

General Description

The MAX1259 battery manager provides backup-battery switching for CMOS RAM, microprocessors, or other low-power logic ICs. It automatically switches to the backup battery when the primary power supply is interrupted. Low-loss switches guarantee an input-to-output differential of only 200mV while supplying 250mA from the primary power supply or 15mA from the battery.

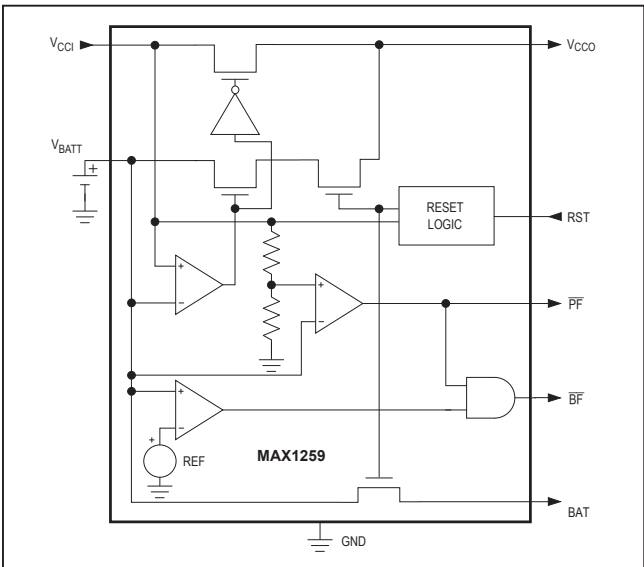
Battery discharge during shipping does not occur in the MAX1259, since the backup battery can be disconnected by strobing the RST input.

A battery-fail output signal indicates when the backup battery is below +2V, and a power-fail output signal indicates when the primary power supply is low. The MAX1259 monitors the backup battery, warns of impending power failures, and switches the memory to the battery when failures occur. The MAX1259 is pincompatible with the DS1259, but consumes three times less supply current. Commercial, extended, and military temperature range devices are available.

Applications

- Battery Backup for CMOS RAM
- Uninterruptible Power Supplies
- Computers
- Controllers

Functional Diagram



Features

- Switches to Backup Battery if Power Fails
- Consumes Less than 100nA of Battery Current
- Power-Fail Output Signals Primary Power-Supply Loss
- Battery Monitor Indicates Low Battery
- Battery Can Be Disconnected to Prevent Discharge During Shipping
- Battery Automatically Reconnected when V<sub>CC</sub> is Applied
- Pin-Compatible with the DS1259
- Supply Current Three Times Lower than DS1259
- Available in Extended-Industrial and Military Temperature Ranges

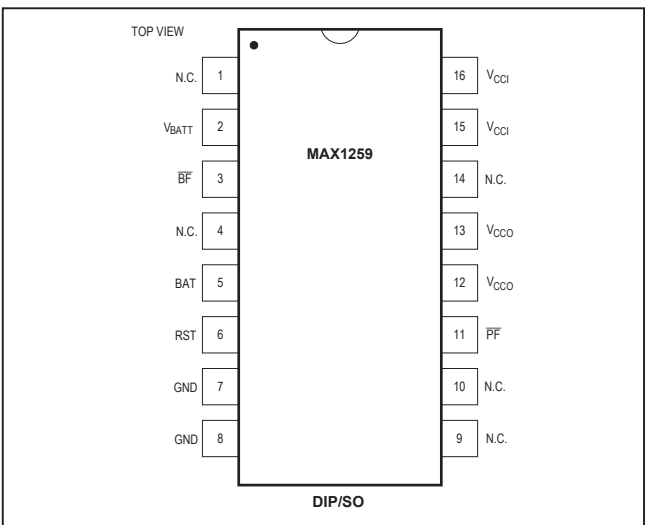
Ordering Information

| PART       | TEMP RANGE      | PIN-PACKAGE |
|------------|-----------------|-------------|
| MAX1259C/D | 0°C to +70°C    | Dice*       |
| MAX1259CPE | 0°C to +70°C    | 16 PDIP     |
| MAX1259CWE | 0°C to +70°C    | 16 Wide SO  |
| MAX1259EPE | -40°C to +85°C  | 16 PDIP     |
| MAX1259EWE | -40°C to +85°C  | 16 Wide SO  |
| MAX1259MJE | -55°C to +125°C | 16 Cerdip   |

\*Contact factory for dice specifications.

