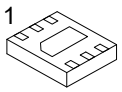
UTVS2200

ESD PROTECTION DIODE



DFN2020-6

■ DESCRIPTION

The UTC **UTVS2200** utilizes innovative Super Surge Control technology to introduce transient diverting suppressors (TDS) for protecting systems from EOS and ESD events. This robust surge solution utilizes integrated circuit technology. Instead of relying on the breakdown and current dissipation of the PN junction in traditional TVS diodes, the TDS diverts the surge current to ground via a built-in surge-rated field-effect transistor (FET), which has a lower on-resistance than the PN junction in TVS diodes. As a result, the TDS device provides a precise, flat, and temperature-independent clamping voltage, minimizing residual voltage in the protected system.

The UTC **UTVS2200** is ideal for protecting power buses operating up to 22V and is rated for transient peak pulse currents up to 70A (tp = 8/20μs). Housed in a compact DFN2020-6L package, the TDS is 90% smaller than the industry-standard SMA/SMB package, offers lower capacitance, and 50% lower leakage current than traditional TVS-based solutions.

■ FEATURES

* IEC 61000-4-2 Level 4 ESD Protection
  ±30kV Contact Discharge
  ±30kV Air Discharge
* High peak pulse current capability:
  70A (tp = 8/20μs) IEC 61000-4-5
* High EFT Withstand Voltage:
  ±4kV (100kHz and 5kHz, 5/50ns) IEC 61000-4-4
* High peak pulse current capability:
  6A IEC 61643-321 (10/1000μs)
* Nearly constant clamping voltage over rated peak pulse current range and temperature range
* Working voltage: 22V
* Reverse Leakage Current: 0.5nA Typ. @ 22V
* Junction Capacitance: 115pF Typ. @ 22V

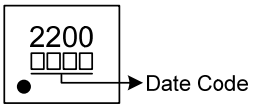
■ ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
UTVS2200L-K06-2020-R	UTVS2200G-K06-2020-R	DFN2020-6	Tape Reel

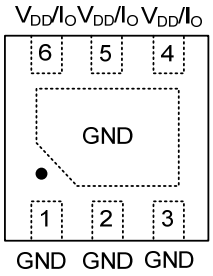
UTVS2200G-K06-2020-R

(1)Packing Type	(1) R: Tape Reel
(2)Package Type	(2) K06-2020: DFN2020-6
(3)Green Package	(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

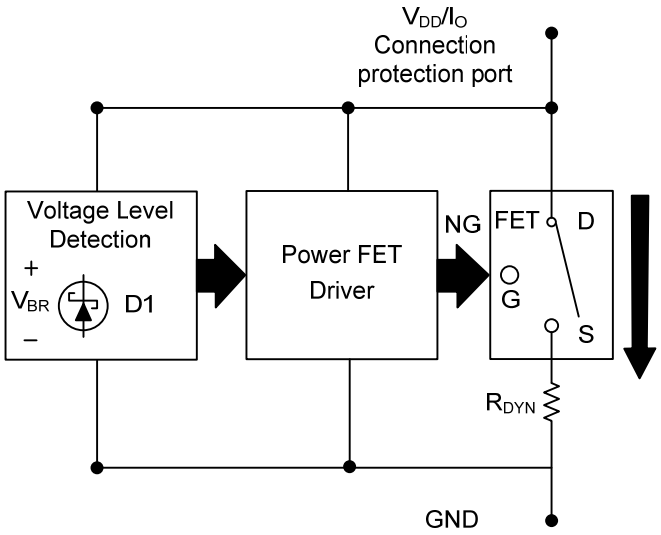


■ PIN CONFIGURATION



(TOP VIEW)

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (T_A=25°C, unless otherwise specified)

