#### TL3016, TL3016Y **ULTRA-FAST LOW-POWER** PRECISION COMPARATORS SLCS130D - MARCH 1997 - REVISED MARCH 2000

- Ultrafast Operation . . . 7.6 ns (Typ)
- Low Positive Supply Current 10.6 mA (Typ)
- **Operates From a Single 5-V Supply or From** a Split ±5-V Supply
- **Complementary Outputs**
- Low Offset Voltage
- No Minimum Slew Rate Requirement
- **Output Latch Capability**
- **Functional Replacement to the LT1016**

#### description

The TL3016 is an ultrafast comparator designed to interface directly to TTL logic while operating from either a single 5-V power supply or dual  $\pm$ 5-V supplies. It features extremely tight offset voltage and high gain for precision applications. It has complementary outputs that can be latched using the LATCH ENABLE terminal. Figure 1 shows the positive supply current of this comparator. The TL3016 only requires 10.6 mA (typical) to achieve a propagation delay of 7.6 ns.

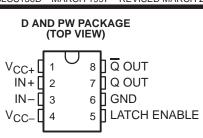
The TL3016 is a pin-for-pin functional replacement for the LT1016 comparator, offering higher speed operation but consuming half the power.

		PACKAG	ED DEVICES	
тА		SMALL OUTLINE <sup>†</sup> (D)	TSSOP (PW)	CHIP FORM <sup>‡</sup> (Y)
0°C to 7	O°C	TL3016CD	TL3016CPWLE	TL3016Y
-40°C to	85°C	TL3016ID	TL3016IPWLE	—

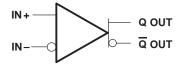
**AVAILABLE OPTIONS** 

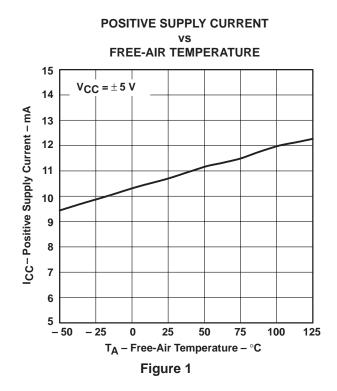
<sup>†</sup> The PW packages are available left-ended taped and reeled only.

<sup>‡</sup>Chip forms are tested at  $T_A = 25^{\circ}C$  only.



symbol (each comparator)







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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

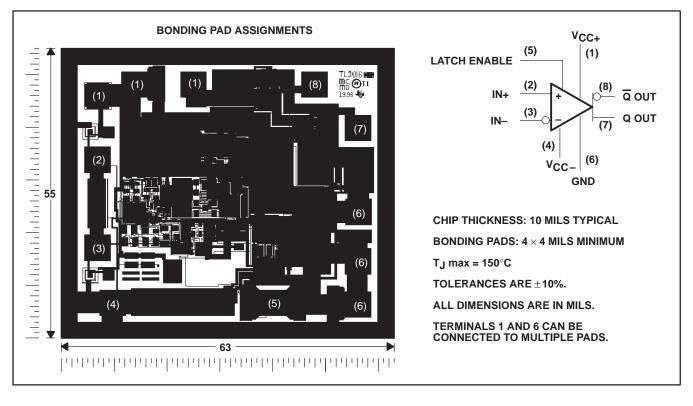


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#### TL3016, TL3016Y ULTRA-FAST LOW-POWER PRECISION COMPARATORS SLCS130D – MARCH 1997 – REVISED MARCH 2000

TL3016Y chip information

This chip displays characteristics similar to the TL3016C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



COMPONENT COUNT							
Bipolars	53						
MOSFETs	49						
Resistors	46						
Capacitors	14						



## TL3016, TL3016Y **ULTRA-FAST LOW-POWER** PRECISION COMPARATORS

SLCS130D - MARCH 1997 - REVISED MARCH 2000

#### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage, $V_{DD}$ (see Note 1) Differential input voltage, $V_{ID}$ (see Note 2) Input voltage range, $V_{I}$ Input voltage, $V_{I}$ (LATCH ENABLE) Output current, $I_{O}$ Continuous total power dissipation Operating free-air temperature range, $T_{A}$	
Storage temperature range, T <sub>stg</sub>	– 65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, except differential voltages, are with respect to network ground.

