

# LTC2912

## ABSOLUTE MAXIMUM RATINGS (Note 1)

### Terminal Voltages

|                                                     |                              |
|-----------------------------------------------------|------------------------------|
| $V_{CC}$ (Note 3)                                   | –0.3V to 6V                  |
| $\overline{OV}$ , $\overline{UV}$ , $\overline{OV}$ | –0.3V to 16V                 |
| TMR                                                 | –0.3V to ( $V_{CC} + 0.3V$ ) |
| $V_H$ , $V_L$ , $\overline{LATCH}$ , DIS            | –0.3V to 7.5V                |

### Terminal Currents

|                                                      |      |
|------------------------------------------------------|------|
| $I_{VCC}$                                            | 10mA |
| $I_{UV}$ , $I_{\overline{OV}}$ , $I_{\overline{OV}}$ | 10mA |

### Operating Temperature Range

|          |                |
|----------|----------------|
| LTC2912C | 0°C to 70°C    |
| LTC2912I | –40°C to 85°C  |
| LTC2912H | –40°C to 125°C |

### Storage Temperature Range

|      |                |
|------|----------------|
| TSOT | –65°C to 125°C |
| DFN  | –65°C to 150°C |

### Lead Temperature (Soldering, 10 sec)

|      |       |
|------|-------|
| TSOT | 300°C |
|------|-------|

## PACKAGE/ORDER INFORMATION

|                                                                                                                                                                    |                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>LTC2912-1</p> <p>TOP VIEW</p> <p>TS8 PACKAGE<br/>8-LEAD PLASTIC TSOT-23<br/><math>T_{JMAX} = 150^{\circ}C</math>, <math>\theta_{JA} = 195^{\circ}C/W</math></p> | <p>LTC2912-1</p> <p>TOP VIEW</p> <p>DDB PACKAGE<br/>8-LEAD (3mm × 2mm) PLASTIC DFN<br/><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 55^{\circ}C/W</math><br/>EXPOSED PAD (PIN 9) IS GND, MUST BE SOLDERED TO PCB</p> |
| <p>LTC2912-2</p> <p>TOP VIEW</p> <p>TS8 PACKAGE<br/>8-LEAD PLASTIC TSOT-23<br/><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 55^{\circ}C/W</math></p>  | <p>LTC2912-2</p> <p>TOP VIEW</p> <p>DDB PACKAGE<br/>8-LEAD (3mm × 2mm) PLASTIC DFN<br/><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 55^{\circ}C/W</math><br/>EXPOSED PAD (PIN 9) IS GND, MUST BE SOLDERED TO PCB</p> |
| <p>LTC2912-3</p> <p>TOP VIEW</p> <p>TS8 PACKAGE<br/>8-LEAD PLASTIC TSOT-23<br/><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 55^{\circ}C/W</math></p>  | <p>LTC2912-3</p> <p>TOP VIEW</p> <p>DDB PACKAGE<br/>8-LEAD (3mm × 2mm) PLASTIC DFN<br/><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 55^{\circ}C/W</math><br/>EXPOSED PAD (PIN 9) IS GND, MUST BE SOLDERED TO PCB</p> |

## ORDER INFORMATION

### Lead Free Finish

| TAPE AND REEL (MINI) | TAPE AND REEL       | PART MARKING* | PACKAGE DESCRIPTION            | TEMPERATURE RANGE |
|----------------------|---------------------|---------------|--------------------------------|-------------------|
| LTC2912CTS8-1#TRMPBF | LTC2912CTS8-1#TRPBF | LTCJW         | 8-Lead Plastic TSOT-23         | 0°C to 70°C       |
| LTC2912ITS8-1#TRMPBF | LTC2912ITS8-1#TRPBF | LTCJW         | 8-Lead Plastic TSOT-23         | -40°C to 85°C     |
| LTC2912HTS8-1#TRMPBF | LTC2912HTS8-1#TRPBF | LTCJW         | 8-Lead Plastic TSOT-23         | -40°C to 125°C    |
| LTC2912CDDb-1#TRMPBF | LTC2912CDDb-1#TRPBF | LCJZ          | 8-Lead (3mm × 2mm) Plastic DFN | 0°C to 70°C       |
| LTC2912IDDb-1#TRMPBF | LTC2912IDDb-1#TRPBF | LCJZ          | 8-Lead (3mm × 2mm) Plastic DFN | -40°C to 85°C     |
| LTC2912HDDb-1#TRMPBF | LTC2912HDDb-1#TRPBF | LCJZ          | 8-Lead (3mm × 2mm) Plastic DFN | -40°C to 125°C    |
| LTC2912CTS8-2#TRMPBF | LTC2912CTS8-2#TRPBF | LTCJX         | 8-Lead Plastic TSOT-23         | 0°C to 70°C       |
| LTC2912ITS8-2#TRMPBF | LTC2912ITS8-2#TRPBF | LTCJX         | 8-Lead Plastic TSOT-23         | -40°C to 85°C     |
| LTC2912HTS8-2#TRMPBF | LTC2912HTS8-2#TRPBF | LTCJX         | 8-Lead Plastic TSOT-23         | -40°C to 125°C    |
| LTC2912CDDb-2#TRMPBF | LTC2912CDDb-2#TRPBF | LCKB          | 8-Lead (3mm × 2mm) Plastic DFN | 0°C to 70°C       |
| LTC2912IDDb-2#TRMPBF | LTC2912IDDb-2#TRPBF | LCKB          | 8-Lead (3mm × 2mm) Plastic DFN | -40°C to 85°C     |
| LTC2912HDDb-2#TRMPBF | LTC2912HDDb-2#TRPBF | LCKB          | 8-Lead (3mm × 2mm) Plastic DFN | -40°C to 125°C    |
| LTC2912CTS8-3#TRMPBF | LTC2912CTS8-3#TRPBF | LTCJY         | 8-Lead Plastic TSOT-23         | 0°C to 70°C       |
| LTC2912ITS8-3#TRMPBF | LTC2912ITS8-3#TRPBF | LTCJY         | 8-Lead Plastic TSOT-23         | -40°C to 85°C     |
| LTC2912HTS8-3#TRMPBF | LTC2912HTS8-3#TRPBF | LTCJY         | 8-Lead Plastic TSOT-23         | -40°C to 125°C    |
| LTC2912CDDb-3#TRMPBF | LTC2912CDDb-3#TRPBF | LCKC          | 8-Lead (3mm × 2mm) Plastic DFN | 0°C to 70°C       |
| LTC2912IDDb-3#TRMPBF | LTC2912IDDb-3#TRPBF | LCKC          | 8-Lead (3mm × 2mm) Plastic DFN | -40°C to 85°C     |
| LTC2912HDDb-3#TRMPBF | LTC2912HDDb-3#TRPBF | LCKC          | 8-Lead (3mm × 2mm) Plastic DFN | -40°C to 125°C    |

Consult LTC Marketing for parts specified with wider operating temperature ranges. \*The temperature grade is identified by a label on the shipping container. Consult LTC Marketing for information on nonstandard lead based finish parts.