**Note:** Devices in PDIP and SO packages are available in both leaded(Pb) and lead(Pb)-free packaging. Specify lead-free by adding the “+” symbol at the end of the part number when ordering. Lead-free not available for Cerdip package.

Pin Configuration



## Absolute Maximum Ratings

Voltage on Any Pin (with respect to GND).....-0.3V to +7.0V  
 Operating Temperature Range  
   C Suffix.....0°C to +70°C  
   E Suffix.....-40°C to +85°C  
   M Suffix.....-55°C to +125°C

Storage Temperature Range .....-55°C to +125°C  
 Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Recommended DC Operating Conditions

(All grades,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.)

| PARAMETER                   | SYMBOL     | CONDITIONS     | MIN              | TYP | MAX             | UNITS |
|-----------------------------|------------|----------------|------------------|-----|-----------------|-------|
| Primary Power Supply        | $V_{CCI}$  | (Note 1)       |                  | 5.0 | 5.5             | V     |
| Input High Voltage (Note 1) | $V_{IH}$   | MAX1259C       | 2.0              |     | $V_{CCI} + 0.3$ | V     |
|                             |            | MAX1259E/M     | 2.4              |     | $V_{CCI} + 0.3$ |       |
| Input Low Voltage           | $V_{IL}$   | (Note 1)       | -0.3             |     | +0.8            | V     |
| Battery Voltage             | $V_{BATT}$ | Pin 2 (Note 2) | 2.5              | 3.0 | 3.7             | V     |
| Battery Output              | BAT        | Pin 5 (Note 1) | $V_{BATT} - 0.1$ |     |                 | V     |

## DC Electrical Characteristics

( $V_{CC} = +4.5V$  to  $+5.5V$ , all grades,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.)

| PARAMETER                                        | SYMBOL      | CONDITIONS                               | MIN                            | TYP                    | MAX                            | UNITS   |
|--------------------------------------------------|-------------|------------------------------------------|--------------------------------|------------------------|--------------------------------|---------|
| Leakage Current                                  | $I_{LO}$    |                                          | -1.0                           |                        | +1.0                           | $\mu A$ |
| Output Current $\overline{PF}$ , $\overline{BF}$ | $I_{OH}$    | $V_{OH} = 2.4V$ (Note 3)                 | -1.0                           |                        |                                | mA      |
|                                                  | $I_{OL}$    | $V_{OL} = 0.4V$                          |                                |                        | 4.0                            |         |
| Input Supply Current                             | $I_{CCI}$   | (Note 4)                                 |                                | 2.00                   | 3.33                           | mA      |
| $V_{CCO}$ Output Current                         | $I_{CCO}$   | $V_{CCO} = V_{CCI} - 0.2V$ , pins 12, 13 |                                |                        | 250                            | mA      |
| Power-Fail Trip Point                            | $V_{TP}$    | Pin 11 (Notes 2, 5)                      | $1.26 \times V_{BATT} - 250mV$ | $1.26 \times V_{BATT}$ | $1.26 \times V_{BATT} + 250mV$ | V       |
| Battery-Fail Trip Point                          | $V_{BATTF}$ | Pin 3 ( $\overline{BF}$ detect) (Note 6) |                                | 2.0                    |                                | V       |

## DC Electrical Characteristics

( $V_{CCI} < V_{BATT}$ , all grades,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.)

| PARAMETER                | SYMBOL       | CONDITIONS                                         | MIN | TYP | MAX | UNITS   |
|--------------------------|--------------|----------------------------------------------------|-----|-----|-----|---------|
| $V_{CCO}$ Output Current | $I_{CCO2}$   | $V_{CCO} = V_{BATT} - 0.2V$ , pins 12, 13 (Note 7) |     |     | 15  | mA      |
| Battery Leakage (Note 8) | $I_{BATT}$   | MAX1259C                                           |     |     | 100 | nA      |
|                          |              | MAX1259E                                           |     |     | 150 |         |
|                          |              | MAX1259M                                           |     |     | 10  | $\mu A$ |
| BAT Output Current       | $I_{BATOUT}$ | Pin 5 (Note 9)                                     |     |     | 100 | $\mu A$ |

## Capacitance

(All grades,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.) (Note 10)

| PARAMETER          | SYMBOL    | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------|-----------|------------|-----|-----|-----|-------|
| Input Capacitance  | $C_{IN}$  |            |     | 5   | 10  | pF    |
| Output Capacitance | $C_{OUT}$ |            |     | 5   | 10  | pF    |

