

# RC4136, RM4136, RV4136 QUAD GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

The RM4136 and RV4136 are obsolete and are no longer supplied.

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- Continuous Short-Circuit Protection
- Wide Common-Mode and Differential Voltage Ranges
- No Frequency Compensation Required
- Low Power Consumption
- No Latch-Up
- Unity-Gain Bandwidth . . . 3 MHz Typ
- Gain and Phase Match Between Amplifiers
- Designed To Be Interchangeable With Raytheon RC4136, RM4136, and RV4136
- Low Noise . . . 8 nV $\sqrt{\text{Hz}}$  Typ at 1 kHz

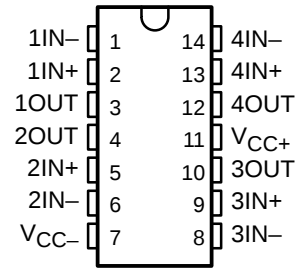
## description

The RC4136, RM4136, and RV4136 are quad general-purpose operational amplifiers, with each amplifier electrically similar to the  $\mu\text{A}741$ , except that offset null capability is not provided.

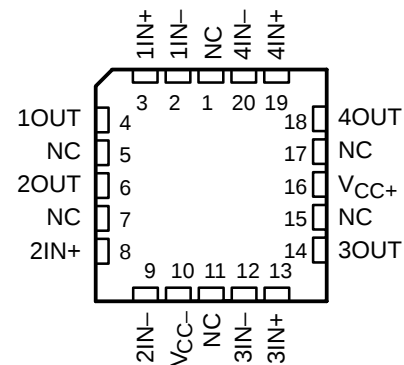
The high common-mode input voltage range and the absence of latch-up make these amplifiers ideal for voltage-follower applications. The devices are short-circuit protected and the internal frequency compensation ensures stability without external components.

The RC4136 is characterized for operation from 0°C to 70°C, the RM4136 is characterized for operation over the full military temperature range of -55°C to 125°C, and the RV4136 is characterized for operation from -40°C to 85°C.

RM4136 . . . J OR W PACKAGE  
ALL OTHERS . . . D OR N PACKAGE  
(TOP VIEW)

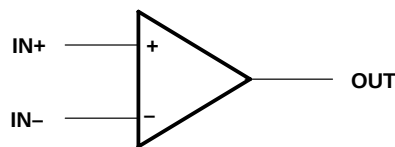


RM4136 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## symbol (each amplifier)



## AVAILABLE OPTIONS

| T <sub>A</sub> | V <sub>IO</sub> MAX<br>AT 25°C | PACKAGE              |                      |                    |                    |             |
|----------------|--------------------------------|----------------------|----------------------|--------------------|--------------------|-------------|
|                |                                | SMALL OUTLINE<br>(D) | CHIP CARRIER<br>(FK) | CERAMIC DIP<br>(J) | PLASTIC DIP<br>(N) | FLAT<br>(W) |
| 0°C to 70°C    | 6 mV                           | RC4136D              | —                    | —                  | RC4136N            | —           |
| -40°C to 85°C  | 6 mV                           | RV4136D              | —                    | —                  | RV4136N            | —           |
| -55°C to 125°C | 4 mV                           | —                    | RM4136FK             | RM4136J            | —                  | RM4136W     |

The D packages are available taped and reeled. Add the suffix R to the device type (e.g., RC4136DR).



