

# Configurable Six Supply Monitor with Adjustable Reset Timer, Manual Reset

## FEATURES

- Simultaneously Monitors Six Supplies
- 16 User Selectable Combinations of 5V, 3.3V, 3V, 2.5V, 1.8V, 1.5V and  $\pm$  Adjustable Voltage Thresholds
- Guaranteed  $\pm 1.5\%$  Threshold Accuracy
- Adjustable Reset Timeout
- Low Supply Current: 52 $\mu$ A
- Manual Reset Pin
- Power Supply Glitch Immunity
- Guaranteed  $\overline{\text{RST}}$  for  $V_{\text{CC}} \geq 1\text{V}$
- High Temperature Operation to 125°C
- 12-Lead 3mm  $\times$  3mm DFN Package

## APPLICATIONS

- Desktop and Notebook Computers
- Multivoltage Systems
- Telecom Equipment
- Portable Battery-Powered Equipment
- Network Servers
- Automotive

## DESCRIPTION

The LTC<sup>®</sup>2930 is a configurable supply monitor for systems with up to six supply voltages. One of 16 preset or adjustable voltage monitor combinations can be selected using an external resistive divider connected to the mode select pin. The preset voltage thresholds are accurate to  $\pm 1.5\%$  over temperature. The LTC2930 also features adjustable inputs with a 0.5V nominal threshold.

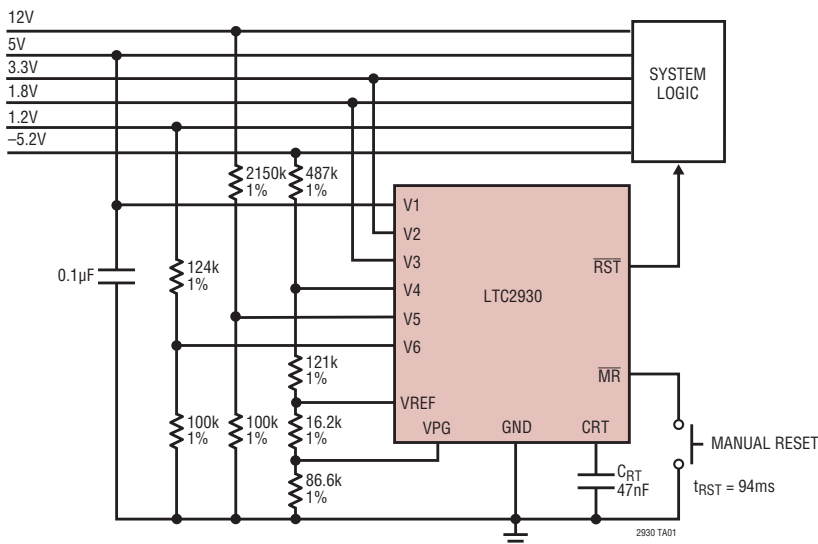
The reset timeout period is adjustable using an external capacitor. A reset event may be generated with a manual reset button on the manual reset input. Tight voltage threshold accuracy and glitch immunity ensure reliable reset operation without false triggering. The  $\overline{\text{RST}}$  output is guaranteed to be in the correct state for  $V_{\text{CC}}$  down to 1V and may be externally pulled up to an external voltage.

The 52 $\mu$ A supply current makes the LTC2930 ideal for power conscious systems and it may be configured to monitor fewer than six inputs.

LT, LT, LTC and LTM are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners. Protected by U.S. Patents including 6967591, 7119714, 7239251.

## TYPICAL APPLICATION

**Six Supply Monitor, 5% Threshold**  
12V, 5V, 3.3V, 1.8V, 1.2V, -5.2V



**Voltage Threshold Configuration Table**

| V1 (V) | V2 (V) | V3 (V) | V4 (V) | V5 (V) | V6 (V) |
|--------|--------|--------|--------|--------|--------|
| 5.0    | 3.3    | 2.5    | 1.8    | ADJ    | ADJ    |
| 5.0    | 3.3    | 2.5    | 1.5    | ADJ    | ADJ    |
| 5.0    | 3.3    | 2.5    | ADJ    | ADJ    | ADJ    |
| 5.0    | 3.3    | 1.8    | ADJ    | ADJ    | ADJ    |
| 5.0    | 3.3    | 1.8    | -ADJ   | ADJ    | ADJ    |
| 5.0    | 3.3    | ADJ    | ADJ    | ADJ    | ADJ    |
| 5.0    | 3.3    | ADJ    | -ADJ   | ADJ    | ADJ    |
| 5.0    | 3.0    | 2.5    | ADJ    | ADJ    | ADJ    |
| 5.0    | 3.0    | 1.8    | ADJ    | ADJ    | ADJ    |
| 5.0    | 3.0    | ADJ    | ADJ    | ADJ    | ADJ    |
| 3.3    | 2.5    | 1.8    | 1.5    | ADJ    | ADJ    |
| 3.3    | 2.5    | 1.8    | ADJ    | ADJ    | ADJ    |
| 3.3    | 2.5    | 1.8    | -ADJ   | ADJ    | ADJ    |
| 3.3    | 2.5    | 1.5    | ADJ    | ADJ    | ADJ    |
| 3.3    | 2.5    | ADJ    | ADJ    | ADJ    | ADJ    |
| 3.3    | 2.5    | ADJ    | -ADJ   | ADJ    | ADJ    |

2930fa

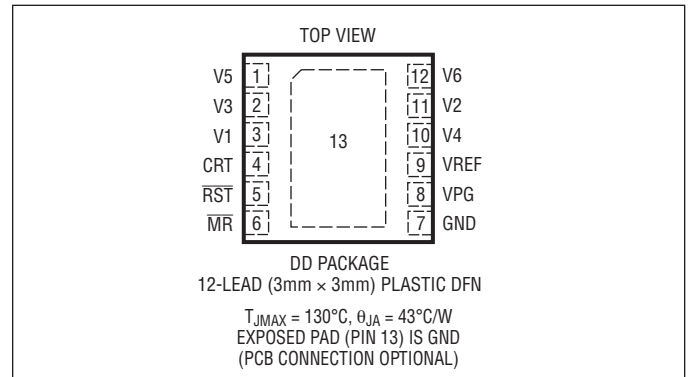
# LTC2930

## ABSOLUTE MAXIMUM RATINGS

(Notes 1, 2, 3)

|                                                      |                                            |
|------------------------------------------------------|--------------------------------------------|
| V1, V2, V3, V4, V5, V6, VPG, $\overline{\text{RST}}$ | –0.3V to 7V                                |
| CRT, VREF, MR                                        | –0.3V to ( $V_{\text{CC}} + 0.3\text{V}$ ) |
| Reference Load Current ( $I_{\text{VREF}}$ )         | $\pm 1\text{mA}$                           |
| V4 Input Current (–ADJ Mode)                         | –1mA                                       |
| $\overline{\text{RST}}$ Current                      | $\pm 10\text{mA}$                          |
| Operating Temperature Range                          |                                            |
| LTC2930C                                             | 0°C to 70°C                                |
| LTC2930I                                             | –40°C to 85°C                              |
| LTC2930H                                             | –40°C to 125°C                             |
| Storage Temperature Range                            | –65°C to 150°C                             |

## PIN CONFIGURATION



## ORDER INFORMATION

| LEAD FREE FINISH | TAPE AND REEL    | PART MARKING* | PACKAGE DESCRIPTION   | TEMPERATURE RANGE |
|------------------|------------------|---------------|-----------------------|-------------------|
| LTC2930CDD#PBF   | LTC2930CDD#TRPBF | LDMJ          | 12-Lead 3mm x 3mm DFN | 0°C to 70°C       |
| LTC2930IDD#PBF   | LTC2930IDD#TRPBF | LDMJ          | 12-Lead 3mm x 3mm DFN | –40°C to 85°C     |
| LTC2930HDD#PBF   | LTC2930HDD#TRPBF | LDMJ          | 12-Lead 3mm x 3mm DFN | –40°C to 125°C    |

