# TC1300

# 300 mA CMOS LDO with Shutdown, Bypass and Independent Delayed Reset Function

## Features

- LDO with Integrated Microcontroller Reset Monitor Functionality
- Low Input Supply Current (80 µA, typical)
- Very Low Dropout Voltage
- 10 µsec (typ.) Wake-Up Time from $\overline{\text{SHDN}}$
- 300 mA Output Current
- Standard or Custom Output and Detected Voltages
- Power-Saving Shutdown Mode
- Bypass Input for Quiet Operation
- Separate Input for Detected Voltage
- 140 msec Minimum $\overline{\text{RESET}}$ Output Duration
- Space-Saving MSOP Package
- Specified Junction Temperature Range: -40°C to +125°C

## Applications

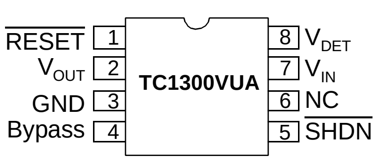
- Battery-Operated Systems
- Portable Computers
- Medical Instruments
- Pagers
- Cellular / GSM / PHS Phones

## Related Literature

- AN765, "Using Microchip's Micropower LDOs", DS00765.
- AN766, "Pin-Compatible CMOS Upgrades to Bipolar LDOs", DS00766.
- AN792, "A Method to Determine How Much Power a SOT23 Can Dissipate in an Application", DS00792.

## Package Type

**MSOP**



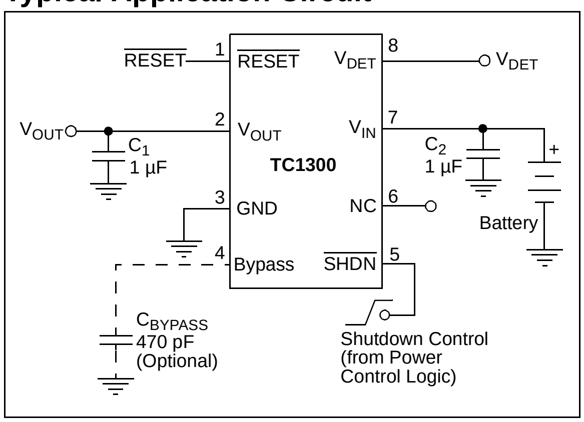

## General Description

The TC1300 combines a low dropout regulator and a microcontroller reset monitor in an 8-Pin MSOP package. Total supply current is 80 µA (typical), 20 to 60 times lower than bipolar regulators.

The TC1300 has a precise output with a typical accuracy of ±0.5%. Other key features include low noise operation, low dropout voltage and internal feedforward compensation for fast response to step changes in load. The TC1300 has both over-temperature and over-current protection. When the shutdown control ($\overline{\text{SHDN}}$) is low, the regulator output voltage falls to zero, $\overline{\text{RESET}}$ output remains valid and supply current is reduced to 30 µA (typical). The TC1300 is rated for 300 mA of output current and stable with a 1 µF output capacitor.

An active-low $\overline{\text{RESET}}$ is asserted when the detected voltage ($V_{DET}$) falls below the reset voltage threshold. The $\overline{\text{RESET}}$ output remains low for 300 msec (typical) after $V_{DET}$ rises above reset threshold. The TC1300 also has a fast wake-up response time (10 µsec., typical) when released from shutdown.

## Typical Application Circuit



# 1.0 ELECTRICAL CHARACTERISTICS

## Absolute Maximum Ratings*

Input Voltage ....................................................................6.5V
Output Voltage ................................ ($V_{SS}$ - 0.3) to ($V_{IN}$ + 0.3)
Power Dissipation ......................... Internally Limited **(Note 6)**
Operating Junction Temperature, $T_J$ ....... – 40°C < $T_J$< 150°C
Maximum Junction Temperature, Tj ............................. 150°C
Storage Temperature..................................– 65°C to +150°C
Maximum Voltage on Any Pin ............. ($V_{SS}$-0.3) to ($V_{IN}$+0.3)

***Notice:** Stresses above those listed under "maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

## PIN DESCRIPTIONS

| Pin | Description |
|---|---|
| $\overline{RESET}$ | $\overline{RESET}$ output remains low while $V_{DET}$ is below the reset voltage threshold and for 300 msec after $V_{DET}$ rises above reset threshold. |
| $V_{OUT}$ | Regulated Voltage Output |
| GND | Ground Terminal |
| Bypass | Reference Bypass Input. Connecting an optional 470 pF to this input further reduces output noise. |
| $\overline{SHDN}$ | Shutdown Control Input. The regulator is fully enabled when a logic high is applied to this input. The regulator enters shutdown when a logic low is applied to this input. During shutdown, regulator output voltage falls to zero, $\overline{RESET}$ output remains valid and supply current is reduced to 30 µA (typ.). |
| NC | No connect |
| $V_{IN}$ | Power Supply Input |
| $V_{DET}$ | Detected Input Voltage. $V_{DET}$ and $V_{IN}$ can be connected together. |

## ELECTRICAL CHARACTERISTICS

$V_{IN}$ = $V_{OUT}$ + 1V, $I_L$ = 0.1 mA, $C_L$ = 3.3 µF, $\overline{SHDN}$ > $V_{IH}$, $T_A$ = 25°C, unless otherwise noted. **BOLDFACE** type specifications apply for junction temperature **(Note 8)** of -40°C to +125°C.

| Parameters | Sym | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| Input Operating Voltage | $V_{IN}$ | **2.7** | — | **6.0** | V | **Note 7** |
| Maximum Output Current | $IOUT_{MAX}$ | **300** | — | — | mA | |
| Output Voltage | $V_{OUT}$ | —<br>**$V_R$ - 2.5%** | $V_R$ ± 0.5%<br>— | —<br>**$V_R$ + 2.5%** | V | **Note 1** |
| $V_{OUT}$ Temperature Coefficient | $\Delta V_{OUT}/\Delta T$ | — | **25** | — | ppm/°C | **Note 2** |
| Line Regulation | $\Delta V_{OUT}/\Delta V_{IN}$ | — | 0.02 | **0.35** | % | $(V_R + 1V) \leq V_{IN} \leq 6V$ |
| Load Regulation | $\Delta V_{OUT}/V_{OUT}$ | — | 0.5 | **2.0** | % | $I_L$ = 0.1 mA to $I_{OUTMAX}$, **Note 3** |

**Note 1:** $V_R$ is the regulator output voltage setting.

**2:** $$TCV_{OUT} = \frac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$$

**3:** Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

**4:** Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at a 1V differential.

**5:** Thermal Regulation is defined as the change in output voltage at a time t after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to $I_{LMAX}$ at $V_{IN}$ = 6V for t = 10 msec.

