

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

SLCS136M – AUGUST 1999 – REVISED NOVEMBER 2005

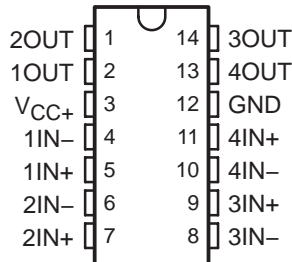
- **2.7-V and 5-V Performance**
- **Low Supply Current:**
LMV331 . . . 60 μ A Typ
LMV393 . . . 100 μ A Typ
LMV339 . . . 170 μ A Typ
- **Input Common-Mode Voltage Range Includes Ground**
- **Low Output Saturation Voltage . . . 200 mV Typ**
- **Open-Collector Output for Maximum Flexibility**

description/ordering information

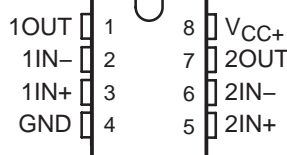
The LMV393 and LMV339 devices are low-voltage (2.7 V to 5.5 V) versions of the dual and quad comparators, LM393 and LM339, which operate from 5 V to 30 V. The LMV331 is the single-comparator version.

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.

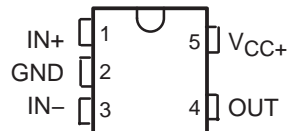
LMV339 . . . D OR PW PACKAGE
(TOP VIEW)



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



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



ORDERING INFORMATION

| T _A | | 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.

‡ 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**

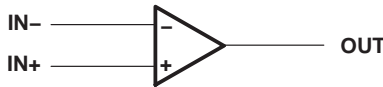
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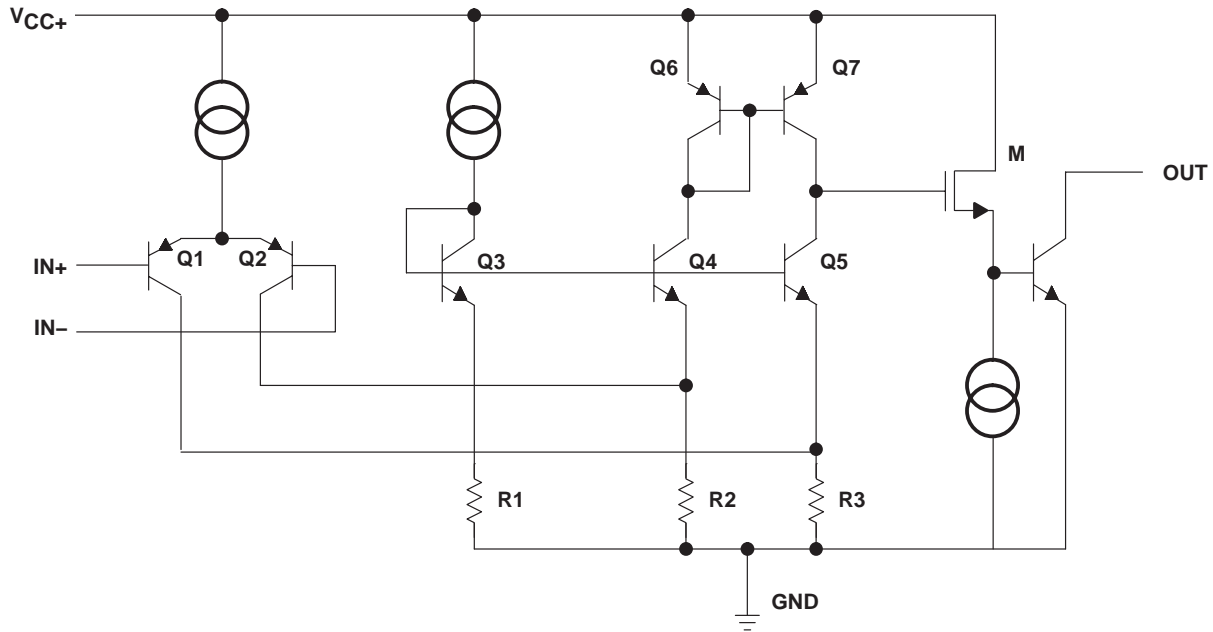
LMV331 SINGLE, LMV393 DUAL, LMV339 QUAD GENERAL-PURPOSE LOW-VOLTAGE COMPARATORS

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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) | ± 5.5 V |
| Input voltage range, V_I (either input) | 0 V to 5.5 V |
| Package thermal impedance, θ_{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 $T_J(\max)$, 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.
 4. The package thermal impedance is calculated in accordance with JESD 51-7.

