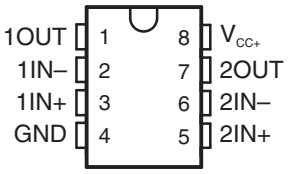
GENERAL-PURPOSE LOW-VOLTAGE COMPARATORS

Check for Samples: LMV331-Q1 SINGLE, LMV393-Q1 DUAL

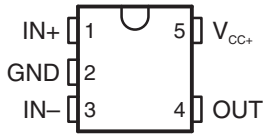
FEATURES

- **Qualified for Automotive Applications**
- **2.7-V and 5-V Performance**
- **Low Supply Current**
  - **LMV331 . . . 60 µA Typ**
  - **LMV393 . . . 100 µA Typ**
- **Input Common-Mode Voltage Range Includes Ground**
- **Low Output Saturation Voltage . . . 200 mV Typ**
- **Open-Collector Output for Maximum Flexibility**

LMV393...D PACKAGE
(TOP VIEW)



LMV331...DBV PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The LMV393-Q1 device is a low-voltage (2.7 V to 5.5 V) version of the dual and quad comparators, LM393 and LM339, which operate from 5 V to 30 V. The LMV331-Q1 is the single-comparator version.

The LMV331-Q1 and LMV393-Q1 are the most cost-effective solutions for applications where low-voltage operation, low power, space saving, and price are the primary specifications in circuit design for portable consumer products. These devices offer specifications that meet or exceed the familiar LM339 and LM393 devices at a fraction of the supply current.

ORDERING INFORMATION(1)

T_A	PACKAGE(2)			ORDERABLE PART NUMBER	TOP-SIDE MARKING(3)
–40°C to 125°C	Single	SOT23-5 – DBV	Reel of 3000	LMV331QDBVRQ1	LADQ
	Dual	SOIC – D	Reel of 2500	LMV393QDRQ1	V393Q1

(1) 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.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(3) DBV: The actual top-side marking has one additional character that designates the wafer fab/assembly site.

Figure 1. SYMBOL (EACH COMPARATOR)

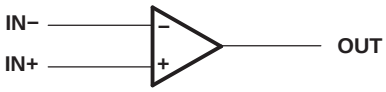
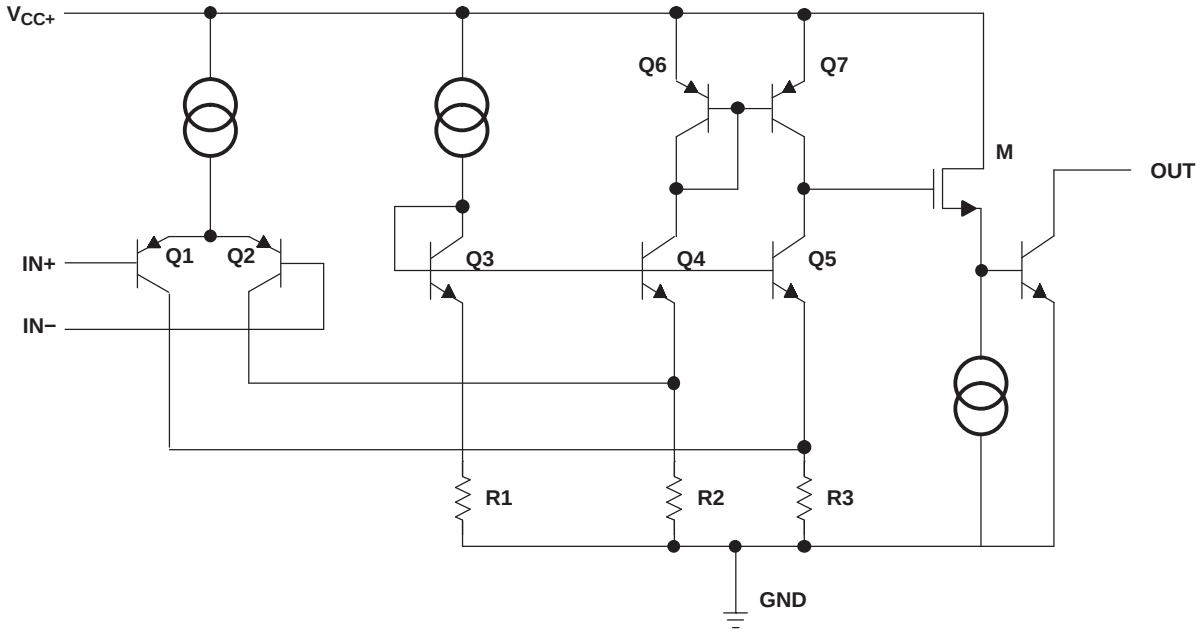


