

Zener Diode Silicon Epitaxial Planar

MUZ series

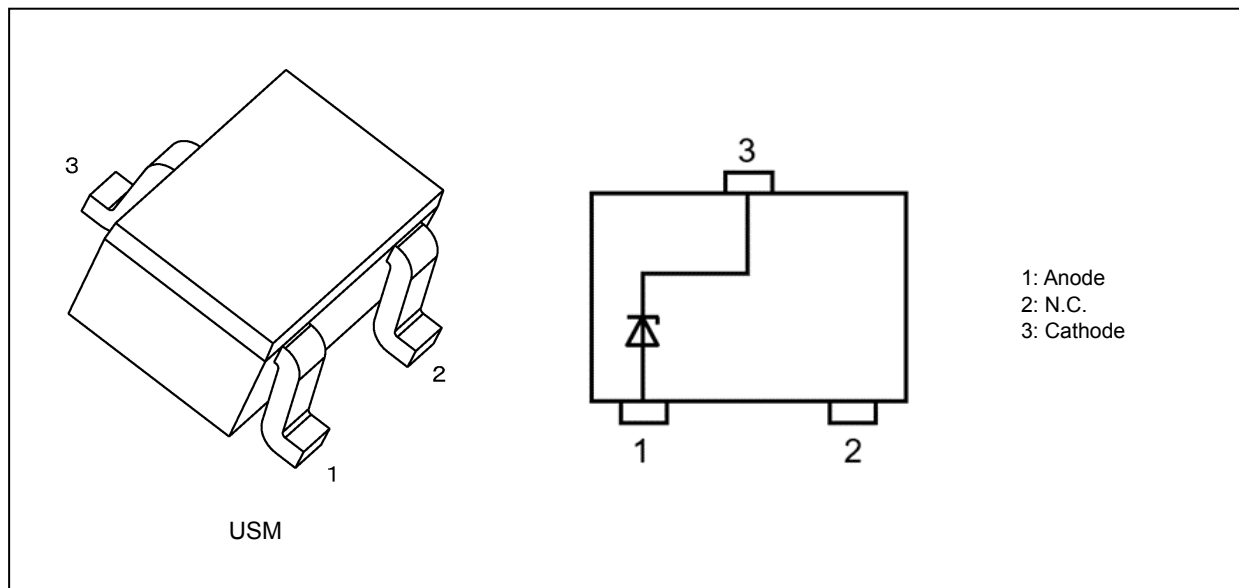
1. Applications

- (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, $T_a = 25\text{ }^\circ\text{C}$)

Characteristics	Symbol	Note	Rating	Unit
Power dissipation	P_D	(Note 1)	150	mW
		(Note 2)	600	
Junction temperature	T_j		150	$^\circ\text{C}$
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: 0.42 mm² × 3

Note 2: Mounted on a glass epoxy circuit board of 25.4 mm × 25.4 mm × 1.6 mm, Cu pad: 645 mm²

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)
MUZ5V6	±30	155	12.0
MUZ6V2	±30	175	11.0
MUZ6V8	±30	180	10.0
MUZ7V5	±30	190	9.5
MUZ8V2	±30	200	8.5
MUZ9V1	±30	200	8.0
MUZ10V	±30	200	7.5
MUZ11V	±30	200	7.25
MUZ12V	±30	200	7.0
MUZ13V	±30	200	6.5
MUZ15V	±30	200	5.6
MUZ16V	±30	200	5.5
MUZ18V	±30	200	5.1
MUZ20V	±30	200	5.0
MUZ22V	±30	200	4.75
MUZ24V	±30	200	4.5
MUZ27V	±20	200	4.1
MUZ30V	±20	200	4.0
MUZ33V	±17	200	3.5
MUZ36V	±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 (t_p = 8 / 20 μs)

6. Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

Type No.	Zener Voltage V_Z (V)				Dynamic Impedance Z_Z (Ω)		Dynamic Resistance R_{DYN} (Ω) (Note 1)	Clamp Voltage V_C (V) (Note 1) (Note 2)	Total Capacitance C_T (pF) (Note 3)	Reverse Current I_R (μA)	
	Min	Typ.	Max	Test Current I_Z (mA)	Max	Test Current I_Z (mA)	Typ.	Typ.	Typ.	Max	Test Voltage V_R (V)
MUZ5V6	5.3	5.6	6.0	5	30	5	0.16	9.0	125	1	3.5
MUZ6V2	5.8	6.2	6.6	5	30	5	0.21	10.0	105	2.5	5.0
MUZ6V8	6.4	6.8	7.2	5	30	5	0.27	13.0	88	1.5	5.5
MUZ7V5	7.0	7.5	7.9	5	30	5	0.32	14.0	78	0.1	6.0
MUZ8V2	7.7	8.2	8.7	5	30	5	0.37	16.5	67	0.1	7.0
MUZ9V1	8.5	9.1	9.6	5	30	5	0.44	17.0	62	0.1	7.5
MUZ10V	9.4	10.0	10.6	5	30	5	0.52	19.0	60	0.1	8.0
MUZ11V	10.4	11.0	11.6	5	30	5	0.60	24.0	48	0.1	9.0
MUZ12V	11.4	12.0	12.6	5	30	5	0.70	26.0	44	0.1	10.0
MUZ13V	12.4	13.0	14.1	5	30	5	0.80	27.0	42	0.1	11.0
MUZ15V	13.8	15.0	15.6	5	30	5	0.60	24.0	36	0.1	12.0
MUZ16V	15.3	16.0	17.1	5	35	5	0.50	27.0	35	0.1	14.0
MUZ18V	16.8	18.0	19.1	5	45	5	0.40	28.5	31	0.1	16.0
MUZ20V	18.8	20.0	21.2	5	70	5	0.35	30.5	29	0.1	17.6
MUZ22V	20.8	22.0	23.3	5	70	5	0.40	32.0	27	0.1	18.0
MUZ24V	22.8	24.0	25.6	5	70	5	0.60	36.5	26	0.1	19.0
MUZ27V	25.1	27.0	28.9	2	70	2	0.90	45.0	23	0.1	23.0
MUZ30V	28.0	30.0	32.0	2	100	2	1.25	47.5	21	0.1	27.0
MUZ33V	31.0	33.0	35.0	2	100	2	1.80	57.0	19	0.1	30.0
MUZ36V	34.0	36.0	38.0	2	100	2	2.60	63.0	18	0.1	32.5

Note1: TLP parameters: $Z_0 = 50\ \Omega$, $t_p = 100\ \text{ns}$, $t_r = 300\ \text{ps}$, averaging window: $t_1 = 30\ \text{ns}$ to $t_2 = 60\ \text{ns}$, extraction of dynamic resistance using least squares fit of TLP characteristics between $I_{TLP1} = 16\ \text{A}$ and $I_{TLP2} = 30\ \text{A}$.

Note2: $I_{TLP} = 16\ \text{A}$

Note3: $V_R = 0\ \text{V}$, $f = 1\ \text{MHz}$

7. Marking List

Type No.	Marking	Type No.	Marking	Type No.	Marking
MUZ5V6	J1	MUZ11V	JL	MUZ22V	JQ
MUZ6V2	J2	MUZ12V	J6	MUZ24V	JB
MUZ6V8	J3	MUZ13V	JM	MUZ27V	JS
MUZ7V5	JJ	MUZ15V	JN	MUZ30V	JC
MUZ8V2	J4	MUZ16V	J7	MUZ33V	JT
MUZ9V1	JK	MUZ18V	JP	MUZ36V	JD
MUZ10V	J5	MUZ20V	JA	—	—