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

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreeel/>

# ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{CC} = 3.3\text{V}$ ,  $V_L = 0.45\text{V}$ ,  $V_H = 0.55\text{V}$ ,  $\text{LATCH} = V_{CC}$  unless otherwise noted. (Note 2)

| SYMBOL                   | PARAMETER                                          | CONDITIONS                                                                                                            |        | MIN          | TYP                | MAX          | UNITS    |
|--------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--------|--------------|--------------------|--------------|----------|
| V <sub>SHUNT</sub>       | V <sub>CC</sub> Shunt Regulator Voltage            | I <sub>CC</sub> = 5mA<br>I <sub>CC</sub> = 5mA (H-Grade)                                                              | ●<br>● | 6.2<br>6.2   | 6.6<br>6.6         | 7.2<br>7.3   | V<br>V   |
| ΔV <sub>SHUNT</sub>      | V <sub>CC</sub> Shunt Regulator Load Regulation    | I <sub>CC</sub> = 2mA to 10mA                                                                                         | ●      | 200          |                    | 300          | mV       |
| V <sub>CC</sub>          | Supply Voltage (Note 3)                            |                                                                                                                       | ●      | 2.3          | V <sub>SHUNT</sub> |              | V        |
| V <sub>CCR(MIN)</sub>    | Minimum V <sub>CC</sub> Output Valid               | DIS = 0V                                                                                                              | ●      |              |                    | 1            | V        |
| V <sub>CC(UVLO)</sub>    | Supply Undervoltage Lockout                        | DIS = 0V, V <sub>CC</sub> Rising                                                                                      | ●      | 1.9          | 2                  | 2.1          | V        |
| ΔV <sub>CC(UVHYST)</sub> | Supply Undervoltage Lockout Hysteresis             | DIS = 0V                                                                                                              | ●      | 5            | 25                 | 50           | mV       |
| I <sub>CC</sub>          | Supply Current                                     | V <sub>CC</sub> = 2.3V to 6V                                                                                          | ●      | 29           |                    | 70           | μA       |
| V <sub>UOT</sub>         | Undervoltage/Overvoltage Threshold                 |                                                                                                                       | ●      | 492          | 500                | 508          | mV       |
| t <sub>UOD</sub>         | Undervoltage/Overvoltage Threshold to Output Delay | V <sub>Hn</sub> = V <sub>UOT</sub> – 5mV or V <sub>Ln</sub> = V <sub>UOT</sub> + 5mV                                  | ●      | 50           | 125                | 500          | μs       |
| I <sub>VHL</sub>         | V <sub>H</sub> , V <sub>L</sub> Input Current      | H-Grade                                                                                                               | ●<br>● |              |                    | ±15<br>±30   | nA<br>nA |
| t <sub>UOTO</sub>        | UV/OV Time-Out Period                              | C <sub>TMR</sub> = 1nF<br>C <sub>TMR</sub> = 1nF (H-Grade)                                                            | ●<br>● | 6<br>6       | 8.5<br>8.5         | 12.5<br>14   | ms<br>ms |
| V <sub>LATCH(VIH)</sub>  | OV Latch Clear Input High                          |                                                                                                                       | ●      | 1.2          |                    |              | V        |
| V <sub>LATCH(VIL)</sub>  | OV Latch Clear Input Low                           |                                                                                                                       | ●      |              |                    | 0.8          | V        |
| I <sub>LATCH</sub>       | LATCH Input Current                                | V <sub>LATCH</sub> > 0.5V                                                                                             | ●      |              |                    | ±1           | μA       |
| I <sub>DIS</sub>         | DIS Input Current                                  | V <sub>DIS</sub> > 0.5V                                                                                               | ●      | 1            | 2                  | 3.3          | μA       |
| V <sub>DIS(VIH)</sub>    | DIS Input High                                     |                                                                                                                       | ●      | 1.2          |                    |              | V        |
| V <sub>DIS(VIL)</sub>    | DIS Input Low                                      |                                                                                                                       | ●      |              |                    | 0.8          | V        |
| I <sub>TMR(UP)</sub>     | TMR Pull-Up Current                                | V <sub>TMR</sub> = 0V<br>V <sub>TMR</sub> = 0V (H-Grade)                                                              | ●<br>● | –1.3<br>–1.2 | –2.1<br>–2.1       | –2.8<br>–2.8 | μA<br>μA |
| I <sub>TMR(DOWN)</sub>   | TMR Pull-Down Current                              | V <sub>TMR</sub> = 1.6V<br>V <sub>TMR</sub> = 1.6V (H-Grade)                                                          | ●<br>● | 1.3<br>1.2   | 2.1<br>2.1         | 2.8<br>2.8   | μA<br>μA |
| V <sub>TMR(DIS)</sub>    | Timer Disable Voltage                              | Referenced to V <sub>CC</sub>                                                                                         | ●      | –180         | –270               |              | mV       |
| V <sub>OH</sub>          | Output Voltage High $\overline{\text{UV/OV/OV}}$   | V <sub>CC</sub> = 2.3V, I $\overline{\text{UV/OV}}$ = –1μA                                                            | ●      | 1            |                    |              | V        |
| V <sub>OL</sub>          | Output Voltage Low $\overline{\text{UV/OV/OV}}$    | V <sub>CC</sub> = 2.3V, I $\overline{\text{UV/OV}}$ = 2.5mA<br>V <sub>CC</sub> = 1V, I $\overline{\text{UV}}$ = 100μA | ●<br>● |              | 0.10<br>0.01       | 0.30<br>0.15 | V<br>V   |

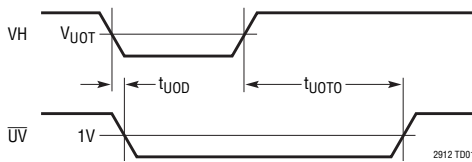
**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

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

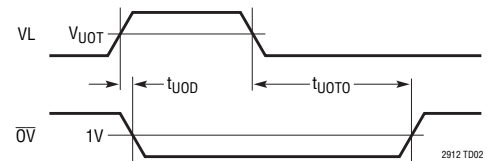
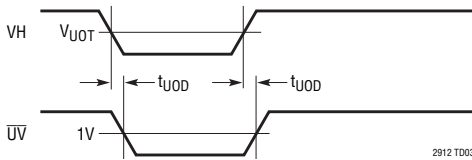
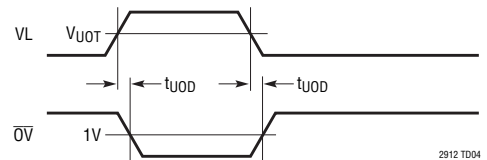
**Note 3:**  $V_{CC}$  maximum pin voltage is limited by input current. Since the  $V_{CC}$  pin has an internal 6.5V shunt regulator, a low impedance supply that exceeds 6V may exceed the rated terminal current. Operation from higher voltage supplies requires a series dropping resistor. See Applications Information.