**6:** The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction-to-air (i.e. $T_A$, $T_J$, $\theta_{JA}$). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. Please see Section 4.0, "Thermal Considerations", of this data sheet for more details.

**7:** The minimum $V_{IN}$ has to meet two conditions: $V_{IN} \geq 2.7V$ and $V_{IN} \geq (V_R + V_{DROPOUT})$.

**8:** The junction temperature of the device is approximated by soaking the device under test at an ambient temperature equal to the desired junction temperature. The test time is small enough such that the rise in the junction temperature over the ambient temperature is not significant.

## ELECTRICAL CHARACTERISTICS (CONTINUED)

$V_{IN} = V_{OUT} + 1V$, $I_L = 0.1$ mA, $C_L = 3.3$ µF, $\overline{SHDN} > V_{IH}$, $T_A = 25°C$, unless otherwise noted. **BOLDFACE** type specifications apply for junction temperature **(Note 8)** of -40°C to +125°C.

| Parameters | Sym | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| Dropout Voltage **(Note 4)** | $V_{IN} – V_{OUT}$ | — | 1<br>70<br>210 | **30**<br>**130**<br>**390** | mV | $I_L = 0.1$ mA<br>$I_L = 100$ mA<br>$I_L = 300$ mA |
| Supply Current | $I_{SS1}$ | — | 80 | **160** | µA | $\overline{SHDN} = V_{IH}$ |
| Shutdown Supply Current | $I_{SS2}$ | — | 30 | **60** | µA | $\overline{SHDN} = 0V$ |
| Power Supply Rejection Ratio | PSRR | — | 60 | — | dB | f ≤ 1 kHz, $C_{BYPASS} = 1$ nF |
| Output Short Circuit Current | $I_{OUTSC}$ | — | 800 | 1200 | mA | $V_{OUT} = 0V$ |
| Thermal Regulation | $\Delta V_{OUT}/\Delta P_D$ | — | 0.04 | — | %/W | **Note 5** |
| Output Noise | eN | — | 900 | — | nV/Hz | f < 1 kHz, $C_{OUT} = 1$ µF,<br>$R_{LOAD} = 50\ \Omega$,<br>$C_{BYPASS} = 1$ nF |
| Wake-Up Time<br>(from Shutdown Mode) | $t_{WK}$ | — | 10 | 20 | µsec | $C_{IN} = 1$ µF, $V_{IN} = 5V$,<br>$C_{OUT} = 4.7$ µF, $I_L = 30$ mA,<br>See Figure 3-2 |
| Settling Time<br>(from Shutdown Mode) | ts | — | 50 | — | µsec | $C_{IN} = 1$ µF, $V_{IN} = 5V$<br>$C_{OUT} = 4.7$ µF<br>$I_L = 30$ mA, See Figure 3-2 |
| Thermal Shutdown Die Temperature | $T_{SD}$ | — | 150 | — | °C | |
| Thermal Shutdown Hysteresis | $T_{HYS}$ | — | 10 | — | °C | |
| Thermal Resistance Junction to Case | RthetaJA | — | 200 | — | °C/Watt | EIA/JEDEC JESD51-751-7 4-Layer Board |
| $\overline{SHDN}$ Input High Threshold | $V_{IH}$ | **45** | — | — | $\%V_{IN}$ | $V_{IN} = 2.5V$ to $6.0V$ |
| $\overline{SHDN}$ Input Low Threshold | $V_{IL}$ | — | — | **15** | $\%V_{IN}$ | $V_{IN} = 2.5V$ to $6.0V$ |

**Note 1:** $V_R$ is the regulator output voltage setting.

**2:** $$TCV_{OUT} = \frac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$$

**3:** Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

**4:** Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at a 1V differential.

**5:** Thermal Regulation is defined as the change in output voltage at a time t after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to $I_{LMAX}$ at $V_{IN} = 6V$ for t = 10 msec.

**6:** The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction-to-air (i.e. $T_A$, $T_J$, $\theta_{JA}$). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. Please see Section 4.0, “Thermal Considerations”, of this data sheet for more details.

**7:** The minimum $V_{IN}$ has to meet two conditions: $V_{IN} \geq 2.7V$ and $V_{IN} \geq (V_R + V_{DROPOUT})$.

**8:** The junction temperature of the device is approximated by soaking the device under test at an ambient temperature equal to the desired junction temperature. The test time is small enough such that the rise in the junction temperature over the ambient temperature is not significant.

