

MKZ series

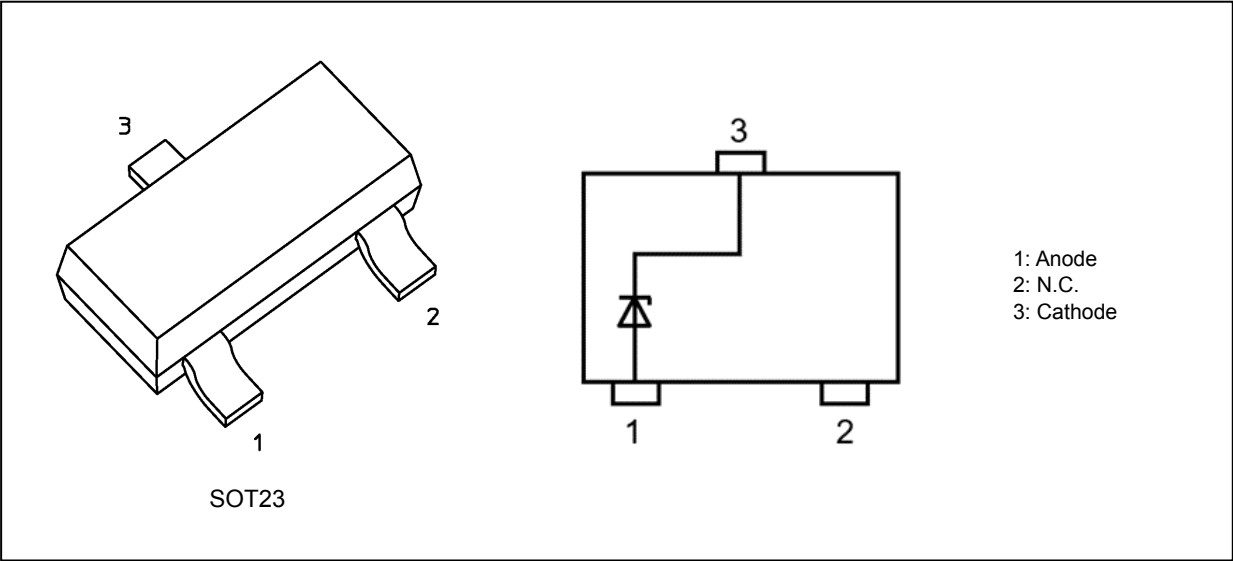
1. Applications

- (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	(Note 1)	320	mW
		(Note 2)	1000	
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: 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
2022-02

5. Absolute Maximum Ratings 2 (Note) (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$)

Type No.	Electrostatic discharge voltage (Contact, Air) $V_{ESD}(\text{kV})$ (Note 1)	Peak pulse power $P_{PK}(\text{W})$ (Note 2)	Peak pulse current $I_{PP}(\text{A})$ (Note 2)
MKZ5V6	± 30	155	12.0
MKZ6V2	± 30	175	11.0
MKZ6V8	± 30	180	10.0
MKZ7V5	± 30	190	9.5
MKZ8V2	± 30	200	8.5
MKZ9V1	± 30	200	8.0
MKZ10V	± 30	200	7.5
MKZ11V	± 30	200	7.25
MKZ12V	± 30	200	7.0
MKZ13V	± 30	200	6.5
MKZ15V	± 30	200	5.6
MKZ16V	± 30	200	5.5
MKZ18V	± 30	200	5.1
MKZ20V	± 30	200	5.0
MKZ22V	± 30	200	4.75
MKZ24V	± 30	200	4.5
MKZ27V	± 20	200	4.1
MKZ30V	± 20	200	4.0
MKZ33V	± 17	200	3.5
MKZ36V	± 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 ($t_p = 8 / 20\text{ }\mu\text{s}$)

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)
MKZ5V6	5.3	5.6	6.0	5	30	5	0.16	9.0	125	1	3.5
MKZ6V2	5.8	6.2	6.6	5	30	5	0.21	10.0	105	2.5	5.0
MKZ6V8	6.4	6.8	7.2	5	30	5	0.27	13.0	88	1.5	5.5
MKZ7V5	7.0	7.5	7.9	5	30	5	0.32	14.0	78	0.1	6.0
MKZ8V2	7.7	8.2	8.7	5	30	5	0.37	16.5	67	0.1	7.0
MKZ9V1	8.5	9.1	9.6	5	30	5	0.44	17.0	62	0.1	7.5
MKZ10V	9.4	10.0	10.6	5	30	5	0.52	19.0	60	0.1	8.0
MKZ11V	10.4	11.0	11.6	5	30	5	0.60	24.0	48	0.1	9.0
MKZ12V	11.4	12.0	12.6	5	30	5	0.70	26.0	44	0.1	10.0
MKZ13V	12.4	13.0	14.1	5	30	5	0.80	27.0	42	0.1	11.0
MKZ15V	13.8	15.0	15.6	5	30	5	0.60	24.0	36	0.1	12.0
MKZ16V	15.3	16.0	17.1	5	35	5	0.50	27.0	35	0.1	14.0
MKZ18V	16.8	18.0	19.1	5	45	5	0.40	28.5	31	0.1	16.0
MKZ20V	18.8	20.0	21.2	5	70	5	0.35	30.5	29	0.1	17.6
MKZ22V	20.8	22.0	23.3	5	70	5	0.40	32.0	27	0.1	18.0
MKZ24V	22.8	24.0	25.6	5	70	5	0.60	36.5	26	0.1	19.0
MKZ27V	25.1	27.0	28.9	2	70	2	0.90	45.0	23	0.1	23.0
MKZ30V	28.0	30.0	32.0	2	100	2	1.25	47.5	21	0.1	27.0
MKZ33V	31.0	33.0	35.0	2	100	2	1.80	57.0	19	0.1	30.0
MKZ36V	34.0	36.0	38.0	2	100	2	2.60	63.0	18	0.1	32.5

Note1: TLP parameters: $Z_0 = 50\text{ }\Omega$, $t_p = 100\text{ ns}$, $t_r = 300\text{ ps}$, 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
MKZ5V6	ZLL	MKZ11V	ZM3	MKZ22V	ZMA
MKZ6V2	ZLM	MKZ12V	ZM4	MKZ24V	ZMB
MKZ6V8	ZLN	MKZ13V	ZM5	MKZ27V	ZMC
MKZ7V5	ZLP	MKZ15V	ZM6	MKZ30V	ZMD
MKZ8V2	ZLQ	MKZ16V	ZM7	MKZ33V	ZME
MKZ9V1	ZLR	MKZ18V	ZM8	MKZ36V	ZMF
MKZ10V	ZM2	MKZ20V	ZM9	—	—

8. Marking

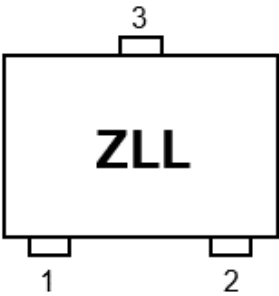


Fig. 8.1 MKZ5V6

9. Land Pattern Dimensions (for reference only)

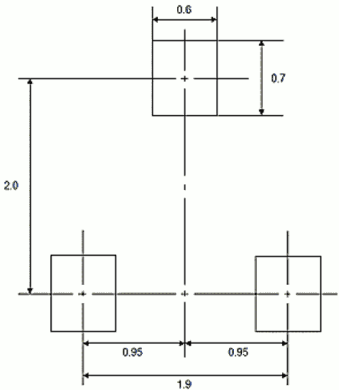


Fig. 9.1 Land Pattern Dimensions
(for reference only) (Unit: mm)

