

Zener Diode   Silicon Epitaxial Planar

# CUZ series

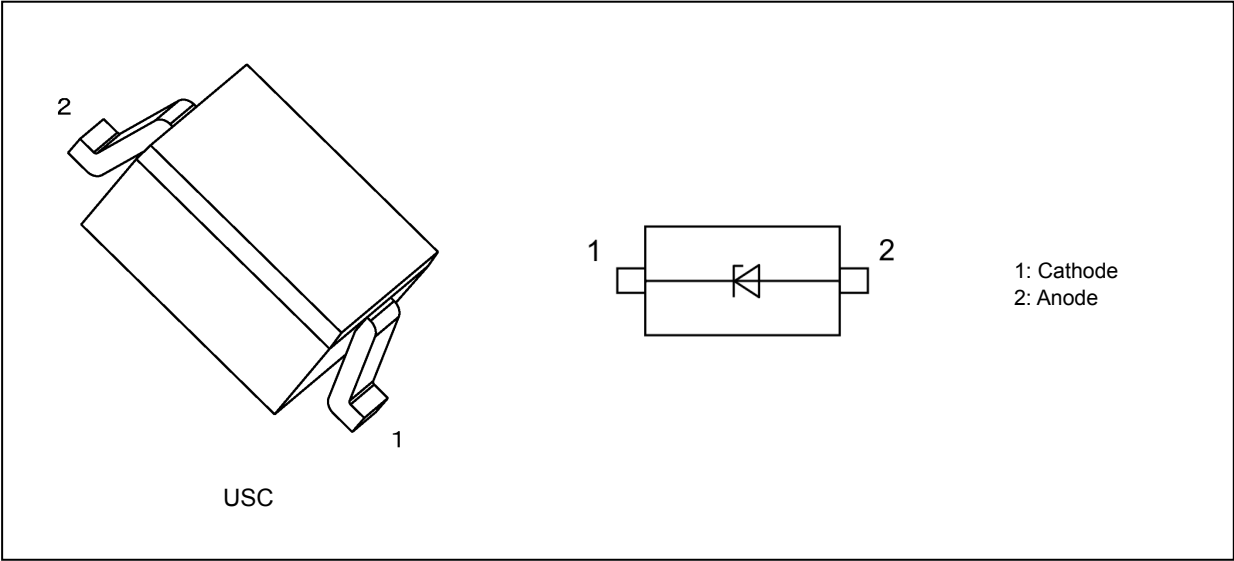
## 1. Applications

- (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)	200	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 20 mm  $\times$  20 mm, Cu pad: 4 mm  $\times$  4 mm.

Note 2: Mounted on a glass epoxy circuit board of 25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu pad: 645 mm<sup>2</sup>

Start of commercial production  
2020-07

## 5. Absolute Maximum Ratings 2 (Note) (Unless otherwise specified, T<sub>a</sub> = 25 °C)

Type No.	Electrostatic discharge voltage (Contact, Air) V <sub>ESD</sub> (kV) (Note 1)	Peak pulse power P <sub>PK</sub> (W) (Note 2)	Peak pulse current I <sub>PP</sub> (A) (Note 2)
CUZ5V6	±30	155	12.0
CUZ6V2	±30	175	11.0
CUZ6V8	±30	180	10.0
CUZ7V5	±30	190	9.5
CUZ8V2	±30	200	8.5
CUZ9V1	±30	200	8.0
CUZ10V	±30	200	7.5
CUZ11V	±30	200	7.25
CUZ12V	±30	200	7.0
CUZ13V	±30	200	6.5
CUZ15V	±30	200	5.6
CUZ16V	±30	200	5.5
CUZ18V	±30	200	5.1
CUZ20V	±30	200	5.0
CUZ22V	±30	200	4.75
CUZ24V	±30	200	4.5
CUZ27V	±20	200	4.1
CUZ30V	±20	200	4.0
CUZ33V	±17	200	3.5
CUZ36V	±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<sub>p</sub> = 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 $Z_Z$ ( $\Omega$ )		Dynamic Resistance $R_{DYN}$ ( $\Omega$ ) (Note 1)	Clamp Voltage $V_C$ (V) (Note 1) (Note 2)	Total Capacitance $C_t$ (pF) (Note 3)	Reverse Current $I_R$ ( $\mu\text{A}$ )	
	Min	Typ.	Max	Test Current $I_Z$ (mA)	Max	Test Current $I_Z$ (mA)	Typ.	Typ.	Typ.	Max	Test Voltage $V_R$ (V)
CUZ5V6	5.3	5.6	6.0	5	30	5	0.16	9.0	125	1	3.5
CUZ6V2	5.8	6.2	6.6	5	30	5	0.21	10.0	105	2.5	5.0
CUZ6V8	6.4	6.8	7.2	5	30	5	0.27	13.0	88	1.5	5.5
CUZ7V5	7.0	7.5	7.9	5	30	5	0.32	14.0	78	0.1	6.0
CUZ8V2	7.7	8.2	8.7	5	30	5	0.37	16.5	67	0.1	7.0
CUZ9V1	8.5	9.1	9.6	5	30	5	0.44	17.0	62	0.1	7.5
CUZ10V	9.4	10.0	10.6	5	30	5	0.52	19.0	60	0.1	8.0
CUZ11V	10.4	11.0	11.6	5	30	5	0.60	24.0	48	0.1	9.0
CUZ12V	11.4	12.0	12.6	5	30	5	0.70	26.0	44	0.1	10.0
CUZ13V	12.4	13.0	14.1	5	30	5	0.80	27.0	42	0.1	11.0
CUZ15V	13.8	15.0	15.6	5	30	5	0.60	24.0	36	0.1	12.0
CUZ16V	15.3	16.0	17.1	5	35	5	0.50	27.0	35	0.1	14.0
CUZ18V	16.8	18.0	19.1	5	45	5	0.40	28.5	31	0.1	16.0
CUZ20V	18.8	20.0	21.2	5	70	5	0.35	30.5	29	0.1	17.6
CUZ22V	20.8	22.0	23.3	5	70	5	0.40	32.0	27	0.1	18.0
CUZ24V	22.8	24.0	25.6	5	70	5	0.60	36.5	26	0.1	19.0
CUZ27V	25.1	27.0	28.9	2	70	2	0.90	45.0	23	0.1	23.0
CUZ30V	28.0	30.0	32.0	2	100	2	1.25	47.5	21	0.1	27.0
CUZ33V	31.0	33.0	35.0	2	100	2	1.80	57.0	19	0.1	30.0
CUZ36V	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
CUZ5V6	LL	CUZ11V	M3	CUZ22V	MA
CUZ6V2	LM	CUZ12V	M4	CUZ24V	MB
CUZ6V8	LN	CUZ13V	M5	CUZ27V	MC
CUZ7V5	LP	CUZ15V	M6	CUZ30V	MD
CUZ8V2	LQ	CUZ16V	M7	CUZ33V	ME
CUZ9V1	LR	CUZ18V	M8	CUZ36V	MF
CUZ10V	M2	CUZ20V	M9	—	—

8. Marking

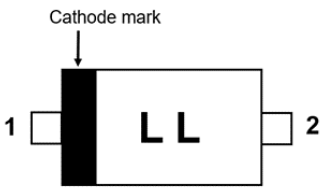


Fig. 8.1 CUZ5V6

9. Land Pattern Dimensions (for reference only)

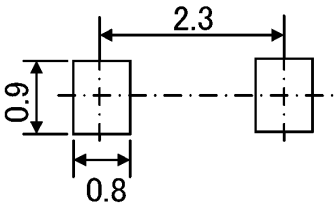


Fig. 9.1 Land Pattern Dimensions  
(for reference only) (Unit: mm)

