SLVS074E-JANUARY 1983-REVISED FEBRUARY 2005

FEATURES

- Complete PWM Power-Control Circuitry
- Uncommitted Outputs for 200-mA Sink or Source Current
- Output Control Selects Single-Ended or Push-Pull Operation
- Internal Circuitry Prohibits Double Pulse at Either Output
- Variable Dead Time Provides Control Over Total Range
- Internal Regulator Provides a Stable 5-V Reference Supply With 5% Tolerance
- Circuit Architecture Allows Easy Synchronization

D, DB, N, NS, OR PW PACKAGE (TOP VIEW) 1IN+ Γ 16 1 2IN+ 1IN- 🛮 2 15 **∏** 2IN− FEEDBACK 13 14 ∏ REF DTC ¶ 4 13 OUTPUT CTRL 12 🛮 V_{CC} CT [] 5 RT 6 11 C2 GND 7 10 E2 C1 [8 9 🛮 E1

DESCRIPTION

The TL494 incorporates all the functions required in the construction of a pulse-width-modulation (PWM) control circuit on a single chip. Designed primarily for power-supply control, this device offers the flexibility to tailor the power-supply control circuitry to a specific application.

The TL494 contains two error amplifiers, an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5-V, 5%-precision regulator, and output-control circuits.

The error amplifiers exhibit a common-mode voltage range from -0.3 V to $V_{CC}-2$ V. The dead-time control comparator has a fixed offset that provides approximately 5% dead time. The on-chip oscillator can be bypassed by terminating RT to the reference output and providing a sawtooth input to CT, or it can drive the common circuits in synchronous multiple-rail power supplies.

The uncommitted output transistors provide either common-emitter or emitter-follower output capability. The TL494 provides for push-pull or single-ended output operation, which can be selected through the output-control function. The architecture of this device prohibits the possibility of either output being pulsed twice during push-pull operation.

The TL494C is characterized for operation from 0°C to 70°C. The TL494I is characterized for operation from -40°C to 85°C.

AVAILABLE OPTIONS

| | PACKAGED DEVICES(1) | | | | | |
|----------------|---------------------|--------------------|--------------------|---------------------------------|--------------------------------------|--|
| T _A | SMALL OUTLINE (D) | PLASTIC DIP (N) | SMALL OUTLINE (NS) | SHRINK SMALL OUTLINE (DB) | THIN SHRINK SMALL OUTLINE (PW) | |
| 0°C to 70°C | TL494CD | TL494CN | TL494CNS | TL494CDB | TL494CPW | |
| -40°C to 85°C | TL494ID | TL494IN | _ | _ | _ | |

(1) The D, DB, NS, and PW packages are available taped and reeled. Add the suffix R to device type (e.g., TL494CDR).



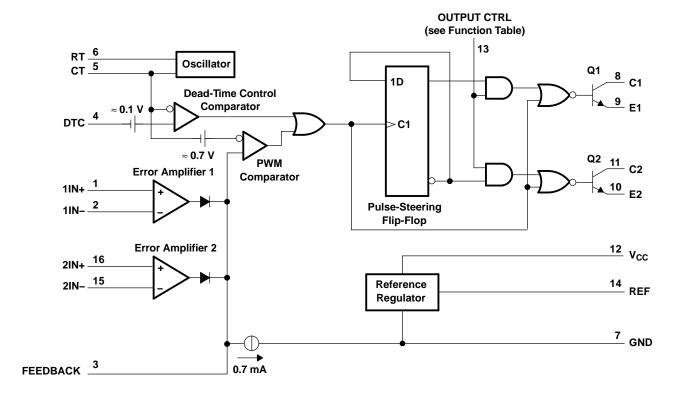
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



FUNCTION TABLE

| INPUT TO OUTPUT CTRL | OUTPUT FUNCTION |
|----------------------|---------------------------------|
| $V_I = GND$ | Single-ended or parallel output |
| $V_I = V_{ref}$ | Normal push-pull operation |

