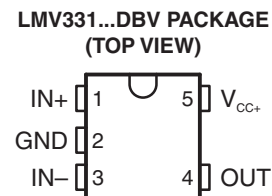
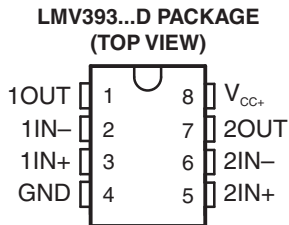


## GENERAL-PURPOSE LOW-VOLTAGE COMPARATORS

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  $\mu$ A Typ
  - LMV393 . . . 100  $\mu$ A Typ
- Input Common-Mode Voltage Range Includes Ground
- Low Output Saturation Voltage . . . 200 mV Typ
- Open-Collector Output for Maximum Flexibility



### 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.

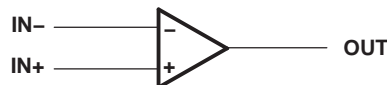
The LMV331-Q1 and LMV393-Q1 are the most cost-effective solutions for applications where low-voltage operation, low power, space saving, and price are the primary specifications in circuit design for portable consumer products. These devices offer specifications that meet or exceed the familiar LM339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

### ORDERING INFORMATION<sup>(1)</sup>

$T_A$	PACKAGE <sup>(2)</sup>			ORDERABLE PART NUMBER	TOP-SIDE MARKING <sup>(3)</sup>
–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](http://www.ti.com).
- (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://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)**



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The diagram shows a detailed circuit model of a 741 operational amplifier. It includes a differential input stage with transistors Q1 and Q2, a voltage divider with resistors R1, R2, and R3, a current source Q3, a differential pair Q4 and Q5, a current source Q6, a second differential pair Q7 and Q8, and a final output stage with a MOSFET M and a current source. The circuit is powered by VCC+ and GND.

## Absolute Maximum Ratings<sup>(1)</sup>

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

		MIN	MAX	UNIT
V <sub>CC+</sub>	Supply voltage <sup>(2)</sup>		5.5	V
V <sub>ID</sub>	Differential input voltage <sup>(3)</sup>		±5.5	V
V <sub>I</sub>	Input voltage range (either input)	0	5.5	V
θ <sub>JA</sub>	Package thermal impedance <sup>(4) (5)</sup>	D (8-pin) package		97
		D (14-pin) package		86
		DBV package		206
T <sub>J</sub>	Operating virtual junction temperature		150	°C
T <sub>stg</sub>	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<sub>CC+</sub> specified for the measurement of I<sub>OS</sub>) 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<sub>J(max)</sub>, θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J(max)</sub> – T<sub>A</sub>)/θ<sub>JA</sub>. 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 <sub>CC+</sub>	Supply voltage (single-supply operation)	2.7	5.5	V
V <sub>OUT</sub>	Output voltage		V <sub>CC+</sub> + 0.3	V
T <sub>A</sub>	Operating free-air temperature	–40	125	°C

## Electrical Characteristics

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

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

## Switching Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_{CC+} = 2.7\text{ V}$ ,  $R_L = 5.1\text{ k}\Omega$ ,  $GND = 0\text{ V}$  (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,  $V_{CC+} = 5\text{ V}$ ,  $GND = 0\text{ V}$  (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	
$\alpha V_{IO}$	Average temperature coefficient of input offset voltage		25°C		5		$\mu\text{V}/^\circ\text{C}$
$I_{IB}$	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)	$V_O \leq 1.5\text{ V}$	25°C	10	84		mA
	Output leakage current		25°C		0.003		$\mu\text{A}$
			–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	$I_O \leq 4\text{ mA}$	25°C		200	400	mV
			–40°C to 125°C			700	
$I_{CC}$	Supply current	LMV331	25°C		60	120	$\mu\text{A}$
			–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

