1. Description

ElecSuper has developed TDS (Transient Diverting Suppressors) using "SuperSurgeControl" technology for protection against EOS (Electrical Overstress) and ESD (Electrostatic Discharge) events. It uses integrated circuit technology to provide a robust surge solution. It is no longer based on the PN junction in the traditional TVS diode for breakdown and current discharge, but transfers the surge current to the ground through the built-in surge rated field effect transistor, which has a lower on-resistance than the PN junction in the TVS diode. Therefore, the TDS device can provide an accurate, gentle and temperature-independent clamping voltage, thereby minimizing the residual voltage of the protected system.

ESTDS3311P is very suitable for protecting the power bus with operating voltage up to 33V, and its rated transient peak pulse current can reach 50A (t_p = 8/20 μs). TDS uses a small DFN1616-6L package, which is 90% smaller than the industry standard SMA / SMB package, and its capacitance is lower, and the leakage current is 50% lower than the traditional TVS-based solution.

2. Features

- IEC 61000-4-2 Level 4 ESD Protection
  - ±30kV Contact Discharge
  - ±30kV Air Discharge
- High peak pulse current capability: 50A (t_p = 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: 4A IEC 61643-321 (10/1000μs)
- Constant clamping voltage across the peak pulse current range and temperature range
- Working voltage: 33V
- Low leakage：0.5nA Typ@33V
- Low capacitance: 113pF Typ@25V

3. Applications

- USB PD
- USB Type-C Vbus
- Notebooks and Tablet Computers
- 4-20 mA transmitter

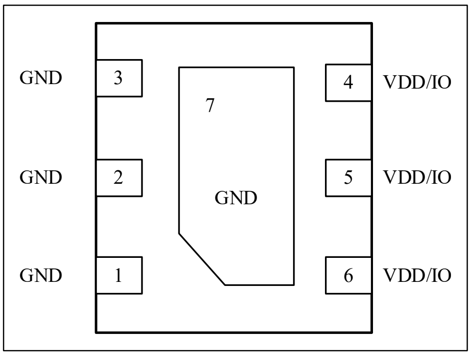
4. Ordering Information

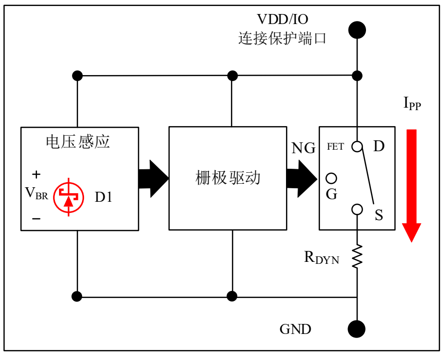
Part Number	Package	Marking	Material	Packing	Quantity per reel	Flammability Rating	Reel Size
ESTDS3311P	DFN1616-6L	.T33A/LOT	Halogen free	Tape & Reel	3,000 PCS	UL 94V-0	7 inches

Table-1 Ordering information

5. Marking, Pin Configuration and Functions

Pin1





6. Specification

6.1 Absolute Maximum rating（T_A=25℃）

Parameters	Symbol	Min.	Max.	Unit
IEC 61000-4-5 Power (8/20 μs)	P_{PK}	-	2100	W
IEC 61000-4-5 Current (8/20 μs)	I_{PP}		50	A
IEC 61643-321 Power (10/1000 μs)	P_{PK1}		165	W
IEC 61643-321 Current (10/1000 μs)	I_{PP1}		4	A
ESD (IEC61000-4-2 air discharge)	V_{ESD}	-	±30	kV
ESD (IEC61000-4-2 contact discharge)	V_{ESD}	-	±30	kV
Operating temperature	T_{OP}	-40	125	℃
Storage temperature	T_{STG}	-55	150	℃

