

# LMV341-N/LMV342-N/LMV344-N Single with Shutdown/Dual/Quad General Purpose, 2.7V, Rail-to-Rail Output, 125°C, Operational Amplifiers

Check for Samples: [LMV341-N](#), [LMV342-N](#), [LMV344-N](#)

## FEATURES

(Typical 2.7V Supply Values; Unless Otherwise Noted)

- **Ensured 2.7V and 5V Specifications**
- **Input Referred Voltage Noise (@ 10kHz)** 29nV/ $\sqrt{\text{Hz}}$
- **Supply Current (per Amplifier)** 100 $\mu\text{A}$
- **Gain Bandwidth Product** 1.0MHz
- **Slew Rate** 1.0V/ $\mu\text{s}$
- **Shutdown Current (LMV341-N)** 45pA
- **Turn-On Time from Shutdown (LMV341-N)** 5 $\mu\text{s}$
- **Input Bias Current** 20fA

## APPLICATIONS

- **Cordless/Cellular Phones**
- **Laptops**
- **PDAs**
- **PCMCIA/Audio**
- **Portable/Battery-Powered Electronic Equipment**
- **Supply Current Monitoring**
- **Battery Monitoring**
- **Buffer**
- **Filter**
- **Driver**

## DESCRIPTION

The LMV341-N/LMV342-N/LMV344-N are single, dual, and quad low voltage, low power Operational Amplifiers. They are designed specifically for low voltage portable applications. Other important product characteristics are low input bias current, rail-to-rail output, and wide temperature range.

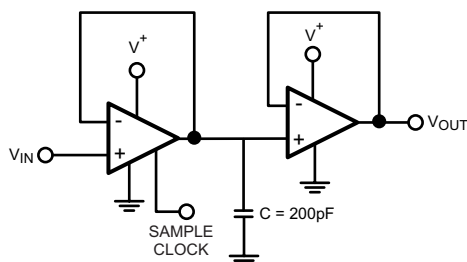
The patented class AB turnaround stage significantly reduces the noise at higher frequencies, power consumption, and offset voltage. The PMOS input stage provides the user with ultra-low input bias current of 20fA (typical) and high input impedance.

The industrial-plus temperature range of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  allows the LMV341-N/LMV342-N/LMV344-N to accommodate a broad range of extended environment applications. LMV341-N expands Texas Instrument's Silicon Dust amplifier portfolio offering enhancements in size, speed, and power savings. The LMV341-N/LMV342-N/LMV344-N are specified to operate over the voltage range of 2.7V to 5.5V and all have rail-to-rail output.

The LMV341-N offers a shutdown pin that can be used to disable the device. Once in shutdown mode, the supply current is reduced to 45pA (typical). The LMV341-N/LMV342-N/LMV344-N have 29nV Voltage Noise at 10kHz, 1MHz GBW, 1.0V/ $\mu\text{s}$  Slew Rate, 0.25mVos, and 0.1 $\mu\text{A}$  shutdown current (LMV341-N.)

The LMV341-N is offered in the tiny 6-Pin SC70 package, the LMV342-N in space saving 8-Pin VSSOP and SOIC, and the LMV344-N in 14-Pin TSSOP and SOIC. These small package amplifiers offer an ideal solution for applications requiring minimum PC board footprint. Applications with area constrained PC board requirements include portable electronics such as cellular handsets and PDAs.

## Sample and Hold Circuit



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings<sup>(1)(2)</sup>

|                                                  |                                           |       |
|--------------------------------------------------|-------------------------------------------|-------|
| ESD Tolerance <sup>(3)</sup>                     | Machine Model                             | 200V  |
|                                                  | Human Body Model                          | 2000V |
| Differential Input Voltage                       | ± Supply Voltage                          |       |
| Supply Voltage (V <sup>+</sup> -V <sup>-</sup> ) | 6.0V                                      |       |
| Output Short Circuit to V <sup>+</sup>           | See <sup>(4)</sup>                        |       |
| Output Short Circuit to V <sup>-</sup>           | See <sup>(5)</sup>                        |       |
| Storage Temperature Range                        | -65°C to 150°C                            |       |
| Junction Temperature <sup>(6)</sup>              | 150°C                                     |       |
| Mounting Temperature                             | Infrared or Convection Reflow (20 sec.)   | 235°C |
|                                                  | Wave Soldering Lead Temperature (10 sec.) | 260°C |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (3) Human Body Model, applicable std. MIL-STD-883, Method 3015.7. Machine Model, applicable std. JESD22-A115-A (ESD MM std. of JEDEC)Field-Induced Charge-Device Model, applicable std. JESD22-C101-C (ESD FICDM std. of JEDEC).
- (4) Shorting output to V<sup>+</sup> will adversely affect reliability.
- (5) Shorting output to V<sup>-</sup> will adversely affect reliability.
- (6) The maximum power dissipation is a function of T<sub>J(MAX)</sub>, θ<sub>JA</sub>. The maximum allowable power dissipation at any ambient temperature is P<sub>D</sub> = (T<sub>J(MAX)</sub> - T<sub>A</sub>) / θ<sub>JA</sub>. All numbers apply for packages soldered directly onto a PC Board.

## Operating Ratings<sup>(1)</sup>

|                                       |                |         |
|---------------------------------------|----------------|---------|
| Supply Voltage                        | 2.7V to 5.5V   |         |
| Temperature Range                     | -40°C to 125°C |         |
| Thermal Resistance (θ <sub>JA</sub> ) | 6-Pin SC70     | 414°C/W |
|                                       | 8-Pin SOIC     | 190°C/W |
|                                       | 8-Pin VSSOP    | 235°C/W |
|                                       | 14-Pin TSSOP   | 155°C/W |
|                                       | 14-Pin SOIC    | 145°C/W |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.

## 2.7V DC Electrical Characteristics<sup>(1)</sup>

Unless otherwise specified, all limits specified for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{CM} = V^+/2$ ,  $V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$ .

**Boldface** limits apply at the temperature extremes.

| Symbol     | Parameter                          | Conditions                                                                           | Min<br>(2)      | Typ<br>(3)             | Max<br>(2)                                            | Units                        |
|------------|------------------------------------|--------------------------------------------------------------------------------------|-----------------|------------------------|-------------------------------------------------------|------------------------------|
| $V_{OS}$   | Input Offset Voltage               | LMV341-N                                                                             |                 | 0.25                   | 4<br><b>4.5</b>                                       | mV                           |
|            |                                    | LMV342-N/LMV344-N                                                                    |                 | 0.55                   | 5<br><b>5.5</b>                                       |                              |
| $TCV_{OS}$ | Input Offset Voltage Average Drift |                                                                                      |                 | 1.7                    |                                                       | $\mu\text{V}/^\circ\text{C}$ |
| $I_B$      | Input Bias Current                 |                                                                                      |                 | 0.02                   | 120<br><b>250</b>                                     | pA                           |
| $I_{OS}$   | Input Offset Current               |                                                                                      |                 | 6.6                    |                                                       | fA                           |
| $I_S$      | Supply Current                     | Per Amplifier                                                                        |                 | 100                    | 170<br><b>230</b>                                     | $\mu\text{A}$                |
|            |                                    | Shutdown Mode, $V_{SD} = 0\text{V}$ (LMV341-N)                                       |                 | 45pA                   | 1 $\mu\text{A}$<br><b>1.5<math>\mu\text{A}</math></b> |                              |
| CMRR       | Common Mode Rejection Ratio        | $0\text{V} \leq V_{CM} \leq 1.7\text{V}$<br>$0\text{V} \leq V_{CM} \leq 1.6\text{V}$ | 56<br><b>50</b> | 80                     |                                                       | dB                           |
| PSRR       | Power Supply Rejection Ratio       | $2.7\text{V} \leq V^+ \leq 5\text{V}$                                                | 65<br><b>60</b> | 82                     |                                                       | dB                           |
| $V_{CM}$   | Input Common Mode Voltage          | For CMRR $\geq 50\text{dB}$                                                          | 0               | -0.2 to 1.9<br>(Range) | 1.7                                                   | V                            |
| $A_V$      | Large Signal Voltage Gain          | $R_L = 10\text{k}\Omega$ to 1.35V                                                    | 78<br><b>70</b> | 113                    |                                                       | dB                           |
|            |                                    | $R_L = 2\text{k}\Omega$ to 1.35V                                                     | 72<br><b>64</b> | 103                    |                                                       |                              |
| $V_O$      | Output Swing                       | $R_L = 2\text{k}\Omega$ to 1.35V                                                     |                 | 24                     | 60<br><b>95</b>                                       | mV                           |
|            |                                    |                                                                                      | 60<br><b>95</b> | 26                     |                                                       |                              |
|            |                                    | $R_L = 10\text{k}\Omega$ to 1.35V                                                    |                 | 5.0                    | 30<br><b>40</b>                                       |                              |
|            |                                    |                                                                                      | 30<br><b>40</b> | 5.3                    |                                                       |                              |
| $I_O$      | Output Short Circuit Current       | Sourcing<br>LMV341-N/LMV342-N                                                        | 20              | 32                     |                                                       | mA                           |
|            |                                    | Sourcing<br>LMV344-N                                                                 | 18              | 24                     |                                                       |                              |
|            |                                    | Sinking                                                                              | 15              | 24                     |                                                       |                              |
| $t_{on}$   | Turn-on Time from Shutdown         | (LMV341-N)                                                                           |                 | 5                      |                                                       | $\mu\text{s}$                |
| $V_{SD}$   | Shutdown Pin Voltage Range         | ON Mode (LMV341-N)                                                                   |                 | 1.7 to 2.7             | 2.4 to 2.7                                            | V                            |
|            |                                    | Shutdown Mode (LMV341-N)                                                             |                 | 0 to 1                 | 0 to 0.8                                              |                              |

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No specification of parametric performance is indicated in the electrical tables under conditions of internal self heating where  $T_J > T_A$ .
- (2) All limits are specified by testing or statistical analysis.
- (3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.

## 2.7V AC Electrical Characteristics<sup>(1)</sup>

Unless otherwise specified, all limits specified for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V^+/2$ ,  $V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$ .