# TIMING DIAGRAMS

VH Monitor Timing

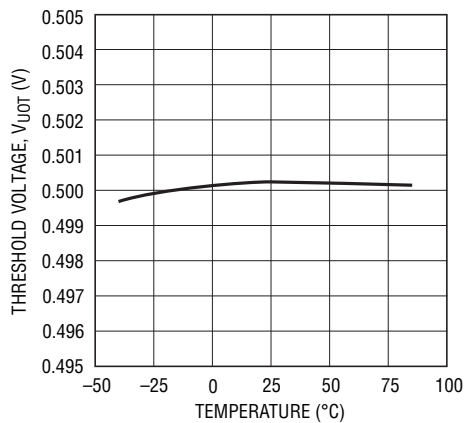


VL Monitor Timing

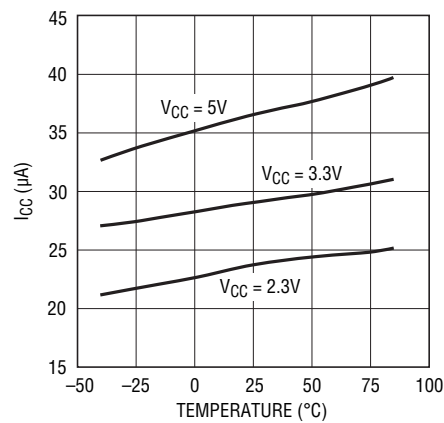
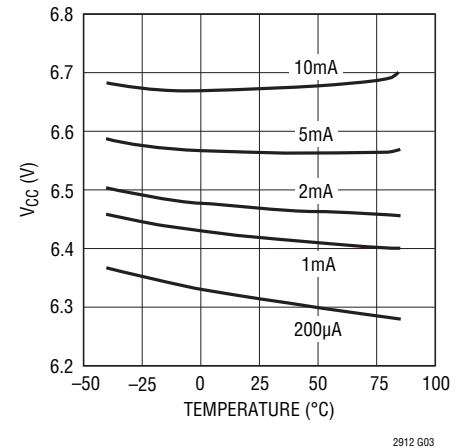
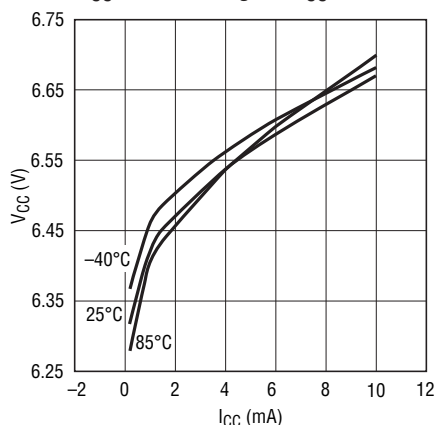

VH Monitor Timing (TMR Pin Strapped to V<sub>CC</sub>)

VL Monitor Timing (TMR Pin Strapped to V<sub>CC</sub>)


# TYPICAL PERFORMANCE CHARACTERISTICS

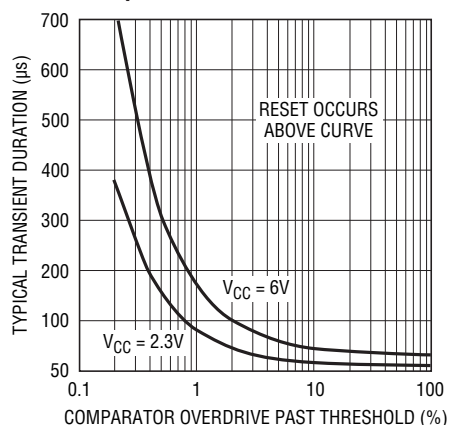
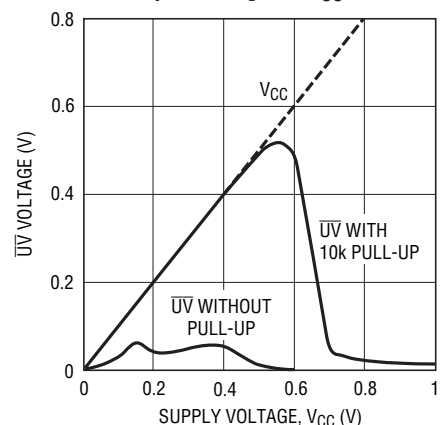
Input Threshold Voltage vs Temperature