10. Characteristics Curves

10.1. MKZ series Characteristics Curves(Note)

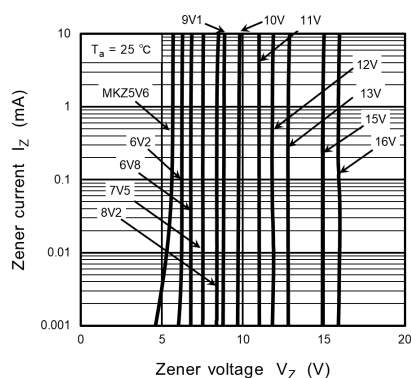


Fig. 10.1.1 $I_Z - V_Z(1)$

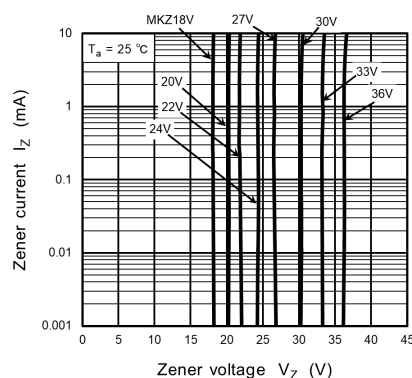


Fig. 10.1.2 $I_Z - V_Z(2)$

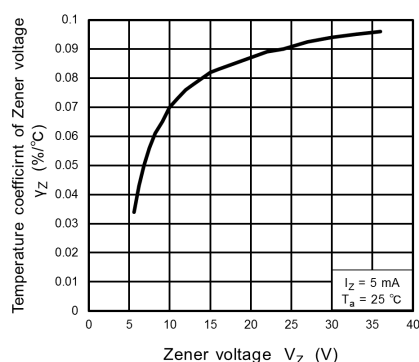


Fig. 10.1.3 $\gamma_Z - V_Z$

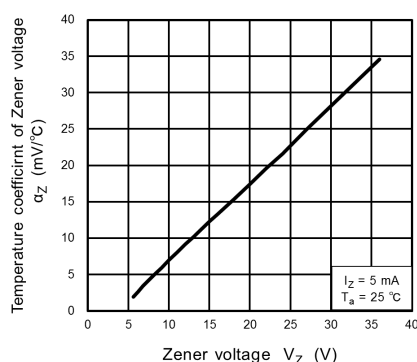


Fig. 10.1.4 $\alpha_Z - V_Z$

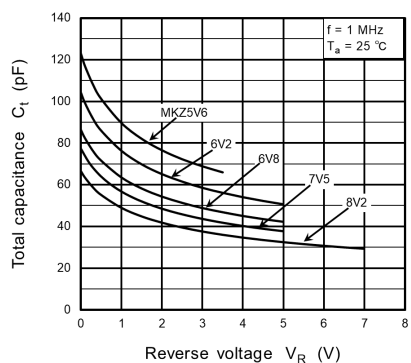


Fig. 10.1.5 $C_t - V_R (1)$

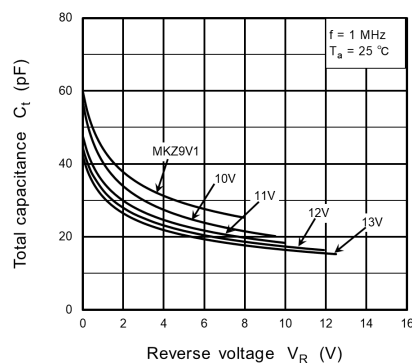


Fig. 10.1.6 $C_t - V_R (2)$

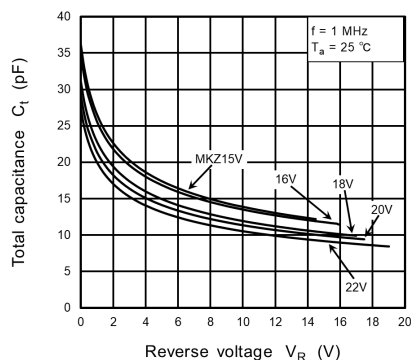


Fig. 10.1.7 $C_t - V_R (3)$

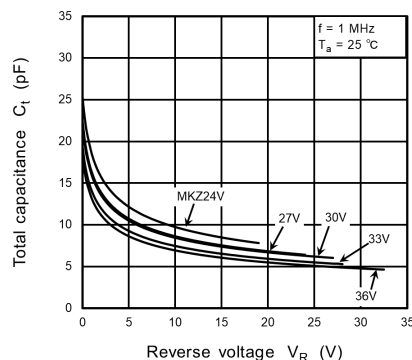


Fig. 10.1.8 $C_t - V_R (4)$

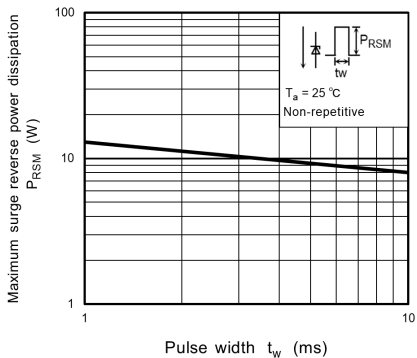


Fig. 10.1.9 $P_{RSM} - t_w$

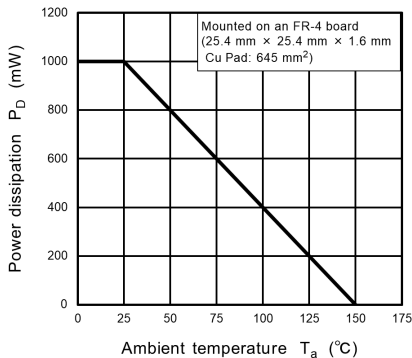


Fig. 10.1.10 $P_D - T_a$

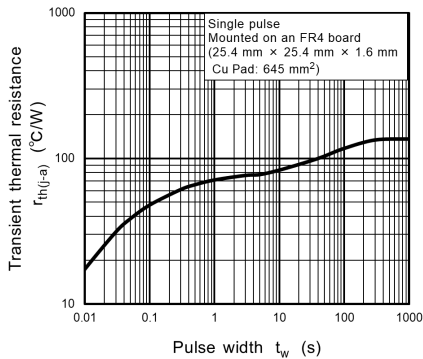


Fig. 10.1.11 $r_{th(j-a)} - t_w$

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

10.2. MKZ5V6 Characteristics Curves(Note)

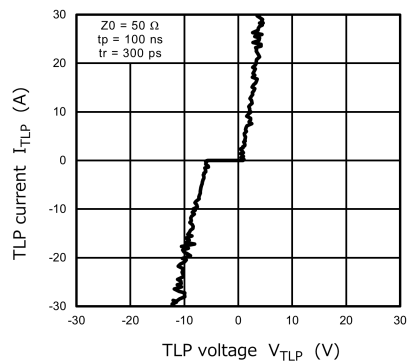


Fig. 10.2.1 $I_{TLP} - V_{TLP}$

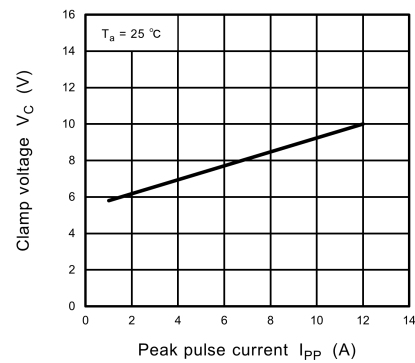


Fig. 10.2.2 $V_C - I_{PP}$

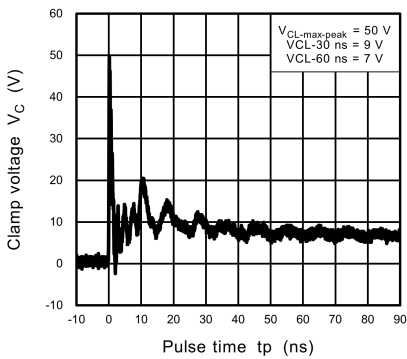


Fig. 10.2.3 IEC61000-4-2 Clamp
Waveform +8 kV

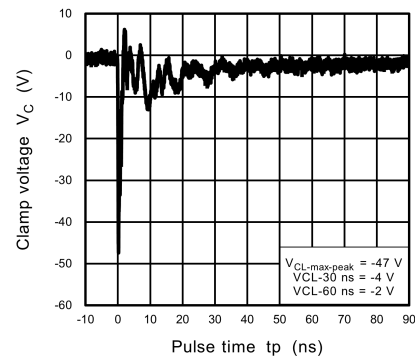


Fig. 10.2.4 IEC61000-4-2 Clamp
Waveform -8 kV

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. MKZ6V2 Characteristics Curves(Note)

