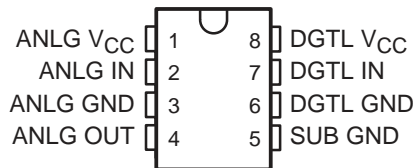


# TL1591 SAMPLE-AND-HOLD CIRCUIT FOR CCD IMAGERS

SOCS026B – SEPTEMBER 1989 – REVISED JUNE 1994

- 15-MHz Sampling Rate
- 30-ns Acquisition Time
- Diode-Bridge Switch
- 25-MHz Bandwidth
- Low-Voltage Supply

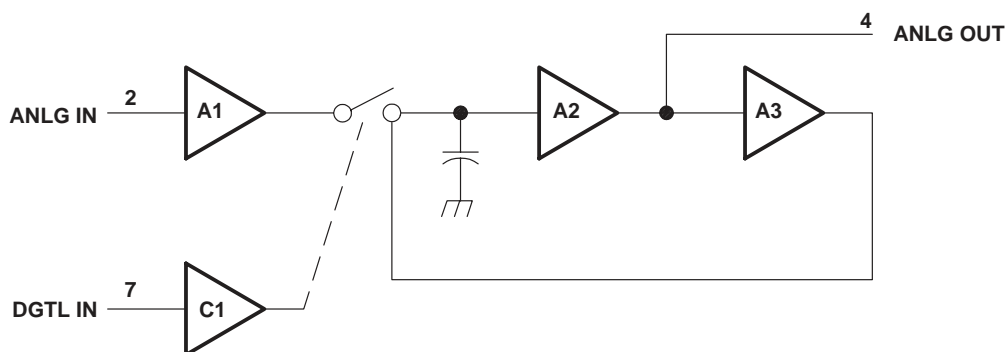
P OR PS PACKAGE  
(TOP VIEW)



## description

The TL1591 is a monolithic integrated sample-and-hold circuit that uses the BiFET process with Schottky-barrier diodes and is designed for use with CCD area imagers. This device consists of an ultra-fast input-buffer amplifier, a digital-controlled diode-bridge switch, and a high-impedance output buffer amplifier. The electronic switch is controlled by an LS-TTL-compatible logic input.

## functional block diagram



This device contains circuits to protect its inputs and outputs against damage due to high static voltages or electrostatic fields. These circuits have been qualified to protect this device against electrostatic discharges (ESD) of up to 2 kV according to MIL-STD-883C, Method 3015; however, precautions should be taken to avoid application of any voltage higher than maximum-rated voltages to these high-impedance circuits. During storage or handling, the device leads should be shorted together or the device should be placed in conductive foam. In a circuit, unused inputs should always be connected to an appropriate logic voltage level, preferably either  $V_{CC}$  or ground. Specific guidelines for handling devices of this type are contained in the publication *Guidelines for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices and Assemblies* available from Texas Instruments.

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.



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# TL1591

## SAMPLE-AND-HOLD CIRCUIT FOR CCD IMAGERS

SOCS026B – SEPTEMBER 1989 – REVISED JUNE 1994

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

|   |                              |
|---|------------------------------|
| Supply voltage, $V_{CC}$                    | 7 V                          |
| Input voltage range, $V_I$                  | 0 to $V_{CC}$                |
| Continuous total dissipation                | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ | -25°C to 80°C                |
| Storage temperature range, $T_{STG}$        | -55°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.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$ | DERATING FACTOR                | $T_A = 80^\circ\text{C}$ |
|---------|-----------------------------|--------------------------------|--------------------------|
|         | POWER RATING                | ABOVE $T_A = 25^\circ\text{C}$ | POWER RATING             |
| P       | 1000 mW                     | 8.0 mW/°C                      | 560 mW                   |
| PS      | 725 mW                      | 5.8 mW/°C                      | 406 mW                   |

