

PROTECTION PRODUCTS

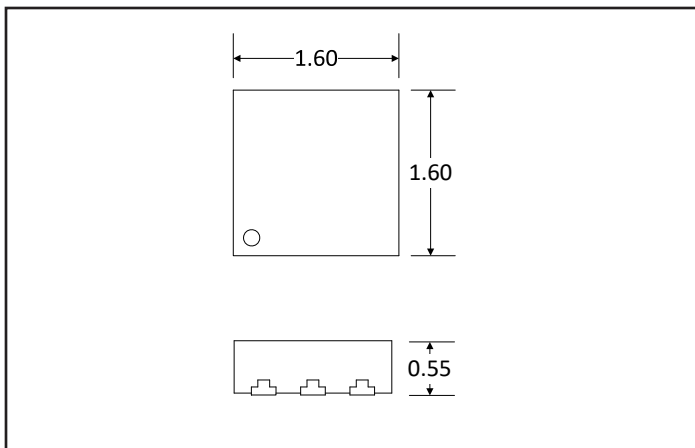
Description

Transient Diverting Suppressors (TDS) are designed to provide high energy EOS protection with superior clamping and temperature characteristics when compared to standard TVS devices. The device uses a surge rated FET as the main protection element. During an EOS event, transient voltage increases beyond the rated breakdown voltage of the device. The FET in turn switches on and conducts transient current to ground. The TDS clamping voltage is nearly constant across the rated peak pulse current range due to the extremely low ON Resistance of the FET. Lower clamping voltage at maximum peak pulse current makes them more suitable for protecting today's sensitive IC's, when compared to standard TVS diodes.

TDS4001P is designed to protect voltage bus or data lines with an operating voltage as high as 40V. It is rated for a high-energy transient current up to 24A ($t_p = 8/20\mu s$) and may be used to meet the common industrial voltage surge standard of $\pm 1kV$ per IEC61000-4-5 ($R_s = 42\text{ Ohms}$, $C_s = 0.5\mu F$).

TDS4001P is in a small DFN 1.6mm x 1.6mm x 0.55mm 6-Lead package and represents significant board space savings over traditional SMAJ and SMBJ packaged devices.

Package Dimension (mm)



Features

- High ESD withstand Voltage: $\pm 20kV$ (Contact) and $\pm 30kV$ (Air) per IEC 61000-4-2
- High peak pulse current capability: 24A ($t_p = 8/20\mu s$), 1kV ($t_p = 1.2/50\mu s$, $R_s = 42\Omega$) per IEC 61000-4-5
- High EFT Withstand Voltage: $\pm 4kV$ (100kHz and 5kHz, 5/50ns) IEC 61000-4-4
- Protects one I/O or power line
- Low clamping voltage: 53V Maximum at $I_{pp} = 24A$ ($t_p = 8/20\mu s$)
- Working voltage: 40V
- Solid-state technology

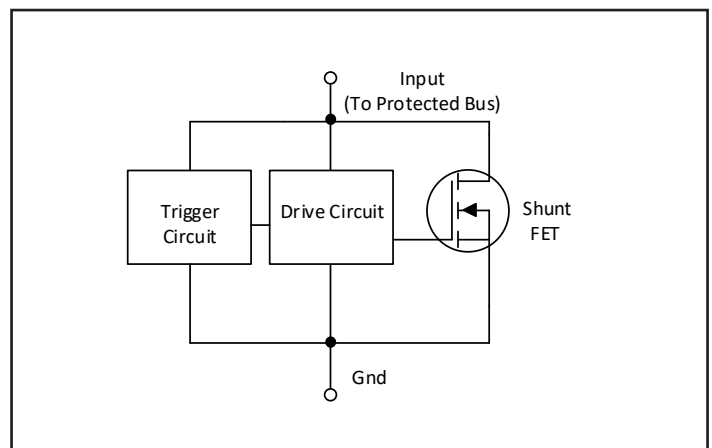
Mechanical Characteristics

- Package: DFN 1.6mm x 1.6mm x 0.55mm 6-Lead
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Molding compound flammability rating: UL 94V-0
- Lead Finish: Lead-Free
- Marking: Marking code and Date Code
- Packaging: Tape and Reel

Applications

- 24V AC Lines
- IoT Devices
- HVAC Systems
- Pachinko Machines
- Thermostats
- Security Cameras
- Industrial Equipment