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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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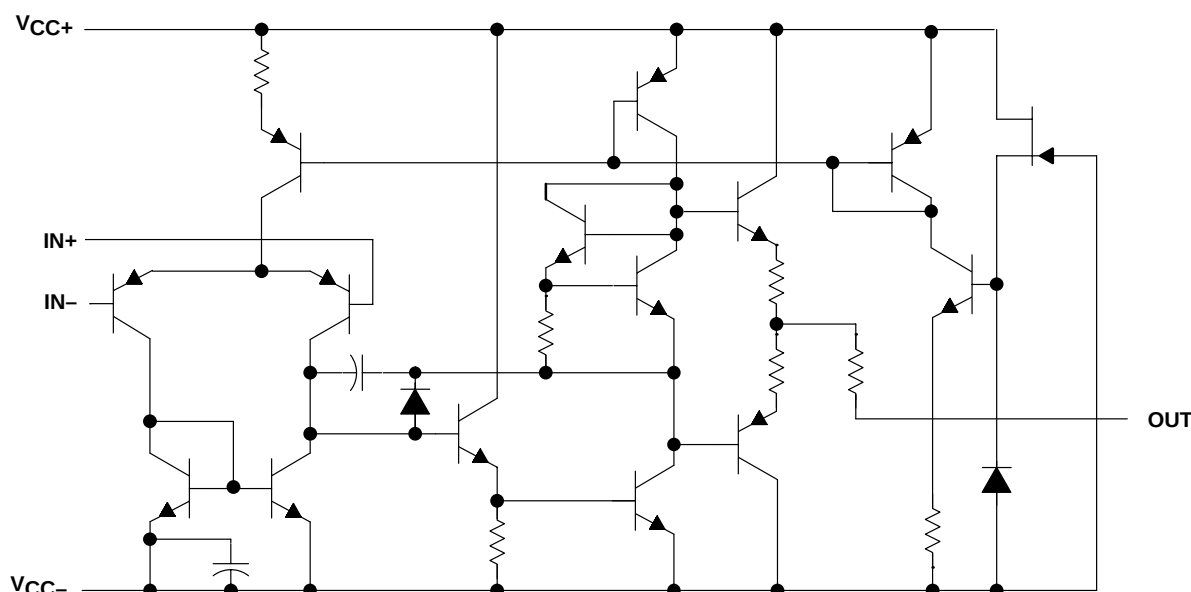
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## schematic (each amplifier)



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

|                                                                                  |                              |
|----------------------------------------------------------------------------------|------------------------------|
| Supply voltage (see Note 1): $V_{CC+}$ , RC4136 and RV4136                       | 18 V                         |
| $V_{CC+}$ , RM4136                                                               | 22 V                         |
| $V_{CC-}$ , RC4136 and RV4136                                                    | -18 V                        |
| $V_{CC-}$ , RM4136                                                               | -22 V                        |
| Differential input voltage, $V_{ID}$ (see Note 2)                                | $\pm 30$ V                   |
| Input voltage, $V_I$ (any input) (see Notes 1 and 3)                             | $\pm 15$ V                   |
| Duration of output short circuit to ground, one amplifier at a time (see Note 4) | Unlimited                    |
| Continuous total dissipation                                                     | See Dissipation Rating Table |
| Package thermal impedance, $\theta_{JA}$ (see Note 5): D package                 | 86°C/W                       |
| N package                                                                        | 80°C/W                       |
| Case temperature for 60 seconds: FK package                                      | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or N package     | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J or W package     | 300°C                        |
| Storage temperature range, $T_{stg}$                                             | -65°C to 150°C               |

<sup>†</sup> 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, unless otherwise noted, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .

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

3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.

4. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

5. The package thermal impedance is calculated in accordance with JESD 51-7.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING<br>FACTOR | DERATE<br>ABOVE $T_A$ | $T_A = 70^\circ\text{C}$<br>POWER RATING | $T_A = 85^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|--------------------|-----------------------|------------------------------------------|------------------------------------------|-------------------------------------------|
| FK      | 800 mW                                      | 11.0 mW/°C         | 77°C                  | 800 mW                                   | 715 mW                                   | 275 mW                                    |
| J       | 800 mW                                      | 11.0 mW/°C         | 77°C                  | 800 mW                                   | 715 mW                                   | 275 mW                                    |
| W       | 800 mW                                      | 8.0 mW/°C          | 50°C                  | 640 mW                                   | 520 mW                                   | 200 mW                                    |



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### recommended operating conditions

|                          | MIN | MAX | UNIT |
|--------------------------|-----|-----|------|
| $V_{CC+}$ Supply voltage | 5   | 15  | V    |
| $V_{CC-}$ Supply voltage | -5  | -15 | V    |