## 10. Characteristics Curves

### 10.1. CUZ series Characteristics Curves(Note)

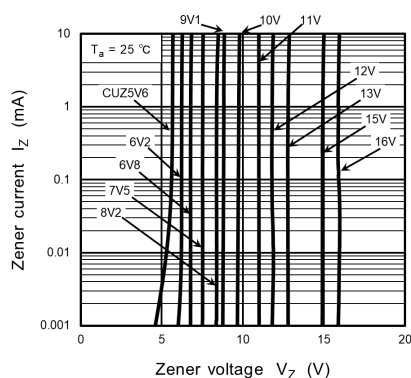


Fig. 10.1.1  $I_Z - V_Z(1)$

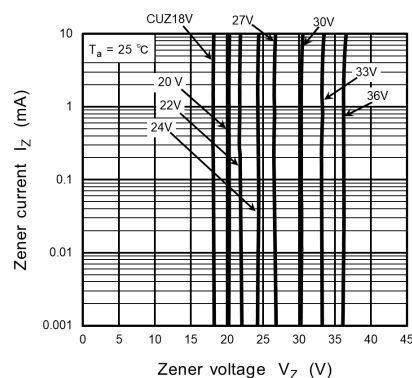


Fig. 10.1.2  $I_Z - V_Z(2)$

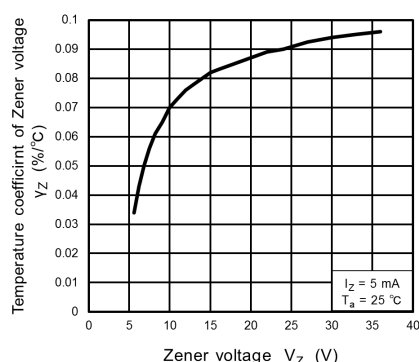


Fig. 10.1.3  $\gamma_Z - V_Z$

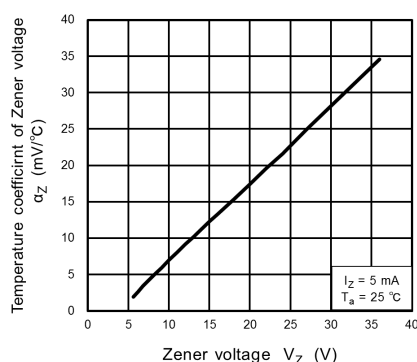


Fig. 10.1.4  $\alpha_Z - V_Z$

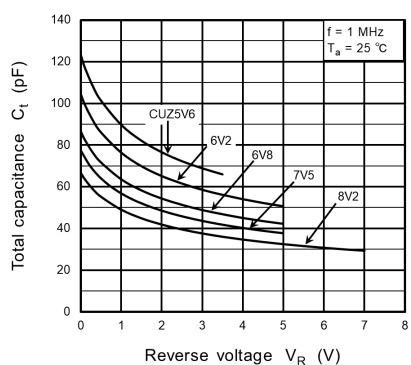


Fig. 10.1.5  $C_t - V_R (1)$

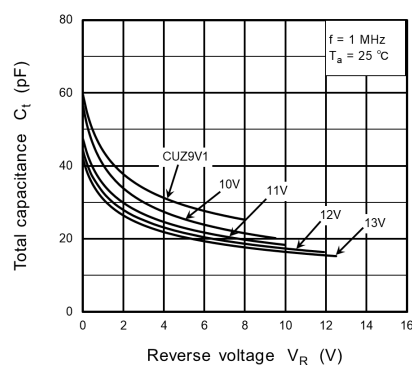


Fig. 10.1.6  $C_t - V_R (2)$

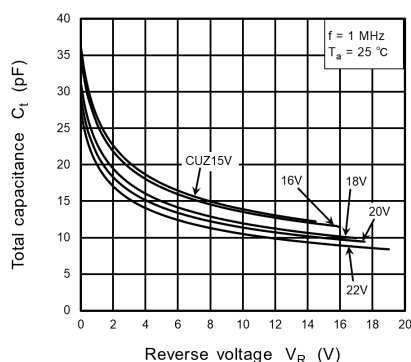


Fig. 10.1.7  $C_t - V_R (3)$

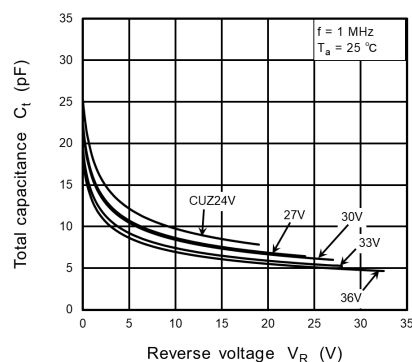


Fig. 10.1.8  $C_t - V_R (4)$

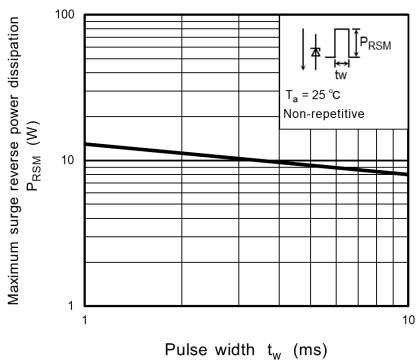


Fig. 10.1.9  $P_{RSM} - t_w$

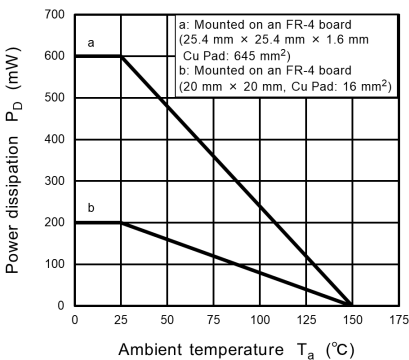


Fig. 10.1.10  $P_D - T_a$

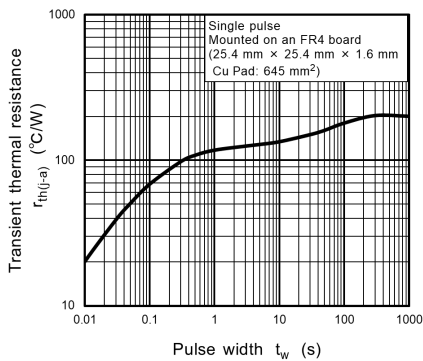


Fig. 10.1.11  $r_{th(j-a)} - t_w$

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

10.2. CUZ5V6 Characteristics Curves(Note)



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

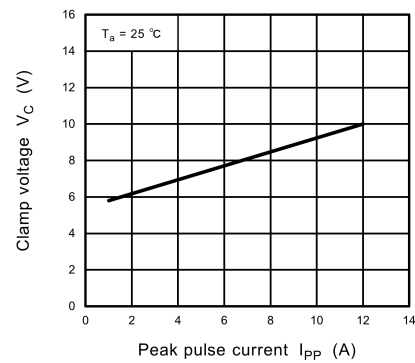


Fig. 10.2.2  $V_C - I_{PP}$

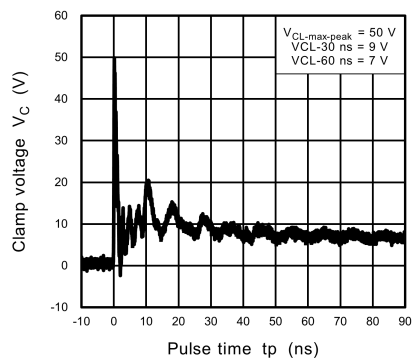


Fig. 10.2.3 IEC61000-4-2 Clamp  
Waveform +8 kV

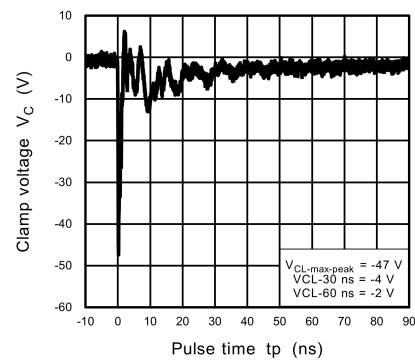


Fig. 10.2.4 IEC61000-4-2 Clamp  
Waveform -8 kV

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. CUZ6V2 Characteristics Curves(Note)