FUNCTIONAL BLOCK DIAGRAM





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Absolute Maximum Ratings⁽¹⁾

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

| | | | MIN MAX | UNIT |
|------------------|--|--------------------|-----------------------|------|
| V_{CC} | Supply voltage ⁽²⁾ | | 41 | V |
| VI | Amplifier input voltage | | V _{CC} + 0.3 | V |
| Vo | Collector output voltage | | 41 | V |
| Io | Collector output current | | 250 | mA |
| | | D package | 73 | |
| | | DB package | 82 | |
| θ_{JA} | Package thermal impedance (3)(4) | N package | 67 | °C/W |
| | | NS package | 64 | |
| | | PW package | 108 | |
| | Lead temperature 1,6 mm (1/16 inch) from c | ase for 10 seconds | 260 | °C |
| T _{stg} | Storage temperature range | | -65 150 | °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.

Recommended Operating Conditions

| | | | MIN | MAX | UNIT |
|-----------------|--|--------|------|---------------------|-----------|
| V _{CC} | Supply voltage | | 7 | 40 | V |
| VI | Amplifier input voltage | | -0.3 | V _{CC} – 2 | V |
| Vo | Collector output voltage | | | 40 | V |
| | Collector output current (each transistor) | | | 200 | mA |
| | Current into feedback terminal | | | 0.3 | mA |
| fosc | Oscillator frequency | | 1 | 300 | kHz |
| C _T | Timing capacitor | | 0.47 | 10000 | nF |
| R _T | Timing resistor | | 1.8 | 500 | $k\Omega$ |
| _ | T. On and the office of the constant | TL494C | 0 | 70 | °C |
| T _A | Operating free-air temperature | TL494I | -40 | 85 | C |

All voltages are with respect to the network ground terminal. Maximum power dissipation is a function of $T_J(max)$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperatire is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability. The package thermal impedance is calculated in accordance with JESD 51-7.

TL494 PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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Electrical Characteristics

over recommended operating free-air temperature range, V_{CC} = 15 V, f = 10 kHz (unless otherwise noted)

Reference Section

| PARAMETER | TEST CONDITIONS(1) | | TL494C, TL494I | | | |
|---|-----------------------------------|------|--------------------|------|------|--|
| FARAMETER | TEST CONDITIONS(*) | MIN | TYP ⁽²⁾ | MAX | UNIT | |
| Output voltage (REF) | I _O = 1 mA | 4.75 | 5 | 5.25 | V | |
| Input regulation | V _{CC} = 7 V to 40 V | | 2 | 25 | mV | |
| Output regulation | I _O = 1 mA to 10 mA | | 1 | 15 | mV | |
| Output voltage change with temperature | $\Delta T_A = MIN \text{ to MAX}$ | | 2 | 10 | mV/V | |
| Short-circuit output current ⁽³⁾ | REF = 0 V | | 25 | | mA | |

- (1) For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
- (2) All typical values, except for parameter changes with temperature, are at $T_A = 25$ °C.
- (3) Duration of short circuit should not exceed one second.

Oscillator Section

 $C_T = 0.01 \mu F$, $R_T = 12 k\Omega$ (see Figure 1)

| DADAMETER | TEST CONDITIONS ⁽¹⁾ | TL494C, TL494I | LINIT |
|--|---|---------------------------|----------|
| PARAMETER | TEST CONDITIONS(*) | MIN TYP ⁽²⁾ MA | X |
| Frequency | | 10 | kHz |
| Standard deviation of frequency ⁽³⁾ | All values of V _{CC} , C _T , R _T , and T _A constant | 100 | Hz/kHz |
| Frequency change with voltage | V _{CC} = 7 V to 40 V, T _A = 25°C | 1 | Hz/kHz |
| Frequency change with temperature (4) | $\Delta T_A = MIN \text{ to MAX}$ | | 0 Hz/kHz |

- (1) For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
- 2) All typical values, except for parameter changes with temperature, are at $T_A = 25$ °C.
- (3) Standard deviation is a measure of the statistical distribution about the mean as derived from the formula:

$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} (x_n - \overline{X})^2}{N-1}}$$

(4) Temperature coefficient of timing capacitor and timing resistor are not taken into account.