Functional Diagram



Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power ($t_p = 8/20\mu s$)	P_{PK}	1120	W
Peak Pulse Current ($t_p = 8/20\mu s$)	I_{PP}	24	A
ESD per IEC 61000-4-2 (Air) ⁽¹⁾ ESD per IEC 61000-4-2 (Contact) ⁽¹⁾	V_{ESD}	± 30 ± 20	kV
Operating Temperature	T_{OP}	-55 to +125	°C
Storage Temperature	T_{STG}	-55 to +150	°C

Electrical Characteristics (T=25°C unless otherwise specified)

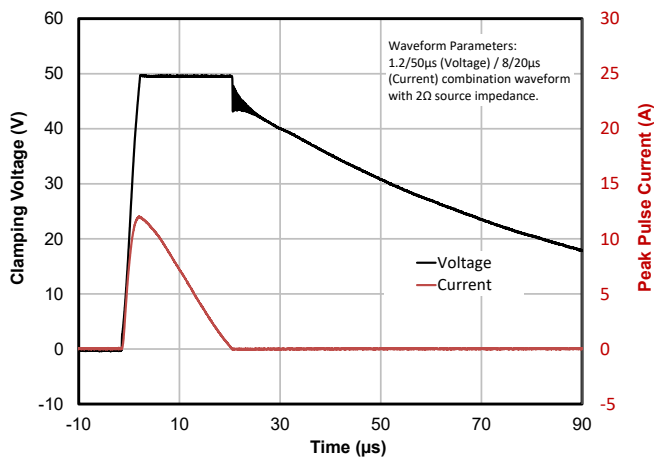
TDS4001P						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V_{RWM}	Line to GND			40	V
Reverse Breakdown Voltage	V_{BR}	$I_t = 1\text{mA}$, Line to GND	46		52	V
Forward Voltage	V_F	$I_t = 1\text{mA}$, GND to Line		0.5		V
Reverse Leakage Current	I_R	$V_{RWM} = 40\text{V}$, Line to GND $T = 25^\circ\text{C}$		100	700	nA
Clamping Voltage ⁽²⁾	V_C	$I_{PP}=12\text{A}$, $t_p = 8/20\mu s$, Line to GND		49.7	52	V
		$I_{PP}=24\text{A}$, $t_p = 8/20\mu s$, Line to GND		49.8	53	V
Dynamic Resistance ^{(2), (3)}	R_{DYN}	$t_p = 8/20\mu s$		6.8		mΩ
Junction Capacitance	C_J	$V_R = 40\text{V}$, $f = 1\text{MHz}$		162		pF

Notes:

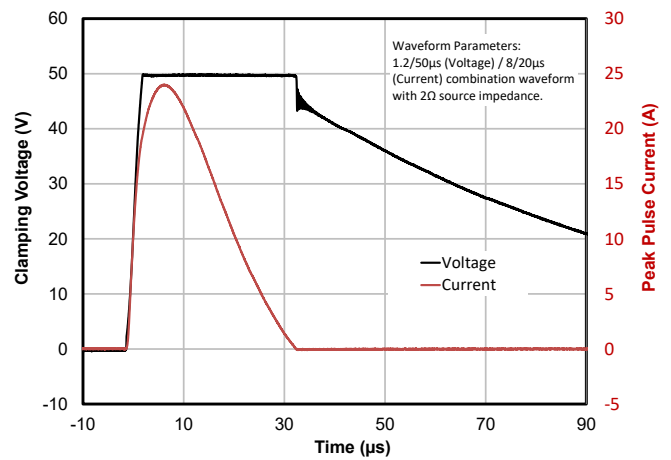
- 1) ESD gun return path connected to ESD ground plane.
- 2) Parameter guaranteed by design.
- 3) Dynamic resistance measured between 1A and 24A.

Typical Characteristics

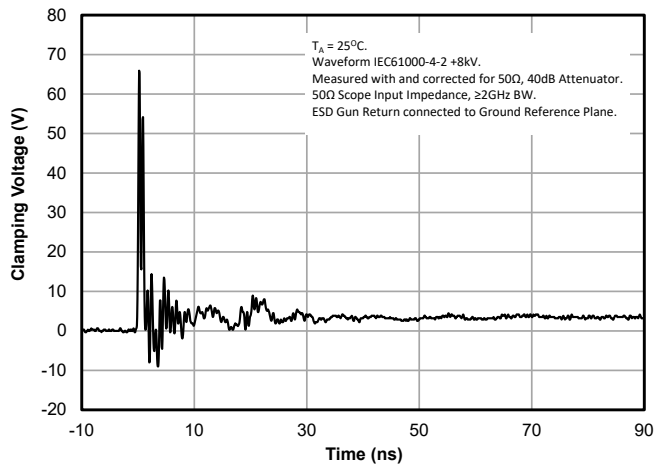
Clamping Voltage ($t_p = 1.2/50\mu s$, $I_{pp} = 12A$)