$T_A = 25^\circ\text{C}$ ,  $V_{CC+} = 5\text{ V}$ ,  $R_L = 5.1\text{ k}\Omega$ ,  $GND = 0\text{ V}$  (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	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LMV331QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LADQ	<a href="#">Samples</a>
LMV393QDRG4Q1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	V393Q1	<a href="#">Samples</a>
LMV393QDRQ1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	V393Q1	<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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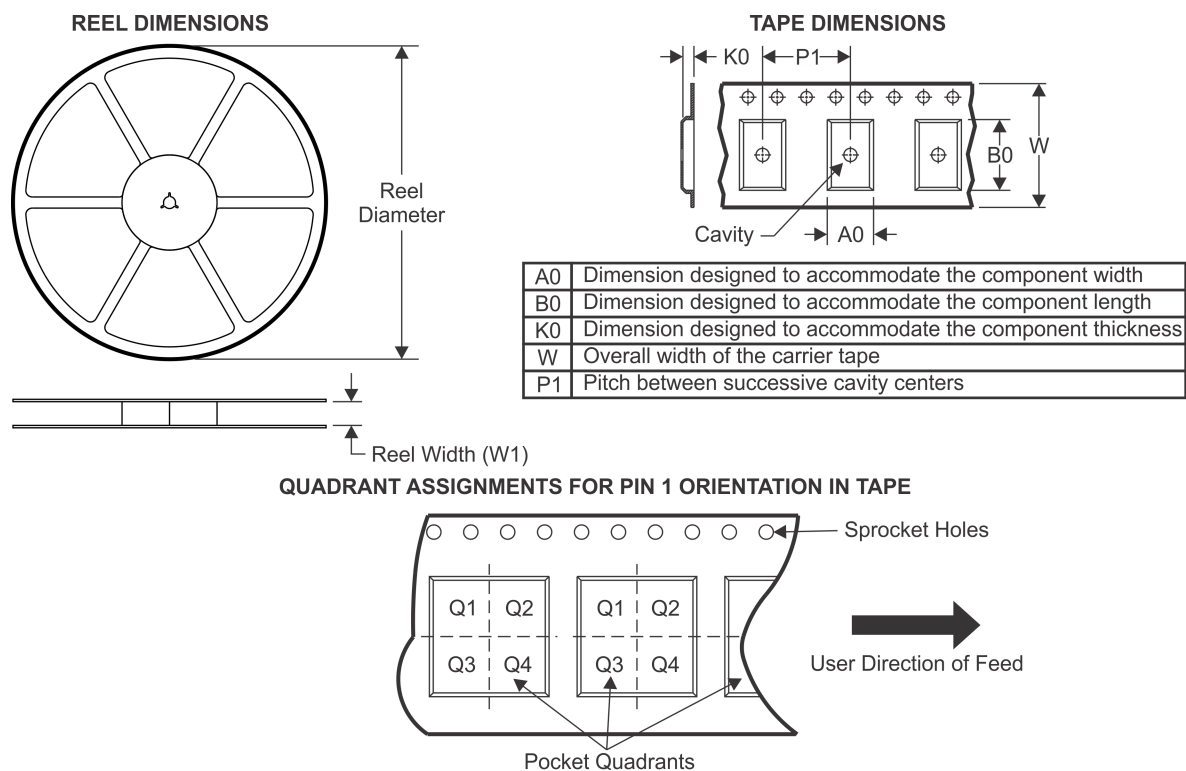
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**OTHER QUALIFIED VERSIONS OF LMV331-Q1, LMV393-Q1 :**

- Catalog: [LMV331](#), [LMV393](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product