### recommended operating conditions

|   | MIN  | NOM | MAX | UNIT |
|---|------|-----|-----|------|
| Supply voltage, $V_{CC}$                | 4.75 | 5   | 5.5 | V    |
| High-level input voltage, $V_{IH}$      | 2    |     |     | V    |
| Low-level input voltage, $V_{IL}$       |      |     | 0.8 | V    |
| Peak-to-peak input voltage, $V_{I(PP)}$ |      |     | 0.8 | V    |
| Operating free-air temperature, $T_A$   | -25  |     | 80  | °C   |

### electrical characteristics over ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER                               | TEST CONDITIONS                                      | MIN   | TYP‡ | MAX  | UNIT          |
|---|--|-------|------|------|---------------|
| $V_{IK}$ Input clamp voltage            |  |       |      | -1.5 | V             |
| $V_{O(PP)}$ Peak-to-peak output voltage |  |       | 1.1  |      | V             |
| $I_{IH}$ High-level input current       | $V_{CC} = 5.5\text{ V}$ ,<br>$V_{IH} = 2.7\text{ V}$ |       |      | 20   | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current        | $V_{CC} = 5.5\text{ V}$ ,<br>$V_{IL} = 0.4\text{ V}$ | -0.28 |      | -0.4 | mA            |
| $I_O$ Output current                    |  |       | 0.6  |      | mA            |
| $I_{CC}$ Supply current                 | $V_{CC} = 5.5\text{ V}$                              |       | 15   | 20   | mA            |
| $r_i$ Input resistance                  |  |       | 10   |      | k $\Omega$    |
| $r_o$ Output resistance                 |  |       | 50   |      | $\Omega$      |

### operating characteristics

| PARAMETER                   | MIN  | TYP‡ | MAX | UNIT                      |
|-----------------------------|------|------|-----|---------------------------|
| Linearity                   |      | 0.7% | 2%  |                           |
| $A_V$ Voltage amplification |      | 0.8  | 0.9 | V/V                       |
| Sample-to-hold offset error |      | 15   |     | mV                        |
| Sample-mode offset error    | -150 | -50  | 50  | mV                        |
| Hold-mode feedthrough       |      |      | -50 | dB                        |
| Hold-mode droop             |      |      | 100 | $\mu\text{V}/\mu\text{s}$ |