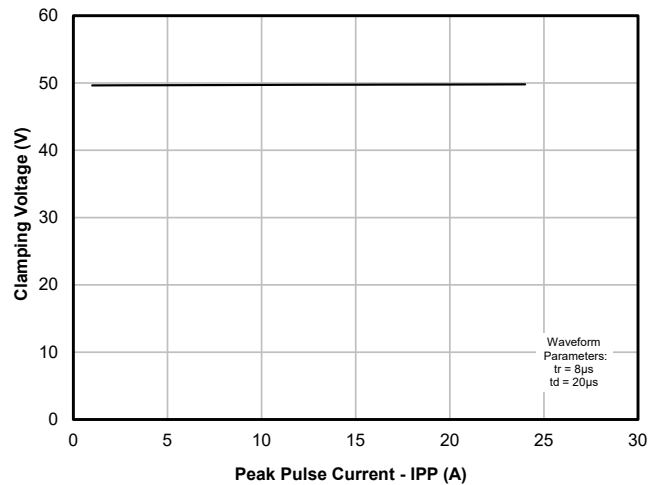
Clamping Voltage ($t_p = 1.2/50\mu s$, $I_{pp} = 24A$)



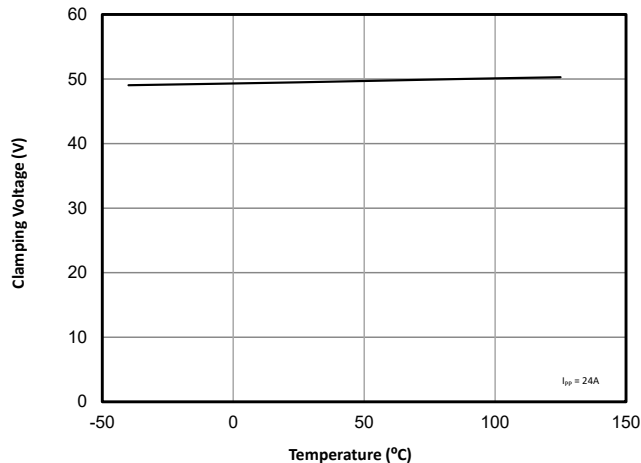
ESD Clamping (+8kV Contact per IEC 61000-4-2)



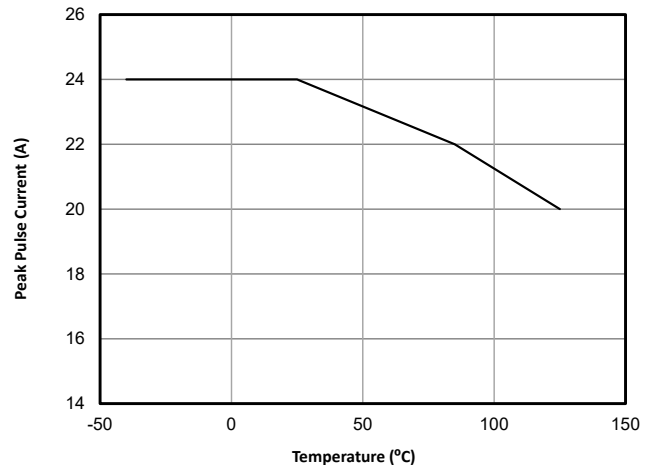
Clamping Voltage vs. Peak Pulse Current ($t_p = 8/20\mu s$)



