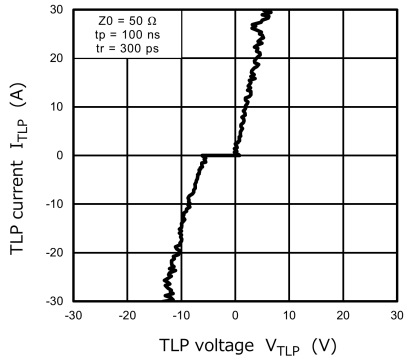


Fig. 10.3.1 I_{TLP} - V_{TLP}

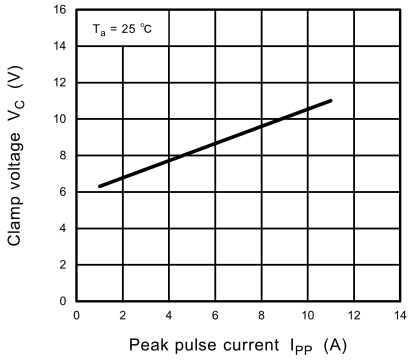


Fig. 10.3.2 V_C - I_{PP}

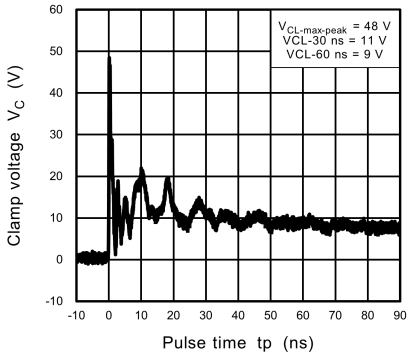


Fig. 10.3.3 IEC61000-4-2 Clamp Waveform +8 kV

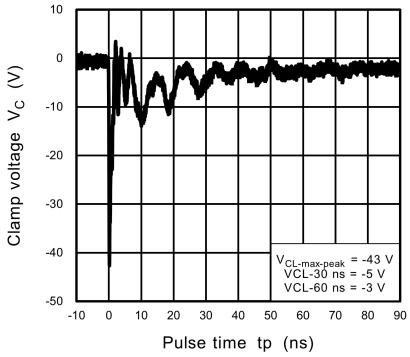


Fig. 10.3.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.4. MSZ6V8 Characteristics Curves(Note)

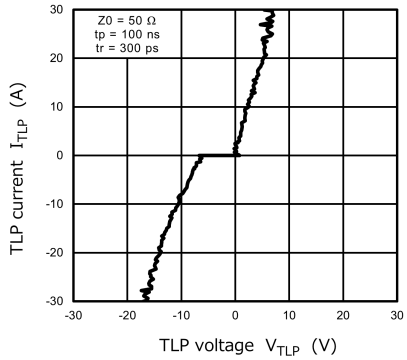


Fig. 10.4.1 I_{TLP} - V_{TLP}

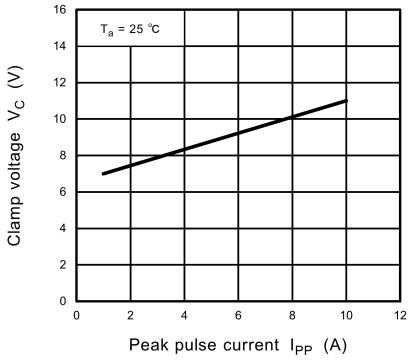


Fig. 10.4.2 V_C - I_{PP}

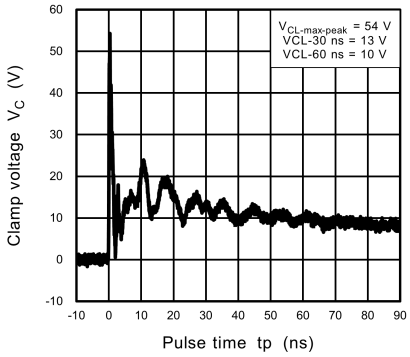


Fig. 10.4.3 IEC61000-4-2 Clamp Waveform +8 kV

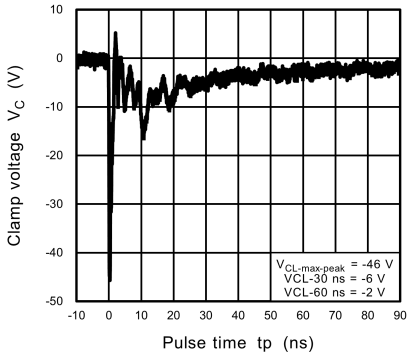


Fig. 10.4.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.5. MSZ7V5 Characteristics Curves(Note)

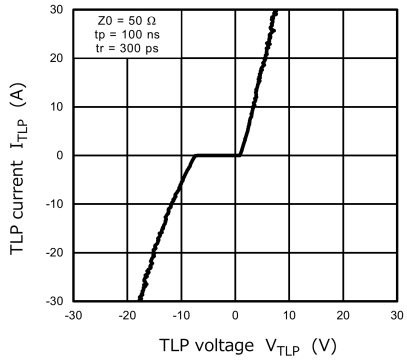


Fig. 10.5.1 I_{TLP} - V_{TLP}

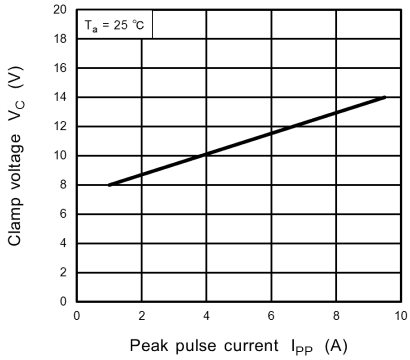


Fig. 10.5.2 V_C - I_{PP}

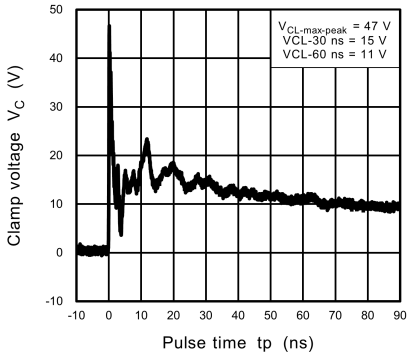


Fig. 10.5.3 IEC61000-4-2 Clamp Waveform +8 kV

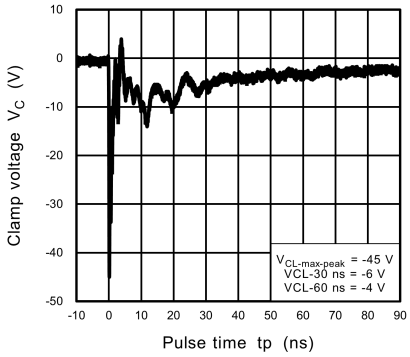


Fig. 10.5.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.6. MSZ8V2 Characteristics Curves(Note)