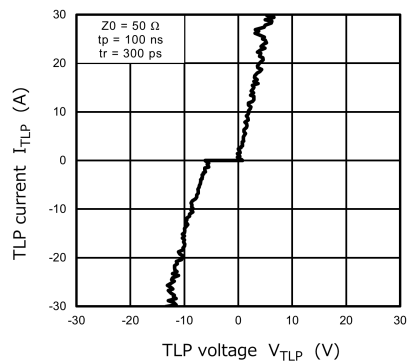


Fig. 10.3.1  $I_{TLP} - V_{TLP}$

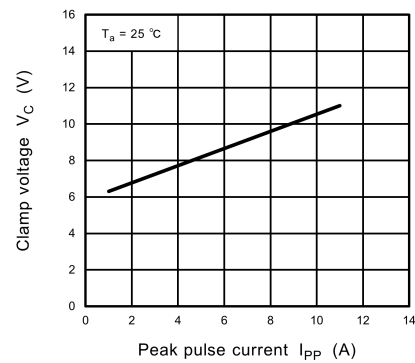


Fig. 10.3.2  $V_C - I_{PP}$

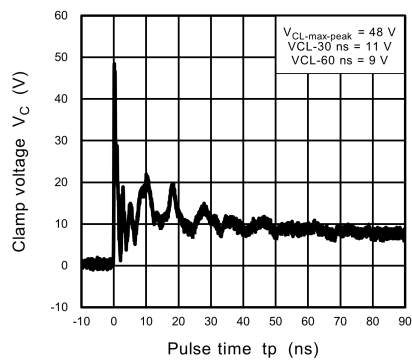


Fig. 10.3.3 IEC61000-4-2  
Clamp Waveform +8 kV

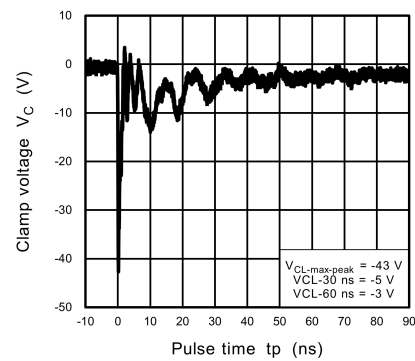


Fig. 10.3.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ6V8 Characteristics Curves(Note)



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

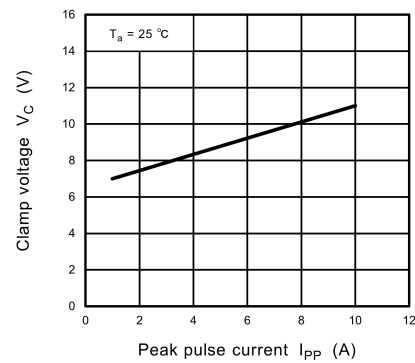


Fig. 10.4.2  $V_C - I_{PP}$

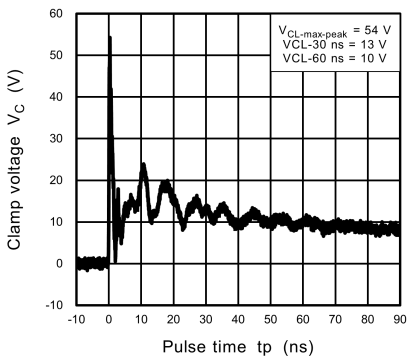


Fig. 10.4.3 IEC61000-4-2  
Clamp Waveform +8 kV

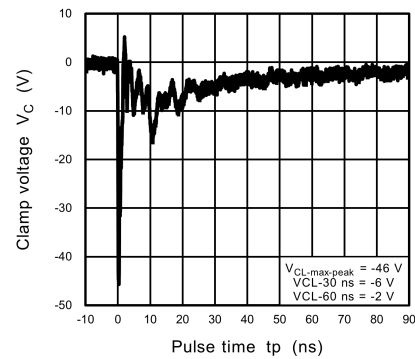


Fig. 10.4.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ7V5 Characteristics Curves(Note)

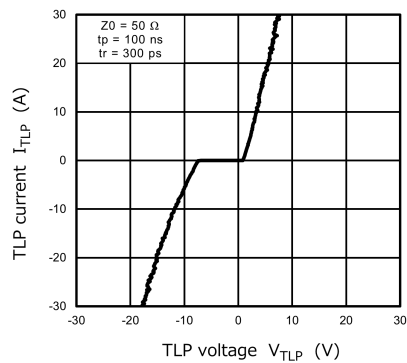


Fig. 10.5.1  $I_{TLP} - V_{TLP}$

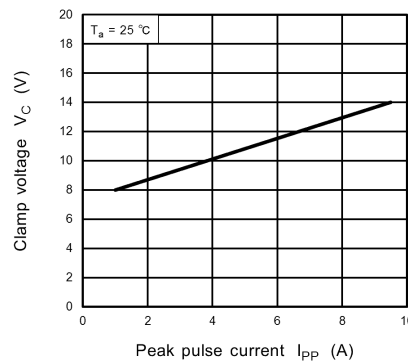


Fig. 10.5.2  $V_C - I_{PP}$

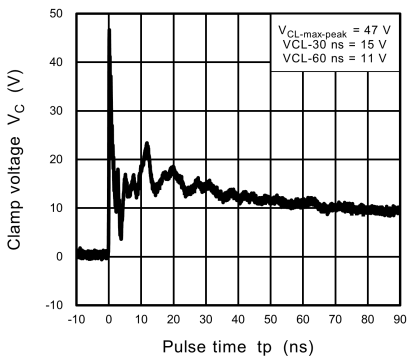


Fig. 10.5.3 IEC61000-4-2  
Clamp Waveform +8 kV

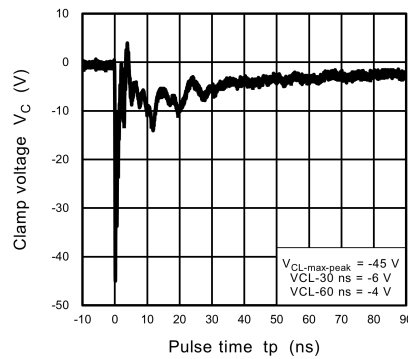


Fig. 10.5.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ8V2 Characteristics Curves(Note)

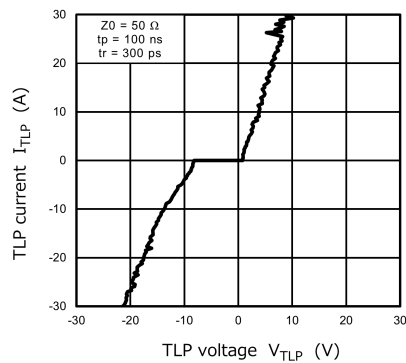


Fig. 10.6.1  $I_{TLP} - V_{TLP}$

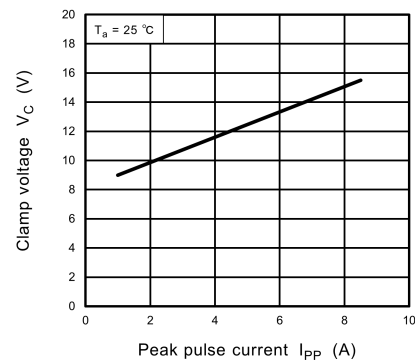


Fig. 10.6.2  $V_C - I_{PP}$

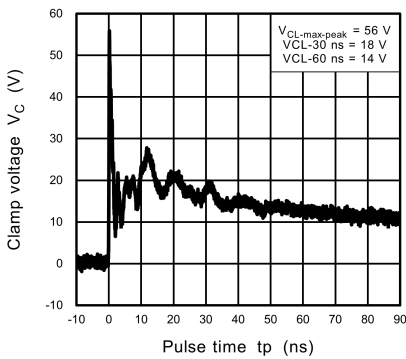


Fig. 10.6.3 IEC61000-4-2  
Clamp Waveform +8 kV

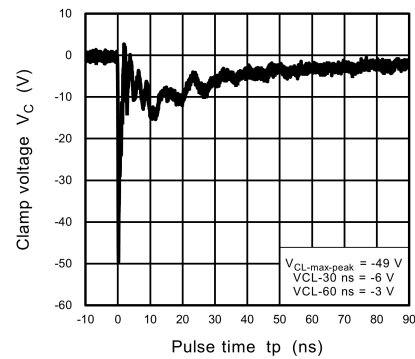


Fig. 10.6.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ9V1 Characteristics Curves(Note)