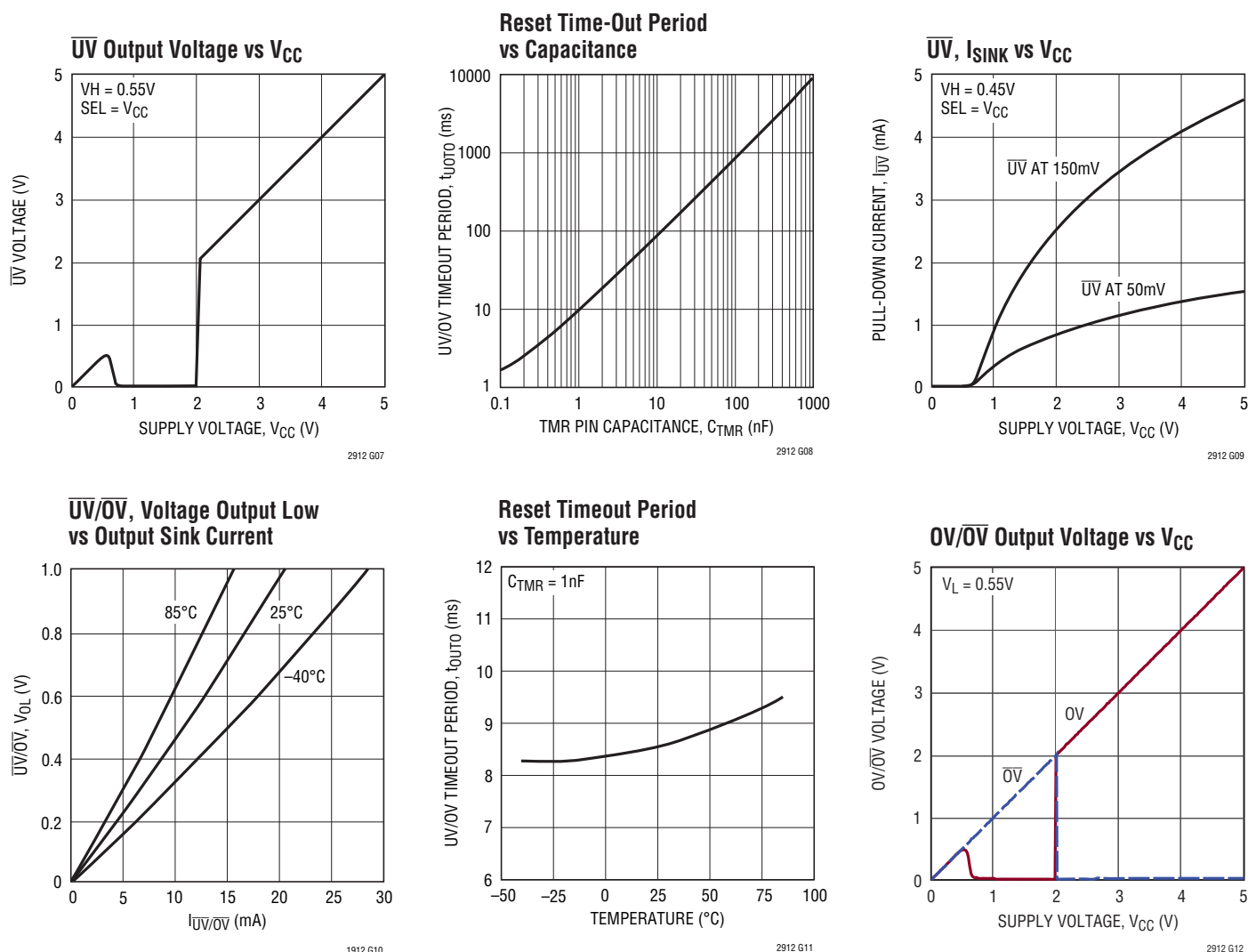
Supply Current vs Temperature


V<sub>CC</sub> Shunt Voltage vs Temperature
V<sub>CC</sub> Shunt Voltage vs I<sub>CC</sub>

Typical Transient Duration vs Comparator Overdrive


UV Output Voltage vs V<sub>CC</sub>

## TYPICAL PERFORMANCE CHARACTERISTICS



## PIN FUNCTIONS (DFN/TSOT Packages)

**DIS (Pin 8/Pin 1, LTC2912-2):** Output Disable Input. Disables the  $\overline{OV}$  and  $\overline{UV}$  output pins. When DIS is pulled high, the  $\overline{OV}$  and  $\overline{UV}$  pins are not asserted except during a UVLO condition. Pin has a weak ( $2\mu A$ ) internal pull-down to GND. Leave pin open if unused.

**Exposed Pad (Pin 9, DDB Package):** Exposed Pad may be left open or connected to device ground.

**GND (Pin 5/Pin 4):** Device Ground.

**LATCH (Pin 8/Pin 1, LTC2912-1, LTC2912-3):**  $OV/\overline{OV}$  Latch Clear/Bypass Input. When pulled high,  $OV/\overline{OV}$  latch

is cleared. While held high,  $OV/\overline{OV}$  has a similar delay and output characteristic as  $\overline{UV}$ .

**$\overline{OV}$  (Pin 6/Pin 3, LTC2912-1, LTC2912-2):** Overvoltage Logic Output. Asserts low when the  $V_L$  input voltage is above threshold. Latched low (LTC2912-1). Held low for programmed delay time after  $V_L$  input is valid (LTC2912-2). Pin has a weak pull-up to  $V_{CC}$  and may be pulled above  $V_{CC}$  using an external pull-up. Leave pin open if unused.

## PIN FUNCTIONS (DFN/TSOT Packages)

**OV (Pin 6/Pin 3, LTC2912-3):** Overvoltage Logic Output. Asserts high with a weak internal pull-up to  $V_{CC}$  when the VL input is above threshold. Latches high. May be pulled above  $V_{CC}$  using an external pull-up. Leave pin open if unused.

**TMR (Pin 4/Pin 5):** Reset Delay Timer. Attach an external capacitor ( $C_{TMR}$ ) of at least 10pF to GND to set a reset delay time of 9ms/nF. A 1nF capacitor will generate an 8.5ms reset delay time. Tie pin to  $V_{CC}$  to bypass timer.

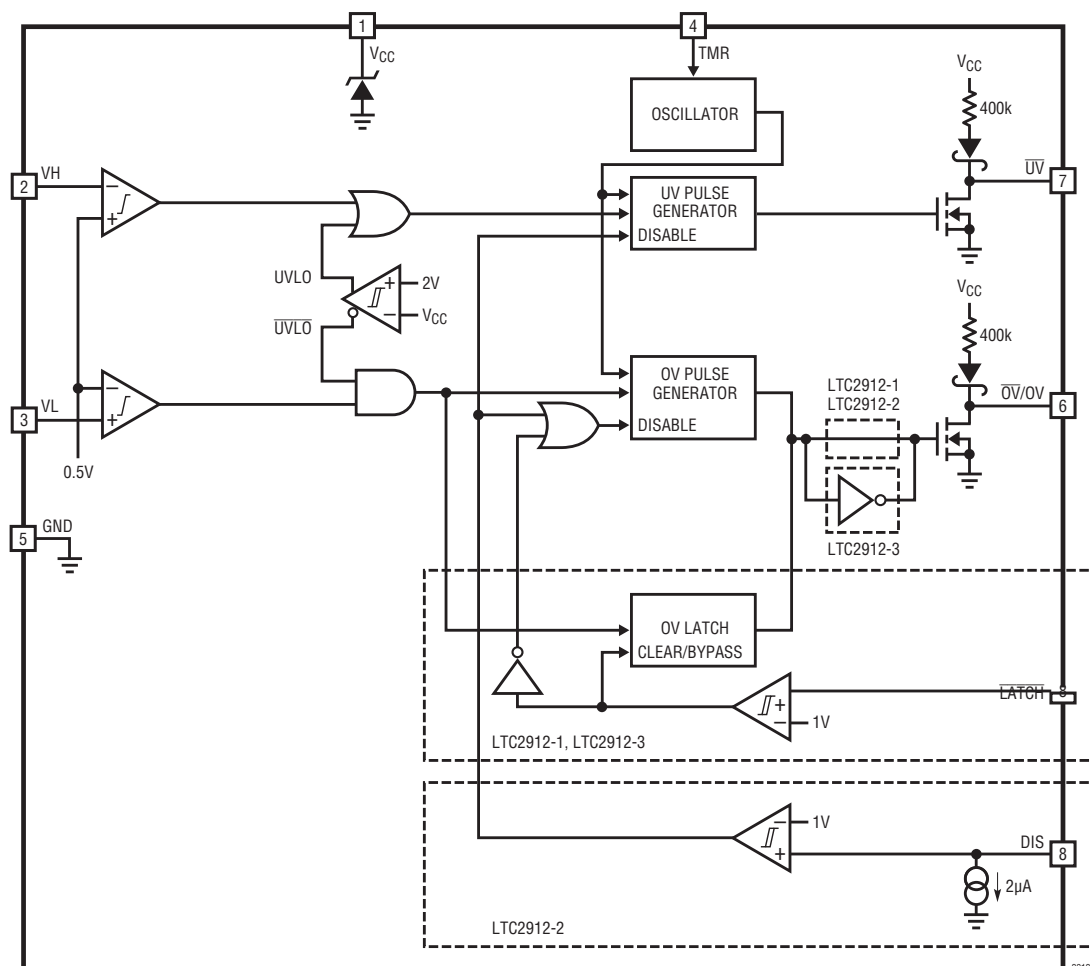
**UV (Pin 7/Pin 2):** Undervoltage Logic Output. Asserts low when the VH input voltage is below threshold. Held low for a programmed delay time after the VH input is valid. Pin has a weak pull-up to  $V_{CC}$  and may be pulled above  $V_{CC}$  using an external pull-up. Leave pin open if unused.