## ELECTRICAL CHARACTERISTICS (CONTINUED)

$V_{IN} = V_{OUT} + 1V$, $I_L = 0.1$ mA, $C_L = 3.3$ µF, $\overline{SHDN} > V_{IH}$, $T_A = 25°C$, unless otherwise noted. **BOLDFACE** type specifications apply for junction temperature **(Note 8)** of -40°C to +125°C.

| Parameters | Sym | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| **$\overline{\text{RESET}}$ Output** | | | | | | |
| Voltage Range | $V_{DET}$ | 1.0<br>**1.2** | —<br>— | 6.0<br>**6.0** | V | $T_A = 0°C$ to +70°C<br>$T_A$ = – 40°C to +125°C |
| $\overline{\text{Reset}}$ Threshold | $V_{TH}$ | 2.59 | 2.63 | 2.66 | V | TC1300R-XX, $T_A$ = +25°C |
| | | **2.55** | — | **2.70** | | TC1300R-XX,<br>$T_A$ = – 40°C to +125°C |
| | | 2.36 | 2.40 | 2.43 | | TC1300Y-XX, $T_A$ = +25°C |
| | | **2.32** | — | **2.47** | | TC1300Y-XX,<br>$T_A$ = – 40°C to +125°C |
| $\overline{\text{Reset}}$ Threshold Tempco | $\Delta V_{TH} / \Delta T$ | — | 30 | — | ppm/°C | |
| $V_{DET}$ to Reset Delay | $t_{RPD}$ | — | 160 | — | µsec | $V_{DET} = V_{TH}$ to ($V_{TH}$ – 100 mV) |
| Reset Active Timeout Period | $t_{RPU}$ | **140** | 300 | **560** | msec | |
| $\overline{\text{RESET}}$ Output Voltage Low | $V_{OL}$ | — | — | 0.3 | V | $V_{DET} = V_{TH}$ min,<br>$I_{SINK}$ = 1.2 mA |
| $\overline{\text{RESET}}$ Output Voltage High | $V_{OH}$ | 0.8 $V_{DET}$ | — | — | V | $V_{DET} > V_{TH}$ max,<br>$I_{SOURCE}$ = 500 µA |

**Note 1:** $V_R$ is the regulator output voltage setting.

**2:** $$TCV_{OUT} = \frac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$$

**3:** Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

**4:** Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at a 1V differential.

**5:** Thermal Regulation is defined as the change in output voltage at a time t after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to $I_{LMAX}$ at $V_{IN}$ = 6V for t = 10 msec.

**6:** The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction-to-air (i.e. $T_A$, $T_J$, $\theta_{JA}$). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. Please see Section 4.0, “Thermal Considerations”, of this data sheet for more details.

**7:** The minimum $V_{IN}$ has to meet two conditions: $V_{IN} \geq 2.7V$ and $V_{IN} \geq (V_R + V_{DROPOUT})$.

**8:** The junction temperature of the device is approximated by soaking the device under test at an ambient temperature equal to the desired junction temperature. The test time is small enough such that the rise in the junction temperature over the ambient temperature is not significant.

## 2.0 TYPICAL CHARACTERISTICS

| | |
|---|---|
| **Note:** | The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range. |

Junction temperature ($T_J$) is approximated by soaking the device under test at an ambient temperature equal to the desired Junction temperature. The test time is small enough such that the rise in the Junction temperature over the Ambient temperature is not significant.

