

# LMV331 SINGLE, LMV393 DUAL, LMV339 QUAD GENERAL-PURPOSE LOW-VOLTAGE COMPARATORS

SLCS136M – AUGUST 1999 – REVISED NOVEMBER 2005

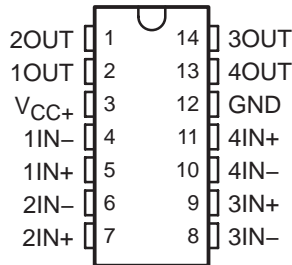
- **2.7-V and 5-V Performance**
- **Low Supply Current:**  
LMV331 . . . 60  $\mu$ A Typ  
LMV393 . . . 100  $\mu$ A Typ  
LMV339 . . . 170  $\mu$ A Typ
- **Input Common-Mode Voltage Range Includes Ground**
- **Low Output Saturation Voltage . . . 200 mV Typ**
- **Open-Collector Output for Maximum Flexibility**

## description/ordering information

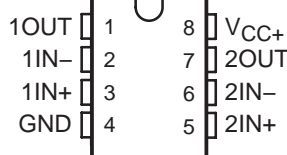
The LMV393 and LMV339 devices are low-voltage (2.7 V to 5.5 V) versions of the dual and quad comparators, LM393 and LM339, which operate from 5 V to 30 V. The LMV331 is the single-comparator version.

The LMV331, LMV339, and LMV393 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.

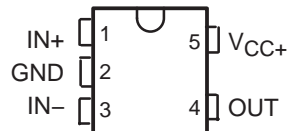
LMV339 . . . D OR PW PACKAGE  
(TOP VIEW)



LMV393 . . . D, DDU, DGK, OR PW PACKAGE  
(TOP VIEW)



LMV331 . . . DBV OR DCK PACKAGE  
(TOP VIEW)



## ORDERING INFORMATION

T <sub>A</sub>		PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
-40°C to 85°C	Single	SC-70 (DCK)	Reel of 3000	LMV331DCKR	R2_
			Reel of 250	LMV331DCKT	
		SOT23-5 (DBV)	Reel of 3000	LMV331DBVR	R11_
			Reel of 250	LMV331DBVT	
	Dual	MSOP/VSSOP (DGK)	Reel of 2500	LMV393DGKR	R9_
			Tube of 75	LMV393ID	
		SOIC (D)	Reel of 2500	LMV393IDR	MV393I
			Tube of 90	LMV393IPW	
		TSSOP (PW)	Reel of 2000	LMV393IPWR	MV393I
			VSSOP (DDU)	Reel of 2000	
	Quad	SOIC (D)	Tube of 50	LMV339ID	LMV339I
			Reel of 2500	LMV339IDR	
TSSOP (PW)		Tube of 150	LMV339IPW	MV339I	
		Reel of 2000	LMV339IPWR		

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

‡ DBV/DCK/DGK: The actual top-side marking has one additional character that designates the assembly/test site.

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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.