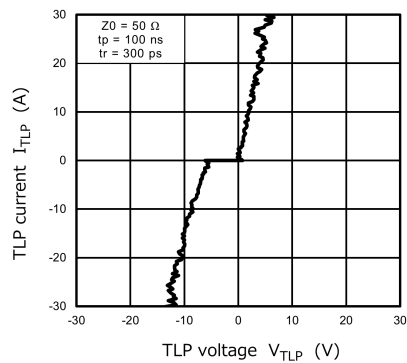


Fig. 10.3.1 $I_{TLP} - V_{TLP}$

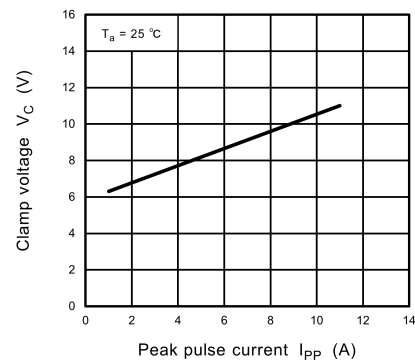


Fig. 10.3.2 $V_C - I_{PP}$

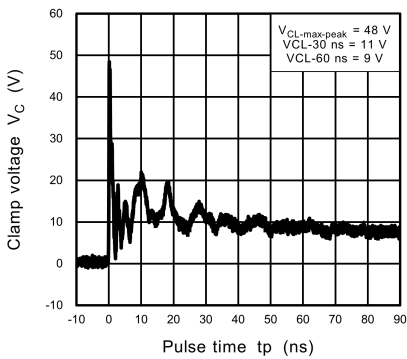


Fig. 10.3.3 IEC61000-4-2
Clamp Waveform +8 kV

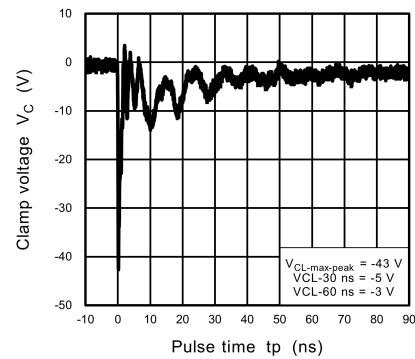


Fig. 10.3.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ6V8 Characteristics Curves(Note)

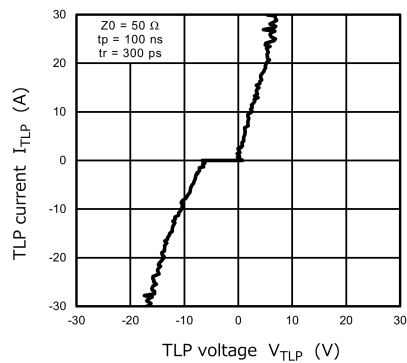


Fig. 10.4.1 $I_{TLP} - V_{TLP}$

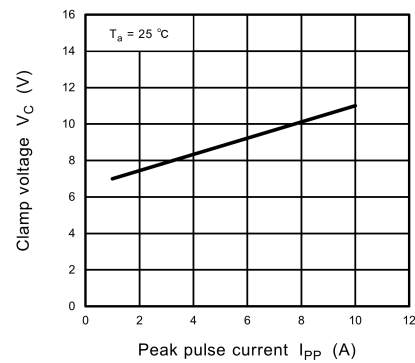


Fig. 10.4.2 $V_C - I_{PP}$

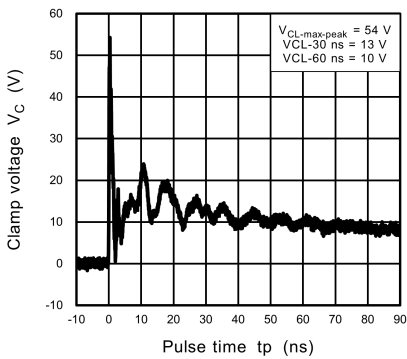


Fig. 10.4.3 IEC61000-4-2
Clamp Waveform +8 kV

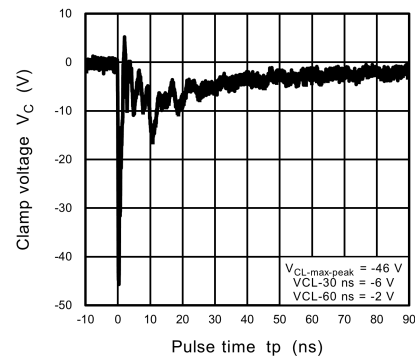


Fig. 10.4.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ7V5 Characteristics Curves(Note)

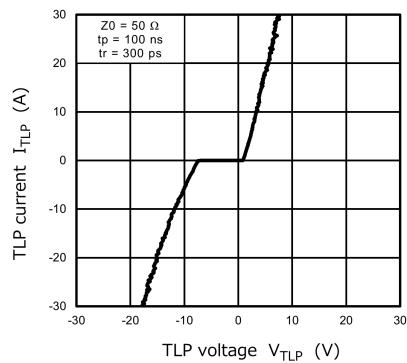


Fig. 10.5.1 $I_{TLP} - V_{TLP}$

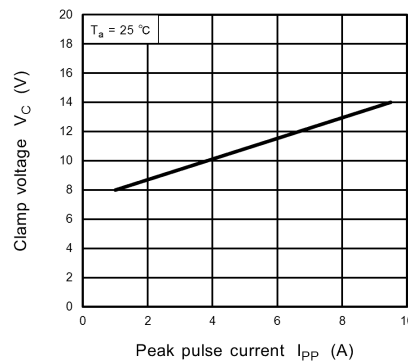


Fig. 10.5.2 $V_C - I_{PP}$

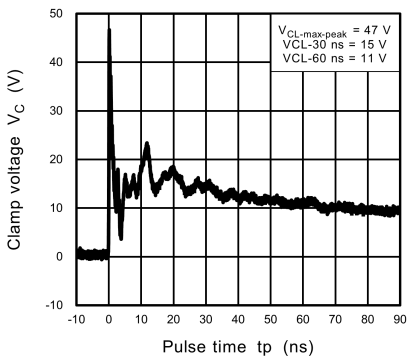


Fig. 10.5.3 IEC61000-4-2
Clamp Waveform +8 kV

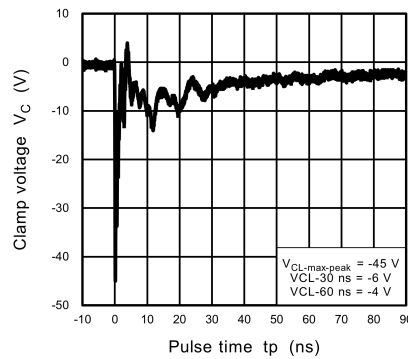


Fig. 10.5.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ8V2 Characteristics Curves(Note)

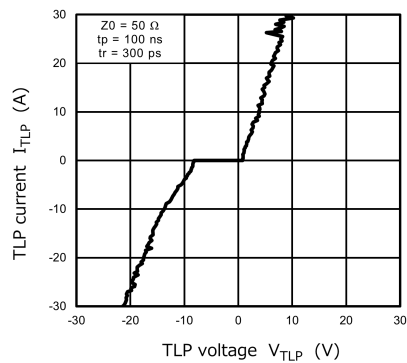


Fig. 10.6.1 $I_{TLP} - V_{TLP}$

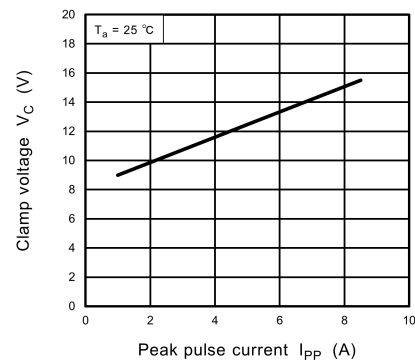


Fig. 10.6.2 $V_C - I_{PP}$

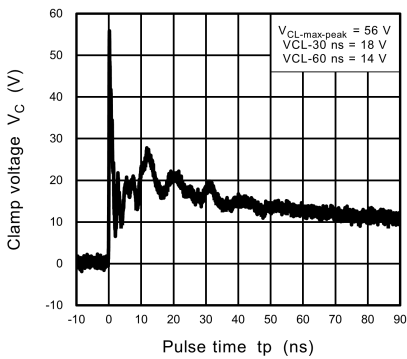


Fig. 10.6.3 IEC61000-4-2
Clamp Waveform +8 kV

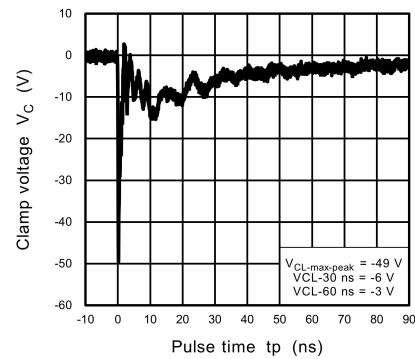


Fig. 10.6.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ9V1 Characteristics Curves(Note)