**Boldface** limits apply at the temperature extremes.

| Symbol   | Parameter                    | Conditions                                                                                    | Min<br>(2) | Typ<br>(3) | Max<br>(2) | Units                  |
|----------|------------------------------|-----------------------------------------------------------------------------------------------|------------|------------|------------|------------------------|
| SR       | Slew Rate                    | $R_L = 10\text{k}\Omega$ <sup>(4)</sup>                                                       |            | 1.0        |            | V/ $\mu\text{s}$       |
| GBW      | Gain Bandwidth Product       | $R_L = 100\text{k}\Omega$ , $C_L = 200\text{pF}$                                              |            | 1.0        |            | MHz                    |
| $\Phi_m$ | Phase Margin                 | $R_L = 100\text{k}\Omega$                                                                     |            | 72         |            | deg                    |
| $G_m$    | Gain Margin                  | $R_L = 100\text{k}\Omega$                                                                     |            | 20         |            | dB                     |
| $e_n$    | Input-Referred Voltage Noise | $f = 1\text{kHz}$                                                                             |            | 40         |            | nV/ $\sqrt{\text{Hz}}$ |
| $i_n$    | Input-Referred Current Noise | $f = 1\text{kHz}$                                                                             |            | 0.001      |            | pA/ $\sqrt{\text{Hz}}$ |
| THD      | Total Harmonic Distortion    | $f = 1\text{kHz}$ , $A_V = +1$<br>$R_L = 600\Omega$ , $V_{\text{IN}} = 1\text{V}_{\text{PP}}$ |            | 0.017      |            | %                      |

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No specification of parametric performance is indicated in the electrical tables under conditions of internal self heating where  $T_J > T_A$ .
- (2) All limits are specified by testing or statistical analysis.
- (3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.
- (4) Connected as voltage follower with  $2\text{V}_{\text{PP}}$  step input. Number specified is the slower of the positive and negative slew rates.

## 5V DC Electrical Characteristics<sup>(1)</sup>

Unless otherwise specified, all limits specified for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V^+/2$ ,  $V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$ .

**Boldface** limits apply at the temperature extremes.

| Symbol                   | Parameter                                | Conditions                                                                                         | Min<br>(2)      | Typ<br>(3)             | Max<br>(2)        | Units                        |
|--------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------|------------------------|-------------------|------------------------------|
| $V_{\text{OS}}$          | Input Offset Voltage                     | LMV341-N                                                                                           |                 | 0.025                  | 4<br><b>4.5</b>   | mV                           |
|                          |                                          | LMV342-N/LMV344-N                                                                                  |                 | 0.70                   | 5<br><b>5.5</b>   |                              |
| $\text{TCV}_{\text{OS}}$ | Input Offset Voltage Average Drift       |                                                                                                    |                 | 1.9                    |                   | $\mu\text{V}/^\circ\text{C}$ |
| $I_B$                    | Input Bias Current                       |                                                                                                    |                 | 0.02                   | 200<br><b>375</b> | pA                           |
| $I_{\text{OS}}$          | Input Offset Current                     |                                                                                                    |                 | 6.6                    |                   | fA                           |
| $I_S$                    | Supply Current                           | Per Amplifier                                                                                      |                 | 107                    | 200<br><b>260</b> | $\mu\text{A}$                |
|                          |                                          | Shutdown Mode, $V_{\text{SD}} = 0\text{V}$ (LMV341-N)                                              |                 | 0.033                  | 1<br><b>1.5</b>   | $\mu\text{A}$                |
| CMRR                     | Common Mode Rejection Ratio              | $0\text{V} \leq V_{\text{CM}} \leq 4.0\text{V}$<br>$0\text{V} \leq V_{\text{CM}} \leq 3.9\text{V}$ | 56<br><b>50</b> | 86                     |                   | dB                           |
| PSRR                     | Power Supply Rejection Ratio             | $2.7\text{V} \leq V^+ \leq 5\text{V}$                                                              | 65<br><b>60</b> | 82                     |                   | dB                           |
| $V_{\text{CM}}$          | Input Common Mode Voltage                | For CMRR $\geq 50\text{dB}$                                                                        | 0               | -0.2 to 4.2<br>(Range) | 4                 | V                            |
| $A_V$                    | Large Signal Voltage Gain <sup>(4)</sup> | $R_L = 10\text{k}\Omega$ to $2.5\text{V}$                                                          | 78<br><b>70</b> | 116                    |                   | dB                           |
|                          |                                          | $R_L = 2\text{k}\Omega$ to $2.5\text{V}$                                                           | 72<br><b>64</b> | 107                    |                   |                              |

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No specification of parametric performance is indicated in the electrical tables under conditions of internal self heating where  $T_J > T_A$ .
- (2) All limits are specified by testing or statistical analysis.
- (3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.
- (4)  $R_L$  is connected to mid-supply. The output voltage is  $\text{GND} + 0.2\text{V} \leq V_O \leq V^+ - 0.2\text{V}$

## 5V DC Electrical Characteristics<sup>(1)</sup> (continued)

Unless otherwise specified, all limits specified for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V^+/2$ ,  $V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$ .

**Boldface** limits apply at the temperature extremes.

| Symbol          | Parameter                    | Conditions                                | Min<br>(2)      | Typ<br>(3) | Max<br>(2)      | Units         |
|-----------------|------------------------------|-------------------------------------------|-----------------|------------|-----------------|---------------|
| $V_O$           | Output Swing                 | $R_L = 2\text{k}\Omega$ to $2.5\text{V}$  |                 | 32         | 60<br><b>95</b> | mV            |
|                 |                              |                                           | 60<br><b>95</b> | 34         |                 |               |
|                 |                              | $R_L = 10\text{k}\Omega$ to $2.5\text{V}$ |                 | 7          | 30<br><b>40</b> | mV            |
|                 |                              |                                           | 30<br><b>40</b> | 7          |                 |               |
| $I_O$           | Output Short Circuit Current | Sourcing                                  | 85              | 113        |                 | mA            |
|                 |                              | Sinking                                   | 50              | 75         |                 |               |
| $t_{\text{on}}$ | Turn-on Time from Shutdown   | (LMV341-N)                                |                 | 5          |                 | $\mu\text{s}$ |
| $V_{\text{SD}}$ | Shutdown Pin Voltage Range   | ON Mode (LMV341-N)                        |                 | 3.1 to 5   | 4.5 to 5.0      | V             |
|                 |                              | Shutdown Mode (LMV341-N)                  |                 | 0 to 1     | 0 to 0.8        |               |

## 5V AC Electrical Characteristics<sup>(1)</sup>

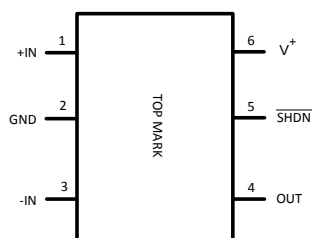
Unless otherwise specified, all limits specified for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V^+/2$ ,  $V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$ .

**Boldface** limits apply at the temperature extremes.

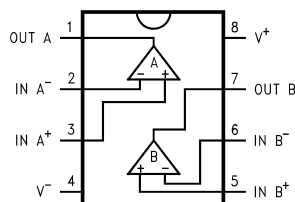
| Symbol   | Parameter                    | Conditions                                                                                    | Min<br>(2) | Typ<br>(3) | Max<br>(2) | Units                        |
|----------|------------------------------|-----------------------------------------------------------------------------------------------|------------|------------|------------|------------------------------|
| SR       | Slew Rate                    | $R_L = 10\text{k}\Omega$ <sup>(4)</sup>                                                       |            | 1.0        |            | $\text{V}/\mu\text{s}$       |
| GBW      | Gain-Bandwidth Product       | $R_L = 10\text{k}\Omega$ , $C_L = 200\text{pF}$                                               |            | 1.0        |            | MHz                          |
| $\Phi_m$ | Phase Margin                 | $R_L = 100\text{k}\Omega$                                                                     |            | 70         |            | deg                          |
| $G_m$    | Gain Margin                  | $R_L = 100\text{k}\Omega$                                                                     |            | 20         |            | dB                           |
| $e_n$    | Input-Referred Voltage Noise | $f = 1\text{kHz}$                                                                             |            | 39         |            | $\text{nV}/\sqrt{\text{Hz}}$ |
| $i_n$    | Input-Referred Current Noise | $f = 1\text{kHz}$                                                                             |            | 0.001      |            | $\text{pA}/\sqrt{\text{Hz}}$ |
| THD      | Total Harmonic Distortion    | $f = 1\text{kHz}$ , $A_V = +1$<br>$R_L = 600\Omega$ , $V_{\text{IN}} = 1\text{V}_{\text{PP}}$ |            | 0.012      |            | %                            |

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No specification of parametric performance is indicated in the electrical tables under conditions of internal self heating where  $T_J > T_A$ .
- (2) All limits are specified by testing or statistical analysis.
- (3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.
- (4) Connected as voltage follower with  $2\text{V}_{\text{PP}}$  step input. Number specified is the slower of the positive and negative slew rates.

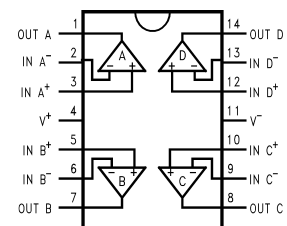
## Connection Diagram



**Figure 1. 6-Pin SC70  
Top View**



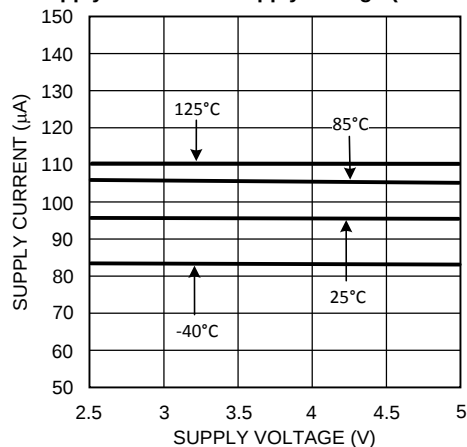
**Figure 2. 8-Pin VSSOP/SOIC  
Package Number DGK/D  
Top View**