\*The temperature grade is identified by a label on the shipping container.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

This product is only offered in trays. For more information go to: <http://www.linear.com/packaging/>

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_{\text{A}} = 25^{\circ}\text{C}$ .  $V_{\text{CC}} = 5\text{V}$ , unless otherwise specified. (Note 3)

| SYMBOL              | PARAMETER                           | CONDITIONS                                                                                                    | MIN   | TYP   | MAX              | UNITS |
|---------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------|-------|-------|------------------|-------|
| $V_{\text{CC}}$     | Minimum Internal Operating Voltage  | $\overline{\text{RST}}$ in Correct Logic State ●                                                              |       |       | 1                | V     |
| $V_{\text{CCMINP}}$ | Minimum Required for Mode Selection | $V_{\text{CC}}$ Rising ●                                                                                      |       |       | 2.4              | V     |
| $V_{\text{RT50}}$   | 5V, 5% Reset Threshold              | V1 Input Threshold ●                                                                                          | 4.600 | 4.675 | 4.750            | V     |
| $V_{\text{RT33}}$   | 3.3V, 5% Reset Threshold            | V1, V2 Input Threshold ●                                                                                      | 3.036 | 3.086 | 3.135            | V     |
| $V_{\text{RT30}}$   | 3V, 5% Reset Threshold              | V2 Input Threshold ●                                                                                          | 2.760 | 2.805 | 2.850            | V     |
| $V_{\text{RT25}}$   | 2.5V, 5% Reset Threshold            | V2, V3 Input Threshold ●                                                                                      | 2.300 | 2.338 | 2.375            | V     |
| $V_{\text{RT18}}$   | 1.8V, 5% Reset Threshold            | V3, V4 Input Threshold ●                                                                                      | 1.656 | 1.683 | 1.710            | V     |
| $V_{\text{RT15}}$   | 1.5V, 5% Reset Threshold            | V3, V4 Input Threshold ●                                                                                      | 1.380 | 1.403 | 1.425            | V     |
| $V_{\text{RTA}}$    | ADJ Reset Threshold                 | V3, V4, V5, V6 Input Threshold ●                                                                              | 492.5 | 500   | 507.5            | mV    |
| $V_{\text{RTAN}}$   | –ADJ Reset Threshold                | V4 Input Threshold ●                                                                                          | –18   | 0     | 18               | mV    |
| $V_{\text{REF}}$    | Reference Voltage                   | $V_{\text{CC}} \geq 2.3\text{V}$ , $I_{\text{VREF}} = \pm 1\text{mA}$ , $C_{\text{REF}} \leq 1000\text{pF}$ ● | 1.192 | 1.210 | 1.228            | V     |
| $V_{\text{PG}}$     | Mode Selection Voltage Range        | $V_{\text{CC}} \geq V_{\text{CCMINP}}$ ●                                                                      | 0     |       | $V_{\text{REF}}$ | V     |
| $I_{\text{VPG}}$    | VPG Input Current                   | $V_{\text{PG}} = V_{\text{REF}}$ ●                                                                            |       |       | $\pm 20$         | nA    |

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{CC} = 5\text{V}$ , unless otherwise specified. (Note 3)

| SYMBOL               | PARAMETER                                            | CONDITIONS                                                                                                                       | MIN         | TYP          | MAX                         | UNITS                     |
|----------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|-----------------------------|---------------------------|
| $I_{V1}$             | V1 Input Current                                     | $V1 = 5\text{V}$ , $I_{VREF} = 12\mu\text{A}$ (Note 4)                                                                           | ●           | 52           | 75                          | $\mu\text{A}$             |
| $I_{V2}$             | V2 Input Current                                     | $V2 = 3.3\text{V}$                                                                                                               | ●           | 0.8          | 2                           | $\mu\text{A}$             |
| $I_{V3}$             | V3 Input Current                                     | $V3 = 2.5\text{V}$<br>$V3 = 0.55\text{V}$ (ADJ Mode)                                                                             | ●<br>●      | 0.52         | 1.2<br>$\pm 15$             | $\mu\text{A}$<br>nA       |
| $I_{V4}$             | V4 Input Current                                     | $V4 = 1.8\text{V}$<br>$V4 = 0.55\text{V}$ (ADJ Mode)<br>$V4 = -0.02\text{V}$ (-ADJ Mode)                                         | ●<br>●<br>● | 0.34         | 0.8<br>$\pm 15$<br>$\pm 15$ | $\mu\text{A}$<br>nA<br>nA |
| $I_{V5}, I_{V6}$     | V5, V6 Input Current                                 | $V5, V6 = 0.55\text{V}$                                                                                                          | ●           |              | $\pm 15$                    | nA                        |
| $I_{\text{CRT(UP)}}$ | CRT Pull-Up Current                                  | $V_{\text{CRT}} = \text{GND}$                                                                                                    | ●           | -1.4         | -2                          | $\mu\text{A}$             |
| $I_{\text{CRT(DN)}}$ | CRT Pull-Down Current                                | $V_{\text{CRT}} = 1.3\text{V}$                                                                                                   | ●           | 10           | 20                          | $\mu\text{A}$             |
| $t_{\text{RST}}$     | Reset Timeout Period                                 | $C_{\text{RT}} = 1500\text{pF}$                                                                                                  | ●           | 2            | 3                           | ms                        |
| $t_{\text{UV}}$      | $V_n$ Undervoltage Detect to $\overline{\text{RST}}$ | $V_n$ Less Than Reset Threshold by More than 1%                                                                                  |             | 150          |                             | $\mu\text{s}$             |
| $V_{\text{OL}}$      | Voltage Output Low $\overline{\text{RST}}$           | $I_{\text{SINK}} = 3\text{mA}$ , $V_{\text{CC}} = 3\text{V}$<br>$I_{\text{SINK}} = 100\mu\text{A}$ , $V_{\text{CC}} = 1\text{V}$ | ●<br>●      | 0.15<br>0.05 | 0.4<br>0.3                  | V<br>V                    |
| $V_{\text{OH}}$      | Voltage Output High $\overline{\text{RST}}$ (Note 5) | $I_{\text{SOURCE}} = -1\mu\text{A}$                                                                                              | ●           | V2-1         |                             | V                         |
| $V_{\text{IL}}$      | $\overline{\text{MR}}$ Input Threshold Low           | $V_{\text{CC}} = 3.3\text{V}$ to $5.5\text{V}$                                                                                   | ●           |              | 0.4                         | V                         |
| $V_{\text{IH}}$      | $\overline{\text{MR}}$ Input Threshold High          | $V_{\text{CC}} = 3.3\text{V}$ to $5.5\text{V}$                                                                                   | ●           | 1.6          |                             | V                         |
| $t_{\text{MRW}}$     | $\overline{\text{MR}}$ Input Pulse Width             | $V_{\text{CC}} = 3.3\text{V}$                                                                                                    | ●           | 150          |                             | ns                        |
| $t_{\text{MRD}}$     | Manual Reset Propagation Delay                       | $V_{\text{CC}} = 3.3\text{V}$ , $V_{\text{MR}}$ Falling                                                                          | ●           | 0.1          | 1                           | $\mu\text{s}$             |
| $I_{\text{MR}}$      | $\overline{\text{MR}}$ Pull-Up Current               | $V_{\text{MR}} = 1\text{V}$                                                                                                      | ●           | -4           | -10                         | $\mu\text{A}$             |