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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 | 85 | °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 |
| α _{V_{IO}} Average temperature coefficient of input offset voltage | | -40°C to 85°C | | 5 | | μV/°C |
| I _{IB} Input bias current | | 25°C | | 10 | 250 | nA |
| | | -40°C to 85°C | | | 400 | |
| I _{IO} Input offset current | | 25°C | | 5 | 50 | nA |
| | | -40°C to 85°C | | | 150 | |
| I _O Output current (sinking) | V _O ≤ 1.5 V | 25°C | 5 | 23 | | mA |
| Output leakage current | | 25°C | | 0.003 | | μA |
| | | -40°C to 85°C | | | 1 | |
| V _{ICR} Common-mode input voltage range | | 25°C | | -0.1 to 2 | | V |
| V _{SAT} Saturation voltage | I _O ≤ 1 mA | 25°C | | 200 | | mV |
| I _{CC} 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_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 | |

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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 | | μA |
| | | | -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 | μA |
| | | | -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 ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 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 |
| 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 | TBD | Call TI | Call TI |
| 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 |
| 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 |
| LMV393ID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| 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 |
| LMV393IDE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 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 |
| 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 |

⁽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.

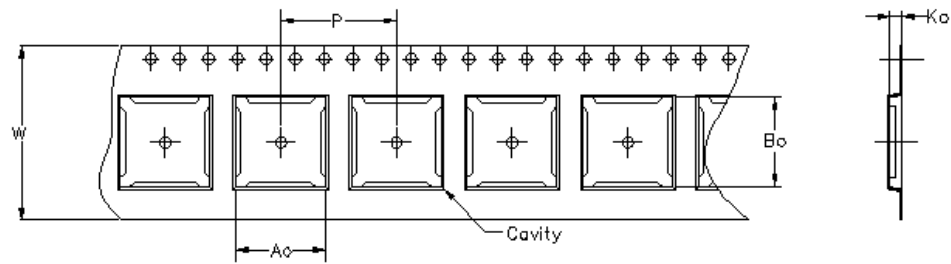
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