**TEXAS  
INSTRUMENTS**

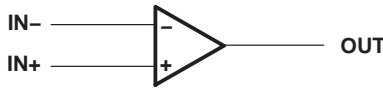
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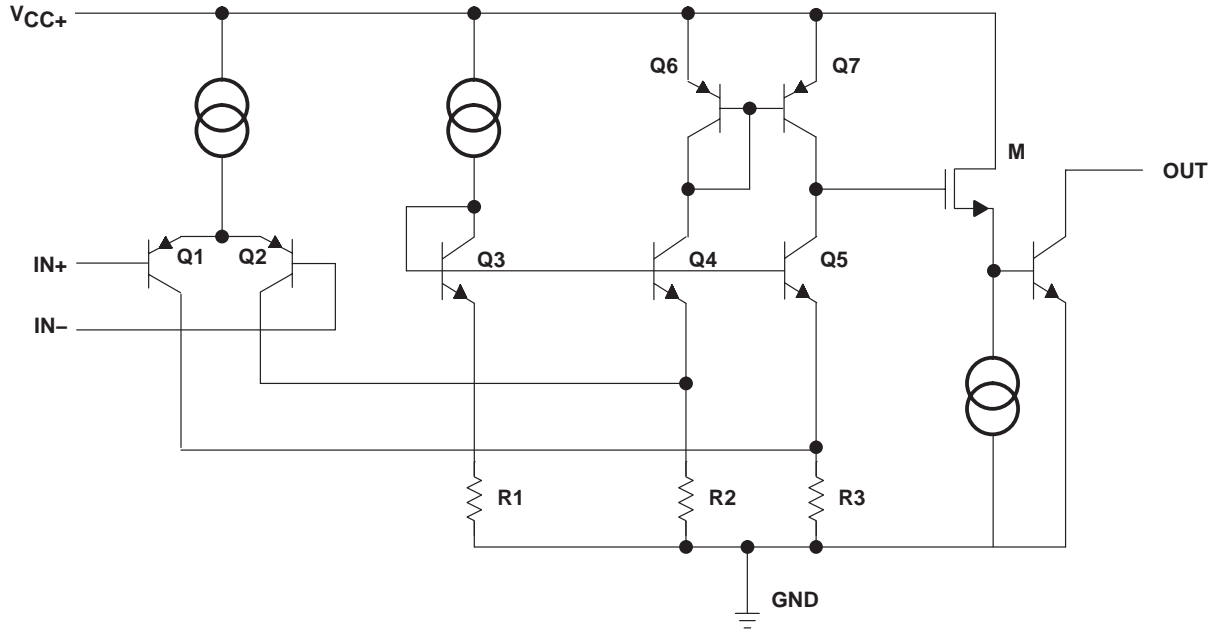
# LMV331 SINGLE, LMV393 DUAL, LMV339 QUAD GENERAL-PURPOSE LOW-VOLTAGE COMPARATORS

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## symbol (each comparator)



## simplified schematic



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

Supply voltage, $V_{CC+}$ (see Note 1)	5.5 V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm 5.5$ V
Input voltage range, $V_I$ (either input)	0 V to 5.5 V
Package thermal impedance, $\theta_{JA}$ (see Notes 3 and 4):	
D (8-pin) package	97°C/W
D (14-pin) package	86°C/W
DBV package	206°C/W
DCK package	252°C/W
DDU package	TBD°C/W
DGK package	172°C/W
PW (8-pin) package	149°C/W
PW (14-pin) package	113°C/W
Operating virtual junction temperature, $T_J$	150°C
Storage temperature range, $T_{stg}$	-65°C to 150°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 and  $V_{CC+}$  specified for the measurement of  $I_{OS}$ ) are with respect to the network GND.
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , 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.
  4. The package thermal impedance is calculated in accordance with JESD 51-7.

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## 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	85	°C

## electrical characteristics at specified free-air temperature, V<sub>CC+</sub> = 2.7 V, GND = 0 V (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
V <sub>IO</sub> Input offset voltage		25°C		1.7	7	mV
α <sub>V<sub>IO</sub></sub> Average temperature coefficient of input offset voltage		-40°C to 85°C		5		μV/°C
I <sub>IB</sub> Input bias current		25°C		10	250	nA
		-40°C to 85°C			400	
I <sub>IO</sub> Input offset current		25°C		5	50	nA
		-40°C to 85°C			150	
I <sub>O</sub> Output current (sinking)	V <sub>O</sub> ≤ 1.5 V	25°C	5	23		mA
Output leakage current		25°C		0.003		μA
		-40°C to 85°C			1	
V <sub>ICR</sub> Common-mode input voltage range		25°C		-0.1 to 2		V
V <sub>SAT</sub> Saturation voltage	I <sub>O</sub> ≤ 1 mA	25°C		200		mV
I <sub>CC</sub> Supply current	LMV331	25°C		40	100	μA
	LMV393 (both comparators)	25°C		70	140	
	LMV339 (all four comparators)	25°C		140	200	