**Figure 3. 14-Pin TSSOP/SOIC  
Package Number PW/D  
Top View**

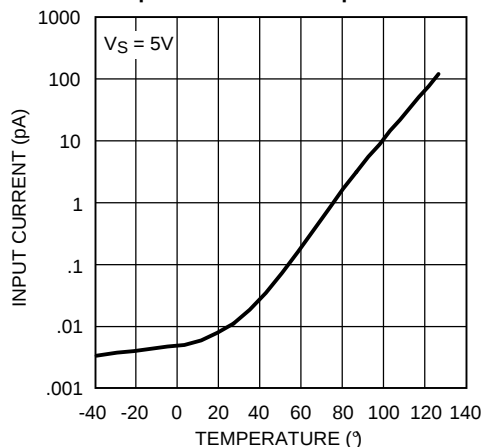
## Typical Performance Characteristics

**Supply Current vs. Supply Voltage (LMV341-N)**



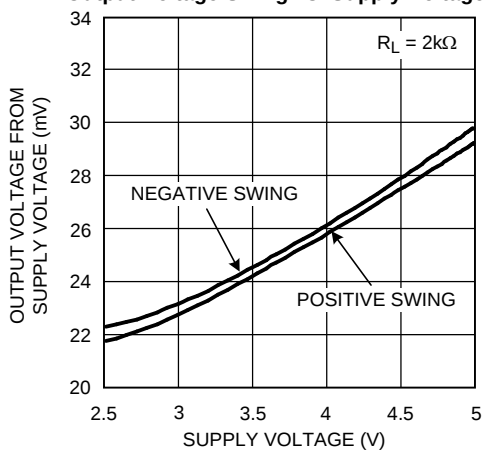
**Figure 4.**

**Input Current vs. Temperature**



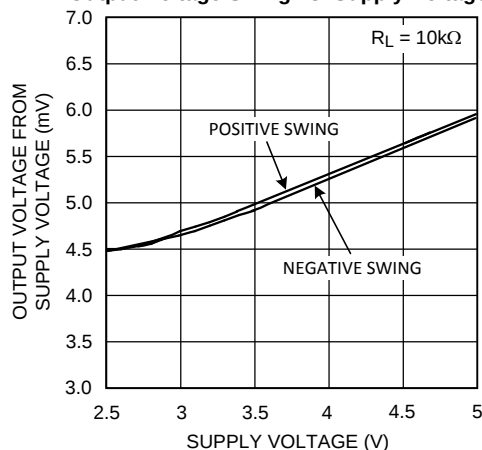
**Figure 5.**

**Output Voltage Swing vs. Supply Voltage**

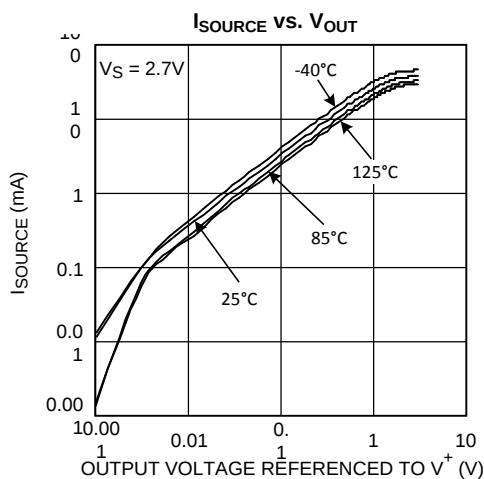


**Figure 6.**

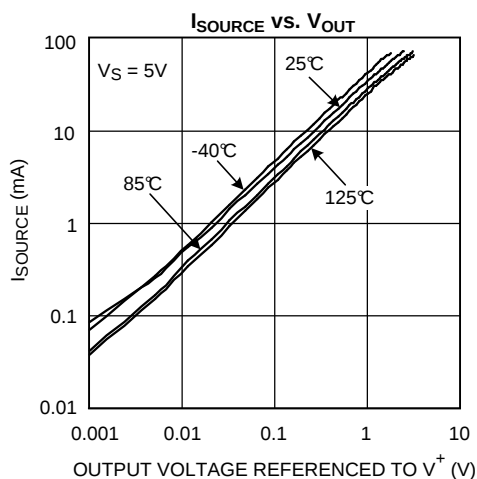
**Output Voltage Swing vs. Supply Voltage**



**Figure 7.**



**Figure 8.**



**Figure 9.**

# Typical Performance Characteristics (continued)

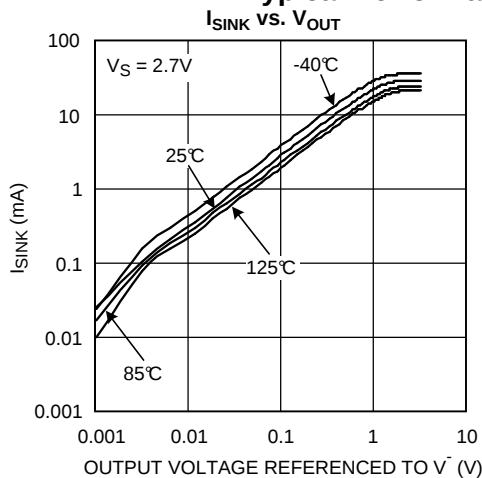


Figure 10.

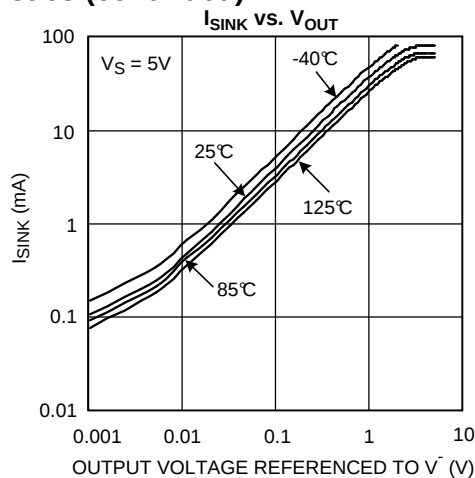


Figure 11.

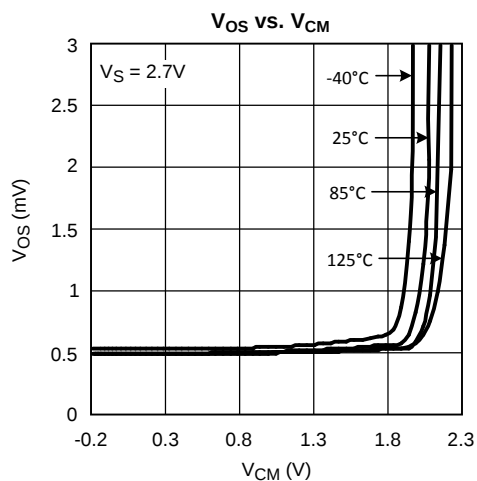


Figure 12.

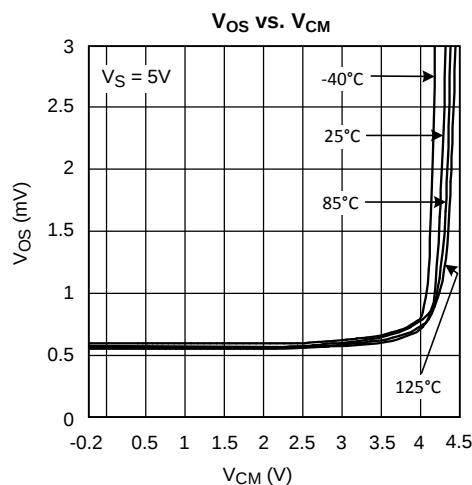


Figure 13.

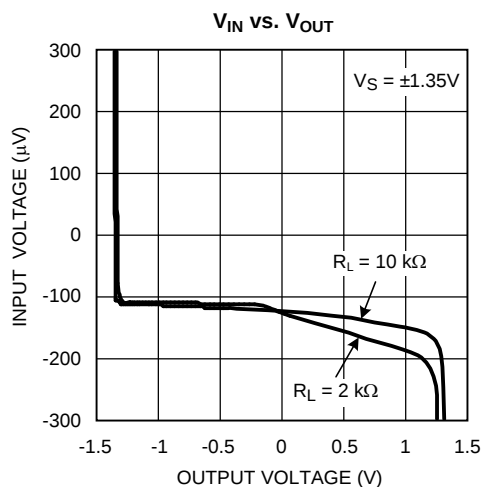


Figure 14.

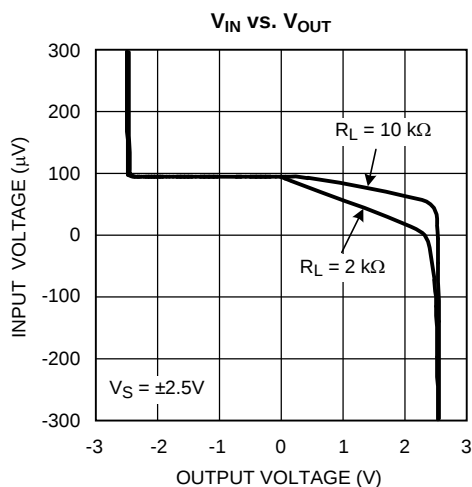


Figure 15.

## Typical Performance Characteristics (continued)

**CMRR vs. Frequency**

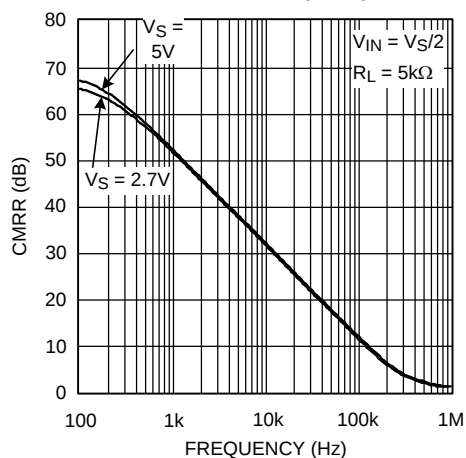


Figure 16.

**PSRR vs. Frequency**

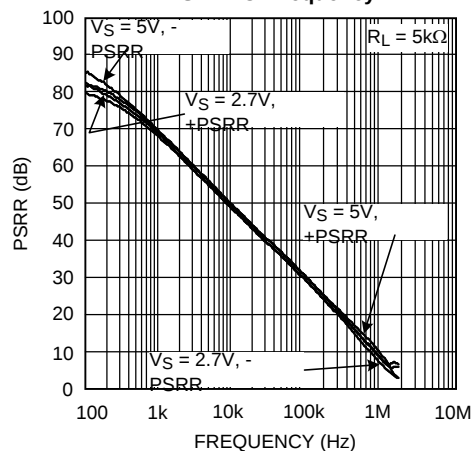


Figure 17.

**Input Voltage Noise vs. frequency**

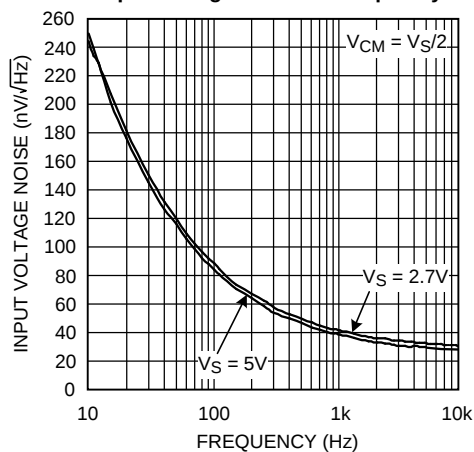


Figure 18.