Table-2 Absolute Maximum rating

6.2 Electrical Characteristics

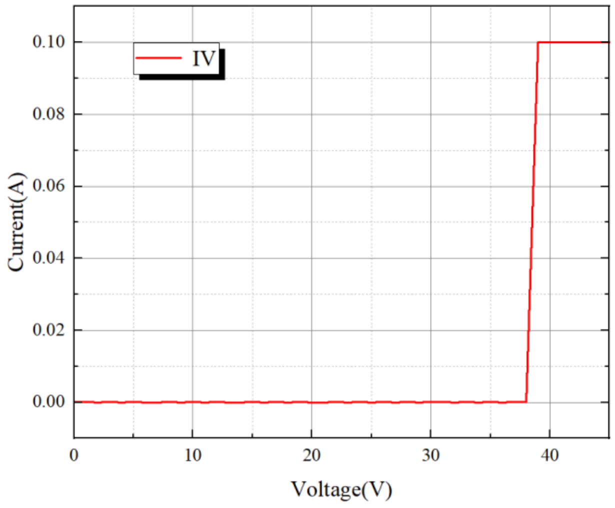
At T_A = 25℃ unless otherwise noted

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-off Voltage	V_{RWM}		-0.5		33	V
Reverse Breakdown Voltage	V_{BR}	I_T=1mA from VDD/IO to GND	37	38.7	40	V
Reverse Leakage Current	I_R	V_{RWM}=33V, T_A = 25℃		0.5	100	nA
		V_{RWM}=33V, T_A =85℃		20	500	nA
Forward Voltage	V_F	I_T=1mA from GND to VDD/IO	0.25	0.5	0.70	V
Clamping Voltage	V_C	I_{PP}=24A, t_p=8/20μs		38.2	40.0	V
		I_{PP}=35A, t_p=8/20μs		38.2	41.0	V
		I_{PP}=50A, t_p=8/20μs		38.6	42.0	V
Dynamic Resistance	R_{DYN}*	t_p=8/20μs		30		mΩ
Junction Capacitance	C_J	V_R=25V, f=1MHz, T=25°C		113		pF

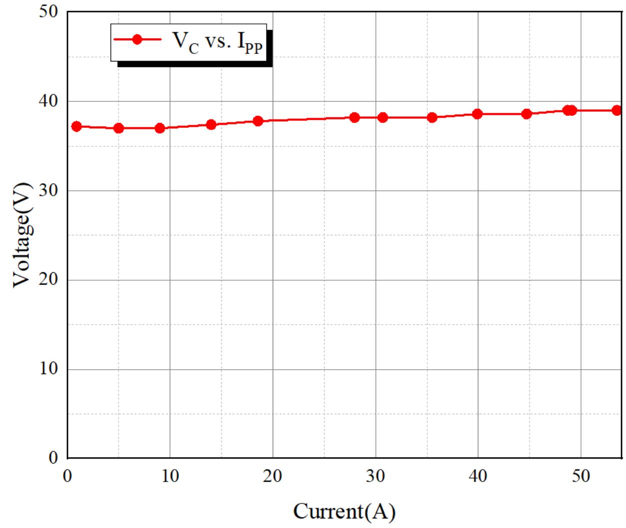
Table-3 Electrical Characteristics

*Dynamic resistance measured between 1A and 50A (t_p=8/20μs).