8. Marking

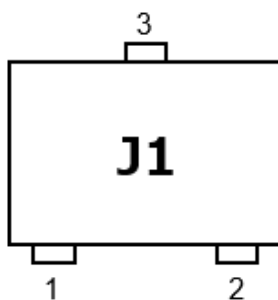


Fig. 8.1 MUZ5V6

9. Land Pattern Dimensions (for reference only)

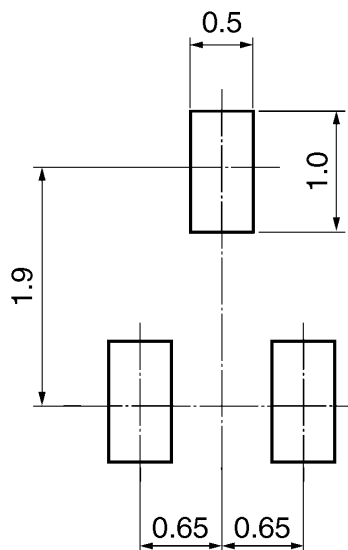


Fig. 9.1 Land Pattern Dimensions
(for reference only) (Unit: mm)

10. Characteristics Curves

10.1. MUZ series Characteristics Curves(Note)

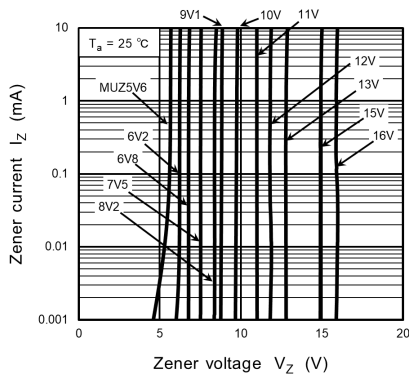


Fig. 10.1.1 $I_z - V_Z(1)$

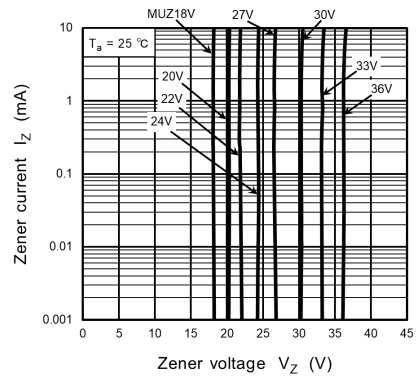


Fig. 10.1.2 $I_z - V_Z(2)$

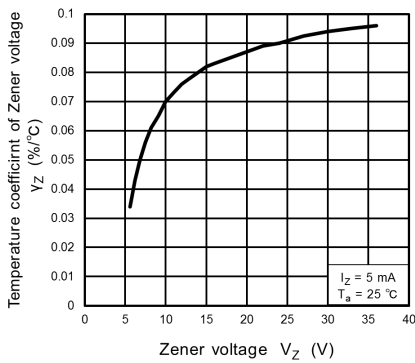


Fig. 10.1.3 $\gamma_Z - V_Z$

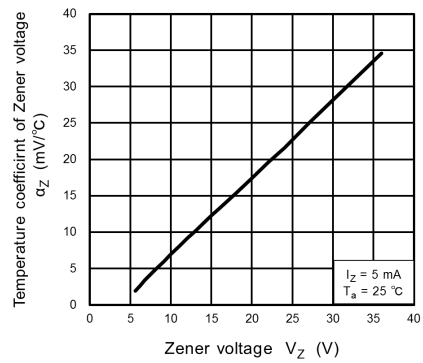


Fig. 10.1.4 $\alpha_Z - V_Z$

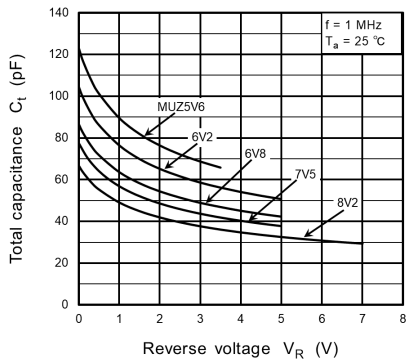


Fig. 10.1.5 $C_t - V_R (1)$

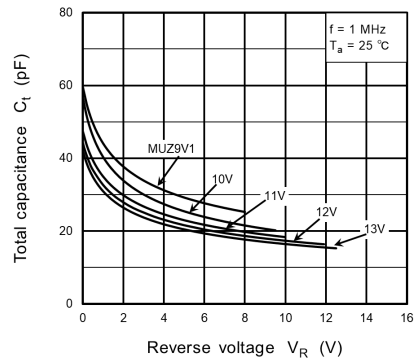


Fig. 10.1.6 $C_t - V_R (2)$

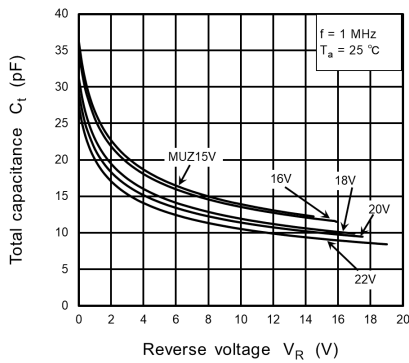


Fig. 10.1.7 $C_t - V_R (3)$

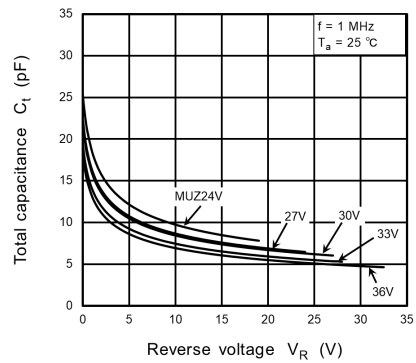


Fig. 10.1.8 $C_t - V_R (4)$

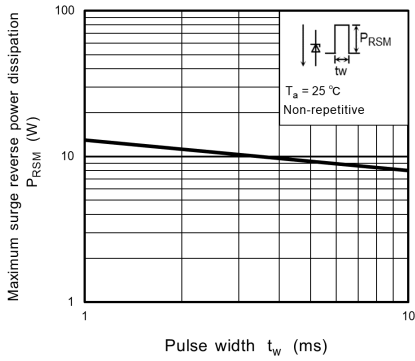


Fig. 10.1.9 $P_{RSM} - t_w$

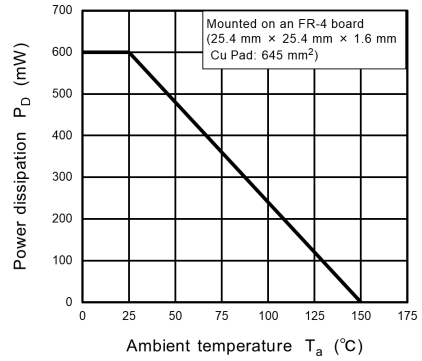


Fig. 10.1.10 $P_D - T_a$

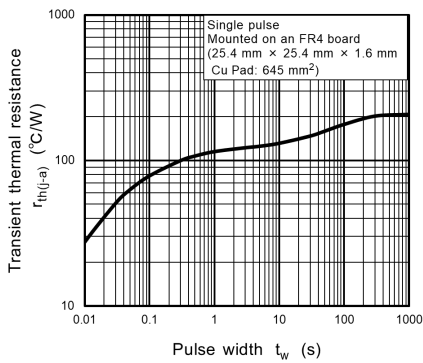


Fig. 10.1.11 $r_{th(j-a)} - t_w$

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

10.2. MUZ5V6 Characteristics Curves(Note)

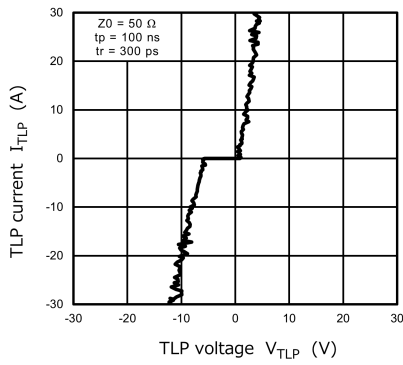


Fig. 10.2.1 $I_{TLP} - V_{TLP}$