**Slew Rate vs. VSUPPLY**

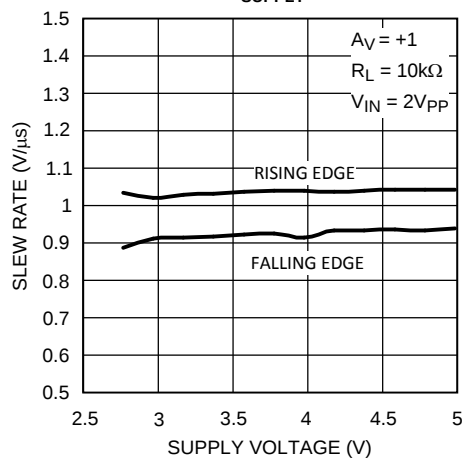


Figure 19.

**Slew Rate vs. Temperature**

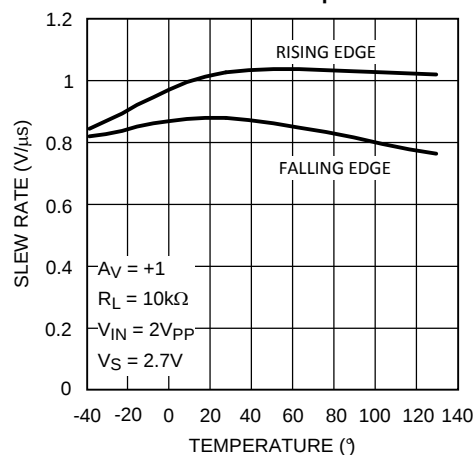


Figure 20.

**Slew Rate vs. Temperature**

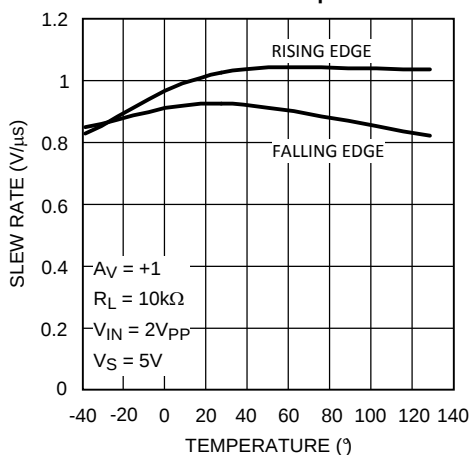


Figure 21.

## Typical Performance Characteristics (continued)

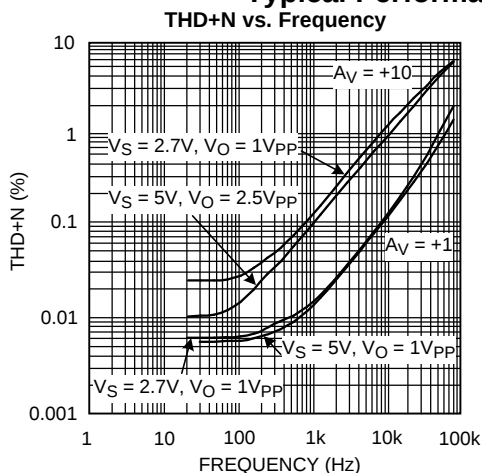


Figure 22.

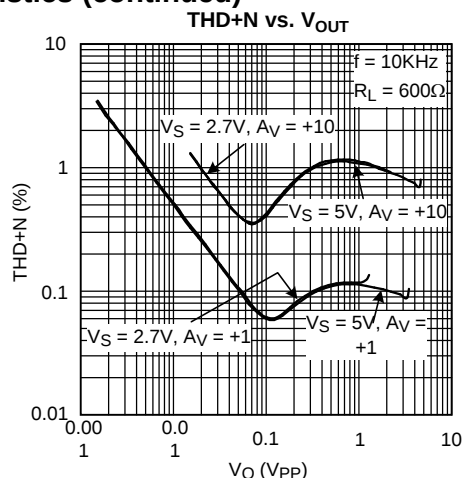


Figure 23.

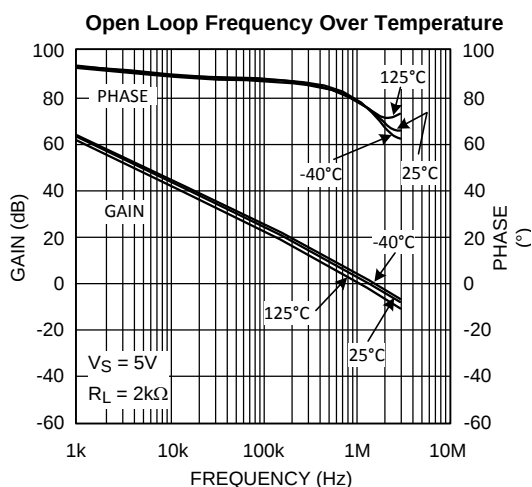


Figure 24.

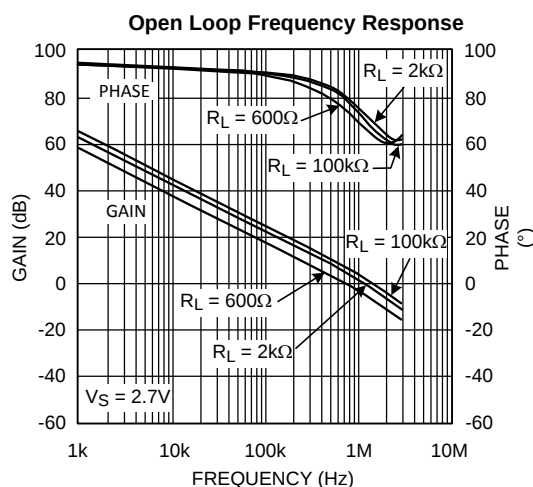


Figure 25.

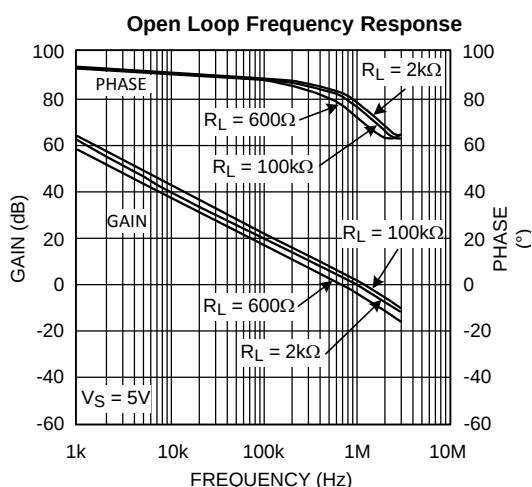


Figure 26.

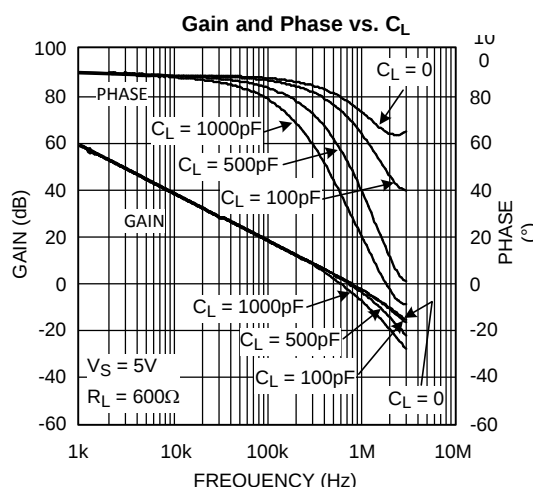


Figure 27.

## Typical Performance Characteristics (continued)

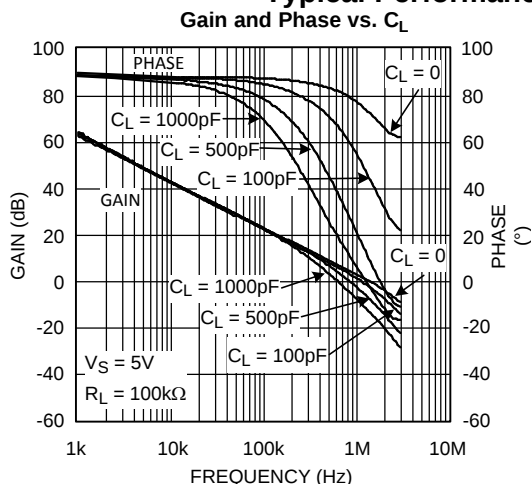


Figure 28.

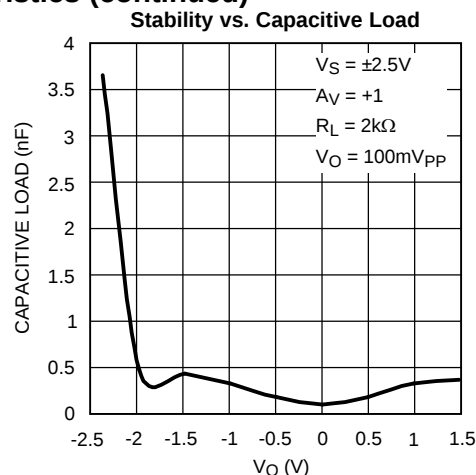


Figure 29.

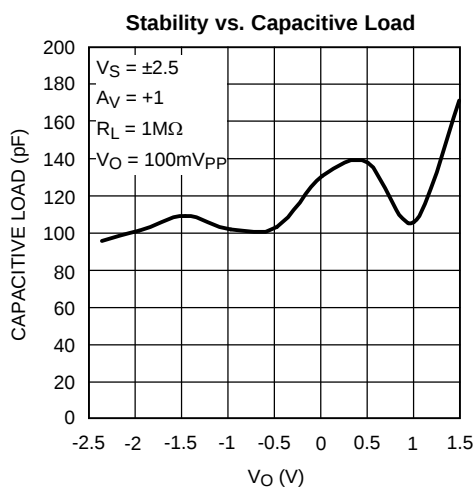


Figure 30.

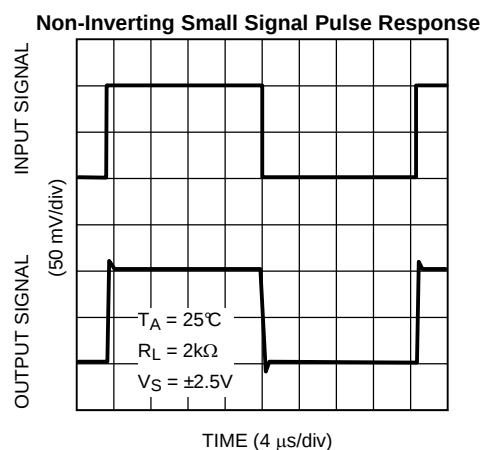


Figure 31.

