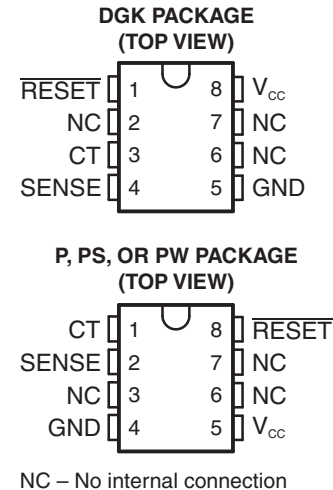


SUPPLY-VOLTAGE SUPERVISOR

Check for Samples: [TL7700](#)

FEATURES

- Adjustable Sense Voltage With Two External Resistors
- Adjustable Hysteresis of Sense Voltage
- Wide Operating Supply-Voltage Range:
1.8 V to 40 V
- Wide Operating Temperature Range:
–40°C to 85°C
- Low Power Consumption:
 $I_{CC} = 0.6 \text{ mA Typ}$, $V_{CC} = 40 \text{ V}$
- Minimum External Components
- Now Available in MSOP (DGK) package



DESCRIPTION/ORDERING INFORMATION

The TL7700 is a bipolar integrated circuit designed for use as a reset controller in microcomputer and microprocessor systems. The SENSE voltage can be set to any value greater than 0.5 V using two external resistors. The hysteresis value of the sense voltage also can be set by the same resistors. The device includes a precision voltage reference, fast comparator, timing generator, and output driver, so it can generate a power-on reset signal in a digital system.

The TL7700 has an internal 1.5-V temperature-compensated voltage reference from which all function blocks are supplied. Circuit function is very stable, with supply voltage in the 1.8-V to 40-V range. Minimum supply current allows use with ac line operation, portable battery operation, and automotive applications.

ORDERING INFORMATION⁽¹⁾

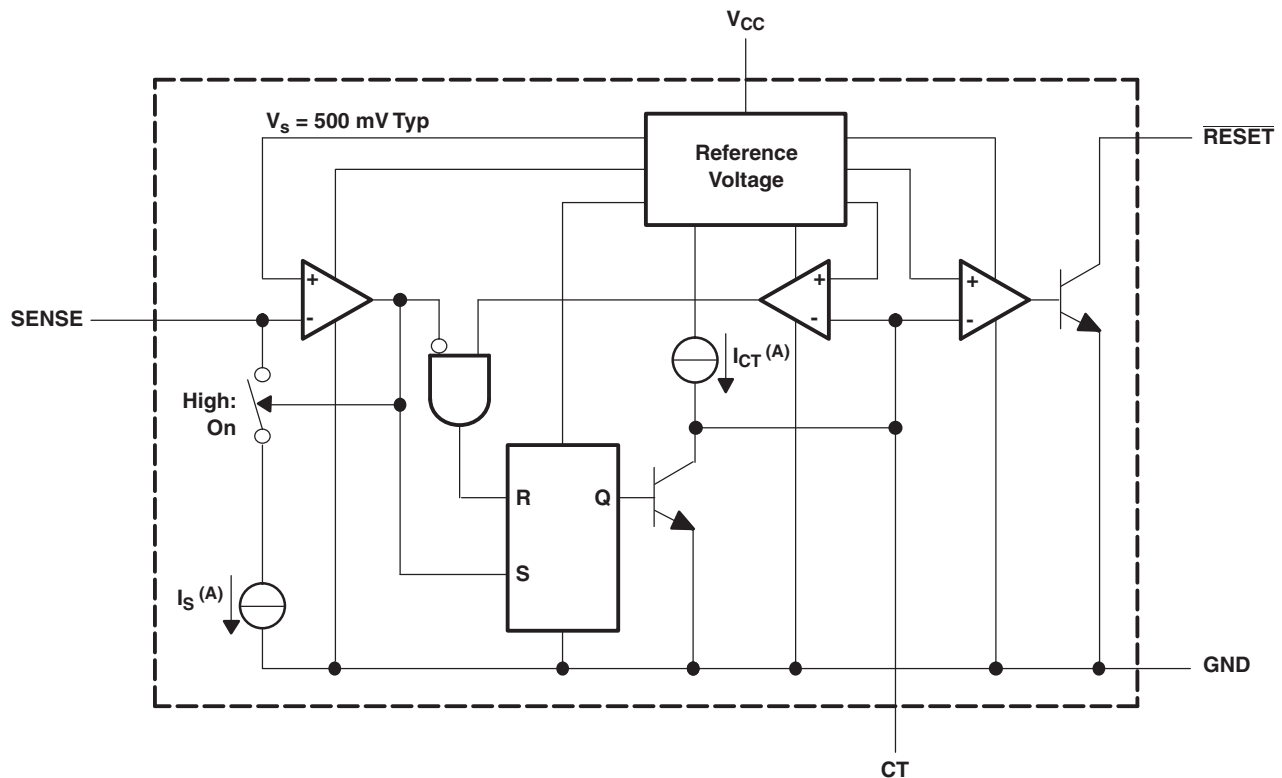
| T_A | PACKAGE ⁽²⁾ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|------------------------|--------------|-----------------------|------------------|
| –40°C to 85°C | PDIP – P | Tube of 50 | TL7700CP | TL7700CP |
| | SOP – PS | Reel of 2000 | TL7700CPSR | T7700 |
| | TSSOP – PW | Tube of 150 | TL7700CPW | T7700 |
| | | Reel of 2000 | TL7700CPWR | |
| | MSOP – DGK | Reel of 250 | TL7700CDGKT | 9TS |
| | | Reel of 2500 | TL7700CDGKR | |

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.



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.