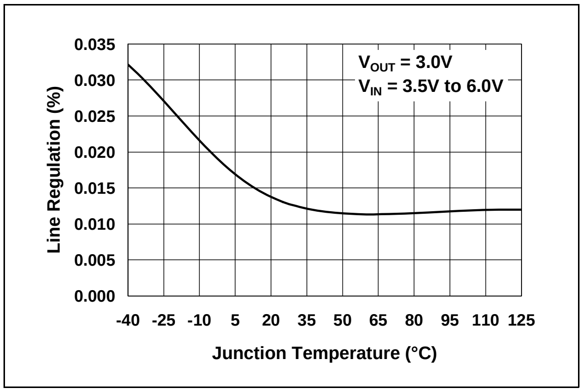



*FIGURE 2-1: Line Regulation vs. Temperature.*

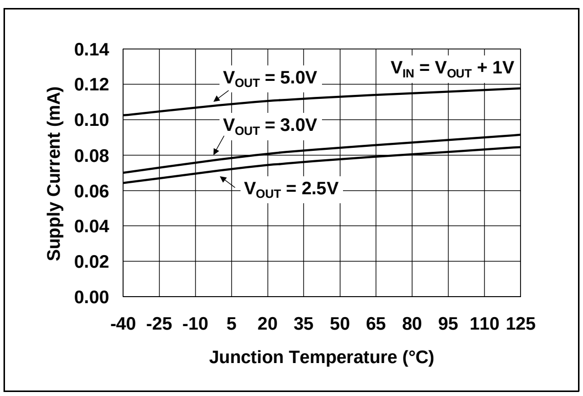



*FIGURE 2-2: Supply Current vs. Temperature.*

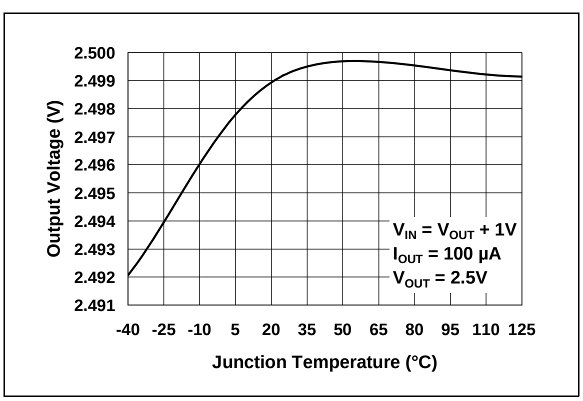



*FIGURE 2-3: Normalized $V_{OUT}$ vs. Temperature.*

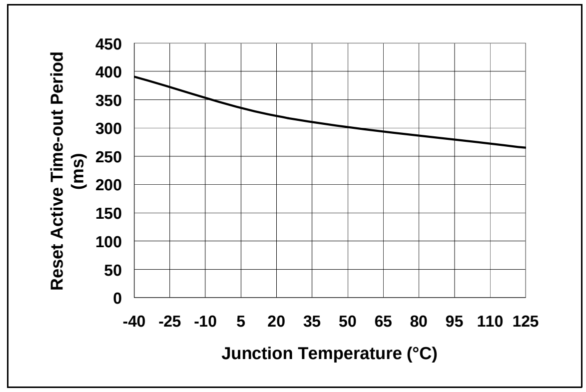



*FIGURE 2-4: Reset Active Time-out Period vs. Temperature.*

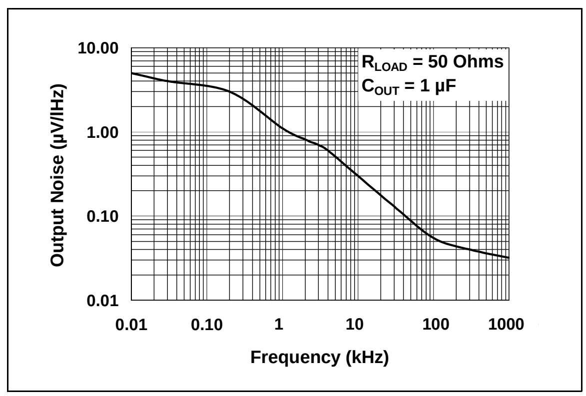



*FIGURE 2-5: Output Noise vs. Frequency.*

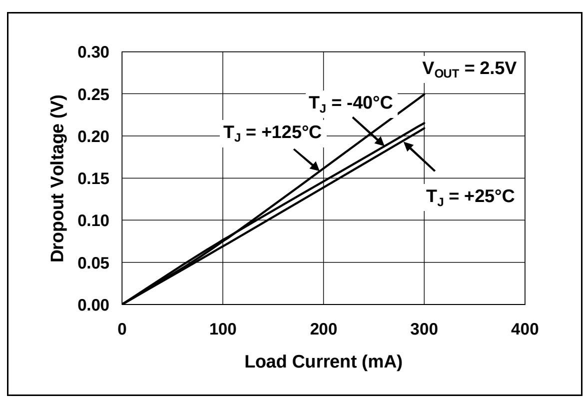



*FIGURE 2-6: Dropout Voltage vs. Load Current (2.5V).*

## 2.0 TYPICAL CHARACTERISTICS (CON'T)

Junction temperature ($T_J$) is approximated by soaking the device under test at an ambient temperature equal to the desired Junction temperature. The test time is small enough such that the rise in the Junction temperature over the Ambient temperature is not significant.