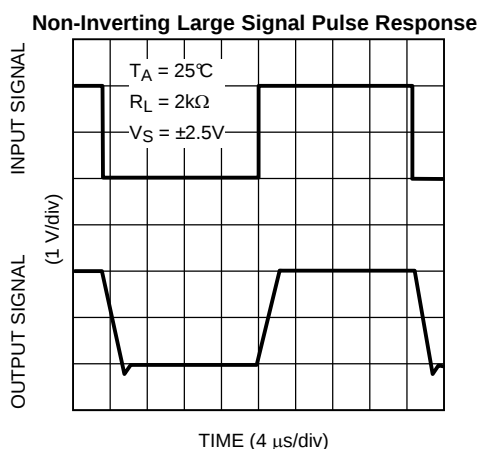


Figure 32.

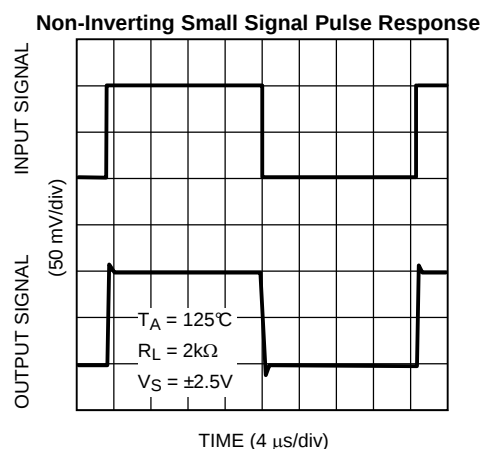
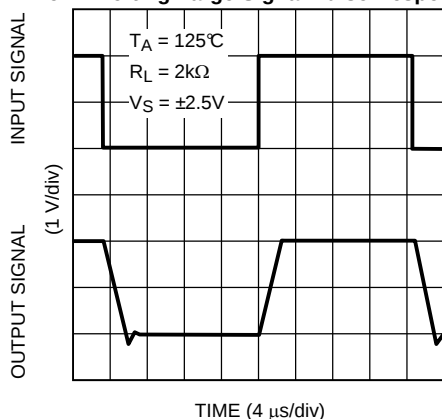


Figure 33.

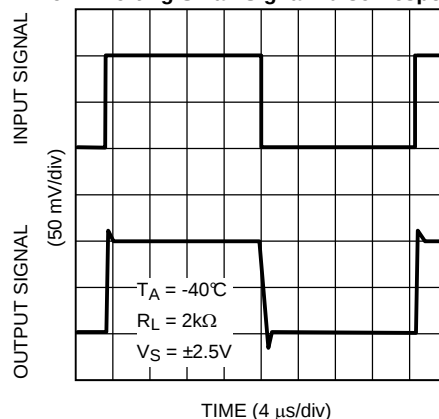
## Typical Performance Characteristics (continued)

**Non-Inverting Large Signal Pulse Response**



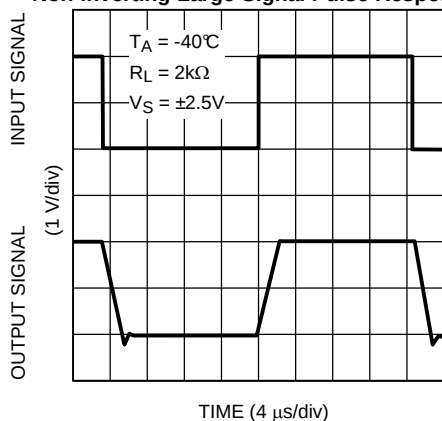
**Figure 34.**

**Non-Inverting Small Signal Pulse Response**



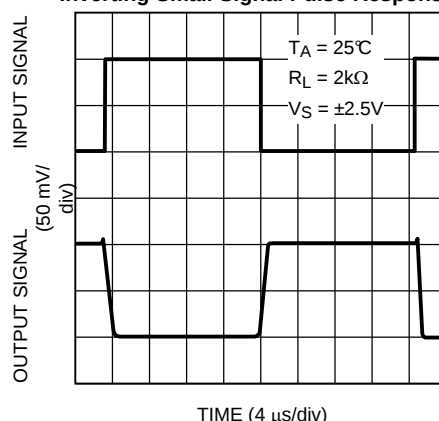
**Figure 35.**

**Non-Inverting Large Signal Pulse Response**



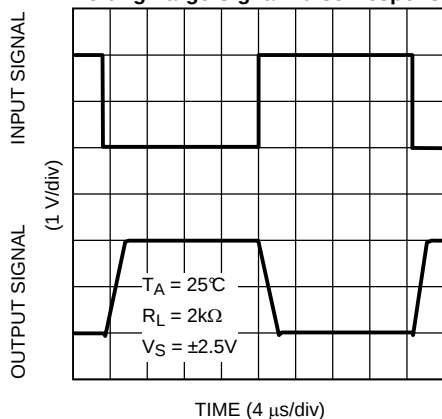
**Figure 36.**

**Inverting Small Signal Pulse Response**



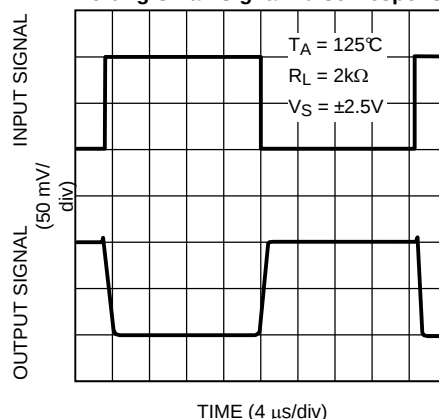
**Figure 37.**

**Inverting Large Signal Pulse Response**



**Figure 38.**

**Inverting Small Signal Pulse Response**



**Figure 39.**

## Typical Performance Characteristics (continued)

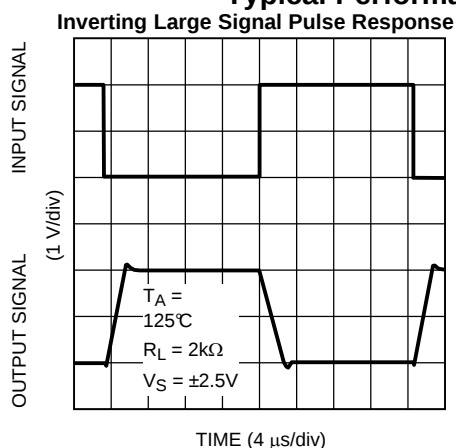


Figure 40.

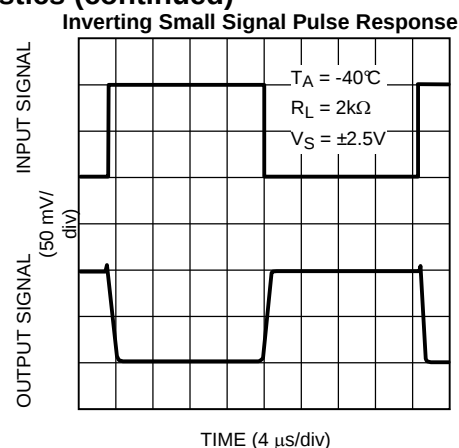


Figure 41.

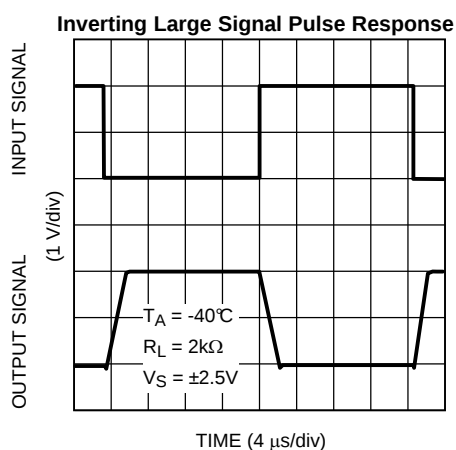


Figure 42.

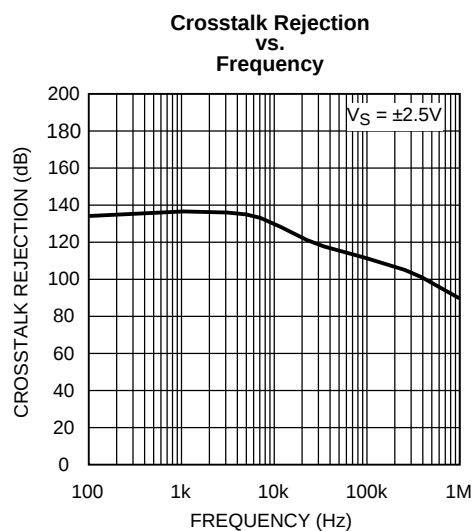


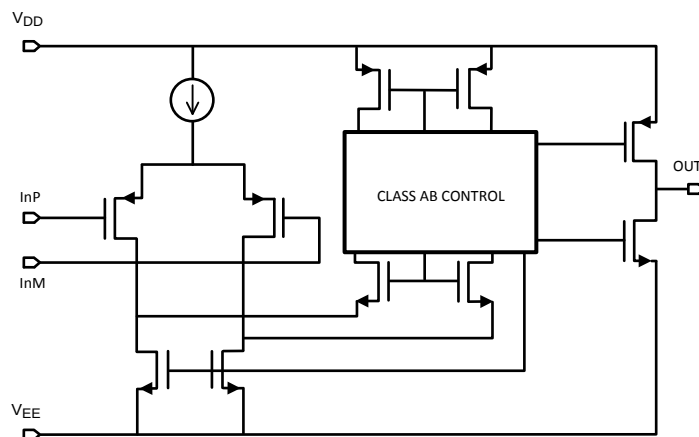
Figure 43.

## APPLICATION SECTION

### LMV341-N/LMV342-N/LMV344-N

The LMV341-N/LMV342-N/LMV344-N family of amplifiers features low voltage, low power, and rail-to-rail output operational amplifiers designed for low voltage portable applications. The family is designed using all CMOS technology. This results in an ultra low input bias current. The LMV341-N has a shutdown option, which can be used in portable devices to increase battery life.

A simplified schematic of the LMV341-N/LMV342-N/LMV344-N family of amplifiers is shown in [Figure 44](#). The PMOS input differential pair allows the input to include ground. The output of this differential pair is connected to the Class AB turnaround stage. This Class AB turnaround has a lower quiescent current, compared to regular turnaround stages. This results in lower offset, noise, and power dissipation, while slew rate equals that of a conventional turnaround stage. The output of the Class AB turnaround stage provides gate voltage to the complementary common-source transistors at the output stage. These transistors enable the device to have rail-to-rail output.