Figure 2. SIMPLIFIED SCHEMATIC



Absolute Maximum Ratings(1)

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

			MIN	MAX	UNIT
V_{CC+}	Supply voltage(2)			5.5	V
V_{ID}	Differential input voltage(3)			±5.5	V
V_I	Input voltage range (either input)		0	5.5	V
θ_{JA}	Package thermal impedance(4) (5)	D (8-pin) package		97	°C/W
		D (14-pin) package		86	
		DBV package		206	
T_J	Operating virtual junction temperature			150	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) 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.
(2) All voltage values (except differential voltages and V_{CC+} specified for the measurement of I_{OS}) are with respect to the network GND.
(3) Differential voltages are at IN+ with respect to IN–.
(4) Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Selecting the maximum of 150°C can affect reliability.
(5) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

		MIN	MAX	UNIT
V_{CC+}	Supply voltage (single-supply operation)	2.7	5.5	V
V_{OUT}	Output voltage		V_{CC+} + 0.3	V
T_A	Operating free-air temperature	–40	125	°C

Electrical Characteristics

at specified free-air temperature, V_{CC+} = 2.7 V, GND = 0 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		25°C		1.7	7	mV
αV_{IO}	Average temperature coefficient of input offset voltage		–40°C to 125°C		5		µV/°C
I_{IB}	Input bias current		25°C		10	250	nA
			–40°C to 125°C			400	
I_{IO}	Input offset current		25°C		5	50	nA
			–40°C to 125°C			150	
I_O	Output current (sinking)	$V_O \leq 1.5$ V	25°C	5	23		mA
	Output leakage current		25°C		0.003		µA
			–40°C to 125°C			1	
V_{ICR}	Common-mode input voltage range		25°C		–0.1 to 2		V
V_{SAT}	Saturation voltage	$I_O \leq 1$ mA	25°C		200		mV
I_{CC}	Supply current	LMV331	25°C		40	100	µA
		LMV393 (both comparators)			70	140	
		LMV339 (all four comparators)			140	200	

Switching Characteristics

T_A = 25°C, V_{CC+} = 2.7 V, R_L = 5.1 kΩ, GND = 0 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TYP	UNIT
t_{PHL}	Propagation delay, high- to low-level output switching	Input overdrive = 10 mV	1000	ns
		Input overdrive = 100 mV	350	
t_{PLH}	Propagation delay, low- to high-level output switching	Input overdrive = 10 mV	500	ns
		Input overdrive = 100 mV	400	

Electrical Characteristics

at specified free-air temperature, V_{CC+} = 5 V, GND = 0 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage		25°C		1.7	7	mV
			–40°C to 125°C			9	
αV_{IO}	Average temperature coefficient of input offset voltage		25°C		5		µV/°C
I_{IB}	Input bias current		25°C		25	250	nA
			–40°C to 125°C			400	
I_{IO}	Input offset current		25°C		2	50	nA
			–40°C to 125°C			150	
I_O	Output current (sinking)	$V_O \le 1.5$ V	25°C	10	84		mA
	Output leakage current		25°C		0.003		µA
			–40°C to 125°C			1	
V_{ICR}	Common-mode input voltage range		25°C		–0.1 to 4.2		V
A_{VD}	Large-signal differential voltage gain		25°C	20	50		V/mV
V_{SAT}	Saturation voltage	$I_O \le 4$ mA	25°C		200	400	mV
			–40°C to 125°C			700	
I_{CC}	Supply current	LMV331	25°C		60	120	µA
			–40°C to 125°C			150	
		LMV393 (both comparators)	25°C		100	200	
			–40°C to 125°C			250	
		LMV339 (all four comparators)	25°C		170	300	
			–40°C to 125°C			350	

Switching Characteristics

T_A = 25°C, V_{CC+} = 5 V, R_L = 5.1 kΩ, GND = 0 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TYP	UNIT
t_{PHL}	Propagation delay, high- to low-level output switching	Input overdrive = 10 mV	600	ns
		Input overdrive = 100 mV	200	
t_{PLH}	Propagation delay, low- to high-level output switching	Input overdrive = 10 mV	450	ns
		Input overdrive = 100 mV	300	

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LMV331QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LADQ	Samples
LMV393QDRQ1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	V393Q1	Samples

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

(5) 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.