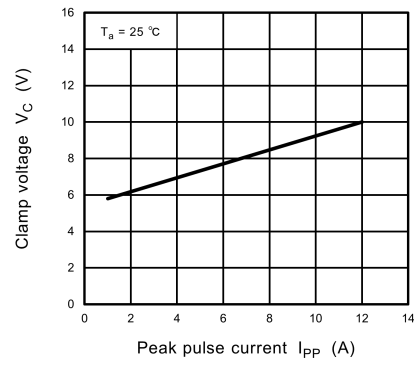


Fig. 10.2.2 $V_C - I_{PP}$

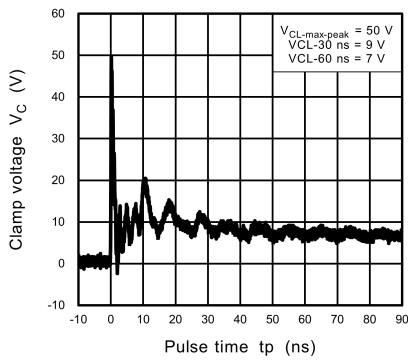


Fig. 10.2.3 IEC61000-4-2 Clamp Waveform +8 kV

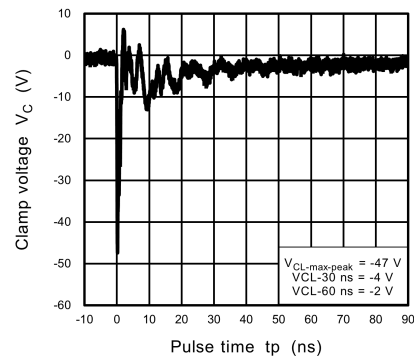


Fig. 10.2.4 IEC61000-4-2 Clamp Waveform -8 kV

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. MUZ6V2 Characteristics Curves(Note)

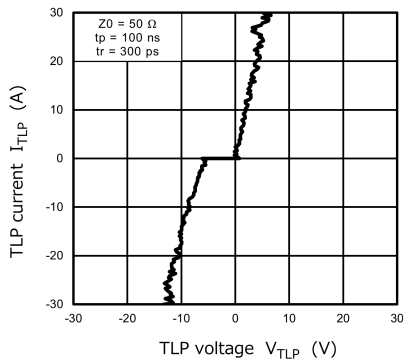


Fig. 10.3.1 $I_{TLP} - V_{TLP}$

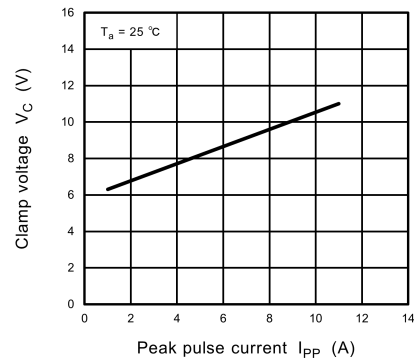
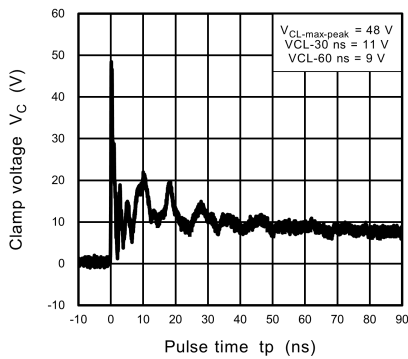
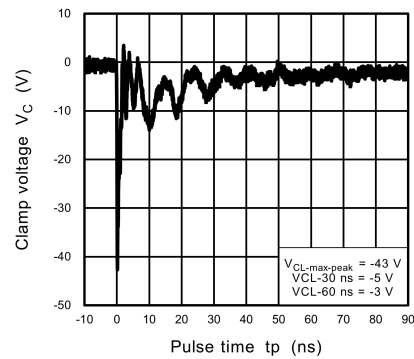


Fig. 10.3.2 $V_C - I_{PP}$



**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. MUZ6V8 Characteristics Curves(Note)

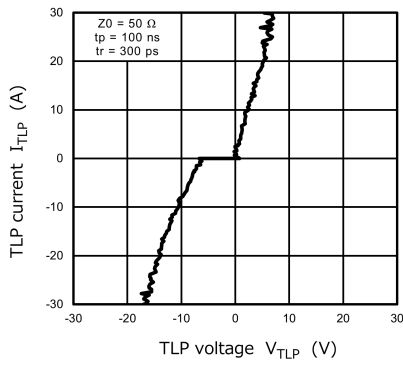


Fig. 10.4.1 $I_{TLP} - V_{TLP}$

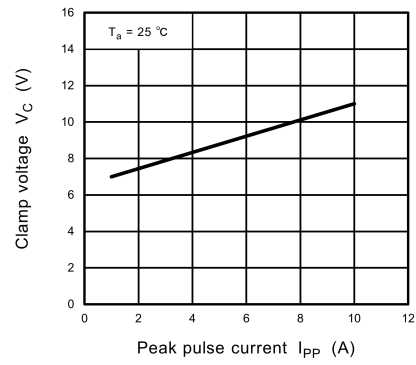


Fig. 10.4.2 $V_C - I_{PP}$

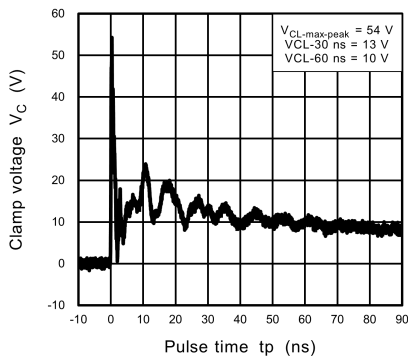


Fig. 10.4.3 IEC61000-4-2
Clamp Waveform +8 kV

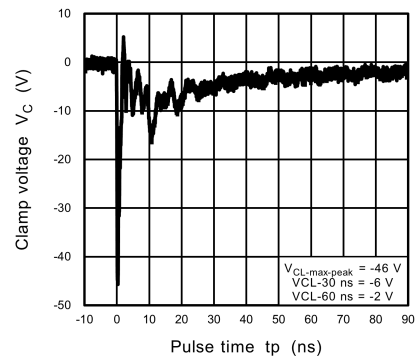


Fig. 10.4.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MUZ7V5 Characteristics Curves(Note)

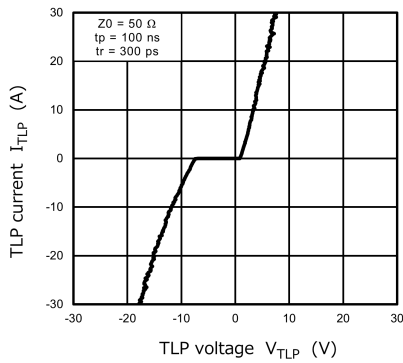


Fig. 10.5.1 $I_{TLP} - V_{TLP}$

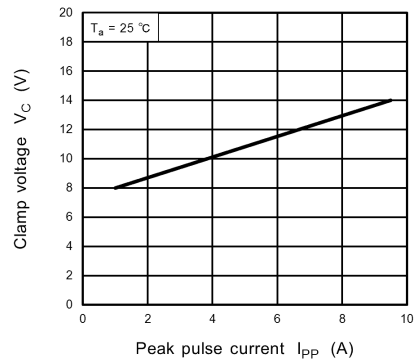
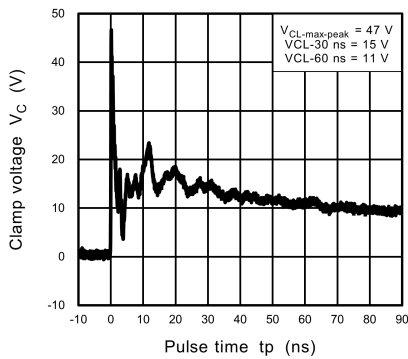
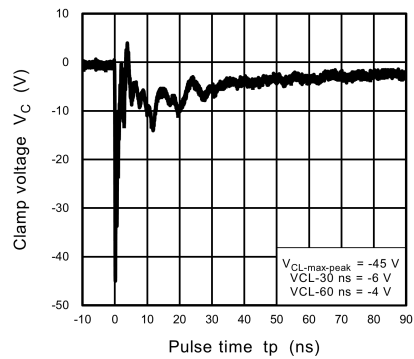