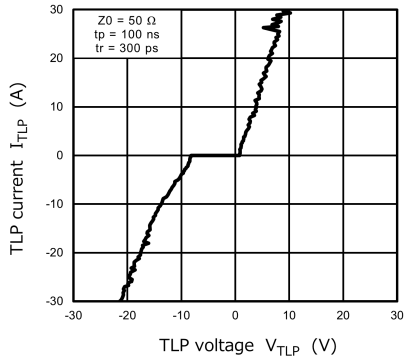


Fig. 10.6.1 I_{TLP} - V_{TLP}

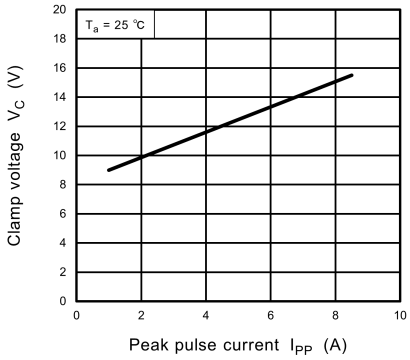


Fig. 10.6.2 V_C - I_{PP}

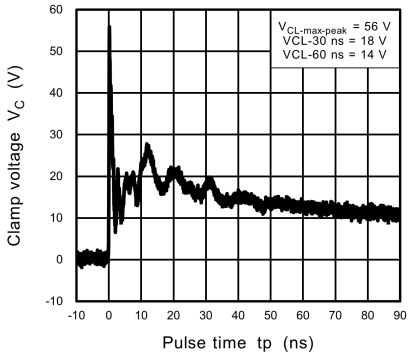


Fig. 10.6.3 IEC61000-4-2 Clamp Waveform +8 kV

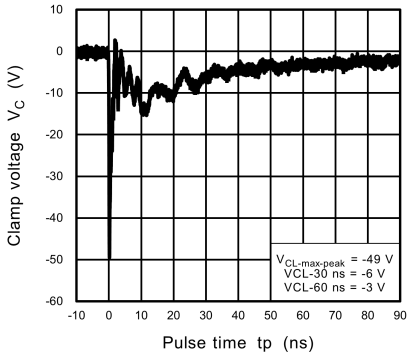


Fig. 10.6.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.7. MSZ9V1 Characteristics Curves(Note)

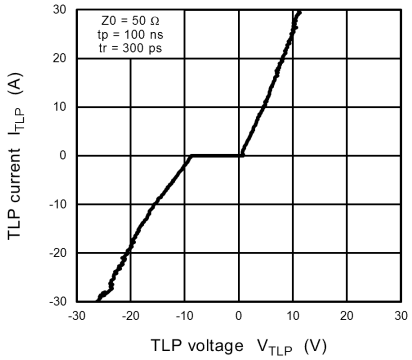


Fig. 10.7.1 I_{TLP} - V_{TLP}

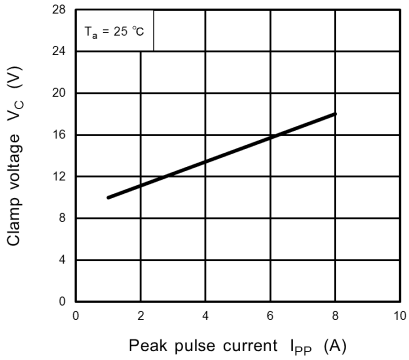


Fig. 10.7.2 V_C - I_{PP}

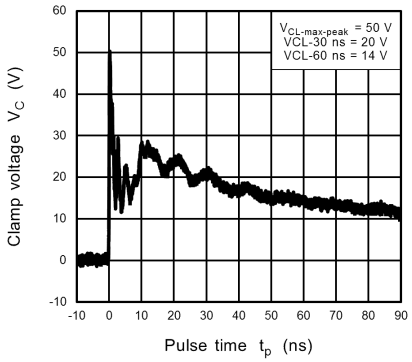


Fig. 10.7.3 IEC61000-4-2 Clamp Waveform +8 kV

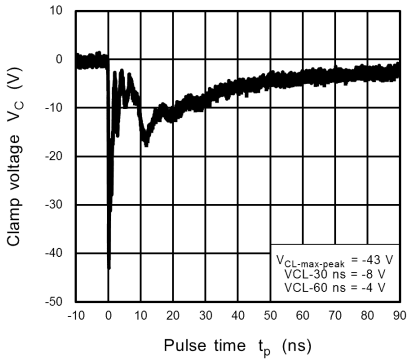


Fig. 10.7.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.8. MSZ10V Characteristics Curves(Note)