**TAPE AND REEL INFORMATION**


\*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

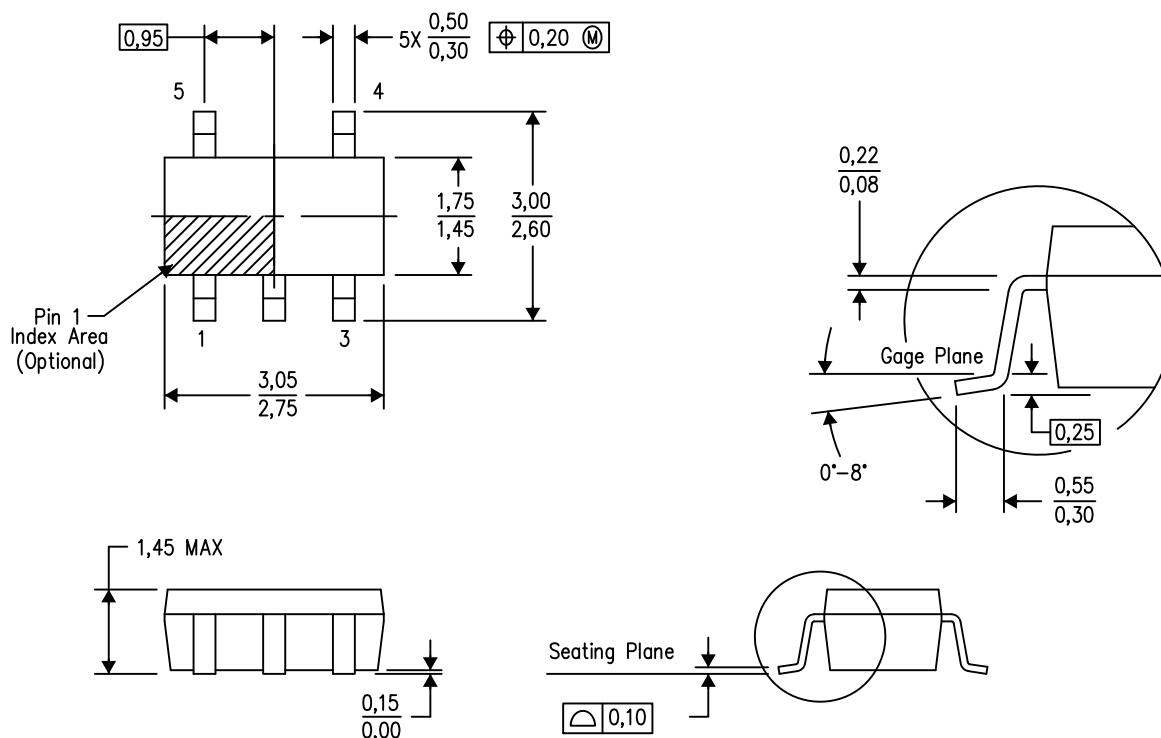


\*All dimensions are nominal

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 (R-PDSO-G5)

