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 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 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.

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 feed-forward compensation for fast response to step changes in load. The TC1300 has both over-temperature and over-current protection. When the shutdown control (SHDN) is low, the regulator output voltage falls to zero, 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 RESET is asserted when the detected voltage (VDET) falls below the reset voltage threshold. The RESET output remains low for 300 msec (typical) after VDET rises above reset threshold. The TC1300 also has a fast wake-up response time (10 µsec., typical) when released from shutdown.

Typical Application Circuit

![Typical Application Circuit Diagram]

TC1300VUA

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1.0 ELECTRICAL CHARACTERISTICS

**Absolute Maximum Ratings**

- Input Voltage: \( V_{\text{IN}} \) = (VIN - 0.3) to (VIN + 0.3)
- Output Voltage: \( V_{\text{OUT}} \) = VR - 2.5% to VR + 2.5%
- Operating Junction Temperature, TJ: -40°C < TJ < 150°C
- Storage Temperature: -65°C to +150°C
- Maximum Voltage on Any Pin: \( V_{\text{SS}} - 0.3 \) to \( V_{\text{IN}} + 0.3 \)

*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.

**ELECTRICAL CHARACTERISTICS**

\[ V_{\text{IN}} = V_{\text{OUT}} + 1V, I_L = 0.1 \text{ mA}, C_L = 3.3 \mu F, SHDN > V_{\text{IH}}, T_A = 25°C, \text{ unless otherwise noted.} \]

**Parameters**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sym</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Operating Voltage</td>
<td>( V_{\text{IN}} )</td>
<td>2.7</td>
<td>—</td>
<td>6.0</td>
<td>V</td>
<td>Note 7</td>
</tr>
<tr>
<td>Maximum Output Current</td>
<td>( I_{\text{OUTMAX}} )</td>
<td>300</td>
<td>—</td>
<td>—</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>( V_{\text{OUT}} )</td>
<td>—</td>
<td>( V_R ) ± 0.5%</td>
<td>—</td>
<td>( V_R ) ± 2.5%</td>
<td>V</td>
</tr>
<tr>
<td>( \Delta V_{\text{OUT}}/\Delta T )</td>
<td>—</td>
<td>25</td>
<td>—</td>
<td>ppm/°C</td>
<td>Note 2</td>
<td></td>
</tr>
<tr>
<td>Line Regulation</td>
<td>( \Delta V_{\text{OUT}}/\Delta V_{\text{IN}} )</td>
<td>—</td>
<td>0.02</td>
<td>0.35</td>
<td>%</td>
<td>(( V_R + 1V )) \leq V_{\text{IN}} \leq 6V</td>
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<tr>
<td>Load Regulation</td>
<td>( \Delta V_{\text{OUT}}/I_{\text{OUT}} )</td>
<td>—</td>
<td>0.5</td>
<td>2.0</td>
<td>%</td>
<td>( I_L = 0.1 \text{ mA to } I_{\text{OUTMAX}} ), Note 3</td>
</tr>
</tbody>
</table>

**Note 1:** \( V_R \) is the regulator output voltage setting.

**Note 2:**

\[ TCV_{\text{OUT}} = \frac{(V_{\text{OUTMAX}} - V_{\text{OUTMIN}}) \times 10^6}{V_{\text{OUT}} \times \Delta T} \]

**Note 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.

**Note 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.

**Note 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 \( I_{\text{MAX}} \) at \( V_{\text{IN}} = 6V \) for \( t = 10 \text{ msec.} \)

**Note 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.

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

**Note 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)

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

### Parameters

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

**Note 1:** \( V_R \) is the regulator output voltage setting.

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

**Note 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.

**Note 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.

**Note 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 \( I_{L\text{MAX}} \) at \( V_{IN} = 6\text{V} \) for \( t = 10 \text{msec} \).

**Note 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.

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

**Note 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.
TC1300

ELECTRICAL CHARACTERISTICS (CONTINUED)

\[ V_{IN} = V_{OUT} + 1V, I_L = 0.1 \text{ mA}, C_L = 3.3 \mu \text{F}, SHDN > V_{IH}, T_A = 25^\circ \text{C}, \text{unless otherwise noted. BOLDFACE type specifications apply for junction temperature (Note 8) of -40^\circ \text{C} to +125^\circ \text{C}.} \]