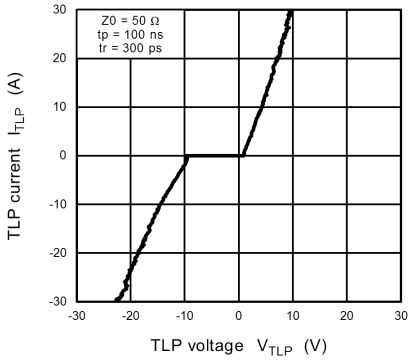


Fig. 10.8.1 I_{TLP} - V_{TLP}

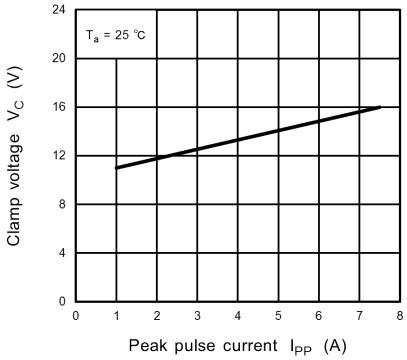


Fig. 10.8.2 V_C - I_{PP}

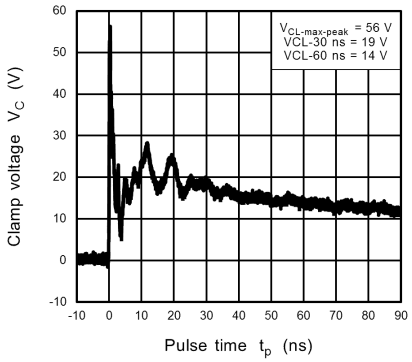


Fig. 10.8.3 IEC61000-4-2 Clamp Waveform +8 kV

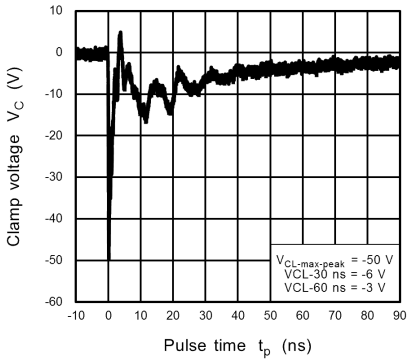


Fig. 10.8.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.9. MSZ11V Characteristics Curves(Note)

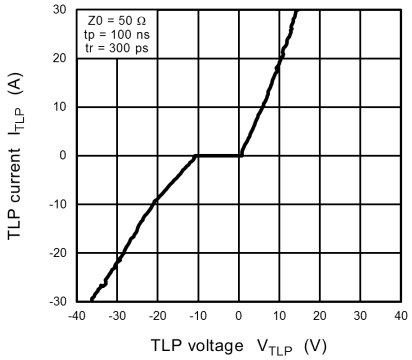


Fig. 10.9.1 I_{TLP} - V_{TLP}

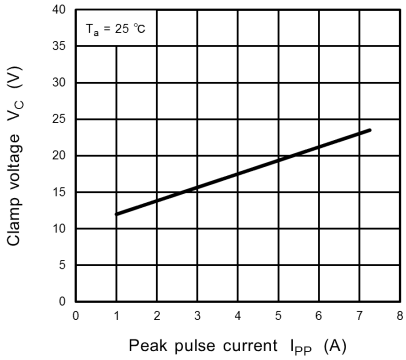


Fig. 10.9.2 V_C - I_{PP}

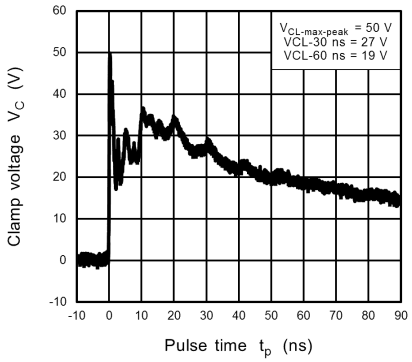


Fig. 10.9.3 IEC61000-4-2 Clamp Waveform +8 kV

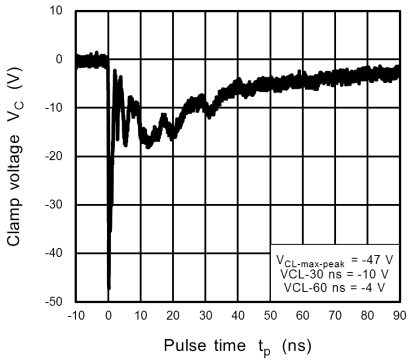


Fig. 10.9.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.10. MSZ12V Characteristics Curves(Note)

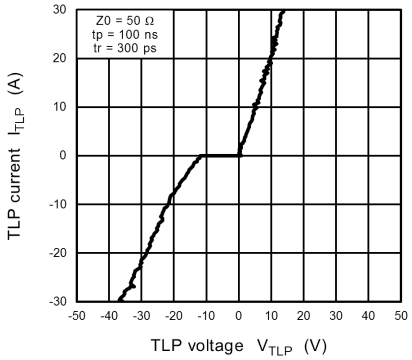


Fig. 10.10.1 I_{TLP} - V_{TLP}

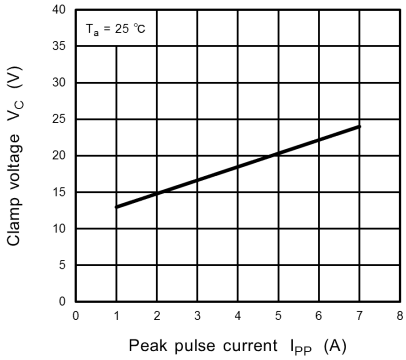


Fig. 10.10.2 V_C - I_{PP}

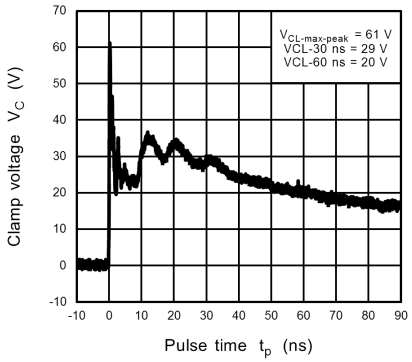


Fig. 10.10.3 IEC61000-4-2 Clamp Waveform +8 kV

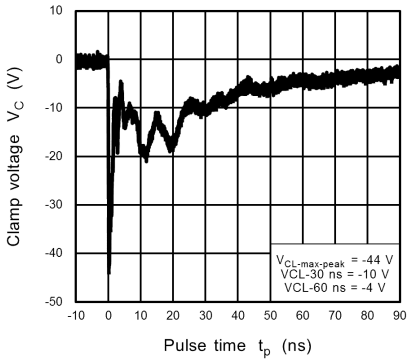


Fig. 10.10.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.11. MSZ13V Characteristics Curves(Note)

