

## Five Channel Space Saving ESD Protection Device

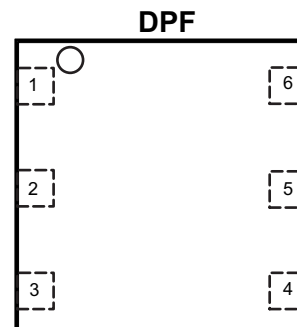
 Check for Samples: [TPD5E003](#)

### FEATURES

- Provides System Level ESD Protection for Low-Voltage IO Interface
- IEC 61000-4-2 Level 4
  - ±15kV (Contact discharge)
  - ±15kV (Air-gap discharge)
- Typical IO Capacitance 7pF ( $V_{IO} = 2.5V$ )
- DC Breakdown Voltage 6V (Min)
- Low Leakage Current 100nA (Max)
- Low ESD Clamping Voltage
- Industrial Temperature Range: –40°C to 125°C
- IEC 61000-4-5 (Surge): 40 W (8/20  $\mu$ s Pulse)
- Small, Easy-to-Route DPF Package

### APPLICATIONS

- SIM Card
- Side Keys
- Audio Interface
- Memory Card



1 mm x 1 mm x 0.4mm  
(0.35-mm pitch)

### DESCRIPTION

The TPD5E003 is a five channel ESD protection device. It offers ±15KV IEC contact and ±15KV air-gap ESD protection. It features five identical ESD clamping diodes that could be used for either five unidirectional (0V to 5V) I/O lines or four bidirectional (-5V to 5V) I/O lines. The lower IO capacitance is suitable for a wide range of applications. Typical application areas include audio lines (mic, earphone, and speakerphone), SD interface, and keypad, or other buttons.

### ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	5000	Tape and reel	TPD5E003DPFR	9Q

(1) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at [www.ti.com](http://www.ti.com).

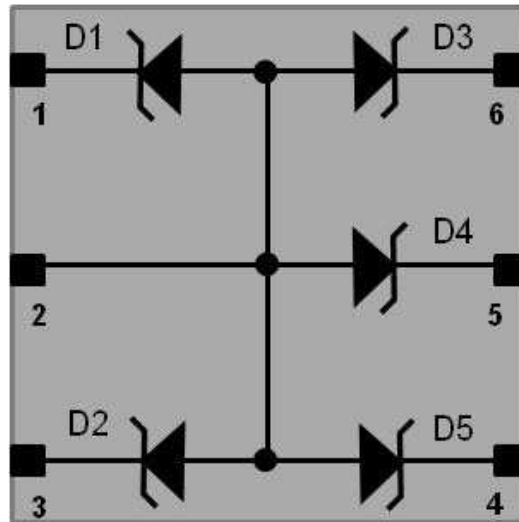


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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**APPLICATION/FUNCTIONAL BLOCK DIAGRAM**



**PIN FUNCTIONS**

PIN NAME	DPF	PIN TYPE	DESCRIPTION
I/O	1, 3, 4, 5, 6	I/O	ESD Protected channel
GND	2	GND	Ground

**ABSOLUTE MAXIMUM RATINGS**

	MIN	MAX	UNIT
IO voltage tolerance		5.5	V
Operating temperature range	-40	125	°C
Storage temperature	-55	150	°C
IEC 61000-4-2 contact ESD		±15	kV
IEC 61000-4-2 air-gap ESD		±15	kV
I <sub>PP</sub> , peak pulse current (tp = 8/20µs)		3	A
P <sub>PP</sub> , peak pulse power (tp = 8/20µs)		40	W