FUNCTIONAL BLOCK DIAGRAM

A. $I_{CT} = 15 \mu\text{A (Typ)}$, $I_s = 2.5 \mu\text{A (Typ)}$

TERMINAL FUNCTIONS

| NAME | TERMINAL NO. | | DESCRIPTION |
|-------|--------------|---------|--|
| | P, PS, PW | DGK | |
| CT | 1 | 3 | Timing capacitor connection. This terminal sets the RESET output pulse duration (t_{po}). It is connected internally to a 15- μA constant-current source. There is a limit on the switching speed of internal elements; even if CT is set to 0, response speeds remain at approximately 5 to 10 μs . If CT is open, the device can be used as an adjustable-threshold noninverting comparator. If CT is low, the internal output-stage comparator is active, and the RESET output transistor is on. An external voltage must not be applied to this terminal due to the internal structure of the device. Therefore, drive the device using an open-collector transistor, FET, or 3-state buffer (in the low-level or high-impedance state). |
| GND | 4 | 5 | Ground. Keep this terminal as low impedance to reduce circuit noise. |
| NC | 3, 6, 7 | 2, 6, 7 | No internal connection |
| RESET | 8 | 1 | Reset output. This terminal can be connected directly to a system that resets in the active-low state. A pullup resistor usually is required because the output is an npn open-collector transistor. An additional transistor should be connected when the active-high reset or higher output current is required. |
| SENSE | 2 | 4 | Voltage sense. This terminal has a threshold level of 500 mV. The sense voltage and hysteresis can be set at the same time when the two voltage-dividing resistors are connected. The reference voltage is temperature compensated to inhibit temperature drift in the threshold voltage within the operating temperature range. |
| VCC | 5 | 8 | Power supply. This terminal is used in an operating-voltage range of 1.8 V to 40 V. |

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

| | | |
|------------------|---|----------------|
| V _{CC} | Supply voltage ⁽²⁾ | 41 V |
| V _s | Sense input voltage range | –0.3 V to 41 V |
| V _{OH} | Output voltage (off state) | 41 V |
| I _{OL} | Output current (on state) | 5 mA |
| θ _{JA} | Package thermal impedance ⁽³⁾ ⁽⁴⁾ | P package |
| | | PS package |
| | | PW package |
| | | DGK package |
| T _J | Operating virtual-junction temperature | 150°C |
| T _{stg} | Storage temperature range | –65°C to 150°C |

- (1) 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.
- (2) All voltage values are with respect to the network ground terminal.
- (3) Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is P_D = (T_J(max) – T_A)/θ_{JA}. Operating at the absolute maximum T_J of 150°C can impact reliability.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

RECOMMENDED OPERATING CONDITIONS

| | | MIN | MAX | UNIT |
|-----------------|--------------------------------|-----|-----|------|
| V _{CC} | Supply voltage | 1.8 | 40 | V |
| I _{OL} | Low-level output current | | 3 | mA |
| T _A | Operating free-air temperature | –40 | 85 | °C |

ELECTRICAL CHARACTERISTICS

V_{CC} = 3 V (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T _A | MIN | TYP | MAX | UNIT |
|-----------------|---------------------------------|---|---------------|-----|-----|------|
| V _s | SENSE input voltage | 25°C | 495 | 500 | 505 | mV |
| | | –40°C to 85°C | 490 | | 510 | |
| I _s | SENSE input current | 25°C | 2 | 2.5 | 3 | μA |
| | | –40°C to 85°C | 1.5 | | 3.5 | |
| I _{CC} | Supply current | V _{CC} = 40 V, V _s = 0.6 V, No load | 25°C | 0.6 | 1 | mA |
| V _{OL} | Low-level output voltage | I _{OL} = 1.5 mA | 25°C | | 0.4 | V |
| | | I _{OL} = 3 mA | 25°C | | 0.8 | |
| I _{OH} | High-level output current | V _{OH} = 40 V, V _s = 0.6 V | –40°C to 85°C | | 1 | μA |
| I _{CT} | Timing-capacitor charge current | V _s = 0.6 V | 25°C | 11 | 15 | 19 |

SWITCHING CHARACTERISTICS

V_{CC} = 3 V, T_A = 25°C (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------|---|--|-----|-----|------|
| t _{pi} | SENSE pulse duration | C _T = 0.01 μF | 2 | | μs |
| t _{po} | Output pulse duration | C _T = 0.01 μF | 0.5 | 1 | 1.5 |
| t _r | Output rise time | C _T = 0.01 μF, R _L = 2.2 kΩ, C _L = 100 pF | | | 15 |
| t _f | Output fall time | C _T = 0.01 μF, R _L = 2.2 kΩ, C _L = 100 pF | | | 0.5 |
| t _{pd} | Propagation delay time, SENSE to output | C _T = 0.01 μF | | | 10 |