**$V_{CC}$  (Pin 1/Pin 8):** Supply Voltage. Bypass this pin to GND with a 0.1 $\mu$ F (or greater) capacitor. Operates as a direct supply input for voltages up to 6V. Operates as a shunt regulator for supply voltages greater than 6V and should have a resistance between the pin and the supply to limit input current to no greater than 10mA. When used without a current-limiting resistance, pin voltage must not exceed 6V.

**VH (Pin 2/Pin 7):** Voltage High Input. When the voltage on this pin is below 0.5V, an undervoltage condition is triggered. Tie pin to  $V_{CC}$  if unused.

**VL (Pin 3/Pin 6):** Voltage Low Input. When the voltage on this pin is above 0.5V, an overvoltage condition is triggered. Tie pin to GND if unused.

## BLOCK DIAGRAM



2912fb

## APPLICATIONS INFORMATION

### Voltage Monitoring

The LTC2912 is a low power voltage monitoring circuit with an undervoltage and an overvoltage input. A timeout period that holds  $\overline{OV}$  and  $\overline{UV}$  asserted after a fault has cleared is adjustable using an external capacitor and may be externally disabled. When configured to monitor a positive voltage  $V_n$  using the 3-resistor circuit configuration shown in Figure 1,  $V_H$  will be connected to the high side tap of the resistive divider and  $V_L$  will be connected to the low side tap of the resistive divider.

### 3-Step Design Procedure

The following 3-step design procedure allows selecting appropriate resistances to obtain the desired UV and OV trip points for the voltage monitor circuit in Figure 1.

For supply monitoring,  $V_n$  is the desired nominal operating voltage,  $I_n$  is the desired nominal current through the resistive divider,  $V_{OV}$  is the desired overvoltage trip point and  $V_{UV}$  is the desired undervoltage trip point.

#### 1. Choose $R_A$ to obtain the desired OV trip point

$R_A$  is chosen to set the desired trip point for the overvoltage monitor.

$$R_A = \left| \frac{0.5V}{I_n} \cdot \frac{V_n}{V_{OV}} \right| \quad (1)$$

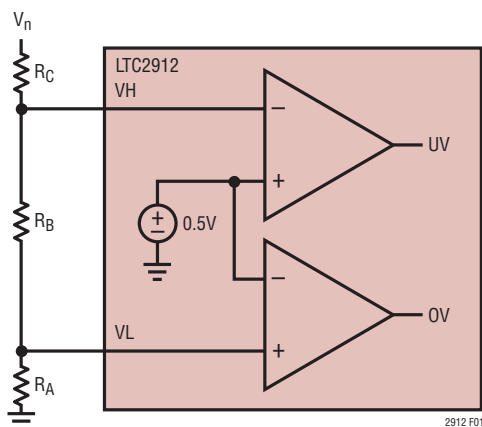


Figure 1. 3-Resistor Positive UV/OV Monitoring Configuration

#### 2. Choose $R_B$ to obtain the desired UV trip point

Once  $R_A$  is known,  $R_B$  is chosen to set the desired trip point for the undervoltage monitor.

$$R_B = \left| \frac{0.5V}{I_n} \cdot \frac{V_n}{V_{UV}} \right| - R_A \quad (2)$$

#### 3. Choose $R_C$ to complete the design

Once  $R_A$  and  $R_B$  are known,  $R_C$  is determined by:

$$R_C = \left| \frac{V_n}{I_n} \right| - R_A - R_B \quad (3)$$

If any of the variables  $V_n$ ,  $I_n$ ,  $V_{UV}$  or  $V_{OV}$  change, then each step must be recalculated.

### Voltage Monitor Example

A typical voltage monitor application is shown in Figure 2. The monitored voltage is a  $5V \pm 10\%$  supply. Nominal current in the resistive divider is  $10\mu A$ .

1. Find  $R_A$  to set the OV trip point of the monitor.

$$R_A = \left| \frac{0.5V}{10\mu A} \cdot \frac{5V}{5.5V} \right| \approx 45.3k$$

2. Find  $R_B$  to set the UV trip point of the monitor.

$$R_B = \left| \frac{0.5V}{10\mu A} \cdot \frac{5V}{4.5V} \right| - 45.3k \approx 10.2k$$

3. Determine  $R_C$  to complete the design.

$$R_C = \left| \frac{5V}{10\mu A} \right| - 45.3k - 10.2k \approx 442k$$

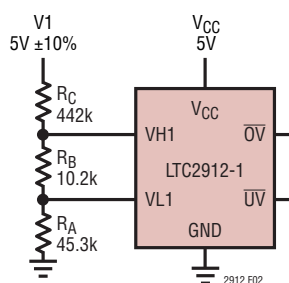


Figure 2. Typical Supply Monitor

## APPLICATIONS INFORMATION

### Power-Up/Power-Down

As soon as  $V_{CC}$  reaches 1V during power up, the  $\overline{UV}$  output asserts low and the  $\overline{OV}$  output weakly pulls to  $V_{CC}$ .

The LTC2912 is guaranteed to assert  $\overline{UV}$  low,  $\overline{OV}$  high (LTC2912-1, LTC2912-2) and OV low (LTC2912-3) under conditions of low  $V_{CC}$ , down to  $V_{CC} = 1V$ . Above  $V_{CC} = 2V$  (2.1V maximum), the VH and VL inputs take control.

Once the VH input and  $V_{CC}$  become valid an internal timer is started. After an adjustable delay time,  $\overline{UV}$  weakly pulls high.

### Threshold Accuracy

Reset threshold accuracy is important in a supply-sensitive system. Ideally, such a system resets only if supply voltages fall outside the exact thresholds for a specified margin. Both LTC2912 inputs have a relative threshold accuracy of  $\pm 1.5\%$  over the full operating temperature range.

For example, when the LTC2912 is programmed to monitor a 5V input with a 10% tolerance, the desired UV trip point is 4.5V. Because of the  $\pm 1.5\%$  relative accuracy of the LTC2912, the UV trip point can be anywhere between 4.433V and 4.567V which is  $4.5V \pm 1.5\%$ .

Likewise, the accuracy of the resistances chosen for  $R_A$ ,  $R_B$  and  $R_C$  can affect the UV and OV trip points as well. Using the example just given, if the resistances used to set the UV trip point have 1% accuracy, the UV trip range is between 4.354V and 4.650V. This is illustrated in the following calculations.