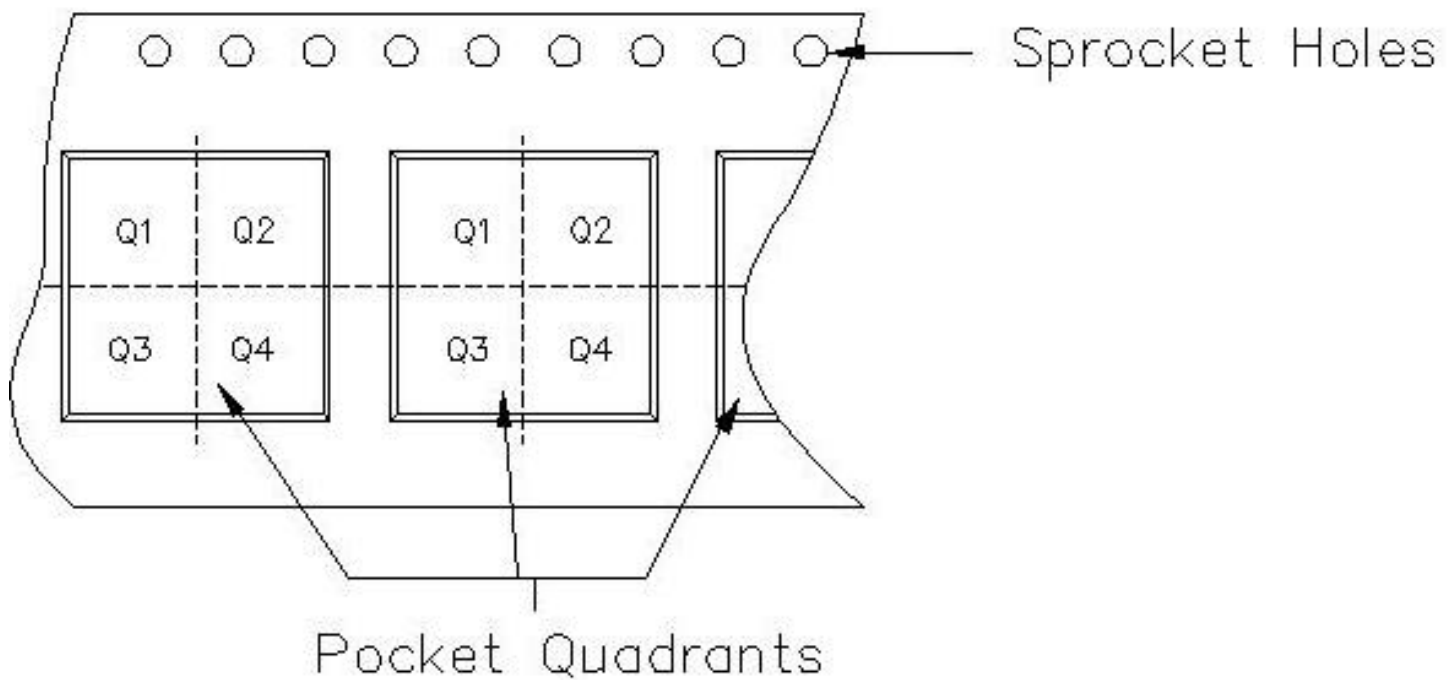
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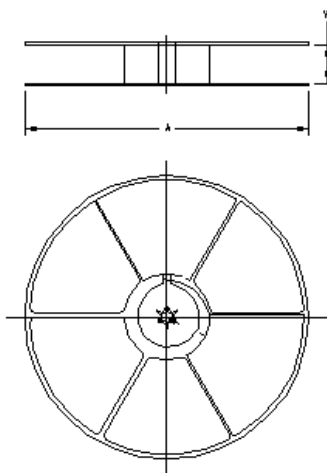
Carrier tape design is defined largely by the component length, width, and thickness.

| |
|--|
| A_o = Dimension designed to accommodate the component width. |
| B_o = Dimension designed to accommodate the component length. |
| K_o = Dimension designed to accommodate the component thickness. |
| W = Overall width of the carrier tape. |
| P = Pitch between successive cavity centers. |



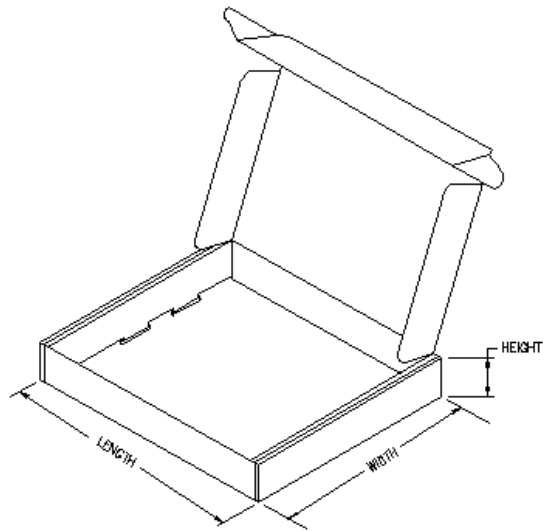
TAPE AND REEL INFORMATION

| Device | Package | Pins | Site | Reel Diameter (mm) | Reel Width (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|---------|------|------|--------------------|-----------------|---------|---------|---------|---------|--------|---------------|
| LMV339IDR | D | 14 | MLA | 330 | 16 | 6.5 | 9.0 | 2.1 | 8 | 16 | Q1 |
| LMV339IPWR | PW | 14 | MLA | 330 | 12 | 7.0 | 5.6 | 1.6 | 8 | 12 | Q1 |
| LMV393IDGKR | DGK | 8 | HNT | 180 | 13 | 5.3 | 3.4 | 1.4 | 8 | 12 | Q1 |
| LMV393IDR | D | 8 | FMX | 330 | 12 | 6.4 | 5.2 | 2.1 | 8 | 12 | Q1 |
| LMV393IPWR | PW | 8 | MLA | 330 | 12 | 7.0 | 3.6 | 1.6 | 8 | 12 | Q1 |