(6) 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.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF LMV331-Q1, LMV393-Q1 :

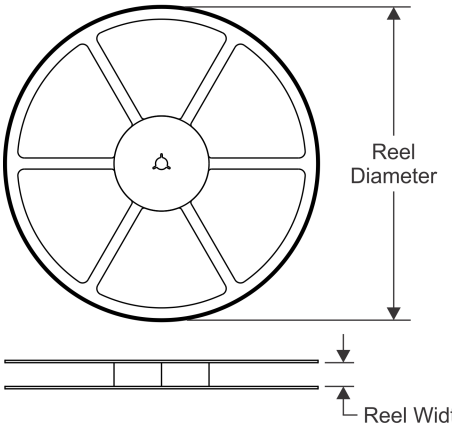
- Catalog: LMV331, LMV393

NOTE: Qualified Version Definitions:

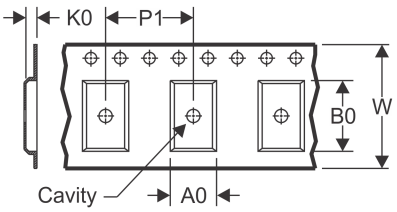
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

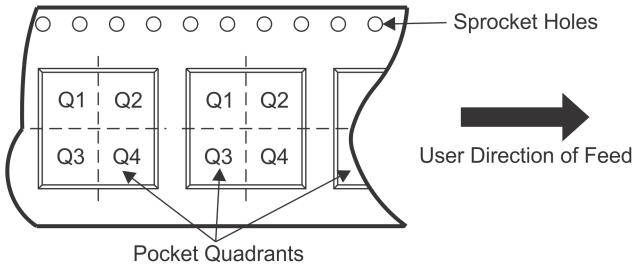


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

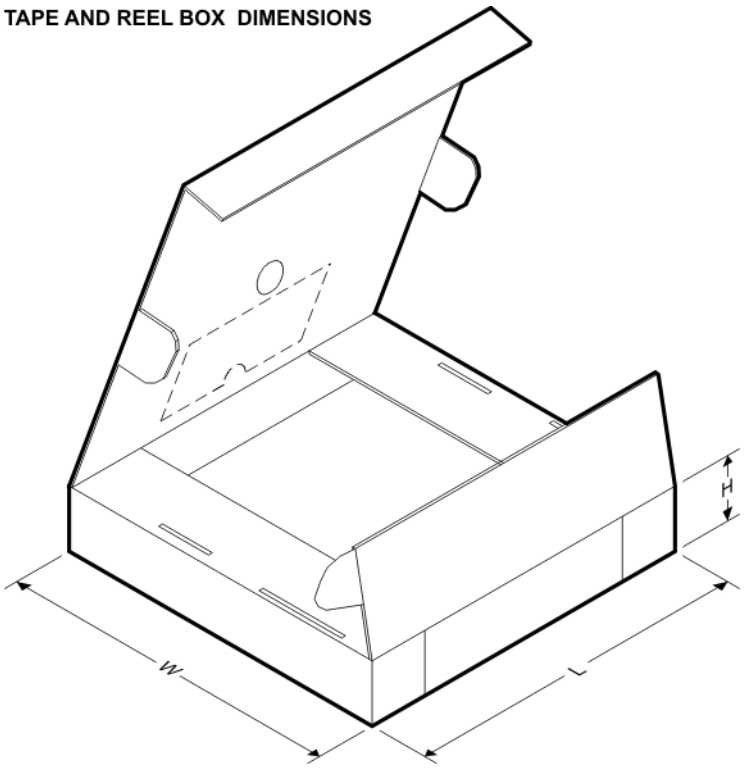
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LMV331QDBVRQ1	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

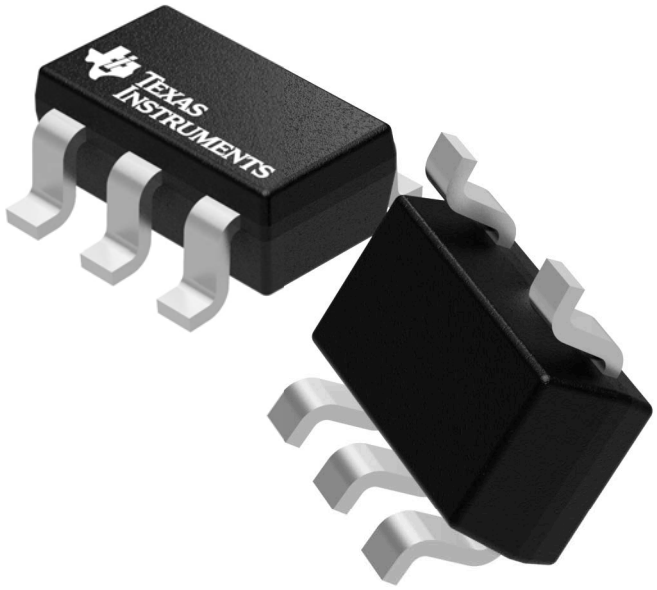


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMV331QDBVRQ1	SOT-23	DBV	5	3000	203.0	203.0	35.0