<table>
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<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Conditions</th>
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<tr>
<td>RESET Output Voltage Range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V</td>
<td>( T_A = 0^\circ \text{C} to +70^\circ \text{C} )  \</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.2</td>
<td></td>
<td></td>
<td>V</td>
<td>TC1300R-XX, ( T_A = +25^\circ \text{C} )  \</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V</td>
<td>TC1300Y-XX, ( T_A = +25^\circ \text{C} )  \</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.55</td>
<td></td>
<td>2.66</td>
<td>V</td>
<td>TC1300R-XX, ( T_A = +25^\circ \text{C} )  \</td>
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<tr>
<td></td>
<td></td>
<td>2.36</td>
<td></td>
<td>2.43</td>
<td>V</td>
<td>TC1300Y-XX, ( T_A = +25^\circ \text{C} )  \</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.32</td>
<td></td>
<td>2.47</td>
<td>V</td>
<td>TC1300Y-XX, ( T_A = +25^\circ \text{C} )  \</td>
</tr>
<tr>
<td>Reset Threshold Temperature</td>
<td>( \Delta V_{TH} / \Delta T )</td>
<td>30</td>
<td></td>
<td></td>
<td>ppm/°C</td>
<td>TC1300R-XX, ( T_A = +25^\circ \text{C} )  \</td>
</tr>
<tr>
<td></td>
<td>V_{DET} to Reset Delay</td>
<td>t_{RPD}</td>
<td>160</td>
<td></td>
<td>µsec</td>
<td>( V_{DET} = V_{TH} ) to (( V_{TH} - 100 \text{ mV} ))  \</td>
</tr>
<tr>
<td></td>
<td>Reset Active Timeout Period</td>
<td>t_{RPU}</td>
<td>140</td>
<td>300</td>
<td>560</td>
<td>msec</td>
</tr>
<tr>
<td></td>
<td>RESET Output Voltage Low</td>
<td>V_{OL}</td>
<td>0.3</td>
<td></td>
<td>V</td>
<td>( V_{DET} = V_{TH} ) min, ( I_{SINK} = 1.2 \text{ mA} )  \</td>
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<tr>
<td>RESET Output Voltage High</td>
<td>V_{OH}</td>
<td>0.8</td>
<td></td>
<td></td>
<td>V</td>
<td>( V_{DET} &gt; V_{TH} ) max, ( I_{SOURCE} = 500 \mu \text{A} )  \</td>
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</table>

Note 1: \( V_R \) is the regulator output voltage setting.

Note 2: \( T_{CV_{OUT}} = \frac{(V_{OUT\text{MAX}} - V_{OUT\text{MIN}}) \times 10^6}{V_{OUT} \times \Delta T} \)

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 \( I_{L\text{MAX}} \) at \( V_{IN} = 6V \) for \( t = 10 \text{ msec} \).

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 \( V_{IN} \geq (V_R + V_{\text{DROP.OUT}}) \).

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\textsubscript{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\textsubscript{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\text{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\text{IH}. The regulator is shutdown (disabled) when SHDN is at or below V\text{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\text{OUT} falls to zero and RESET remains valid.

3.1 RESET Output

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

3.2 Output Capacitor

A 1 µF (min) capacitor from V\text{OUT} to ground is required. A 1 µF capacitor should also be connected from V\text{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\text{WK}) and Settling Time (t\text{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\text{WK}. The Wake-Up Time is defined as the time it takes for the output to rise to 2% of the V\text{OUT} value after being released from shutdown.

The total turn-on response is defined as the Settling Time (t\text{S}) (see Figure 3-2). Settling Time (inclusive with t\text{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\text{OUT} (RC response).
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:

\[ P_D = (V_{INMAX} - V_{OUTMIN})I_{LOADMAX} \]

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.

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

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:

Legend:

<table>
<thead>
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<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXXX</td>
<td>Customer specific information*</td>
</tr>
<tr>
<td>Y</td>
<td>Year code (last digit of calendar year)</td>
</tr>
<tr>
<td>WW</td>
<td>Week code (week of January 1 is week ‘01’)</td>
</tr>
<tr>
<td>NNN</td>
<td>Alphanumeric traceability code</td>
</tr>
</tbody>
</table>

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.

* Standard marking consists of Microchip part number, year code, week code, traceability code (facility code, mask rev#, and assembly code). For marking beyond this, certain price adders apply. Please check with your Microchip Sales Office.
5.2 Package Dimensions

Component Taping Orientation for 8-Pin MSOP Devices

User Direction of Feed

Standard Reel Component Orientation for TR Suffix Device

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

<table>
<thead>
<tr>
<th>Package</th>
<th>Carrier Width (W)</th>
<th>Pitch (P)</th>
<th>Part Per Full Reel</th>
<th>Reel Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-Pin MSOP</td>
<td>12 mm</td>
<td>8 mm</td>
<td>2500</td>
<td>13 in.</td>
</tr>
</tbody>
</table>
8-Lead Plastic Micro Small Outline Package (UA) (MSOP)