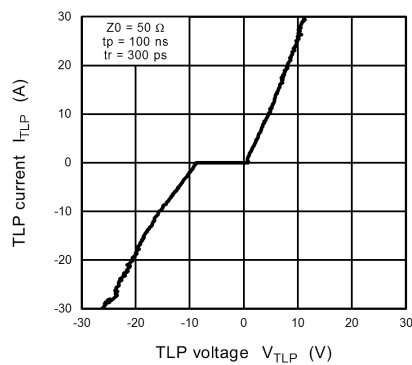


Fig. 10.7.1  $I_{TLP} - V_{TLP}$

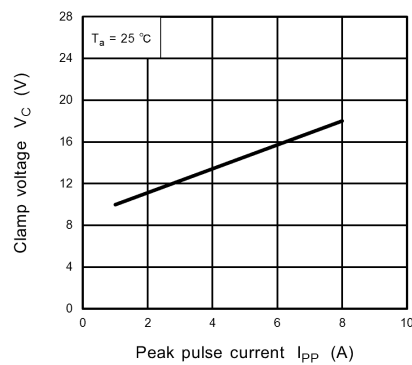


Fig. 10.7.2  $V_C - I_{PP}$

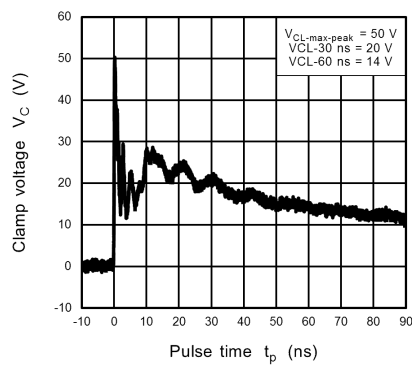


Fig. 10.7.3 IEC61000-4-2  
Clamp Waveform +8 kV

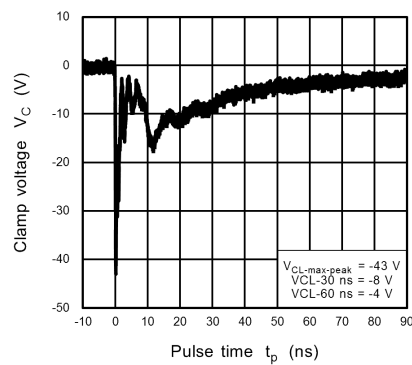


Fig. 10.7.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ10V Characteristics Curves(Note)

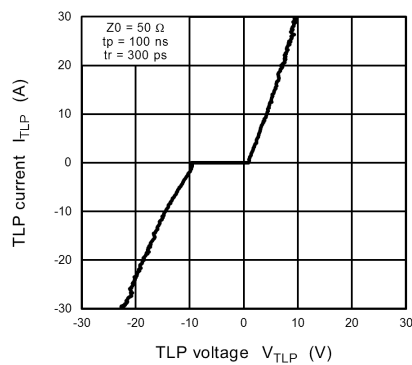


Fig. 10.8.1  $I_{TLP} - V_{TLP}$

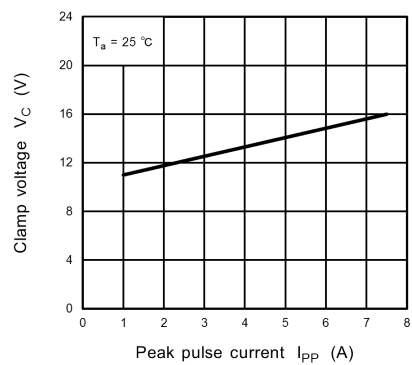


Fig. 10.8.2  $V_C - I_{PP}$

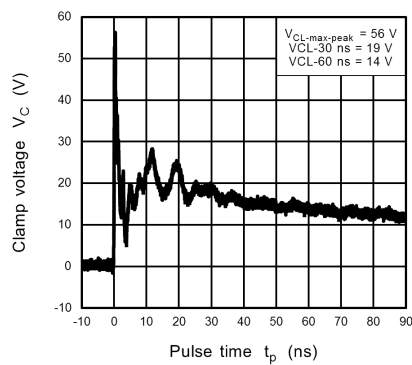


Fig. 10.8.3 IEC61000-4-2  
Clamp Waveform +8 kV

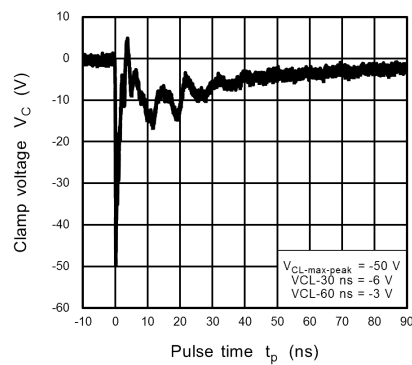


Fig. 10.8.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ11V Characteristics Curves(Note)

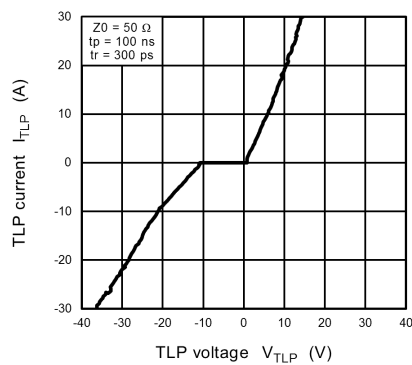


Fig. 10.9.1  $I_{TLP} - V_{TLP}$

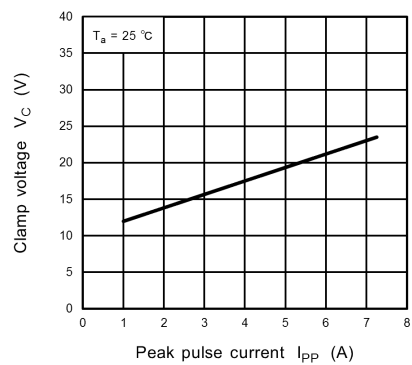


Fig. 10.9.2  $V_C - I_{PP}$

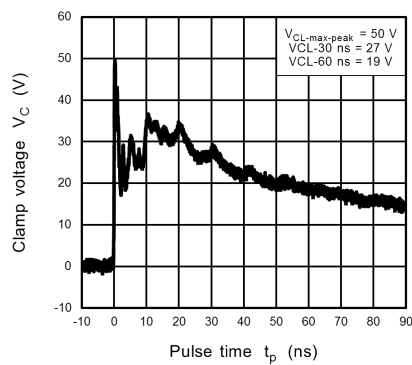


Fig. 10.9.3 IEC61000-4-2  
Clamp Waveform +8 kV

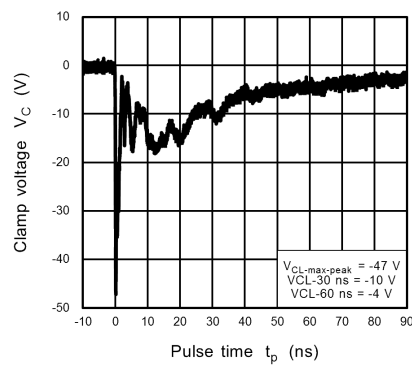


Fig. 10.9.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ12V Characteristics Curves(Note)