Fig. 10.5.2 $V_C - I_{PP}$



**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. MUZ8V2 Characteristics Curves(Note)

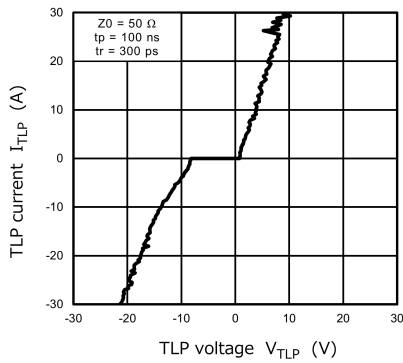


Fig. 10.6.1 $I_{TLP} - V_{TLP}$

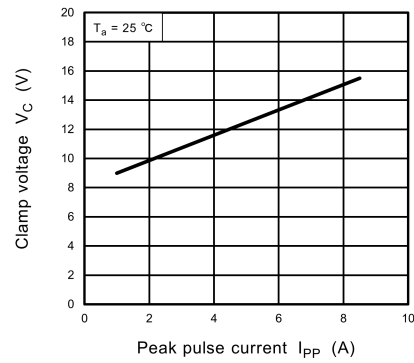


Fig. 10.6.2 $V_C - I_{PP}$

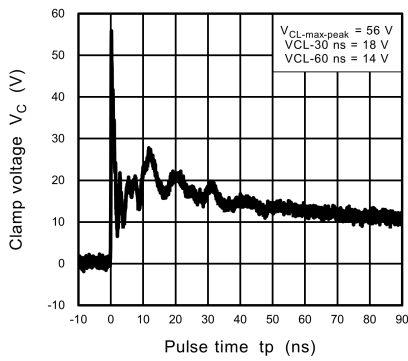


Fig. 10.6.3 IEC61000-4-2
Clamp Waveform +8 kV

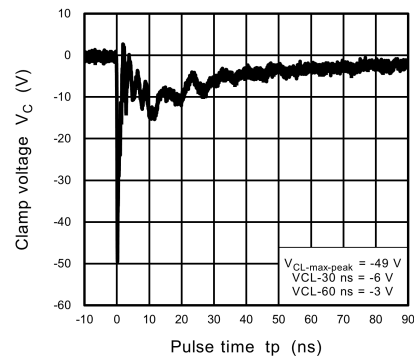


Fig. 10.6.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MUZ9V1 Characteristics Curves(Note)

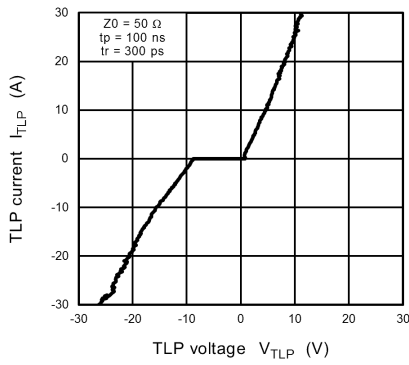


Fig. 10.7.1 $I_{TLP} - V_{TLP}$

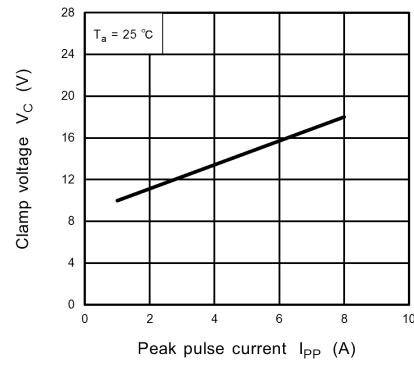
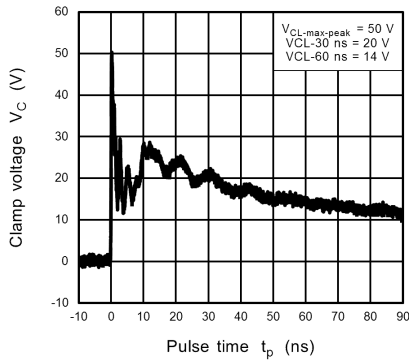
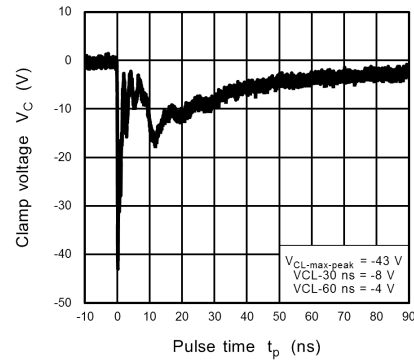


Fig. 10.7.2 $V_C - I_{PP}$



**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. MUZ10V Characteristics Curves(Note)

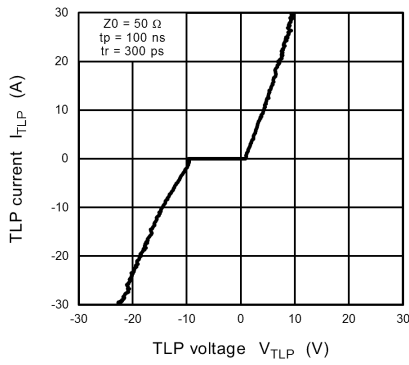


Fig. 10.8.1 $I_{TLP} - V_{TLP}$

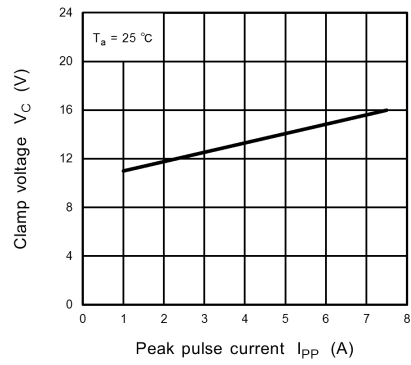
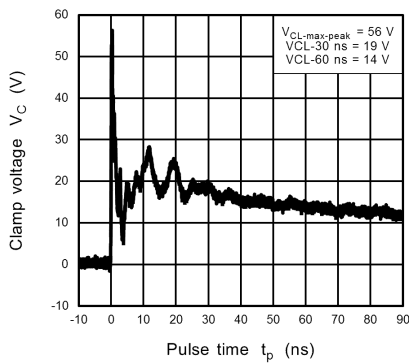
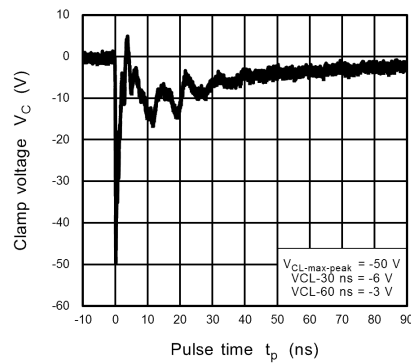


Fig. 10.8.2 $V_C - I_{PP}$



**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. MUZ11V Characteristics Curves(Note)

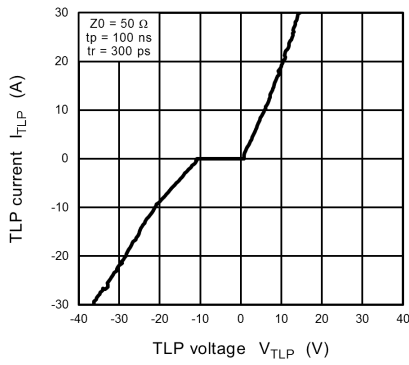


Fig. 10.9.1 $I_{TLP} - V_{TLP}$

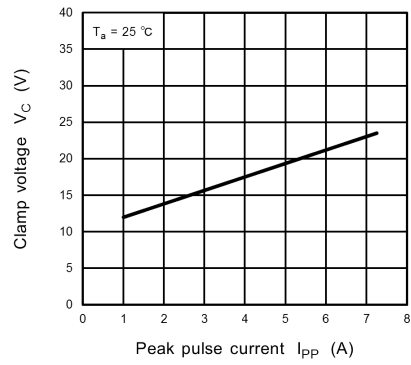


Fig. 10.9.2 $V_C - I_{PP}$

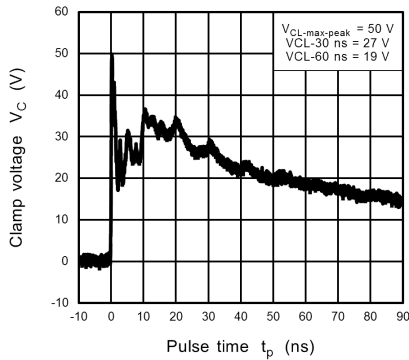


Fig. 10.9.3 IEC61000-4-2
Clamp Waveform +8 kV

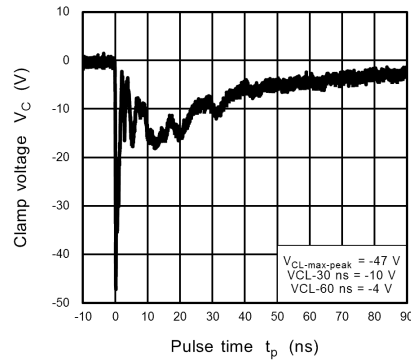


Fig. 10.9.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MUZ12V Characteristics Curves(Note)