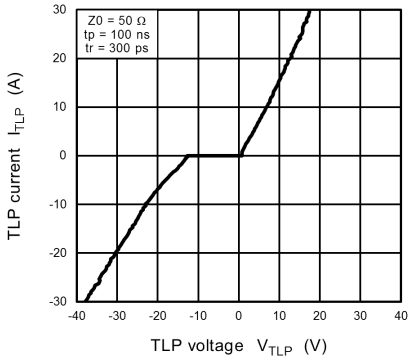


Fig. 10.11.1 I_{TLP} - V_{TLP}

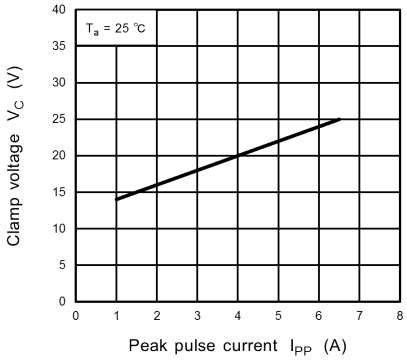


Fig. 10.11.2 V_C - I_{PP}

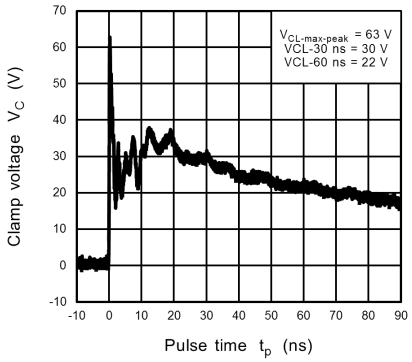


Fig. 10.11.3 IEC61000-4-2 Clamp Waveform +8 kV

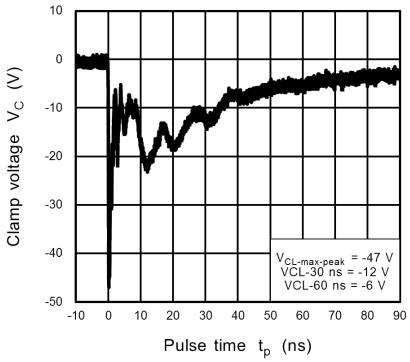


Fig. 10.11.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.12. MSZ15V Characteristics Curves(Note)

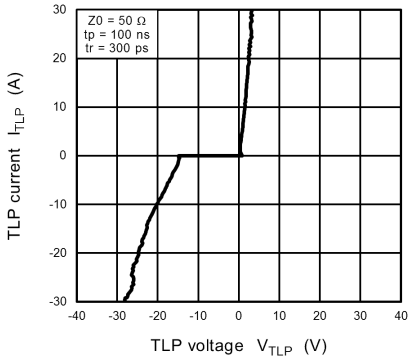


Fig. 10.12.1 I_{TLP} - V_{TLP}

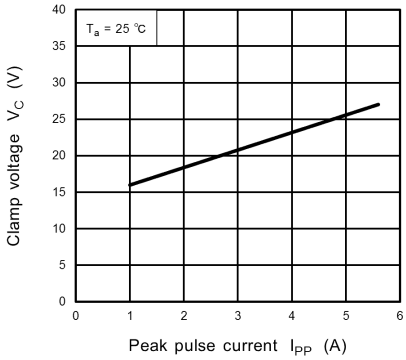


Fig. 10.12.2 V_C - I_{PP}

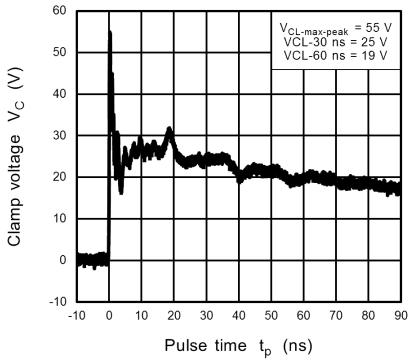


Fig. 10.12.3 IEC61000-4-2 Clamp Waveform +8 kV

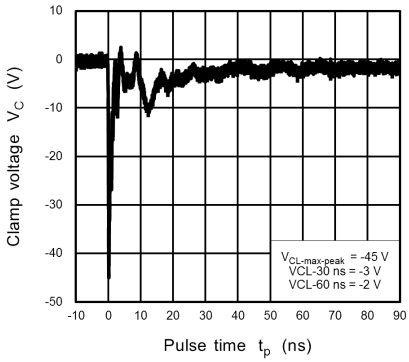


Fig. 10.12.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.13. MSZ16V Characteristics Curves(Note)

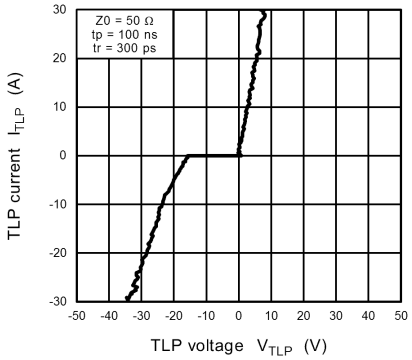


Fig. 10.13.1 I_{TLP} - V_{TLP}

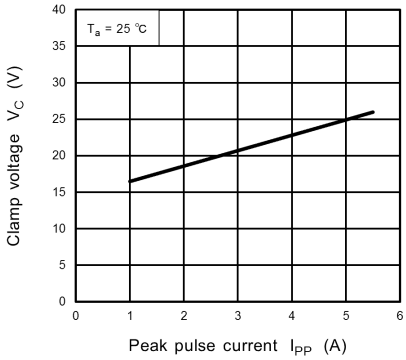


Fig. 10.13.2 V_C - I_{PP}

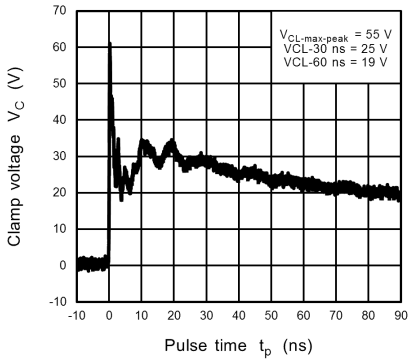


Fig. 10.13.3 IEC61000-4-2 Clamp Waveform +8 kV

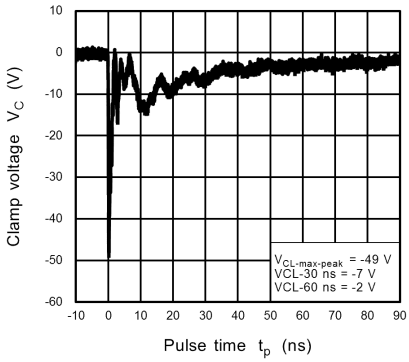


Fig. 10.13.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.14. MSZ18V Characteristics Curves(Note)

