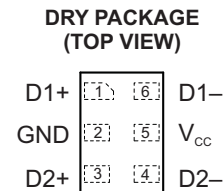
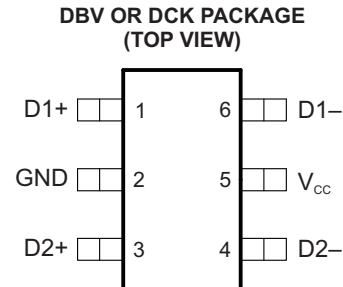


4-CHANNEL ESD SOLUTION FOR HIGH-SPEED DIFFERENTIAL INTERFACE

FEATURES

- Supports High-Speed Differential Data Rates (3-dB Bandwidth > 4 GHz)
- 0.05-pF Matching Capacitance Between Differential Signal Pairs
- Low 0.8-pF Line Capacitance for Each Data Line to GND
- Flow-Through Single-in-Line Pin Mapping for High-Speed Lines Ensures No Additional Board Layout Burden While Placing ESD Protection Chip Near Connector
- IEC 61000-4-2 (Level 4) System-Level ESD Compliance
- 2.5-A Peak Pulse Current (8/20-μs Pulse)
- I_{off} Feature
- Industrial Temperature Range: –40°C to 85°C
- Space-Saving Package Options



DESCRIPTION/ORDERING INFORMATION

The TPD4S009 provides an electrostatic discharge (ESD) solution for high-speed differential lines. This device offers four ESD clamp circuits for dual differential lines. The monolithic silicon technology allows matching between the differential signal pairs. The excellent matching between the differential pair signal lines (0.05-pF line-line) enables this device to operate at high-speed differential data rates (3-dB bandwidth > 4 GHz). The TPD4S009 is suitable for high-speed differential applications, such as high-definition multimedia interface (HDMI), low-voltage differential signaling (LVDS), serial advanced technology attachment (SATA), Ethernet, 1394 (FireWire®), etc.

The TPD4S009 complies with IEC 61000-4-2 (Level 4) ESD. This device is offered in space-saving DBV, DCK, and DRY packages.

The TPD4S009 is characterized for operation over the ambient air temperature range of –40°C to 85°C.

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SON – DRY	Reel of 5000	TPD4S009DRYR	3H
	SOT (SOT-23) – DBV	Reel of 3000	TPD4S009DBVR	NFJK
	SOT (SC-70) – DCK	Reel of 3000	TPD4S009DCKR	PREVIEW

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

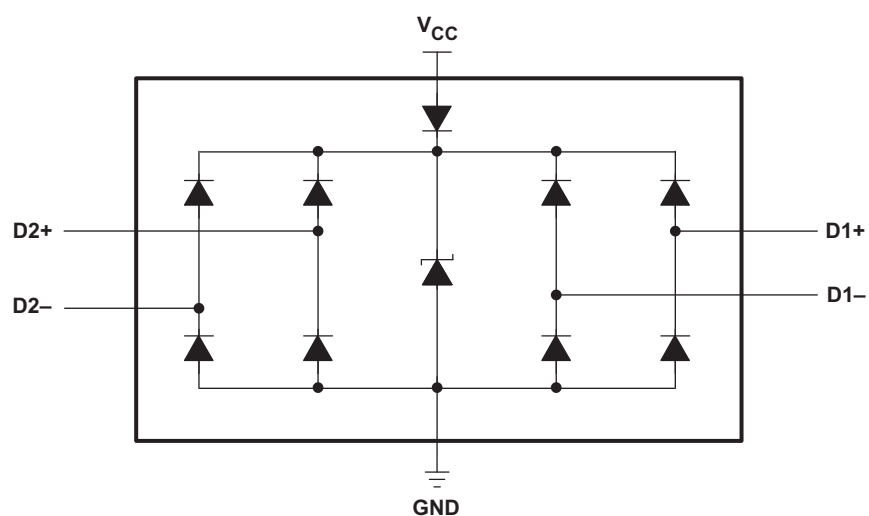
(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.



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FireWire is a registered trademark of Apple Inc.