Error-Amplifier Section

See Figure 2

| DADAMETED | TEST CONDITIONS | TL494C, TL494I | | | LINUT |
|----------------------------------|--|--------------------------------|--------------------|-----|-------|
| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
| Input offset voltage | V _O (FEEDBACK) = 2.5 V | | 2 | 10 | mV |
| Input offset current | V _O (FEEDBACK) = 2.5 V | | 25 | 250 | nA |
| Input bias current | V _O (FEEDBACK) = 2.5 V | | 0.2 | 1 | μΑ |
| Common-mode input voltage range | V _{CC} = 7 V to 40 V | -0.3 to V _{CC} - 2 | | | V |
| Open-loop voltage amplification | $\Delta V_{O} = 3 \text{ V}, V_{O} = 0.5 \text{ V} \text{ to } 3.5 \text{ V}, R_{L} = 2 \text{ k}\Omega$ | 70 | 95 | | dB |
| Unity-gain bandwidth | $V_O = 0.5 \text{ V to } 3.5 \text{ V}, R_L = 2 \text{ k}\Omega$ | | 800 | | kHz |
| Common-mode rejection ratio | $\Delta V_{O} = 40 \text{ V}, T_{A} = 25^{\circ}\text{C}$ | 65 | 80 | | dB |
| Output sink current (FEEDBACK) | $V_{ID} = -15$ mV to -5 V, V (FEEDBACK) = 0.7 V | 0.3 | 0.7 | | mA |
| Output source current (FEEDBACK) | V _{ID} = 15 mV to 5 V, V (FEEDBACK) = 3.5 V | -2 | | | mA |

(1) All typical values, except for parameter changes with temperature, are at $T_A = 25$ °C.



Electrical Characteristics

over recommended operating free-air temperature range, V_{CC} = 15 V, f = 10 kHz (unless otherwise noted)

Output Section

| PARAMETER | | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|--------------------------------------|------------------|--|-----|--------------------|------|------|
| Collector off-state current | | $V_{CE} = 40 \text{ V}, V_{CC} = 40 \text{ V}$ | | 2 | 100 | μΑ |
| Emitter off-state current | | $V_{CC} = V_{C} = 40 \text{ V}, V_{E} = 0$ | | | -100 | μΑ |
| Collector emitter acturation valtage | Common emitter | V _E = 0, I _C = 200 mA | | 1.1 | 1.3 | V |
| Collector-emitter saturation voltage | Emitter follower | $V_{O(C1 \text{ or } C2)} = 15 \text{ V}, I_E = -200 \text{ mA}$ | | 1.5 | 2.5 | |
| Output control input current | | $V_I = V_{ref}$ | | | 3.5 | mA |

⁽¹⁾ All typical values, except for temperature coefficient, are at T_A = 25°C.

Dead-Time Control Section

See Figure 1

| PARAMETER | TEST CONDITIONS | MIN TY | P ⁽¹⁾ | MAX | UNIT |
|---|---|--------|------------------|-----|------|
| Input bias current (DEAD-TIME CTRL) | V _I = 0 to 5.25 V | | -2 | -10 | μΑ |
| Maximum duty cycle, each output | V_I (DEAD-TIME CTRL) = 0, C_T = 0.01 μF , R_T = 12 $k\Omega$ | | 45 | | % |
| Input throughold voltage (DEAD TIME CTPL) | Zero duty cycle | 3 | | 3.3 | V |
| Input threshold voltage (DEAD-TIME CTRL) | Maximum duty cycle | 0 | | | V |

⁽¹⁾ All typical values, except for temperature coefficient, are at T_A = 25°C.