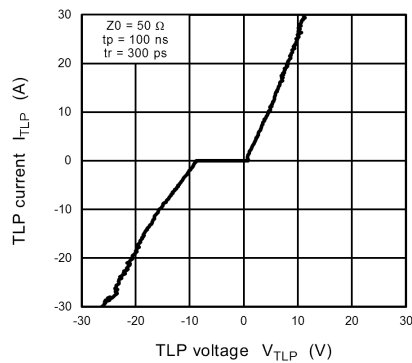


Fig. 10.7.1 $I_{TLP} - V_{TLP}$

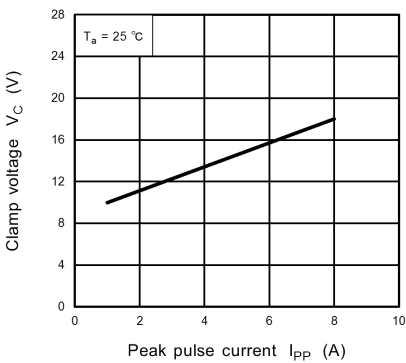


Fig. 10.7.2 $V_C - I_{PP}$

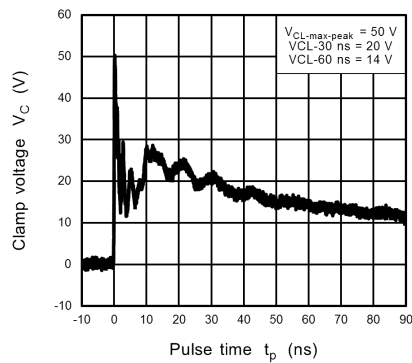


Fig. 10.7.3 IEC61000-4-2
Clamp Waveform +8 kV

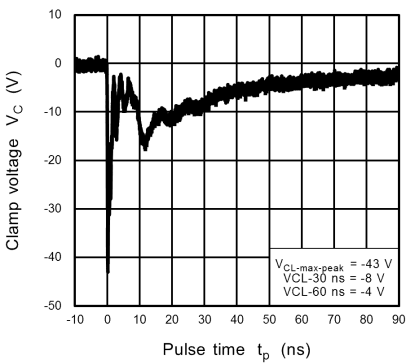


Fig. 10.7.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ10V Characteristics Curves(Note)

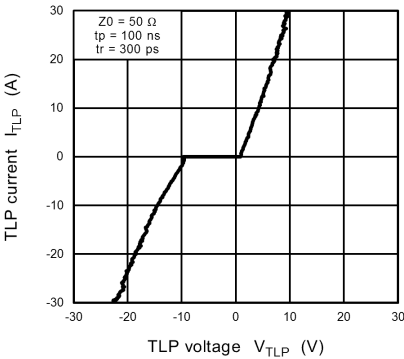


Fig. 10.8.1 $I_{TLP} - V_{TLP}$

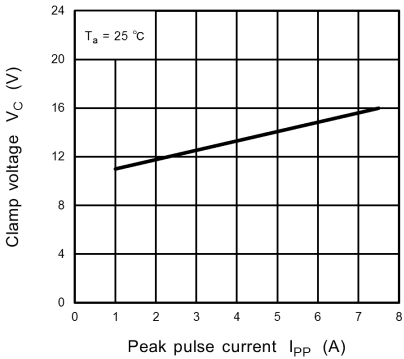


Fig. 10.8.2 $V_C - I_{PP}$

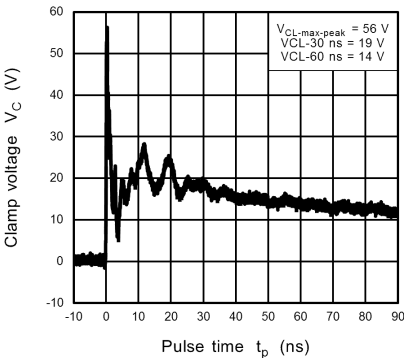


Fig. 10.8.3 IEC61000-4-2
Clamp Waveform +8 kV

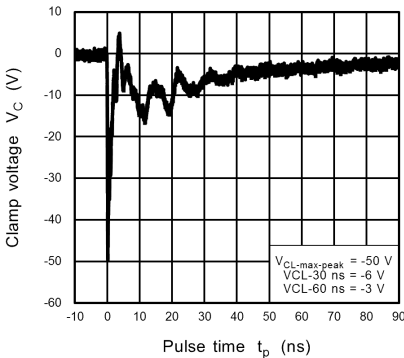


Fig. 10.8.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ11V Characteristics Curves(Note)

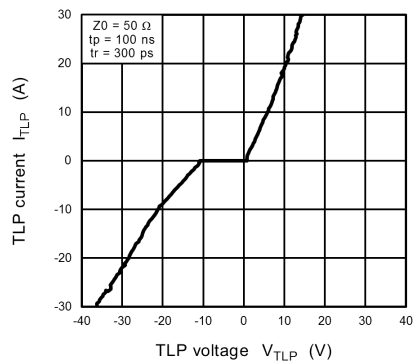


Fig. 10.9.1 $I_{TLP} - V_{TLP}$

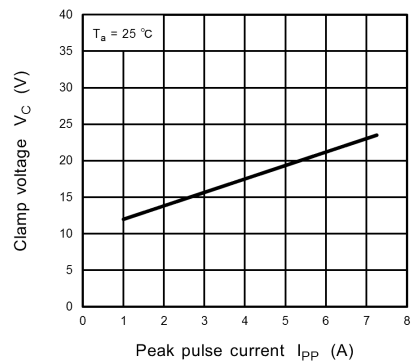


Fig. 10.9.2 $V_C - I_{PP}$

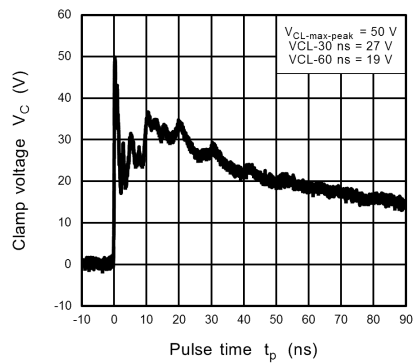


Fig. 10.9.3 IEC61000-4-2
Clamp Waveform +8 kV

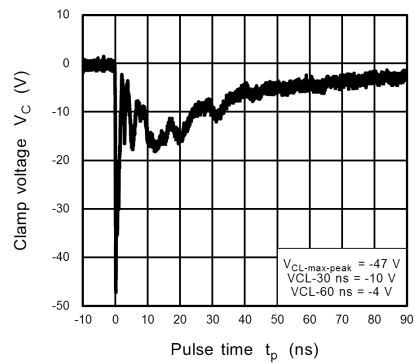


Fig. 10.9.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ12V Characteristics Curves(Note)