CIRCUIT DIAGRAM



TERMINAL FUNCTIONS

TERMINAL		TYPE	DESCRIPTION
NAME	NO.		
D1+, D1-, D2+, D2-	1, 3, 4, 6	ESD port	High-speed ESD clamp provides ESD protection to the high-speed differential data lines.
GND	2	GND	Ground
V _{CC}	5	Supply	Supply

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	–0.3	6	V
V_{IO}	IO signal voltage range	0	V_{CC}	V
T_{stg}	Storage temperature range	–65	125	°C
T_A	Characterized free-air operating temperature range	–40	85	°C
	Lead temperature, 1.6 mm (1/16 in) from case for 10 s		260	°C
	IEC 61000-4-2 Contact Discharge		±8	kV
	IEC 61000-4-2 Air-Gap Discharge		±9	kV
	Peak pulse power ($t_p = 8/20 \mu s$)		25	W
	Peak pulse current ($t_p = 8/20 \mu s$)		2.5	A

ELECTRICAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{RWM}	Reverse standoff voltage	Any IO pin to ground			5.5	V
V_{BR}	Breakdown voltage	$I_{IO} = 1 \text{ mA}$ Any IO pin to ground	9			V
I_{IO}	IO port current	$V_{IO} = 3.3 \text{ V}$, $V_{CC} = 5 \text{ V}$ Any IO pin		0.01	0.1	μA
I_{off}	Current from IO port to supply pins	$V_{IO} = 3.3 \text{ V}$, $V_{CC} = 5 \text{ V}$ Any IO pin		0.01	0.1	μA
V_D	Diode forward voltage	$I_{IO} = 8 \text{ mA}$ Lower clamp diode	0.6	0.8	0.95	V
R_{DYN}	Dynamic resistance	$I = 1 \text{ A}$ Any IO pin		1.1		Ω
C_{IO}	IO capacitance	$V_{CC} = 5 \text{ V}$, $V_{IO} = 2.5 \text{ V}$ Any IO pin		0.8		pF
I_{CC}	Operating supply current	$V_{IO} = \text{Open}$, $V_{CC} = 5 \text{ V}$ V_{CC} pin		0.1	1	μA

TYPICAL CHARACTERISTICS

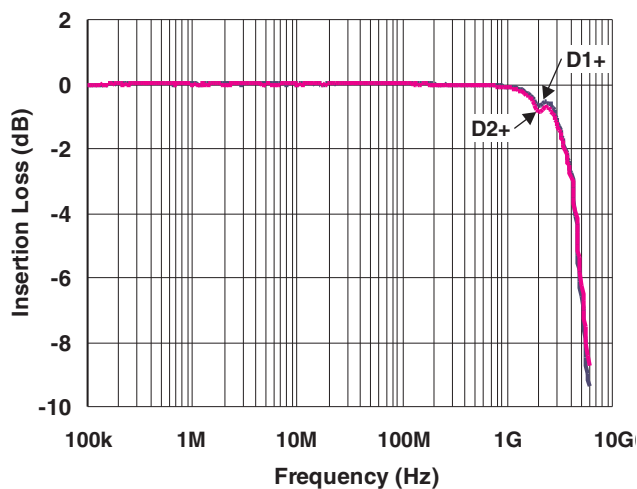


Figure 1. Insertion Loss S21 – I/O to GND

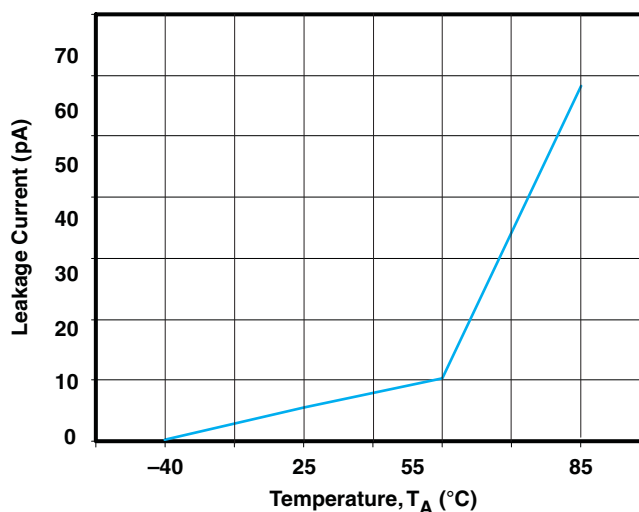


Figure 2. Leakage Current vs Temperature ($V_{IO} = 2.5\text{ V}$)