**Figure 44. Simplified Schematic**

### Class AB Turnaround Stage Amplifier

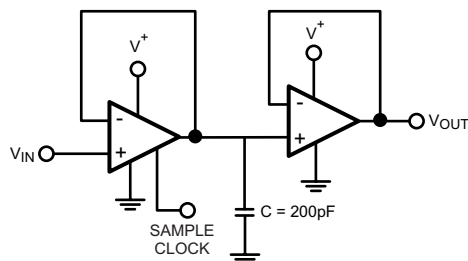
This patented folded cascode stage has a combined class AB amplifier stage, which replaces the conventional folded cascode stage. Therefore, the class AB folded cascode stage runs at a much lower quiescent current compared to conventional folded cascode stages. This results in significantly smaller offset and noise contributions. The reduced offset and noise contributions in turn reduce the offset voltage level and the voltage noise level at the input of the LMV341-N/LMV342-N/LMV344-N. Also the lower quiescent current results in a high open-loop gain for the amplifier. The lower quiescent current does not affect the slew rate of the amplifier nor its ability to handle the total current swing coming from the input stage.

The input voltage noise of the device at low frequencies, below 1kHz, is slightly higher than devices with a BJT input stage; However the PMOS input stage results in a much lower input bias current and the input voltage noise drops at frequencies above 1kHz.

### Sample and Hold Circuit

The lower input bias current of the LMV341-N results in a very high input impedance. The output impedance when the device is in shutdown mode is quite high. These high impedances, along with the ability of the shutdown pin to be derived from a separate power source, make LMV341-N a good choice for sample and hold circuits. The sample clock should be connected to the shutdown pin of the amplifier to rapidly turn the device on or off.

Figure 45 shows the schematic of a simple sample and hold circuit. When the sample clock is high the first amplifier is in normal operation mode and the second amplifier acts as a buffer. The capacitor, which appears as a load on the first amplifier, will be charging at this time. The voltage across the capacitor is that of the non-inverting input of the first amplifier since it is connected as a voltage-follower. When the sample clock is low the first amplifier is shut off, bringing the output impedance to a high value. The high impedance of this output, along with the very high impedance on the input of the second amplifier, prevents the capacitor from discharging. There is very little voltage droop while the first amplifier is in shutdown mode. The second amplifier, which is still in normal operation mode and is connected as a voltage follower, also provides the voltage sampled on the capacitor at its output.



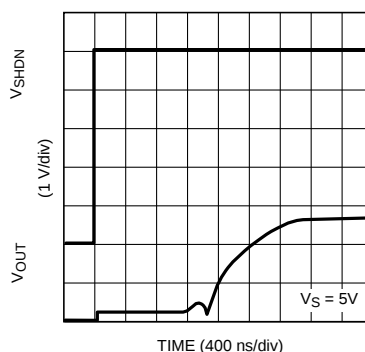
**Figure 45. Sample and Hold Circuit**

## Shutdown Feature

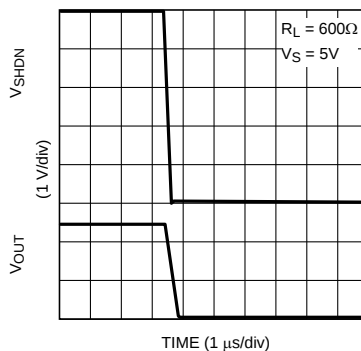
The LMV341-N is capable of being turned off in order to conserve power and increase battery life in portable devices. Once in shutdown mode the supply current is drastically reduced, 1 $\mu$ A maximum, and the output will be "tri-stated."

The device will be disabled when the shutdown pin voltage is pulled low. The shutdown pin should never be left unconnected. Leaving the pin floating will result in an undefined operation mode and the device may oscillate between shutdown and active modes.

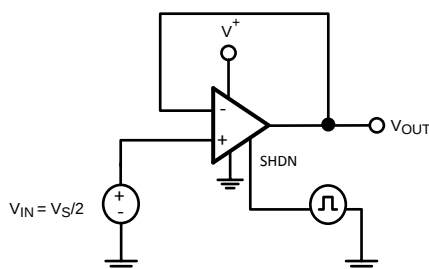
The LMV341-N typically turns on 2.8 $\mu$ s after the shutdown voltage is pulled high. The device turns off in less than 400ns after shutdown voltage is pulled low. Figure 46 and Figure 47 show the turn-on and turn-off time of the LMV341-N, respectively. In order to reduce the effect of the capacitance added to the circuit by the scope probe, in the turn-off time circuit a resistive load of 600 $\Omega$  is added. Figure 48 and Figure 49 show the test circuits used to obtain the two plots.



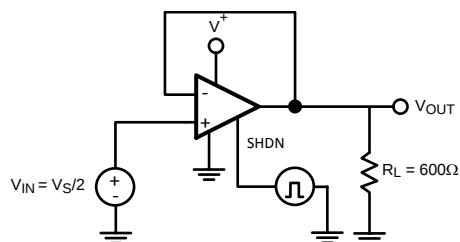
**Figure 46. Turn-on Time**



**Figure 47. Turn-off Time**



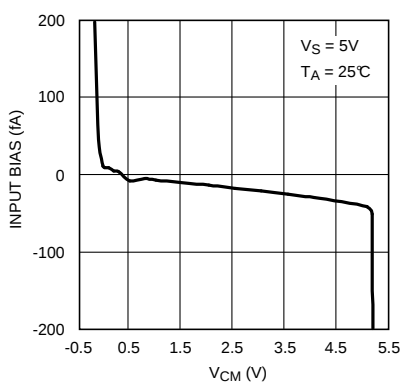
**Figure 48. Turn-on Time**



**Figure 49. Turn-off Time**

## Low Input Bias Current

The LMV341-N/LMV342-N/LMV344-N Amplifiers have a PMOS input stage. As a result, they will have a much lower input bias current than devices with BJT input stages. This feature makes these devices ideal for sensor circuits. A typical curve of the input bias current of the LMV341-N is shown in [Figure 50](#).

**Figure 50. Input Bias Current vs. V<sub>CM</sub>**

## REVISION HISTORY

### Changes from Revision F (March 2013) to Revision G

### Page

- Changed layout of National Data Sheet to TI format ..... [16](#)

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| LMV341MG         | ACTIVE        | SC70         | DCK                | 6    | 1000           | TBD                        | Call TI          | Call TI              | -40 to 125   | A78                      | <a href="#">Samples</a> |
| LMV341MG/NOPB    | ACTIVE        | SC70         | DCK                | 6    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | A78                      | <a href="#">Samples</a> |
| LMV341MGX        | ACTIVE        | SC70         | DCK                | 6    | 3000           | TBD                        | Call TI          | Call TI              | -40 to 125   | A78                      | <a href="#">Samples</a> |
| LMV341MGX/NOPB   | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | A78                      | <a href="#">Samples</a> |
| LMV342MA         | ACTIVE        | SOIC         | D                  | 8    | 95             | TBD                        | Call TI          | Call TI              | -40 to 125   | LMV34<br>2MA             | <a href="#">Samples</a> |
| LMV342MA/NOPB    | ACTIVE        | SOIC         | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LMV34<br>2MA             | <a href="#">Samples</a> |
| LMV342MAX        | ACTIVE        | SOIC         | D                  | 8    | 2500           | TBD                        | Call TI          | Call TI              | -40 to 125   | LMV34<br>2MA             | <a href="#">Samples</a> |
| LMV342MAX/NOPB   | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LMV34<br>2MA             | <a href="#">Samples</a> |
| LMV342MM         | ACTIVE        | VSSOP        | DGK                | 8    | 1000           | TBD                        | Call TI          | Call TI              | -40 to 125   | A82A                     | <a href="#">Samples</a> |
| LMV342MM/NOPB    | ACTIVE        | VSSOP        | DGK                | 8    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | A82A                     | <a href="#">Samples</a> |
| LMV342MMX        | ACTIVE        | VSSOP        | DGK                | 8    | 3500           | TBD                        | Call TI          | Call TI              | -40 to 125   | A82A                     | <a href="#">Samples</a> |
| LMV342MMX/NOPB   | ACTIVE        | VSSOP        | DGK                | 8    | 3500           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | A82A                     | <a href="#">Samples</a> |
| LMV344MA         | ACTIVE        | SOIC         | D                  | 14   | 55             | TBD                        | Call TI          | Call TI              | -40 to 125   | LMV344MA                 | <a href="#">Samples</a> |
| LMV344MA/NOPB    | ACTIVE        | SOIC         | D                  | 14   | 55             | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LMV344MA                 | <a href="#">Samples</a> |
| LMV344MAX        | ACTIVE        | SOIC         | D                  | 14   | 2500           | TBD                        | Call TI          | Call TI              | -40 to 125   | LMV344MA                 | <a href="#">Samples</a> |
| LMV344MAX/NOPB   | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LMV344MA                 | <a href="#">Samples</a> |
| LMV344MT         | ACTIVE        | TSSOP        | PW                 | 14   | 94             | TBD                        | Call TI          | Call TI              | -40 to 125   | LMV34<br>4MT             | <a href="#">Samples</a> |
| LMV344MT/NOPB    | ACTIVE        | TSSOP        | PW                 | 14   | 94             | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LMV34<br>4MT             | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| LMV344MTX        | ACTIVE        | TSSOP        | PW                 | 14   | 2500           | TBD                        | Call TI          | Call TI              | -40 to 125   | LMV34<br>4MT             | <a href="#">Samples</a> |
| LMV344MTX/NOPB   | ACTIVE        | TSSOP        | PW                 | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LMV34<br>4MT             | <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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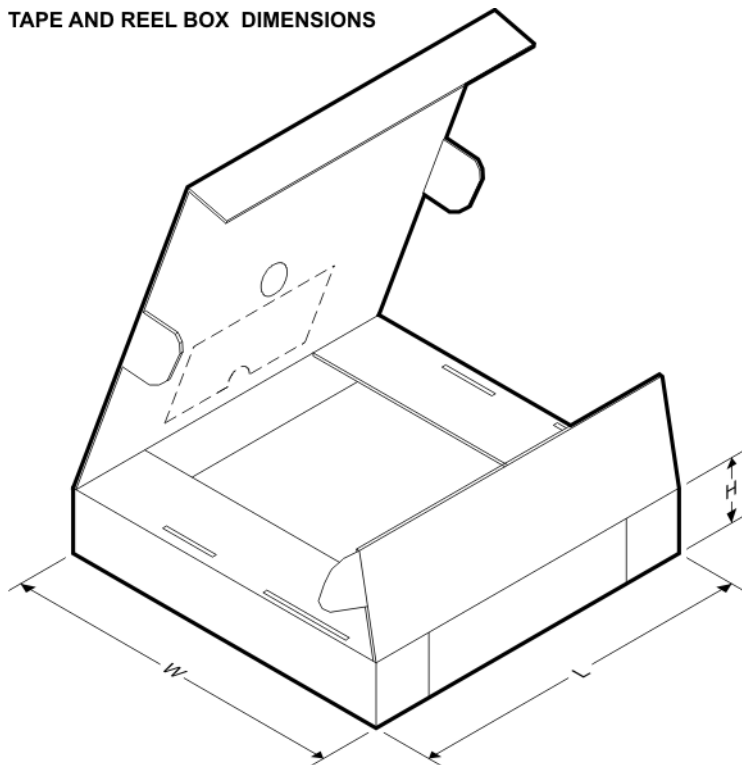
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**TAPE AND REEL INFORMATION**