‡ All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

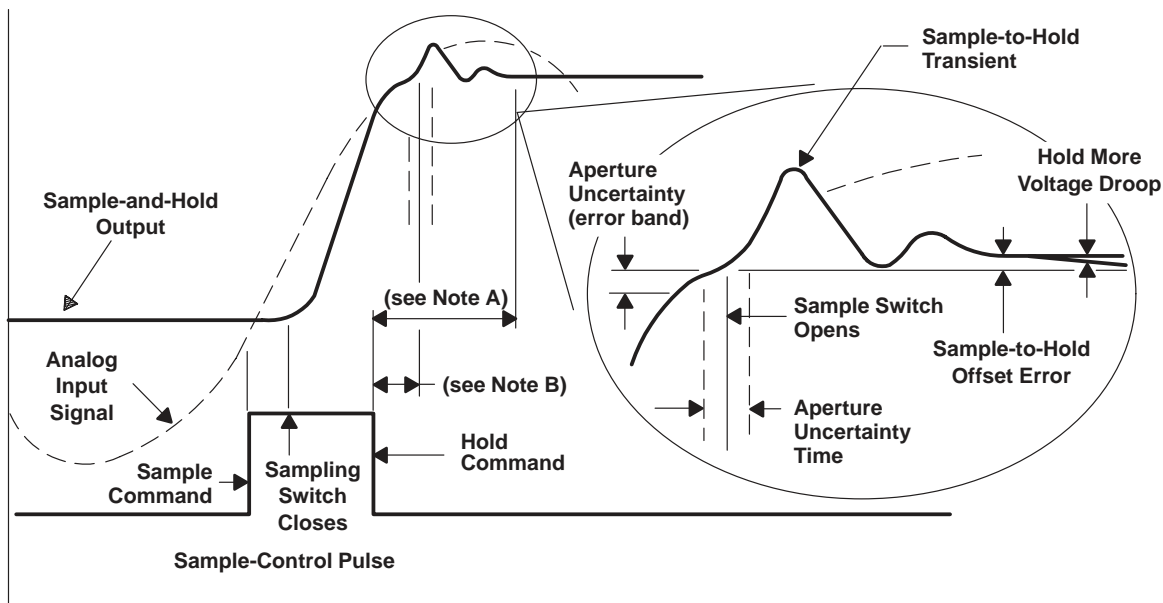


**dynamic characteristics (see Figure 1)**

| PARAMETER                     | MIN | TYP† | MAX | UNIT |
|-------------------------------|-----|------|-----|------|
| Acquisition time, 0.6 V to 2% |     | 18   |     | ns   |
| Acquisition time, 0.6 V to 1% |     | 31   |     | ns   |
| Hold-mode settling time       |     | 35   |     | ns   |
| Sampling-mode bandwidth       |     | 25   |     | MHz  |
| Sampling rate                 |     |      | 15  | MHz  |

† All typical values are at  $V_{CC} = 5\text{ V}$  and  $T_A = 25^\circ\text{C}$ .

**PARAMETER MEASUREMENT INFORMATION**



**Figure 1. Sample-Hold Definitions**

- NOTES: A. Hold-mode settling time is the time from the hold command transition until the output has settled within a specified error band around the final value.  
 B. Acquisition time is the time required, after the closing of the sampling switch, for the hold capacitor to charge to a full-scale voltage change and then remain within a specified error band around the final value.