<table>
<thead>
<tr>
<th>Units</th>
<th>INCHES</th>
<th>MILLIMETERS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension Limits</td>
<td>MIN</td>
<td>NOM</td>
</tr>
<tr>
<td>Number of Pins</td>
<td>n</td>
<td>8</td>
</tr>
<tr>
<td>Pitch</td>
<td>p</td>
<td>.026</td>
</tr>
<tr>
<td>Overall Height</td>
<td>A</td>
<td>.044</td>
</tr>
<tr>
<td>Molded Package Thickness</td>
<td>A2</td>
<td>.030</td>
</tr>
<tr>
<td>Standoff</td>
<td>A1</td>
<td>.002</td>
</tr>
<tr>
<td>Overall Width</td>
<td>E</td>
<td>.184</td>
</tr>
<tr>
<td>Molded Package Width</td>
<td>E1</td>
<td>.114</td>
</tr>
<tr>
<td>Overall Length</td>
<td>D</td>
<td>.114</td>
</tr>
<tr>
<td>Foot Length</td>
<td>L</td>
<td>.016</td>
</tr>
<tr>
<td>Footprint (Reference)</td>
<td>F</td>
<td>.035</td>
</tr>
<tr>
<td>Foot Angle</td>
<td>φ</td>
<td>0</td>
</tr>
<tr>
<td>Lead Thickness</td>
<td>c</td>
<td>0.004</td>
</tr>
<tr>
<td>Lead Width</td>
<td>B</td>
<td>.010</td>
</tr>
<tr>
<td>Mold Draft Angle Top</td>
<td>α</td>
<td>7</td>
</tr>
<tr>
<td>Mold Draft Angle Bottom</td>
<td>β</td>
<td>7</td>
</tr>
</tbody>
</table>

*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
PRODUCT IDENTIFICATION SYSTEM

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

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>-X.X</th>
<th>X</th>
<th>/XX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>Output Voltages</td>
<td>Temperature Range</td>
<td>Package</td>
</tr>
<tr>
<td>TC1300X-X.XXXX</td>
<td>300mA CMOS LDO w/Shutdown, Bypass &amp; Independent Delayed Reset</td>
<td>TC1300X-X.XXXXT</td>
<td>300mA CMOS LDO w/Shutdown, Bypass &amp; Independent Delayed Reset (Tape and Reel)</td>
</tr>
</tbody>
</table>

Output Voltages: 2.5V = 2.5
2.7V = 2.7

RESET Threshold 2.8V = 2.8
V = 2.4V = Y
V = 3.0V = 3.0
V = 3.3V = 3.3

Temperature Range: V = −40°C to +125°C

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-2.85VTR: 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset, 2.85V output voltage, 2.63V RESET Threshold.
g) TC1300Y-2.7VUA: 300mA CMOS LDO w/Shutdown, Bypass & Independent Delayed Reset, 2.7V output voltage, 2.4V RESET Threshold.

Sales and Support

Data Sheets
Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site (www.microchip.com)

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

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WORLDWIDE SALES AND SERVICE

AMERICAS
Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: http://www.microchip.com

Rocky Mountain
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-4338

Atlanta
500 Sugar Mill Road, Suite 200B
Atlanta, GA  30350
Tel: 770-640-0034 Fax: 770-640-0307

Boston
2 Lan Drive, Suite 120
Westford, MA  01886
Tel: 978-692-3848 Fax: 978-692-3821

Chicago
333 Pierce Road, Suite 180
Itasca, IL  60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas
4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7924 Fax: 972-818-2924

Detroit
Tri-Aria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI  48334
Tel: 248-538-2250 Fax: 248-538-2260

Kokomo
2767 S. Albright Road
Kokomo, Indiana  46902
Tel: 765-864-8380 Fax: 765-864-8387

Los Angeles
18201 Von Karman, Suite 1090
Irvine, CA  92612
Tel: 949-263-1888 Fax: 949-263-1338

San Jose
Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA  95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto
6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

Asia/Pacific

Australia
Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing
Microchip Technology Consulting (Shanghai) Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu
Microchip Technology Consulting (Shanghai) Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-86766200 Fax: 86-28-86766599

China - Fuzhou
Microchip Technology Consulting (Shanghai) Co., Ltd., Fuzhou Liaison Office
Unit 71 Wul Road
Fuzhou 350001, China
Tel: 86-591-7503505 Fax: 86-591-7503521

Japan
Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinjyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea
Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-824
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore
Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-6334-8870 Fax: 65-6334-8850

Taiwan
Microchip Technology (Barbados) Inc.,
Taiwan Branch
11F-3, No. 207
Tung Hua North Road
Taipei, 106, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

Europe

Austria
Microchip Technology Austria GmbH
Duralistrasse 2
A-4600 Wels
Austria
Tel: 43-7242-2244-399 Fax: 43-7242-2244-393

Denmark
Microchip Technology Nordic ApS
Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France
Microchip Technology SARL
Parc d’Activite du Moulin de Massy
43 Rue du Saule Trapa
Bâtiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany
Microchip Technology GmbH
Steinheilstrasse 10
D-65737 Ismaning, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy
Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom
Microchip Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

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