PWM Comparator Section

See Figure 1

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|------------------------------------|----------------------|-----|--------------------|-----|------|
| Input threshold voltage (FEEDBACK) | Zero duty cyle | | 4 | 4.5 | ٧ |
| Input sink current (FEEDBACK) | V (FEEDBACK) = 0.7 V | 0.3 | 0.7 | | mA |

⁽¹⁾ All typical values, except for temperature coefficient, are at T_A = 25°C.

Total Device

| PARAMETER | TEST CONDIT | IONS | MIN TYP(1) | MAX | UNIT |
|-------------------------|--|------------------------|------------|-----|------|
| Ctandley augusts august | $R_T = V_{ref}$ | V _{CC} = 15 V | 6 | 10 | A |
| Standby supply current | All other inputs and outputs open | V _{CC} = 40 V | 9 | 15 | mA |
| Average supply current | V _I (DEAD-TIME CTRL) = 2 V, See Fig | ure 1 | 7.5 | | mA |

⁽¹⁾ All typical values, except for temperature coefficient, are at $T_A = 25$ °C.

Switching Characteristics

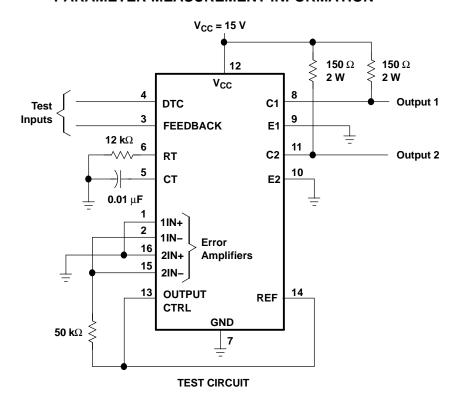
 $T_A = 25^{\circ}C$

| PARAMETER | TEST CONDITIONS | MIN TYP(1) | MAX | UNIT |
|-----------|--|------------|-----|------|
| Rise time | Common emitter configuration. See Figure 2 | 100 | 200 | ns |
| Fall time | Common-emitter configuration, See Figure 3 | 25 | 100 | ns |
| Rise time | Emitter fellower configuration Con Figure 4 | 100 | 200 | ns |
| Fall time | Emitter-follower configuration, See Figure 4 | 40 | 100 | ns |

⁽¹⁾ All typical values, except for temperature coefficient, are at $T_A = 25$ °C.



PARAMETER MEASUREMENT INFORMATION



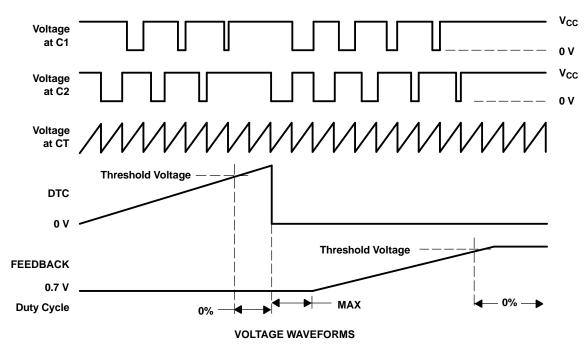


Figure 1. Operational Test Circuit and Waveforms



PARAMETER MEASUREMENT INFORMATION

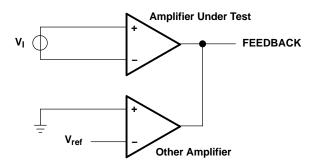
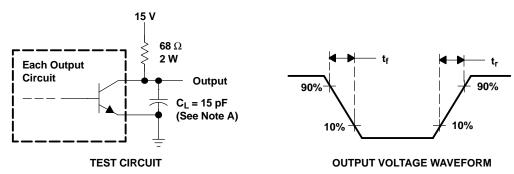
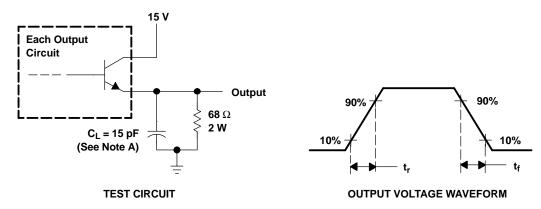


Figure 2. Amplifier Characteristics



NOTE A: C_L includes probe and jig capacitance.