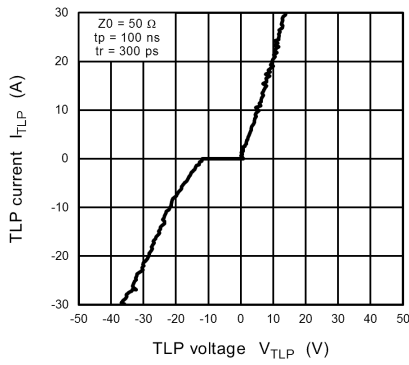


Fig. 10.10.1 $I_{TLP} - V_{TLP}$

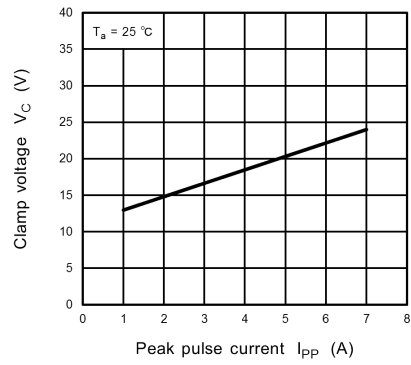
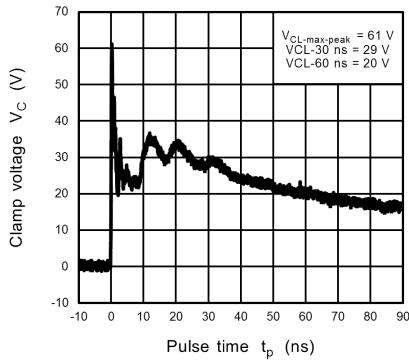
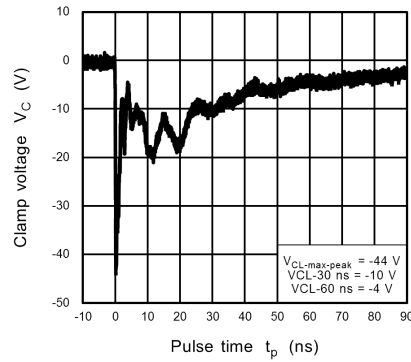


Fig. 10.10.2 $V_C - I_{PP}$



**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. MUZ13V Characteristics Curves(Note)

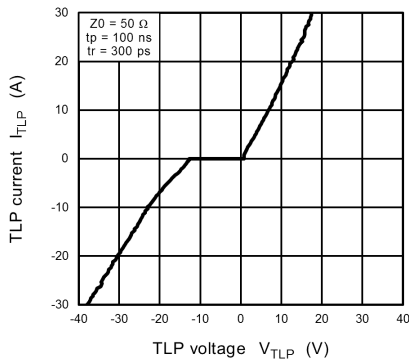


Fig. 10.11.1 $I_{TLP} - V_{TLP}$

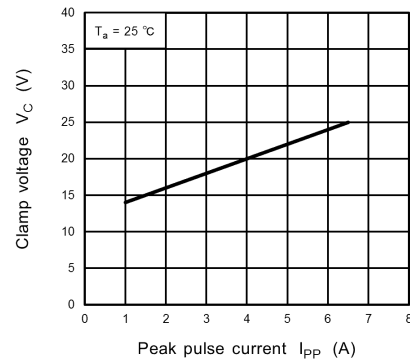
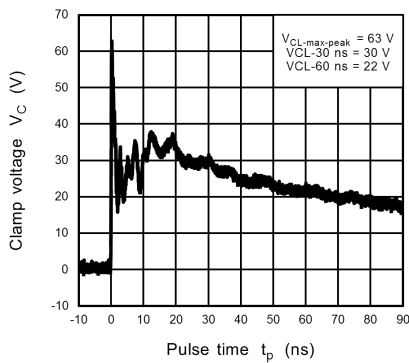
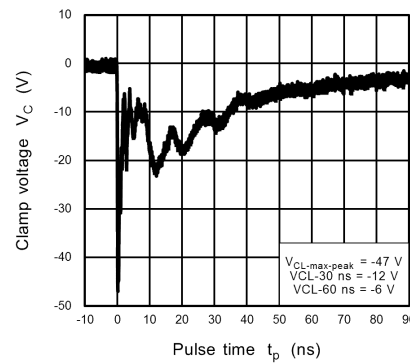


Fig. 10.11.2 $V_C - I_{PP}$



**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. MUZ15V Characteristics Curves(Note)

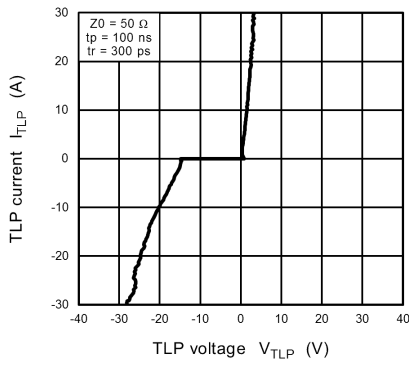


Fig. 10.12.1 $I_{TLP} - V_{TLP}$

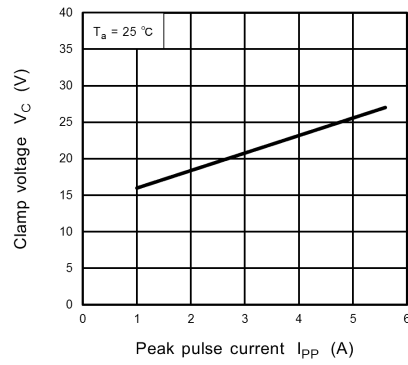
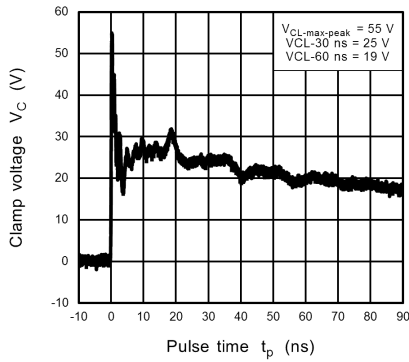
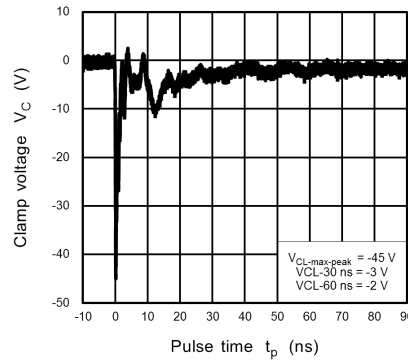