The UV trip point is given as:

$$V_{UV} = 0.5V \left( 1 + \frac{R_C}{R_A + R_B} \right)$$

The two extreme conditions, with a relative accuracy of 1.5% and resistance accuracy of 1%, result in:

$$V_{UV(MIN)} = 0.5V \cdot 0.985 \cdot \left( 1 + \frac{R_C \cdot 0.99}{(R_A + R_B) \cdot 1.01} \right)$$

and

$$V_{UV(MAX)} = 0.5V \cdot 1.015 \cdot \left( 1 + \frac{R_C \cdot 1.01}{(R_A + R_B) \cdot 0.99} \right)$$

For a desired trip point of 4.5V,  $\frac{R_C}{R_A + R_B} = 8$

Therefore,

$$V_{UV(MIN)} = 0.5V \cdot 0.985 \cdot \left( 1 + 8 \frac{0.99}{1.01} \right) = 4.354V$$

and

$$V_{UV(MAX)} = 0.5V \cdot 1.015 \cdot \left( 1 + 8 \frac{1.01}{0.99} \right) = 4.650V$$

### Glitch Immunity

In any supervisory application, noise riding on the monitored DC voltage causes spurious resets. To solve this problem without adding hysteresis, which causes a new error term in the trip voltage, the LTC2912 lowpass filters the output of the first stage comparator at each input. This filter integrates the output of the comparator before asserting the UV or OV logic. A transient at the input of the comparator of sufficient magnitude and duration triggers the output logic. The Typical Performance Characteristics show a graph of the Transient Duration vs Comparator Overdrive.

### UV/OV Timing

The LTC2912 has an adjustable timeout period ( $t_{UOTO}$ ) that holds OV,  $\overline{OV}$  or  $\overline{UV}$  asserted after each fault has cleared. This delay assures a minimum reset pulse width allowing settling time for the monitored voltage after it has entered the "valid" region of operation.

## APPLICATIONS INFORMATION

When the  $V_H$  input drops below its designed threshold, the  $\overline{UV}$  pin asserts low. When the input recovers above its designed threshold, the UV output timer starts. If the input remains above the designed threshold when the timer finishes, the  $\overline{UV}$  pin weakly pulls high. However, if the input falls below its designed threshold during this timeout period, the timer resets and restarts when the input is above the designed threshold. The OV and  $\overline{OV}$  outputs behave as the  $\overline{UV}$  output when  $\overline{LATCH}$  is high (LTC2912-1, LTC2912-3).

### Selecting the UV/OV Timing Capacitor

The UV and OV timeout period ( $t_{UOTO}$ ) for the LTC2912 is adjustable to accommodate a variety of applications. Connecting a capacitor,  $C_{TMR}$ , between the TMR pin and ground sets the timeout period. The value of capacitor needed for a particular timeout period is:

$$C_{TMR} = t_{UOTO} \cdot 115 \cdot 10^{-9} \text{ [F/s]}$$

The Reset Timeout Period vs Capacitance graph found in the Typical Performance Characteristics shows the desired delay time as a function of the value of the timer capacitor that must be used. The TMR pin must have a minimum 10pF load or be tied to  $V_{CC}$ . For long timeout periods, the only limitation is the availability of a large value capacitor with low leakage. Capacitor leakage current must not exceed the minimum TMR charging current of 1.3 $\mu$ A. Tying the TMR pin to  $V_{CC}$  bypasses the timeout period.

### Undervoltage Lockout

When  $V_{CC}$  falls below 2V, the LTC2912 asserts an undervoltage lockout (UVLO) condition. During UVLO,  $\overline{UV}$  is asserted and pulled low while OV and  $\overline{OV}$  are cleared and blocked from asserting. When  $V_{CC}$  rises above 2V,  $\overline{UV}$  follows the same timing procedure as an undervoltage condition on the  $V_H$  input.

### Shunt Regulator

The LTC2912 has an internal shunt regulator. The  $V_{CC}$  pin operates as a direct supply input for voltages up to 6V. Under this condition, the quiescent current of the device remains below a maximum of 70 $\mu$ A. For  $V_{CC}$  voltages higher than 6V, the device operates as a shunt regulator

and should have a resistance  $R_Z$  between the supply and the  $V_{CC}$  pin to limit the current to no greater than 10mA.

When choosing this resistance value, select an appropriate location on the I-V curve shown in the Typical Performance Characteristics to accommodate any variations in  $V_{CC}$  due to changes in current through  $R_Z$ .

### $\overline{UV}$ , $\overline{OV}$ and OV Output Characteristics

The DC characteristics of the  $\overline{UV}$ ,  $\overline{OV}$  and OV pull-up and pull-down strength are shown in the Typical Performance Characteristics. Each pin has a weak internal pull-up to  $V_{CC}$  and a strong pull-down to ground. This arrangement allows these pins to have open-drain behavior while possessing several other beneficial characteristics. The weak pull-up eliminates the need for an external pull-up resistor when the rise time on the pin is not critical. On the other hand, the open-drain configuration allows for wired-OR connections, and is useful when more than one signal needs to pull down on the output.  $V_{CC}$  of 1V guarantees a maximum  $V_{OL} = 0.15V$  at  $\overline{UV}$ .

At  $V_{CC} = 1V$ , the weak pull-up current on  $\overline{OV}$  is barely turned on. Therefore, an external pull-up resistor of no more than 100k is recommended on the  $\overline{OV}$  pin if the state and pull-up strength of the  $\overline{OV}$  pin is crucial at very low  $V_{CC}$ .

Note however, by adding an external pull-up resistor, the pull-up strength on the  $\overline{OV}$  pin is increased. Therefore, if it is connected in a wired-OR connection, the pull-down strength of any single device must accommodate this additional pull-up strength.

### Output Rise and Fall Time Estimation

The  $\overline{UV}$ ,  $\overline{OV}$  and OV outputs have strong pull-down capability. The following formula estimates the output fall time (90% to 10%) for a particular external load capacitance ( $C_{LOAD}$ ):

$$t_{FALL} \approx 2.2 \cdot R_{PD} \cdot C_{LOAD}$$

where  $R_{PD}$  is the on-resistance of the internal pull-down transistor, typically 50 $\Omega$  at  $V_{CC} > 1V$  and at room temperature (25°C).  $C_{LOAD}$  is the external load capacitance on the pin. Assuming a 150pF load capacitance, the fall time is 16.5ns.

## APPLICATIONS INFORMATION

The rise time on the  $\overline{UV}$ ,  $\overline{OV}$  and  $OV$  pins is limited by a 400k pull-up resistance to  $V_{CC}$ . A similar formula estimates the output rise time (10% to 90%) at the  $\overline{UV}$ ,  $\overline{OV}$  and  $OV$  pins:

$$t_{RISE} \approx 2.2 \cdot R_{PU} \cdot C_{LOAD}$$

where  $R_{PU}$  is the pull-up resistance.

### $\overline{OV}/OV$ Latch (LTC2912-1, LTC2912-3)

With the  $\overline{LATCH}$  pin held low, the  $\overline{OV}$  pin latches low (LTC2912-1) and the  $OV$  pin latches high (LTC2912-3) when an  $OV$  condition is detected. The latch is cleared by raising the  $\overline{LATCH}$  pin high. If an  $OV$  condition clears while  $\overline{LATCH}$  is held high, the latch is bypassed and the  $OV$  and  $\overline{OV}$  pins behave the same as the  $\overline{UV}$  pin with a similar timeout period at the output. If  $\overline{LATCH}$  is pulled

low while the timeout period is active, the  $OV$  and  $\overline{OV}$  pins latch as before.