PARAMETER			SYMBOL	RATINGS	UNIT
ESD Discharge	IEC61000-4-2	Air Discharge	V_{ESD}	±30	kV
		Contact Discharge		±30	kV
Peak Pulse Current	IEC61000-4-5	t_p=8/20μs	I_{PP}	70	A
Peak Pulse Power			P_{PK}	2000	W
Peak Pulse Current	IEC61643-321	t_p=10/1000μs	I_{PP1}	6	A
Peak Pulse Power			P_{PK1}	192	W
Operating temperature			T_{OPR}	-40 ~ +125	°C
Storage Temperature			T_{STG}	-55 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ ELECTRICAL CHARACTERISTICS (T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reverse Stand-Off Voltage	V_{RWM}		-0.5		22	V
Reverse Breakdown Voltage	V_{BR}	I_T=1mA form V_{DD}/I_O to GND	24.6	25.8	27.6	V
Forward Voltage Drop	V_F	I_T=1mA form GND to V_{DD}/I_O	0.25	0.5	0.7	V
Forward Clamp Voltage	V_{FC}	I_{PP}=10A, t_P=8/20μs	1.0	2.7	5.0	V
Clamping Voltage	V_C	I_{PP}=10A, t_P=8/20μs		25.6	26.6	V
		I_{PP}=20A, t_P=8/20μs		26	27.5	V
		I_{PP}=40A, t_P=8/20μs		26.4	28	V
		I_{PP}=70A, t_P=8/20μs		27.6	28.6	V
Reverse Leakage Current	I_R	V_{RWM}=22V, T_A=25°C		0.5	100	nA
		V_{RWM}=22V, T_A=85°C		25	200	nA
		V_{RWM}=22V, T_A=105°C		80	800	nA
Dynamic Resistance	R_{DYN} (Note)	t_P=8/20μs		35		mΩ
Junction Capacitance	C_J	V_R=22V, f=1MHz, T_A=25°C		115		pF

Note: ON Resistance Test: 1A-70A (t_P=8/20μs).

■ FUNCTION DESCRIPTION

Overview

TDS diodes are designed to provide protection against high-energy EOS, ESD, and surges, offering superior clamping performance and stable temperature characteristics compared to traditional TVS diodes. Traditional PN-junction-based TVS diodes have a fixed resistance or dynamic resistance (R_{DYN}) (Figure 1). The clamping voltage of a traditional TVS diode is $V_C = V_{BR} + I_{PP} \times R_{DYN}$. Because the dynamic resistance is fixed, the clamping voltage increases with I_{PP}, resulting in a linear increase in the clamping voltage within the peak pulse current range. Furthermore, the ability of a traditional TVS diode to absorb transient current is related to the junction area and junction (ambient) temperature. When absorbing or dissipating surge energy, the diode's temperature rises, significantly increasing the clamping voltage and consequently reducing the transient peak current I_{PP}.

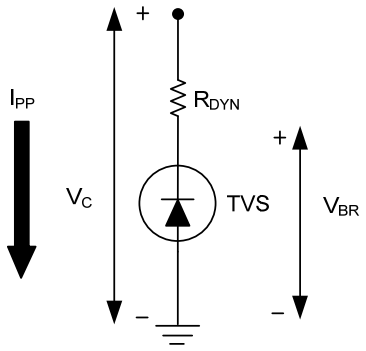


Figure 1. Traditional TVS diode Equivalent Circuit

The TDS uses a surge-rated field-effect transistor as its primary protection element (Figure 2). It consists of a precision trigger circuit, a driver circuit, and a surge-rated field-effect transistor. When the trigger circuit detects an EOS event, it activates the driver circuit and turns on the field-effect transistor, effectively closing the switch and diverting the transient current to ground. As IPP increases, the FET's R_{DYN} decreases to a negligible value, making the clamping voltage approximately the same as the breakdown voltage of the trigger circuit. As a result, the TDS clamping voltage remains nearly constant within the rated peak pulse current range (Figure 3). Furthermore, because the TDS no longer relies on a traditional PN junction to dissipate surge current, its clamping voltage remains stable over the normal operating temperature range.