# TL1591 SAMPLE-AND-HOLD CIRCUIT FOR CCD IMAGERS

SOCS026B – SEPTEMBER 1989 – REVISED JUNE 1994

## PARAMETER MEASUREMENT INFORMATION

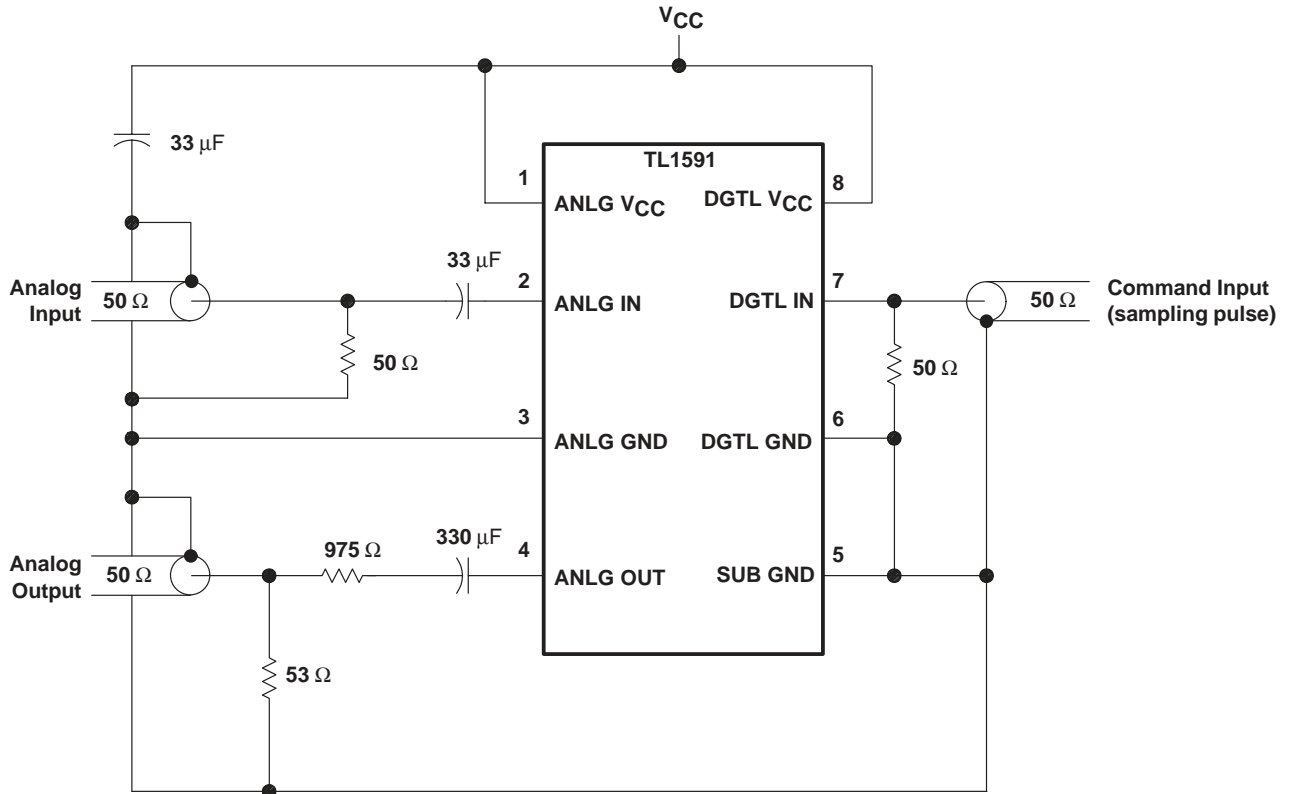


Figure 2. Test Circuit

TYPICAL CHARACTERISTICS