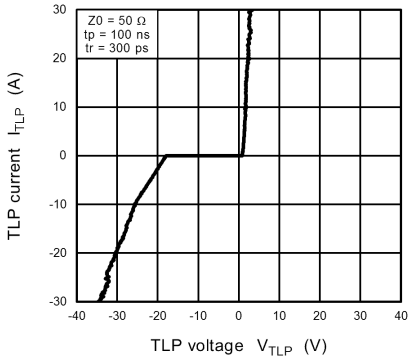


Fig. 10.14.1 I_{TLP} - V_{TLP}

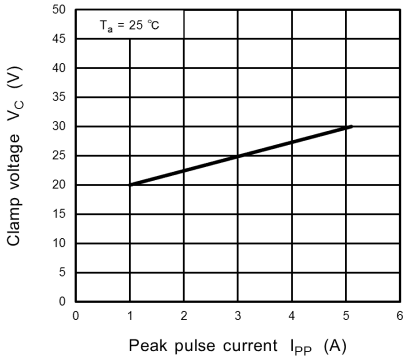


Fig. 10.14.2 V_C - I_{PP}

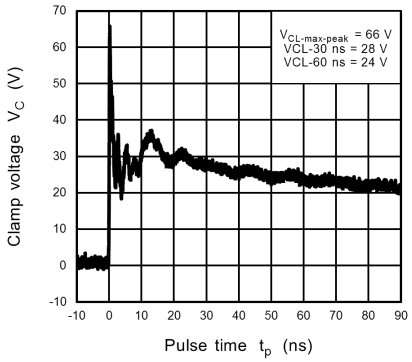


Fig. 10.14.3 IEC61000-4-2 Clamp Waveform +8 kV

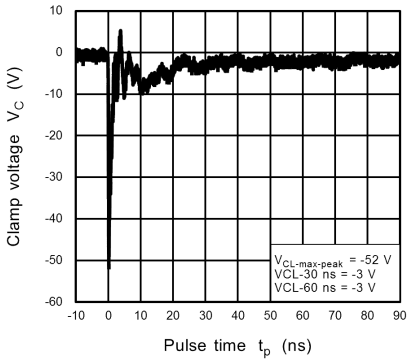


Fig. 10.14.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.15. MSZ20V Characteristics Curves(Note)

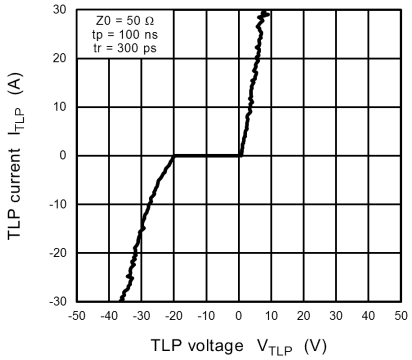


Fig. 10.15.1 I_{TLP} - V_{TLP}

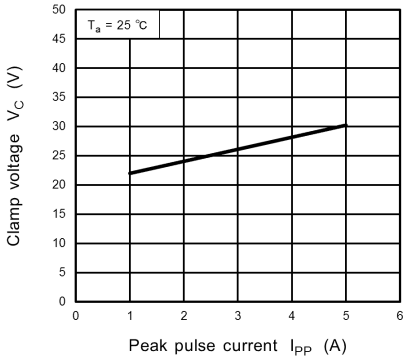


Fig. 10.15.2 V_C - I_{PP}

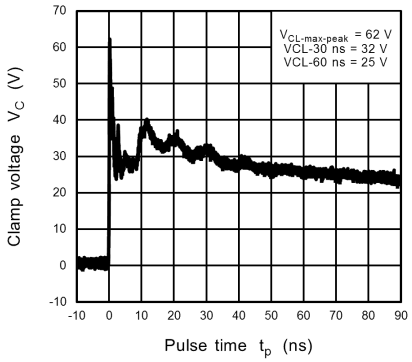


Fig. 10.15.3 IEC61000-4-2 Clamp Waveform +8 kV

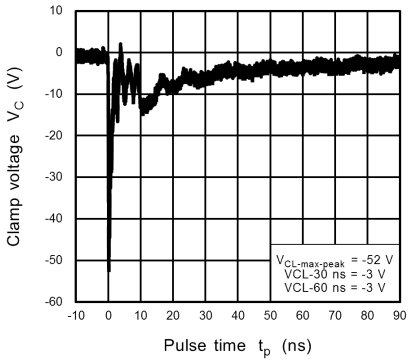


Fig. 10.15.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.16. MSZ22V Characteristics Curves(Note)