DBV 5 SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



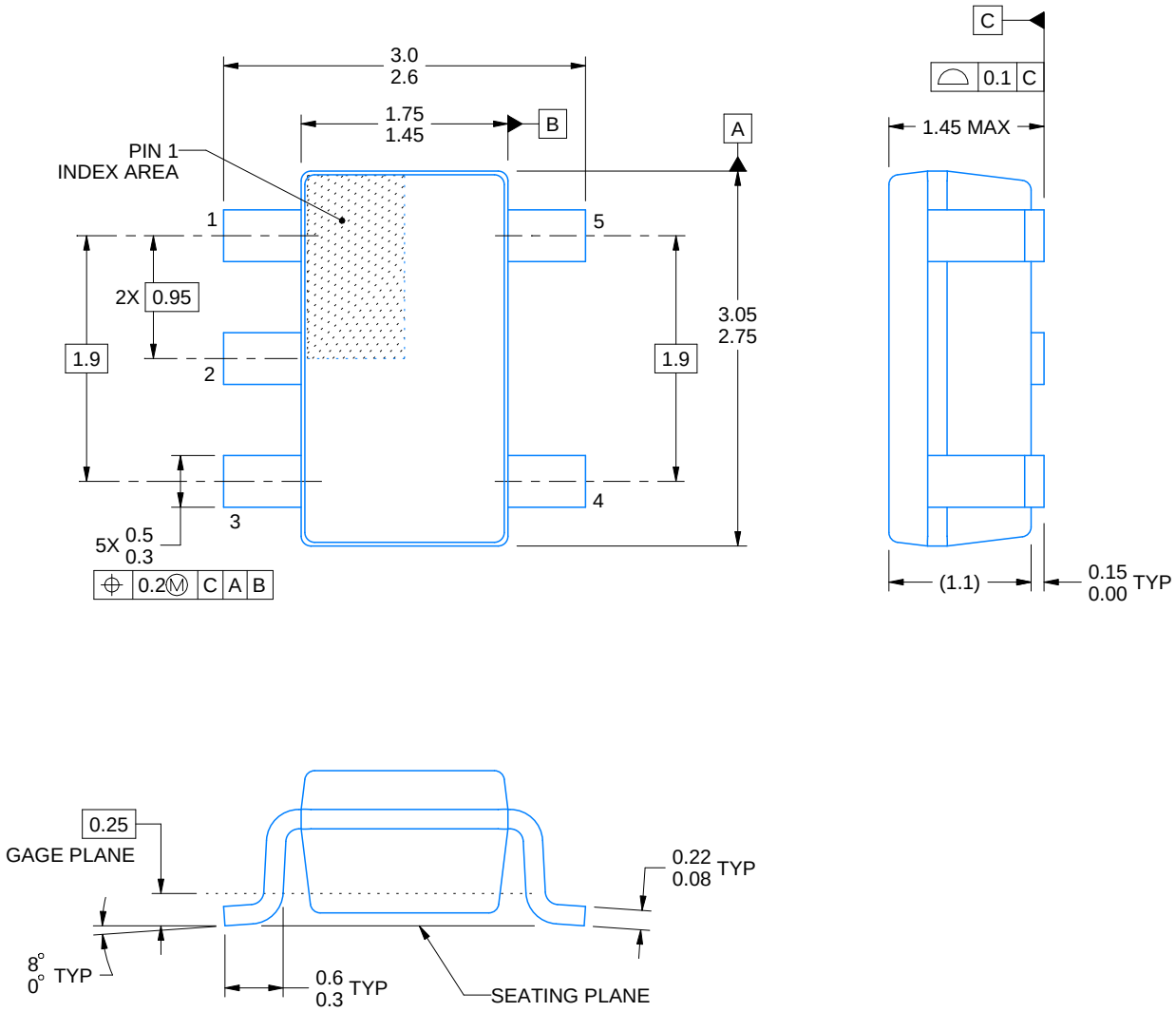
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