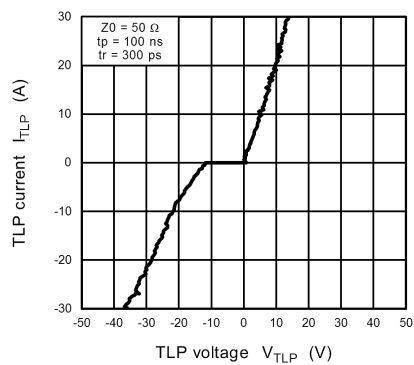


Fig. 10.10.1  $I_{TLP} - V_{TLP}$

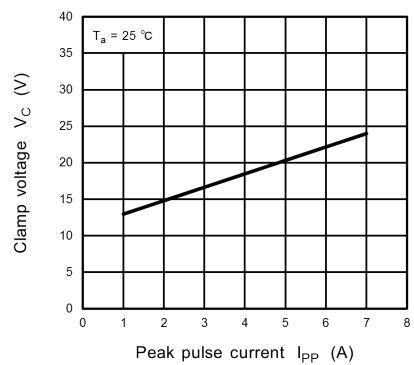


Fig. 10.10.2  $V_C - I_{PP}$

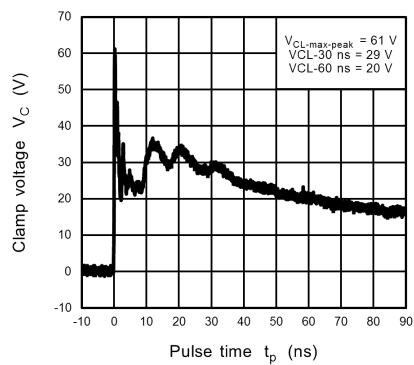


Fig. 10.10.3 IEC61000-4-2  
Clamp Waveform +8 kV

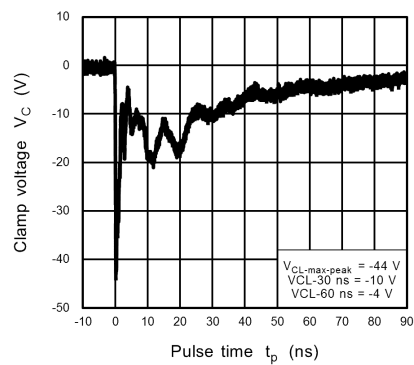


Fig. 10.10.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ13V Characteristics Curves(Note)

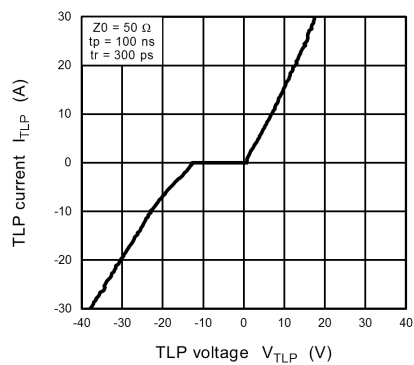


Fig. 10.11.1  $I_{TLP} - V_{TLP}$

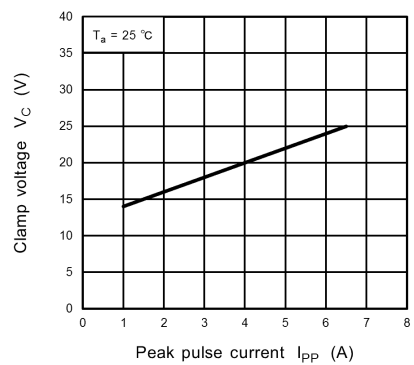


Fig. 10.11.2  $V_C - I_{PP}$

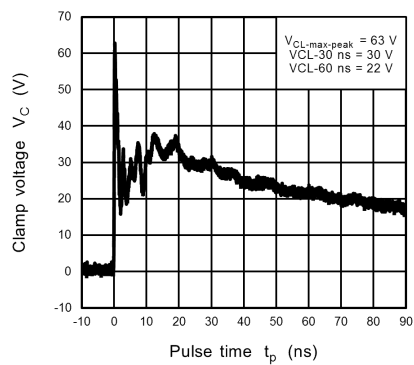


Fig. 10.11.3 IEC61000-4-2  
Clamp Waveform +8 kV

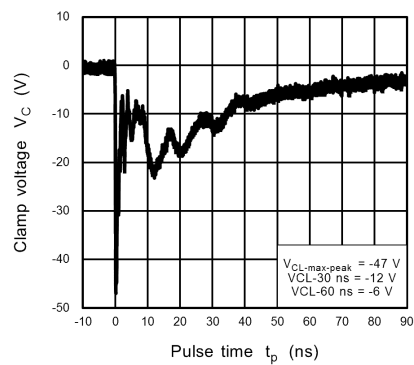


Fig. 10.11.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ15V Characteristics Curves(Note)

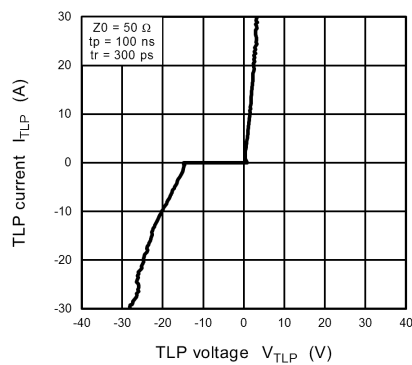


Fig. 10.12.1  $I_{TLP} - V_{TLP}$

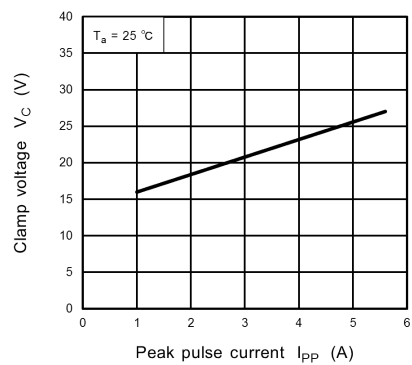


Fig. 10.12.2  $V_C - I_{PP}$

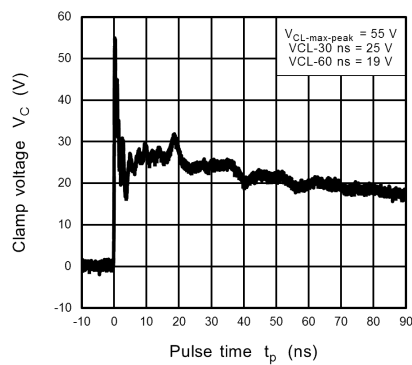


Fig. 10.12.3 IEC61000-4-2  
Clamp Waveform +8 kV

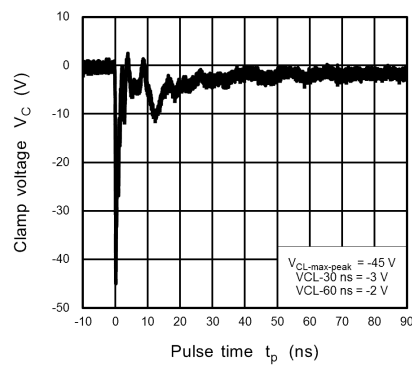


Fig. 10.12.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ16V Characteristics Curves(Note)

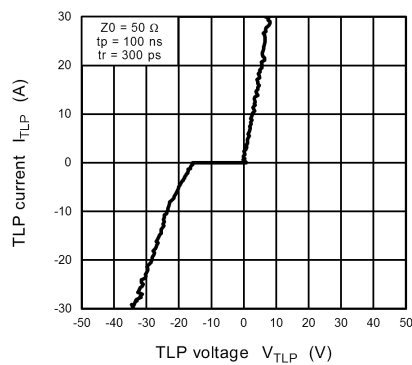


Fig. 10.13.1  $I_{TLP} - V_{TLP}$

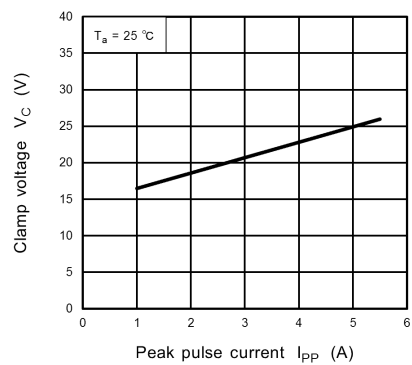


Fig. 10.13.2  $V_C - I_{PP}$

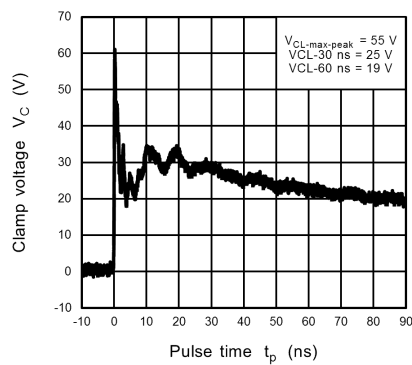


Fig. 10.13.3 IEC61000-4-2  
Clamp Waveform +8 kV

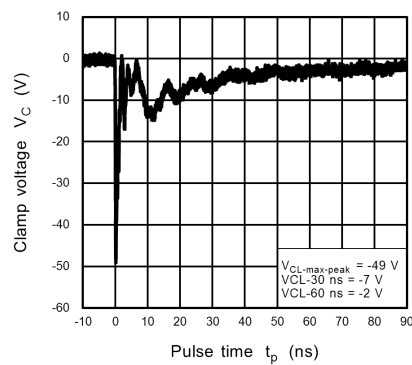


Fig. 10.13.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ18V Characteristics Curves(Note)