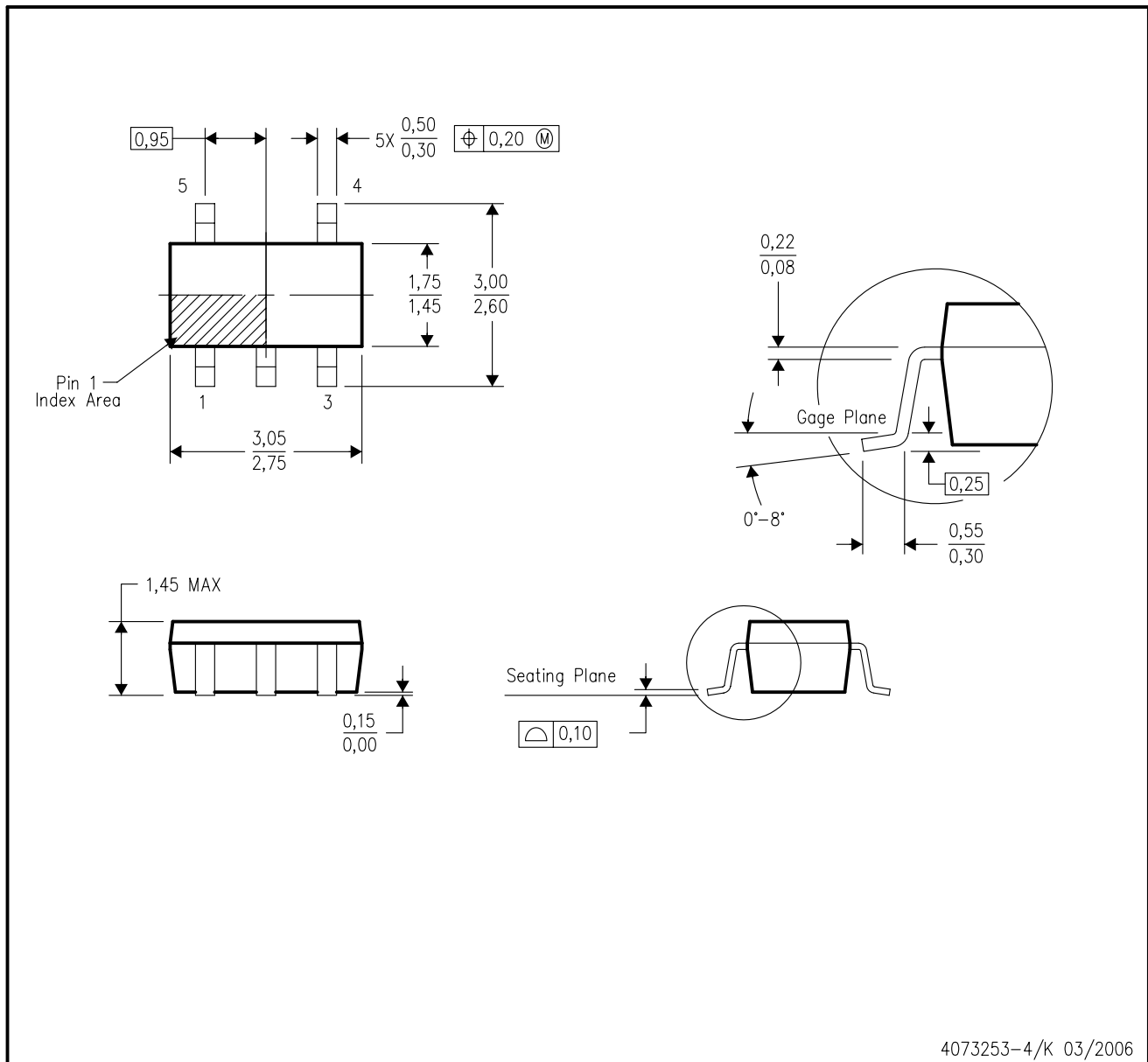
TAPE AND REEL BOX INFORMATION

| Device | Package | Pins | Site | Length (mm) | Width (mm) | Height (mm) |
|-------------|---------|------|------|-------------|------------|-------------|
| LMV339IDR | D | 14 | MLA | 333.2 | 333.2 | 28.58 |
| LMV339IPWR | PW | 14 | MLA | 338.1 | 340.5 | 20.64 |
| LMV393IDGKR | DGK | 8 | HNT | 0.0 | 0.0 | 0.0 |
| LMV393IDR | D | 8 | FMX | 338.1 | 340.5 | 20.64 |
| LMV393IPWR | PW | 8 | MLA | 338.1 | 340.5 | 20.64 |