## AC Electrical Characteristics

( $V_{CC} = 4.0\text{V}$  to  $5.5\text{V}$ , all grades,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

| PARAMETER                                  | SYMBOL            | CONDITIONS | MIN | TYP | MAX | UNITS         |
|--------------------------------------------|-------------------|------------|-----|-----|-----|---------------|
| $V_{CCI}$ Fall Time                        | $t_F$             |            | 300 |     |     | $\mu\text{s}$ |
| $V_{CCI}$ Rise Time                        | $t_R$             |            | 1   |     |     | $\mu\text{s}$ |
| Power-Down to $\overline{\text{PF}}$ Low   | $t_{PF}$          |            | 0   |     |     | $\mu\text{s}$ |
| $\overline{\text{PF}}$ High After Power-Up | $t_{REC}$         |            |     |     | 100 | $\mu\text{s}$ |
| RST Pulse Width                            | $\text{RST}_{PW}$ |            | 50  | 10  |     | ns            |

**Note 1:** All voltages referenced to ground.

**Note 2:** Trip-point voltage for power-fail detect:  $V_{TP} = 1.26 \times V_{BATT}$ . For 5% operation:  $V_{BATT} = 3.7\text{V}$  max.

**Note 3:** 50pF load capacity.

**Note 4:** Measured with pins 3, 11, 12, 13, and open.

**Note 5:**  $V_{TP}$  is the point at which  $\overline{\text{PF}}$  is driven low.

**Note 6:**  $V_{BATTF}$  is the point at which  $\overline{\text{BF}}$  is driven low.

**Note 7:**  $I_{CCO2}$  may be limited by battery capacity.

**Note 8:** Battery leakage is the internal energy consumed by the MAX1259.

**Note 9:** See the *Typical Operating Characteristics* BAT Switch Drop vs. Battery Voltage graph.

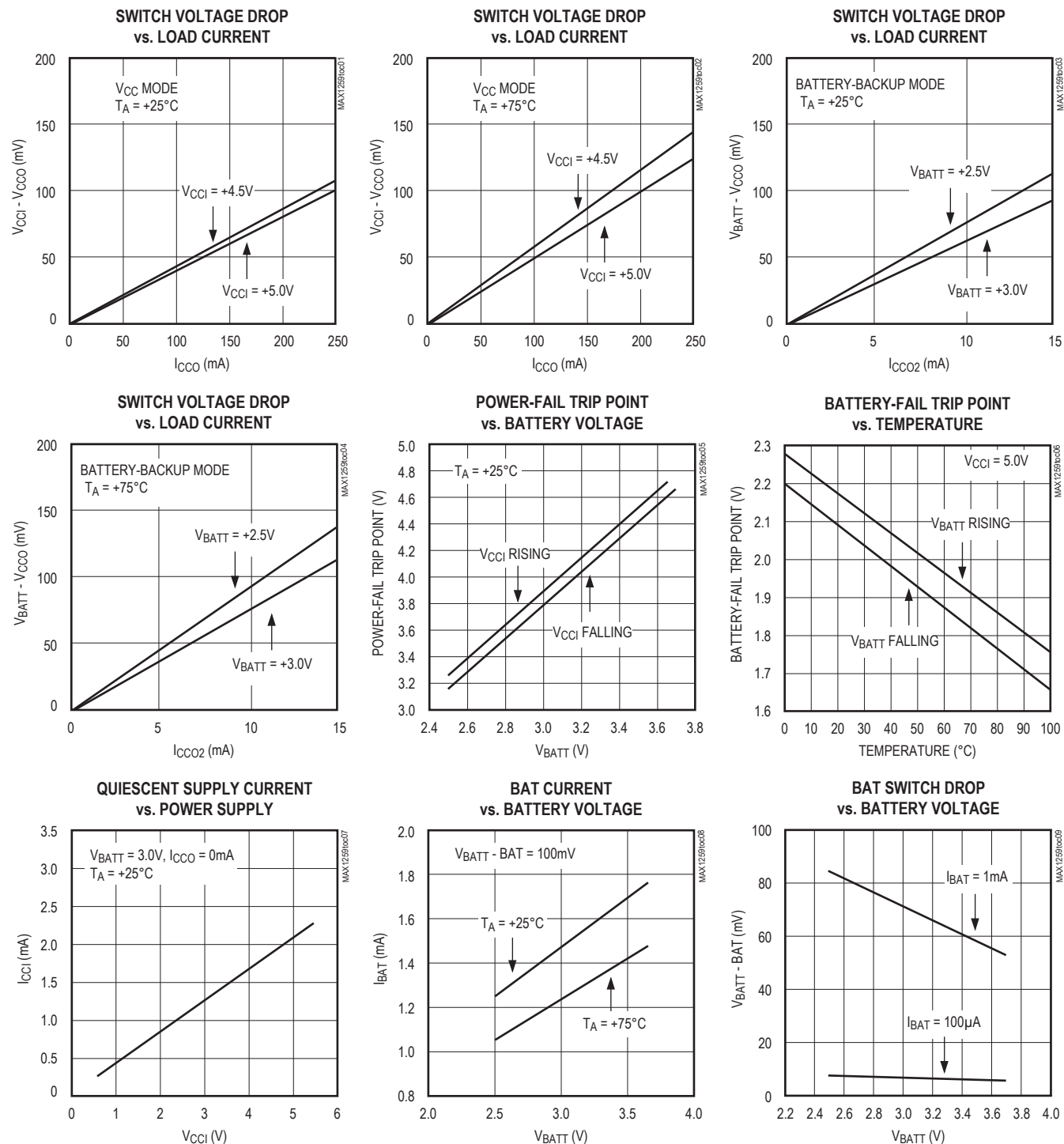
**Note 10:** Guaranteed by design. Not tested.