## switching characteristics, T<sub>A</sub> = 25°C, V<sub>CC+</sub> = 2.7 V, R<sub>L</sub> = 5.1 kΩ, GND = 0 V (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TYP	UNIT
t <sub>PHL</sub> Propagation delay, high- to low-level output switching	Input overdrive = 10 mV	1000	ns
	Input overdrive = 100 mV	350	
t <sub>PLH</sub> Propagation delay, low- to high-level output switching	Input overdrive = 10 mV	500	ns
	Input overdrive = 100 mV	400	

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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 85°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 85°C			400	
$I_{IO}$	Input offset current		25°C		2	50	nA
			-40°C to 85°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 85°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 85°C			700	
$I_{CC}$	Supply current	LMV331	25°C		60	120	$\mu\text{A}$
			-40°C to 85°C			150	
		LMV393 (both comparators)	25°C		100	200	
			-40°C to 85°C			250	
		LMV339 (all four comparators)	25°C		170	300	
			-40°C to 85°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	



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**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
LMV331IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDBvre4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDCKRE4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDCKRG4	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDCKTE4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV331IDCKTG4	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IPWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IPWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IPWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV339IPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
LMV393IDDUR	ACTIVE	VSSOP	DDU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDDURE4	ACTIVE	VSSOP	DDU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDDURG4	ACTIVE	VSSOP	DDU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IPWE4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IPWRE4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LMV393IPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<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.

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

<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.

**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.

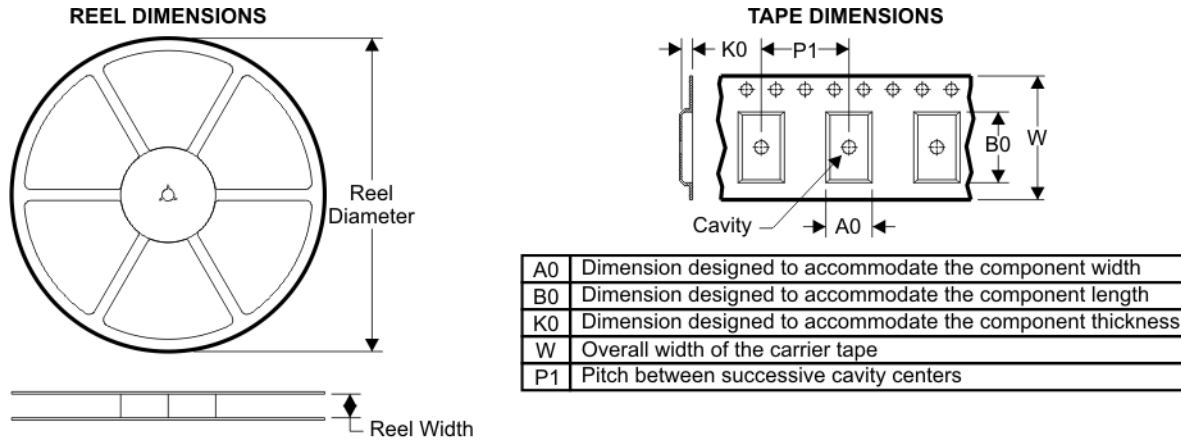
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