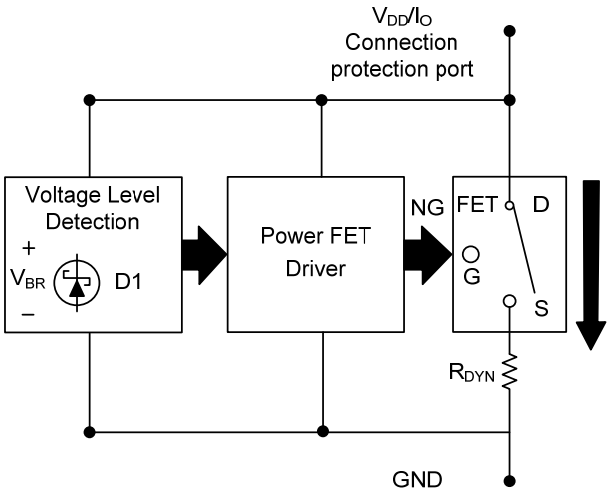


Figure 2. TDS Working Principle

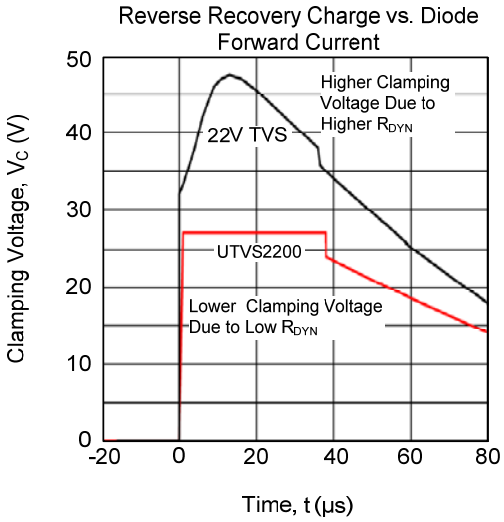


Figure 3. Comparison of Clamping Voltages between TDS and TVS

■ FUNCTION DESCRIPTION (Cont.)

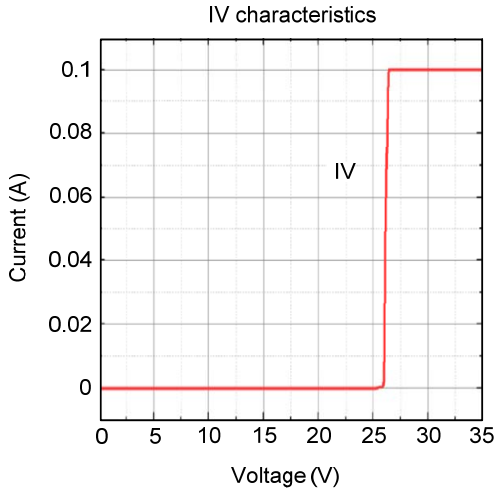
Application Areas

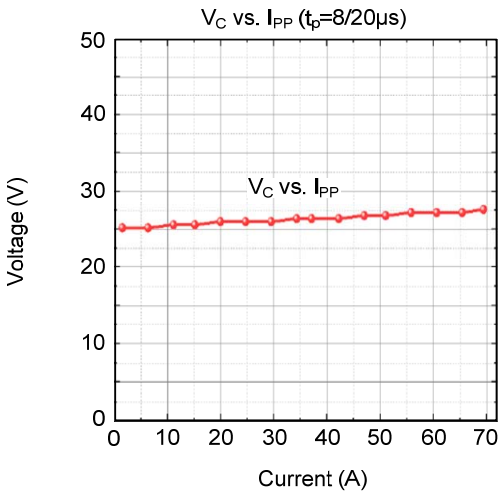
A typical application for the UTC **UTVS2200** is protecting USB Type-C interfaces, including USB Type-C buses with PD (power delivery) functionality, with a nominal operating voltage of up to 22V (Figure 4). If the voltage on the bus exceeds its design parameters, the USB PD controller may be damaged. Traditional TVS diodes are commonly used to protect the bus, but designers are often forced to select devices with larger peak pulse currents to keep the clamping voltage below the breakdown threshold of the PD controller.