**ELECTRICAL CHARACTERISTICS**

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
V <sub>RWM</sub> Reverse stand-off voltage	I <sub>l</sub> = 0.1 µA			5.0	V
I <sub>LEAK</sub> Leakage Current	Pin 1, 3, 4, 5, or 6 = 5V, Pin 2 = 0V		10	100	nA
V <sub>Clamp</sub> Clamp voltage with ESD strike	I <sub>PP</sub> = 6A, TLP, Dx pin to GND, T <sub>A</sub> = 25 °C		13	15.6	V
	I <sub>PP</sub> = 10 A, TLP, Dx pin to GND, T <sub>A</sub> = 25 °C		16.3	19.5	V
R <sub>DYN</sub> Dynamic resistance	I <sub>TLP</sub> = 6A to 10 A, Dx pin to GND, T <sub>A</sub> = 25 °C		0.8	1	Ω
	I <sub>TLP</sub> = 6A to 10 A, GND to Dx pin, T <sub>A</sub> = 25 °C		0.3	0.4	Ω
C <sub>IO</sub> IO capacitance	V <sub>IO</sub> = 2.5V, 1 MHz, T <sub>A</sub> = 25 °C	5.6	7	8.4	pF
	V <sub>IO</sub> = 0V, 1 MHz, T <sub>A</sub> = 25 °C	8	10	12	pF
V <sub>BR</sub> Break-down voltage	I <sub>IO</sub> = 1 mA	6.0	7	8.5	V

APPLICATION INFORMATION

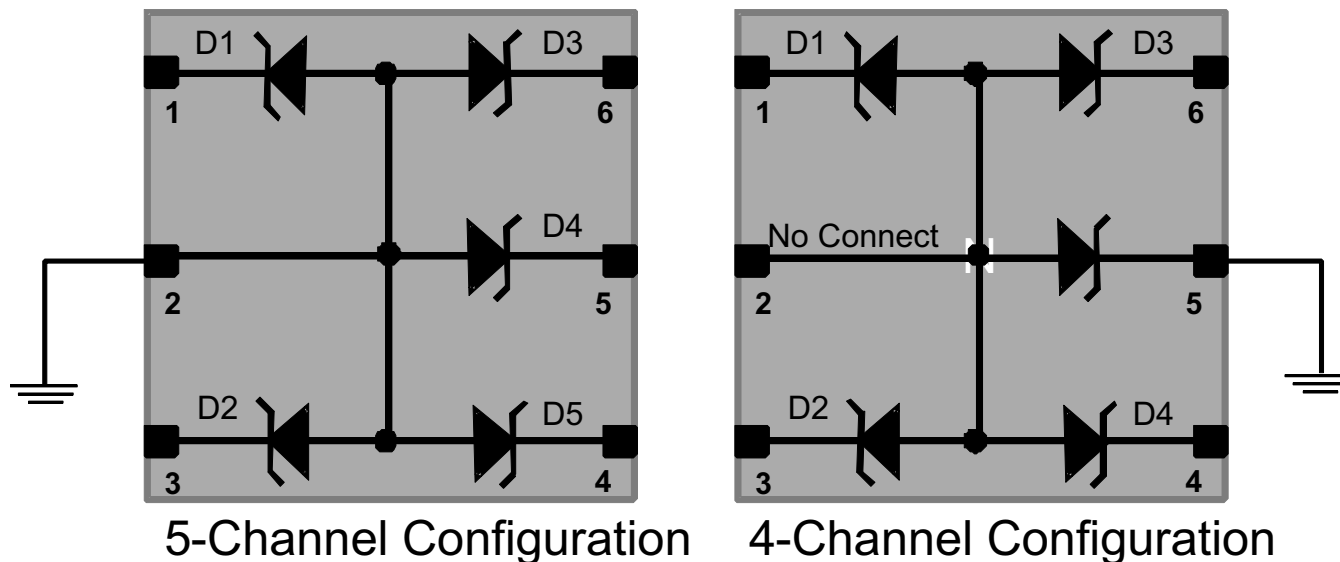


Figure 1. Application Diagram

The TPD5E003 offers 5 identical unidirectional ESD protection channels. To use all 5 channels, the recommended configuration is shown in Figure 1. The TPD5E003 can also be used as 4 identical bidirectional ESD protection channels. To do so, pin 5 would be connected to ground, with pin 1, 3, 4, and 6 connected to the I/O to be protected. In the bidirectional configuration, IO capacitance is reduced by half and the breakdown voltage is doubled.