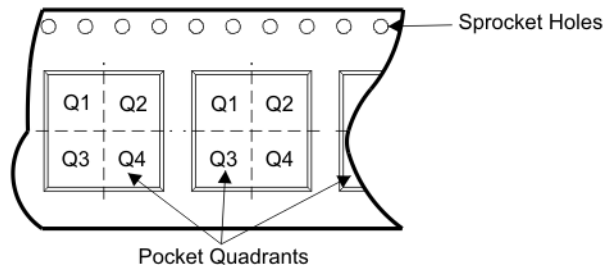
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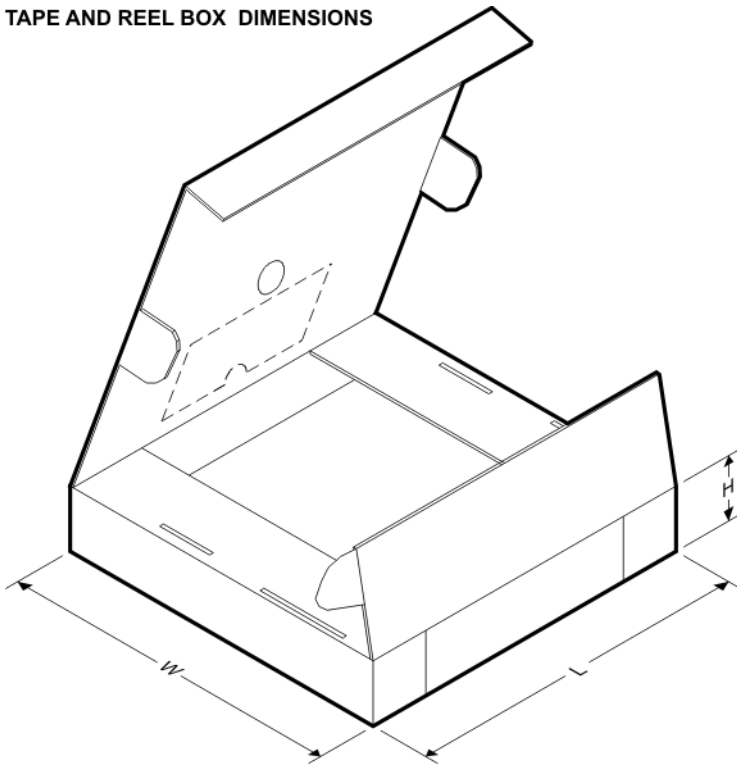


**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMV331IDBVR	DBV	5	SITE 34	180	9	3.23	3.17	1.37	4	8	Q3
LMV331IDBVR	DBV	5	SITE 45	0	0	3.23	3.17	1.37	4	8	Q3
LMV331IDBVT	DBV	5	SITE 34	180	9	3.23	3.17	1.37	4	8	Q3
LMV331IDBVT	DBV	5	SITE 45	330	16	10.6	15.8	4.9	16	24	Q3
LMV331IDCKR	DCK	5	SITE 34	180	9	2.24	2.34	1.22	4	8	Q3
LMV331IDCKT	DCK	5	SITE 34	180	9	2.24	2.34	1.22	4	8	Q3
LMV331IDCKT	DCK	5	SITE 45	0	0	2.4	2.5	1.2	4	8	Q3
LMV339IDR	D	14	SITE 41	330	16	6.5	9.0	2.1	8	16	Q1
LMV339IPWR	PW	14	SITE 41	330	12	7.0	5.6	1.6	8	12	Q1
LMV393IDDUR	DDU	8	SITE 35	180	9	2.25	3.35	1.05	4	8	Q3
LMV393IDGKR	DGK	8	SITE 35	330	13	5.3	3.4	1.4	8	12	Q1
LMV393IDR	D	8	SITE 27	330	12	6.4	5.2	2.1	8	12	Q1
LMV393IPWR	PW	8	SITE 41	330	12	7.0	3.6	1.6	8	12	Q1

**TAPE AND REEL BOX DIMENSIONS**



Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
LMV331IDBVR	DBV	5	SITE 34	205.0	200.0	33.0
LMV331IDBVR	DBV	5	SITE 45	0.0	185.0	220.0
LMV331IDBVT	DBV	5	SITE 34	201.0	192.0	26.0
LMV331IDBVT	DBV	5	SITE 45	0.0	0.0	0.0
LMV331IDCKR	DCK	5	SITE 34	205.0	200.0	33.0
LMV331IDCKT	DCK	5	SITE 34	201.0	192.0	26.0
LMV331IDCKT	DCK	5	SITE 45	0.0	185.0	220.0
LMV339IDR	D	14	SITE 41	346.0	346.0	33.0
LMV339IPWR	PW	14	SITE 41	346.0	346.0	29.0
LMV393IDDUR	DDU	8	SITE 35	202.0	201.0	28.0
LMV393IDGKR	DGK	8	SITE 35	358.0	335.0	35.0
LMV393IDR	D	8	SITE 27	342.9	336.6	20.64
LMV393IPWR	PW	8	SITE 41	346.0	346.0	29.0