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

**Note 2:** All currents into pins are positive, all voltages are referenced to GND unless otherwise noted.

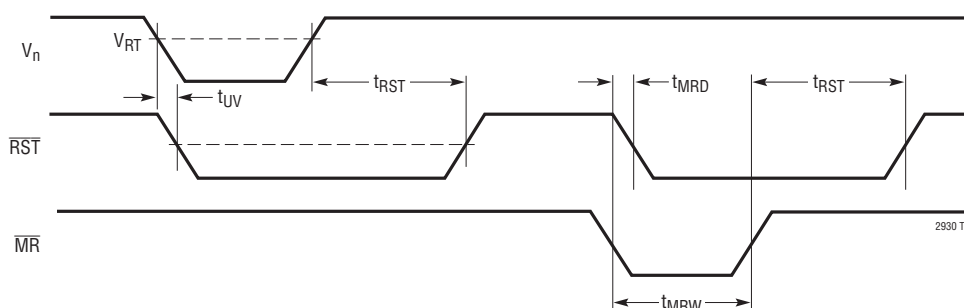
**Note 3:** The greater of V1, V2 is the internal supply voltage ( $V_{\text{CC}}$ ).

**Note 4:** Under static no-fault conditions, V1 will necessarily supply quiescent current. If at any time V2 is larger than V1, V2 must be capable of supplying the quiescent current, programming (transient) current and reference load current.

**Note 5:** The output pin  $\overline{\text{RST}}$  has a diode protected internal pull-up to V2 of typically  $6\mu\text{A}$ . However, an external pull-up resistor may be used when faster rise times are required or for  $V_{\text{OH}}$  voltages greater than V2.

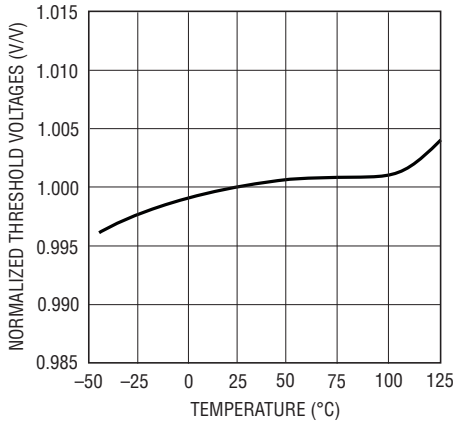
## TIMING DIAGRAM

$V_n$  Monitor Timing

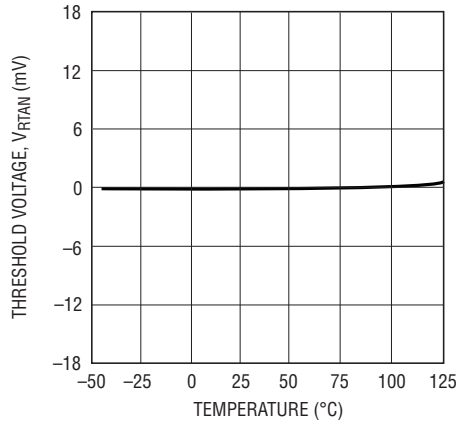


## TYPICAL PERFORMANCE CHARACTERISTICS

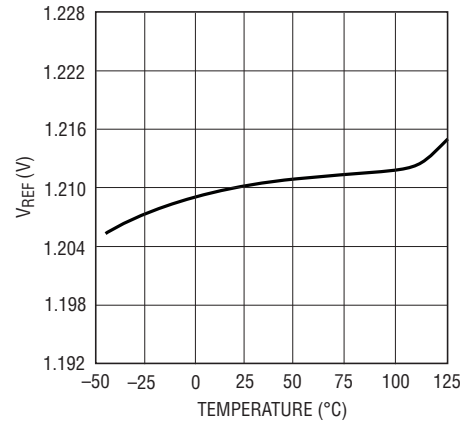
**Normalized Threshold Voltages vs Temperature**



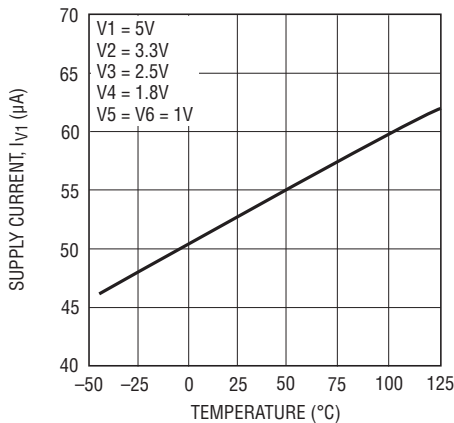
**-ADJ Threshold Voltage vs Temperature**



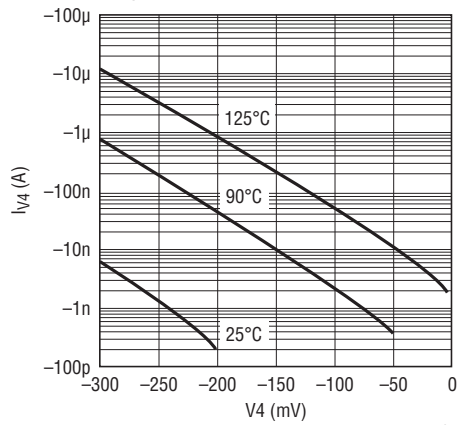
**V<sub>REF</sub> vs Temperature**



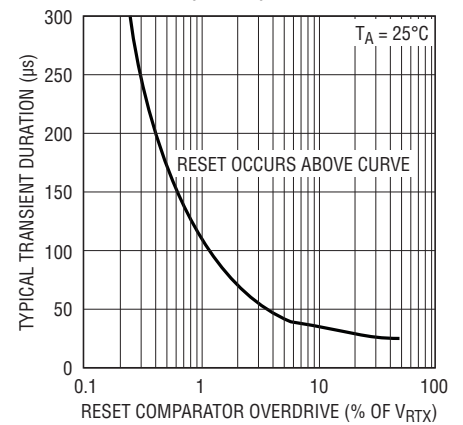
**Supply Current vs Temperature**



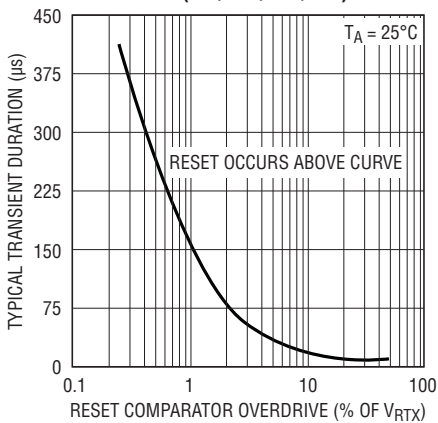
**I(V4) vs V4 in Negative Adjust Mode**



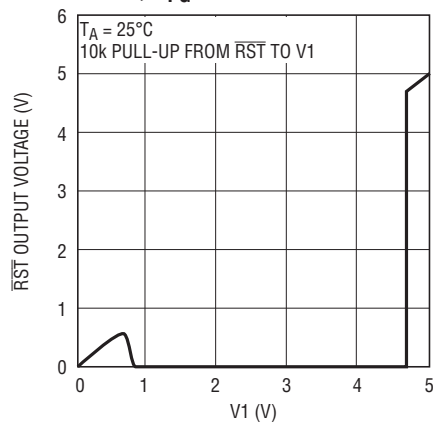
**Transient Duration vs Comparator Overdrive (V1, V2)**