# PLASTIC SMALL-OUTLINE PACKAGE

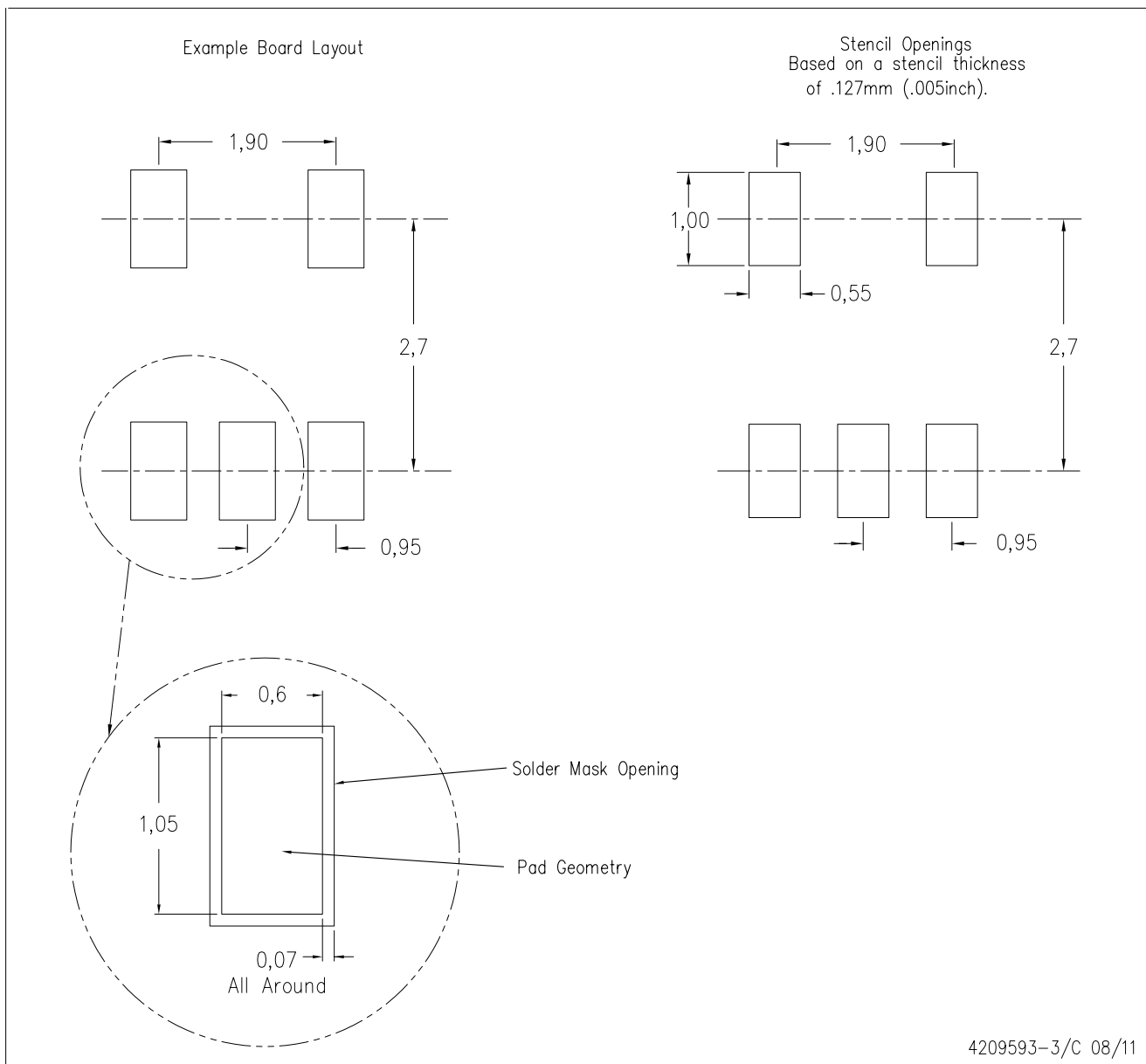


4073253-4/L 08/2013

- 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-178 Variation AA.

DBV (R-PDSO-G5)

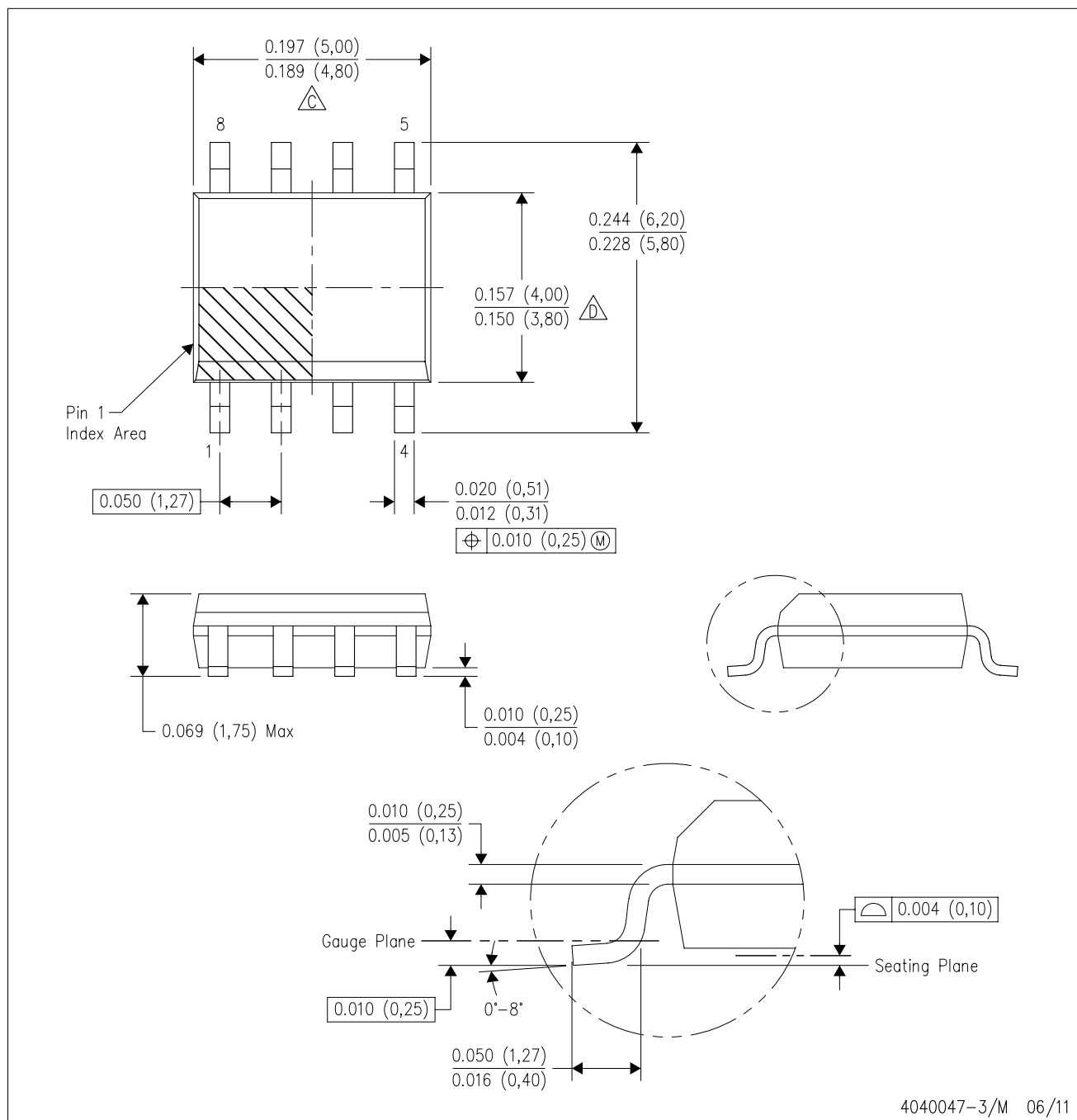
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE