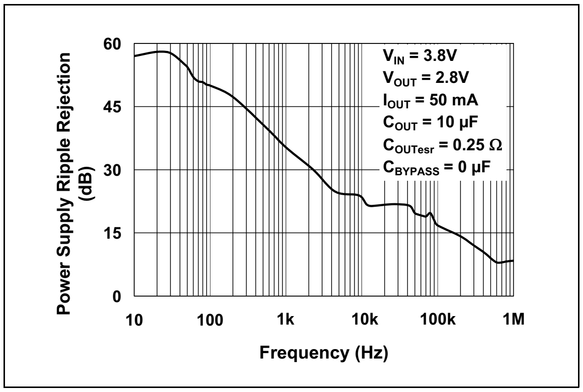



***FIGURE 2-7:*** *Power Supply Rejection Ratio vs. Frequency.*

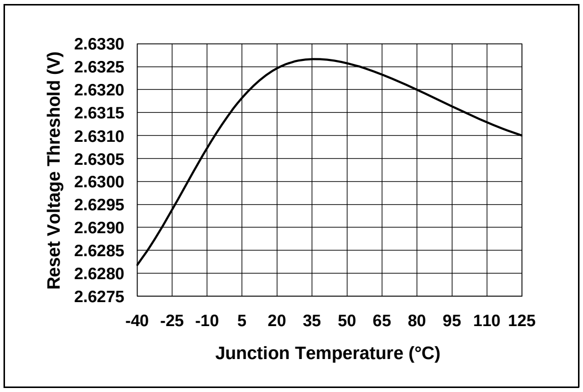



***FIGURE 2-8:*** *Reset Voltage Threshold vs. Junction Temperature.*

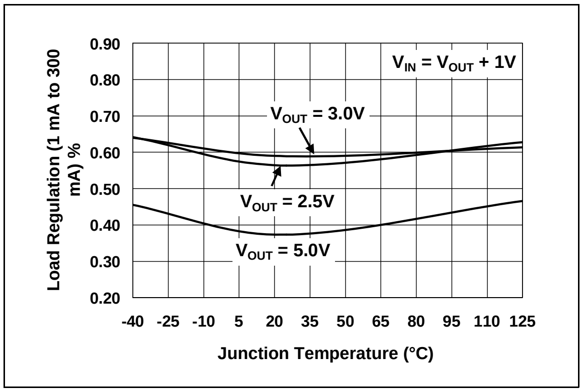



***FIGURE 2-9:*** *Load Regulation vs. Temperature.*

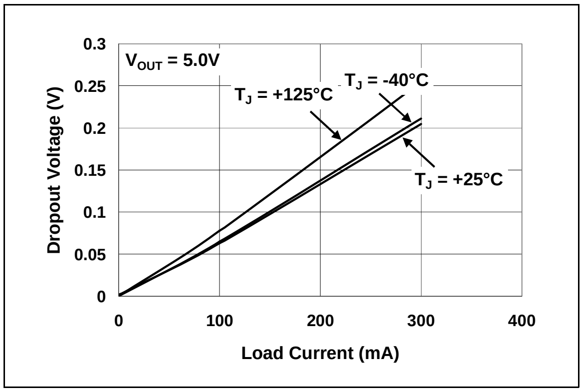



***FIGURE 2-10:*** *Dropout Voltage vs. Load Current (5.0V).*

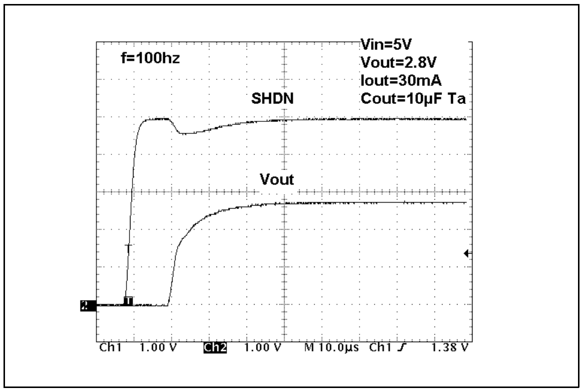



***FIGURE 2-11:*** *Wake-Up Response Time.*

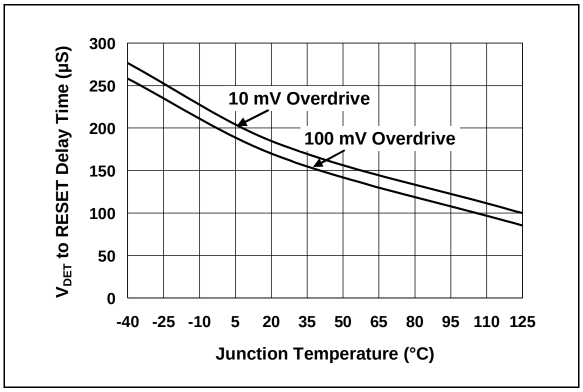



***FIGURE 2-12:*** *$V_{DET}$ to Reset Delay vs. Temperature.*

## 2.0 TYPICAL CHARACTERISTICS (CON'T)

Junction temperature ($T_J$) is approximated by soaking the device under test at an ambient temperature equal to the desired Junction temperature. The test time is small enough such that the rise in the Junction temperature over the Ambient temperature is not significant.