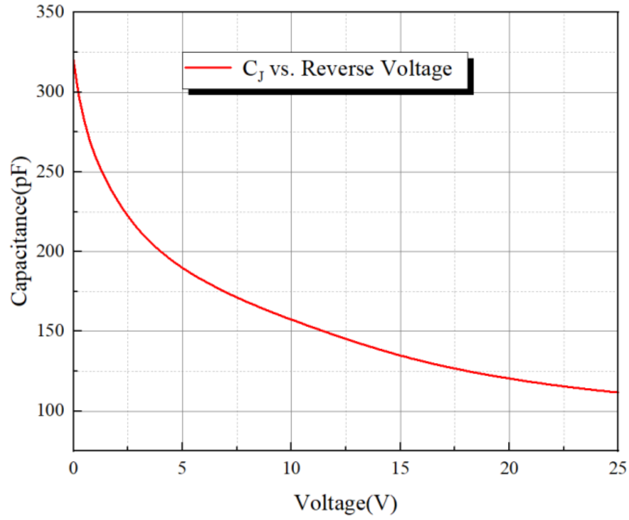
7. Typical Characteristics



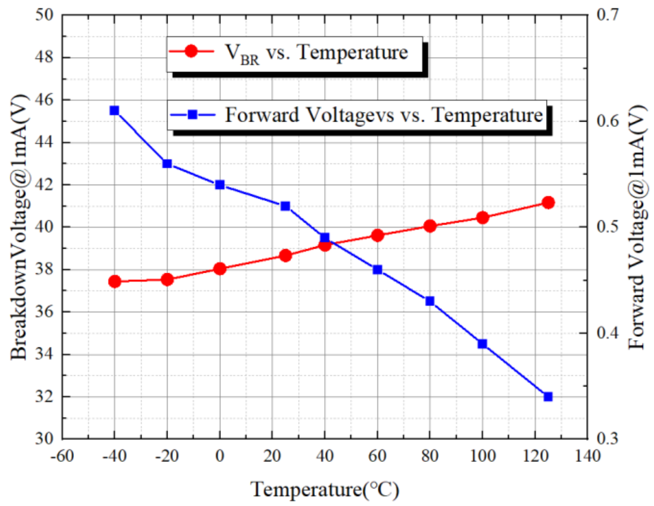
IV Characteristics



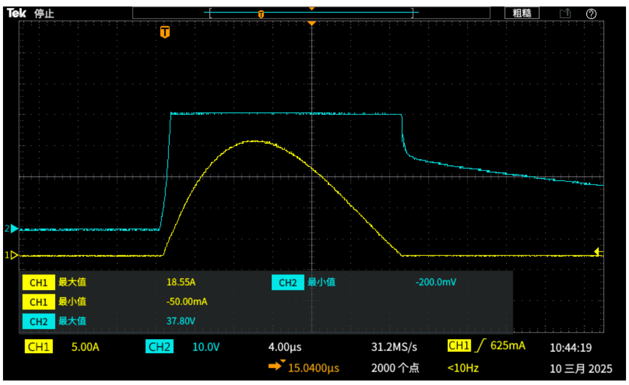
V_C vs. I_{PP}(t_p= 8/20μs)