PARAMETER MEASUREMENT INFORMATION

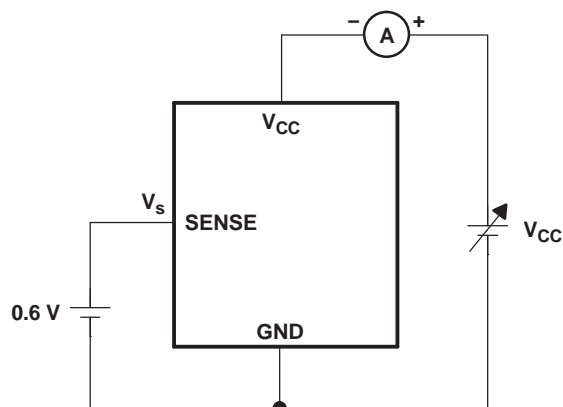


Figure 1. V_{CC} vs I_{CC} Measurement Circuit

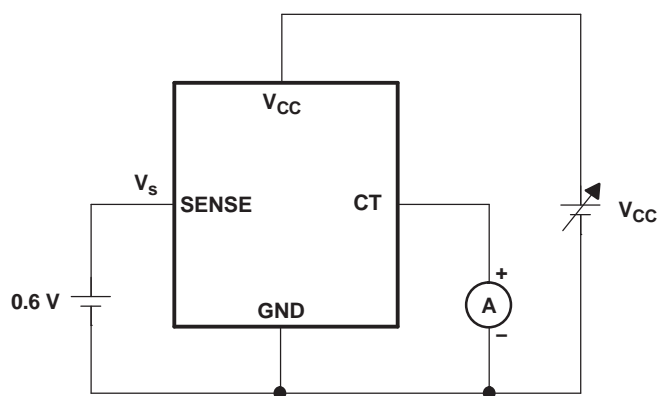


Figure 2. V_{CC} vs I_{CT} Measurement Circuit

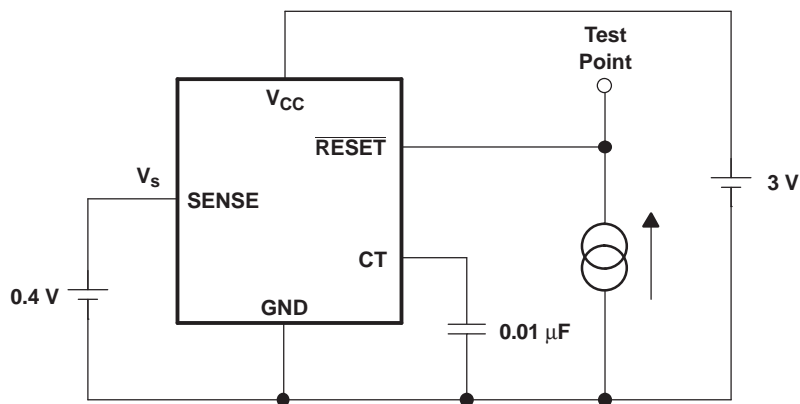


Figure 3. I_{OL} vs V_{OL} Measurement Circuit

PARAMETER MEASUREMENT INFORMATION (continued)

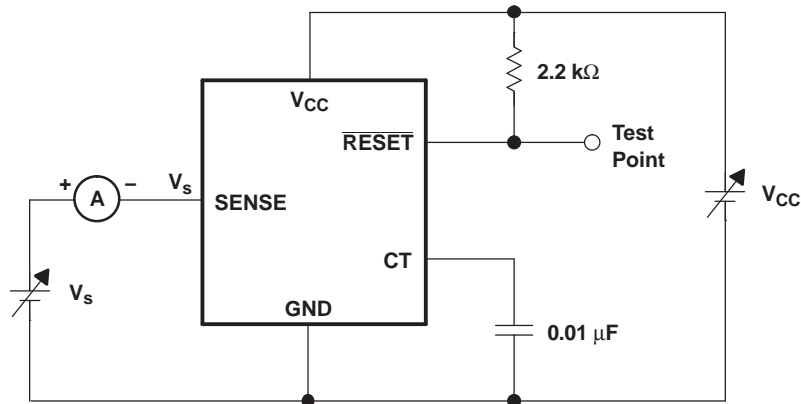


Figure 4. V_s , I_s Characteristics Measurement Circuit

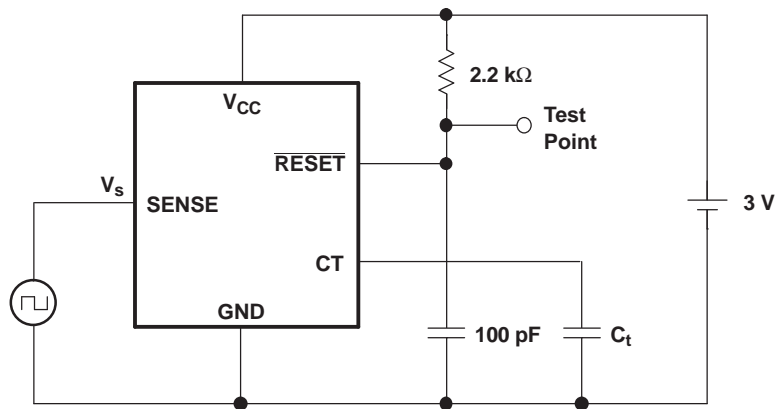


Figure 5. Switching Characteristics Measurement Circuit

TYPICAL CHARACTERISTICS

Data at high and low temperatures are applicable only within the recommended operating conditions.

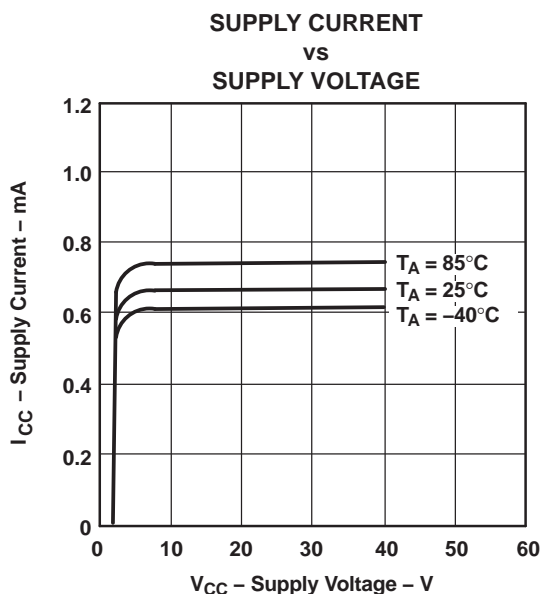


Figure 6.

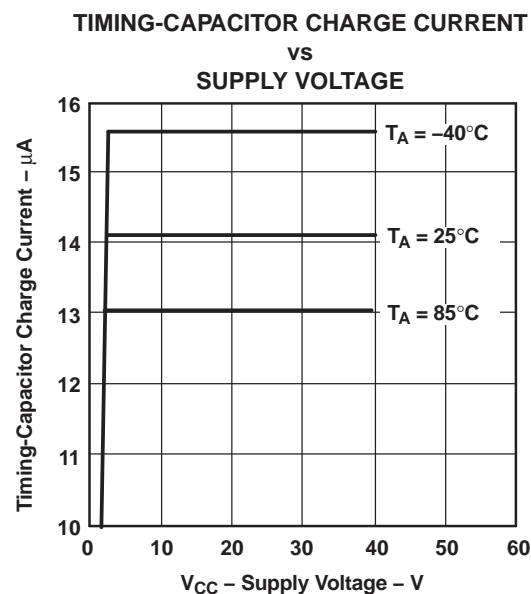


Figure 7.