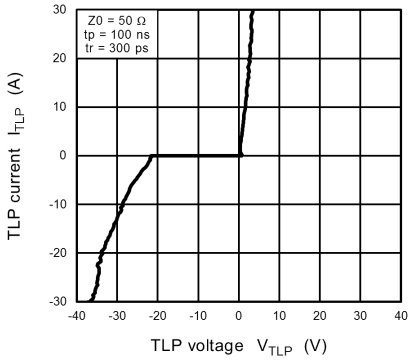


Fig. 10.16.1 I_{TLP} - V_{TLP}

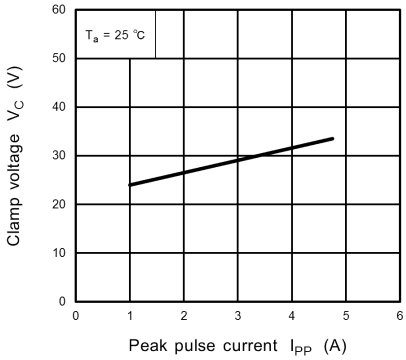


Fig. 10.16.2 V_C - I_{PP}

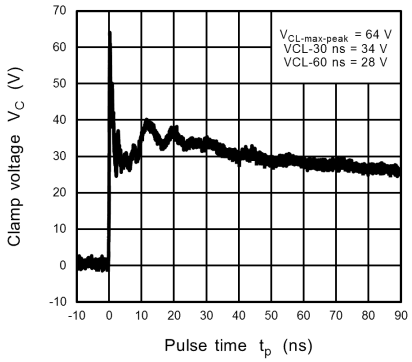


Fig. 10.16.3 IEC61000-4-2 Clamp Waveform +8 kV

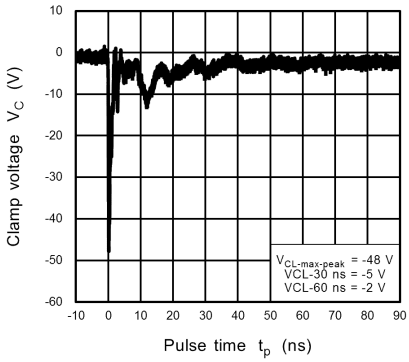


Fig. 10.16.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.17. MSZ24V Characteristics Curves(Note)

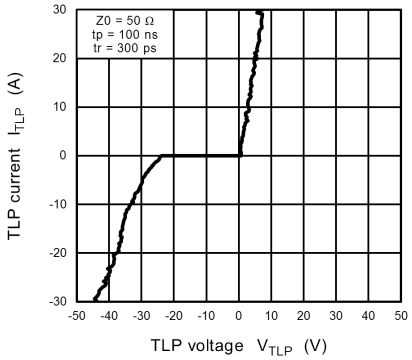


Fig. 10.17.1 I_{TLP} - V_{TLP}

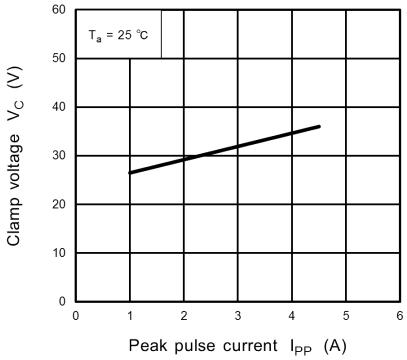


Fig. 10.17.2 V_C - I_{PP}

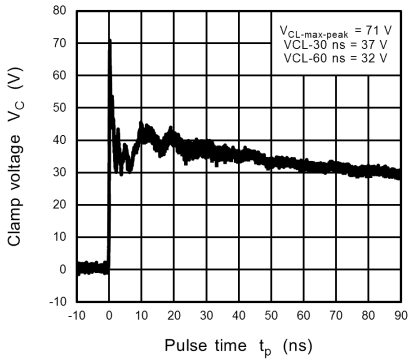


Fig. 10.17.3 IEC61000-4-2 Clamp Waveform +8 kV

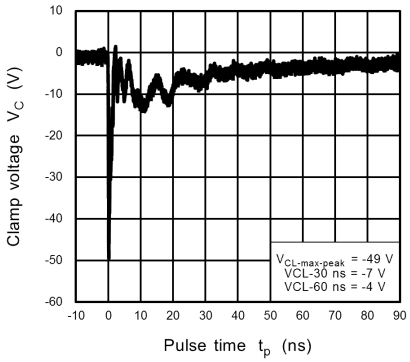


Fig. 10.17.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.18. MSZ27V Characteristics Curves(Note)

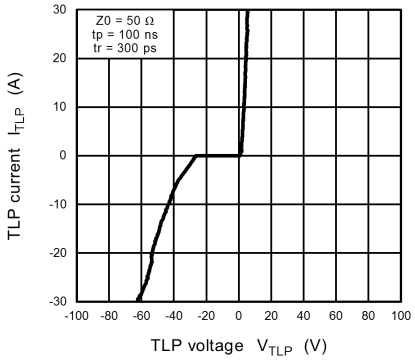


Fig. 10.18.1 I_{TLP} - V_{TLP}

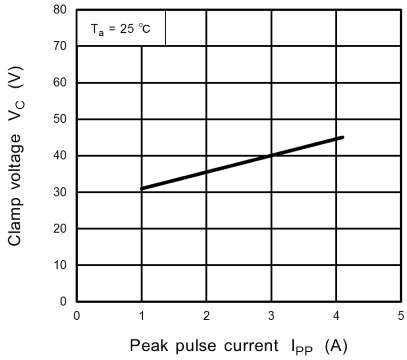


Fig. 10.18.2 V_C - I_{PP}

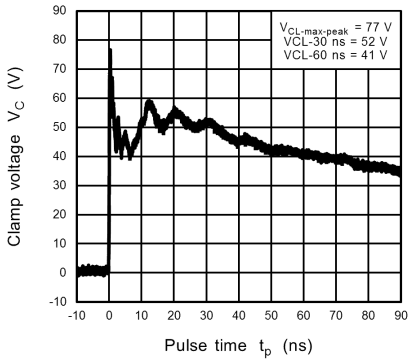


Fig. 10.18.3 IEC61000-4-2 Clamp Waveform +8 kV

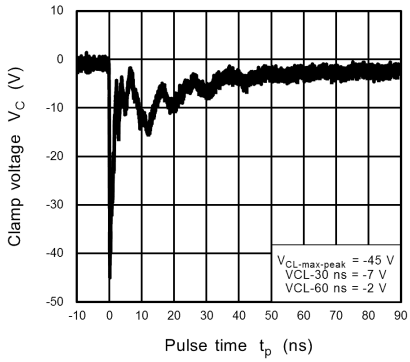


Fig. 10.18.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.19. MSZ30V Characteristics Curves(Note)