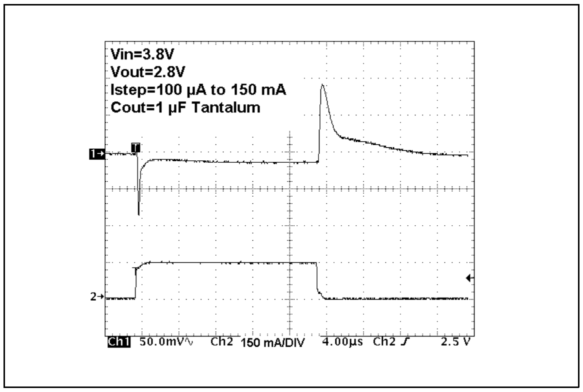



***FIGURE 2-13:*** *Load Transient Response 1 µF Output Capacitor.*

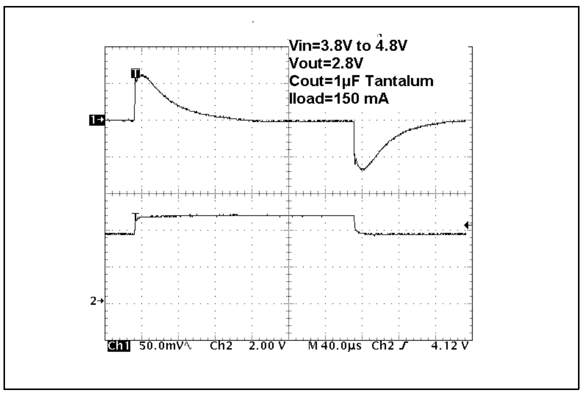



***FIGURE 2-14:*** *Line Transient Response 1 µF Output Capacitor.*

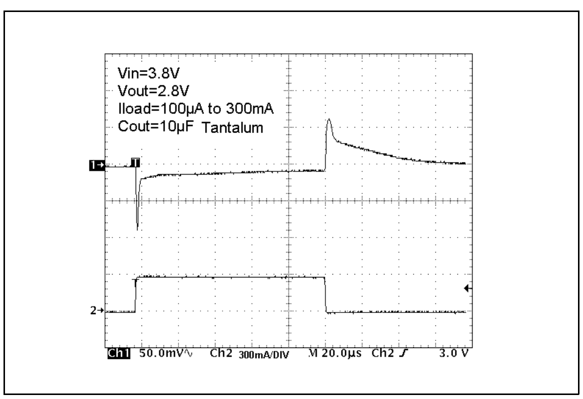



***FIGURE 2-15:*** *Load Transient Response 10 µF Output Capacitor.*

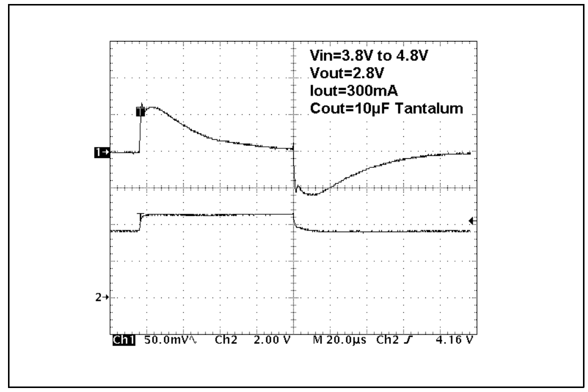



***FIGURE 2-16:*** *Line Transient Response 10 µF Output Capacitor.*

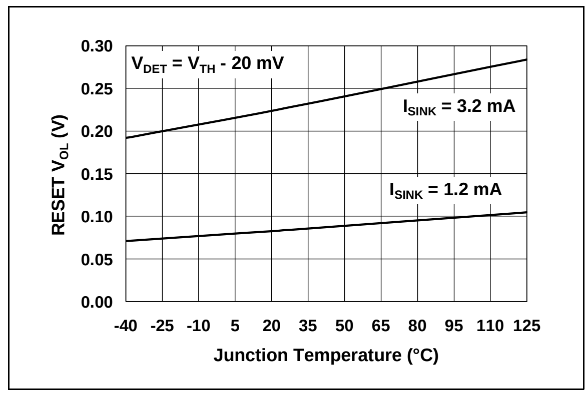



***FIGURE 2-17:*** *RESET Output Voltage Low vs. Junction Temperature.*

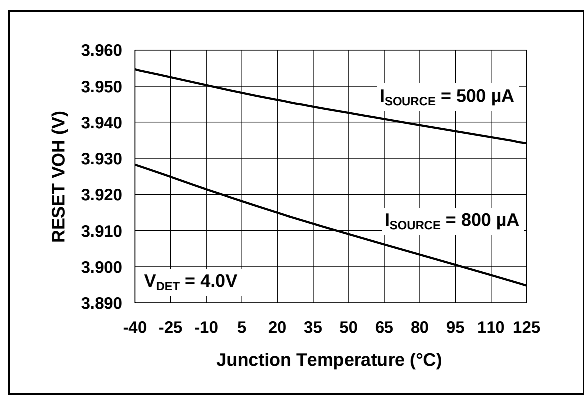



***FIGURE 2-18:*** *RESET Output Voltage High vs. Junction Temperature.*

## 3.0 DETAILED DESCRIPTION

The TC1300 is a combination of a fixed output, low dropout regulator and a microcontroller monitor/RESET. Unlike bipolar regulators, the TC1300 supply current does not increase with load current. In addition, $V_{OUT}$ remains stable and within regulation over the entire specified operating load range (0 mA to 300 mA) and operating input voltage range (2.7V to 6.0V).

Figure 3-1 shows a typical application circuit. The regulator is enabled any time the shutdown input (SHDN) is above $V_{IH}$. The regulator is shutdown (disabled) when SHDN is at or below $V_{IL}$. SHDN may be controlled by a CMOS logic gate or an I/O port of a microcontroller. If the SHDN input is not required, it should be connected directly to the input supply. While in shutdown, supply current decreases to 30 µA (typical), $V_{OUT}$ falls to zero and RESET remains valid.

### 3.1 RESET Output

The RESET output is driven active-low within 160 µsec of $V_{DET}$ falling through the reset voltage threshold. RESET is maintained active for a minimum of 140 msec after $V_{DET}$ rises above the reset threshold. The TC1300 has an active-low RESET output. The output of the TC1300 is valid down to $V_{DET}$ = 1V and is optimized to reject fast transient glitches on the $V_{DET}$ line.

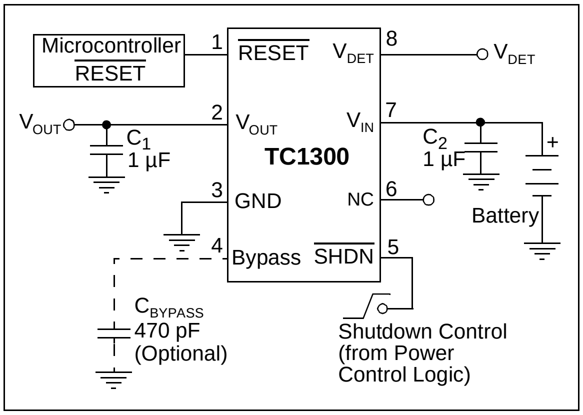



***FIGURE 3-1:*** *Typical Application Circuit.*

### 3.2 Output Capacitor

A 1 µF (min) capacitor from $V_{OUT}$ to ground is required. A 1 µF capacitor should also be connected from $V_{IN}$ to GND if there is more than 10 inches of wire between the regulator and the AC filter capacitor, or if a battery is used as the power source. As with all low dropout regulators, a minimum output capacitance is required to stabilize the output voltage. For the TC1300, a minimum of 1 µF of output capacitance is enough to stabilize the device over the entire operating load and line range. The selected output capacitor plays an important role is compensating the LDO regulator. For the TC1300, the selected output capacitor equivalent series resistance (ESR) range is 0.1 ohms to 5 ohms when using 1 µF of output capacitance, and 0.01 ohms to 5 ohms when using 10 µF of output capacitance. Because of the ESR requirement, tantalum and aluminum electrolytic capacitors are recommended. Aluminum electrolytic capacitors are not recommended for operation at temperatures below -25°C. When operating from sources other than batteries, rejection and transient responses can be improved by increasing the value of the input and output capacitors and employing passive filtering techniques.

### 3.3 Bypass Input (Optional)

An optional 470 pF capacitor connected from the Bypass input to ground reduces noise present on the internal reference, which in turn significantly reduces output noise and improves PSRR performance. This input may be left unconnected. Larger capacitor values may be used, but results in a longer time period to rated output voltage when power is initially applied.

### 3.4 Turn On Response

The turn-on response is defined as two separate response categories, Wake-Up Time ($t_{WK}$) and Settling Time ($t_S$).

The TC1300 has a fast Wake-Up Time (10 µsec typical) when released from shutdown. See Figure 3-2 for the Wake-Up Time designated as $t_{WK}$. The Wake-Up Time is defined as the time it takes for the output to rise to 2% of the $V_{OUT}$ value after being released from shutdown.

The total turn-on response is defined as the Settling Time ($t_S$) (see Figure 3-2). Settling Time (inclusive with $t_{WK}$) is defined as the condition when the output is within 2% of its fully enabled value (50 µsec typical) when released from shutdown. The settling time of the output voltage is dependent on load conditions and output capacitance on $V_{OUT}$ (RC response).

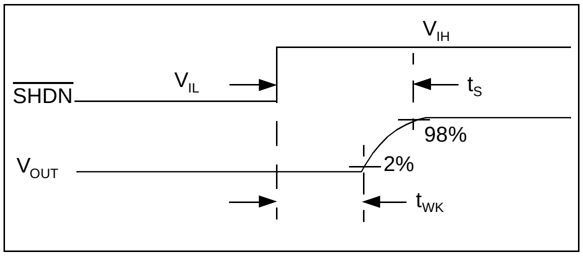



***FIGURE 3-2:*** *Wake-Up Response Time.*

# 4.0 THERMAL CONSIDERATIONS

## 4.1 Thermal Shutdown

Integrated thermal protection circuitry shuts the regulator off when the die temperature exceeds 150°C. The regulator remains off until the die temperature drops to approximately 140°C.