2. Differential voltages are at IN+ with respect to IN-.

#### **DISSIPATION RATING TABLE**

PACKAGE	T <sub>A</sub> ≤ 25°C POWER RATING	DERATING FACTOR ABOVE T <sub>A</sub> = 25°C	T <sub>A</sub> = 70°C POWER RATING
D	725 mW	5.8 mW/°C	464 mW
PW	525 mW	4.2 mW/°C	336 mW



### electrical characteristics at specified operating free-air temperature, V<sub>DD</sub> = $\pm$ 5 V, V<sub>LE</sub> = 0 (unless otherwise noted)

	DADAMETED				TL3016C	;	TL3016I			UNIT
	PARAMETER	TEST CONI	MIN	TYP‡	MAX	MIN TYP <sup>‡</sup> MAX		UNIT		
\/	lanut offerst veltere	T <sub>A</sub> = 25°C			0.5	3		0.5	3	
VIO	Input offset voltage	T <sub>A</sub> = full range				3.5			3.5	mV
αΛΙΟ	Temperature coefficient of input offset voltage				-4.8			-4.5		μV/° <b>(</b>
li o	Input offect ourrept	T <sub>A</sub> = 25°C			0.1	0.6		0.1	0.6	
10	Input offset current	T <sub>A</sub> = full range				0.9			1.3	μA
lin.	Input bias current	$T_A = 25^{\circ}C$			6	10		6	10	μA
IВ	input bias current	T <sub>A</sub> = full range				10			10	μА
Vien	Common-mode input	$V_{DD} = \pm 5 V$		-3.75		3.5	-3.75		3.5	V
VICR	voltage range	$V_{DD} = 5 V$		1.25		3.5	1.25		3.5	v
CMRR	Common-mode rejection ratio	$-3.75 \le V_{IC} \le 3.5 V$ ,	$T_A = 25^{\circ}C$	80	97		80	97		dB
Supply-voltage rejection		Positive supply: 4.6 V $T_A = 25^{\circ}C$	$V \le +V_{DD} \le 5.4 \text{ V},$	60	72		60	72		dB
<sup>k</sup> SVR	ratio	Negative supply: $-7$ V T <sub>A</sub> = 25°C	$V \leq -V_{DD} \leq -2 V$ ,	80	100		80	100		иВ
Ve	Low-level output voltage	l <sub>(sink)</sub> = 4 mA, T <sub>A</sub> = 25°C	$V \textbf{+} \leq 4.6 \text{ V},$		500	600		500	600	mV
VOL	Low-level output voltage	I <sub>(sink)</sub> = 10 mA, T <sub>A</sub> = 25°C	$V \textbf{+} \leq 4.6 \text{ V},$		750			750		mv
Varia	High-level output voltage	$V+ \le 4.6 V,$ $T_A = 25^{\circ}C$	l <sub>O</sub> = 1 mA,	3.6	3.9		3.6	3.9		V
VOH	nigh-level output voltage	$V+ \le 4.6 V,$ $T_A = 25^{\circ}C$	l <sub>O</sub> = 10 mA,	3.4	3.7		3.4	3.7		v
1	Positive supply current				10.6	12.5		10.6	12.5	
IDD	Negative supply current	$T_A = $ full range		-1.8	-1.3		-2.4	-1.3		mA
VIL	Low-level input voltage (LATCH ENABLE)					0.8			0.8	V
VIH	High-level input voltage (LATCH ENABLE)			2			2			V
۱	Low-level input current	$V_{LE} = 0$			0	1		0	1	μA
	(LATCH ENABLE)	$V_{LE} = 2 V$			24	39		24	45	F.

<sup>†</sup> Full range for the TL3016C is  $T_A = 0^{\circ}$ C to 70°C. Full range for the TL3016I is  $T_A = -40^{\circ}$ C to 85°C. <sup>‡</sup> All typical values are measures with  $T_A = 25^{\circ}$ C.



## TL3016, TL3016Y **ULTRA-FAST LOW-POWER** PRECISION COMPARATORS

SLCS130D - MARCH 1997 - REVISED MARCH 2000

### switching characteristics, $V_{DD}$ = ±5 V, $V_{LE}$ = 0 (unless otherwise noted)

	PARAMETER		TEST CONDITIONS <sup>†</sup>			TL3016C				
PARAMETER		TEST COM				MAX	MIN	TYP	MAX	UNIT
		$\Delta V_{I} = 100 \text{ mV},$	$T_A = 25^{\circ}C$		7.8	10		7.8	10	
		$V_{OD} = 5 \text{ mV}$	T <sub>A</sub> = full range		7.8	11.2		7.8	12.2	
<sup>t</sup> pd1	Propagation delay time‡	$\Delta V_{I} = 100 \text{ mV},$	T <sub>A</sub> = 25°C		7.6	10		7.6	10	ns
			$T_A = $ full range		7.6	11.2		7.6	12.2	
t <sub>sk(p)</sub>	Pulse skew ( t <sub>pd+</sub> – t <sub>pd</sub> _ )	$\Delta V_I = 100 \text{ mV},$ T <sub>A</sub> = 25°C	V <sub>OD</sub> = 5 mV,		0.5			0.5		ns
t <sub>su</sub>	Setup time, LATCH ENABLE				2.5			2.5		ns