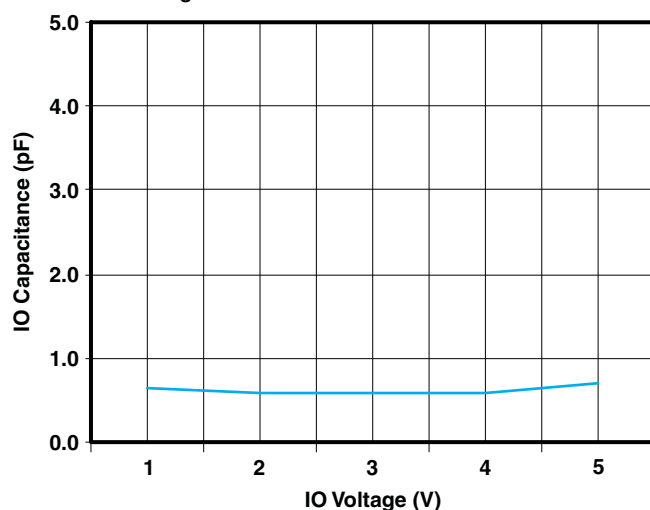


Figure 3. IO Capacitance vs Input Voltage ($V_{CC} = 5\text{ V}$)

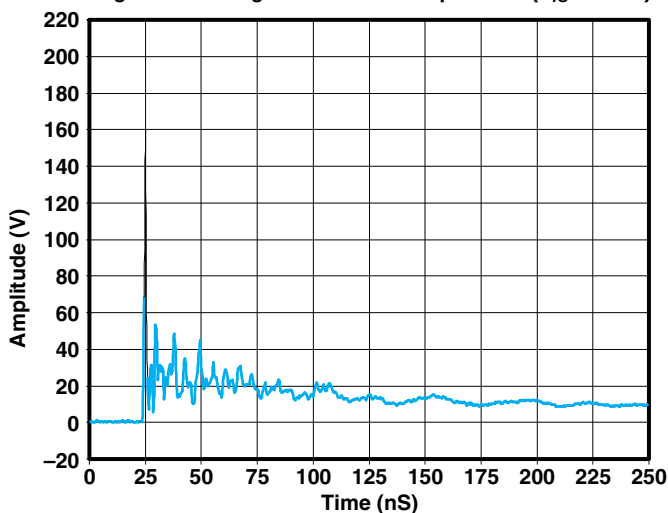


Figure 4. IEC Clamping Waveforms
(8-kV Contact, Average of Ten Waveforms)

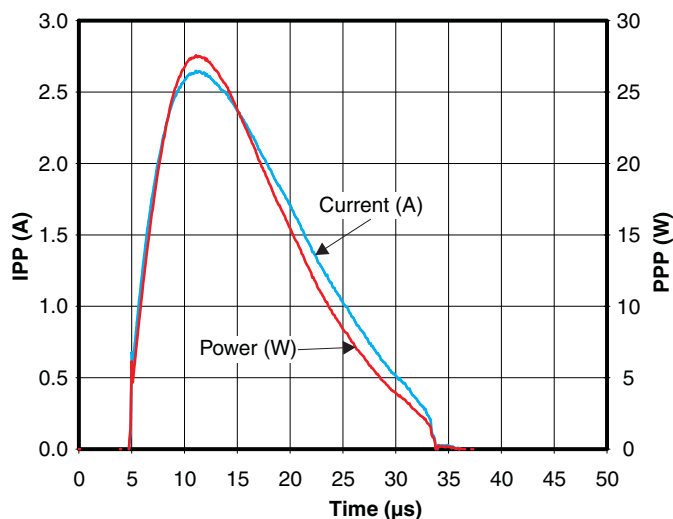


Figure 5. Pulse Waveform (8/20 μs Pulse)

TYPICAL CHARACTERISTICS (continued)