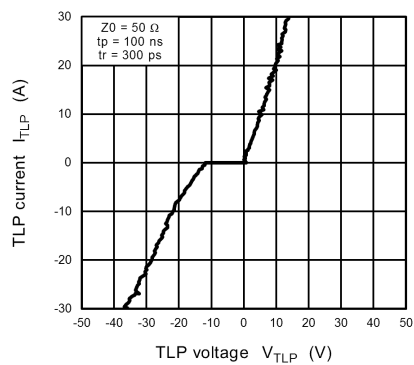


Fig. 10.10.1 $I_{TLP} - V_{TLP}$

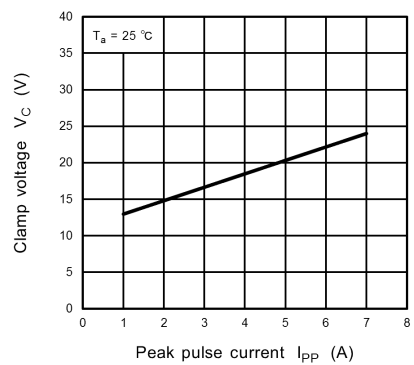


Fig. 10.10.2 $V_C - I_{PP}$

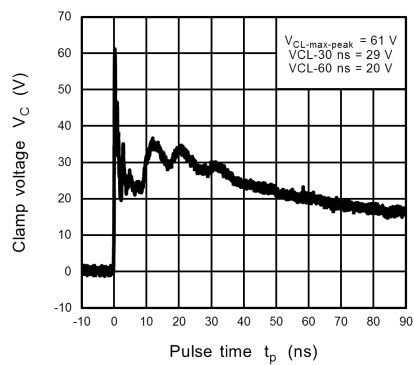


Fig. 10.10.3 IEC61000-4-2
Clamp Waveform +8 kV

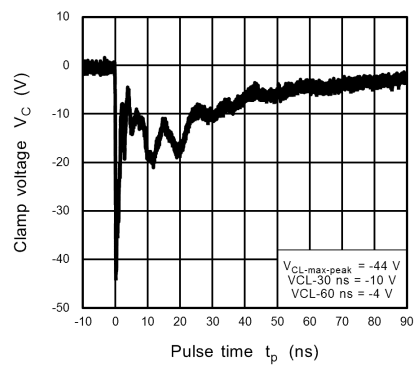


Fig. 10.10.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ13V Characteristics Curves(Note)

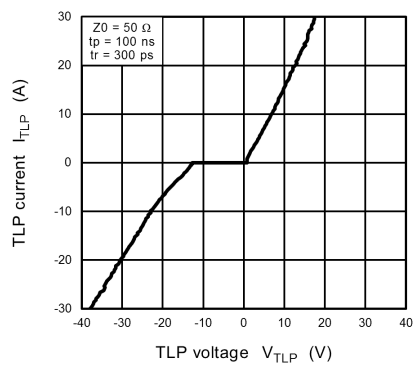


Fig. 10.11.1 $I_{TLP} - V_{TLP}$

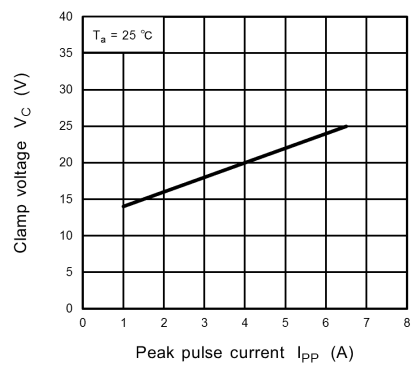


Fig. 10.11.2 $V_C - I_{PP}$

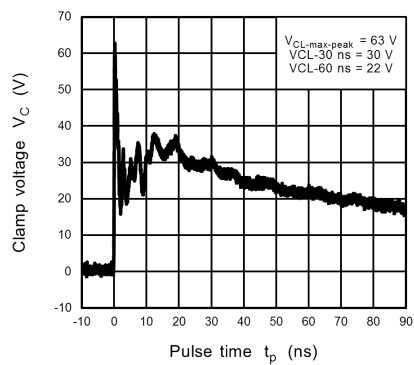


Fig. 10.11.3 IEC61000-4-2
Clamp Waveform +8 kV

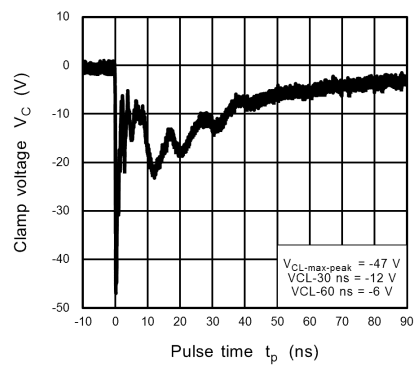


Fig. 10.11.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ15V Characteristics Curves(Note)

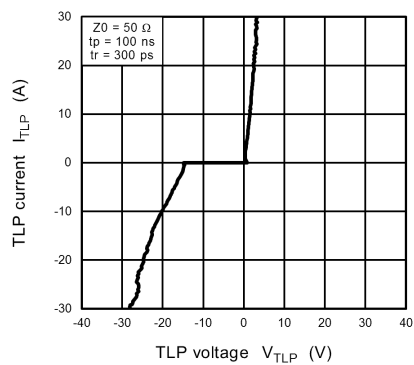


Fig. 10.12.1 $I_{TLP} - V_{TLP}$

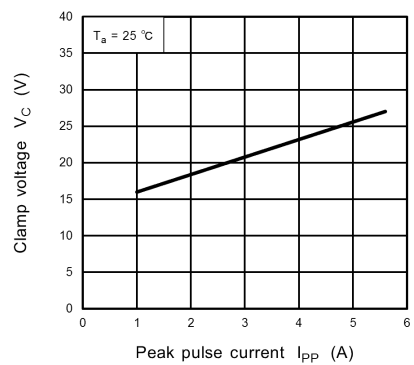


Fig. 10.12.2 $V_C - I_{PP}$

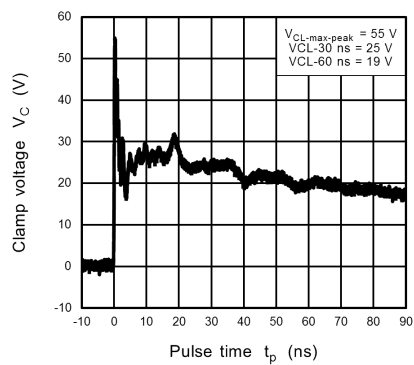


Fig. 10.12.3 IEC61000-4-2
Clamp Waveform +8 kV

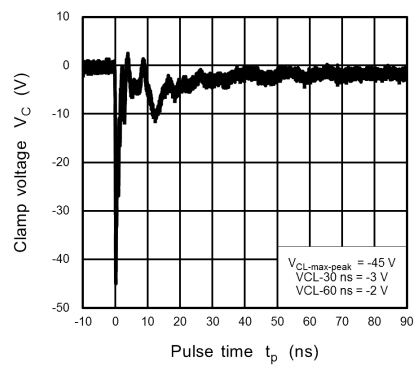


Fig. 10.12.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ16V Characteristics Curves(Note)

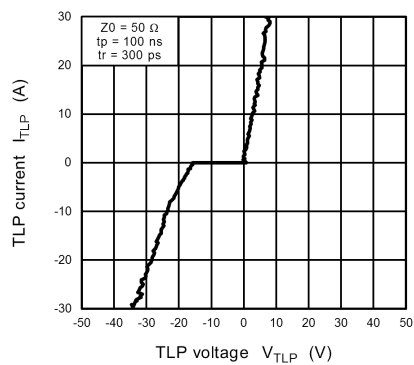


Fig. 10.13.1 $I_{TLP} - V_{TLP}$

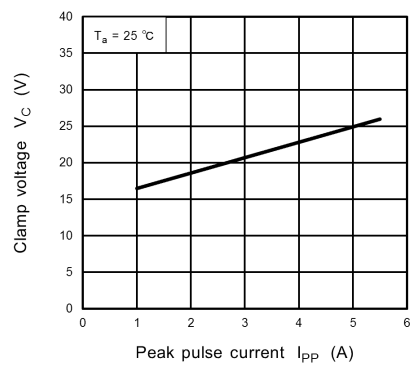


Fig. 10.13.2 $V_C - I_{PP}$

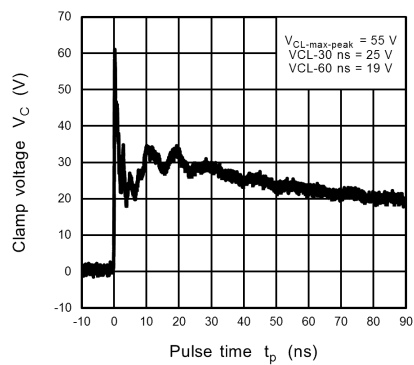


Fig. 10.13.3 IEC61000-4-2
Clamp Waveform +8 kV

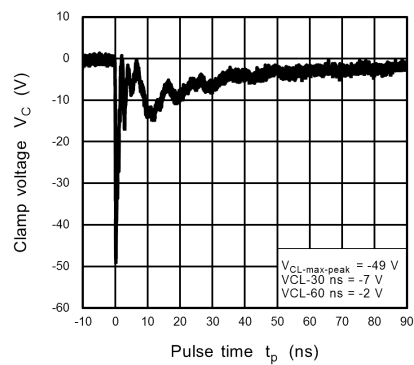


Fig. 10.13.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ18V Characteristics Curves(Note)