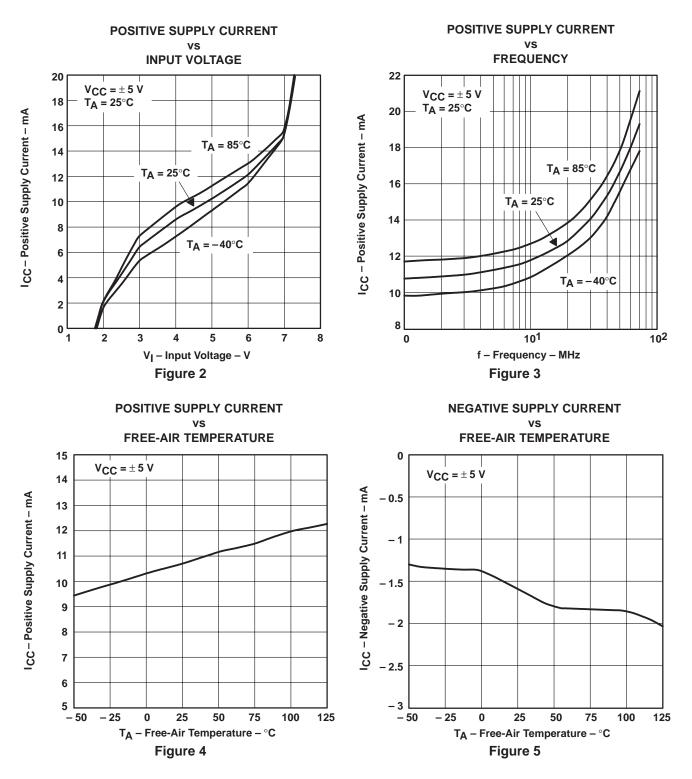
Full range for the TL3016C is 0°C to 70°C. Full range for the TL3016I is -40°C to 85°C.  $t_{pd1}$  cannot be measured in automatic handling equipment with low values of overdrive. The TL3016 is 100% tested with a 1-V step and 500-mV overdrive at T<sub>A</sub> = 25°C only. Correlation tests have shown that  $t_{pd1}$  limits given can be ensured with this test, if additional dc tests are performed to ensure that all internal bias conditions are correct. For low overdrive conditions, V<sub>OS</sub> is added to the overdrive.

### **TYPICAL CHARACTERISTICS**

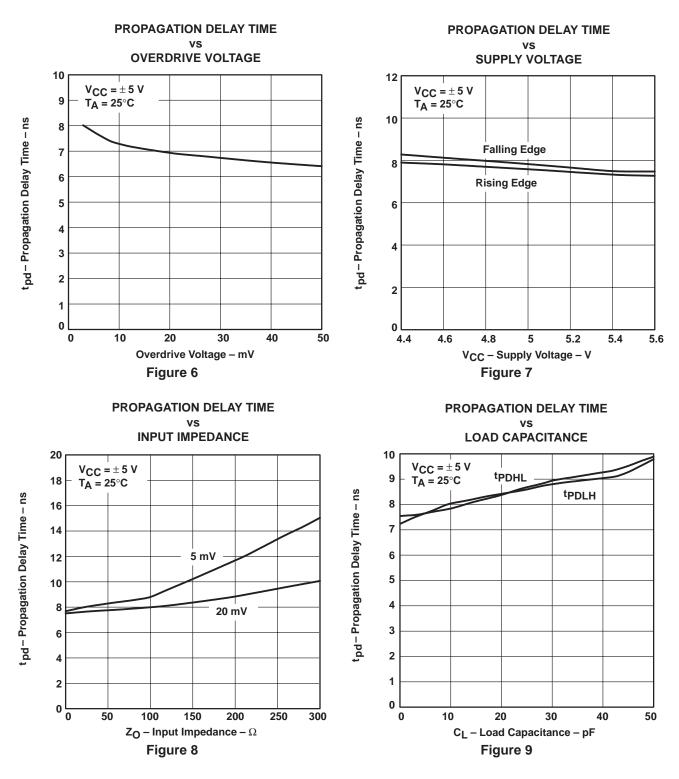
			FIGURE
		vs Input voltage	2
ICC	Positive supply current	vs Frequency	3
		vs Free-air temperature	4
ICC	Negative supply current	vs Free-air temperature	5
		vs Overdrive voltage	6
		vs Supply voltage	7
tpd	Propagation delay time	vs Input impedance	8
		vs Load capacitance	9
		vs Free-air temperature	10
VIC	Common-mode input voltage	vs Free-air temperature	11
	Input threshold voltage (LATCH ENABLE)	vs Free-air temperature	12
		vs Output source current	13
VO	Output voltage	vs Output sink current	14
lj	Input current (LATCH ENABLE)	vs Input voltage	15