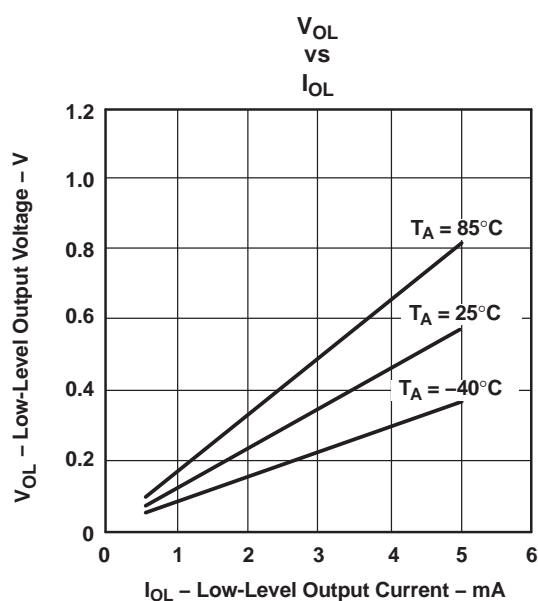


Figure 8.

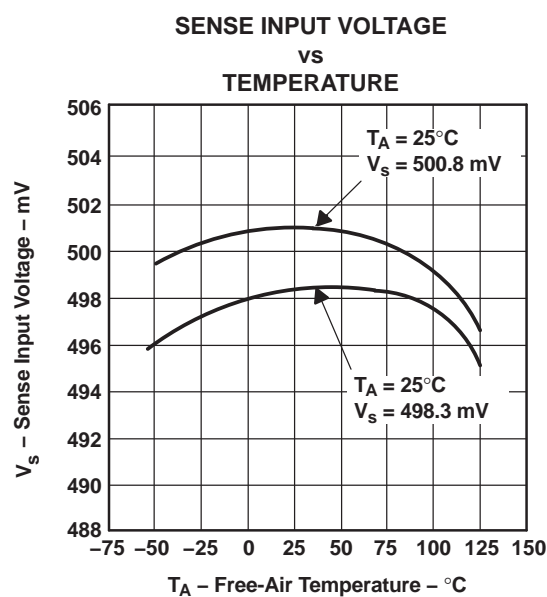


Figure 9.

TYPICAL CHARACTERISTICS (continued)

Data at high and low temperatures are applicable only within the recommended operating conditions.

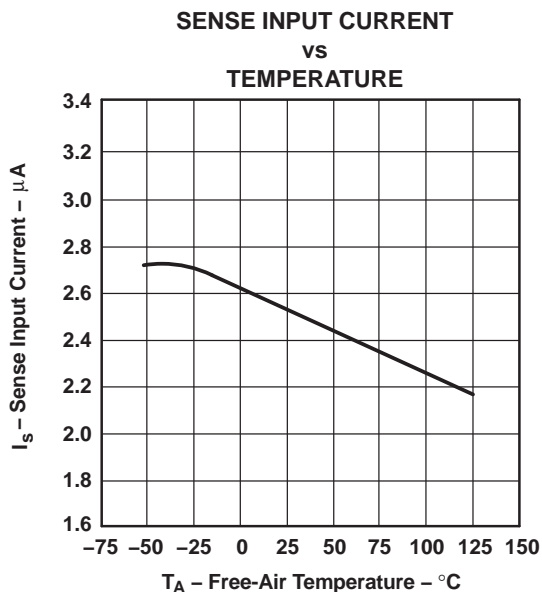


Figure 10.

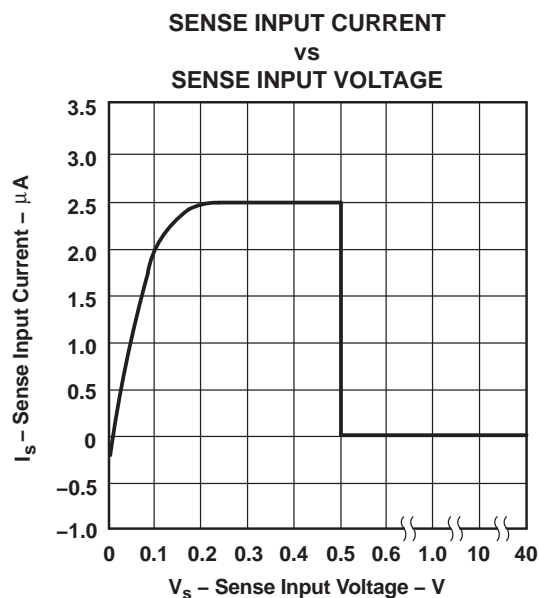


Figure 11.

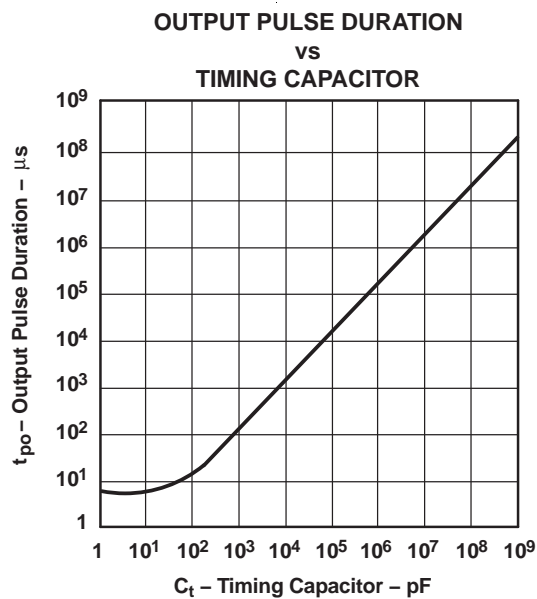


Figure 12.

TYPICAL CHARACTERISTICS (continued)

Data at high and low temperatures are applicable only within the recommended operating conditions.