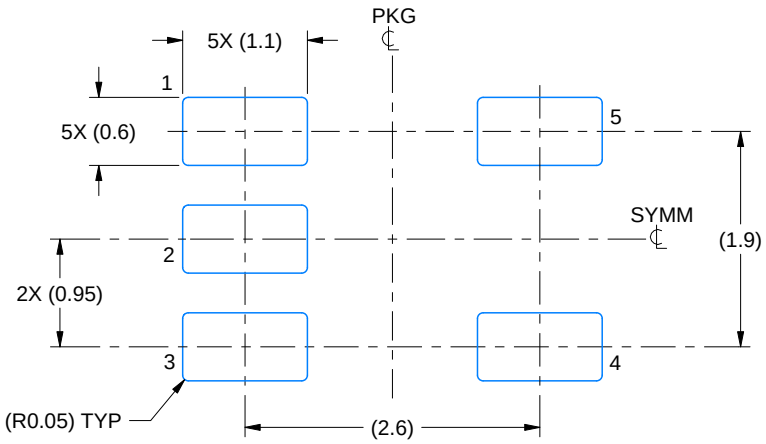
SMALL OUTLINE TRANSISTOR



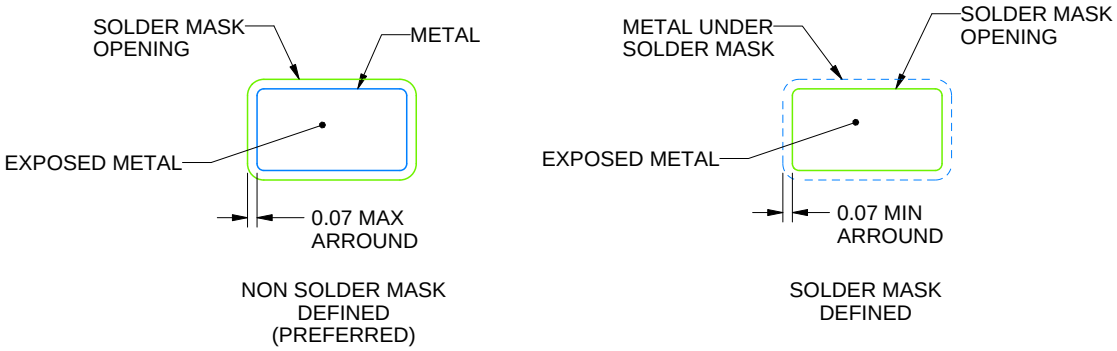
4214839/C 04/2017

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. Refernce JEDEC MO-178.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

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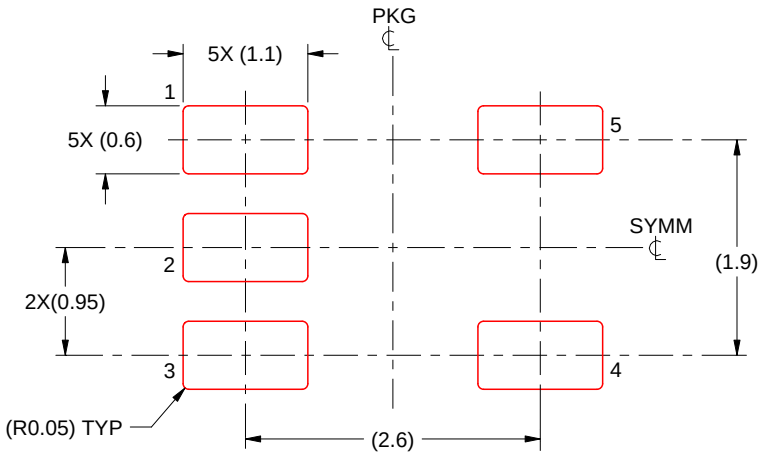
NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/C 04/2017

NOTES: (continued)