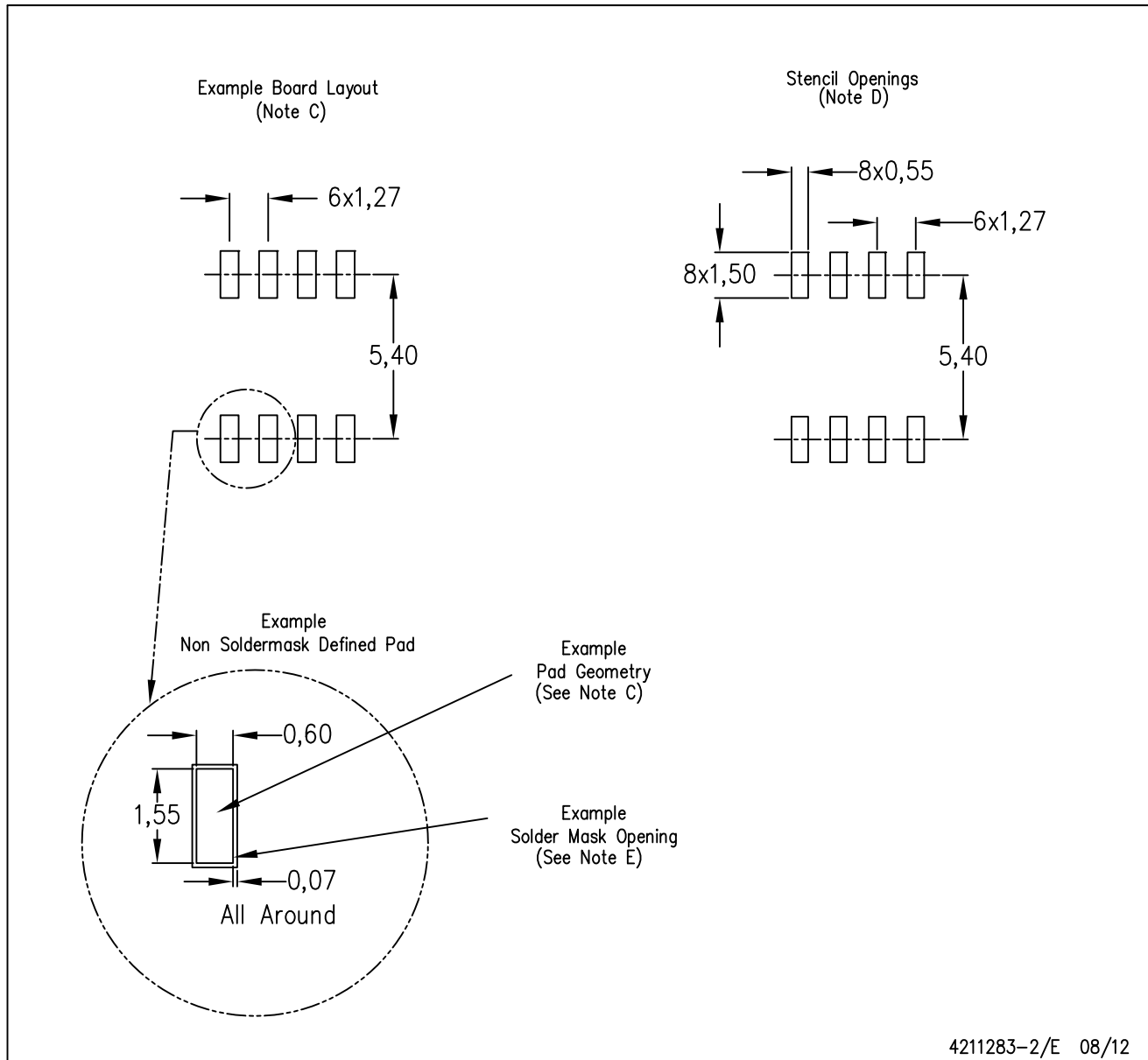


## NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- $\triangle C$  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.
- $\triangle D$  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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