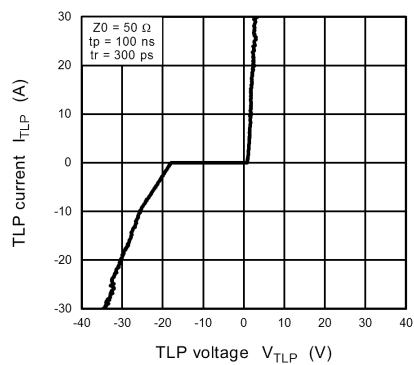


Fig. 10.14.1  $I_{TLP} - V_{TLP}$

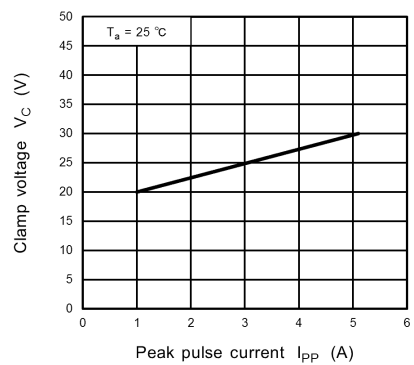


Fig. 10.14.2  $V_C - I_{PP}$

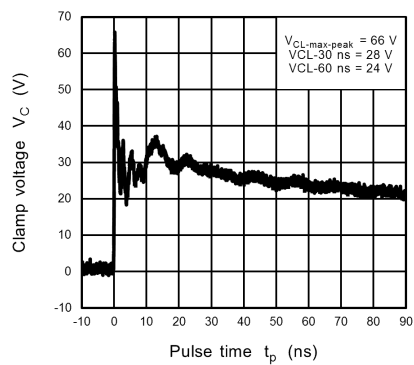


Fig. 10.14.3 IEC61000-4-2  
Clamp Waveform +8 kV

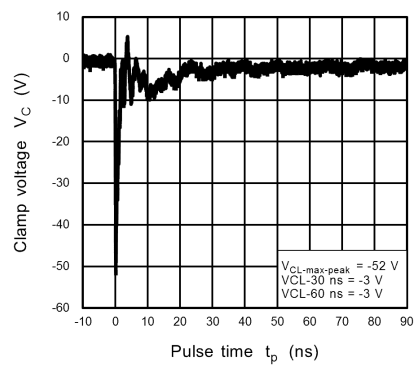


Fig. 10.14.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ20V Characteristics Curves(Note)

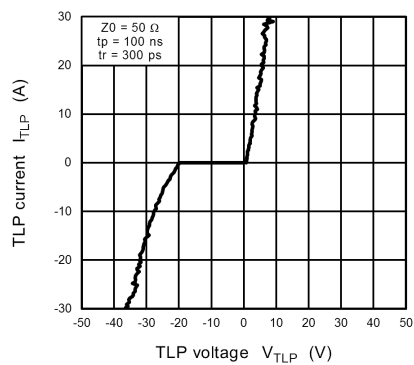


Fig. 10.15.1  $I_{TLP}$  -  $V_{TLP}$

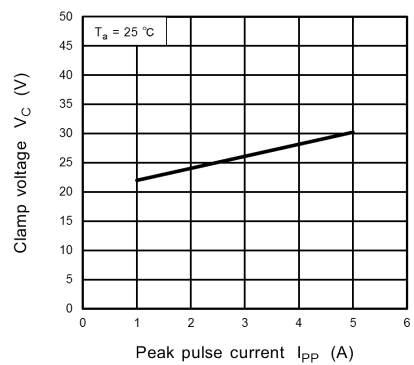


Fig. 10.15.2  $V_C$  -  $I_{PP}$

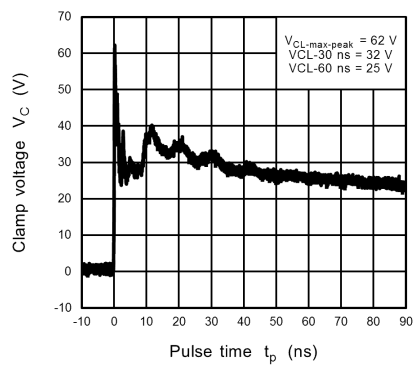


Fig. 10.15.3 IEC61000-4-2  
Clamp Waveform +8 kV

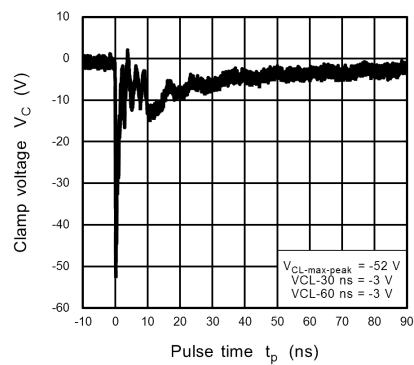


Fig. 10.15.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ22V Characteristics Curves(Note)

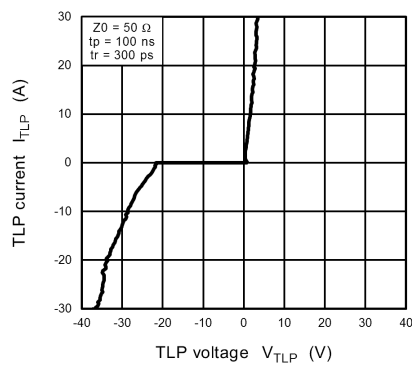


Fig. 10.16.1  $I_{TLP} - V_{TLP}$

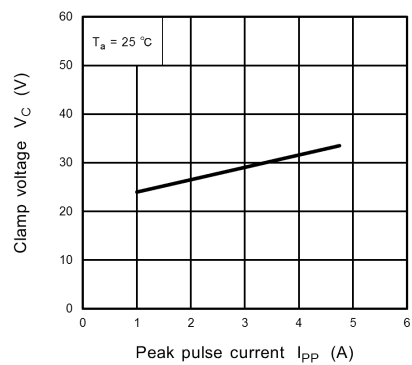


Fig. 10.16.2  $V_C - I_{PP}$

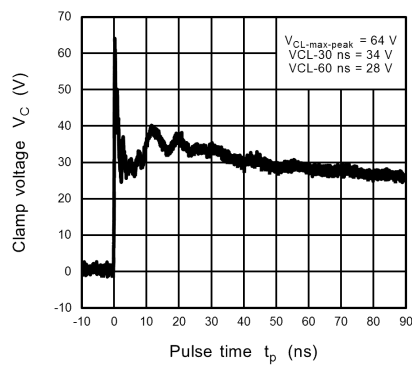


Fig. 10.16.3 IEC61000-4-2  
Clamp Waveform +8 kV

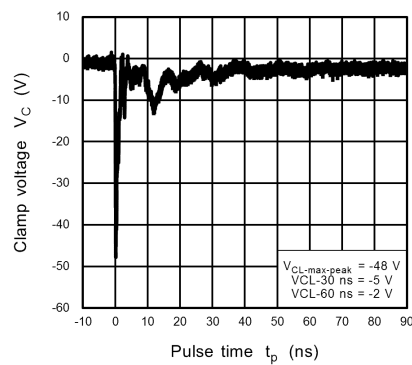


Fig. 10.16.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ24V Characteristics Curves(Note)