Clamping Voltage ($t_p = 1.2/50\mu s$, $I_{pp} = 24A$) vs Temperature

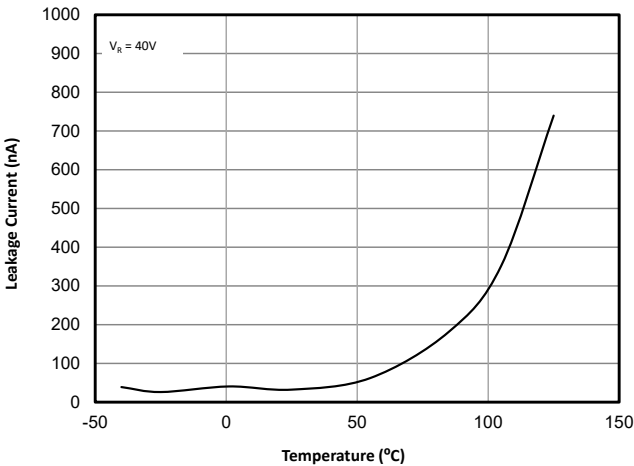


Peak Pulse Current ($t_p = 8x20\mu s$) vs Temperature

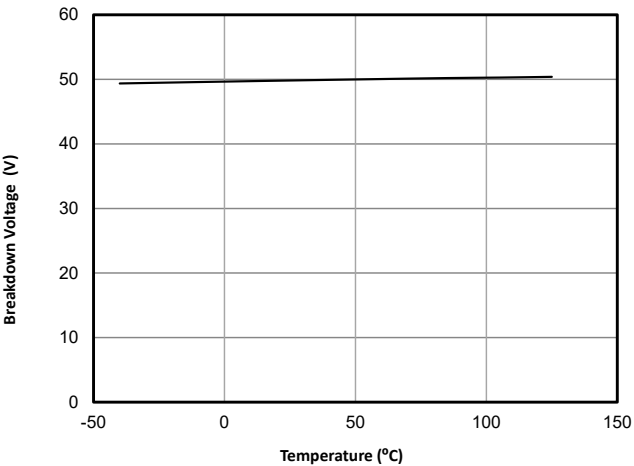


Typical Characteristics

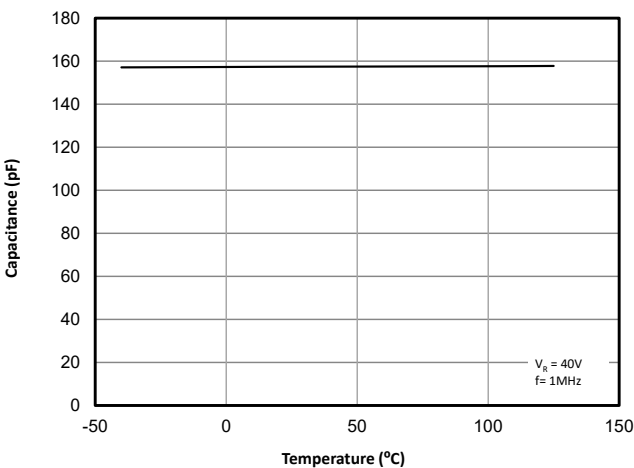
Reverse Leakage vs. Temperature



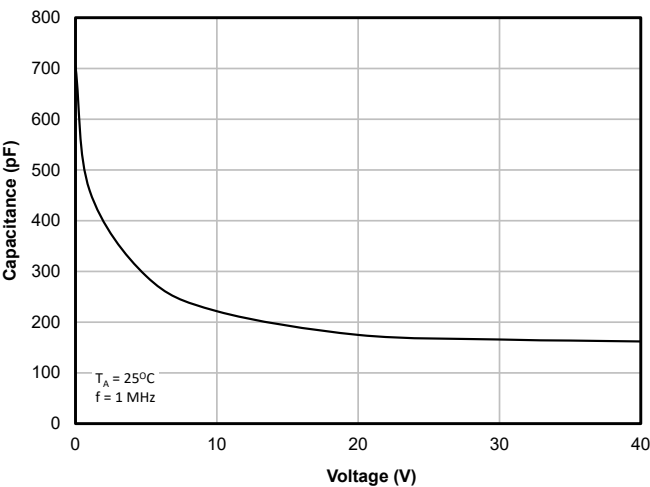
Breakdown Voltage vs. Temperature



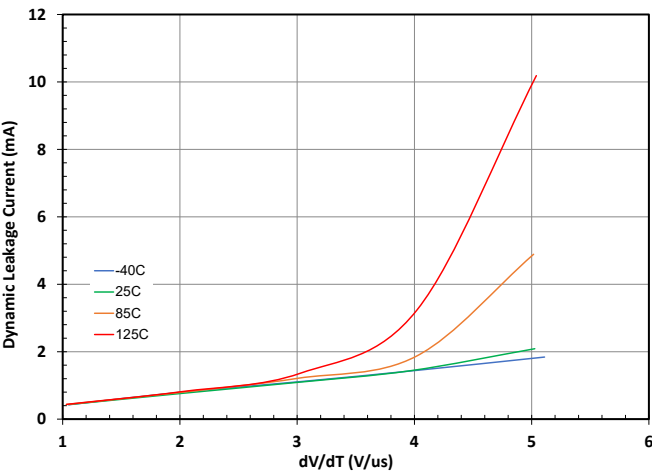
Capacitance vs. Temperature



Capacitance vs. Reverse Voltage



Dynamic Leakage vs. Signal Slew Rate over Temperature



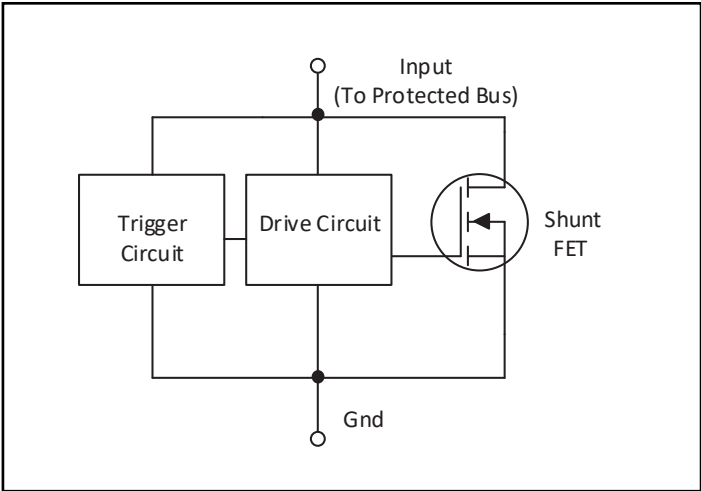
Application Information

Description

Transient Diverting Suppressors(TDS) are designed to provide high energy EOS protection with superior clamping and temperature characteristics when compared to standard TVS devices.