Figure 3. Common-Emitter Configuration



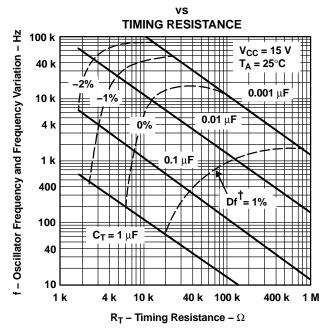
NOTE A: C_L includes probe and jig capacitance.

Figure 4. Emitter-Follower Configuration



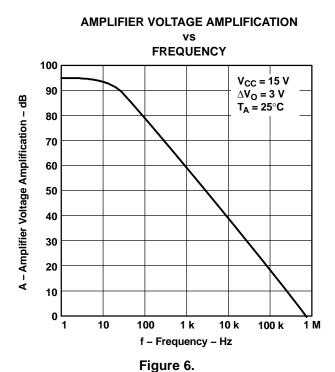
TYPICAL CHARACTERISTICS

OSCILLATOR FREQUENCY AND FREQUENCY VARIATION†



 $^{^{\}dagger}$ Frequency variation (Δf) is the change in oscillator frequency that occurs over the full temperature range.

Figure 5.



8



PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | e Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|-----------------|--------------------|------|----------------|---|------------------|------------------------------|
| TL494CD | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDBR | ACTIVE | SSOP | DB | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDBRE4 | ACTIVE | SSOP | DB | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDBRG4 | ACTIVE | SSOP | DB | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDRE4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CDRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CJ | OBSOLETE | CDIP | J | 16 | | TBD Call TI C | | Call TI |
| TL494CN | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TL494CNE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TL494CNSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CNSRG4 | ACTIVE | so | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CPW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CPWE4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & CU NIPDAU Level-1-2 no Sb/Br) | | Level-1-260C-UNLIM |
| TL494CPWG4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CPWLE | OBSOLETE | TSSOP | PW | 16 | | TBD | Call TI | Call TI |
| TL494CPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CPWRE4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494CPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494ID | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494IDE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494IDG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494IDR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| | | | | | | | | |



PACKAGE OPTION ADDENDUM

28-May-2007

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|-----------------|--------------------|------|----------------|-------------------------|------------------|------------------------------|
| | | | | | | no Sb/Br) | | |
| TL494IDRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TL494IN | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TL494INE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TL494MJ | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI |
| TL494MJB | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION





| | Dimension designed to accommodate the component width |
|----|---|
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

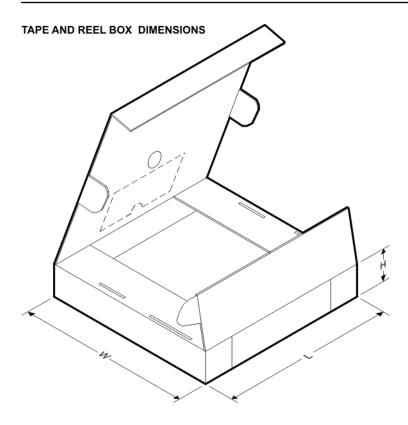
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------|-----------------|--------------------|----|------|--------------------------|--------------------------|---------|---------|---------|------------|-----------|------------------|
| TL494CDBR | SSOP | DB | 16 | 2000 | 330.0 | 16.4 | 8.2 | 6.6 | 2.5 | 12.0 | 16.0 | Q1 |
| TL494CDR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| TL494CDR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| TL494CNSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| TL494CPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TL494IDR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |





*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL494CDBR | SSOP | DB | 16 | 2000 | 346.0 | 346.0 | 33.0 |
| TL494CDR | SOIC | D | 16 | 2500 | 346.0 | 346.0 | 33.0 |
| TL494CDR | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| TL494CNSR | SO | NS | 16 | 2000 | 346.0 | 346.0 | 33.0 |
| TL494CPWR | TSSOP | PW | 16 | 2000 | 346.0 | 346.0 | 29.0 |
| TL494IDR | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |

14 LEADS SHOWN



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package is hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
- E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

MECHANICAL DATA

NS (R-PDSO-G**)

14-PINS SHOWN

PLASTIC SMALL-OUTLINE PACKAGE



- 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.