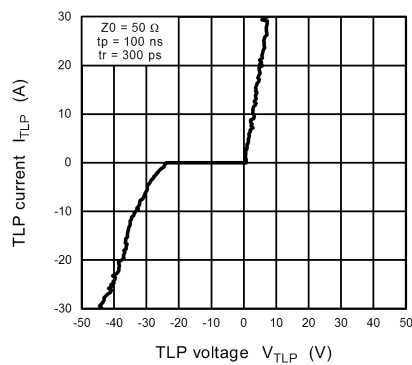


Fig. 10.17.1  $I_{TLP} - V_{TLP}$

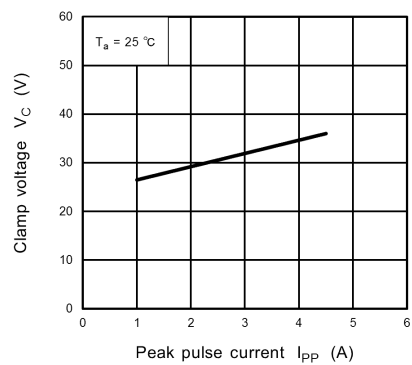


Fig. 10.17.2  $V_C - I_{PP}$

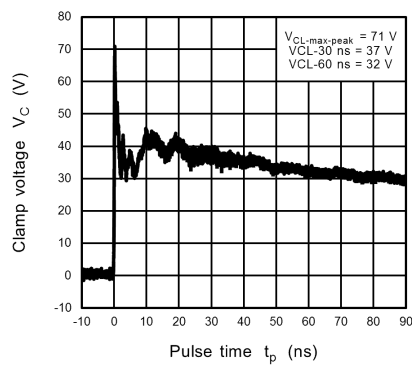


Fig. 10.17.3 IEC61000-4-2  
Clamp Waveform +8 kV

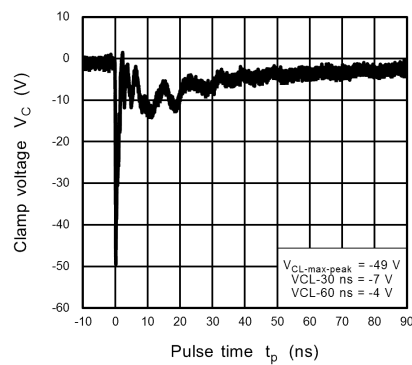


Fig. 10.17.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ27V Characteristics Curves(Note)

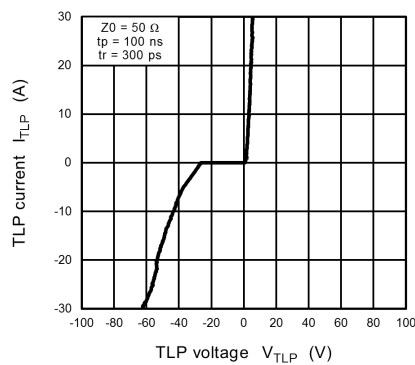


Fig. 10.18.1  $I_{TLP}$  -  $V_{TLP}$

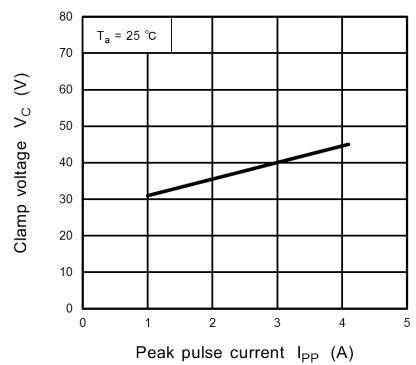


Fig. 10.18.2  $V_C$  -  $I_{PP}$

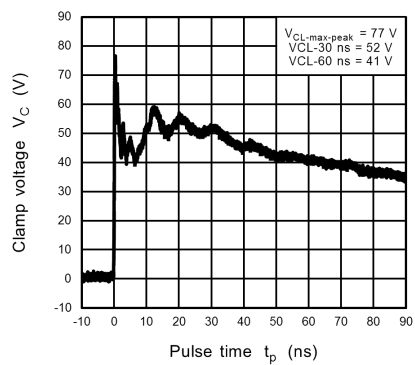


Fig. 10.18.3 IEC61000-4-2  
Clamp Waveform +8 kV

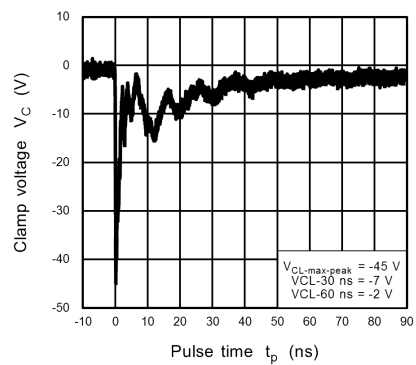


Fig. 10.18.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ30V Characteristics Curves(Note)

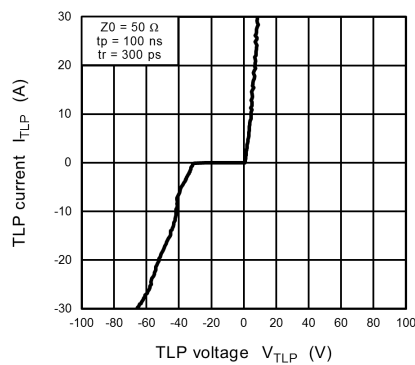


Fig. 10.19.1  $I_{TLP} - V_{TLP}$

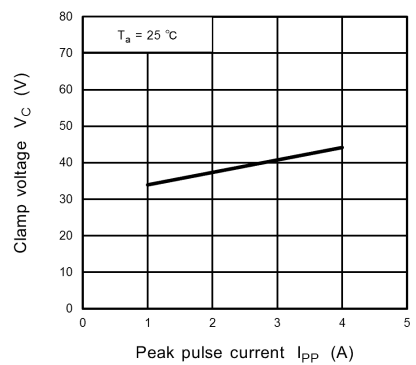


Fig. 10.19.2  $V_C - I_{PP}$

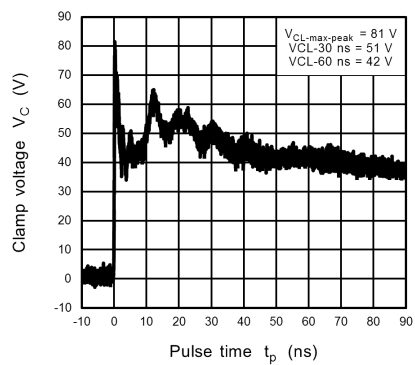


Fig. 10.19.3 IEC61000-4-2  
Clamp Waveform +8 kV

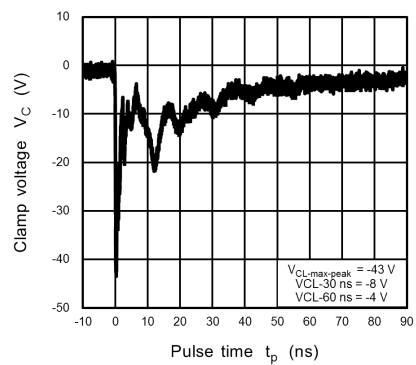


Fig. 10.19.4 IEC61000-4-2  
Clamp Waveform -8 kV

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. CUZ33V Characteristics Curves(Note)