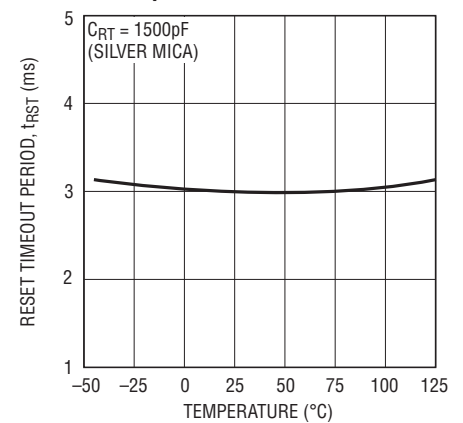
**Transient Duration vs Comparator Overdrive (V3, V4, V5, V6)**



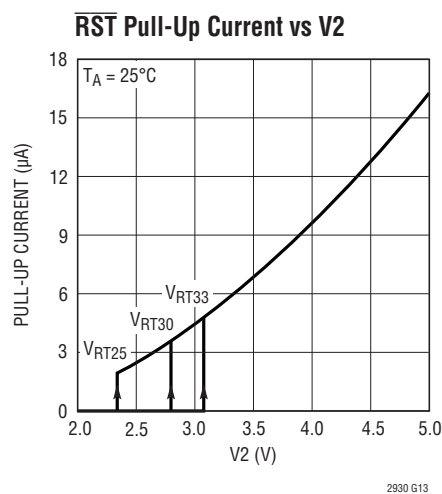
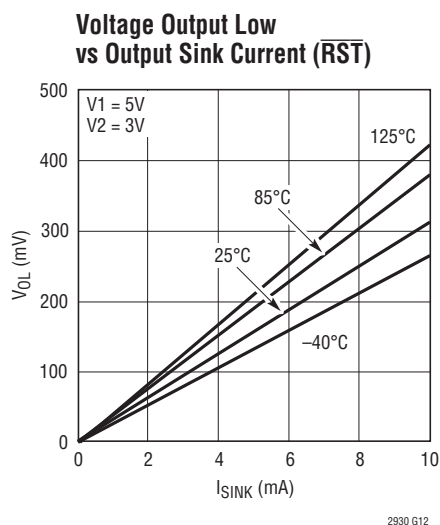
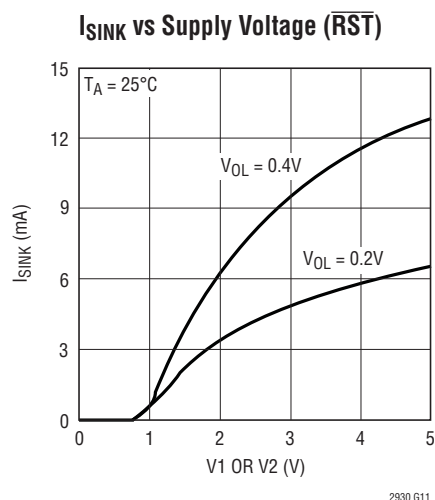
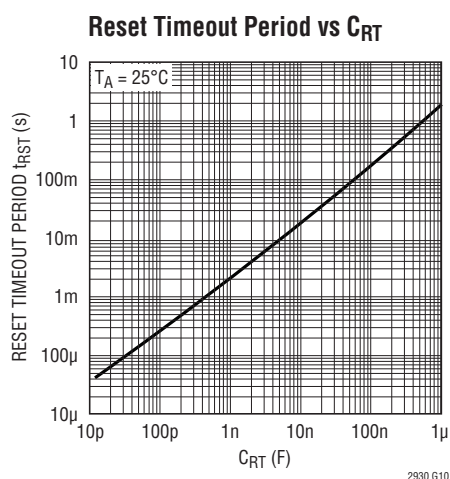
**RST Output Voltage vs V1, V<sub>PG</sub> = GND**



**Reset Timeout Period vs Temperature**



## TYPICAL PERFORMANCE CHARACTERISTICS



## PIN FUNCTIONS

**V5 (Pin 1):** Adjustable Voltage Input 5. High impedance comparator input with 0.5V typical threshold. See Applications Information for details. Tie to V1 if unused.

**V3 (Pin 2):** Voltage Input 3. Select from 2.5V, 1.8V, 1.5V, or ADJ. See Applications Information for details. Tie to V1 if unused.

**V1 (Pin 3):** Voltage Input 1. Select from 5V or 3.3V. See Applications Information for details. The greater of V1 or V2 is also  $V_{CC}$  for the device. Bypass this pin to ground with a 0.1 $\mu\text{F}$  (or greater) capacitor.

**CRT (Pin 4):** Reset Timeout Capacitor. Attach an external capacitor ( $C_{RT}$ ) to GND to set a reset timeout of 2ms/nF. Leaving the pin open generates a minimum delay of approximately 25 $\mu\text{s}$ . A 47nF capacitor generates a 94ms reset delay time.

**$\overline{RST}$  (Pin 5):** Reset Output. Logic output with weak 6 $\mu\text{A}$  pull-up to V2. Pulls low when any voltage input is below the reset threshold and held low for the configured delay time after all voltage inputs are above threshold. Use an external pull-up to pull greater than V2. Leave open if unused.

## PIN FUNCTIONS

**MR (Pin 6):** Manual Reset Input. A logic low on this pin pulls  $\overline{\text{RST}}$  low. When the  $\overline{\text{MR}}$  pin returns high,  $\overline{\text{RST}}$  returns high after the configured reset timeout if all six voltage inputs are above threshold. A weak internal pull-up allows the pin to be left open for normal monitor operation. When using a switch, the switch is debounced through the reset circuitry using the delay provided by the  $C_{\text{RT}}$  timing capacitor.

**GND (Pin 7):** Ground.

**VPG (Pin 8):** Threshold Select Input. Connect to an external 1% resistive divider between  $V_{\text{REF}}$  and GND to select 1 of 16 combinations and/or  $\pm$ adjustable voltage thresholds (See Table 1). Do not add capacitance on the VPG pin.

**VREF (Pin 9):** Buffered Reference Voltage Output. A 1.210V nominal reference used for the mode selection voltage ( $V_{\text{PG}}$ ) and for the offset of negative adjustable

applications. The buffered reference can source and sink up to 1mA. The reference can drive a bypass capacitor of up to 1000pF without oscillation.

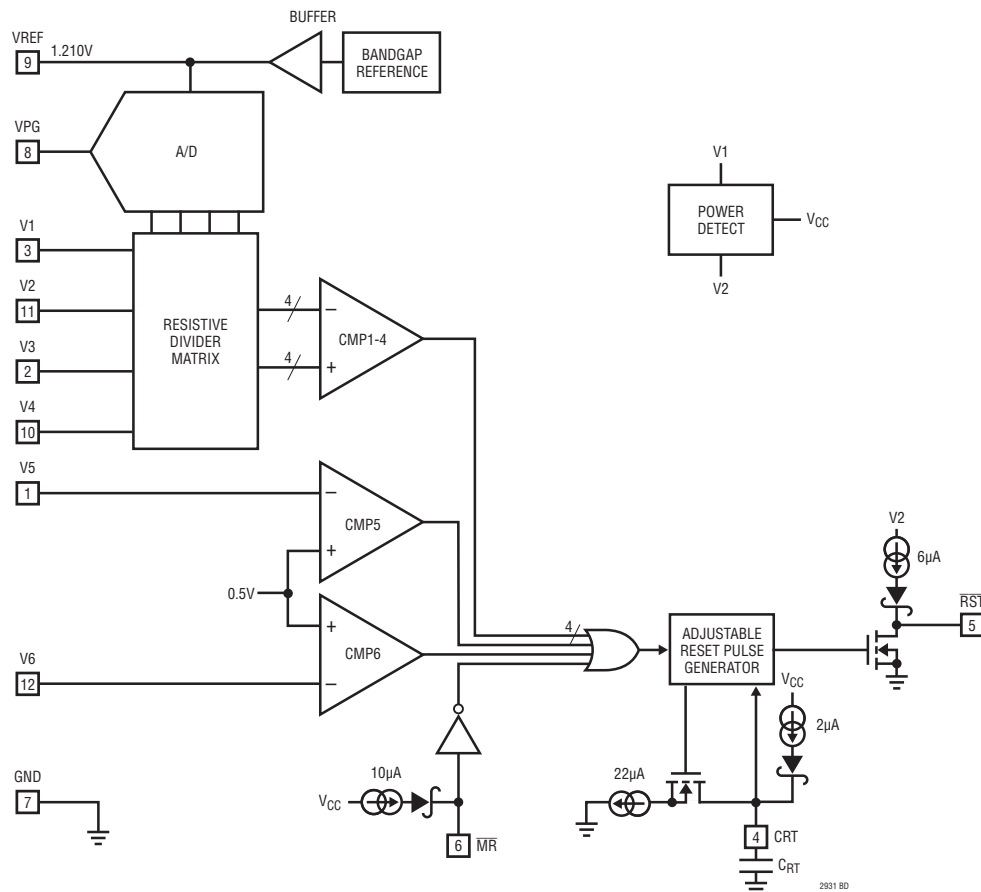
**V4 (Pin 10):** Voltage Input 4. Select from 1.8V, 1.5V, ADJ or  $-\text{ADJ}$ . See Applications Information for details. Tie to V1 if unused.