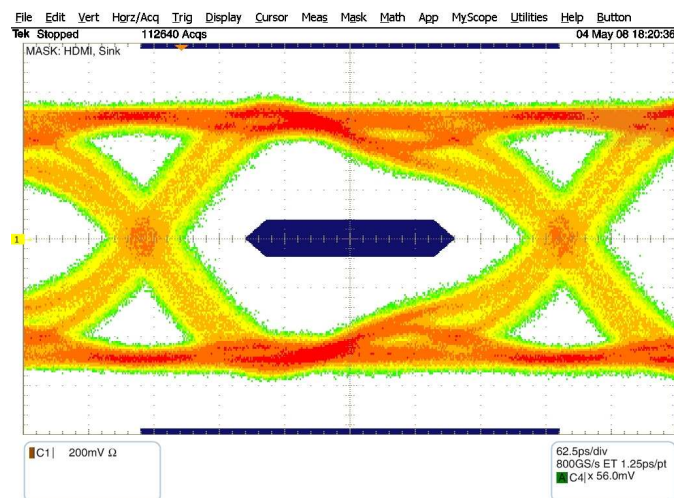


Figure 6. Eye Diagram Without TPD4S009

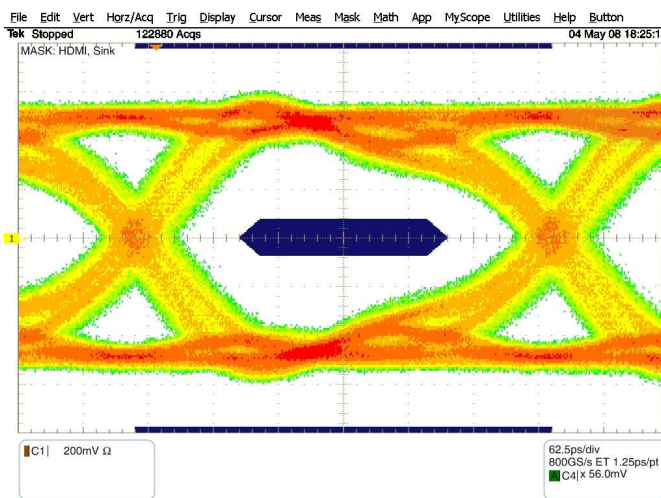


Figure 7. Eye Diagram With TPD4S009

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TPD4S009DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPD4S009DCKR	PREVIEW	SC70	DCK	6	3000	TBD	Call TI	Call TI
TPD4S009DRYR	ACTIVE	SON	DRY	6	5000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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.

OBSELETE: 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.