### electrical characteristics at specified free-air temperature, $V_{CC+} = 15\text{ V}$ , $V_{CC-} = -15\text{ V}$

| PARAMETER                                                              | TEST CONDITIONS†                                                                              |            | RC4136 |     |      | RM4136 |     |      | RV4136 |     |      | UNIT   |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------|--------|-----|------|--------|-----|------|--------|-----|------|--------|
|                                                                        |                                                                                               |            | MIN    | TYP | MAX  | MIN    | TYP | MAX  | MIN    | TYP | MAX  |        |
| $V_{IL}$ Input offset voltage                                          | $V_O = 0$                                                                                     | 25°C       |        | 0.5 | 6    |        | 0.5 | 4    |        | 0.5 | 6    | mV     |
|                                                                        |                                                                                               | Full range |        |     | 7.5  |        |     | 6    |        |     | 7.5  |        |
| $I_{IO}$ Input offset current                                          | $V_O = 0$                                                                                     | 25°C       |        | 5   | 200  |        | 5   | 150  |        | 5   | 200  | nA     |
|                                                                        |                                                                                               | Full range |        |     | 300  |        |     | 500  |        |     | 500  |        |
| $I_{IB}$ Input bias current                                            | $V_O = 0$                                                                                     | 25°C       |        | 140 | 500  |        | 140 | 400  |        | 140 | 500  | nA     |
|                                                                        |                                                                                               | Full range |        |     | 800  |        |     | 1500 |        |     | 1500 |        |
| $V_i$ Input voltage range                                              |                                                                                               | 25°C       | ±12    | ±14 |      | ±12    | ±14 |      | ±12    | ±14 |      | V      |
| $V_{OM}$ Maximum peak output voltage swing                             | $R_L = 10\text{ k}\Omega$                                                                     | 25°C       | ±12    | ±14 |      | ±12    | ±14 |      | ±12    | ±14 |      | V      |
|                                                                        | $R_L = 2\text{ k}\Omega$                                                                      | 25°C       | ±10    | ±13 |      | ±10    | ±13 |      | ±10    | ±13 |      |        |
|                                                                        | $R_L \geq 2\text{ k}\Omega$                                                                   | Full range | ±10    |     |      | ±10    |     |      | ±10    |     |      |        |
| $A_{VD}$ Large-signal differential voltage amplification               | $V_O = \pm 10\text{ V}$ ,<br>$R_L \geq 2\text{ k}\Omega$                                      | 25°C       | 20     | 300 |      | 50     | 350 |      | 20     | 300 |      | V/mV   |
|                                                                        |                                                                                               | Full range | 15     |     |      | 25     |     |      | 15     |     |      |        |
| $B_1$ Unity-gain bandwidth                                             |                                                                                               | 25°C       |        | 3   |      |        | 3.5 |      |        | 3   |      | MHz    |
| $r_i$ Input resistance                                                 |                                                                                               | 25°C       | 0.3*   | 5   |      | 0.3*   | 5   |      | 0.3*   | 5   |      | MΩ     |
| CMRR Common-mode rejection ratio                                       | $V_O = 0$ , $R_S = 50\text{ }\Omega$                                                          | 25°C       | 70     | 90  |      | 70     | 90  |      | 70     | 90  |      | dB     |
| $k_{SVS}$ Supply-voltage sensitivity ( $\Delta V_{IO}/\Delta V_{CC}$ ) | $V_{CC} = \pm 9\text{ V}$ to $\pm 15\text{ V}$ ,<br>$V_O = 0$                                 | 25°C       |        | 30  | 150  |        | 30  | 150  |        | 30  | 150  | μV/V   |
| $V_n$ Equivalent input noise voltage (closed loop)                     | $A_{VD} = 100$ ,<br>$BW = 1\text{ Hz}$ ,<br>$f = 1\text{ kHz}$ ,<br>$R_S = 100\text{ }\Omega$ | 25°C       |        | 8   |      |        | 8   |      |        | 8   |      | nV/√Hz |
| $I_{CC}$ Supply current (all four amplifiers)                          | $V_O = 0$ , No load                                                                           | 25°C       |        | 5   | 11.3 |        | 5   | 11.3 |        | 5   | 11.3 | mA     |
|                                                                        |                                                                                               | MIN $T_A$  |        | 6   | 13.7 |        | 6   | 13.3 |        | 6   | 13.7 |        |
|                                                                        |                                                                                               | MAX $T_A$  |        | 4.5 | 10   |        | 4.5 | 10   |        | 4.5 | 10   |        |
| $P_D$ Total power dissipation (all four amplifiers)                    | $V_O = 0$ , No load                                                                           | 25°C       |        | 150 | 340  |        | 150 | 340  |        | 150 | 340  | mW     |
|                                                                        |                                                                                               | MIN $T_A$  |        | 180 | 400  |        | 180 | 400  |        | 180 | 400  |        |
|                                                                        |                                                                                               | MAX $T_A$  |        | 135 | 300  |        | 135 | 300  |        | 135 | 300  |        |
| Crosstalk attenuation ( $V_{O1}/V_{O2}$ )                              | $A_{VD} = 100$ ,<br>$f = 10\text{ kHz}$ ,<br>$R_S = 1\text{ k}\Omega$                         | 25°C       |        | 105 |      |        | 105 |      |        | 105 |      | dB     |

\* This parameter is not production tested.