**V2 (Pin 11):** Voltage Input 2. Select from 3.3V, 3V or 2.5V. See Applications Information for details. The greater of V1, V2 is also  $V_{\text{CC}}$  for the device. Bypass this pin to ground with a 0.1 $\mu\text{F}$  (or greater) capacitor.  $\text{RST}$  is weakly pulled up to V2.

**V6 (Pin 12):** Adjustable Voltage Input 6. High impedance comparator input with 0.5V typical threshold. See Applications Information for details. Tie to V1 if unused.

**Exposed Pad (Pin 13):** Exposed pad may be left open or connected to device ground.

## BLOCK DIAGRAM



2931 BD

2930fa

## APPLICATIONS INFORMATION

### Supply Monitoring

The LTC2930 is a low power, high accuracy configurable six supply monitoring circuit with a common reset output. An external capacitor sets the reset timeout period. An external resistive divider between VREF, VPG and GND selects 1 of 16 possible input voltage monitor combinations. All six voltage inputs must be above their predetermined thresholds for the reset not to be activated. The LTC2930 asserts the reset output during power-up, power-down and brownout conditions on any one of the voltage inputs.

### Power-Up

The greater of V1 and V2 serves as the internal supply voltage ( $V_{CC}$ ). On power-up,  $V_{CC}$  powers the drive circuits for the  $\overline{RST}$  pin. This ensures that the  $\overline{RST}$  output will be low as soon as either V1 or V2 reaches 1V. The  $\overline{RST}$  output remains low until the part is configured. Once voltage thresholds are set, if any of the supply monitor inputs is below its configured threshold,  $\overline{RST}$  will be a logic low. Once all the monitor inputs rise above their thresholds, an internal timer is started and  $\overline{RST}$  is released after the delay time. If  $V_{CC} < (V3 - 1.0V)$  and  $V_{CC} < 2.4V$ , the V3 input impedance will be low (10k $\Omega$  typical).

### Threshold Accuracy

Consider a 5V system with  $\pm 5\%$  tolerance. The 5V supply may vary between 4.75V to 5.25V. System ICs powered by this supply must operate reliably within this band (and a little more as explained below). A perfectly accurate su-

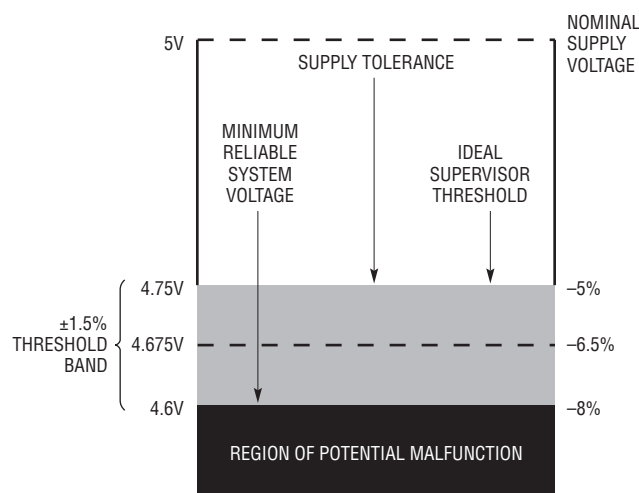


Figure 1. 1.5% Threshold Accuracy Improves System Reliability

Table 1. Voltage Threshold Modes\*

| MODE | V1 (V) | V2 (V) | V3 (V) | V4 (V) | R1 (k $\Omega$ ) | R2 (k $\Omega$ ) | $\frac{V_{PG}}{V_{REF}}$ |
|------|--------|--------|--------|--------|------------------|------------------|--------------------------|
| 0    | 5.0    | 3.3    | ADJ    | ADJ    | Open             | Short            | 0.000                    |
| 1    | 5.0    | 3.3    | ADJ    | –ADJ   | 93.1             | 9.53             | 0.094                    |
| 2    | 3.3    | 2.5    | ADJ    | ADJ    | 86.6             | 16.2             | 0.156                    |
| 3    | 3.3    | 2.5    | ADJ    | –ADJ   | 78.7             | 22.1             | 0.219                    |
| 4    | 3.3    | 2.5    | 1.5    | ADJ    | 71.5             | 28.0             | 0.281                    |
| 5    | 5.0    | 3.3    | 2.5    | ADJ    | 66.5             | 34.8             | 0.344                    |
| 6    | 5.0    | 3.3    | 2.5    | 1.8    | 59.0             | 40.2             | 0.406                    |
| 7    | 5.0    | 3.3    | 2.5    | 1.5    | 53.6             | 47.5             | 0.469                    |
| 8    | 5.0    | 3.0    | 2.5    | ADJ    | 47.5             | 53.6             | 0.531                    |
| 9    | 5.0    | 3.0    | ADJ    | ADJ    | 40.2             | 59.0             | 0.594                    |
| 10   | 3.3    | 2.5    | 1.8    | 1.5    | 34.8             | 66.5             | 0.656                    |
| 11   | 3.3    | 2.5    | 1.8    | ADJ    | 28.0             | 71.5             | 0.719                    |
| 12   | 3.3    | 2.5    | 1.8    | –ADJ   | 22.1             | 78.7             | 0.781                    |
| 13   | 5.0    | 3.3    | 1.8    | –ADJ   | 16.2             | 86.6             | 0.844                    |
| 14   | 5.0    | 3.3    | 1.8    | ADJ    | 9.53             | 93.1             | 0.906                    |
| 15   | 5.0    | 3.0    | 1.8    | ADJ    | Short            | Open             | 1.000                    |

\*V5 and V6 are always adjustable (ADJ).

pervisor for this supply generates a reset at exactly 4.75V, however no supervisor is this perfect. The actual reset threshold of a supervisor varies over a specified band; the LTC2930 varies  $\pm 1.5\%$  around its nominal threshold voltage (see Figure 1) over temperature.

The reset threshold band and the power supply tolerance bands should not overlap. This prevents false or nuisance resets when the power supply is actually within its specified tolerance band.