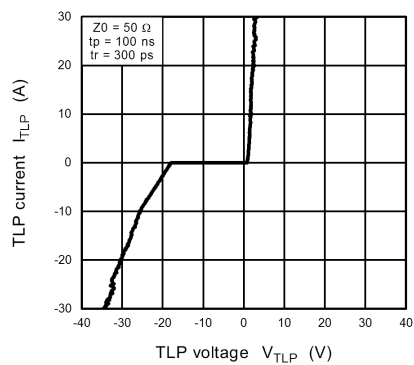


Fig. 10.14.1 $I_{TLP} - V_{TLP}$

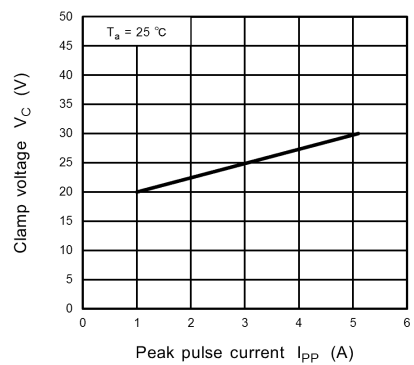


Fig. 10.14.2 $V_C - I_{PP}$

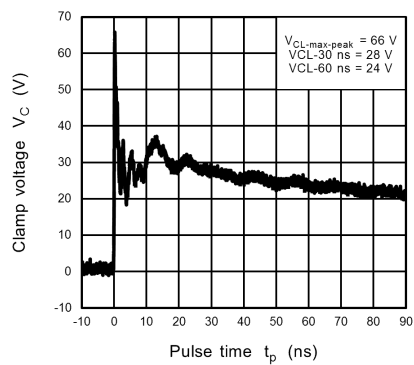


Fig. 10.14.3 IEC61000-4-2
Clamp Waveform +8 kV

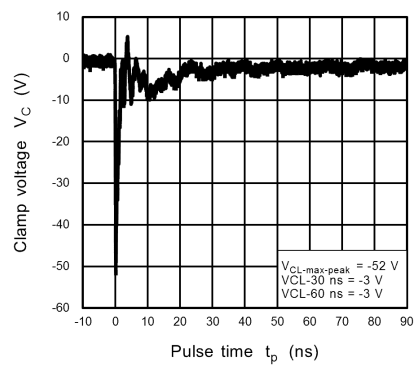


Fig. 10.14.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ20V Characteristics Curves(Note)

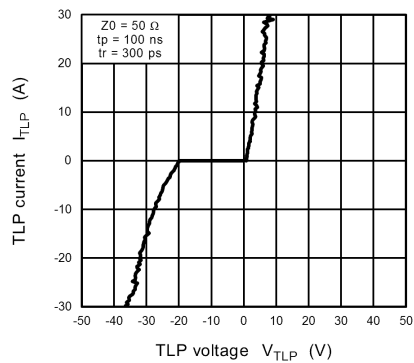


Fig. 10.15.1 $I_{TLP} - V_{TLP}$

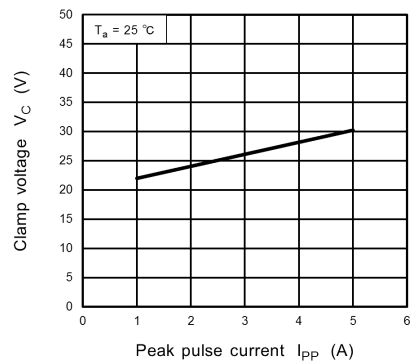


Fig. 10.15.2 $V_C - I_{PP}$

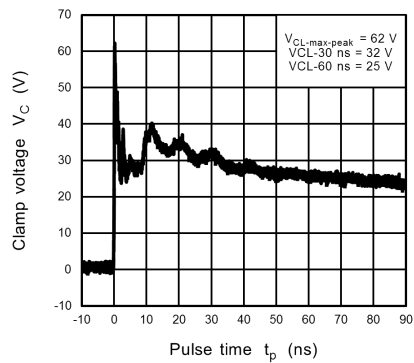


Fig. 10.15.3 IEC61000-4-2
Clamp Waveform +8 kV

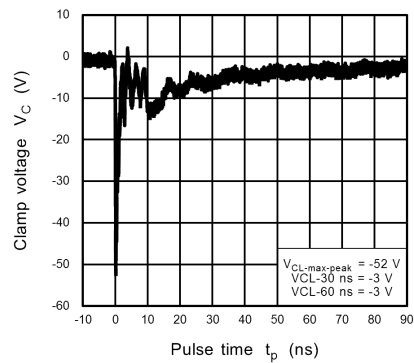


Fig. 10.15.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ22V Characteristics Curves(Note)

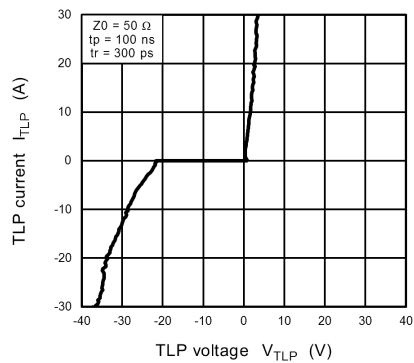


Fig. 10.16.1 $I_{TLP} - V_{TLP}$

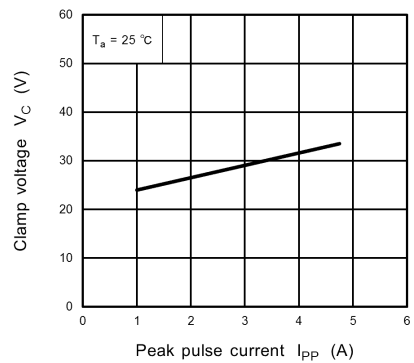


Fig. 10.16.2 $V_C - I_{PP}$

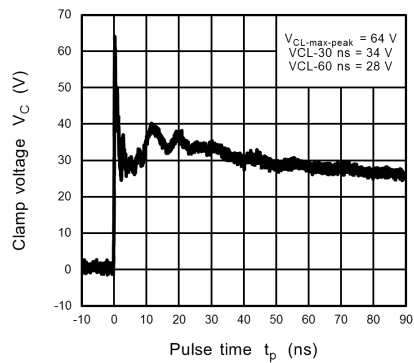


Fig. 10.16.3 IEC61000-4-2
Clamp Waveform +8 kV

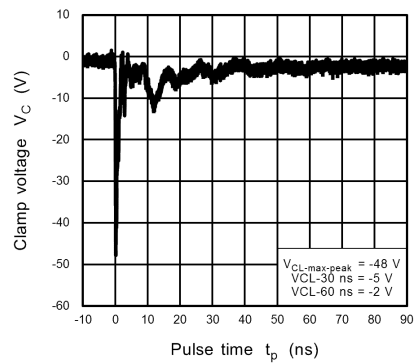


Fig. 10.16.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ24V Characteristics Curves(Note)