Fig. 10.12.2 $V_C - I_{PP}$



**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. MUZ16V Characteristics Curves(Note)

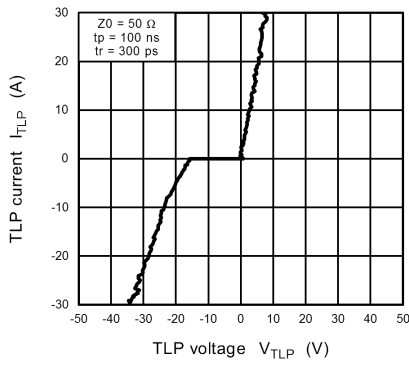


Fig. 10.13.1 $I_{TLP} - V_{TLP}$

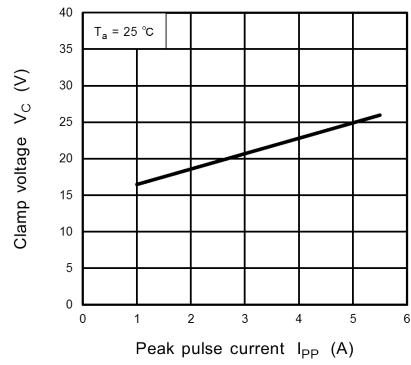
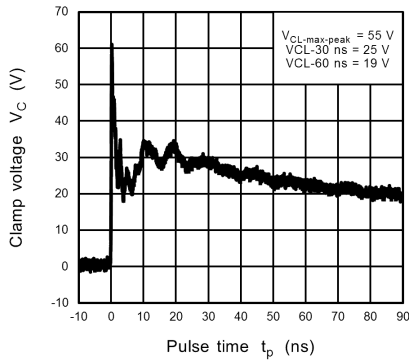
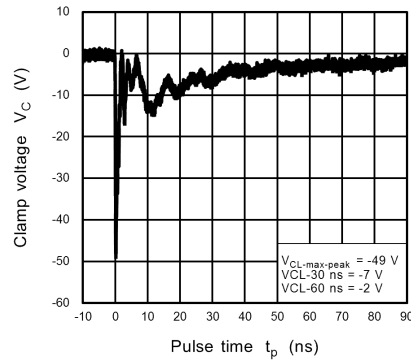


Fig. 10.13.2 $V_C - I_{PP}$



**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. MUZ18V Characteristics Curves(Note)

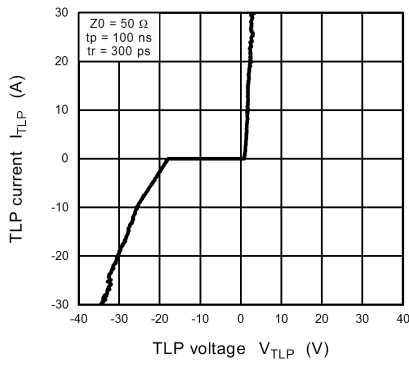


Fig. 10.14.1 $I_{TLP} - V_{TLP}$

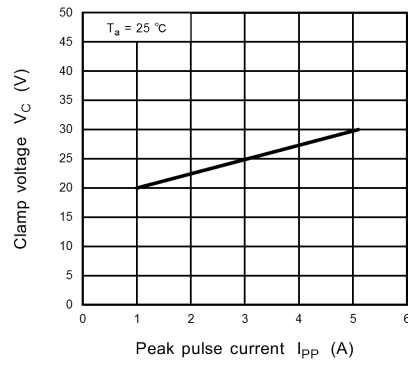
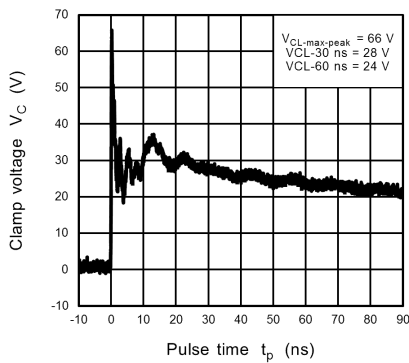
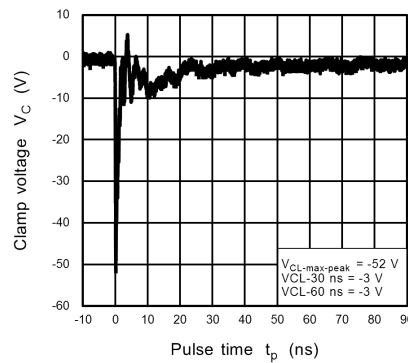


Fig. 10.14.2 $V_C - I_{PP}$



**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. MUZ20V Characteristics Curves(Note)

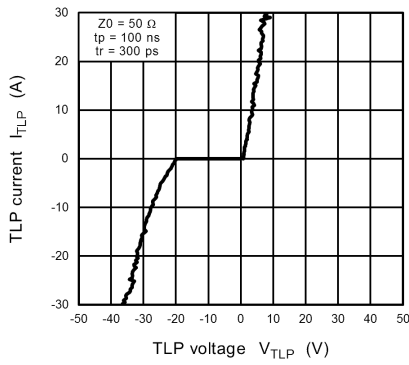


Fig. 10.15.1 $I_{TLP} - V_{TLP}$

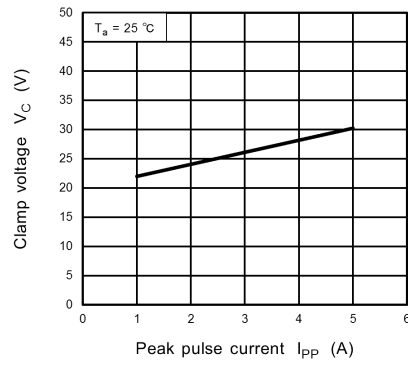
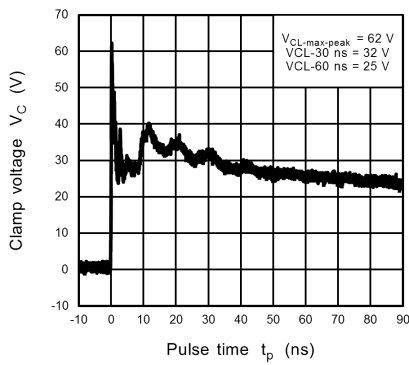
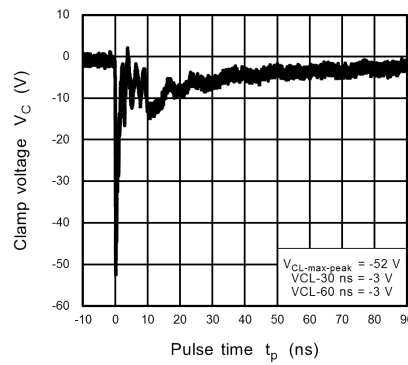


Fig. 10.15.2 $V_C - I_{PP}$



**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. MUZ22V Characteristics Curves(Note)

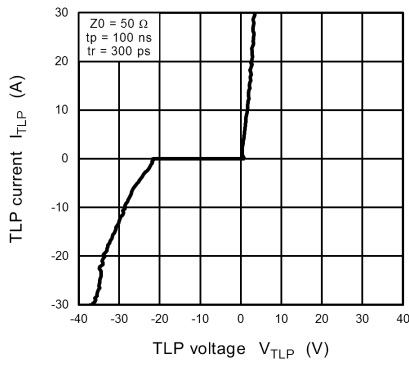


Fig. 10.16.1 $I_{TLP} - V_{TLP}$

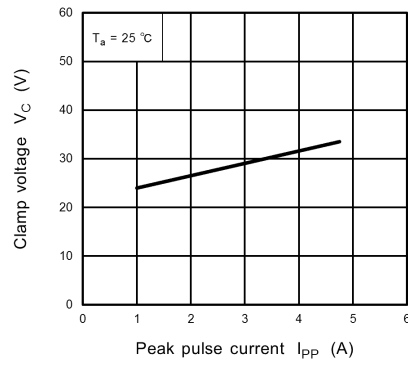
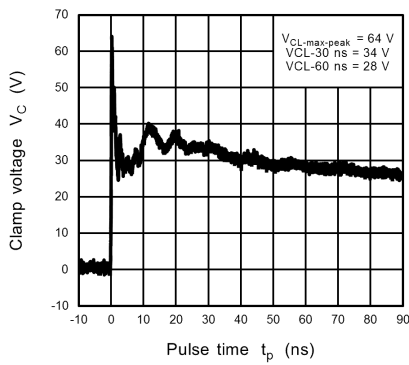
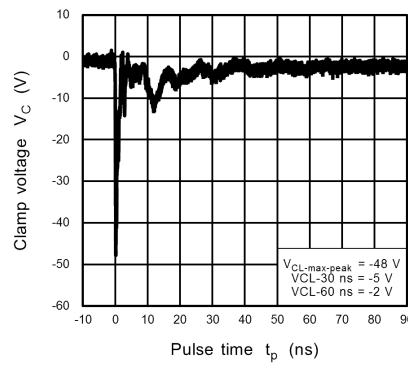