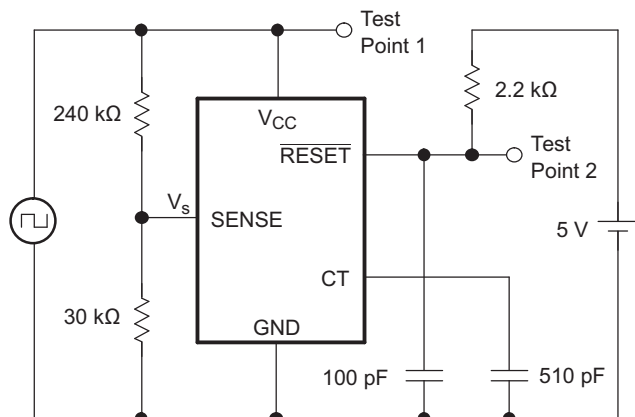
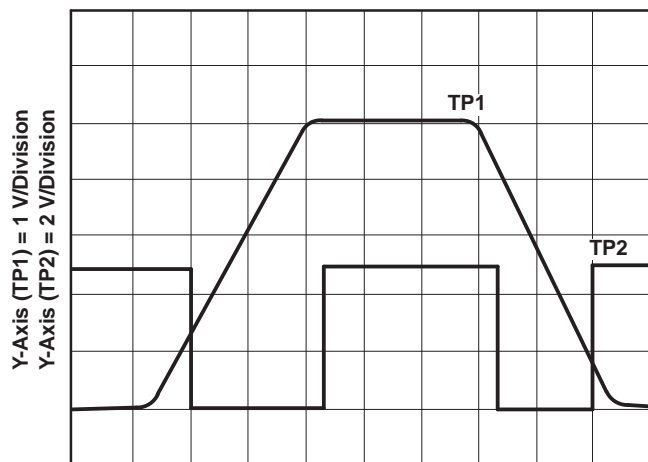


Figure 13. V_{CC} vs Output Test Circuit 1



X-Axis = 0.2 ms/Division
Figure 14. V_{CC} vs Output Waveform 1

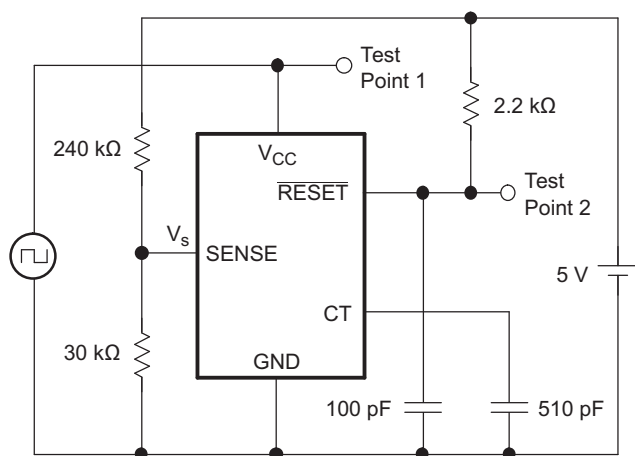
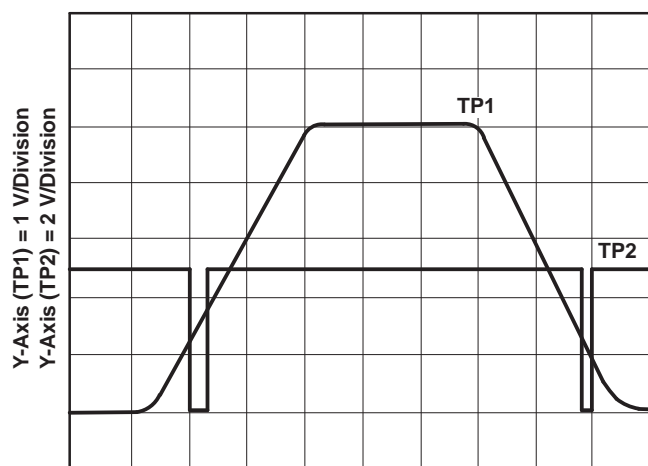


Figure 15. V_{CC} vs Output Test Circuit 2



X-Axis = 0.2 ms/Division
Figure 16. V_{CC} vs Output Waveform 2

TYPICAL CHARACTERISTICS (continued)

Data at high and low temperatures are applicable only within the recommended operating conditions.

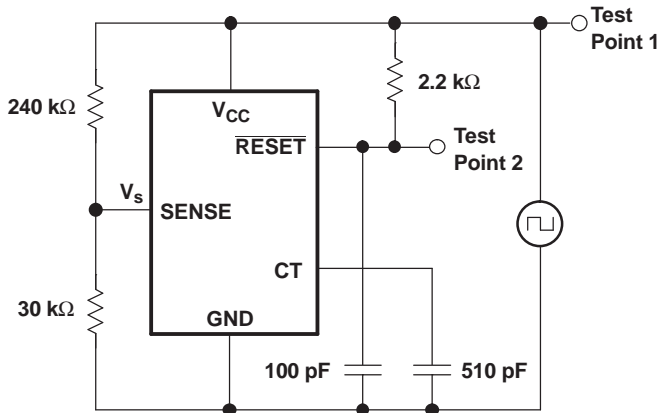


Figure 17. V_{CC} vs Output Test Circuit 3

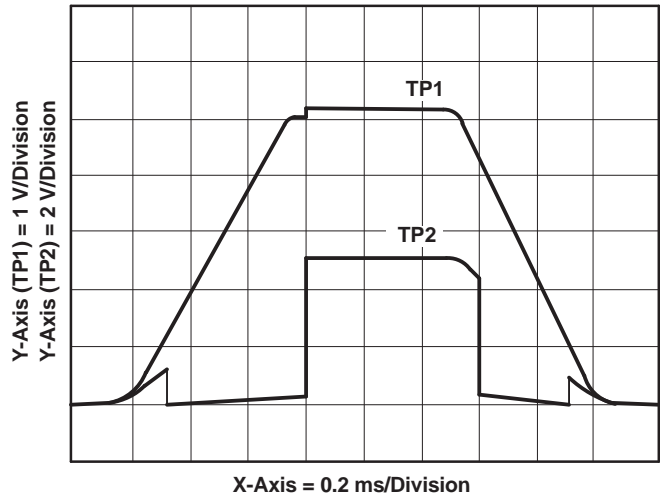


Figure 18. V_{CC} vs Output Waveform 3

DETAILED DESCRIPTION

Sense-Voltage Setting

The SENSE terminal input voltage, V_s , of the TL7700 typically is 500 mV. By using two external resistors, the circuit designer can obtain any sense voltage over 500 mV. In Figure 19, the sensing voltage, $V_{s'}$, is calculated as:

$$V_{s'} = V_s \times (R1 + R2)/R2$$

Where:

$$V_s = 500 \text{ mV typ at } T_A = 25^\circ\text{C}$$

At room temperature, V_s has a variation of $500 \text{ mV} \pm 5 \text{ mV}$. In the basic circuit shown in Figure 19, variations of $[\pm 5 \pm (R1 + R2)/R2] \text{ mV}$ are superimposed on V_s .

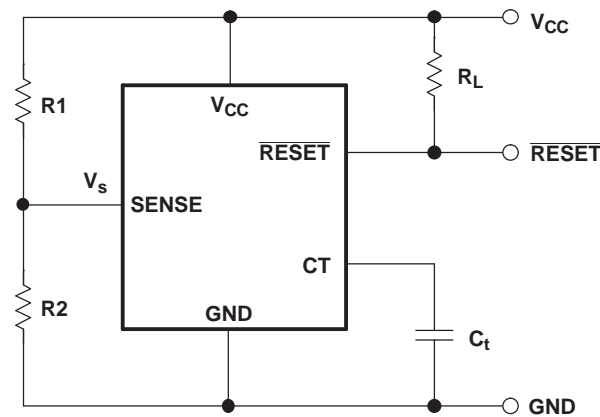


Figure 19.

Sense-Voltage Hysteresis Setting

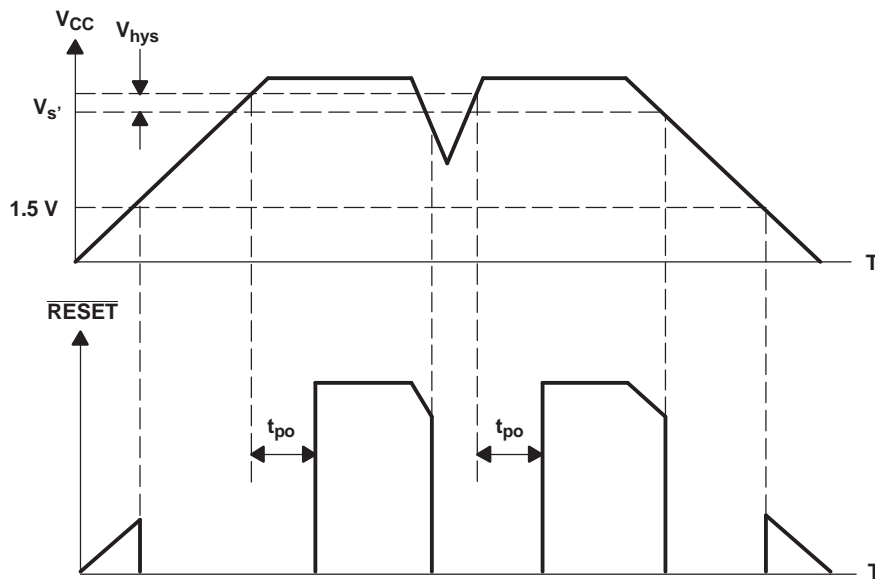
If the sense voltage (V_s) does not have hysteresis in it, and the voltage on the sensing line contains ripples, the resetting of TL7700 is unstable. Hysteresis is added to the sense voltage to prevent such problems. As shown in Figure 20, the hysteresis (V_{hys}) is added, and the value is determined as:

$$V_{hys} = I_s \times R1$$

Where:

$$I_s = 2.5 \mu\text{A typ at } T_A = 25^\circ\text{C}$$

At room temperature, I_s has variations of $2.5 \text{ mA} \pm 0.5 \text{ mA}$. Therefore, in the circuit shown in Figure 19, V_{hys} has variations of $(\pm 0.5 \times R1) \text{ mV}$. In circuit design, it is necessary to consider the voltage-dividing resistor tolerance and temperature coefficient in addition to variations in V_s and V_{hys} .



- A. The sense voltage, $V_{s'}$, is different from the SENSE terminal input voltage, V_s . $V_{s'}$ normally is 500 mV for triggering.

Figure 20. V_{cc} -RESET Timing Chart

Output Pulse-Duration Setting

Constant-current charging starts on the timing capacitor when the sensing-line voltage reaches the TL7700 sense voltage. When the capacitor voltage exceeds the threshold level of the output drive comparator, $\overline{\text{RESET}}$ changes from a low to a high level. The output pulse duration is the time between the point when the sense-pin voltage exceeds the threshold level and the point when the $\overline{\text{RESET}}$ output changes from a low level to a high level. When the TL7700 is used for system power-on reset, the output pulse duration, t_{po} , must be set longer than the power rise time. The value of t_{po} is:

$$t_{po} = C_t \times 10^5 \text{ seconds}$$

Where:

C_t is the timing capacitor in farads

There is a limit on the device response speed. Even if $C_t = 0$, t_{po} is not 0, but approximately 5 μs to 10 μs . Therefore, when the TL7700 is used as a comparator with hysteresis without connecting C_t , switching speeds (t_r/t_f , t_{po}/t_{pd} , etc.) must be considered.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TL7700CDGKR | ACTIVE | VSSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9TS | Samples |
| TL7700CDGKRG4 | ACTIVE | VSSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9TS | Samples |
| TL7700CDGKT | ACTIVE | VSSOP | DGK | 8 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9TS | Samples |
| TL7700CDGKTG4 | ACTIVE | VSSOP | DGK | 8 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 9TS | Samples |
| TL7700CP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | TL7700CP | Samples |
| TL7700CPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | TL7700CP | Samples |
| TL7700CPSR | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPSRG4 | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPW | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPWE4 | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPWG4 | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPWR | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPWRE4 | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |
| TL7700CPWRG4 | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | T7700 | Samples |