#### Table of Graphs

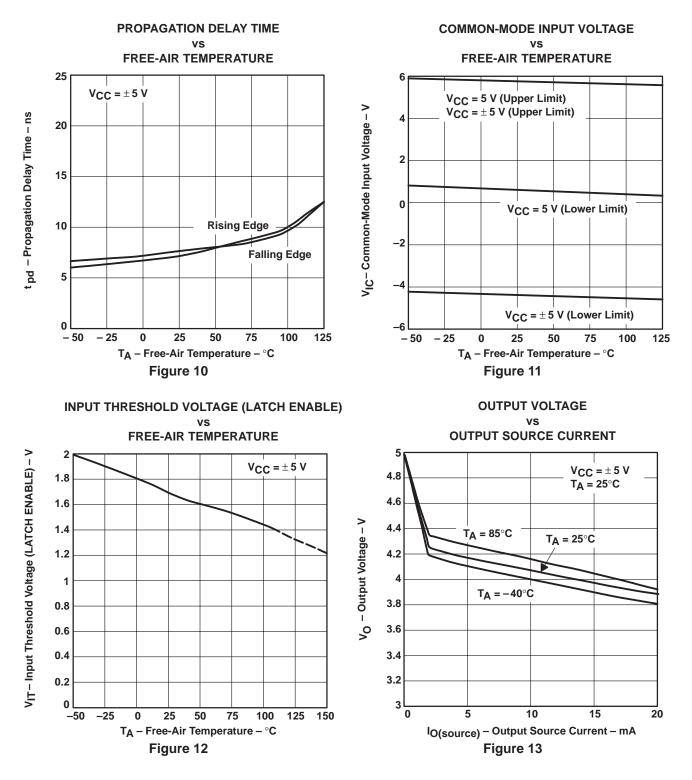




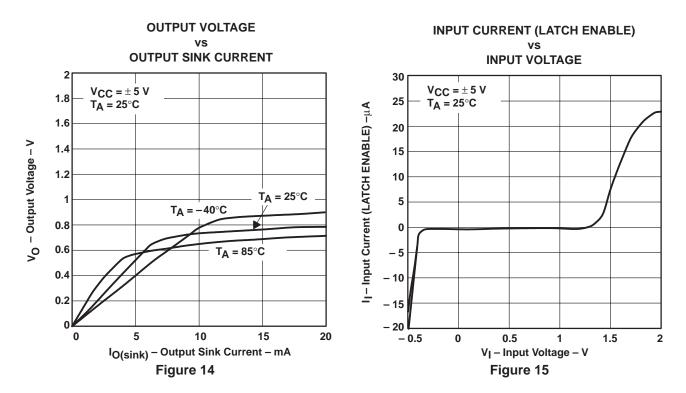
















10-Jun-2014

### **PACKAGING INFORMATION**

Orderable Device	Status	Package Type		Pins	Package	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
	(1)		Drawing		Qty	(2)	(6)	(3)		(4/5)	
TL3016CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	3016C	Samples
TL3016CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	3016C	Samples
TL3016CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	3016C	Samples
TL3016CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	3016C	Samples
TL3016CPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	T3016	Samples
TL3016CPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI			
TL3016CPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	T3016	Samples
TL3016ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	30161	Samples
TL3016IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	30161	Samples
TL3016IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	30161	Samples
TL3016IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	30161	Samples
TL3016IPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	Z3016	Samples
TL3016IPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI			
TL3016IPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	Z3016	Samples
TL3016IPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	Z3016	Samples

<sup>(1)</sup> 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.



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10-Jun-2014

<sup>(2)</sup> 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.