TYPICAL CHARACTERISTICS

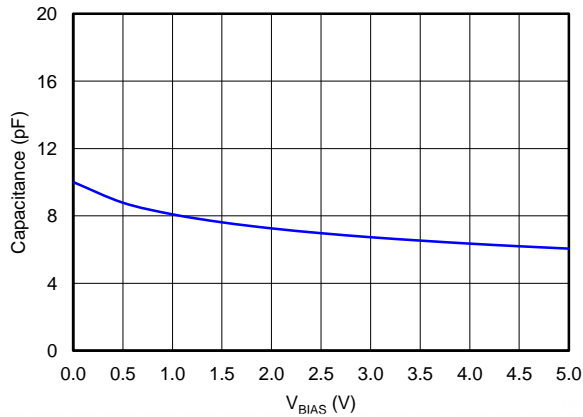


Figure 2. Capacitance vs DC Bias Voltage

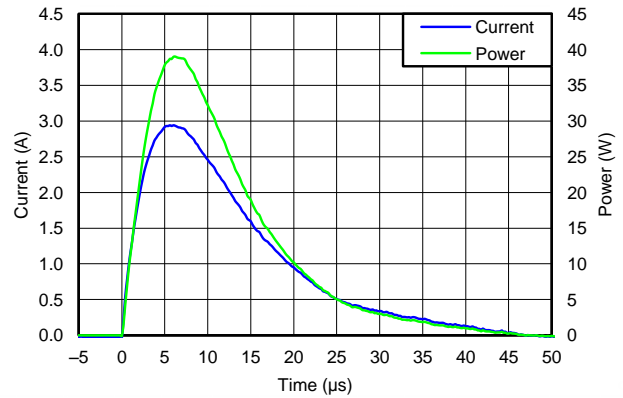


Figure 3. Surge Plot ( $t_p = 8/20\mu s$ ), Pin Dx to GND

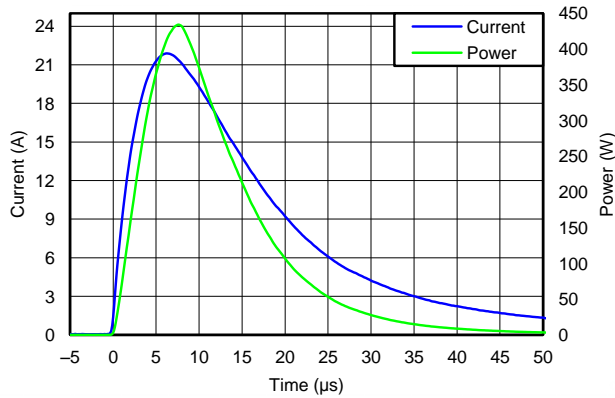


Figure 4. Surge Plot ( $t_p = 8/20\mu s$ ), Pin GND to Dx

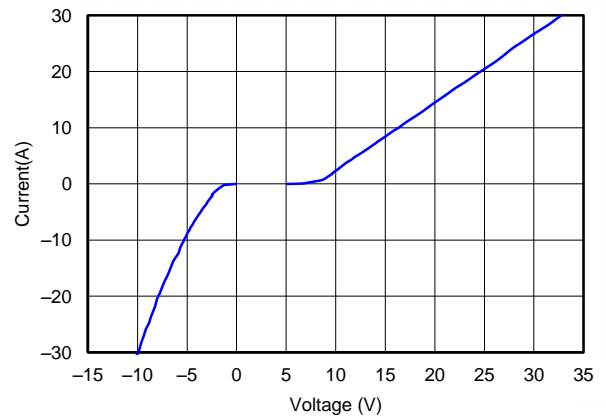


Figure 5. 30 Amps TLP Plot

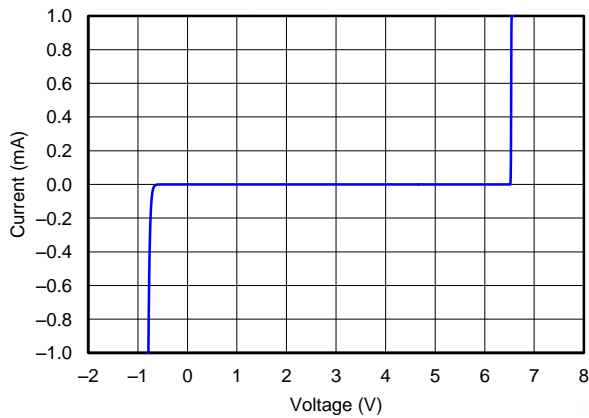


Figure 6. DC SWEEP V-I Curve

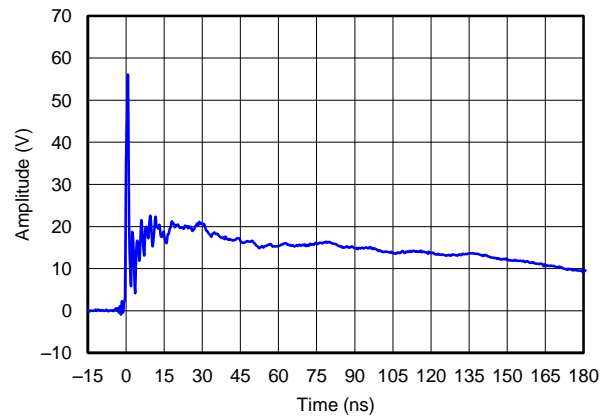
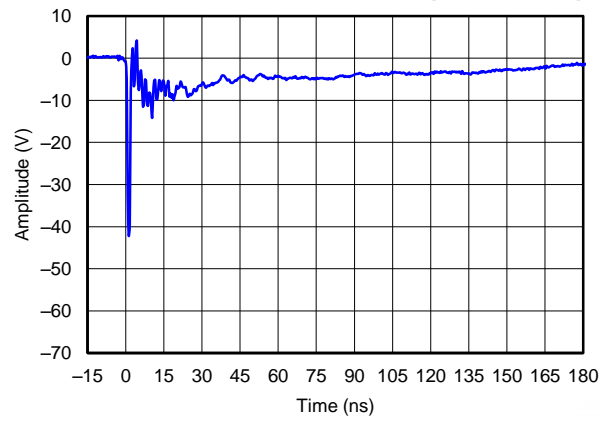


Figure 7. IEC 61000-4-2 Clamping Voltage, +8kV Contact

**TYPICAL CHARACTERISTICS (continued)**



**Figure 8. IEC 61000-4-2 Clamping Voltage, -8kV Contact**

## REVISION HISTORY

Changes from Original (December 2012) to Revision A	Page
• Added IO voltage tolerance to the ABSOLUTE MAXIMUM RATINGS table. ....	2
• Added MAX values to parameters in the ELECTRICAL CHARACTERISTICS table. ....	2

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
TPD5E003DPFR	ACTIVE	X2SON	DPF	6	5000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	9Q	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPD5E003DPFR	X2SON	DPF	6	5000	180.0	9.5	1.16	1.16	0.63	4.0	8.0	Q2