† All characteristics are measured under open-loop conditions with zero common-mode input voltage, unless otherwise specified. Full range is 0°C to 70°C for RC4136, -55°C to 125°C for RM4136, and -40°C to 85°C for RV4136. Minimum  $T_A$  is 0°C for RC4136, -55°C for RM4136, and -40°C for RV4136. Maximum  $T_A$  is 70°C for RC4136, 125°C for RM4136, and 85°C for RV4136.



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operating characteristics,  $V_{CC+} = 15\text{ V}$ ,  $V_{CC-} = -15\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER |                         | TEST CONDITIONS                                                         | TYP  | UNIT                   |
|-----------|-------------------------|-------------------------------------------------------------------------|------|------------------------|
| $t_r$     | Rise time               | $V_I = 20\text{ mV}$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ | 0.13 | $\mu\text{s}$          |
|           | Overshoot factor        | $V_I = 20\text{ mV}$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ | 5    | %                      |
| SR        | Slew rate at unity gain | $V_I = 10\text{ V}$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$  | 1.7  | $\text{V}/\mu\text{s}$ |



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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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| RC4136D          | OBSOLETE              | SOIC         | D               | 14   |             | TBD                     | Call TI          | Call TI                      |
| RC4136DR         | OBSOLETE              | SOIC         | D               | 14   |             | TBD                     | Call TI          | Call TI                      |
| RC4136N          | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| RC4136NE4        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| RV4136N          | OBSOLETE              | PDIP         | N               | 14   |             | TBD                     | Call TI          | Call TI                      |

<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.

<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.

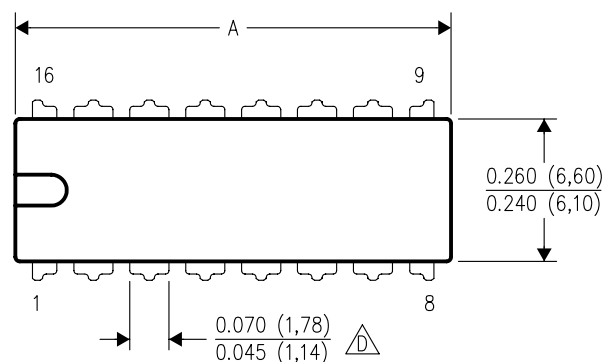
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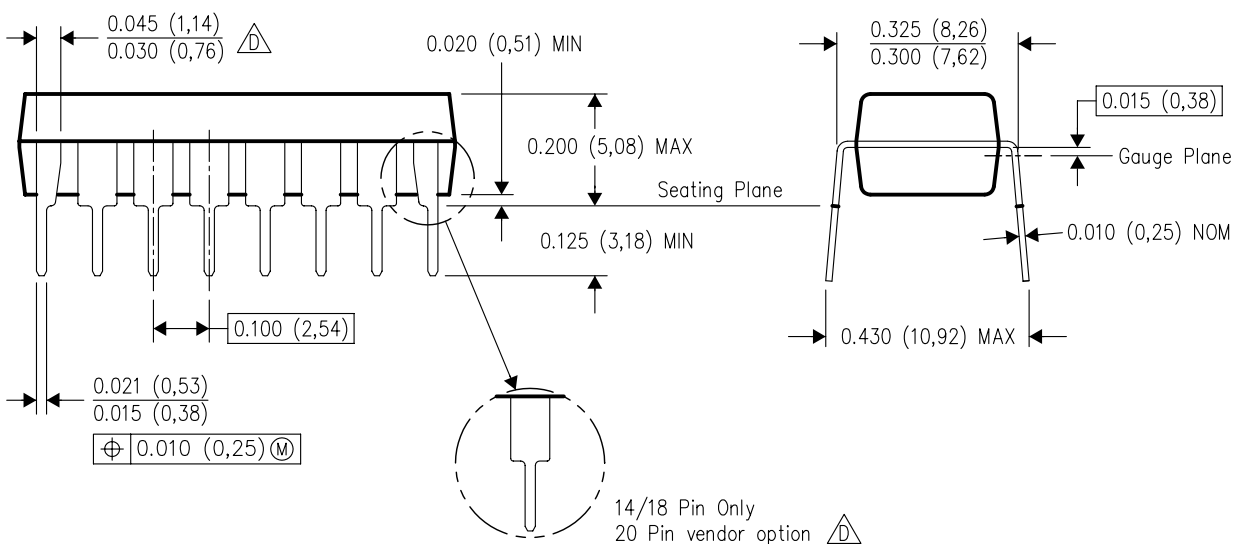
N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