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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)

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

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(<sup>5)</sup> Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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# PACKAGE MATERIALS INFORMATION

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### TAPE AND REEL INFORMATION





### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



All dimensions are nominal <b>Device</b>	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TL3016CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL3016CPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TL3016IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL3016IPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1

TEXAS INSTRUMENTS

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# PACKAGE MATERIALS INFORMATION

29-Apr-2016



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL3016CDR	SOIC	D	8	2500	367.0	367.0	38.0
TL3016CPWR	TSSOP	PW	8	2000	367.0	367.0	35.0
TL3016IDR	SOIC	D	8	2500	367.0	367.0	38.0
TL3016IPWR	TSSOP	PW	8	2000	367.0	367.0	35.0

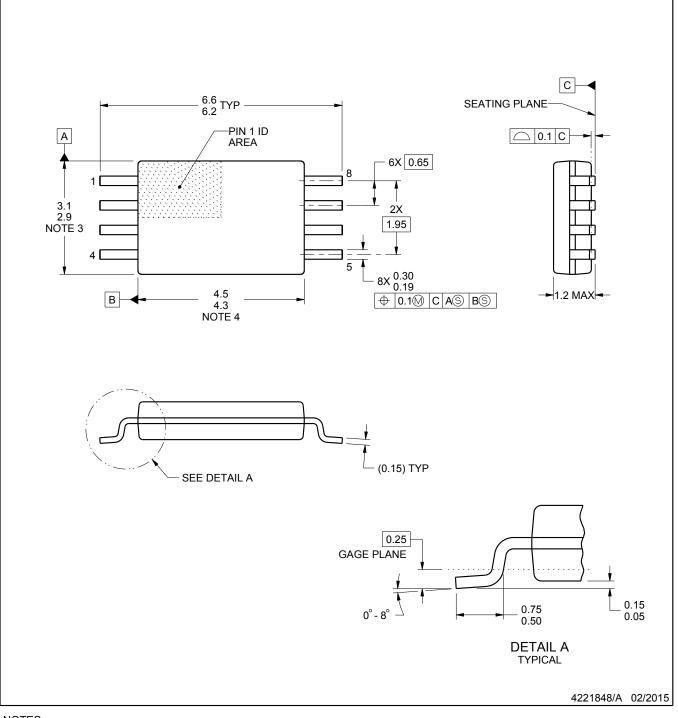
# **PW0008A**



# **PACKAGE OUTLINE**

### TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M. 2. This drawing is subject to change without notice. 3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- 5. Reference JEDEC registration MO-153, variation AA.

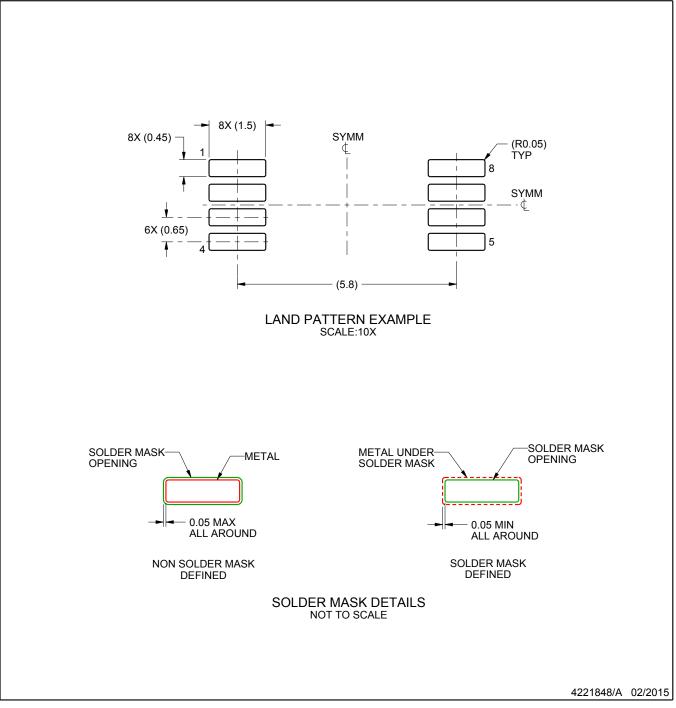


# PW0008A

# **EXAMPLE BOARD LAYOUT**

### TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# PW0008A

# **EXAMPLE STENCIL DESIGN**

### TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

9. Board assembly site may have different recommendations for stencil design.



<sup>8.</sup> Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).

- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AA.





NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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