This device uses a surge rated FET as the main protection element. During an EOS event, transient voltage increases beyond the breakdown voltage of the trigger circuit. This in turn activates the drive circuit and turns on the shunt FET which conducts transient current to ground. The TDS has an extremely low dynamic resistance and exhibits a nearly constant clamping voltage across the rated peak pulse current range.

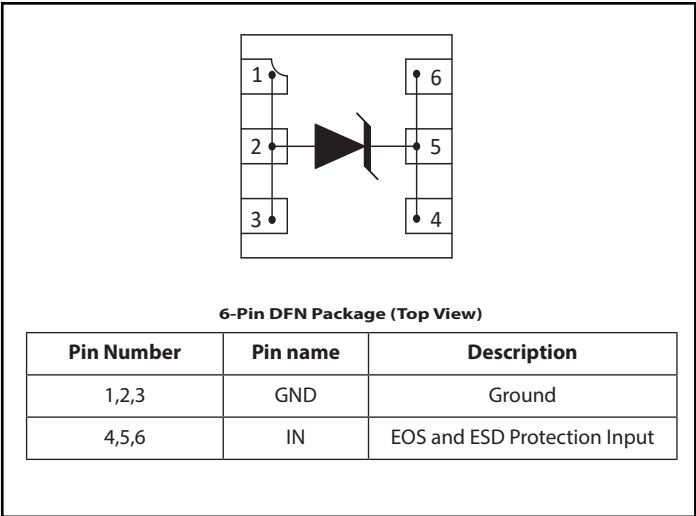
Figure 1- Function Diagram



Pin Configuration

TDS4001P is in a 1.6 x 1.6mm, 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.

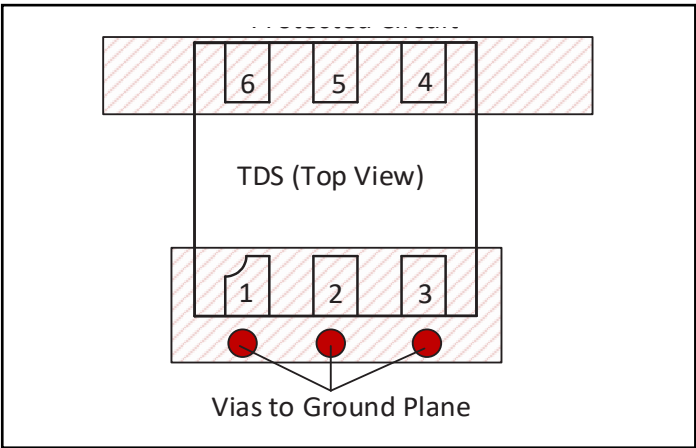
Figure 2- Pin Configuration and Description



Layout Guidelines

Figure 3 shows a recommended layout for TDS4001P. All the I/O pins (Pin 4, 5 and 6) are connected through a single straight trace. All of the I/O pins must be connected for surge performance. Likewise, all GND pins (Pin 1, 2 and 3) must be connected for maximum surge current capability. Ground connection with multiple vias is recommended.