Fig. 10.16.2 $V_C - I_{PP}$



**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. MUZ24V Characteristics Curves(Note)

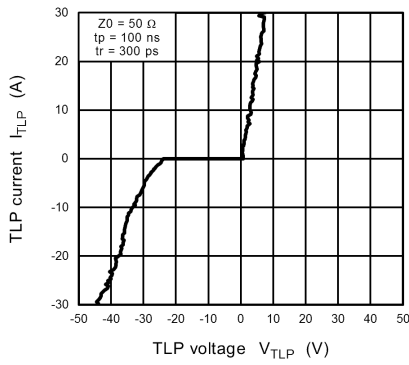


Fig. 10.17.1 $I_{TLP} - V_{TLP}$

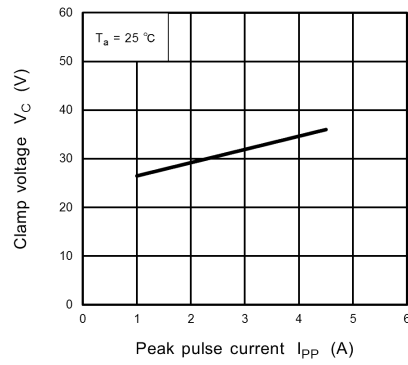
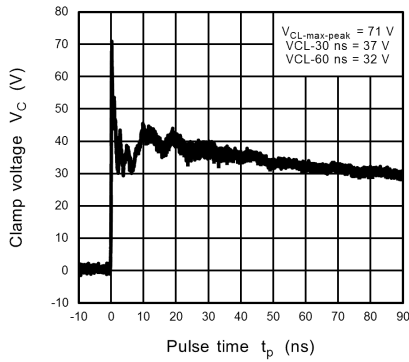
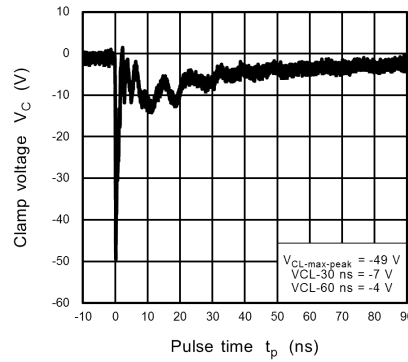


Fig. 10.17.2 $V_C - I_{PP}$



**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. MUZ27V Characteristics Curves(Note)

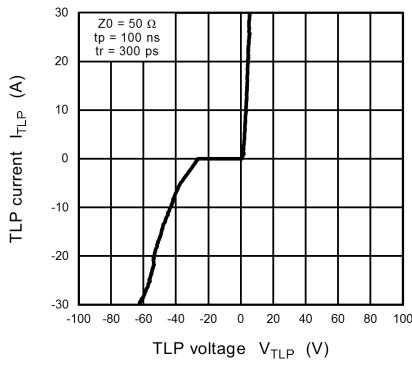


Fig. 10.18.1 $I_{TLP} - V_{TLP}$

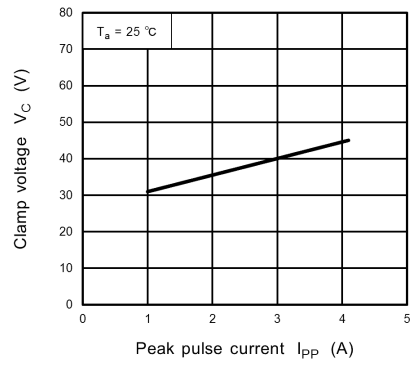
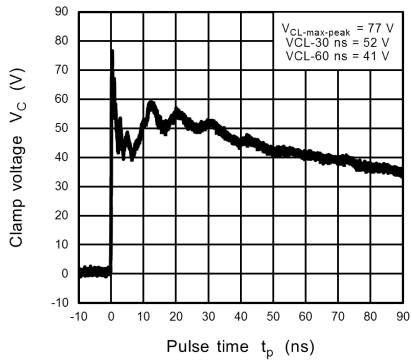
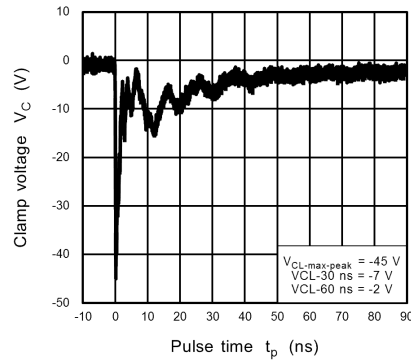


Fig. 10.18.2 $V_C - I_{PP}$



**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. MUZ30V Characteristics Curves(Note)

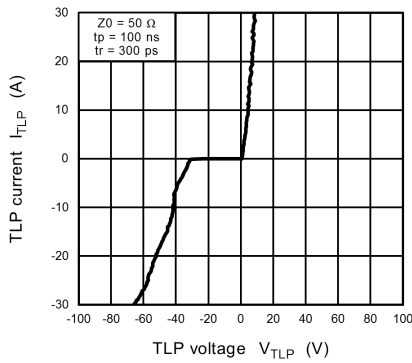


Fig. 10.19.1 $I_{TLP} - V_{TLP}$

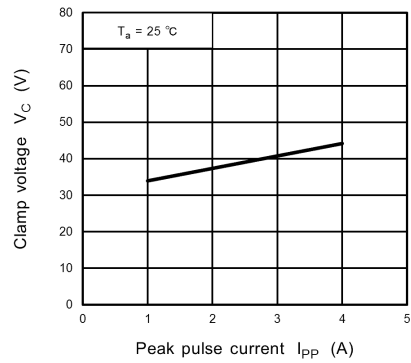


Fig. 10.19.2 $V_C - I_{PP}$

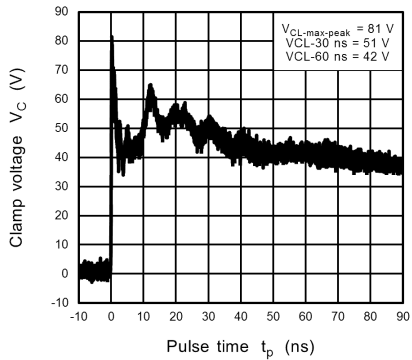


Fig. 10.19.3 IEC61000-4-2
Clamp Waveform +8 kV

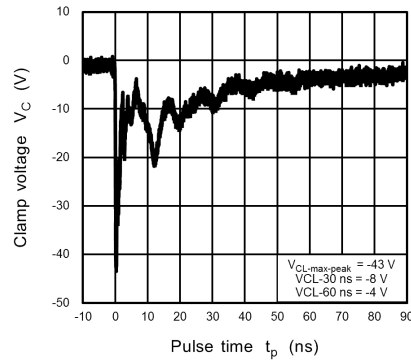


Fig. 10.19.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MUZ33V Characteristics Curves(Note)

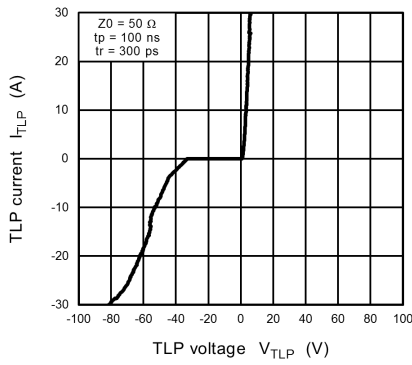


Fig. 10.20.1 $I_{TLP} - V_{TLP}$

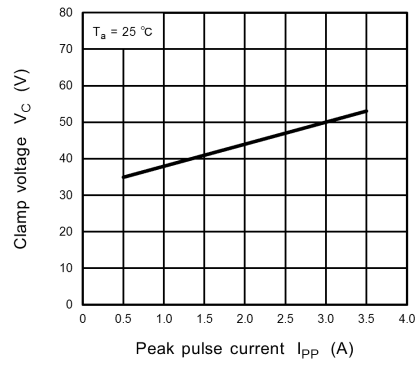
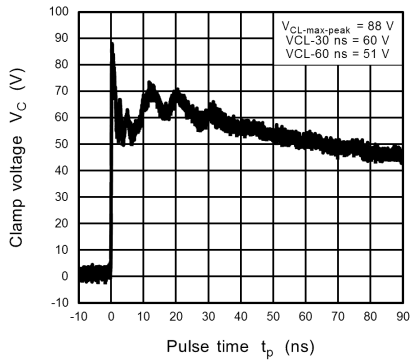
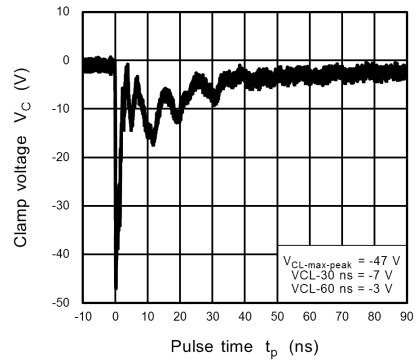