(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⁾ Only one of markings shown within the brackets will appear on the physical device.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL7700CDGKR | VSSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TL7700CDGKT | VSSOP | DGK | 8 | 250 | 177.8 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TL7700CPSR | SO | PS | 8 | 2000 | 330.0 | 16.4 | 8.2 | 6.6 | 2.5 | 12.0 | 16.0 | Q1 |
| TL7700CPWR | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TL7700CPWRG4 | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL7700CDGKR | VSSOP | DGK | 8 | 2500 | 358.0 | 335.0 | 35.0 |
| TL7700CDGKT | VSSOP | DGK | 8 | 250 | 358.0 | 335.0 | 35.0 |
| TL7700CPSR | SO | PS | 8 | 2000 | 367.0 | 367.0 | 38.0 |
| TL7700CPWR | TSSOP | PW | 8 | 2000 | 367.0 | 367.0 | 35.0 |
| TL7700CPWRG4 | TSSOP | PW | 8 | 2000 | 367.0 | 367.0 | 35.0 |

P (R-PDIP-T8)

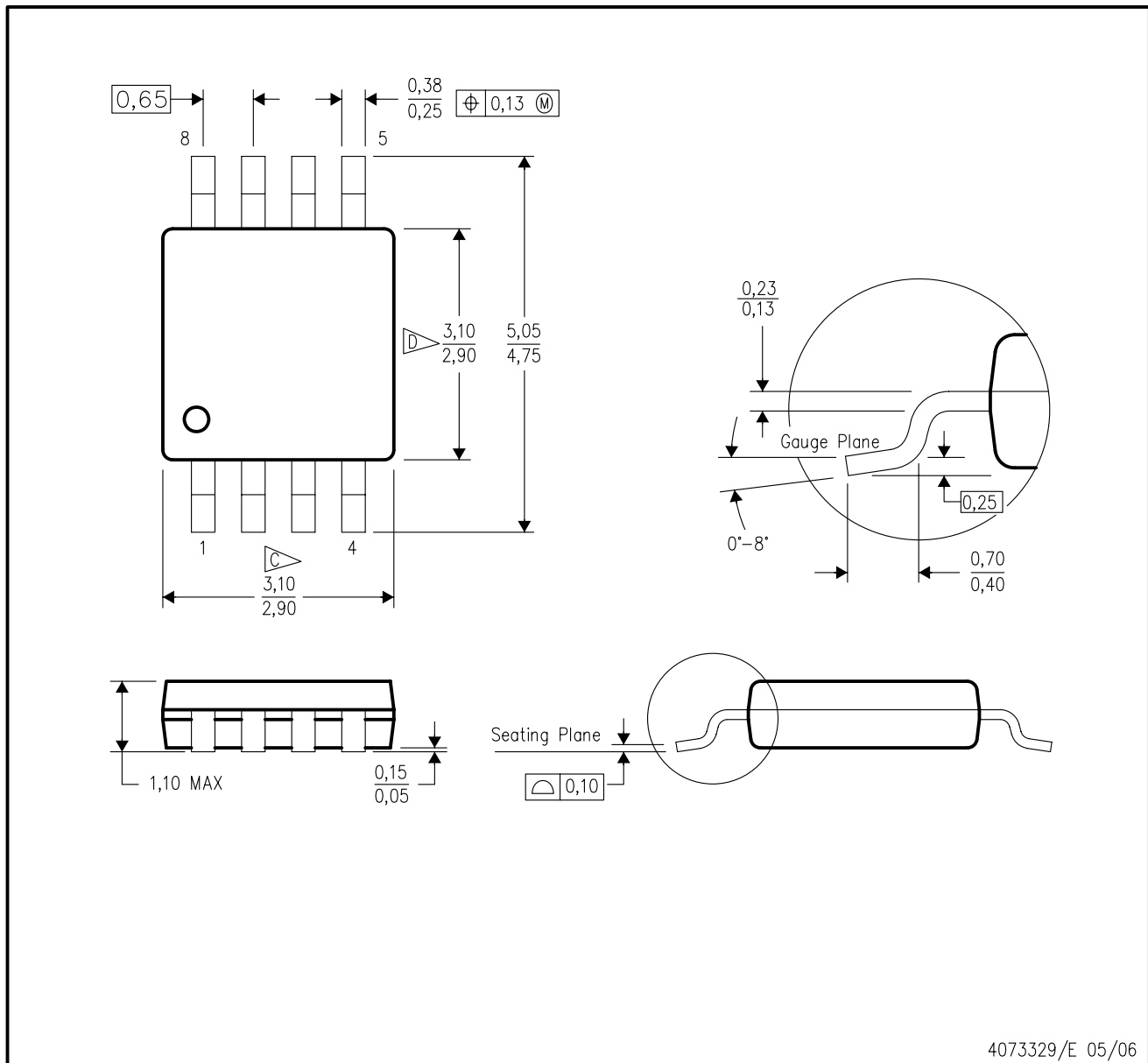
PLASTIC DUAL-IN-LINE PACKAGE



- 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.