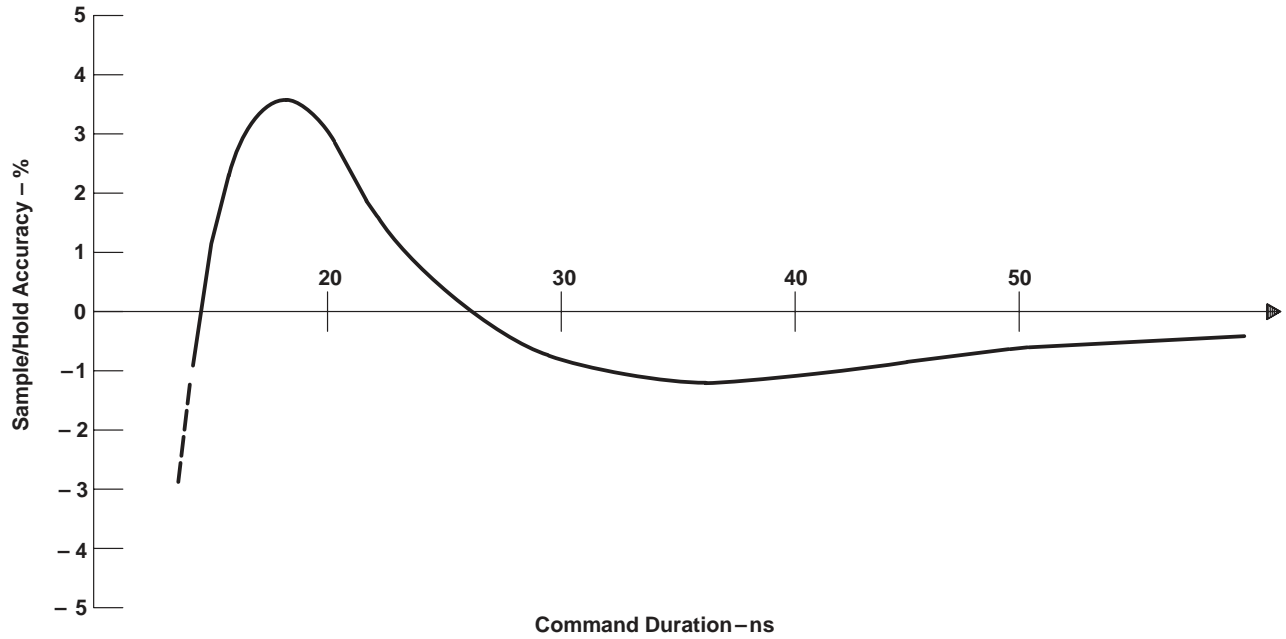


Figure 3. Sample/Hold Accuracy Versus Command Duration

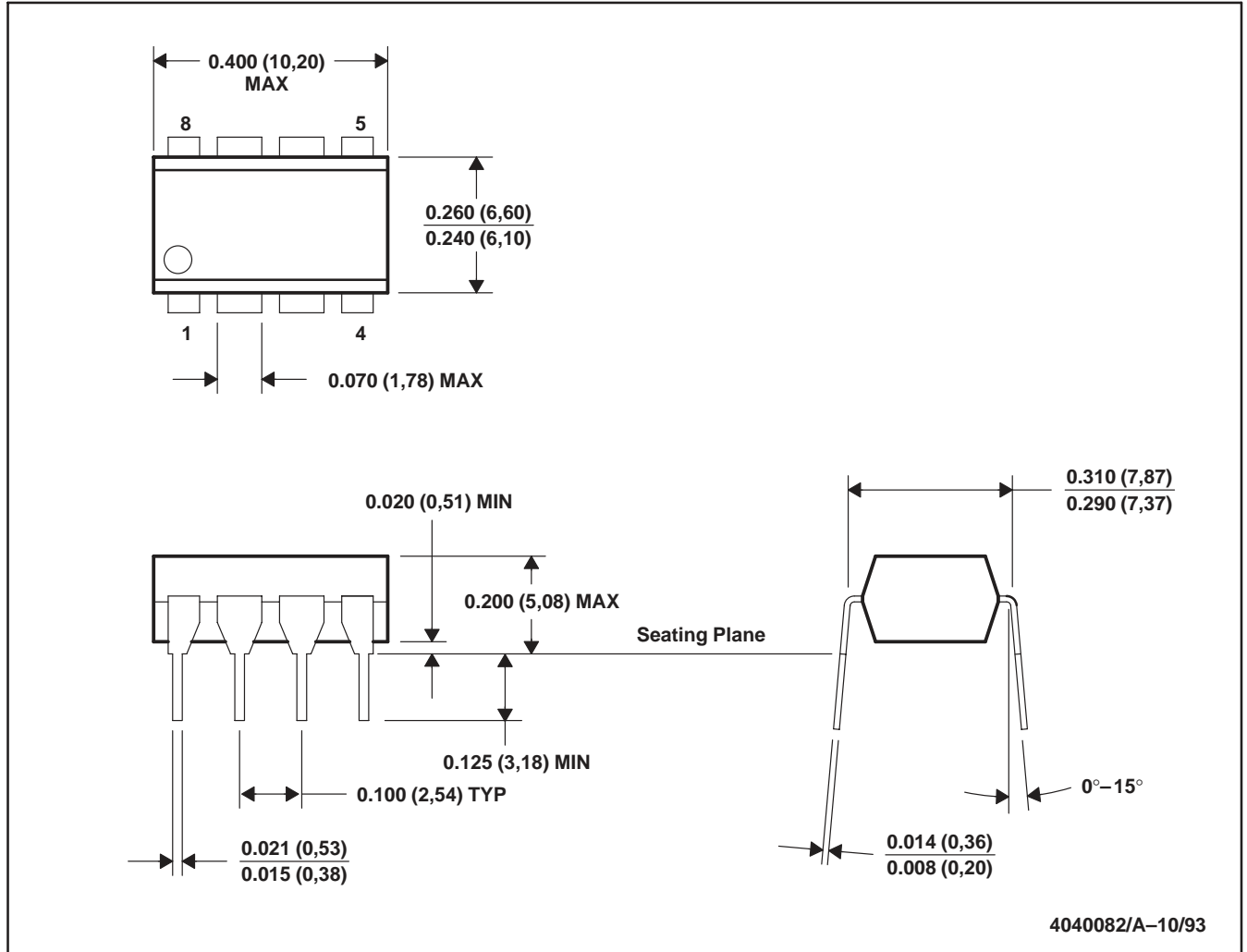
# TL1591 SAMPLE-AND-HOLD CIRCUIT FOR CCD IMAGERS

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## MECHANICAL DATA