Fig. 10.20.2 $V_C - I_{PP}$



**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. MUZ36V Characteristics Curves(Note)

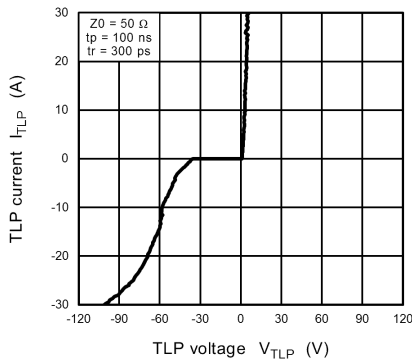


Fig. 10.21.1 $I_{TLP} - V_{TLP}$

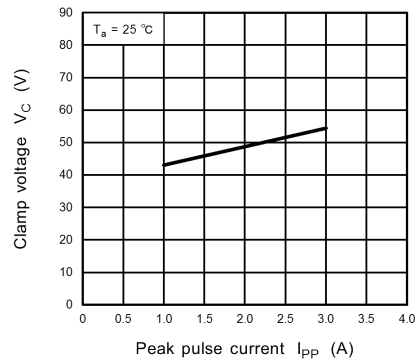


Fig. 10.21.2 $V_C - I_{PP}$

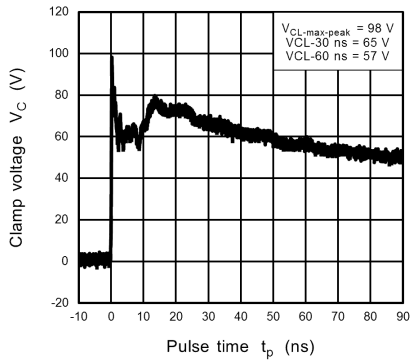


Fig. 10.21.3 IEC61000-4-2
Clamp Waveform +8 kV

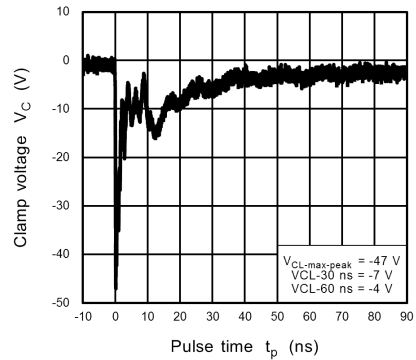


Fig. 10.21.4 IEC61000-4-2
Clamp Waveform -8 kV

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

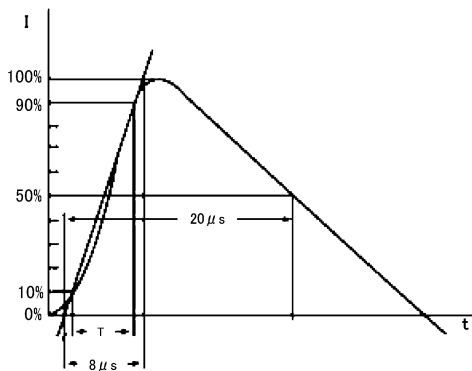


Fig. 10.22.1 V_C-I_{PP} Peak Pulse Current
(according to IEC61000-4-5 8/20 μ s pulse)

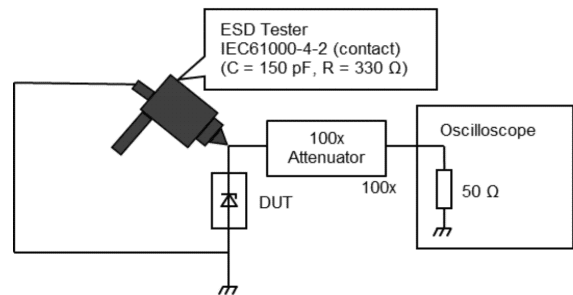
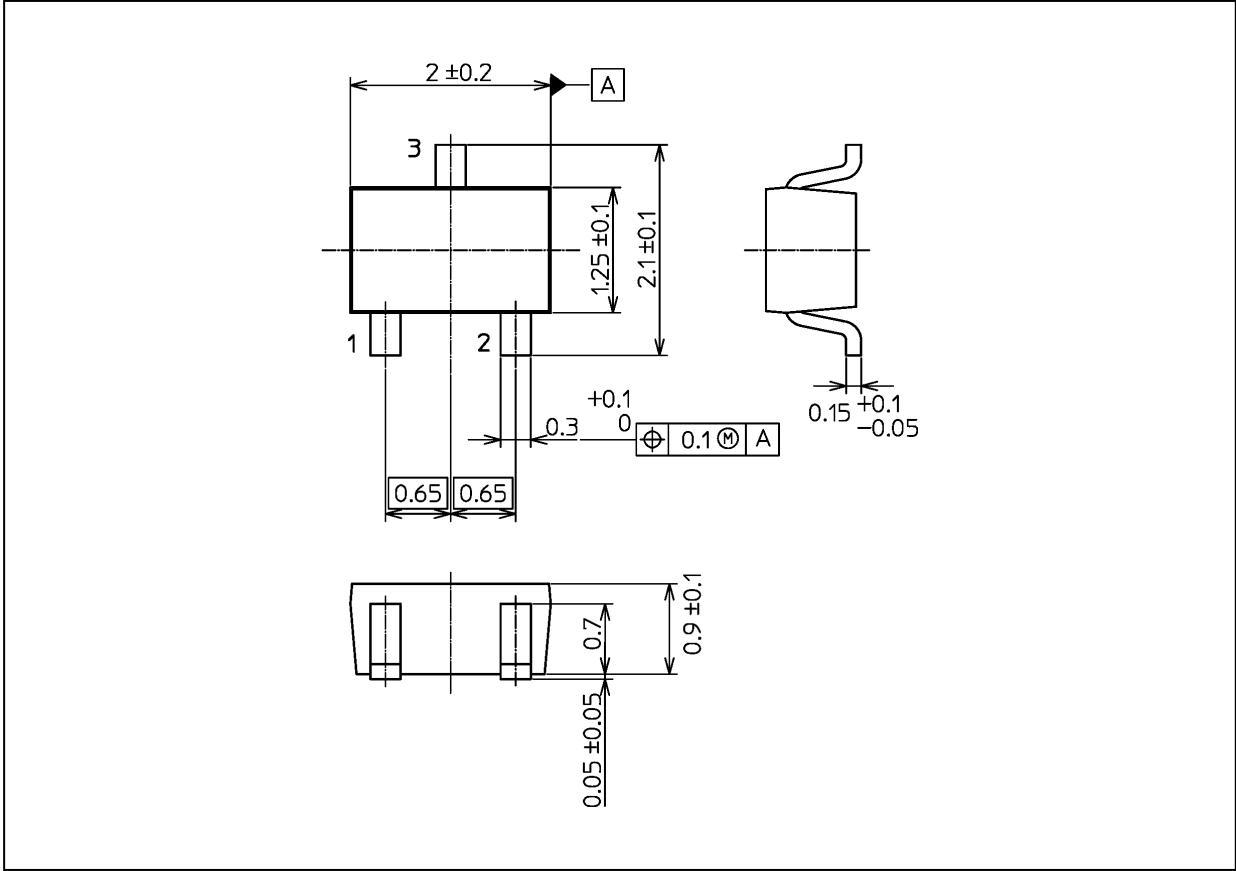


Fig. 10.22.2 Clamp waveform measurement
circuit (according to IEC61000-4-2)

Package Dimensions

Unit: mm



Weight: 6.0 mg (typ.)

Package Name(s)
Nickname: USM

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