## Pin Description

| PIN             | NAME                   | FUNCTION                                                                                                                                                                                                                                        |
|-----------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 4, 9, 10, 14 | N.C.                   | No Connection. Make no connection to these pins.                                                                                                                                                                                                |
| 2               | $V_{BATT}$             | Backup Battery Input                                                                                                                                                                                                                            |
| 3               | $\overline{\text{BF}}$ | Battery-Fail Output. $\overline{\text{BF}}$ is high for $V_{CCI}$ at or above $V_{TP}$ and the backup battery greater than 2V. If the backup battery is below 2V or $V_{CCI}$ falls below $V_{TP}$ , $\overline{\text{BF}}$ will be driven low. |
| 5               | BAT                    | Battery Output. During normal operation, the BAT output supplies up to 1mA of continuous battery current. In shipping mode, the BAT output is high impedance.                                                                                   |
| 6               | RST                    | Battery-Disconnect Input. The RST input is used to prevent battery discharge during shipping. Pulsing the RST input disconnects the backup battery from the $V_{CCO}$ and BAT outputs.                                                          |
| 7, 8            | GND                    | Ground                                                                                                                                                                                                                                          |
| 11              | $\overline{\text{PF}}$ | Power-Fail Output. $\overline{\text{PF}}$ is high for $V_{CCI}$ greater than $1.26 \times V_{BATT}$ ( $V_{TP}$ ), indicating a valid $V_{CCI}$ voltage.                                                                                         |
| 12, 13          | $V_{CCO}$              | CMOS RAM is Powered from $V_{CCO}$ . The battery switchover circuit compares $V_{CCI}$ to the $V_{BATT}$ input, and connects $V_{CCO}$ to whichever is higher.                                                                                  |
| 15, 16          | $V_{CCI}$              | +5V $V_{CC}$ Input                                                                                                                                                                                                                              |