Figure 3- PCB Layout Recommendation



Application Information (Continued)

Typical Application

A typical application for TDS4001P is protecting 24VAC input lines in IoT devices such as a smart thermostat as shown in Figure 4. In this example, TDS4001P is connected on each line of a solid-state isolation switch. Relay switching in the HVAC system, or power supply transients can easily reach several hundreds of volts, and easily damage the switch. With TDS4001P, the transient voltage will be clamped to less than 53V. They may be used to meet the common industrial voltage surge standard of $\pm 1\text{kV}$ per IEC61000-4-5 ($R_s = 42\text{ Ohms}$, $C_s = 0.5\mu\text{F}$).

Clamping Voltage

TDS4001P has an extremely low typical dynamic resistance resulting in a nearly constant clamping voltage across the rated peak pulse current range and temperature as shown in Figure 5.

Figure 5- Clamping Voltage vs. Peak Pulse Current

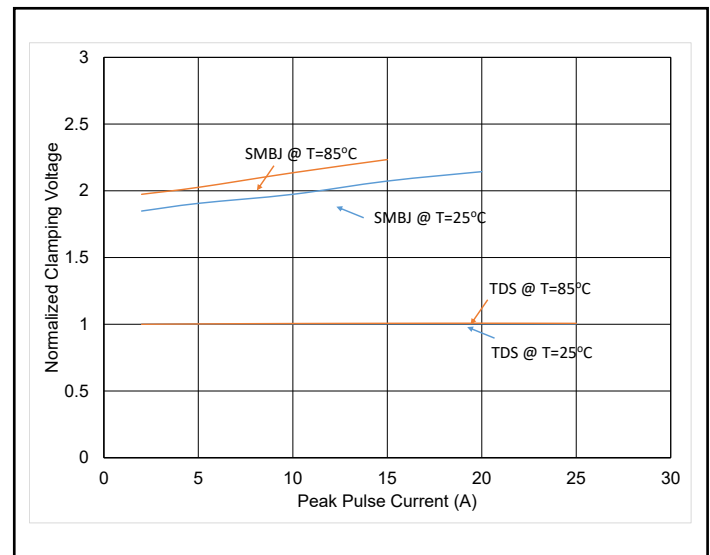
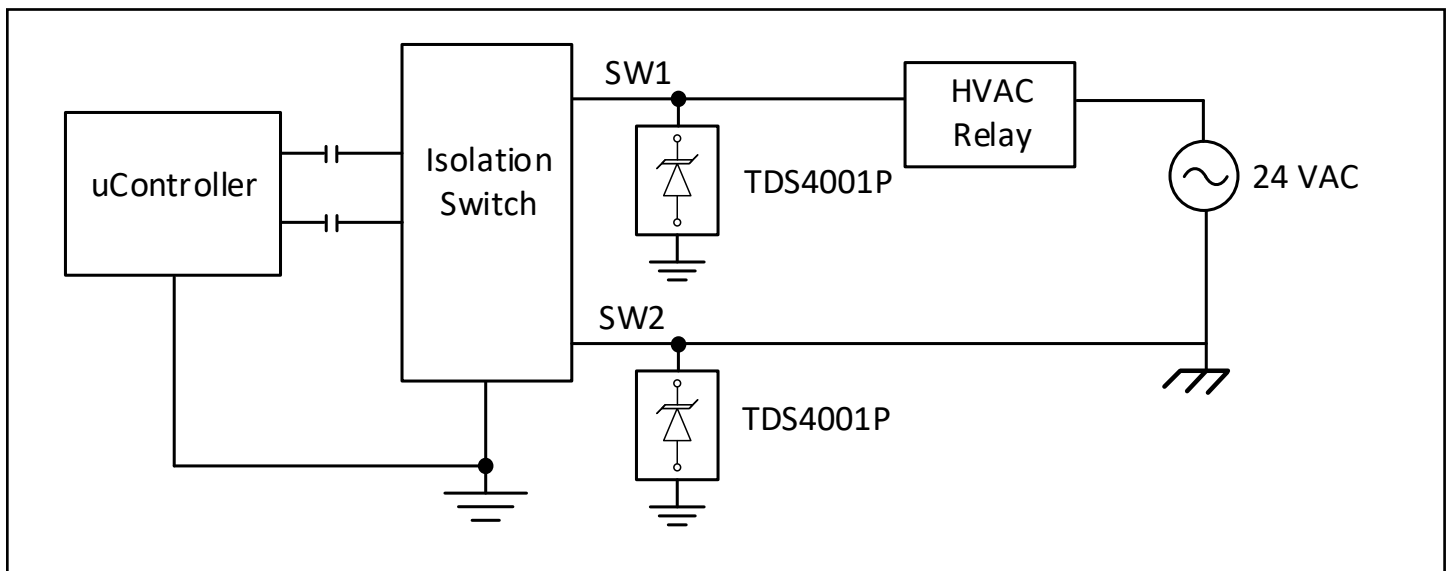
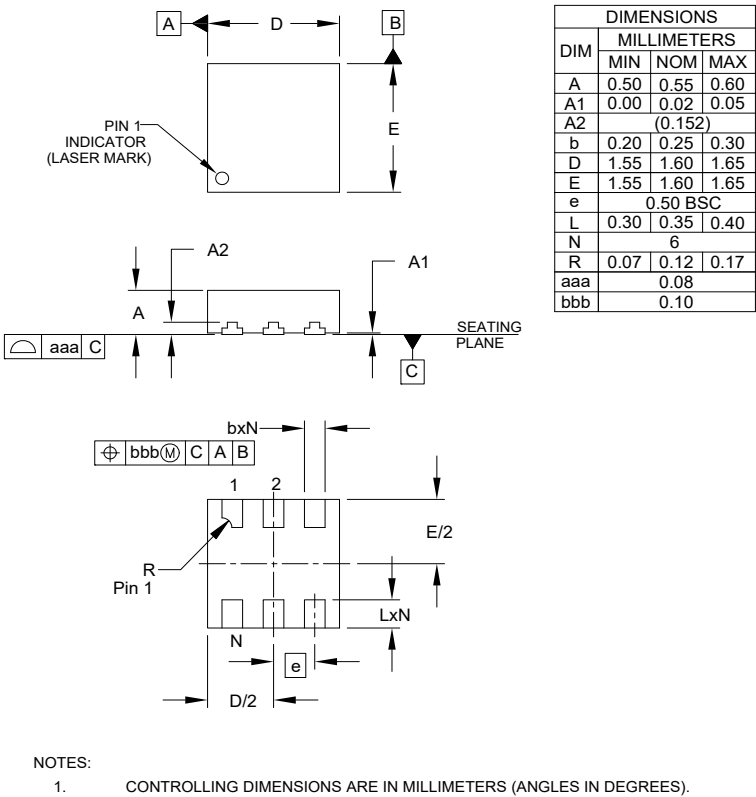