DCK (R-PDSO-G5)

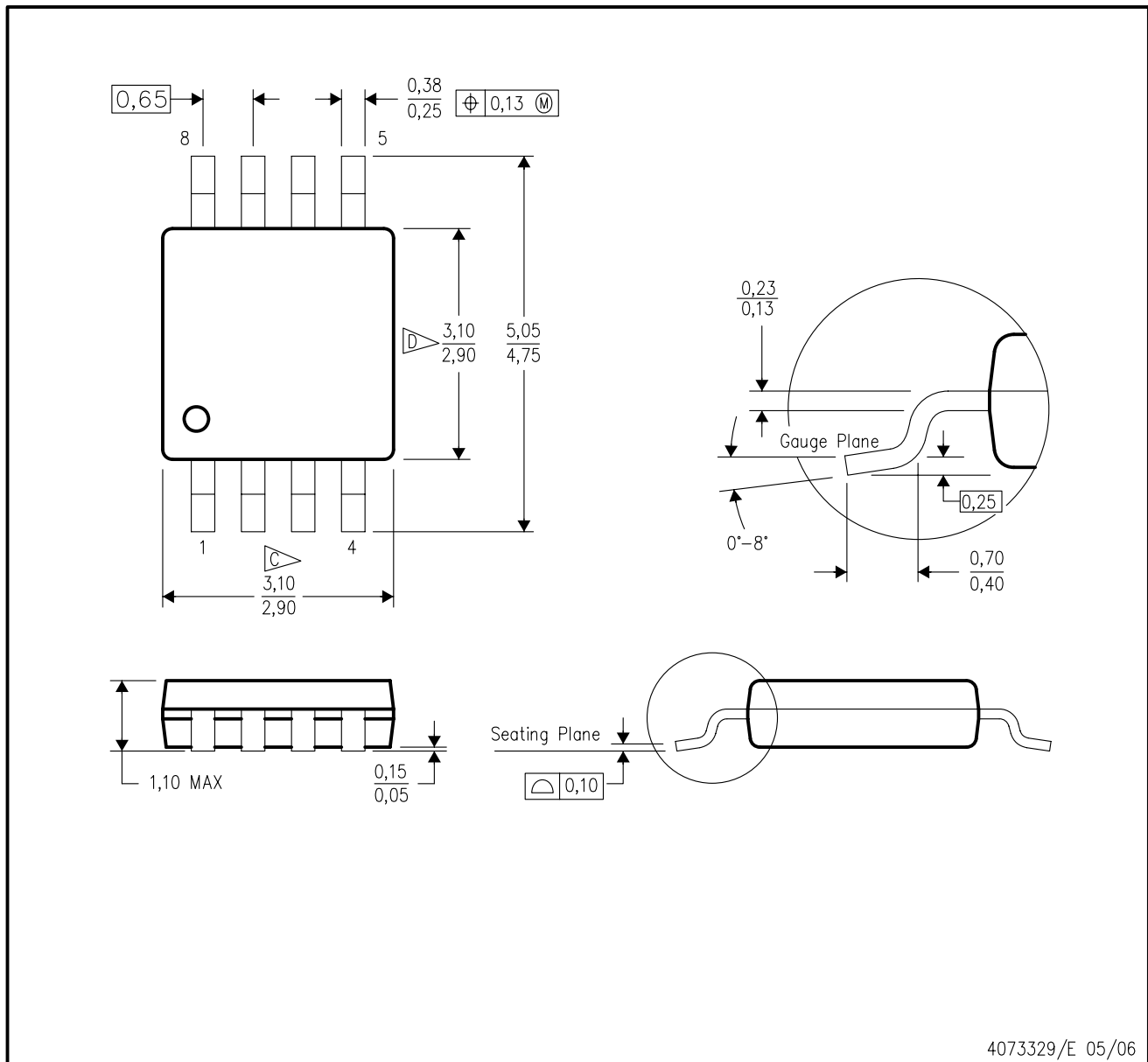
PLASTIC SMALL-OUTLINE PACKAGE



- 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 AA.