P(R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE

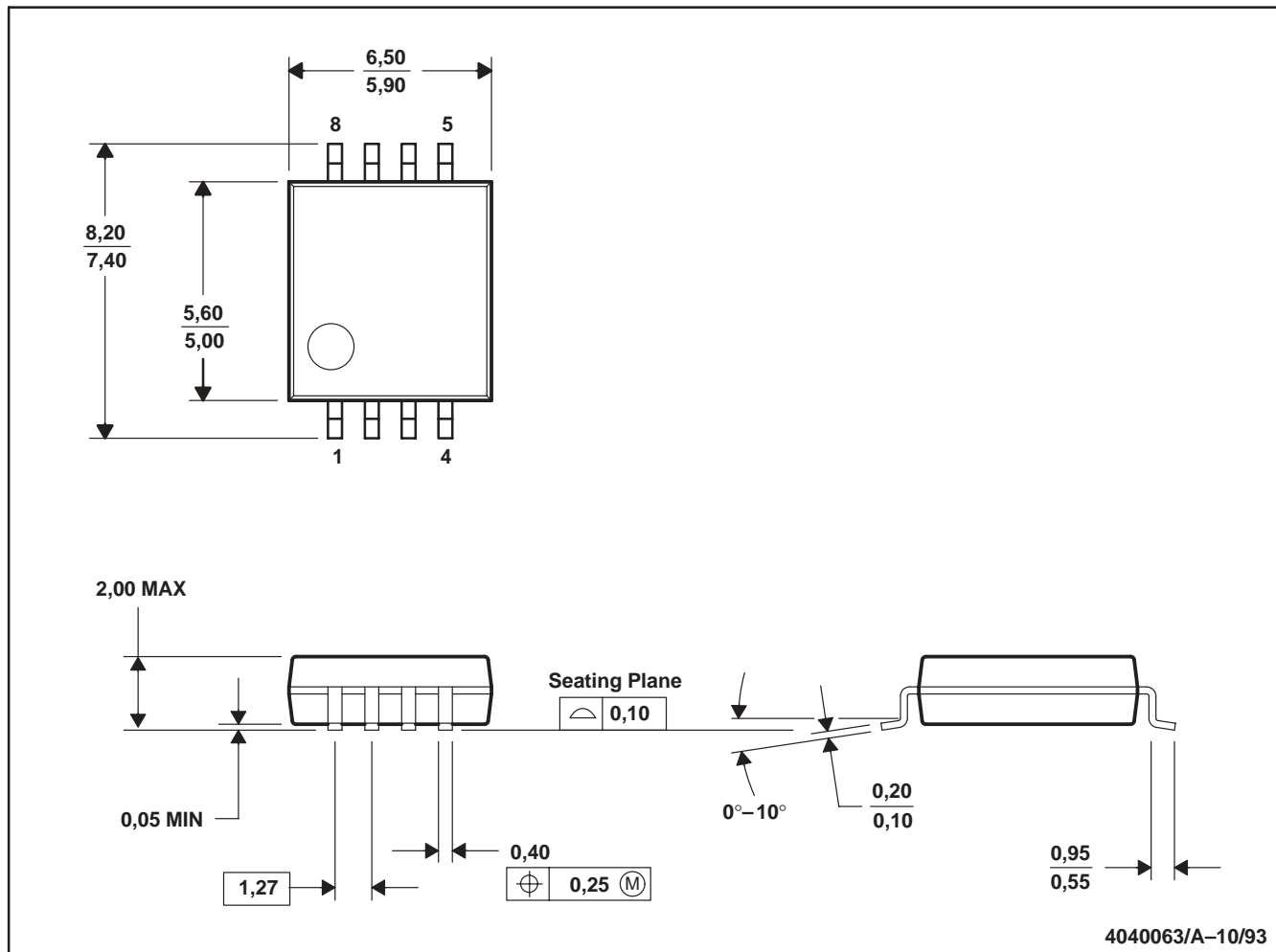


- NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.

MECHANICAL DATA

PS/R-PDSO-G8

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.