The LTC2930 has a  $\pm 1.5\%$  reset threshold accuracy, so a “5%” threshold is typically set to 6.5% below the nominal input voltage. Therefore, a typical 5V, “5%” threshold is 4.675V. The threshold is guaranteed to lie in the band between 4.750V and 4.600V over temperature. The powered system must work reliably down to the low end of the threshold band, or risk malfunction before a reset signal is properly issued.

A less accurate supervisor increases the required system voltage margin and increases the probability of system malfunction. The LTC2930  $\pm 1.5\%$  specification improves the reliability of the system over supervisors with wider threshold tolerances.



## APPLICATIONS INFORMATION

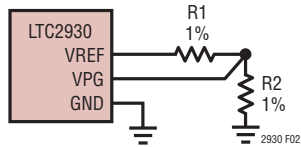


Figure 2. Mode Selection

## Monitor Configuration

Select the LTC2930 input voltage combination by placing the recommended resistive divider from VREF to GND and connecting the tap point to VPG, as shown in Figure 2. Table 1 offers recommended 1% resistor values for each of the 16 modes. The last column in Table 1 specifies optimum  $V_{PG}/V_{REF}$  ratios ( $\pm 0.01$ ), when configuring with a ratiometric DAC.

At power-up, once V1 or V2 reaches 2.4V, the monitor enters a setup period of approximately 150 $\mu$ s. During the setup time, the voltage on the VPG pin is sampled and the monitor is configured to the desired input combination. The comparators are enabled and supply monitoring begins. Do not add capacitance to the VPG pin.

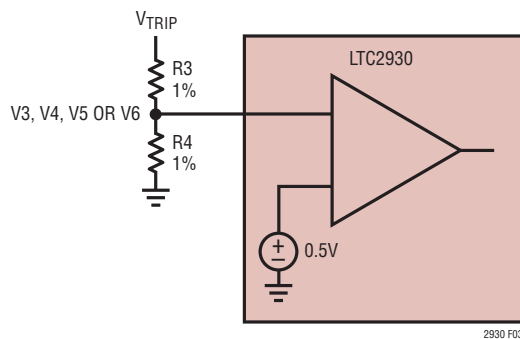


Figure 3. Setting the Positive Adjustable Trip Point

## Using The Adjustable Thresholds

The reference inputs on the V3 and/or V4 comparators are set to 0.5V when the positive adjustable modes are selected (Figure 3). The reference inputs on the V5 and V6 comparators are always set to 0.5V. The tap point on an external resistive divider, connected between the positive voltage being sensed and ground, is connected to the high impedance, adjustable inputs (V3, V4, V5, V6). Calculate the trip voltage from:

Table 2. Suggested 1% Resistor Values for the ADJ Inputs

| $V_{SUPPLY}$ (V) | $V_{TRIP}$ (V) | R3 (k $\Omega$ ) | R4 (k $\Omega$ ) |
|------------------|----------------|------------------|------------------|
| 12               | 11.25          | 2150             | 100              |
| 10               | 9.4            | 1780             | 100              |
| 8                | 7.5            | 1400             | 100              |
| 7.5              | 7              | 1300             | 100              |
| 6                | 5.6            | 1020             | 100              |
| 5                | 4.725          | 845              | 100              |
| 3.3              | 3.055          | 511              | 100              |
| 3                | 2.82           | 464              | 100              |
| 2.5              | 2.325          | 365              | 100              |
| 1.8              | 1.685          | 237              | 100              |
| 1.5              | 1.410          | 182              | 100              |
| 1.2              | 1.120          | 124              | 100              |
| 1                | 0.933          | 86.6             | 100              |
| 0.9              | 0.840          | 68.1             | 100              |

\* See Figure 3.

Table 3. Suggested 1% Resistor Values for the –ADJ Inputs

| $V_{SUPPLY}$ (V) | $V_{TRIP}$ (V) | R3 (k $\Omega$ ) | R4 (k $\Omega$ ) |
|------------------|----------------|------------------|------------------|
| –2               | –1.87          | 187              | 121              |
| –5               | –4.64          | 464              | 121              |
| –5.2             | –4.87          | 487              | 121              |
| –10              | –9.31          | 931              | 121              |
| –12              | –11.30         | 1130             | 121              |

\* See Figure 4.

$$V_{TRIP} = 0.5V \cdot \left(1 + \frac{R3}{R4}\right)$$

In the negative adjustable mode, the reference level on the V4 comparator is connected to ground (Figure 4). The tap point on an external resistive divider, connected between the negative voltage being sensed and the VREF pin, is

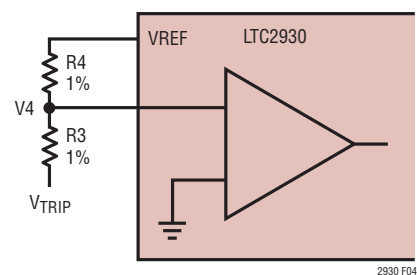


Figure 4. Setting the Negative Adjustable Trip Point

2930fa



## APPLICATIONS INFORMATION

connected to the high impedance adjustable input (V4).  $V_{REF}$  provides the necessary level shift required to operate at ground. The negative trip voltage is calculated from:

$$V_{TRIP} = -V_{REF} \cdot \frac{R3}{R4}; V_{REF} = 1.210V \text{ Nominal}$$

In a negative adjustable application, the minimum value for  $R4$  is limited by the sourcing capability of  $V_{REF}$  ( $\pm 1mA$ ). With no other load on  $V_{REF}$ ,  $R4$  (minimum) is:

$$\frac{1.210V}{1mA} = 1.210k$$

Tables 2 and 3 offer suggested 1% resistor values for various positive and negative supply adjustable applications assuming 5% monitor thresholds.

Although all six supply monitor comparators have built-in glitch immunity, bypass capacitors on  $V1$  and  $V2$  are recommended because the greater of  $V1$  or  $V2$  is also the  $V_{CC}$  for the device. Filter capacitors on the  $V3$ ,  $V4$ ,  $V5$  and  $V6$  inputs are allowed.

### Power-Down

On power-down, once any of the monitor inputs drops below its threshold,  $\overline{RST}$  is held at a logic low. A logic low of 0.4V is guaranteed until both  $V1$  and  $V2$  drop below 1V. If the bandgap reference becomes invalid ( $V_{CC} < 2V$  typical), the LTC2930 will enter the 150 $\mu s$  setup period when  $V_{CC}$  rises above 2.4V max.

### Selecting the Reset Timing Capacitor

The reset timeout period is adjustable in order to accommodate a variety of microprocessor applications. The reset timeout period,  $t_{RST}$ , is adjusted by connecting a capacitor,  $C_{RT}$ , between the  $\overline{CRT}$  pin and ground. The value of this capacitor is determined by:

$$C_{RT} = \frac{t_{RST}}{2M\Omega} = 500[pF / ms] \cdot t_{RST}$$

Leaving the  $\overline{CRT}$  pin unconnected generates a minimum reset timeout of approximately 25 $\mu s$ . Maximum reset timeout is limited by the largest available low leakage capacitor. The accuracy of the timeout period is affected by capacitor leakage (the nominal charging current is 2 $\mu A$ ) and capacitor tolerance. A low leakage ceramic capacitor is recommended.

### OR-ed System Reset

In Figure 5, two LTC2930s are configured to monitor 11 supply voltages simultaneously. The unused adjustable input pin is tied to the  $V1$  input. The open-drain  $\overline{RST}$  outputs are OR-tied and pulled up to 5V through a 10k $\Omega$  resistor.  $\overline{RST}$  pulls high 94ms after all the inputs are above the threshold voltages. Should a reset event occur on either LTC2930, both  $\overline{RST}$  outputs pull low. Similarly, if the manual reset pushbutton is pressed, both  $\overline{RST}$  outputs also pull low.