## 4.2 Power Dissipation

The amount of power the regulator dissipates is primarily a function of input and output voltage, and output current. The following equation is used to calculate worst case *actual* power dissipation:

**EQUATION**

$$P_D \approx (V_{INMAX} - V_{OUTMIN}) I_{LOADMAX}$$

Where:

$P_D$ = worst case actual power dissipation
$V_{INMAX}$ = maximum voltage on $V_{IN}$
$V_{OUTMIN}$ = minimum regulator output voltage
$I_{LOADMAX}$ = maximum output (load) current

The maximum allowable power dissipation, $P_{DMAX}$, is a function of the maximum ambient temperature ($T_{AMAX}$), the maximum recommended die temperature (125°C) and the thermal resistance from junction-to-air ($\theta_{JA}$). The MSOP-8 package has a $\theta_{JA}$ of approximately 200°C/Watt when mounted on a FR4 dielectric copper clad PC board.

**EQUATION**

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$

The worst case actual power dissipation equation can be used in conjunction with the LDO maximum allowable power dissipation equation to ensure regulator thermal operation is within limits. For example:

Given:

| | | |
|---|---|---|
| $V_{INMAX}$ | = | 4.1V |
| $V_{OUTMIN}$ | = | 3.0V -2.5% |
| $I_{LOADMAX}$ | = | 200 mA |
| $T_{JMAX}$ | = | 125°C |
| $T_{AMAX}$ | = | 55°C |
| $\theta_{JA}$ | = | 200°C/W |

Find:

**EQUATION: ACTUAL POWER DISSIPATION**

$$\begin{aligned} P_D &\approx (V_{INMAX} - V_{OUTMIN}) I_{LOADMAX} \\ &= [(4.1) - (3.0 \times .975)] 200 \times 10^{-3} \\ &= 220\ mW \end{aligned}$$

**EQUATION: MAXIMUM ALLOWABLE POWER DISSIPATION**

$$\begin{aligned} P_{DMAX} &= \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}} \\ &= \frac{(125 - 55)}{200} \\ &= 350\ mW \end{aligned}$$

In this example, the TC1300 dissipates a maximum of only 220 mW; below the allowable limit of 350 mW. In a similar manner, the maximum actual power dissipation equation and the maximum allowable power dissipation equation can be used to calculate maximum current and/or input voltage limits. For example, the maximum allowable $V_{IN}$ is found by substituting the maximum allowable power dissipation of 350 mW into the actual power dissipation equation, from which $V_{IN_{MAX}}$ = 4.97V.

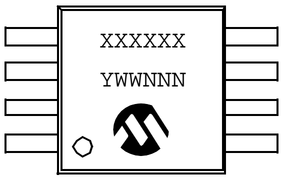
## 4.3 Layout Considerations

The primary path of heat conduction out of the package is via the package leads. Therefore, layouts having a ground plane, wide traces at the pads and wide power supply bus lines combine to lower $\theta_{JA}$ and, therefore, increase the maximum allowable power dissipation limit.

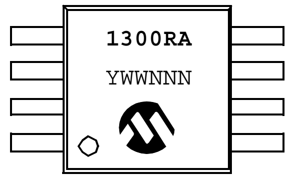
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

8-Lead MSOP




Example:



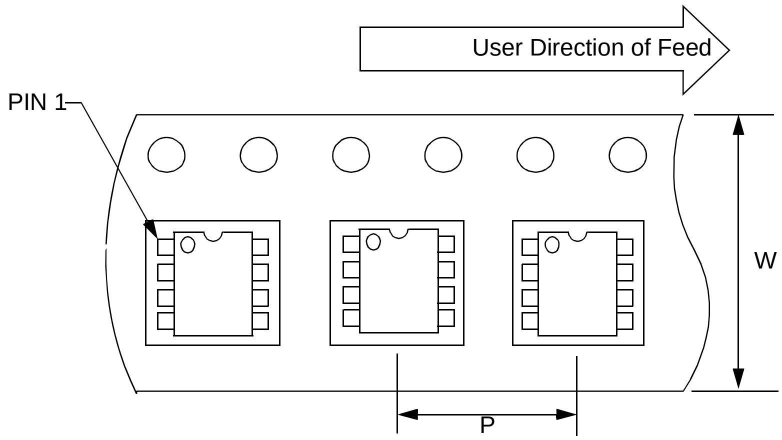

| Part Number | Marking Code (XXXXXX) |
|---|---|
| TC1300R - 2.5VUA | 1300RA |
| TC1300Y - 2.7VUA | 1300YF |
| TC1300R - 2.8VUA | 1300RB |
| TC1300R - 2.85VUA | 1300RC |
| TC1300R - 3.0VUA | 1300RD |
| TC1300R - 3.3VUA | 1300RE |

| **Legend:** | | |
|---|---|---|
| | XX...X | Customer-specific information |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week ‘01’) |
| | NNN | Alphanumeric traceability code |
| | (e3) | Pb-free JEDEC designator for Matte Tin (Sn) |
| | * | This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package. |