\*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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMV341MG       | SC70         | DCK             | 6    | 1000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LMV341MG/NOPB  | SC70         | DCK             | 6    | 1000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LMV341MGX      | SC70         | DCK             | 6    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LMV341MGX/NOPB | SC70         | DCK             | 6    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LMV342MAX      | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LMV342MAX/NOPB | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LMV342MM       | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LMV342MM/NOPB  | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LMV342MMX      | VSSOP        | DGK             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LMV342MMX/NOPB | VSSOP        | DGK             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LMV344MAX      | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.35    | 2.3     | 8.0     | 16.0   | Q1            |
| LMV344MAX/NOPB | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.35    | 2.3     | 8.0     | 16.0   | Q1            |
| LMV344MTX      | TSSOP        | PW              | 14   | 2500 | 330.0              | 12.4               | 6.95    | 8.3     | 1.6     | 8.0     | 12.0   | Q1            |
| LMV344MTX/NOPB | TSSOP        | PW              | 14   | 2500 | 330.0              | 12.4               | 6.95    | 8.3     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

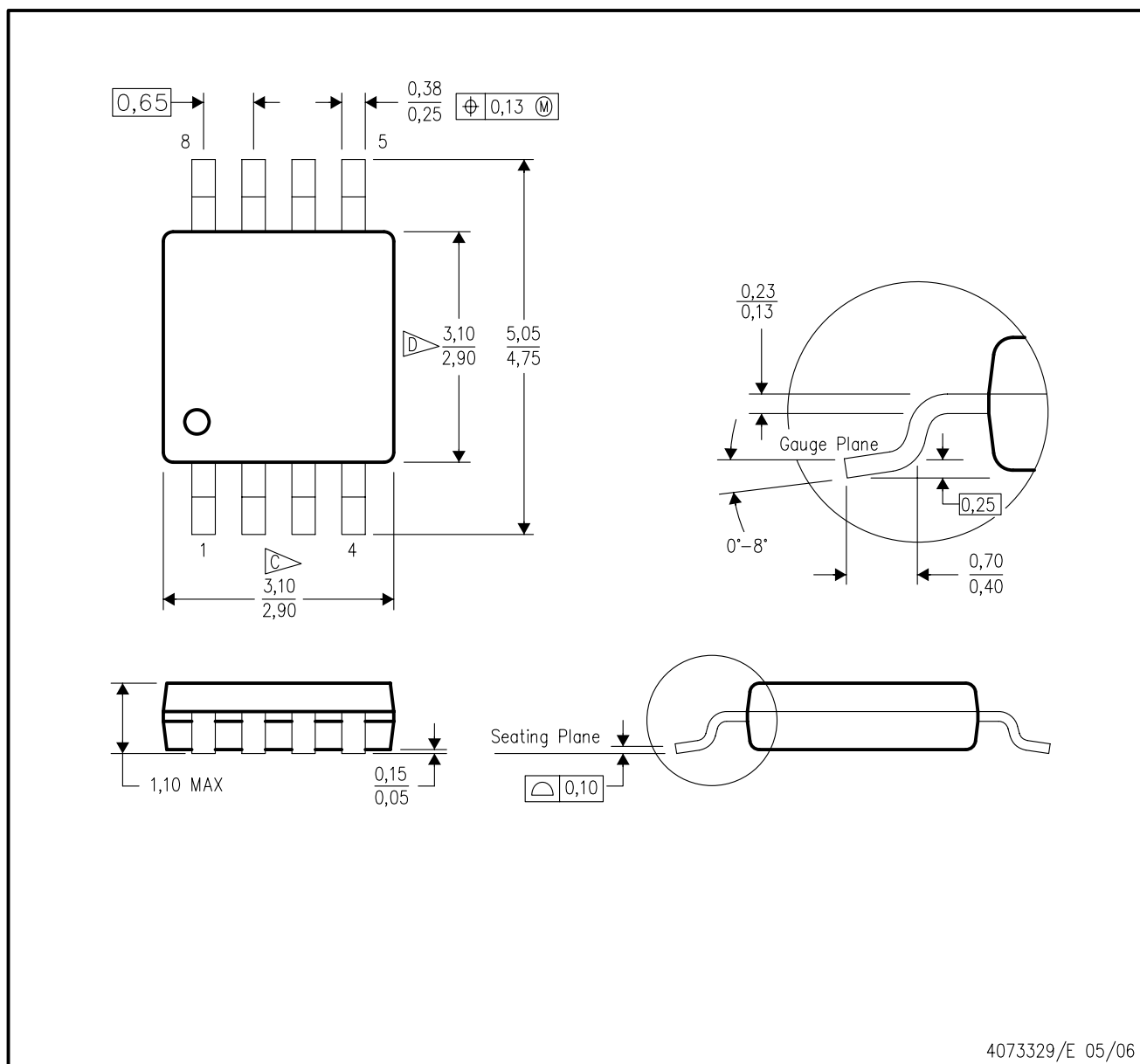


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMV341MG       | SC70         | DCK             | 6    | 1000 | 210.0       | 185.0      | 35.0        |
| LMV341MG/NOPB  | SC70         | DCK             | 6    | 1000 | 210.0       | 185.0      | 35.0        |
| LMV341MGX      | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| LMV341MGX/NOPB | SC70         | DCK             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| LMV342MAX      | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LMV342MAX/NOPB | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LMV342MM       | VSSOP        | DGK             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LMV342MM/NOPB  | VSSOP        | DGK             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LMV342MMX      | VSSOP        | DGK             | 8    | 3500 | 367.0       | 367.0      | 35.0        |
| LMV342MMX/NOPB | VSSOP        | DGK             | 8    | 3500 | 367.0       | 367.0      | 35.0        |
| LMV344MAX      | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LMV344MAX/NOPB | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LMV344MTX      | TSSOP        | PW              | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LMV344MTX/NOPB | TSSOP        | PW              | 14   | 2500 | 367.0       | 367.0      | 35.0        |