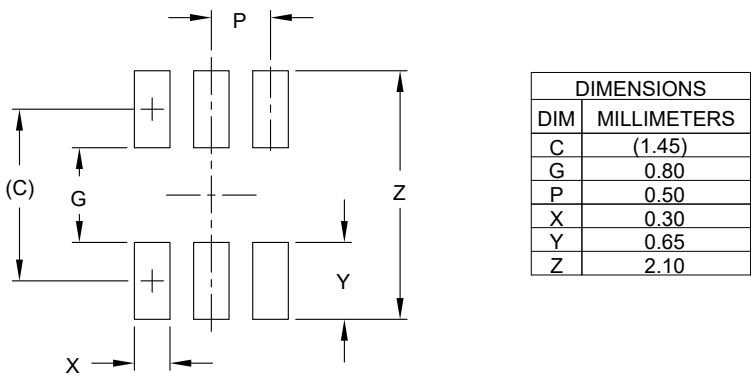
Figure 4- TDS4001P Application Example



Outline Drawing - DFN 1.6mm x 1.6mm x 0.55mm 6-Lead

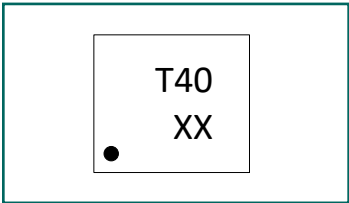


Land Pattern - DFN 1.6mm x 1.6mm x 0.55mm 6-Lead



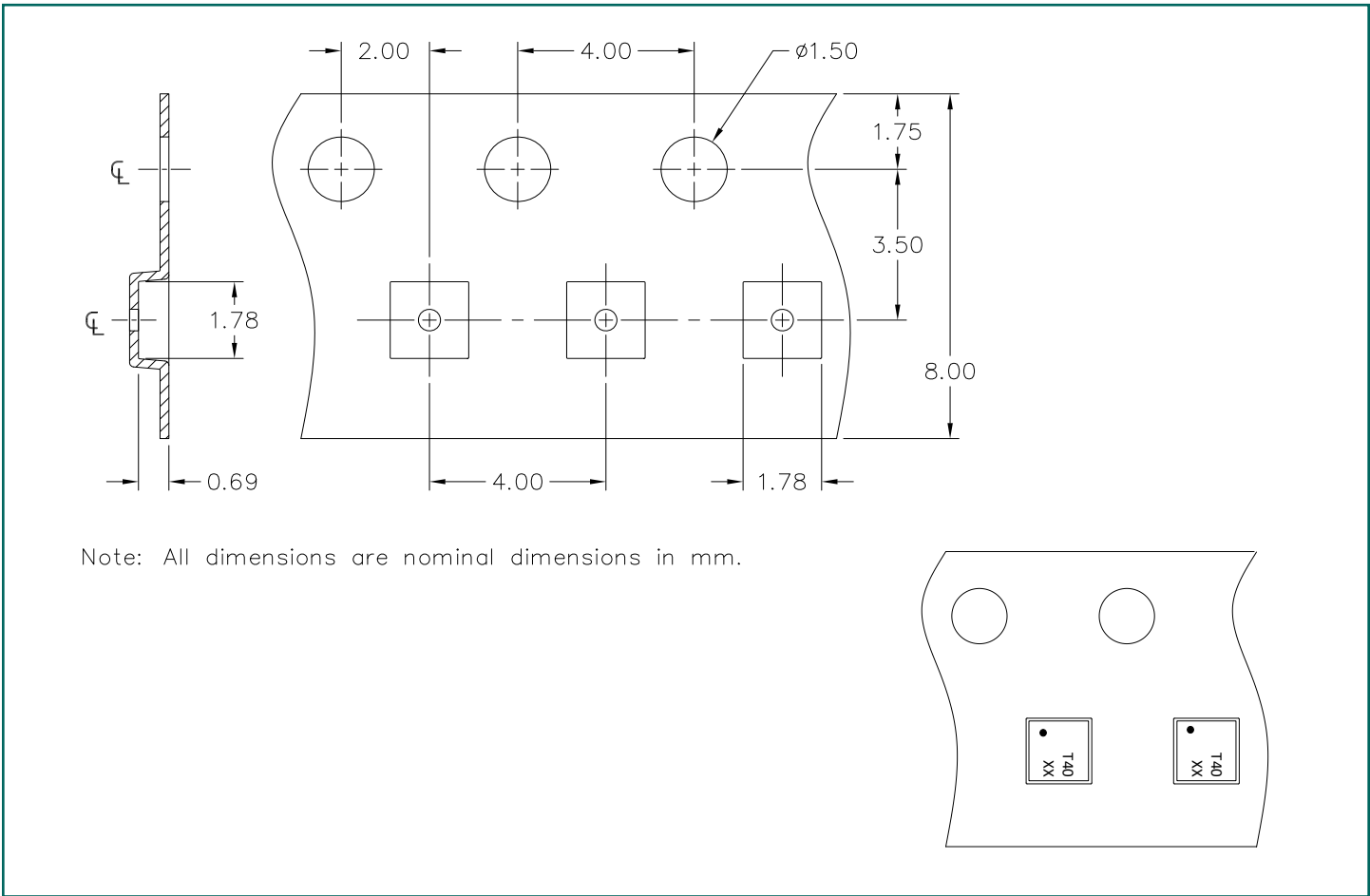
- NOTES:**
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
 2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

Marking Code



- Notes:
- 1. XX: Date Code.
 - 2. Dot indicates Pin 1 location.

Tape and Reel Specification



Ordering Information

Part Number	V _{RWM}	Qty per Reel	Reel Size
TDS4001P.C	40V	3,000	7"



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