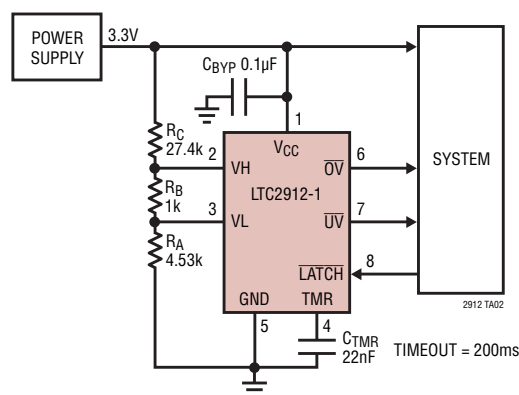
### Disable (LTC2912-2)

The LTC2912-2 allows disabling the  $\overline{UV}$  and  $\overline{OV}$  outputs via the  $\overline{DIS}$  pin. Pulling  $\overline{DIS}$  high forces both outputs to remain weakly pulled high, regardless of any faults that occur on the inputs. However, if a  $UVLO$  condition occurs,  $\overline{UV}$  asserts and pulls low, but the timeout function is bypassed.  $\overline{UV}$  pulls high as soon as the  $UVLO$  condition is cleared.

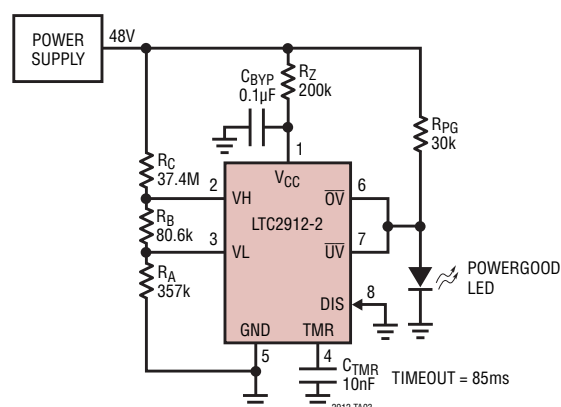
$\overline{DIS}$  has a weak 2 $\mu A$  (typical) internal pull-down current guaranteeing normal operation with the pin left open.

## TYPICAL APPLICATIONS

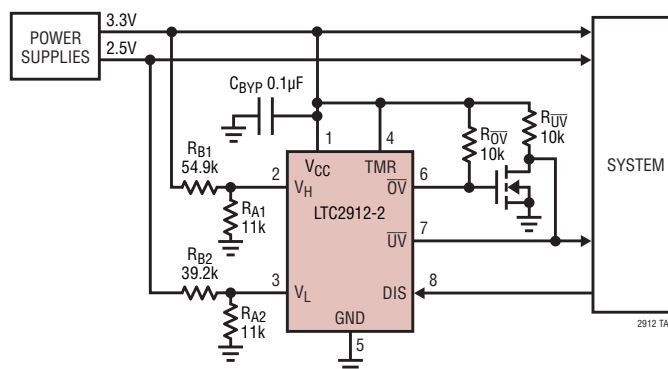
Dual UV/OV Supply Monitor, 3.3V  $\pm 10\%$  Tolerance



48V Supply Monitor ( $< \pm 10\%$  = Powergood)



Dual UV Supply Monitor, 3.3V, 2.5V, 10% Tolerance

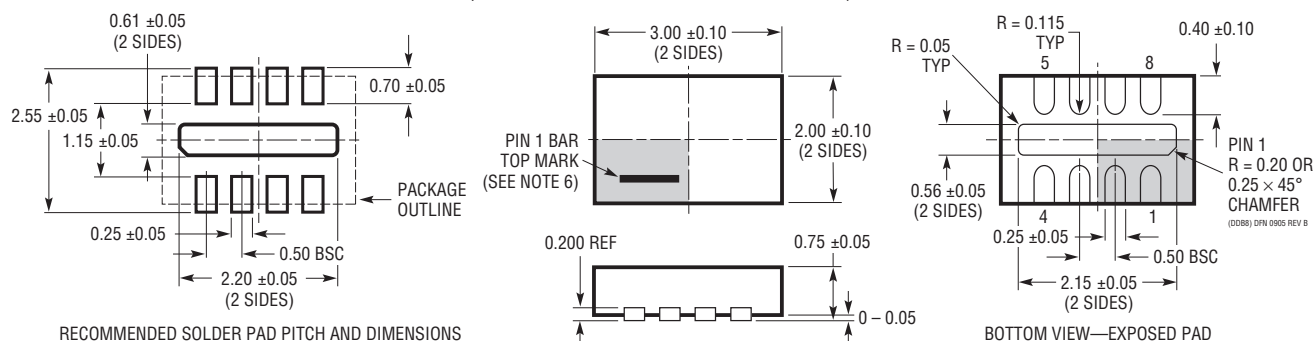


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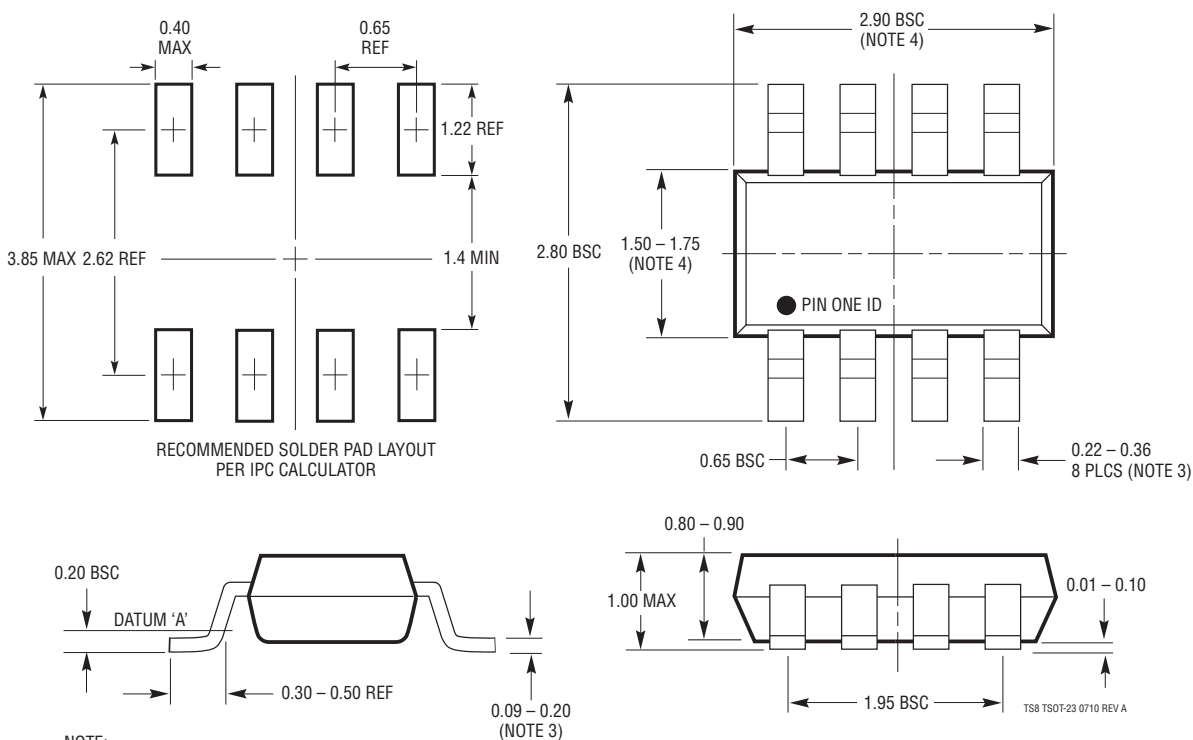
## PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