DBV (R-PDSO-G5)

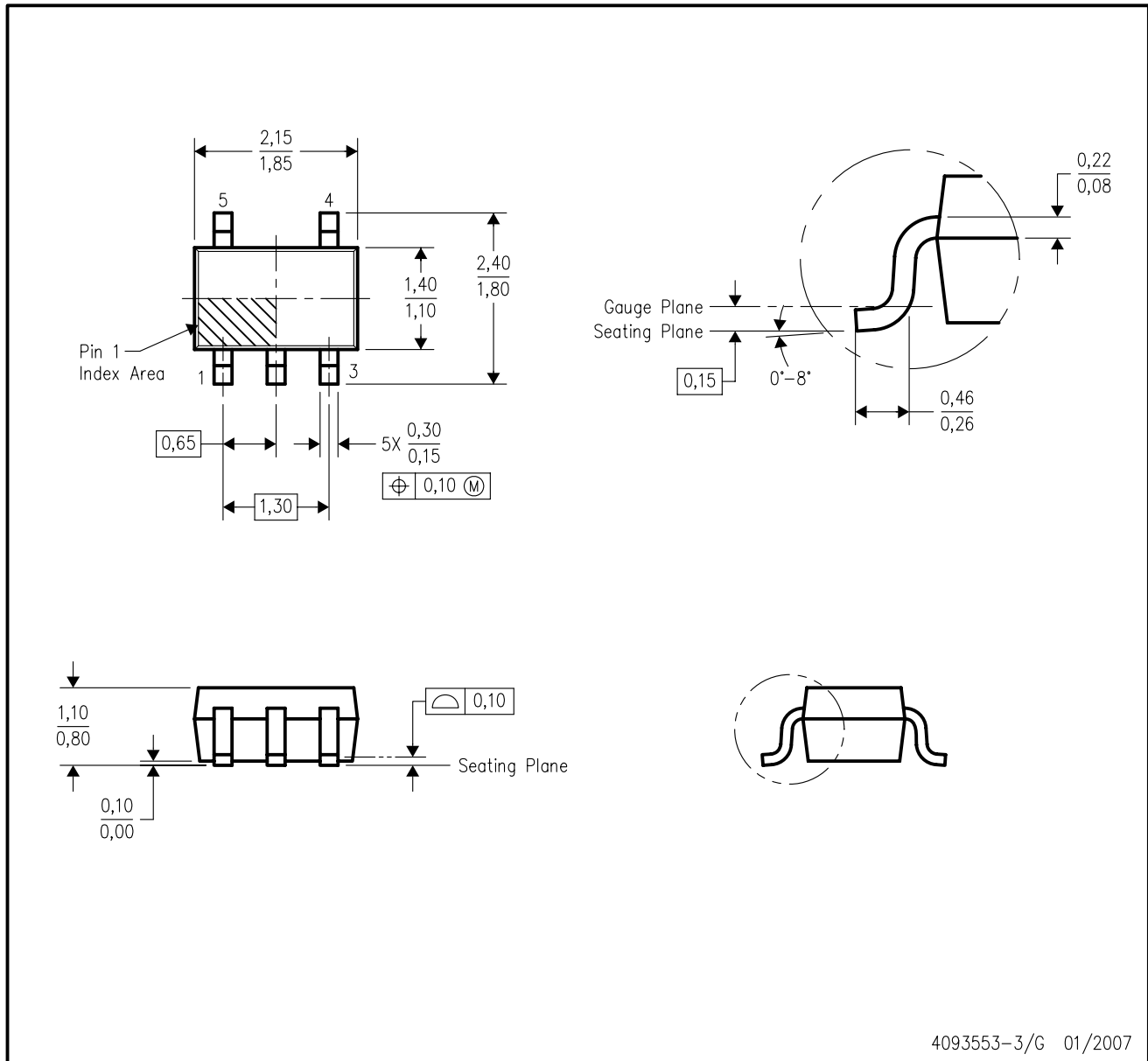
PLASTIC SMALL-OUTLINE PACKAGE



- 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-178 Variation AA.