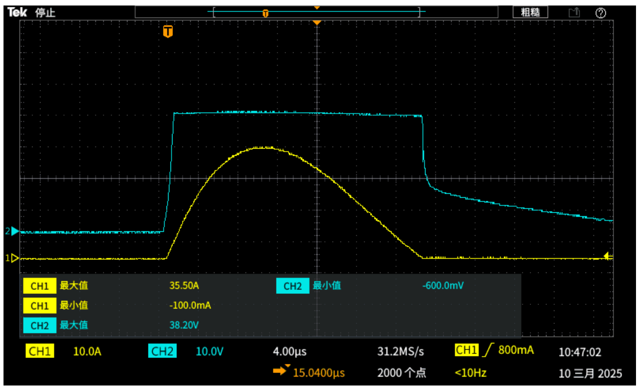
Capacitance vs. Reverse Voltage



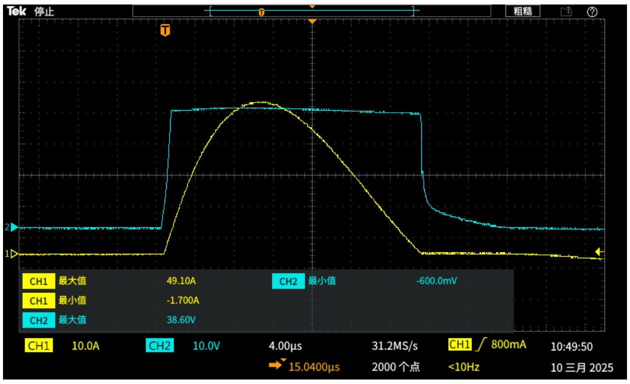
V_{BR} and V_F vs. Temperature



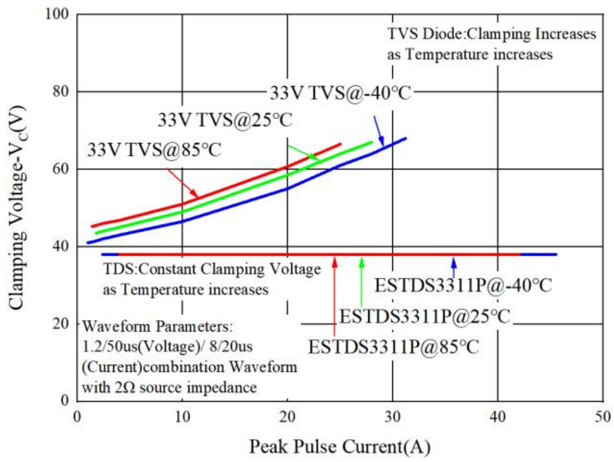
37.8V@18.6A



38.2V@35.5A



38.6V@49.1A



V_C vs. Current

8. Application Information

Description

The conventional TVS diode based on PN junction has a fixed dynamic resistance (R_{DYN}) (Fig.1). The clamping voltage of the traditional TVS diode is $V_C=V_{BR}+I_{PP}*R_{DYN}$. Because the dynamic resistance of TVS is a fixed value, the clamping voltage increases with the increase of I_{PP}, which leads to a linear increase of the clamping voltage in the peak pulse current range. In addition, the ability of traditional TVS diodes to absorb transient current is related to junction area and junction (ambient) temperature. When it absorbs or dissipates the surge energy, its own temperature increases, the clamping voltage increases significantly, and the peak transient current I_{PP} decreases.