### DDB Package 8-Lead Plastic DFN (3mm × 2mm) (Reference LTC DWG # 05-08-1702 Rev B)



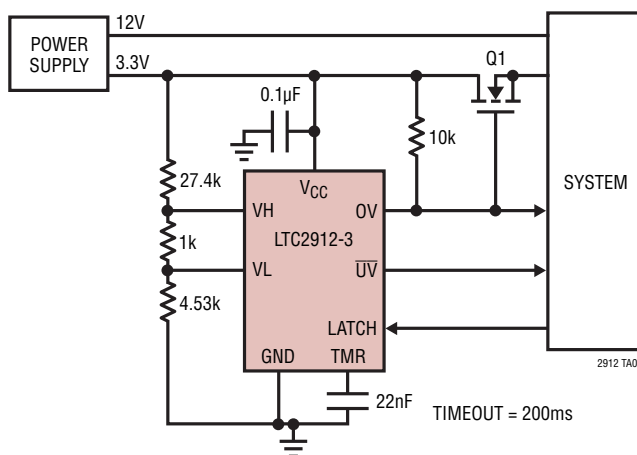
### TS8 Package 8-Lead Plastic TSOT-23 (Reference LTC DWG # 05-08-1637 Rev A)



**REVISION HISTORY** (Revision history begins at Rev B)

| REV | DATE  | DESCRIPTION                                                                                                   | PAGE NUMBER |
|-----|-------|---------------------------------------------------------------------------------------------------------------|-------------|
| B   | 06/14 | Updated Package/Order Information<br>Added OV/ $\overline{\text{OV}}$ Output Voltage vs $V_{\text{CC}}$ graph | 2, 3<br>6   |

## TYPICAL APPLICATION

Single UV/OV Supply Monitor with 3.3V  $\pm 10\%$ 

## RELATED PARTS

| PART NUMBER                                                 | DESCRIPTION                                                          | COMMENTS                                                                                                                       |
|-------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">LTC690</a>                                      | 5V Supply Monitor, Watchdog Timer and Battery Backup                 | 4.65 Threshold                                                                                                                 |
| <a href="#">LTC694-3.3</a>                                  | 3.3V Supply Monitor, Watchdog Timer and Battery Backup               | 2.9V Threshold                                                                                                                 |
| <a href="#">LTC699</a>                                      | 5V Supply Monitor and Watchdog Timer                                 | 4.65 Threshold                                                                                                                 |
| <a href="#">LTC1232</a>                                     | 5V Supply Monitor, Watchdog Timer and Push-Button Reset              | 4.37V/4.62V Threshold                                                                                                          |
| <a href="#">LTC1326/</a><br><a href="#">LTC1326-2.5</a>     | Micropower Precision Triple Supply Monitor for 5V/2.5V, 3.3V and ADJ | 4.725V, 3.118V, 1V Threshold ( $\pm 0.75\%$ )                                                                                  |
| <a href="#">LTC1536</a>                                     | Precision Triple Supply Monitor for PCI Applications                 | Meets PCI $t_{\text{FAIL}}$ Timing Specifications                                                                              |
| <a href="#">LTC1726-2.5/</a><br><a href="#">LTC1726-5</a>   | Micropower Triple Supply Monitor for 2.5V/5V, 3.3V and ADJ           | Adjustable $\overline{\text{RESET}}$ and Watchdog Time-Outs                                                                    |
| <a href="#">LTC1728-1.8/</a><br><a href="#">LTC1728-3.3</a> | Micropower Triple Supply Monitor with Open-Drain Reset               | 5-Lead SOT-23 Package                                                                                                          |
| <a href="#">LTC1985-1.8</a>                                 | Micropower Triple Supply Monitor with Open-Drain Reset               | 5-Lead SOT-23 Package                                                                                                          |
| <a href="#">LTC2900</a>                                     | Programmable Quad Supply Monitor                                     | Adjustable RESET, 10-Lead MSOP and 3mm $\times$ 3mm 10-Lead DFN Package                                                        |
| <a href="#">LTC2901</a>                                     | Programmable Quad Supply Monitor                                     | Adjustable RESET and Watchdog Timer, 16-Lead SSOP Package                                                                      |
| <a href="#">LTC2902</a>                                     | Programmable Quad Supply Monitor                                     | Adjustable RESET and Tolerance, 16-Lead SSOP Package, Margining Functions                                                      |
| <a href="#">LTC2903-1</a>                                   | Precision Quad Supply Monitor                                        | 6-Lead TSOT-23 Package, Ultralow Voltage Reset                                                                                 |
| <a href="#">LTC2904</a>                                     | 3-State Programmable Precision Dual Supply Monitor                   | Adjustable Tolerance, 8-Lead TSOT-23 Package                                                                                   |
| <a href="#">LTC2905</a>                                     | 3-State Programmable Precision Dual Supply Monitor                   | Adjustable RESET and Tolerance, 8-Lead TSOT-23 Package                                                                         |
| <a href="#">LTC2906</a>                                     | Precision Dual Supply Monitor 1-Selectable and 1 Adjustable          | Separate $V_{\text{CC}}$ Pin, RST/ $\overline{\text{RST}}$ Outputs                                                             |
| <a href="#">LTC2907</a>                                     | Precision Dual Supply Monitor 1-Selectable and 1 Adjustable          | Separate $V_{\text{CC}}$ , Adjustable Reset Timer                                                                              |
| <a href="#">LTC2908</a>                                     | Precision Six Supply Monitor (Four Fixed and 2 Adjustable)           | 8-Lead TSOT-23 and DFN Packages                                                                                                |
| <a href="#">LTC2909</a>                                     | Prevision Dual Input UV, OV and Negative Voltage Monitor             | Separate $V_{\text{CC}}$ Pin, Adjustable Reset Timer, 8-Lead TSOT-23 and DFN Packages                                          |
| <a href="#">LTC2913</a>                                     | Dual UV/OV Voltage Monitor                                           | Separate $V_{\text{CC}}$ Pin, Two Inputs, Adjustable Reset Timer, 10-Lead MSOP and DFN Packages                                |
| <a href="#">LTC2914</a>                                     | Quad UV/OV Positive/Negative Voltage Monitor                         | Separate $V_{\text{CC}}$ Pin, Four inputs, Up To Two Negative Monitors, Adjustable Reset Timer, 16-Lead TSSOP and DFN Packages |

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