**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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TL1591CP         | OBSOLETE              | PDIP         | P               | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL1591CPSLE      | OBSOLETE              | SO           | PS              | 8    |             | 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) 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.

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**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.

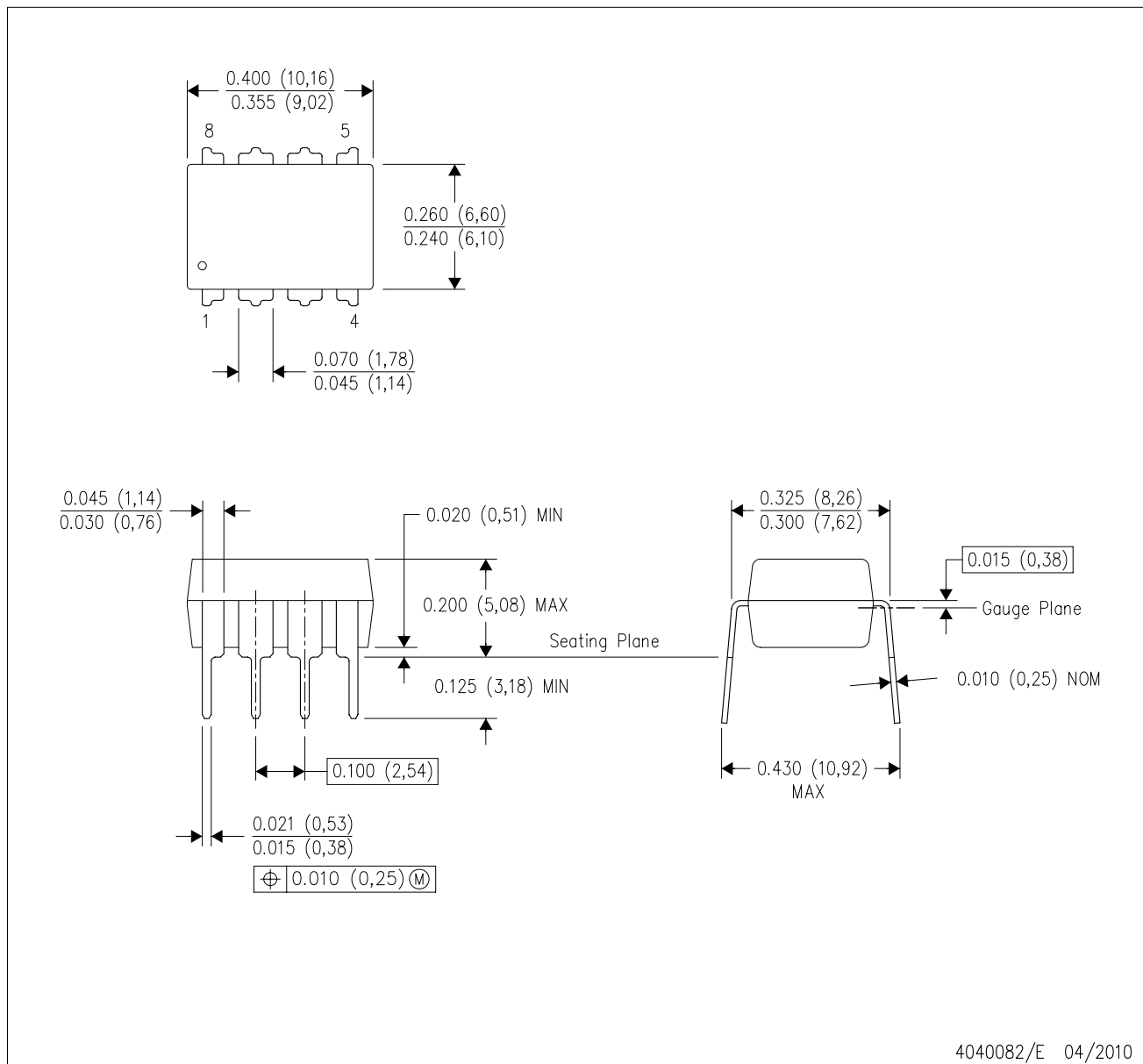
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P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE

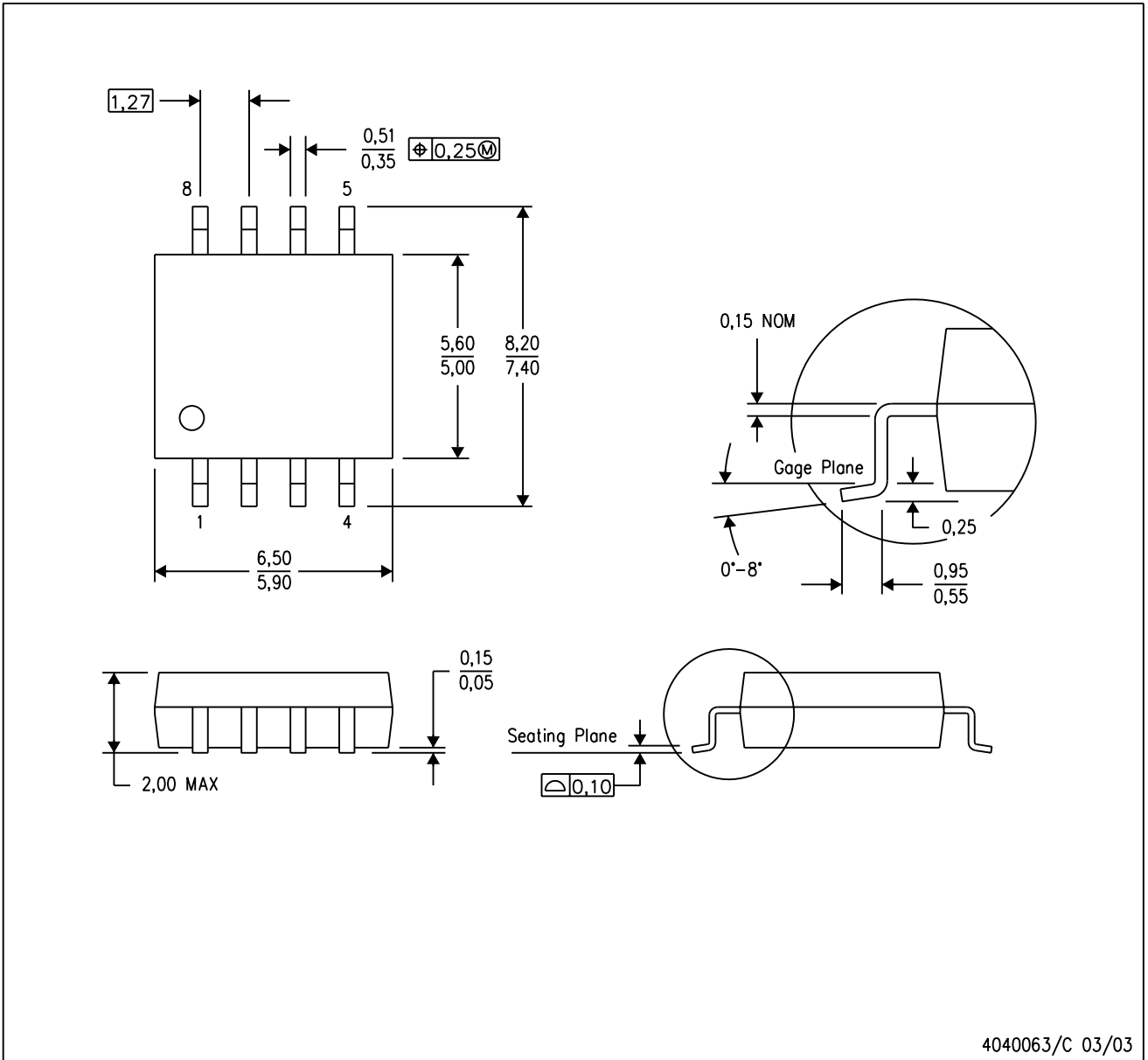


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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