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4073329/E 05/06

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

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

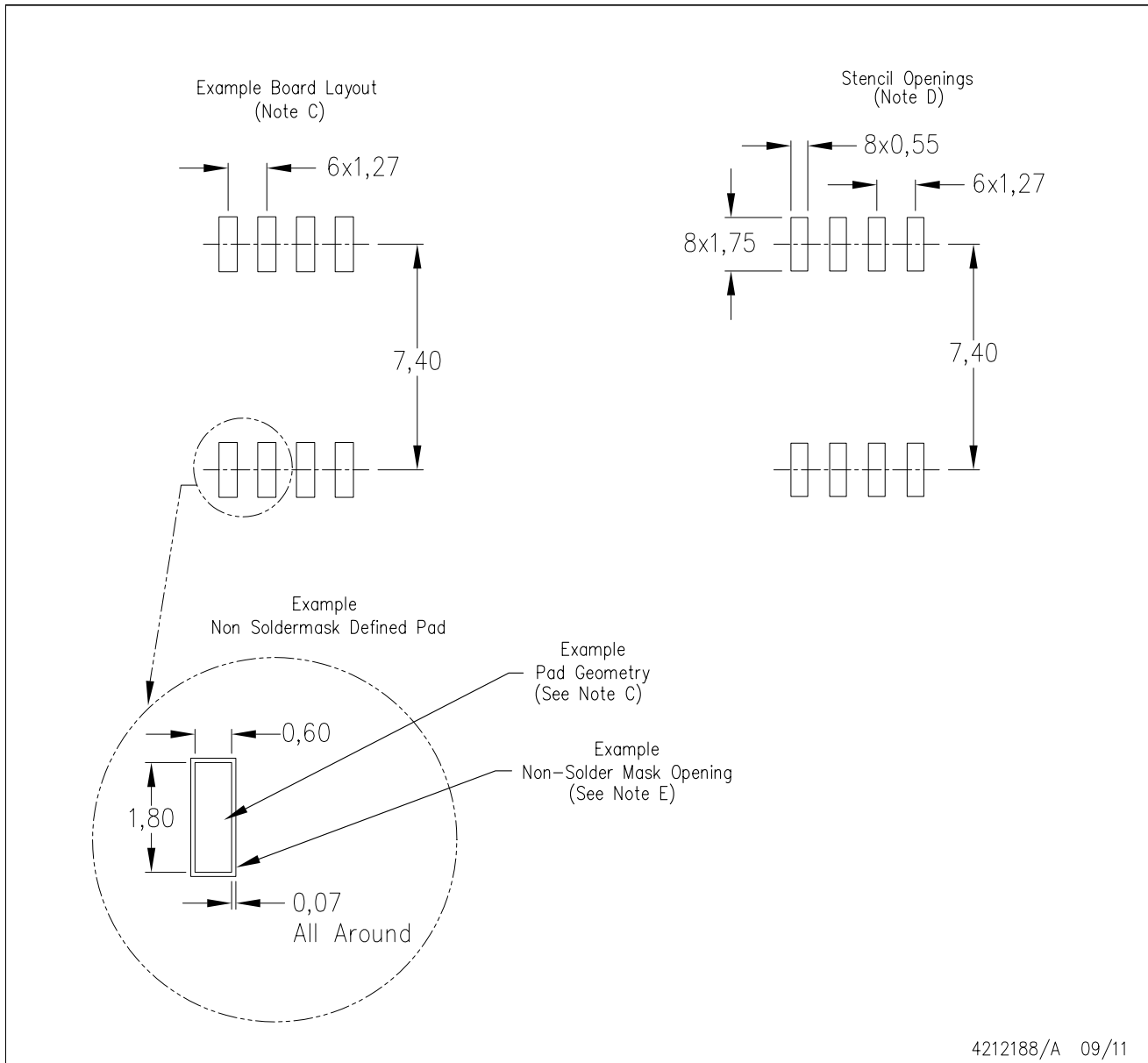


4040063/C 03/03

- 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.

PS (R-PDSO-G8)

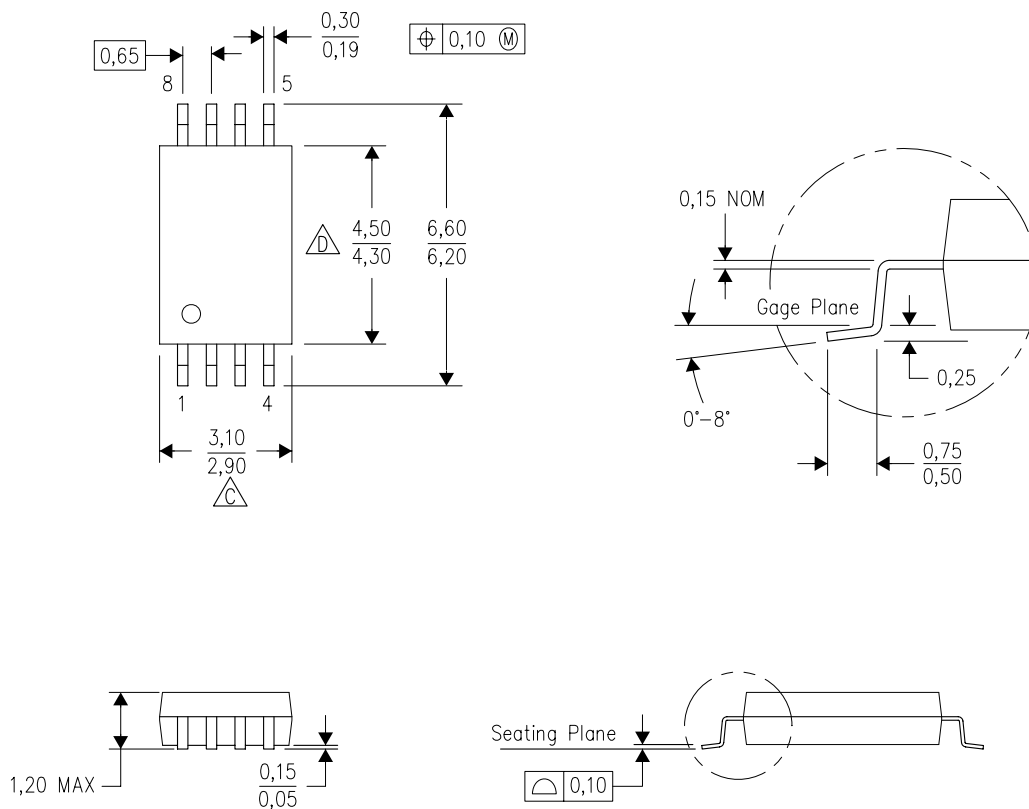
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4040064-2/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.
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