## DGK (S-PDSO-G8)

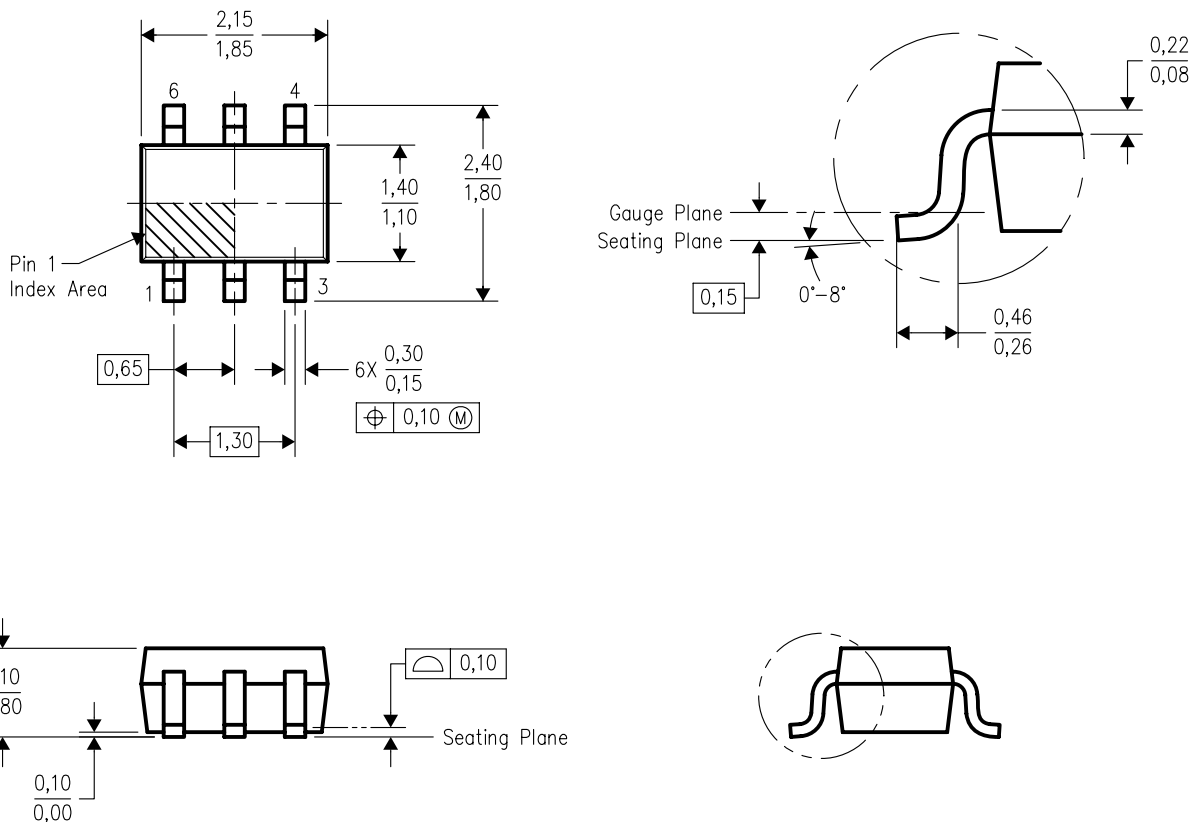
## PLASTIC SMALL-OUTLINE PACKAGE



4073329/E 05/06

## DCK (R-PDSO-G6)

## PLASTIC SMALL-OUTLINE PACKAGE

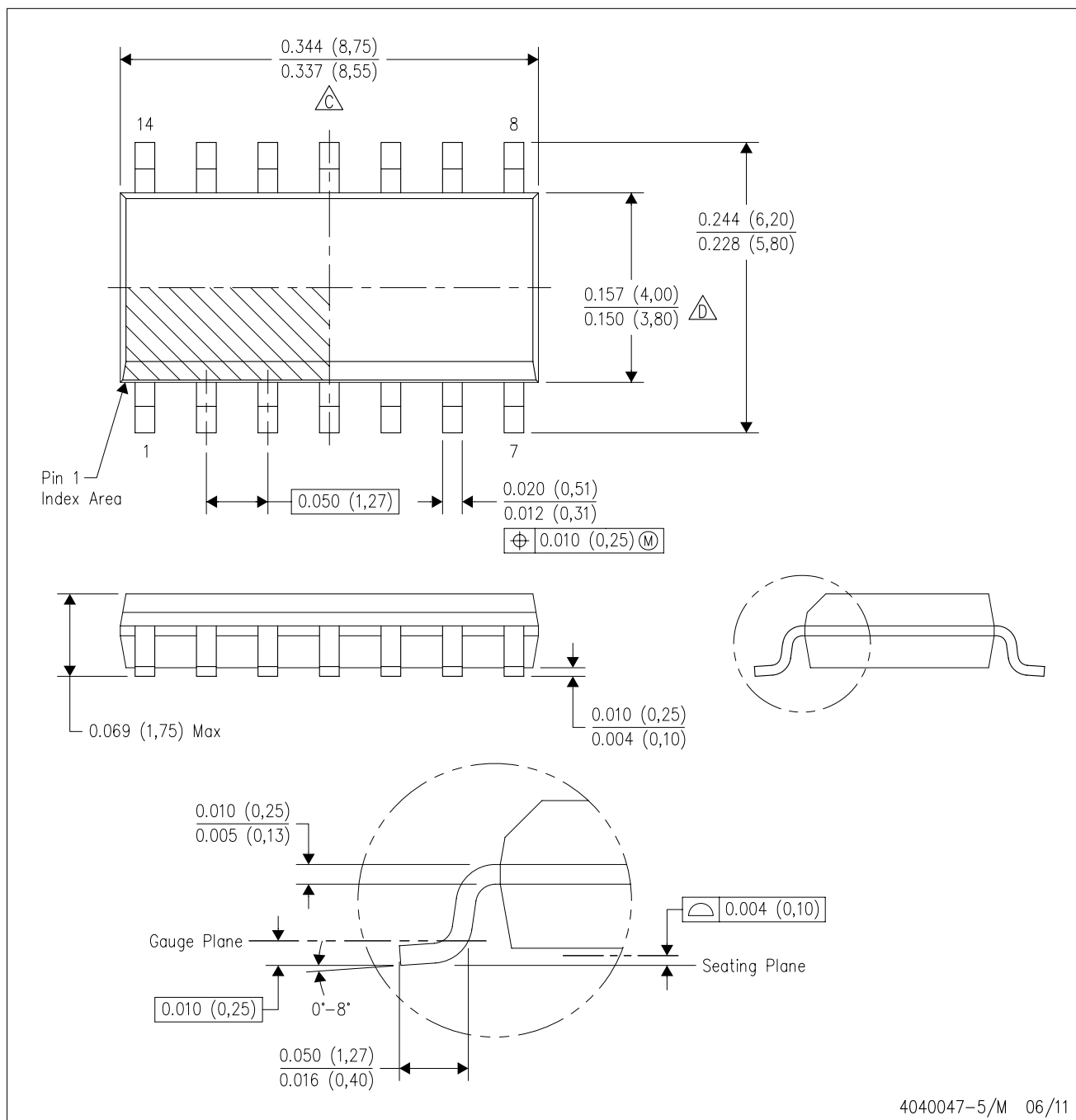


4093553-4/G 01/2007

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - Falls within JEDEC MO-203 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



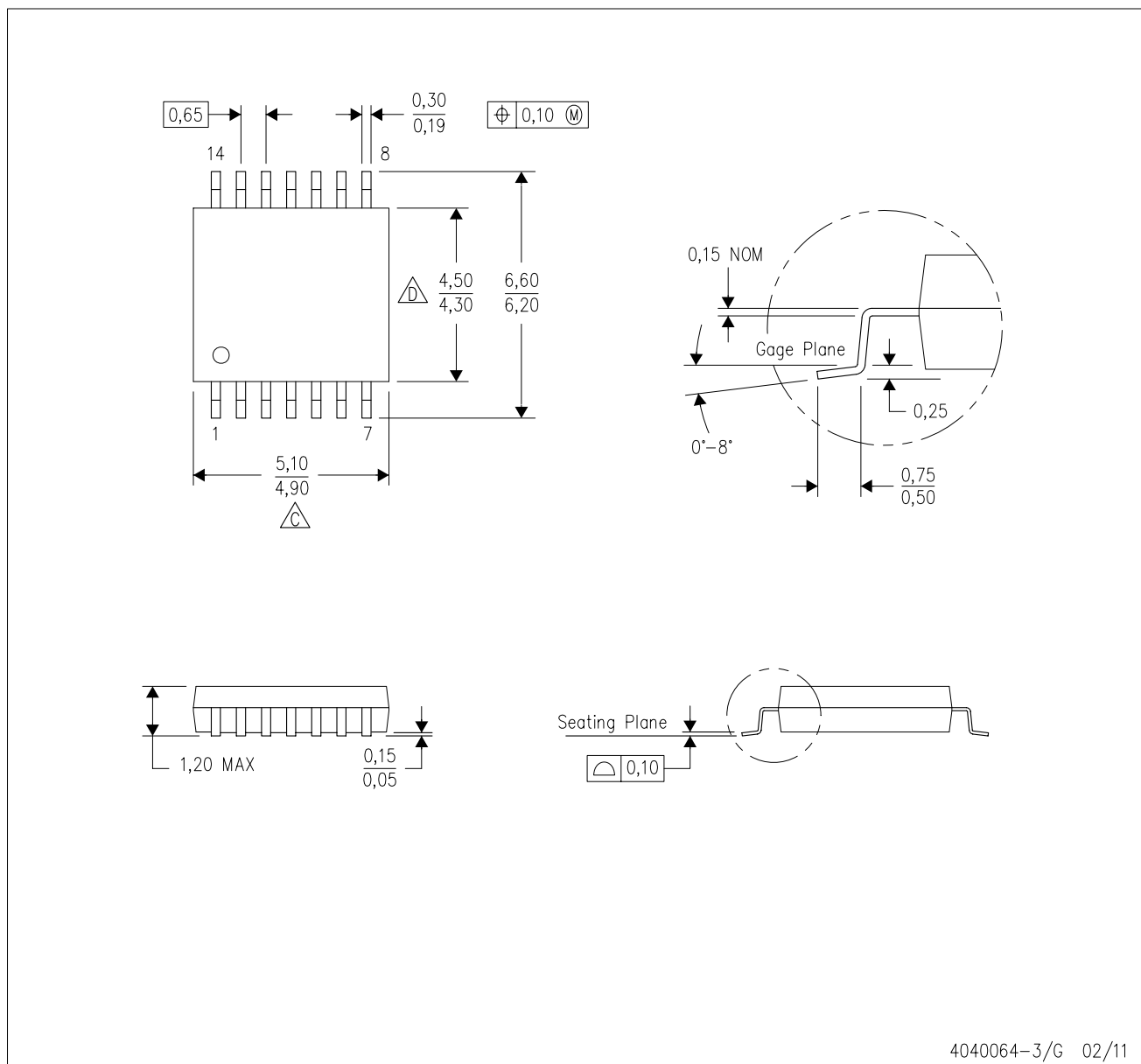
4040047-5/M 06/11

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 AB.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

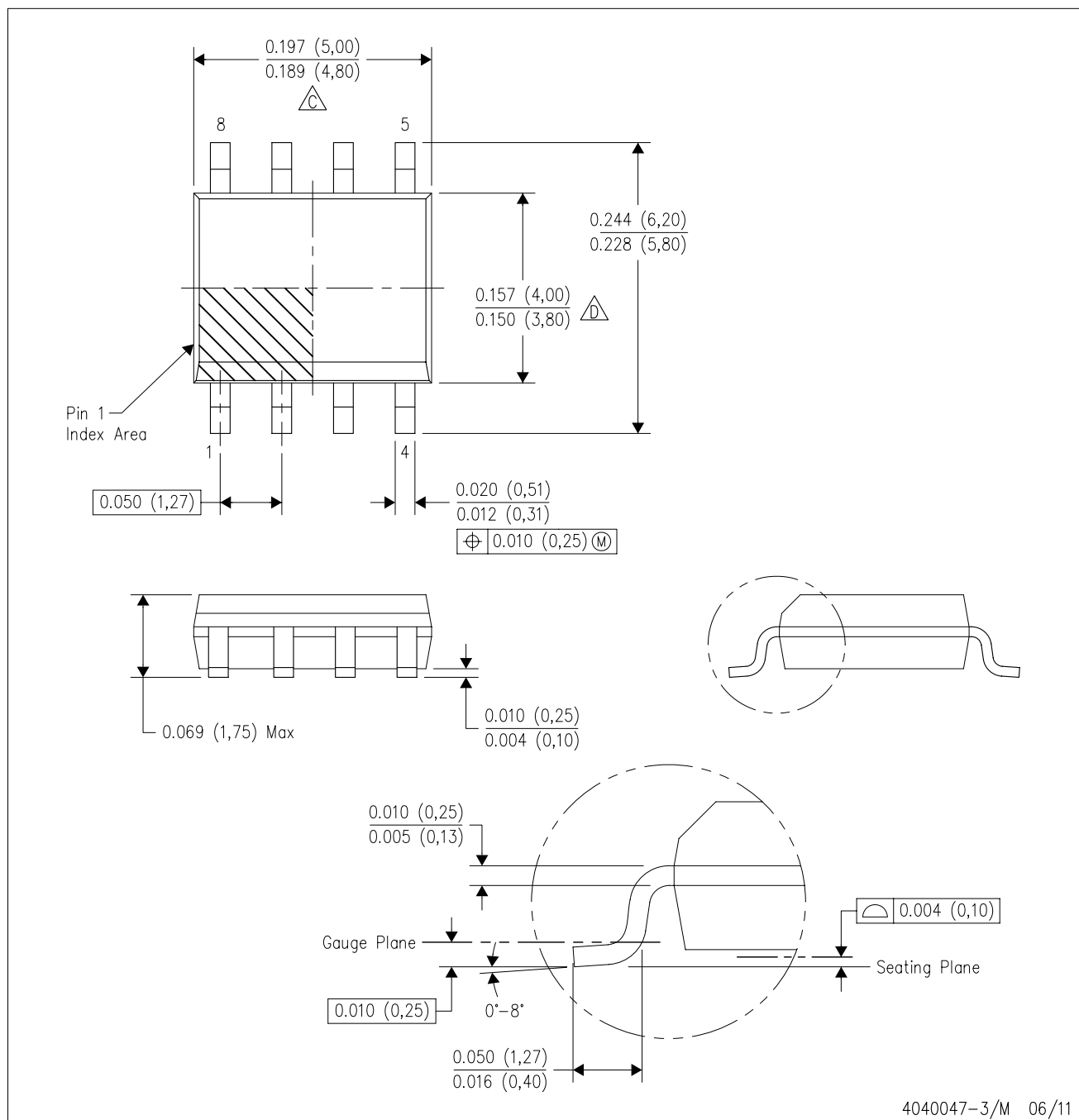


4040064-3/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

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.

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|                               |                                                                                          |
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