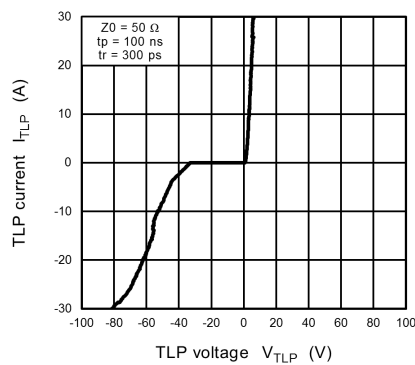


Fig. 10.20.1  $I_{TLP} - V_{TLP}$

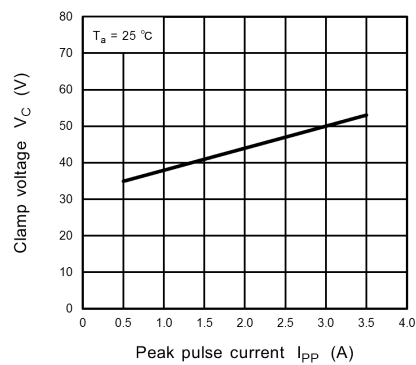


Fig. 10.20.2  $V_C - I_{PP}$

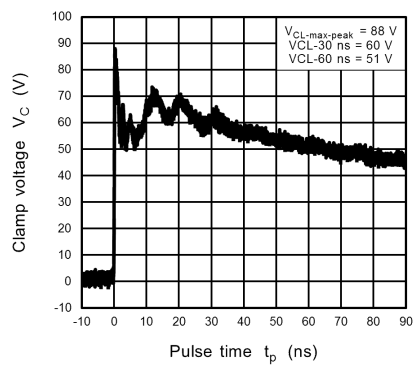


Fig. 10.20.3 IEC61000-4-2  
Clamp Waveform +8 kV

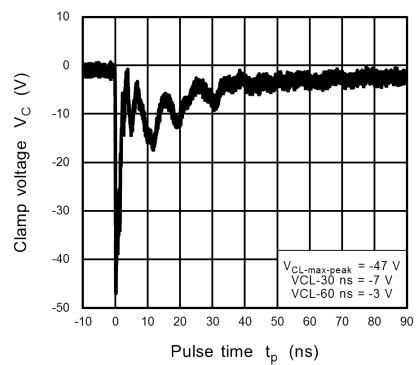
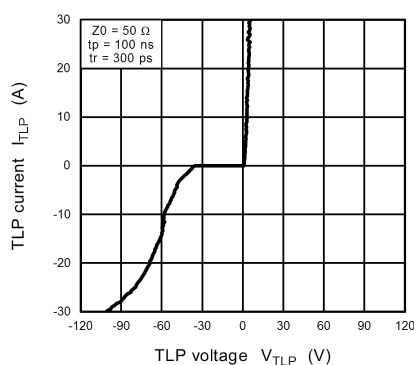


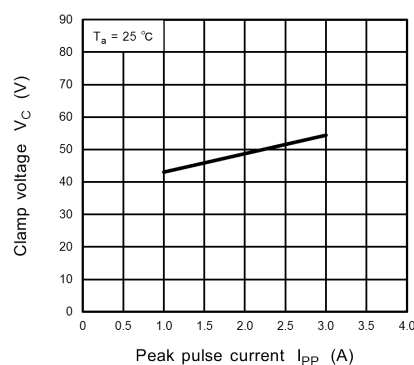
Fig. 10.20.4 IEC61000-4-2  
Clamp Waveform -8 kV

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.

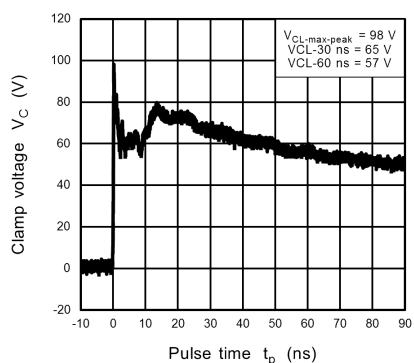
## 10.21. CUZ36V Characteristics Curves(Note)



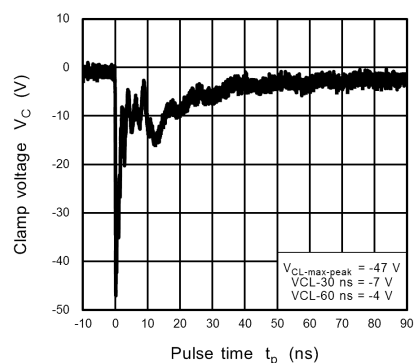
**Fig. 10.21.1  $I_{TLP} - V_{TLP}$**



**Fig. 10.21.2  $V_C - I_{PP}$**



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

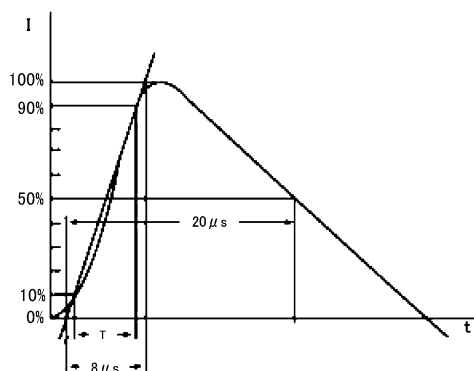


**Fig. 10.21.4 IEC61000-4-2  
Clamp Waveform -8 kV**

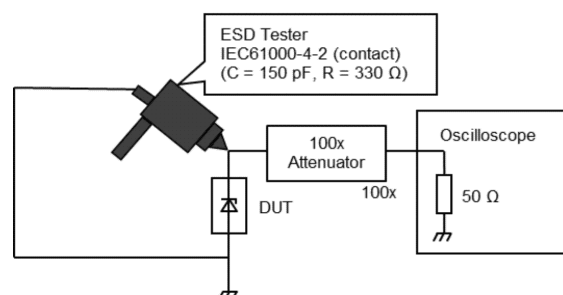
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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



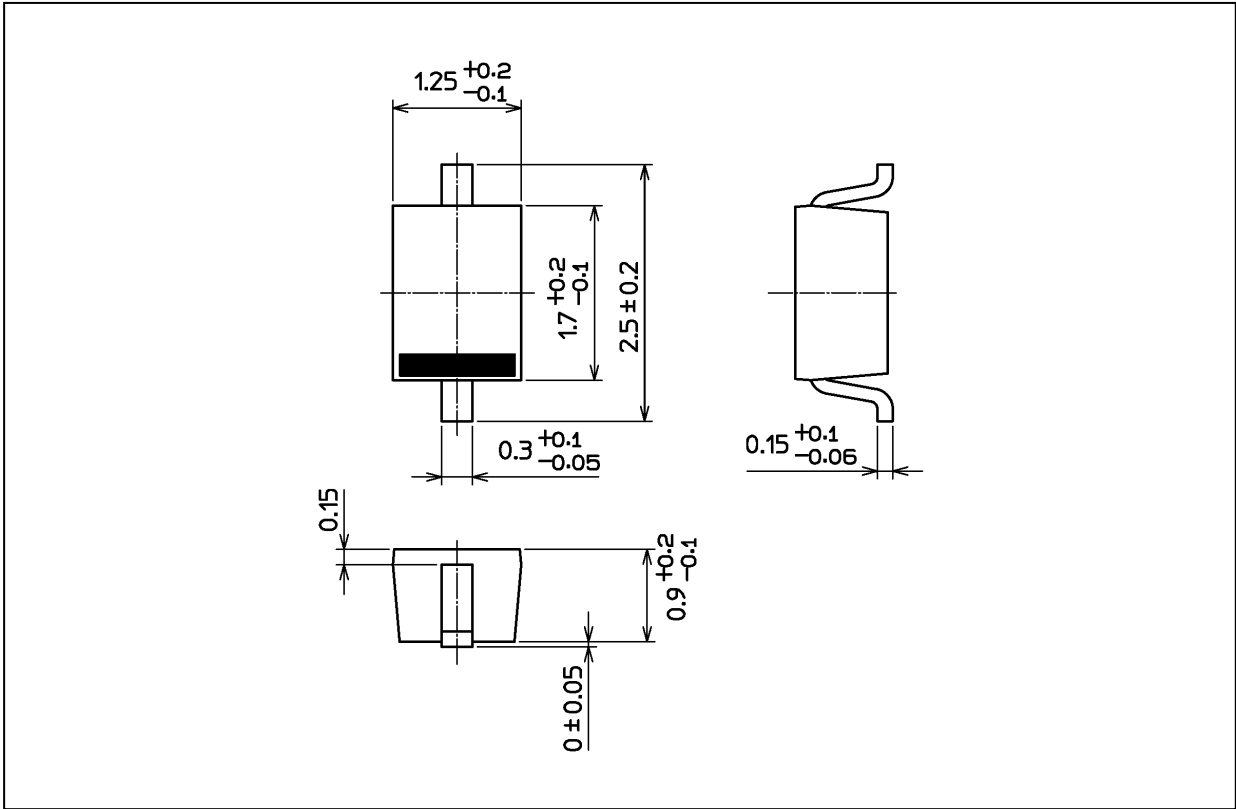
**Fig. 10.22.1  $V_C$ - $I_{PP}$  Peak Pulse Current  
(according to IEC61000-4-5 8/20  $\mu$ s pulse)**



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

Package Dimensions

Unit: mm



Weight: 4.5 mg (typ.)

Package Name(s)
Nickname: USC

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