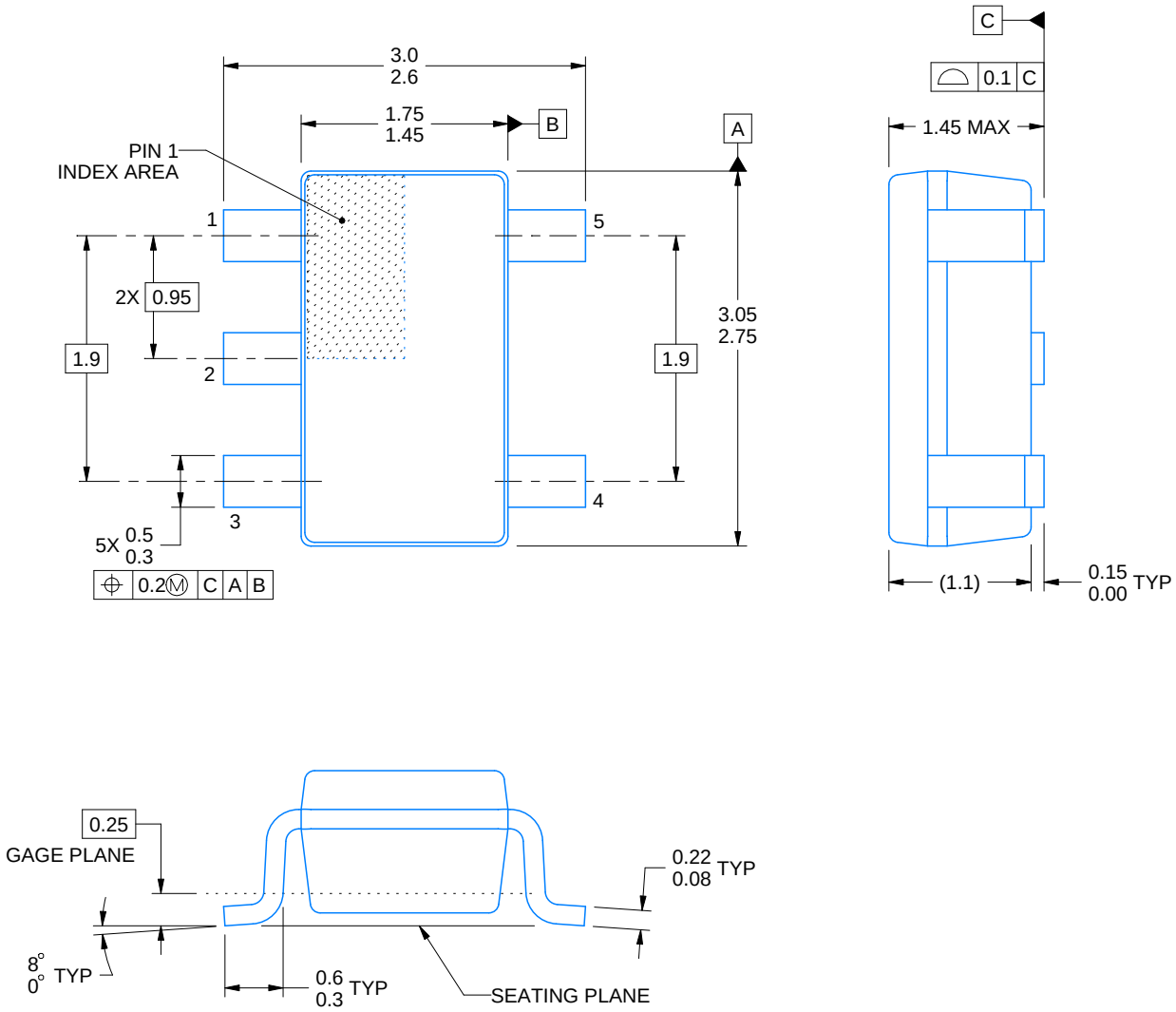
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
7. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



4214839/C 04/2017

NOTES:

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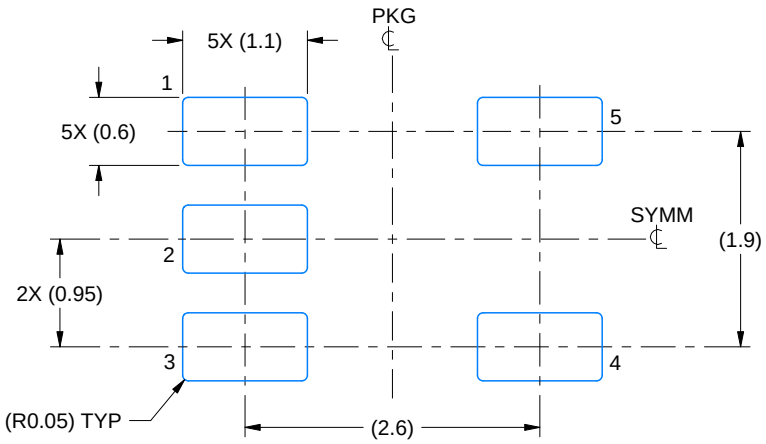
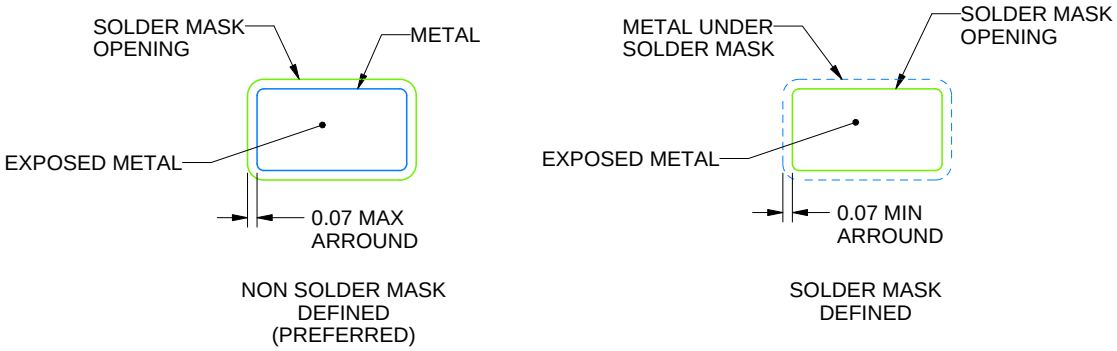
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-178.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