TAPE AND REEL BOX DIMENSIONS

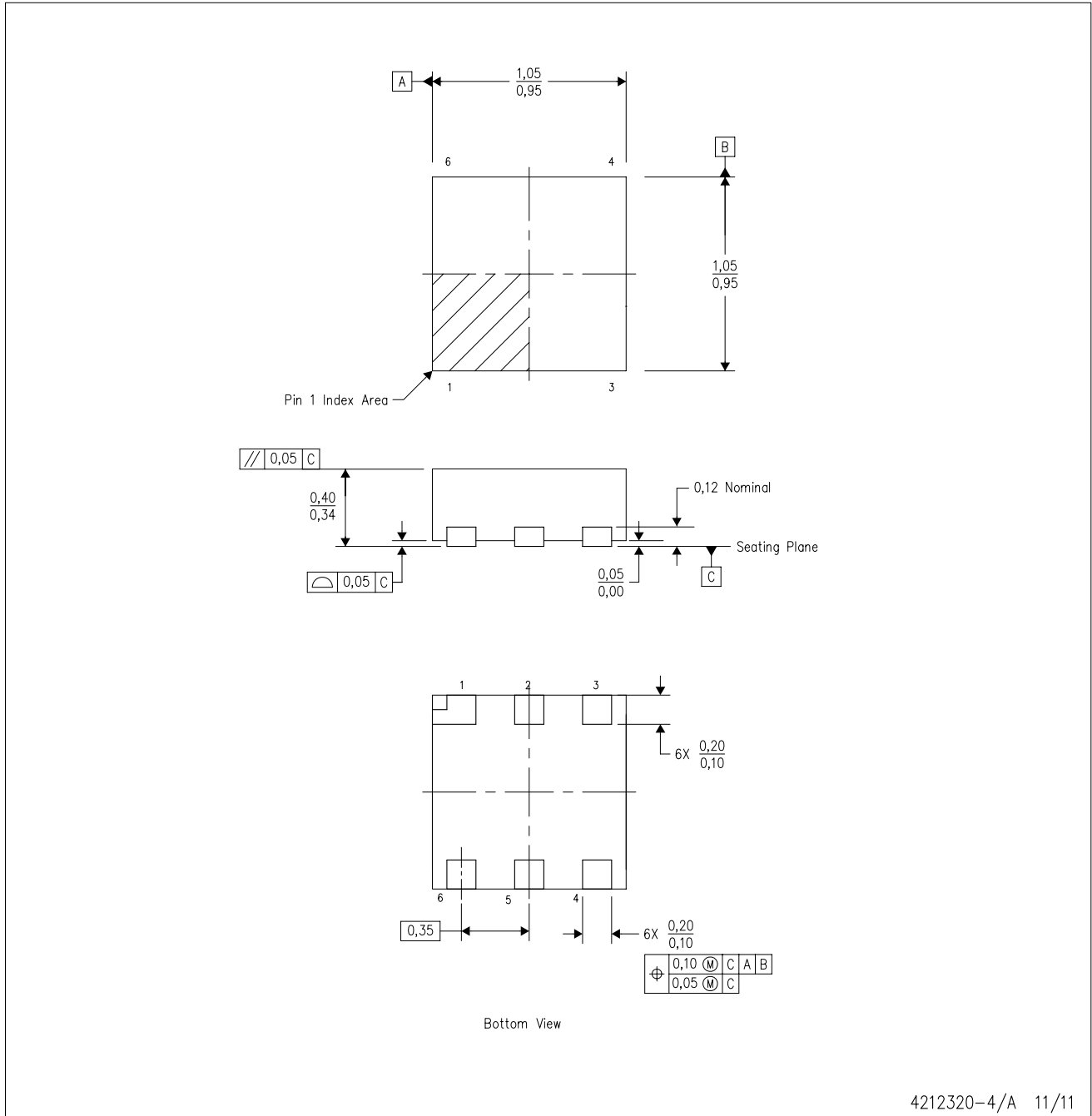


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPD5E003DPFR	X2SON	DPF	6	5000	180.0	180.0	30.0

DPF (S-PX2SON-N6)

PLASTIC SMALL OUTLINE NO-LEAD



4212320-4/A 11/11

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - SON (Small Outline No-Lead) package configuration.

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