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

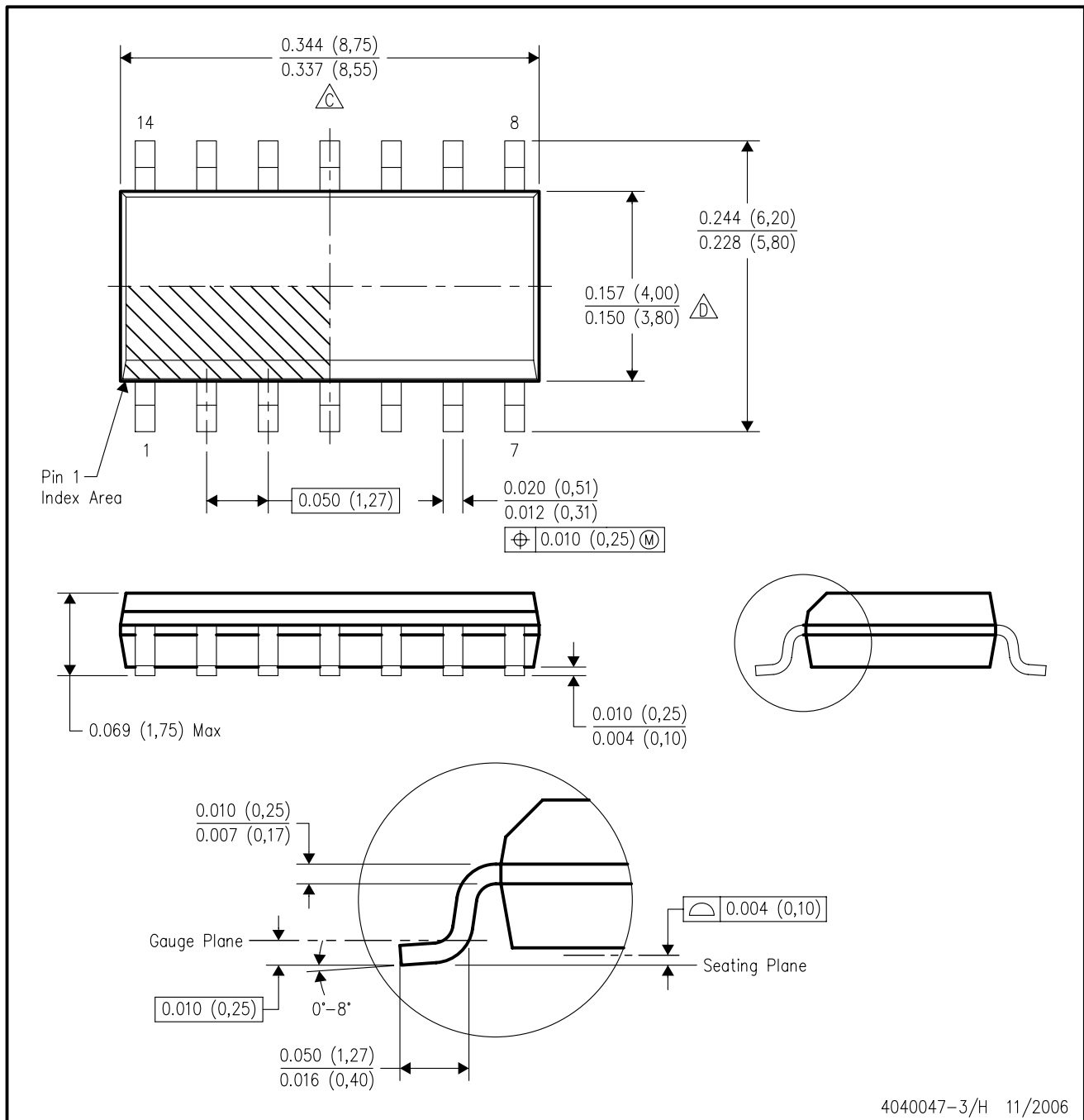


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
  - E. Falls within JEDEC MO-187 variation AA, except interlead flash.