### Using a Pushbutton On/Off Controller with the LTC2930

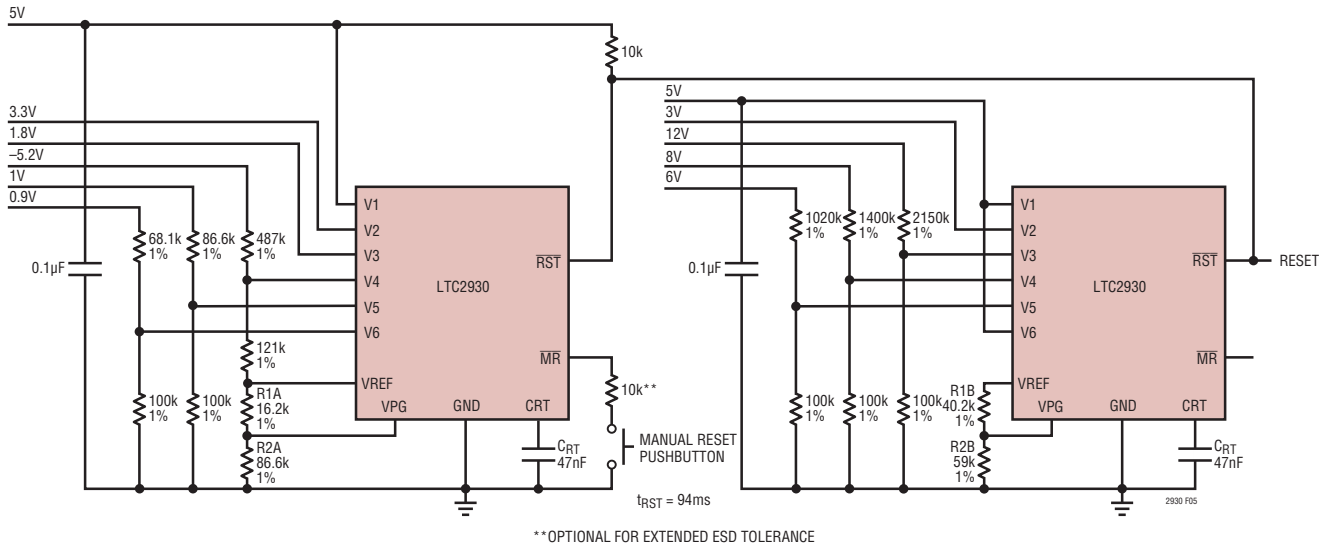
In Figure 6, the LTC2950-1 pushbutton controller powers a system on and off. The system starts after the pushbutton is pressed, which brings the LTM4600's  $\overline{RUN}$  pin high. Subsequently, the LTM4600 generates a 5V output which applies power to each of the four DC/DC converters.

The LTC2930 is configured to mode 13 (see Table 1). The voltages monitored are 5V, 3.3V, 1.8V, -5.2V, 2.5V and 12V.

If the  $\overline{KILL}$  input is not driven high within 512ms of a valid turn-on event,  $\overline{EN}$  pulls low shutting down the system. If the external 12V supply drops below 9.6V,  $\overline{EN}$  pulls low, powering down the LTM4600 and subsequent circuitry. An external 4.7nF capacitor sets the 9.4ms reset timeout period. Therefore, 9.4ms after the last supply is above threshold,  $\overline{RST}$  pulls high. The reset timing capacitor must be chosen to keep the reset timeout period below 512ms. Otherwise, the  $\overline{KILL}$  timer will expire and shut down the system.

Pressing the pushbutton after the system is powered initiates the power off sequence. An interrupt is set, bringing  $\overline{EN}$  low immediately and disabling the LTM4600.

## APPLICATIONS INFORMATION



\*\*OPTIONAL FOR EXTENDED ESD TOLERANCE

Figure 5. OR-ed System Reset

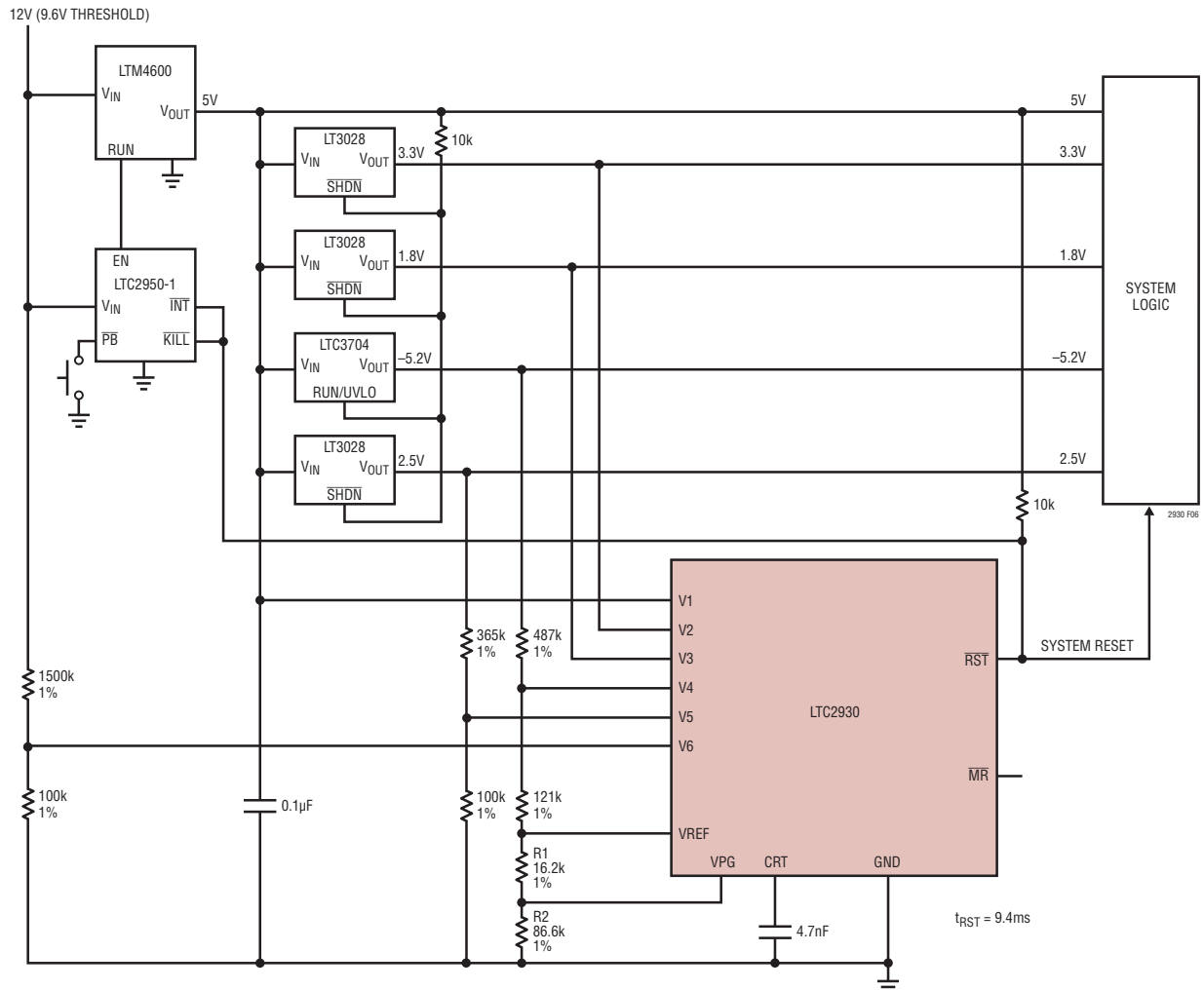
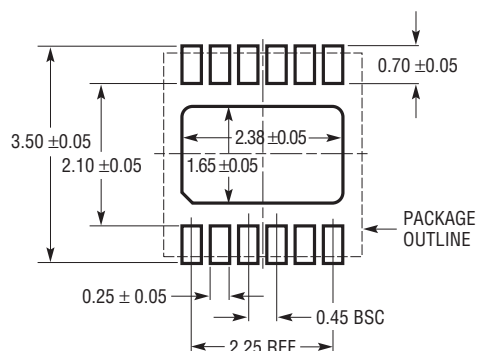