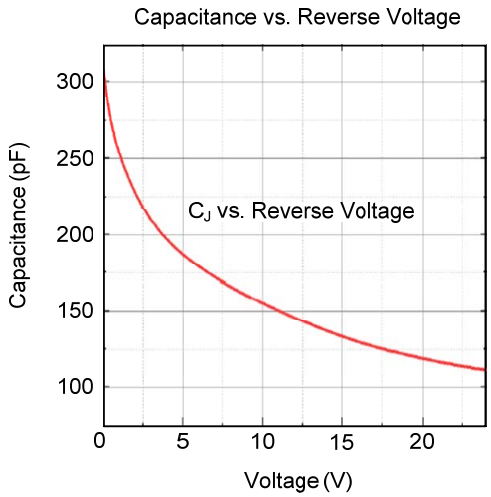
Furthermore, because the clamping voltage of traditional TVS diodes increases with temperature, designers have difficulty predicting their protection capabilities at higher operating temperatures. The UTC **UTVS2200** is a more reliable solution because it maintains a lower clamping voltage across the rated peak pulse current range and operating temperature range.

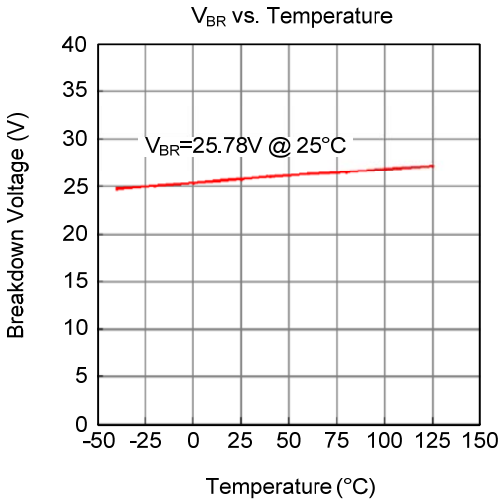
The UTC **UTVS2200** can also be used to protect the inputs of load switches, overvoltage protection ICs, and e-fuses in applications such as industrial equipment, remote instrumentation, robotics, USB PD, and IoT devices. In these cases, the UTC **UTVS2200** not only protects downstream components from lightning, ESD, and EOS events, but also protects the load switch by keeping the clamping voltage below the breakdown threshold of the switch's internal FET.

■ TYPICAL CHARACTERISTICS

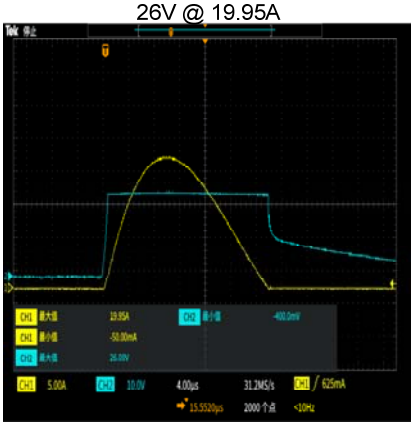




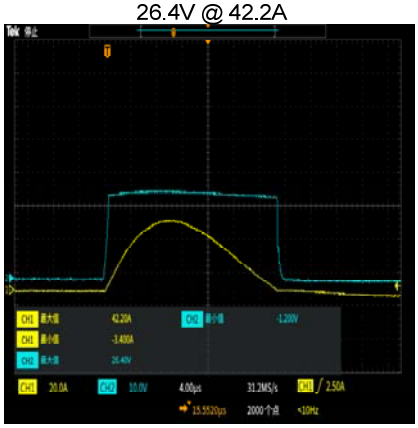




26V @ 19.95A



26.4V @ 42.2A



■ TYPICAL CHARACTERISTICS (Cont.)

27.6V @ 69.4A