TDS uses a surge rated field-effect transistor as its main protective element (Fig 2). It consists of precision trigger circuit, drive circuit and surge rated field effect transistor. When the trigger circuit detects EOS events, the drive circuit is activated by the trigger circuit and turns on the field effect transistor, and the transient current is transferred to the ground. As the I_{PP} increases, the R_{DYN} of the FET is reduced to a negligible value, so that the clamping voltage is

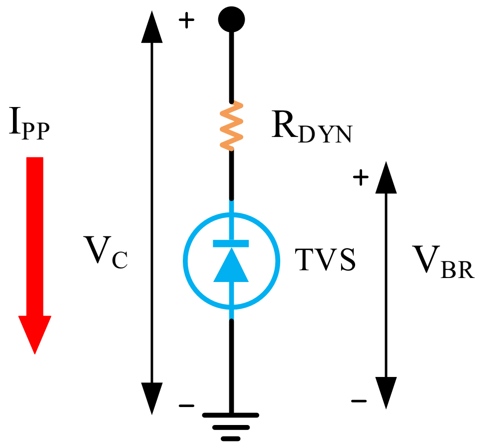


Fig.1 Equivalent circuit of traditional TVS diode

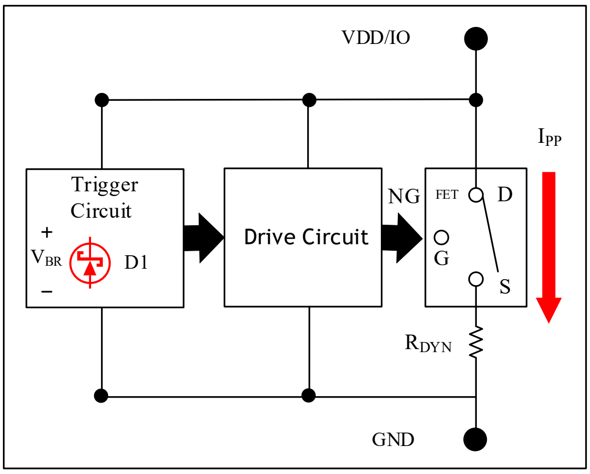


Fig. 2 The working principle of TDS

approximately the same as the breakdown voltage of the trigger circuit. Therefore, the clamping voltage of TDS is almost constant within the rated peak pulse current range (Fig. 3). In addition, the TDS is not based on the traditional PN junction to discharge the surge current, so its clamping voltage within the normal operating temperature range also remains stable.