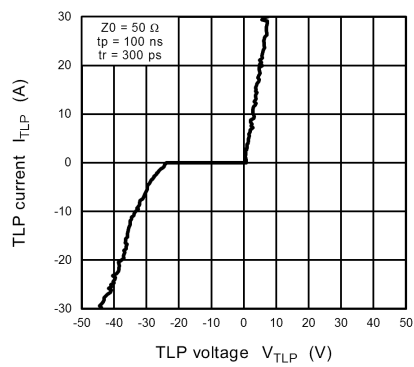


Fig. 10.17.1 $I_{TLP} - V_{TLP}$

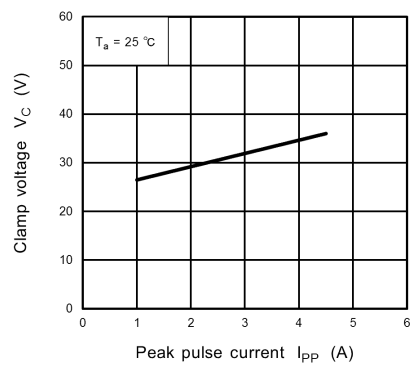


Fig. 10.17.2 $V_C - I_{PP}$

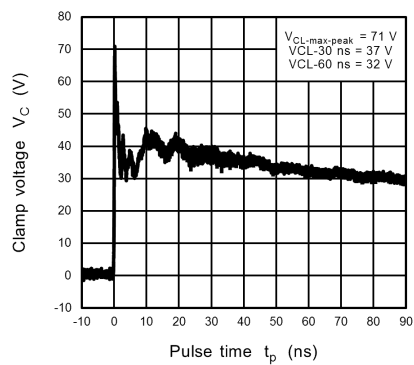


Fig. 10.17.3 IEC61000-4-2
Clamp Waveform +8 kV

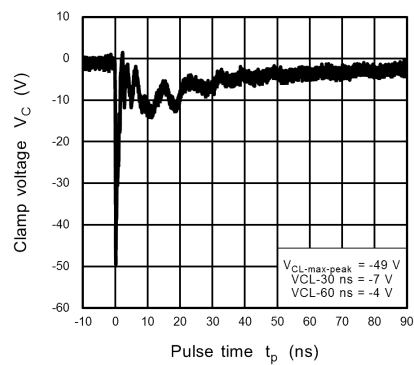


Fig. 10.17.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ27V Characteristics Curves(Note)

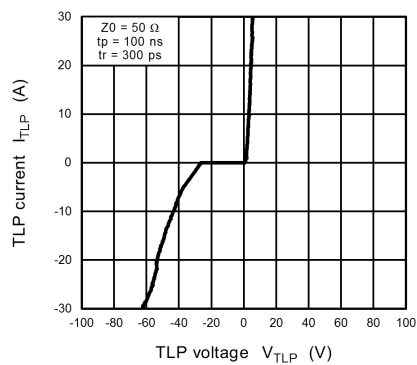


Fig. 10.18.1 $I_{TLP} - V_{TLP}$

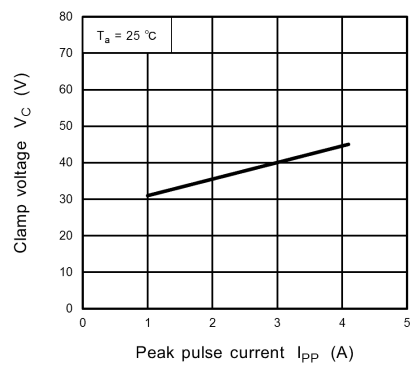


Fig. 10.18.2 $V_C - I_{PP}$

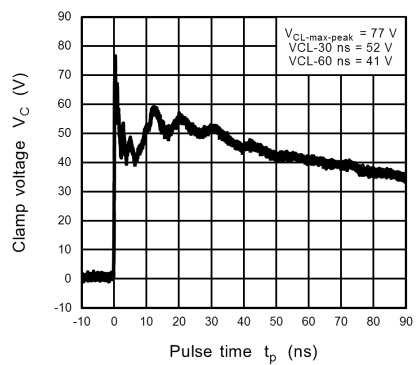


Fig. 10.18.3 IEC61000-4-2
Clamp Waveform +8 kV

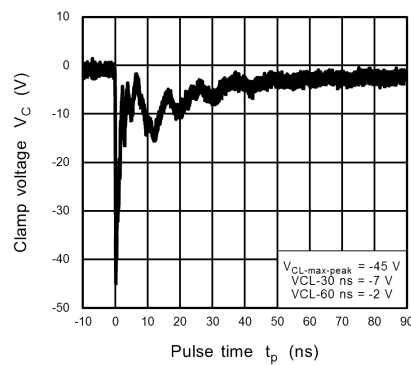


Fig. 10.18.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ30V Characteristics Curves(Note)

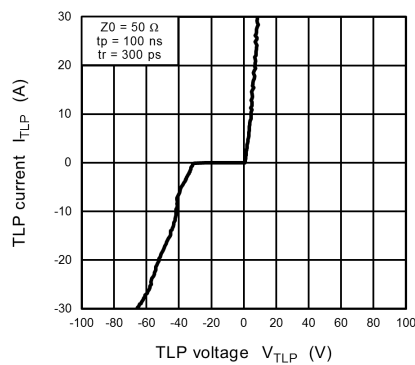


Fig. 10.19.1 $I_{TLP} - V_{TLP}$

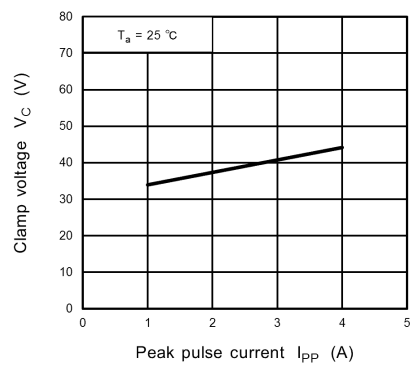


Fig. 10.19.2 $V_C - I_{PP}$

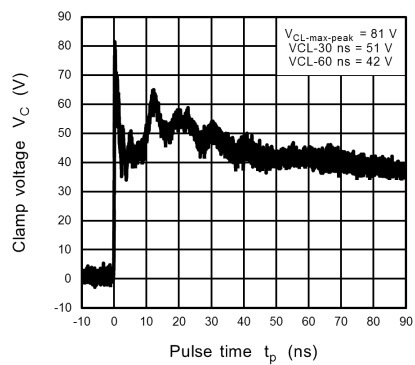


Fig. 10.19.3 IEC61000-4-2
Clamp Waveform +8 kV

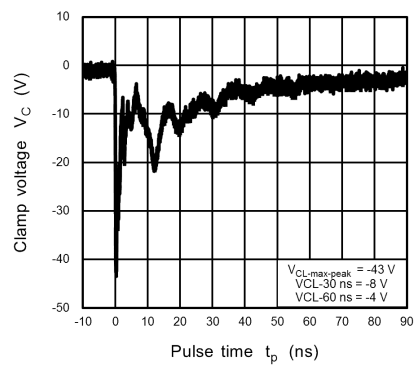


Fig. 10.19.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ33V Characteristics Curves(Note)

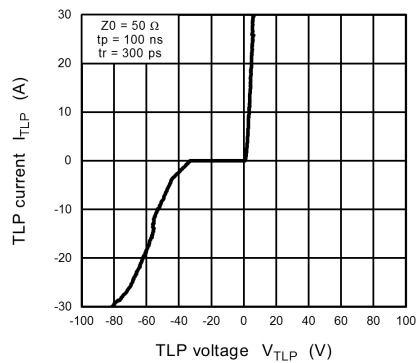


Fig. 10.20.1 I_{TLP} - V_{TLP}

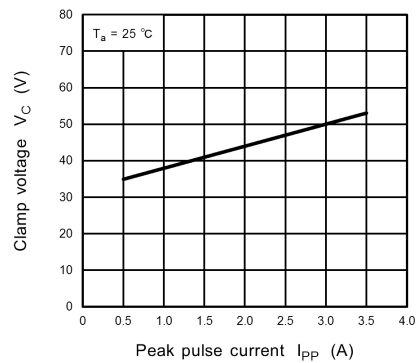


Fig. 10.20.2 V_C - I_{PP}

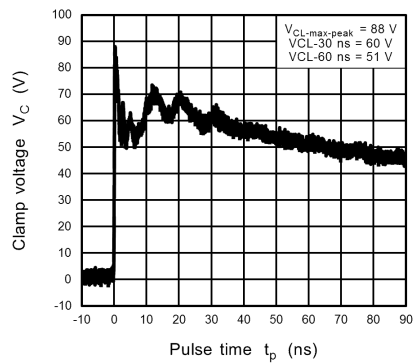


Fig. 10.20.3 IEC61000-4-2
Clamp Waveform +8 kV

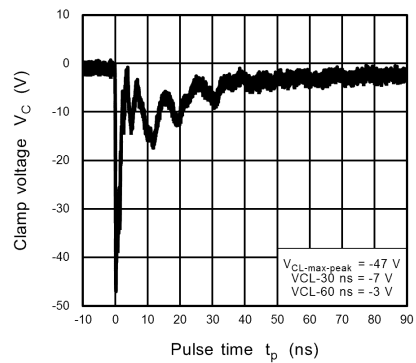


Fig. 10.20.4 IEC61000-4-2
Clamp Waveform -8 kV

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. MKZ36V Characteristics Curves(Note)