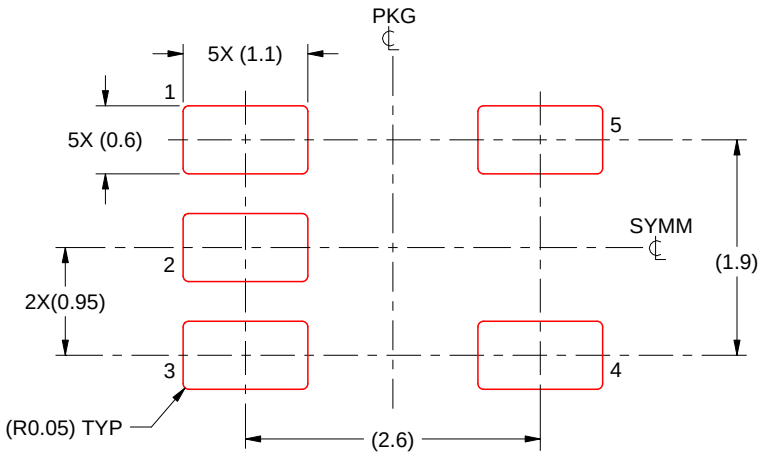


SOLDER MASK DETAILS

4214839/C 04/2017

NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



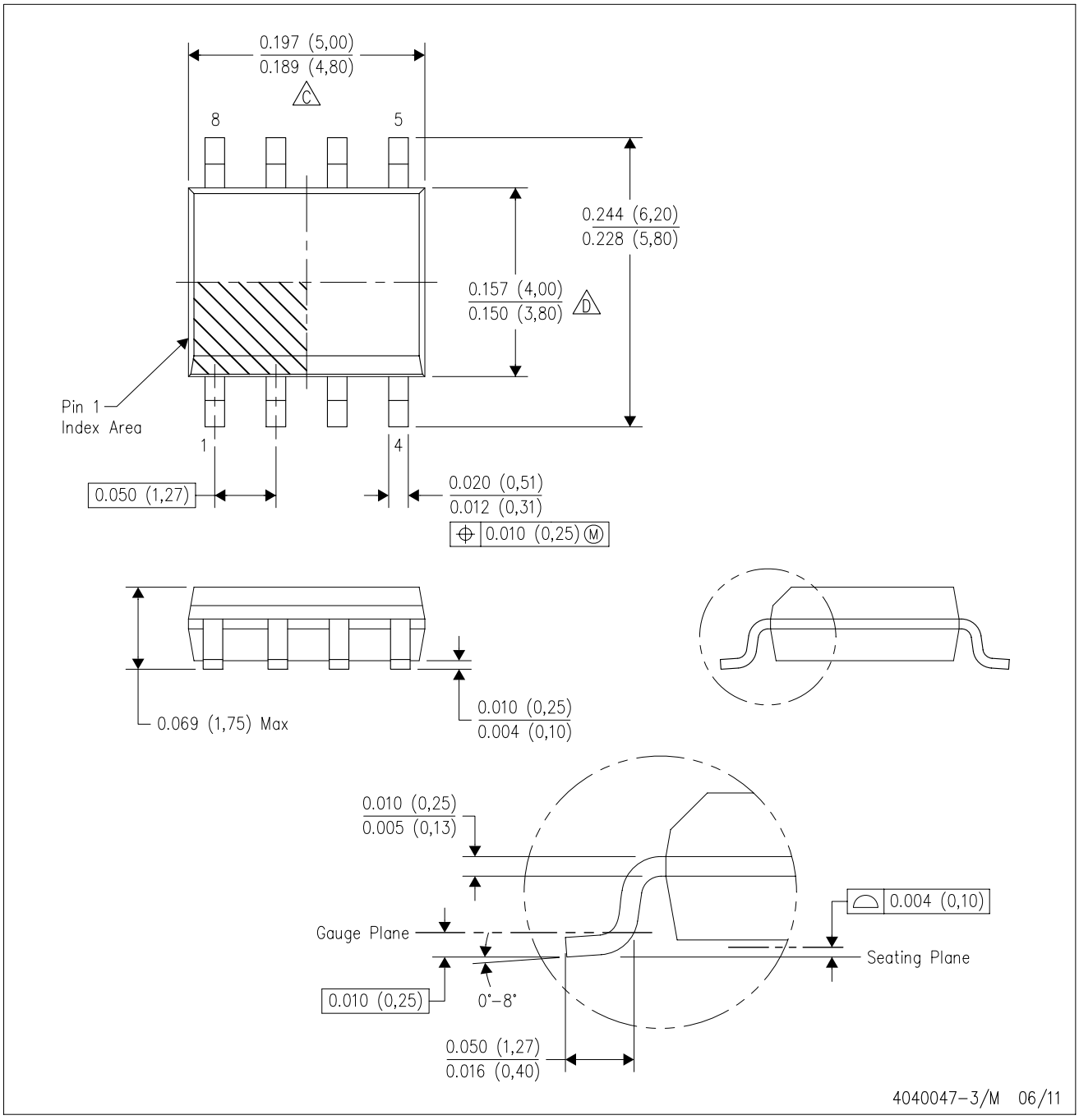
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/C 04/2017