**Note**: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

## 5.2 Package Dimensions

Component Taping Orientation for 8-Pin MSOP Devices



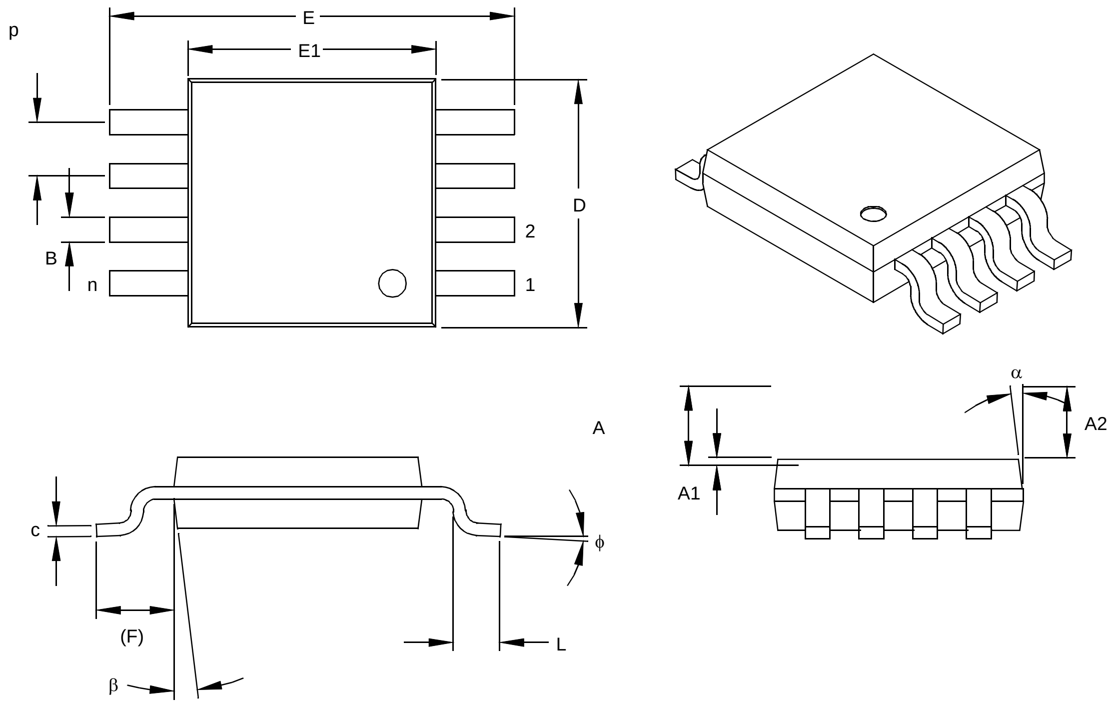

Standard Reel Component Orientation
for TR Suffix Device

**Carrier Tape, Number of Components Per Reel and Reel Size:**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| 8-Pin MSOP | 12 mm | 8 mm | 2500 | 13 in. |

## 8-Lead Plastic Micro Small Outline Package (UA) (MSOP)

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging




| Units | | INCHES | | | MILLIMETERS* | | |
|---|---|---|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX | MIN | NOM | MAX |
| Number of Pins | n | | 8 | | | | 8 |
| Pitch | p | | .026 | | | 0.65 | |
| Overall Height | A | | | .044 | | | 1.18 |
| Molded Package Thickness | A2 | .030 | .034 | .038 | 0.76 | 0.86 | 0.97 |
| Standoff § | A1 | .002 | | .006 | 0.05 | | 0.15 |
| Overall Width | E | .184 | .193 | .200 | 4.67 | 4.90 | .5.08 |
| Molded Package Width | E1 | .114 | .118 | .122 | 2.90 | 3.00 | 3.10 |
| Overall Length | D | .114 | .118 | .122 | 2.90 | 3.00 | 3.10 |
| Foot Length | L | .016 | .022 | .028 | 0.40 | 0.55 | 0.70 |
| Footprint (Reference) | F | .035 | .037 | .039 | 0.90 | 0.95 | 1.00 |
| Foot Angle | φ | 0 | | 6 | 0 | | 6 |
| Lead Thickness | c | .004 | .006 | .008 | 0.10 | 0.15 | 0.20 |
| Lead Width | B | .010 | .012 | .016 | 0.25 | 0.30 | 0.40 |
| Mold Draft Angle Top | α | | 7 | | | 7 | |
| Mold Draft Angle Bottom | β | | 7 | | | 7 | |

*Controlling Parameter
§ Significant Characteristic

Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

Drawing No. C04-111

## 6.0 REVISION HISTORY

### Revision D (November 2010)

Added a note to each package outline drawing.

**NOTES:**

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| PART NO. | -X.X | X | /XX |
|---|---|---|---|
| Device | Output Voltages | Temperature Range | Package |

| | | |
|---|---|---|
| Device: | TC1300X-X.XXXX: | 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset |
| | TC1300X-X.XXXXTR: | 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset (Tape and Reel) |
| Output Voltages: | 2.5V = 2.5 | |
| | 2.7V = 2.7 | |
| RESET Threshold | 2.8V = 2.8 | |
| Voltages: | 2.85V = 2.85 | |
| - 2.4V = Y | 3.0V = 3.0 | |
| - 2.63V = R | 3.3V = 3.3 | |
| Temperature Range: | V = -40°C to +125°C | |
| Package: | UA = Micro Small Outline Package (MSOP), 8-lead | |

**Examples:**

a) TC1300R-2.5VUA: 300mA CMOS LDO w/ Shutdown, Bypass & Independent Delayed Reset, 2.5V output voltage, 2.63V RESET Threshold.

b) TC1300R-2.8VUA: 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset, 2.8V output voltage, 2.63V RESET Threshold.

c) TC1300R-2.85VUA: 300mA CMOS LDO w/ Shutdown, Bypass & Independent Delayed Reset, 2.85V output voltage, 2.63V RESET Threshold.

d) TC1300R-3.0VUA: 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset, 3.0V output voltage, 2.63V RESET Threshold.

e) TC1300R-3.3VUA: 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset, 3.3V output voltage, 2.63V RESET Threshold.

f) TC1300R-2.85VUATR: 300mA CMOS LDO w/ Shutdown, Bypass & Independent Delayed Reset, 2.85V output voltage, 2.63V RESET Threshold, tape and reel.

g) TC1300Y-2.7VUA: 300mA CMOS LDO w/ Shutdown, Bypass & independant Delayed Reset, 2.7V output voltage, 2.4V RESET Threshold.

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Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

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