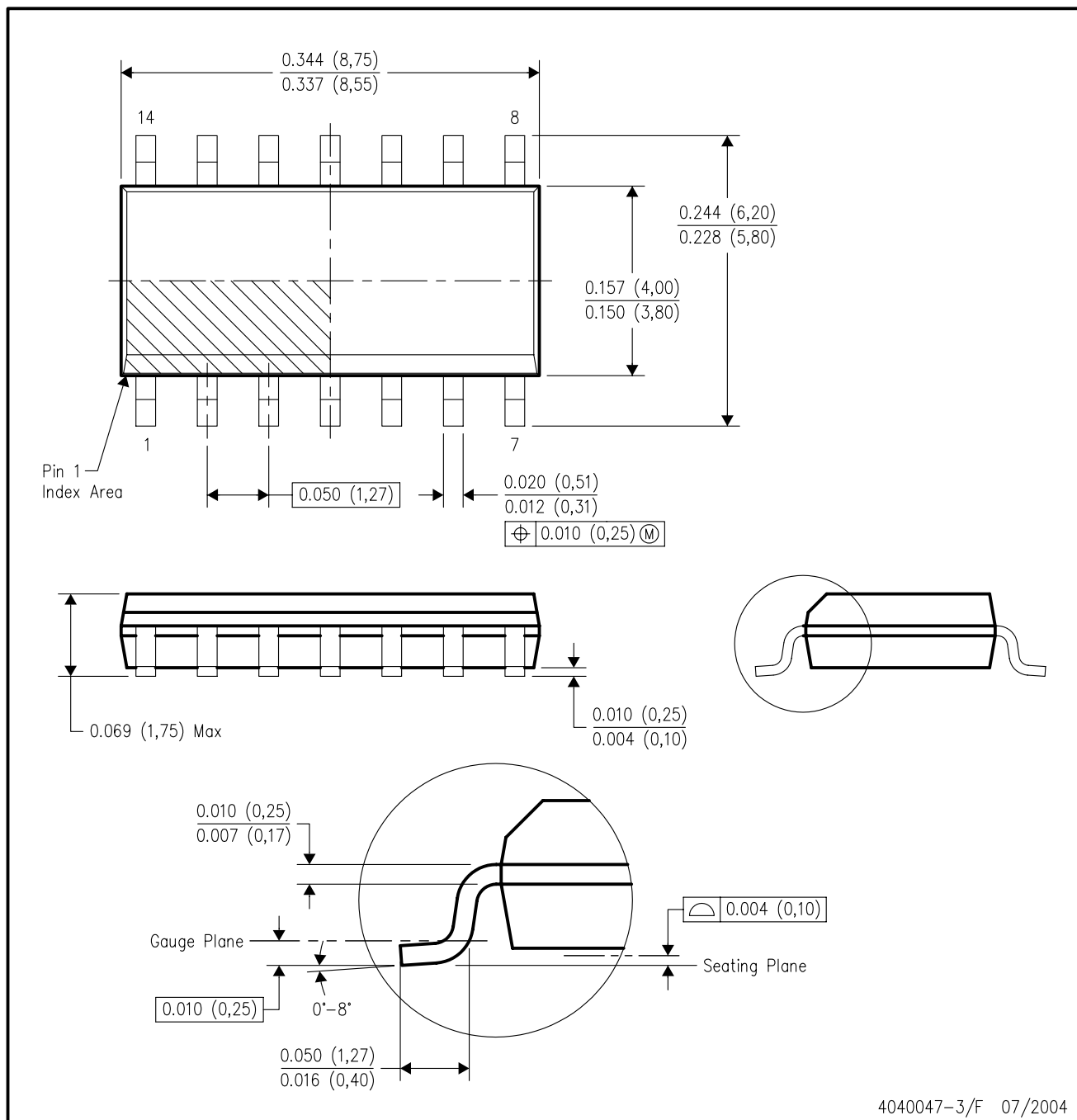
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NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

## D (R-PDSO-G14)

## PLASTIC SMALL-OUTLINE PACKAGE



4040047-3/F 07/2004

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| Microcontrollers | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> | Security            | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
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