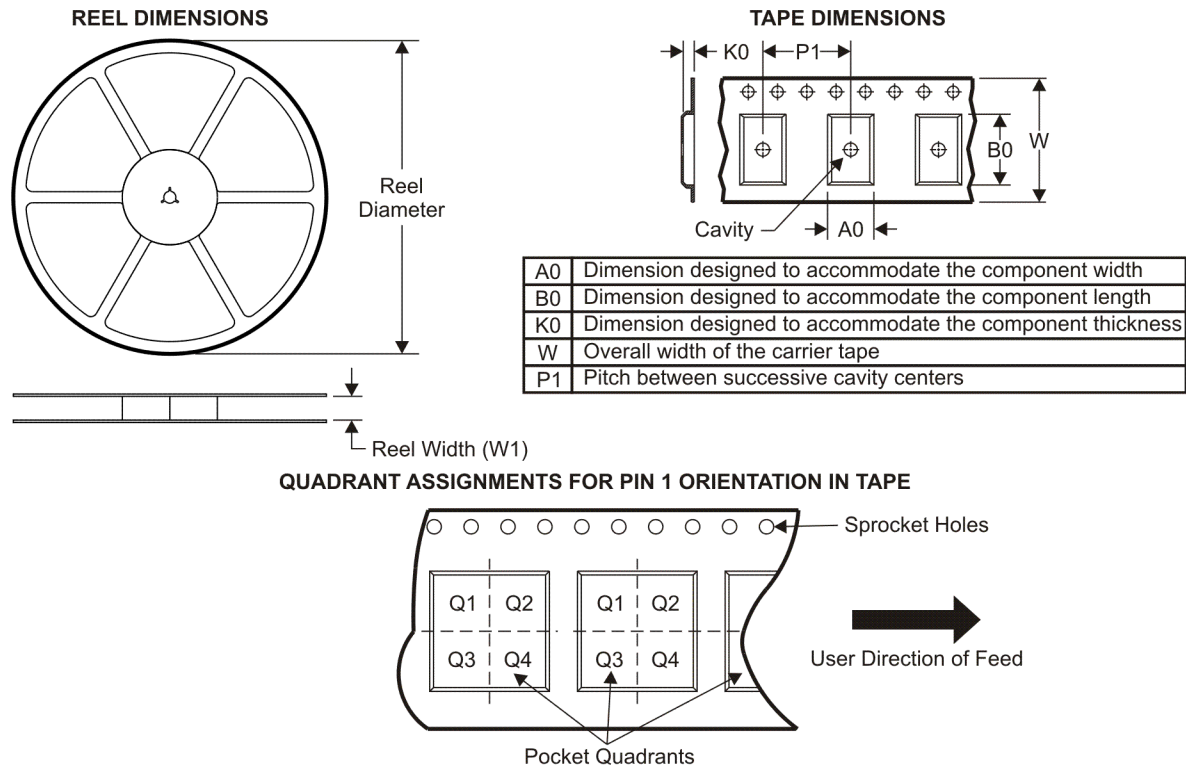
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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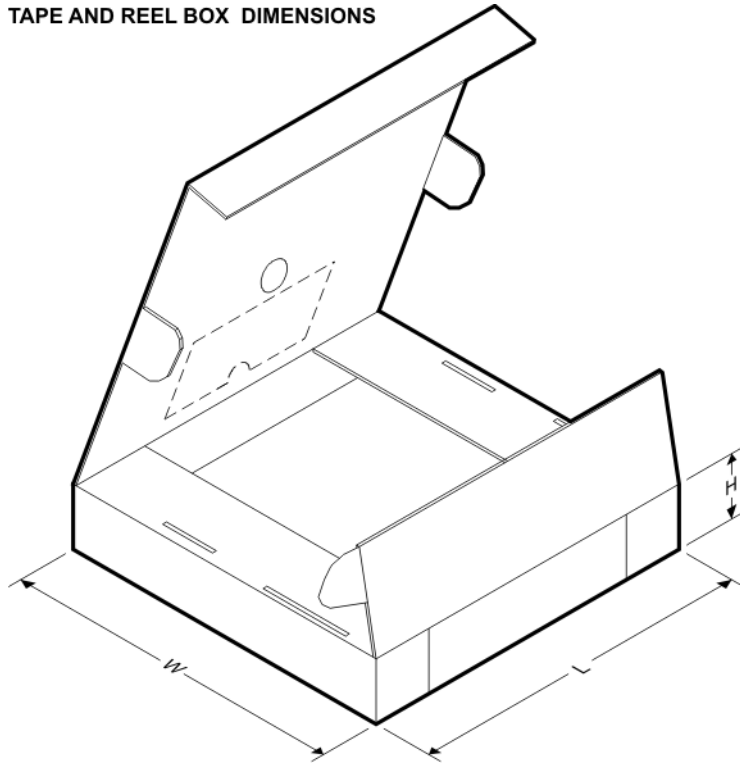
TAPE AND REEL INFORMATION



*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
TPD4S009DBVR	SOT-23	DBV	6	3000	180.0	9.2	3.23	3.17	1.37	4.0	8.0	Q3
TPD4S009DRYR	SON	DRY	6	5000	179.0	8.4	1.2	1.65	0.7	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS

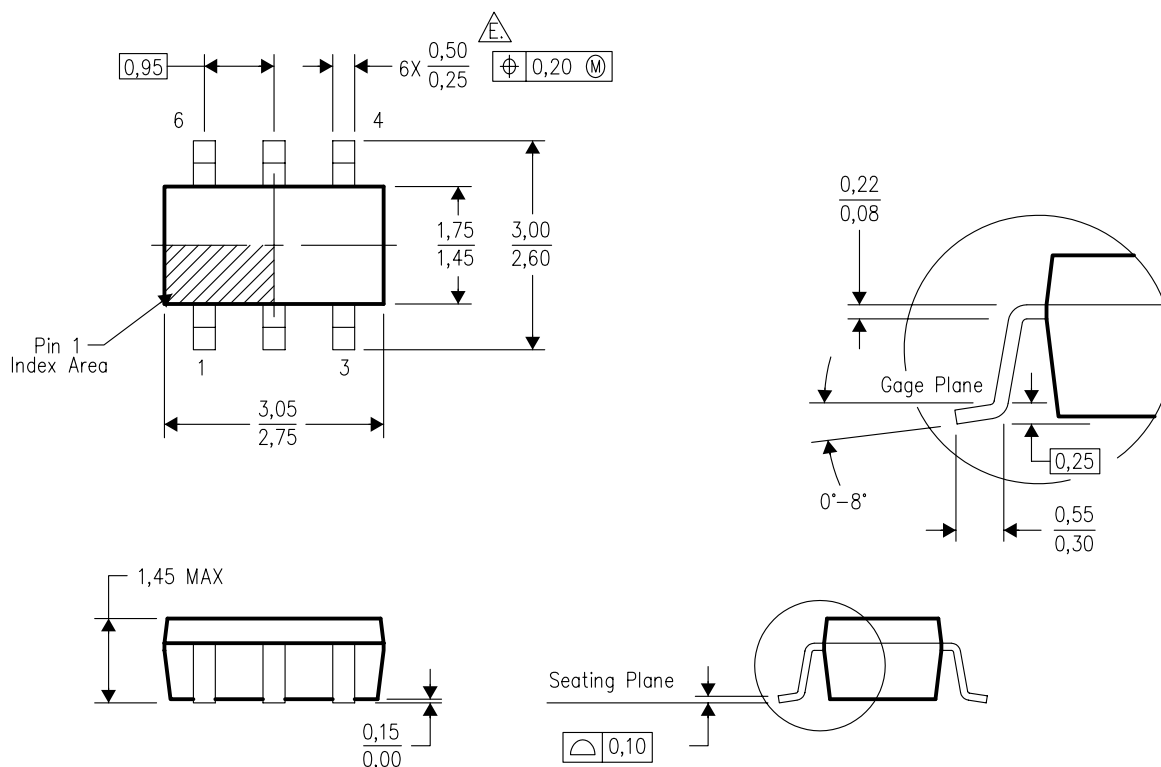


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPD4S009DBVR	SOT-23	DBV	6	3000	205.0	200.0	33.0
TPD4S009DRYR	SON	DRY	6	5000	220.0	205.0	50.0

DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE

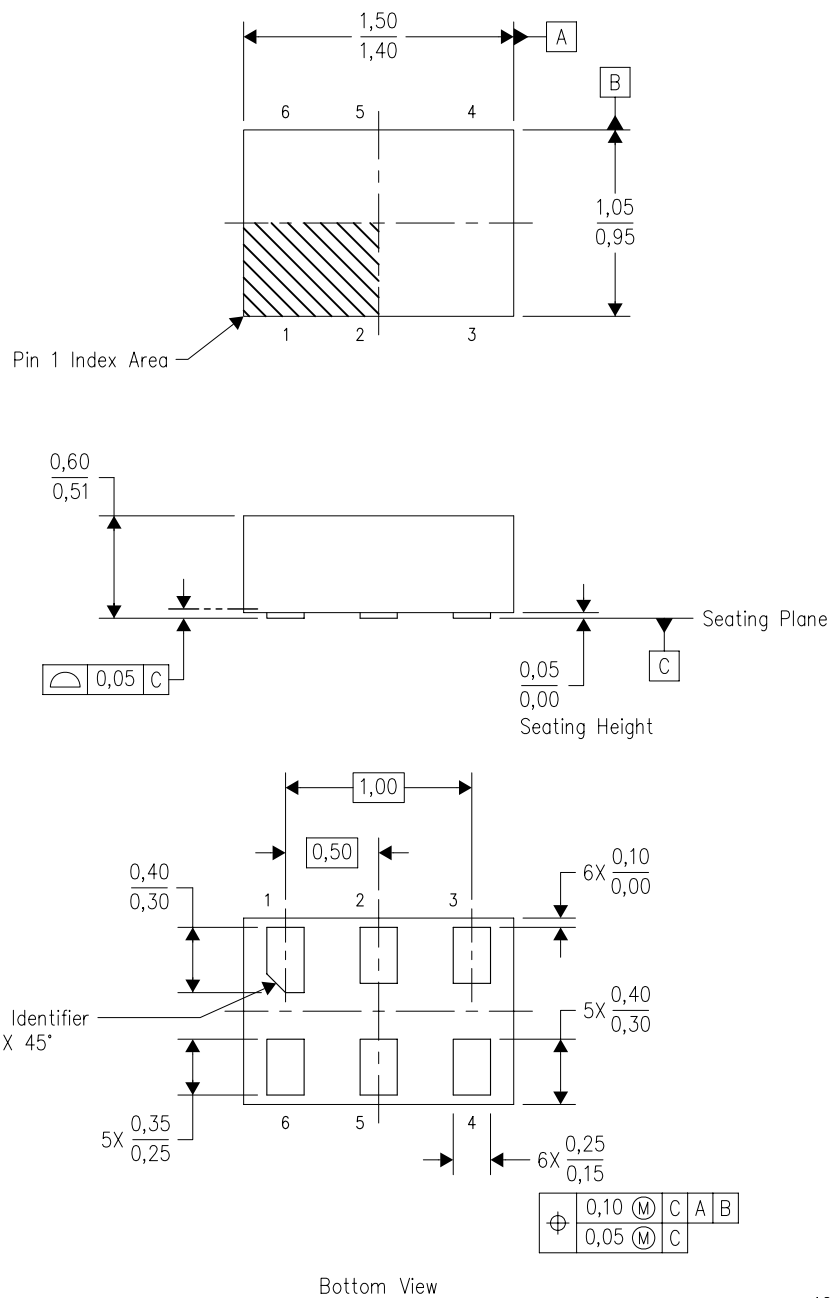


4073253-5/K 03/2006

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
-  Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DRY (R-PDSO-N6)

PLASTIC SMALL OUTLINE

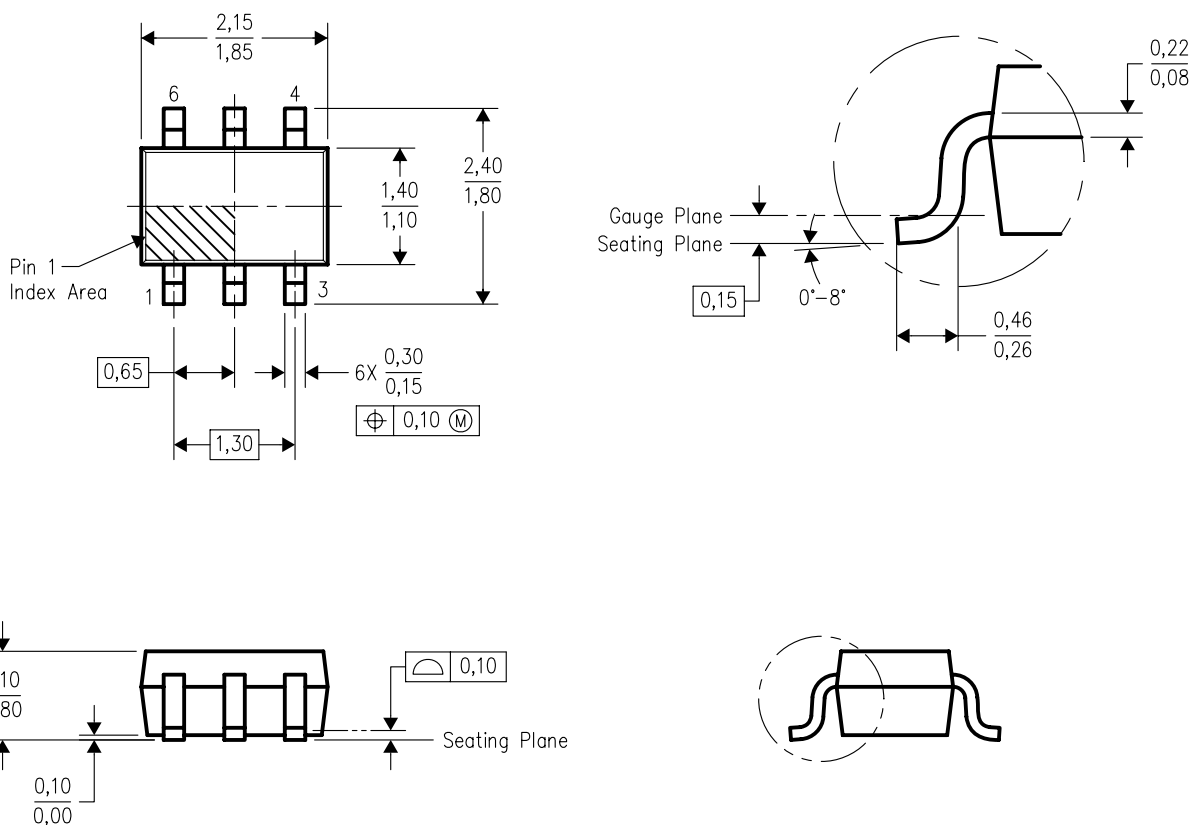


4207181/B 12/2007

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. SON (Small Outline No-Lead) package configuration.
 - D. This package complies to JEDEC MO-287 variation UFAD.

DCK (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



4093553-4/G 01/2007

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-203 variation AB.

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