PW (R-PDSO-G**)

14 PINS SHOWN

PLASTIC SMALL-OUTLINE PACKAGE



NOTES: A. All linear dimensions are in millimeters.

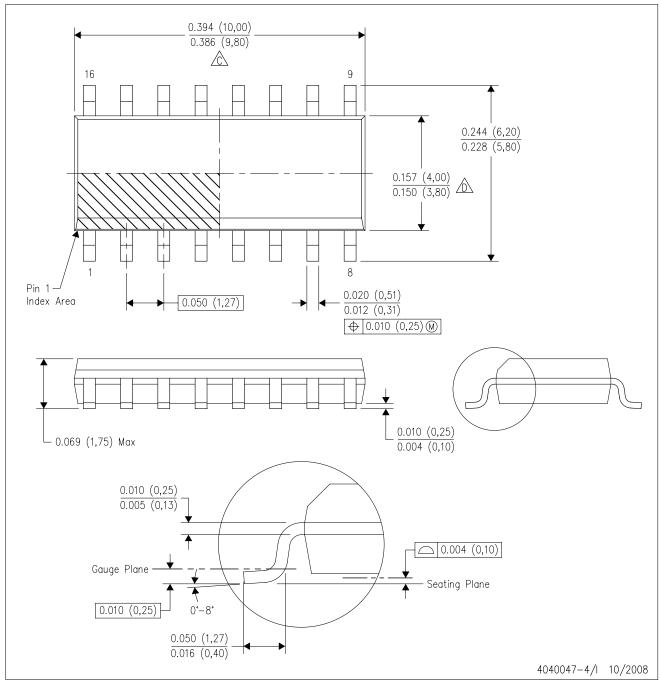
B. This drawing is subject to change without notice.

C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.

D. Falls within JEDEC MO-153

D (R-PDSO-G16)

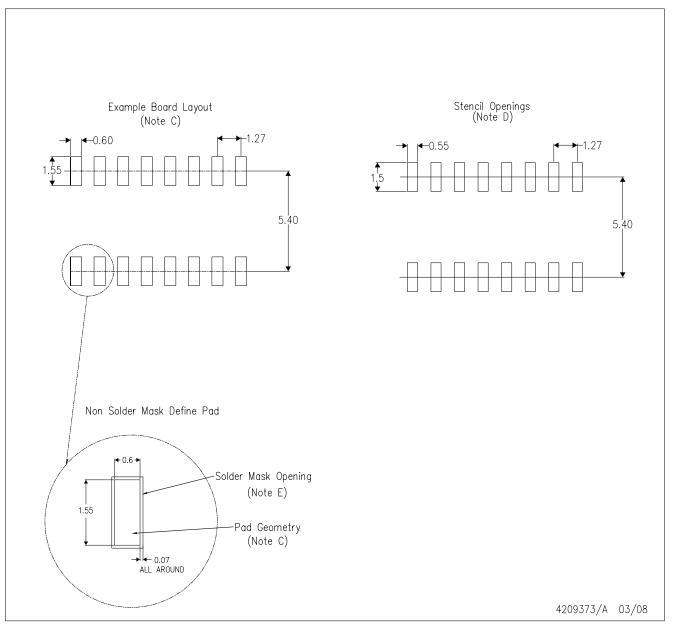
PLASTIC SMALL-OUTLINE PACKAGE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
- Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS-012 variation AC.



D(R-PDSO-G16)



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Refer to IPC7351 for alternate board design.
- 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
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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