NOTES: (continued)

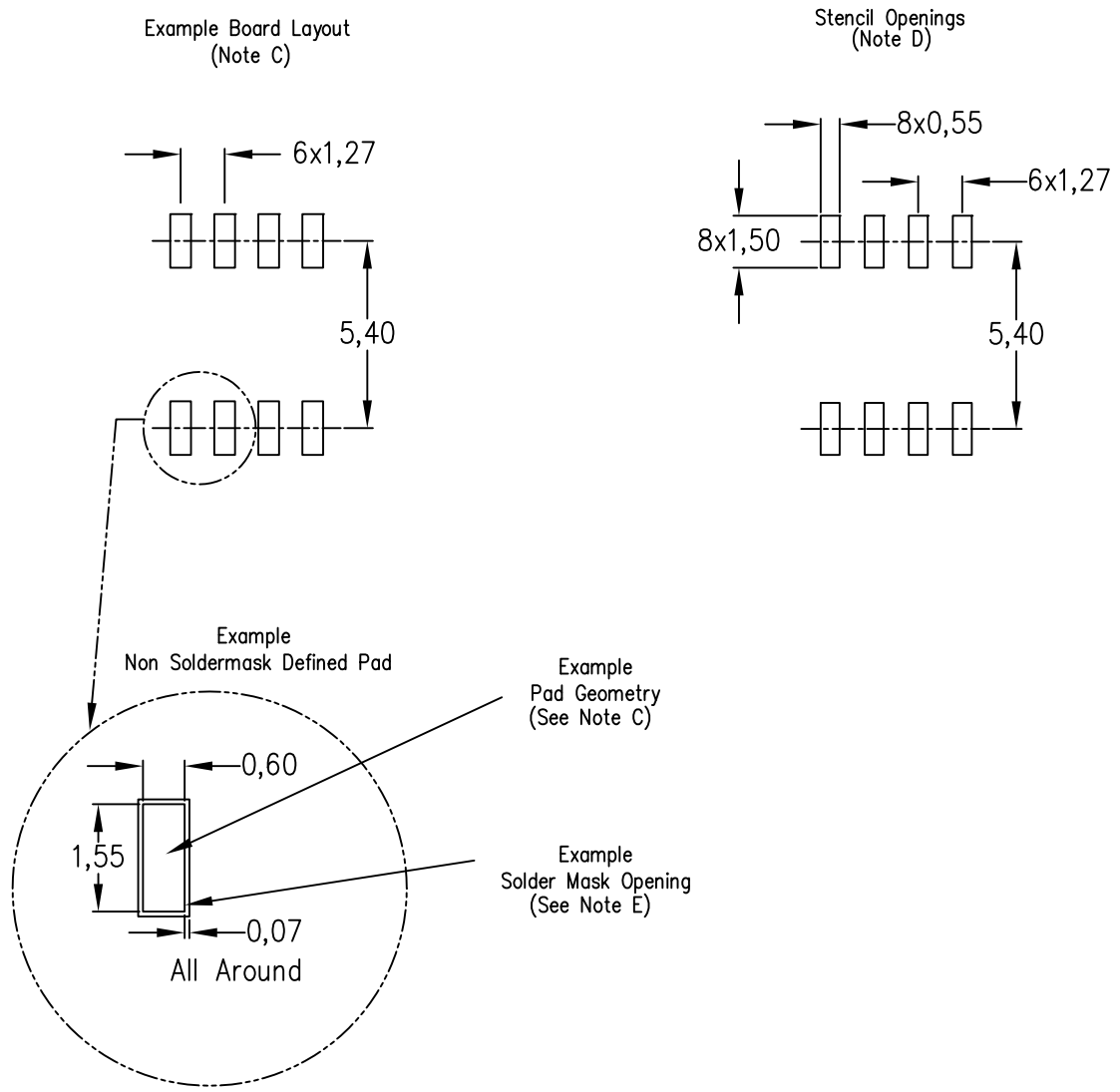
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
7. Board assembly site may have different recommendations for stencil design.

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.
C. 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.
D. 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.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



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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