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

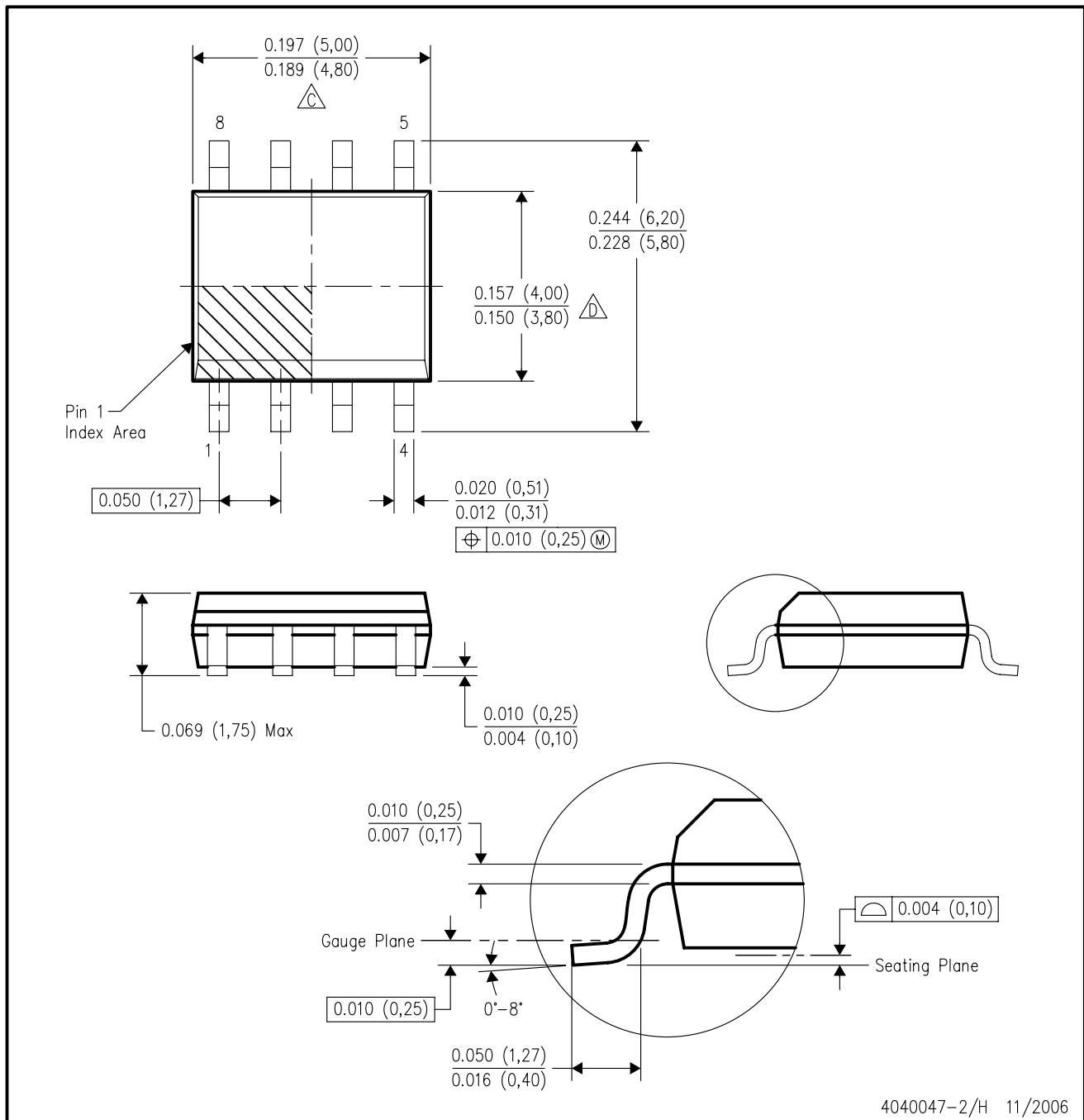


4073329/E 05/06

- 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-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