D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE

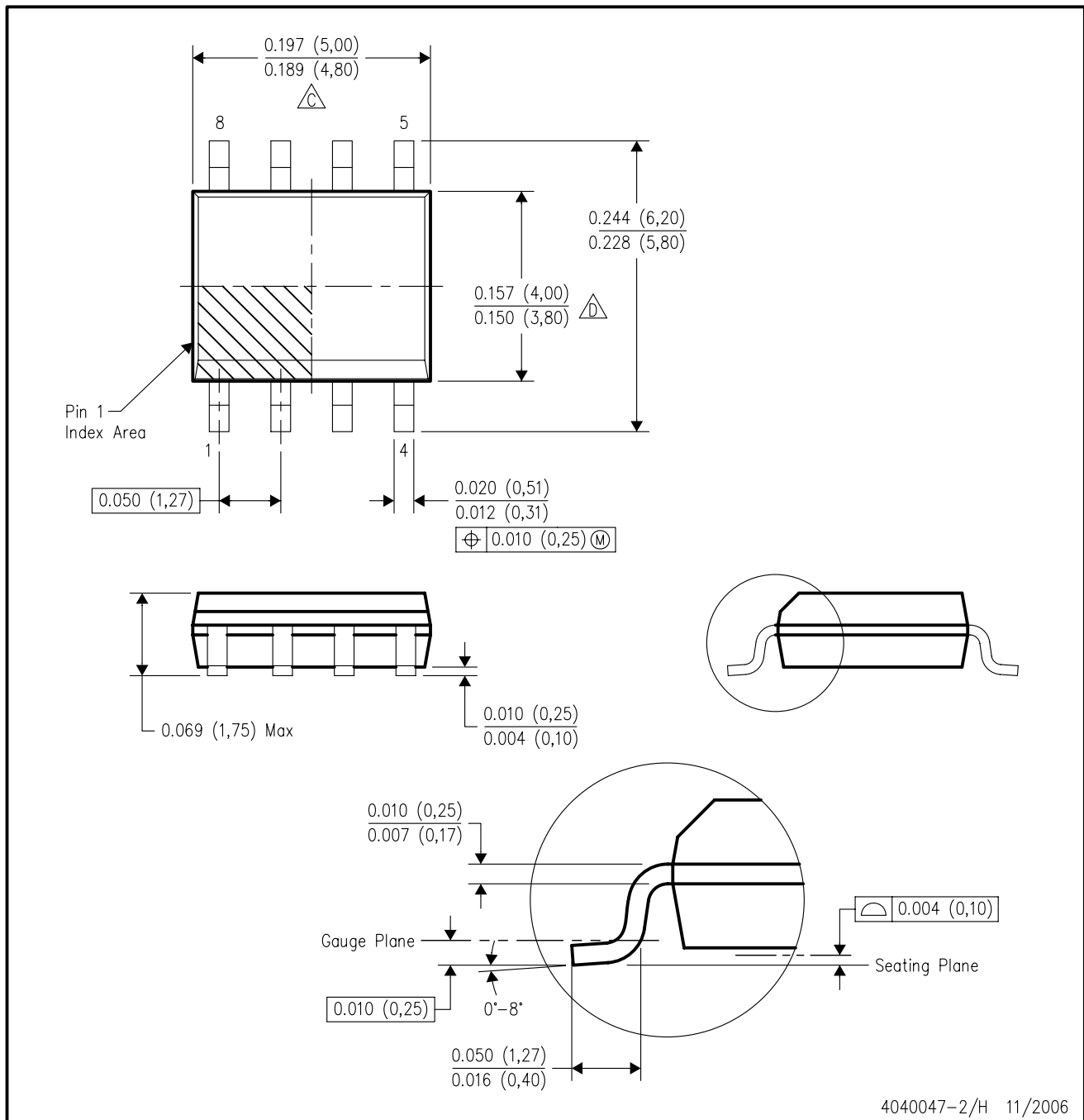


4040047-3/H 11/2006

- 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 .006 (0,15) per end.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AA.

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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 not to exceed 0,15.  
 D. Falls within JEDEC MO-153