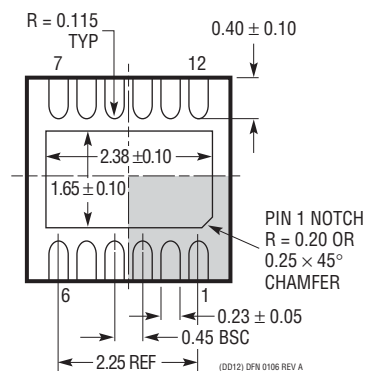
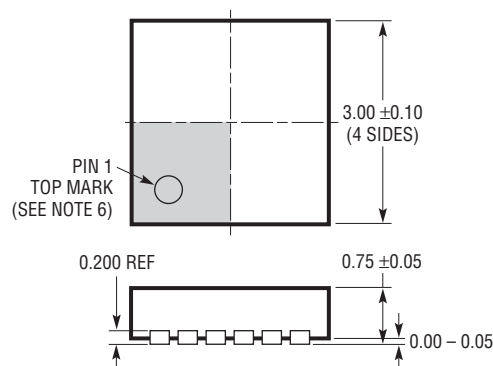
Figure 6. Using a Pushbutton On/Off Controller with the LTC2930

# PACKAGE DESCRIPTION

## DD Package 12-Lead Plastic DFN (3mm × 3mm) (Reference LTC DWG # 05-08-1725 Rev A)



**RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS**  
APPLY SOLDER MASK TO AREAS THAT ARE NOT SOLDERED



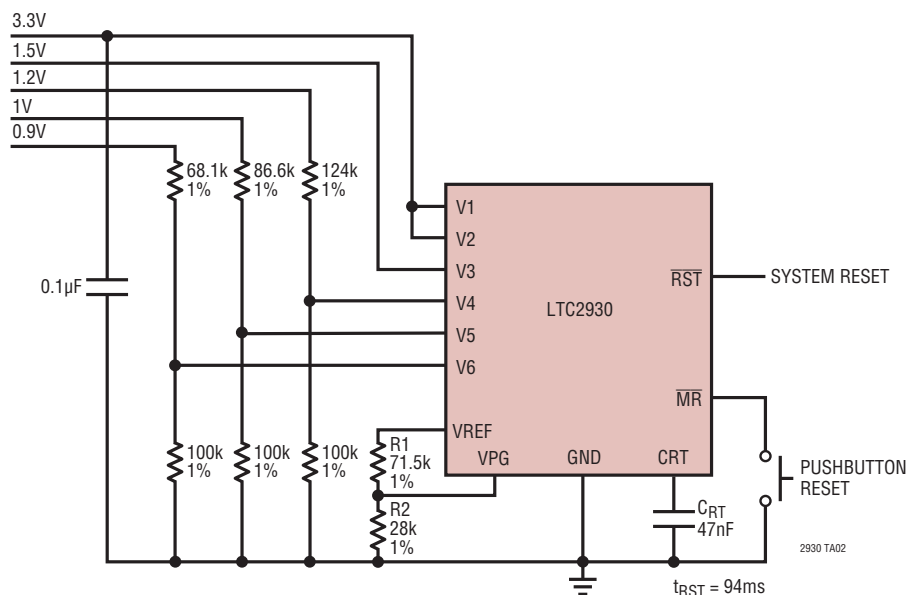
**BOTTOM VIEW—EXPOSED PAD**

### NOTE:

1. DRAWING IS NOT A JEDEC PACKAGE OUTLINE
2. DRAWING NOT TO SCALE
3. ALL DIMENSIONS ARE IN MILLIMETERS
4. DIMENSIONS OF EXPOSED PAD ON BOTTOM OF PACKAGE DO NOT INCLUDE MOLD FLASH. MOLD FLASH, IF PRESENT, SHALL NOT EXCEED 0.15mm ON ANY SIDE
5. EXPOSED PAD AND TIE BARS SHALL BE SOLDER PLATED
6. SHADED AREA IS ONLY A REFERENCE FOR PIN 1 LOCATION ON THE TOP AND BOTTOM OF PACKAGE

## TYPICAL APPLICATION

Five Supply Monitor, 5% Threshold (3.3V, 1.5V, 1.2V, 1V, 0.9V)



## RELATED PARTS

| PART NUMBER     | DESCRIPTION                                                        | COMMENTS                                                                                                                                |
|-----------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| LTC1326         | Micropower Triple Supply Monitor for 5V/2.5V, 3.3V and ADJ         | 4.725V, 3.118V, 1V Threshold ( $\pm 0.75\%$ ) and ADJ                                                                                   |
| LTC1728         | Micropower Triple Supply Monitor with Open-Drain Reset             | 5-Lead SOT-23 Package                                                                                                                   |
| LTC2900         | Programmable Quad Supply Monitor                                   | Adjustable Reset, 10-Lead MSOP and DFN Packages                                                                                         |
| LTC2901         | Programmable Quad Supply Monitor                                   | Adjustable Reset and Watchdog Timer                                                                                                     |
| LTC2902         | Programmable Quad Supply Monitor                                   | Adjustable Reset and Tolerance (5%, 7.5%, 10%, or 12.5%)                                                                                |
| LTC2903         | Precision Quad Supply Monitor                                      | 6-Lead SOT-23 Package                                                                                                                   |
| LTC2904-LTC2907 | Three-State Programmable Precision Dual Supply Monitor             | 8-Lead SOT-23 and DFN Packages                                                                                                          |
| LTC2908         | Precision Six Supply Monitor (Four Fixed & Two Adjustable)         | 8-Lead TSOT-23 and DFN Packages                                                                                                         |
| LTC2909         | Precision Triple/Dual Input UV, OV and Negative Voltage Monitor    | Shunt Regulated $V_{CC}$ Pin, Adjustable Threshold and Reset, 8-Lead SOT-23 and DFN Packages                                            |
| LTC2910         | Precision Octal Positive/Negative Voltage Supply Monitor           | 16-Lead SSOP and 5mm $\times$ 3mm DFN Packages, H-Grade Temperature Range                                                               |
| LTC2912-LTC2914 | Single/Dual/Quad UV and OV Voltage Monitors                        | Separate $V_{CC}$ Pin, Adjustable Reset Timer, H-Grade Temperature Range                                                                |
| LTC2915-LTC2918 | Single Supply Monitor with 27 Pin-Selectable Thresholds            | Manual Reset, Watchdog, TSOT-8/MSOP-10 and 3mm $\times$ 2mm DFN Packages, H-Grade Temperature Range                                     |
| LTC2928         | Quad Power Supply Sequencer and Supervisor                         | Easily Configure Power Management without Software, 36-Lead 5mm $\times$ 7mm QFN and SSOP Packages                                      |
| LTC2931         | Configurable Six Supply Monitor with Individual Comparator Outputs | Adjustable Reset and Watchdog Timers, TSSOP-20 Package                                                                                  |
| LTC2932         | Configurable Six Supply Monitor with Individual Comparator Outputs | Adjustable Reset Timer and Tolerance, TSSOP-20 Package, Pin-Selectable Tolerance (5%, 7.5%, 10%, or 12.5%), Reset Disable for Margining |