Typical Applications

ESTDS3311P can be used to protect any power supply, analog or digital signal from transient overvoltage events caused by the environment or other electrical components.

The typical application of ESTDS3311P is the analog output module on the PLC in Fig.4. In this case, ESTDS3311P protects the 4-20mA transmitter of XTR115, which is a standard transmitter with a nominal voltage of 24V and a maximum input voltage of 40V. The industrial interface requires ± 1kV surge test protection through a 42Ω coupling resistor and a 0.5μF capacitor, which is equivalent to about 24A surge current. If there is no input protection, when lightning, coupling, ringing or other overvoltage conditions cause surge events, the input voltage will rise to hundreds of volts in a few microseconds, exceeding the absolute maximum input voltage, which will cause damage to the equipment. The ideal surge protection diode will maximize the operating voltage range and can be clamped within the safe voltage range of the system. The TDS technology introduced by Hunan Jingxin provides the best protection solution. ESTDS3311P is used to protect the device. During surge events, when the voltage rises to 38.7 V, the ESTDS3311P will be quickly triggered to instantaneously shunt the surge current to the ground. Because ESTDS3311P uses a built-in rated surge field effect transistor to

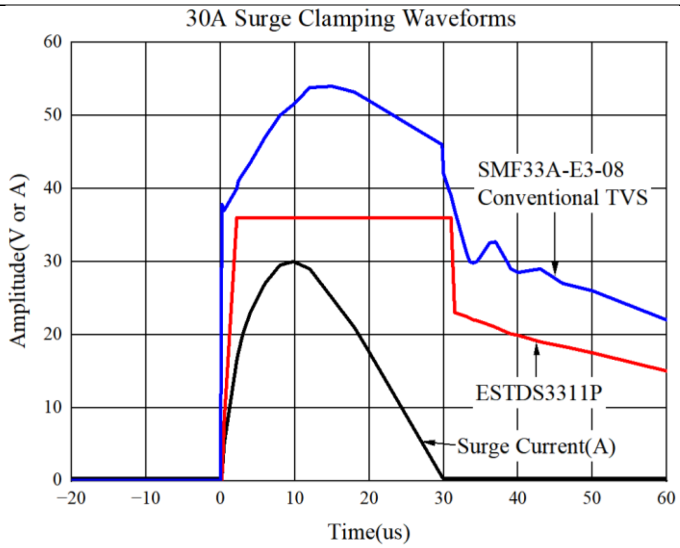


Fig. 3 Comparison of clamping voltages between TDS and TVS

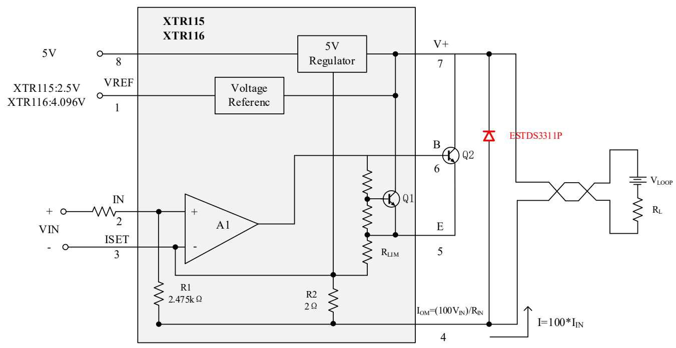


Fig. 4 Surge protection scheme for 4-20ma transmitters

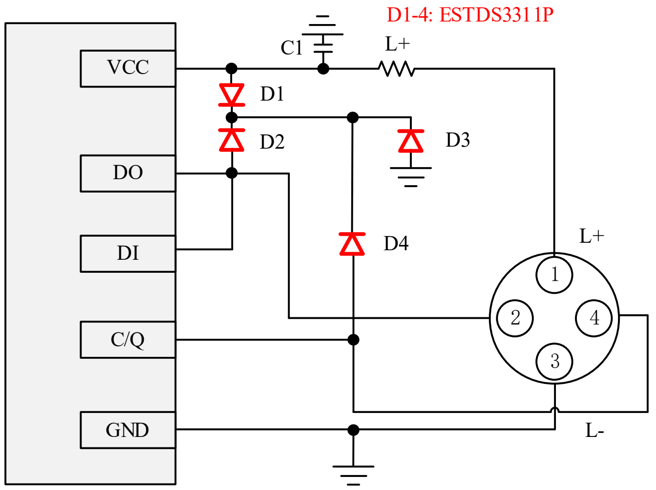


Fig. 5 ESD and surge protection of IO-Link

discharge current, its dynamic resistance is low, so the impact of surge current on the clamping voltage is very small. The dynamic resistance of the ESTDS3311P is about 30mΩ, and the surge current of 24A will cause the clamping voltage to increase by 24A×30mΩ = 0.72V. This means that during the surge pulse, the input voltage of XTR115 is 38.7V + 0.72V = 39.42V, which is completely within the absolute maximum input voltage range (<40V). This ensures the strong protection of the back-end circuit by ESTDS3311P, which is beneficial to increase the reliability of the system.

ESTDS3311P can be used to protect the power line and I / O line of industrial sensors, and its typical applications include IO-Link interface and digital sensor input. In these applications, ESTDS3311P can be used to protect power and I / O lines, as shown in Figure 5-8.

Pin Configuration

ESTDS3311P is in a 1.6mmx1.6mm, 6-pin DFN package. The input or connection to the protected bus is made at pins 4, 5, and 6. Ground connection is made at pins 1, 2, and 3. All pins must be connected for maximum peak pulse current handling capability (Fig. 9).