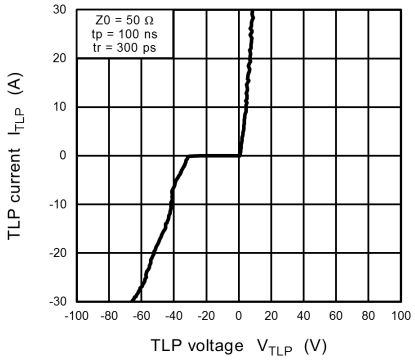


Fig. 10.19.1 I_{TLP} - V_{TLP}

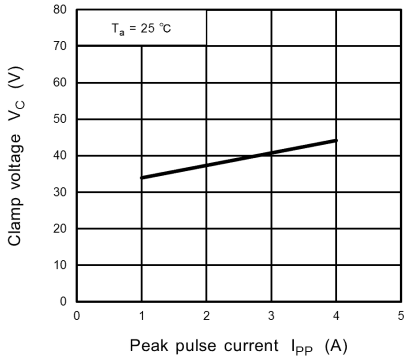


Fig. 10.19.2 V_C - I_{PP}

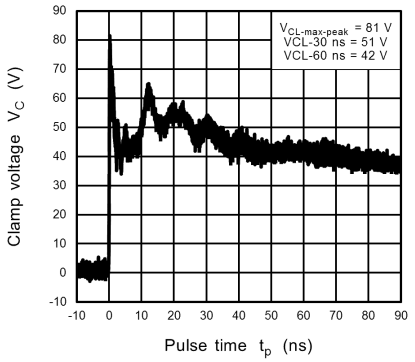


Fig. 10.19.3 IEC61000-4-2 Clamp Waveform +8 kV

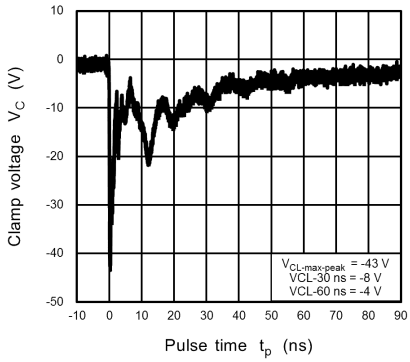


Fig. 10.19.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.20. MSZ33V Characteristics Curves(Note)

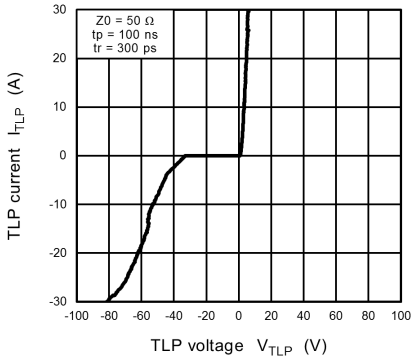


Fig. 10.20.1 I_{TLP} - V_{TLP}

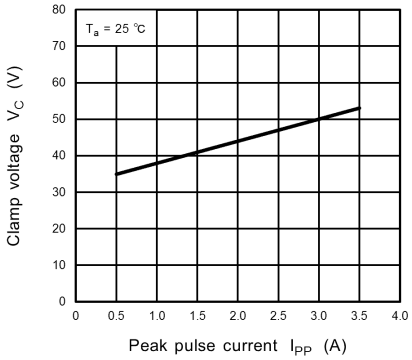


Fig. 10.20.2 V_C - I_{PP}

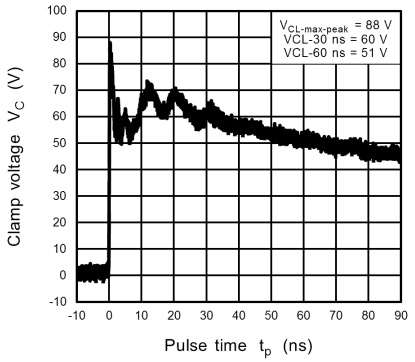


Fig. 10.20.3 IEC61000-4-2 Clamp Waveform +8 kV

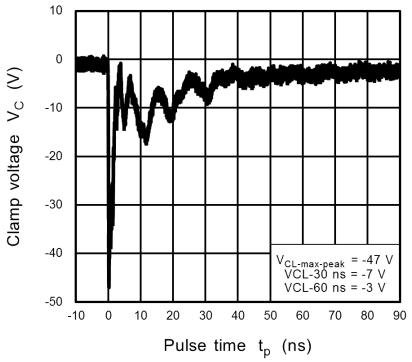


Fig. 10.20.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.21. MSZ36V Characteristics Curves(Note)

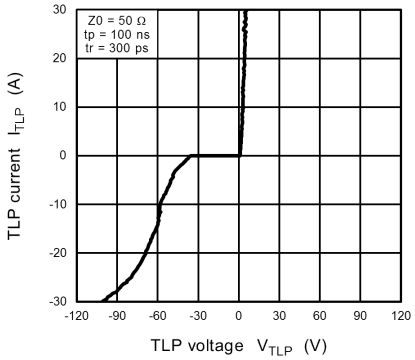


Fig. 10.21.1 I_{TLP} - V_{TLP}

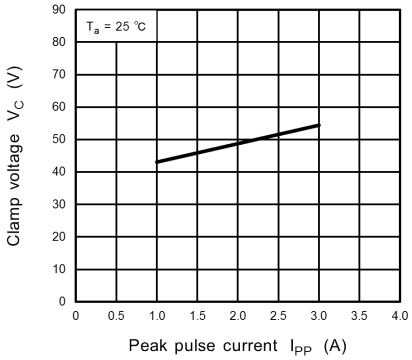


Fig. 10.21.2 V_C - I_{PP}

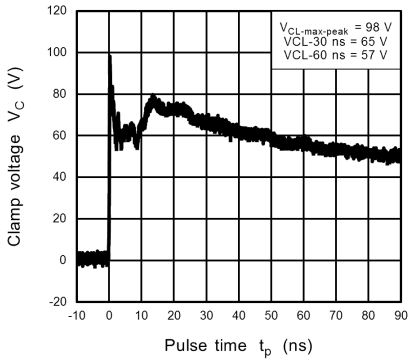


Fig. 10.21.3 IEC61000-4-2 Clamp Waveform +8 kV

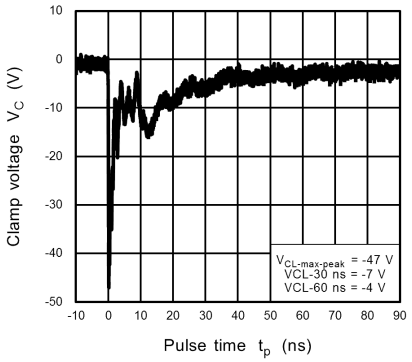


Fig. 10.21.4 IEC61000-4-2 Clamp Waveform -8 kV

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.
Refer to Fig.10.22.1, Fig.10.22.2 for peak pulse current(V_C-I_{PP}) and clamp waveform measurement circuit.