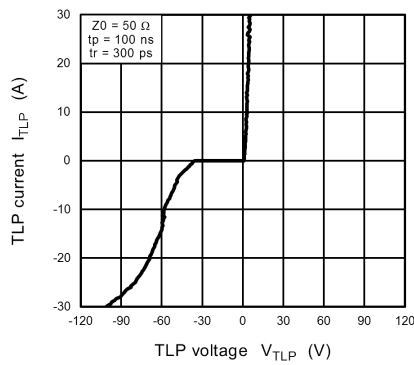


Fig. 10.21.1 $I_{TLP} - V_{TLP}$

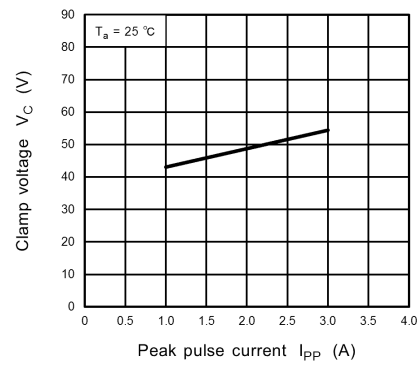


Fig. 10.21.2 $V_C - I_{PP}$

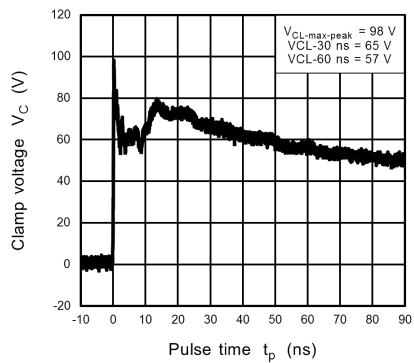


Fig. 10.21.3 IEC61000-4-2
Clamp Waveform +8 kV

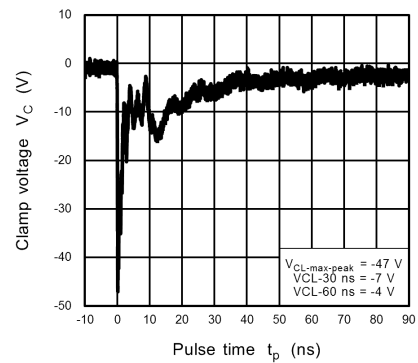


Fig. 10.21.4 IEC61000-4-2
Clamp Waveform -8 kV

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

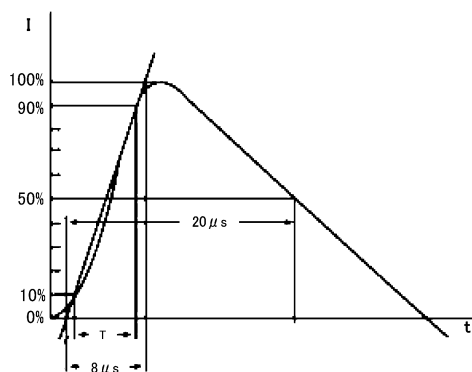


Fig. 10.22.1 V_C - I_{PP} Peak Pulse Current
(according to IEC61000-4-5 8/20 μ s pulse)

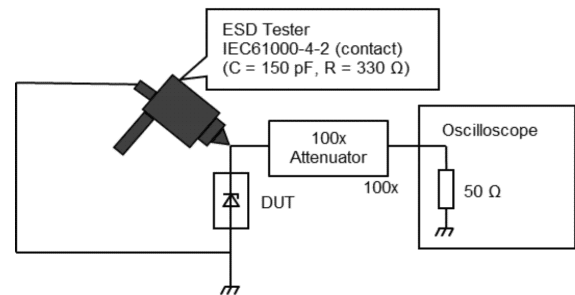
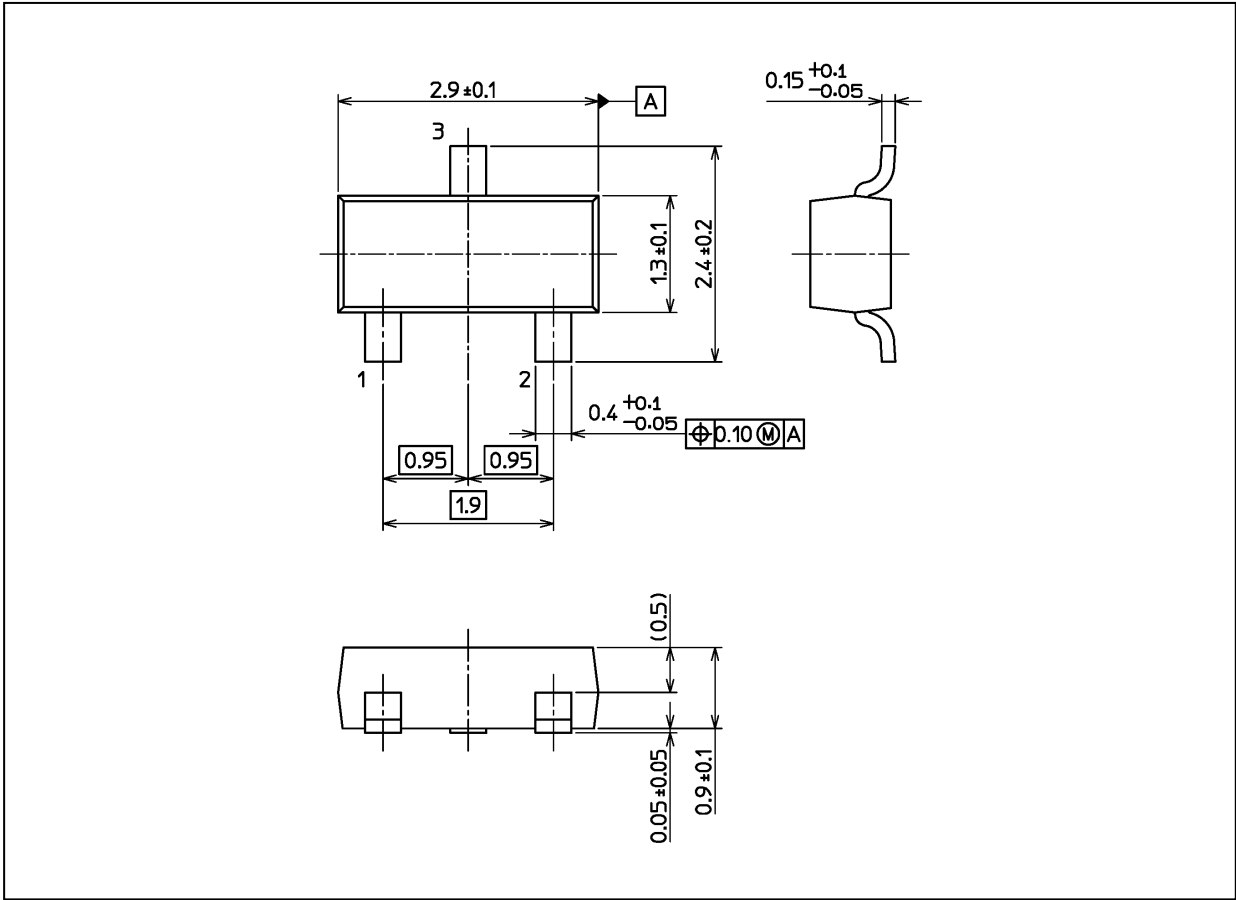


Fig. 10.22.2 Clamp waveform measurement
circuit (according to IEC61000-4-2)

Package Dimensions

Unit: mm



Weight: 9 mg (typ.)

Package Name(s)
Nickname: SOT23

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