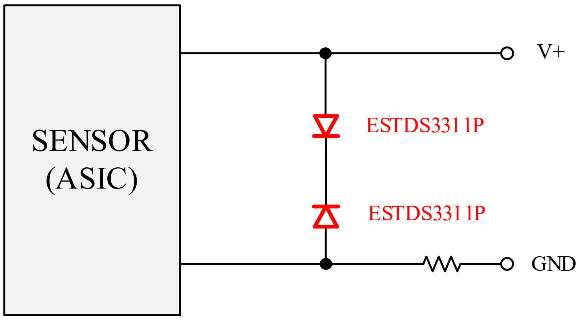


Fig. 6 Application of 2-wire sensor

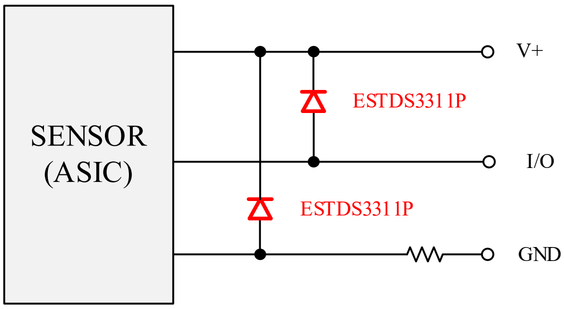


Fig. 7 Application of 3-wire sensor

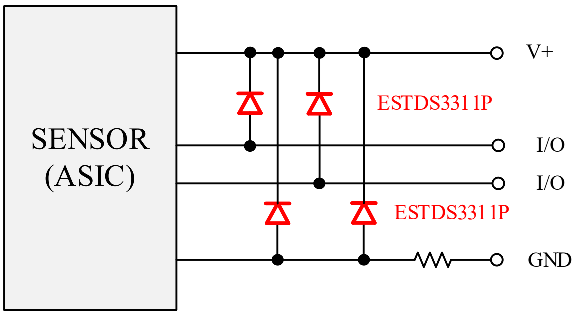
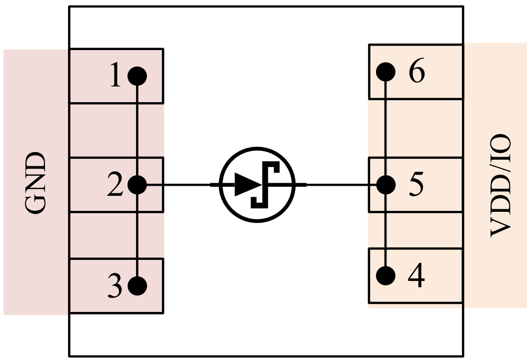


Fig. 8 Application of 4-wire sensor

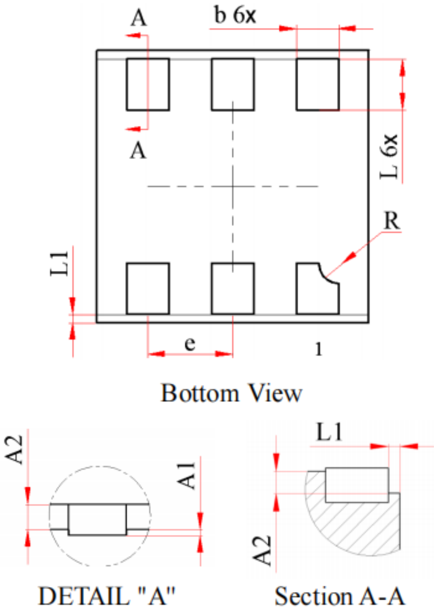


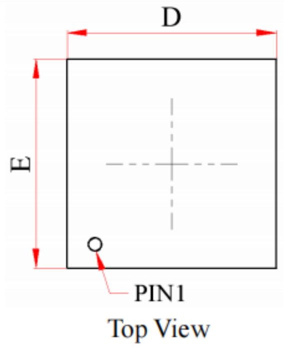
PIN	NAME
1、2、3	GND
4、5、6	VDD/IO

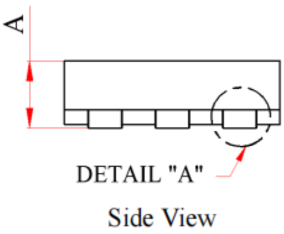
Fig.9 Configuration and description of pins