10.22. V_C-I_{PP} Peak Pulse and Clamp waveform measurement circuit

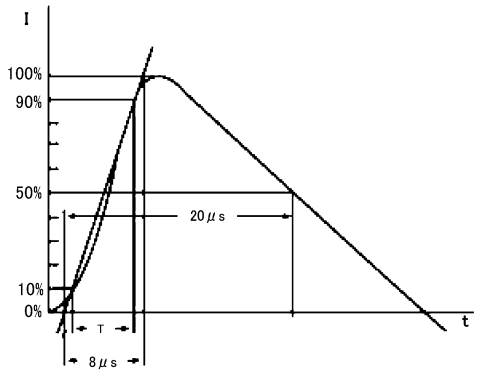


Fig. 10.22.1 V_C-I_{PP} Peak Pulse Current (according to IEC61000-4-5 8/20 μs pulse)

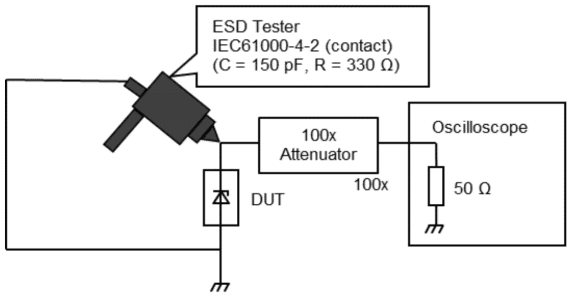
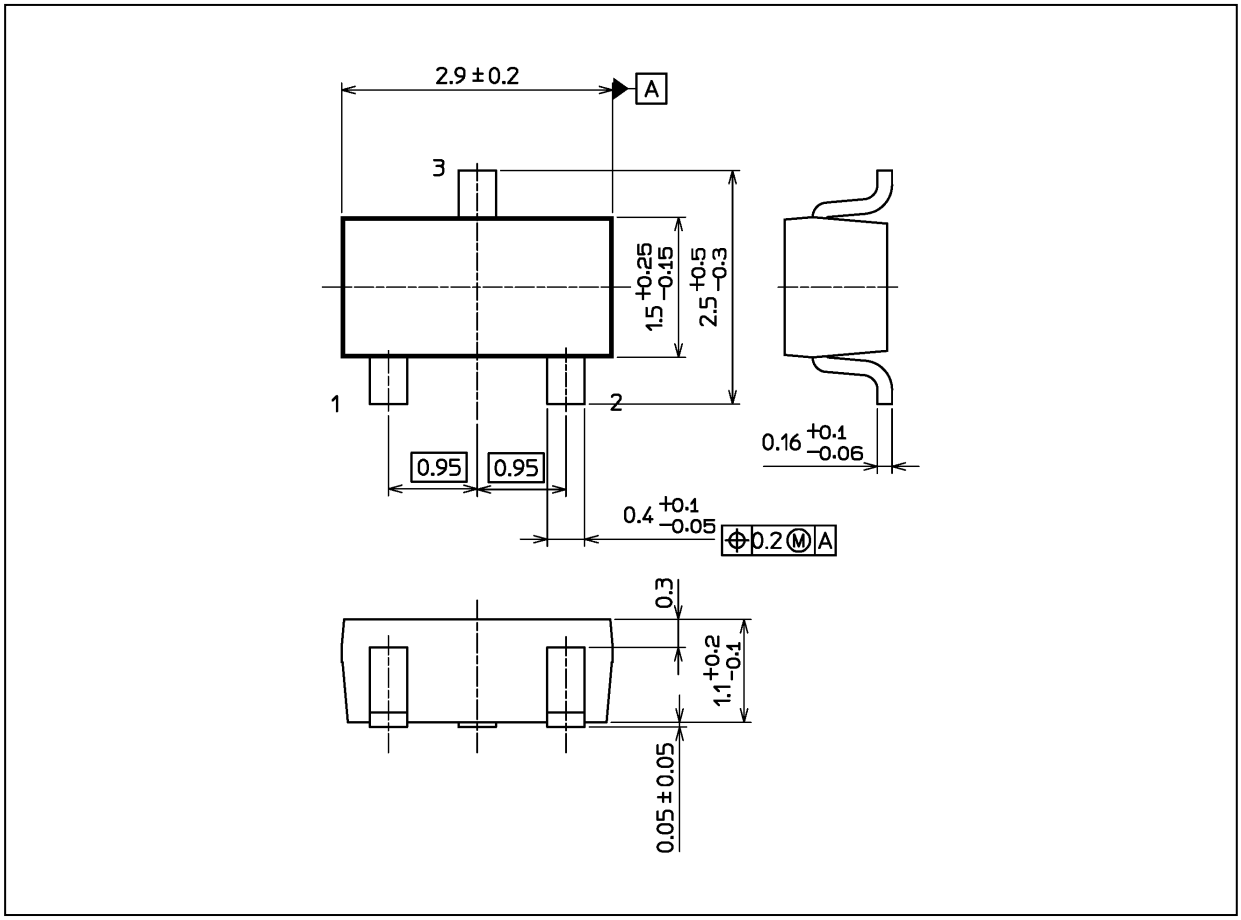


Fig. 10.22.2 Clamp waveform measurement circuit (according to IEC61000-4-2)

Package Dimensions

Unit: mm



Weight: 12 mg (typ.)

Package Name(s)
Nickname: S-Mini

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