9. Dimension

POD

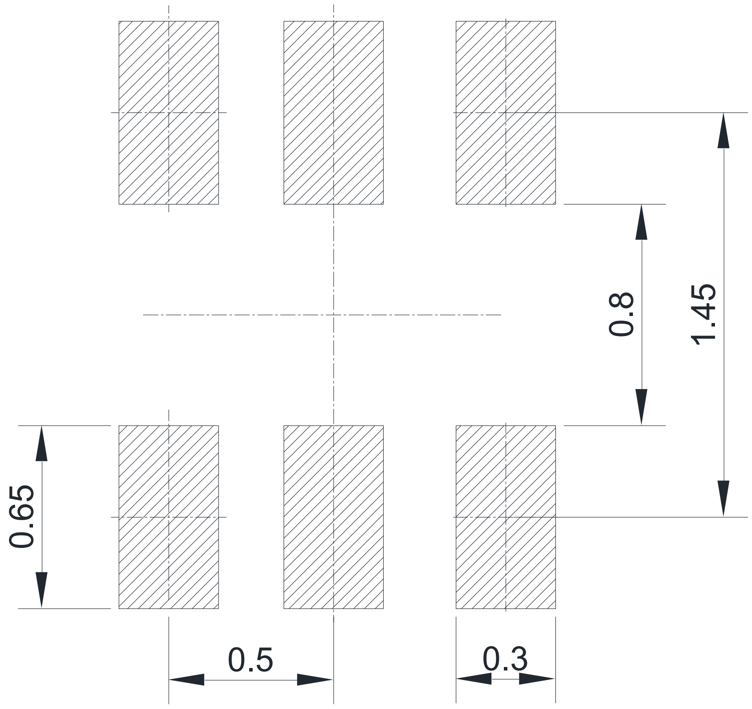






Symbol	Dimension In Millimeters			Dimension In Inches		
	Normal	Min	Max	Normal	Min	Max
A	0.550	0.500	0.600	0.22	0.020	0.024
A1	--	0.000	0.005	--	0.000	0.000
A2	--	0.050	0.250	--	0.002	0.010
D	1.600	1.550	1.650	0.063	0.061	0.065
E	1.600	1.550	1.650	0.063	0.061	0.065
b	0.250	0.200	0.300	0.010	0.008	0.012
L	0.300	0.250	0.350	0.012	0.010	0.014
L1	0.050	0.010	0.090	0.002	0.000	0.004
R	0.120	0.070	0.170	0.005	0.003	0.007
e	0.500 BSC			0.020 BSC		

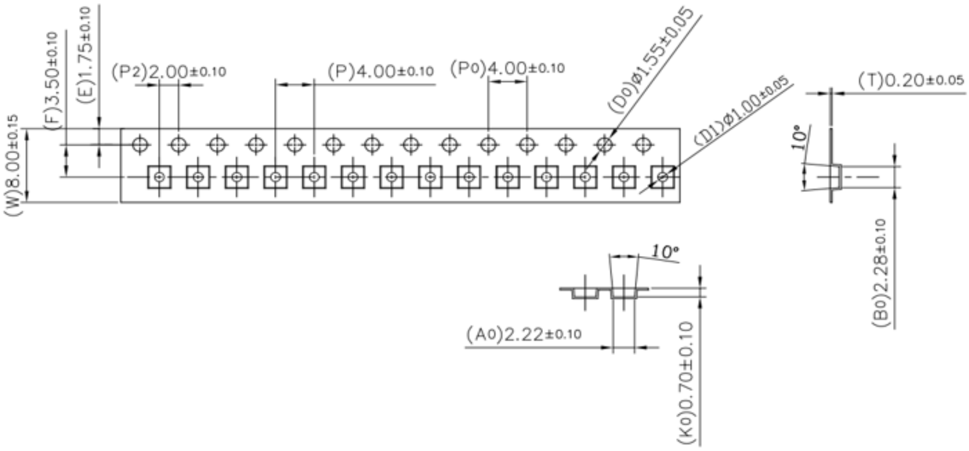
10.Recommended Soldering Footprint



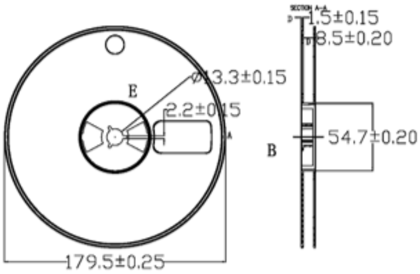
DIMENSIONS: MILLIMETERS

11.Tape and Reel Information

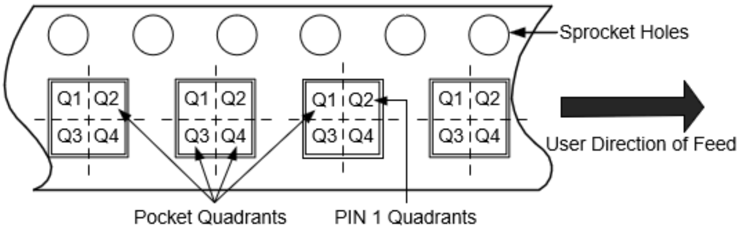
TAPE DIMENSIONS



REEL DIMENSIONS



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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