## Typical Operating Characteristics

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



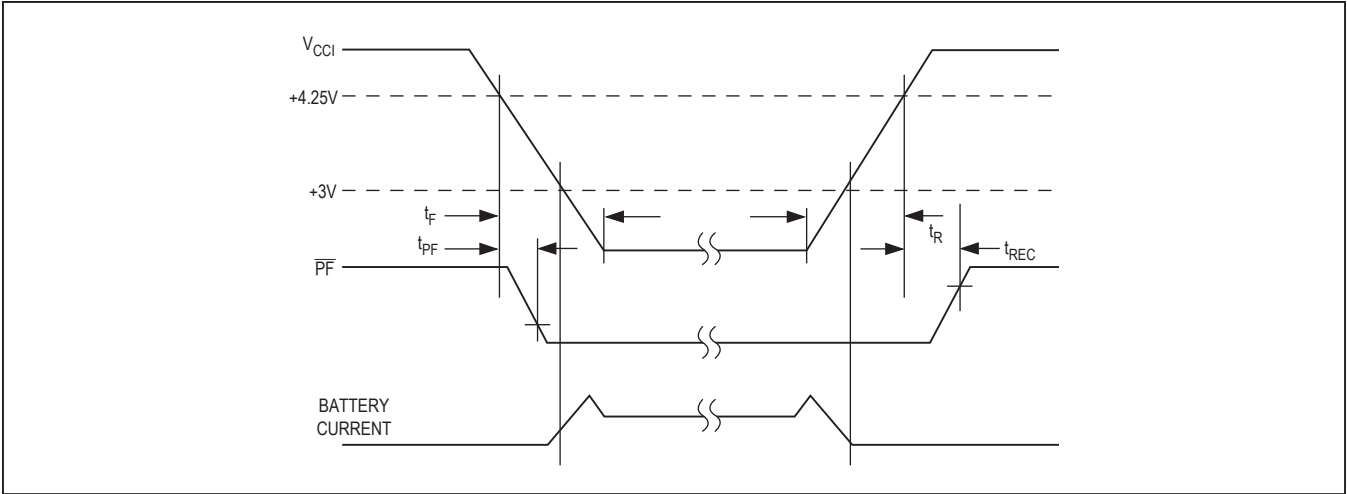


Figure 1. Power-Down/Power-Up Conditions

Detailed Description

Battery Switchover and V<sub>CCO</sub>

Figure 2 shows a typical application for the MAX1259. CMOS RAM is powered from V<sub>CCO</sub>. The battery switchover circuit compares V<sub>CC</sub> to the V<sub>BATT</sub> input, and connects V<sub>CCO</sub> to whichever is higher. Switchover occurs when V<sub>CC</sub> equals V<sub>BATT</sub> as V<sub>CC</sub> falls, and when V<sub>CC</sub> is 60mV greater than V<sub>BATT</sub> as V<sub>CC</sub> rises. This hysteresis prevents repeated, rapid switching if V<sub>CC</sub> falls very slowly or remains nearly equal to the battery voltage. Low-loss switches guarantee an input-to-output differential of only 200mV, while supplying 250mA from the primary power supply or 15mA from the battery.

**Note:** With adequate filtering, the MAX1259 need only supply the average current drawn by the CMOS RAM. Many RAM data sheets specify a 75mA maximum supply current, but this peak current spike lasts only 100ns. If the sum of the peak currents is greater than 250mA, a capacitor placed on the V<sub>CCO</sub> output can supply the high instantaneous current, while V<sub>CCO</sub> need only supply the average current, which is much less. The MAX1259 operates with battery voltages from 2.5V to 3.7V. High-value capacitors—either standard electrolytic or farad-sized, double-layer capacitors—can also be used for short-term memory backup (Figure 3).

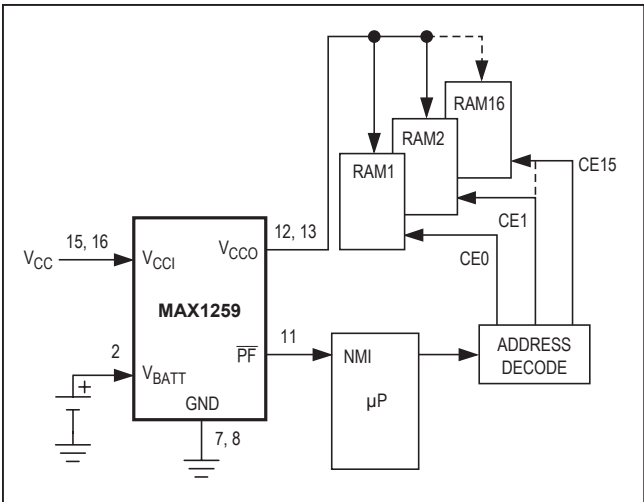


Figure 2. Typical Application Circuit

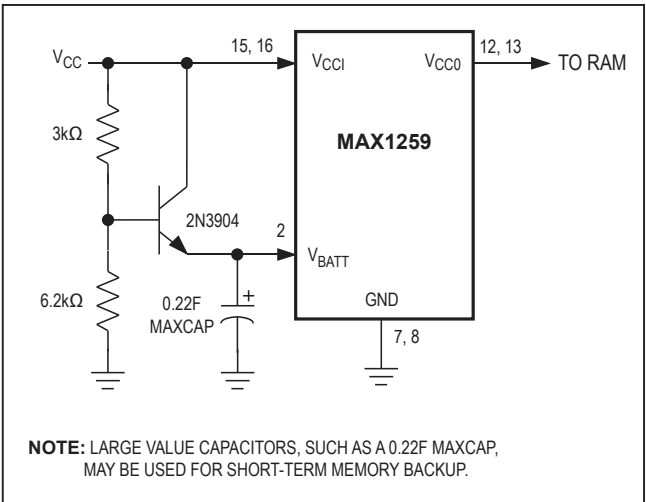


Figure 3. Using a MAXCAP as a Backup Battery

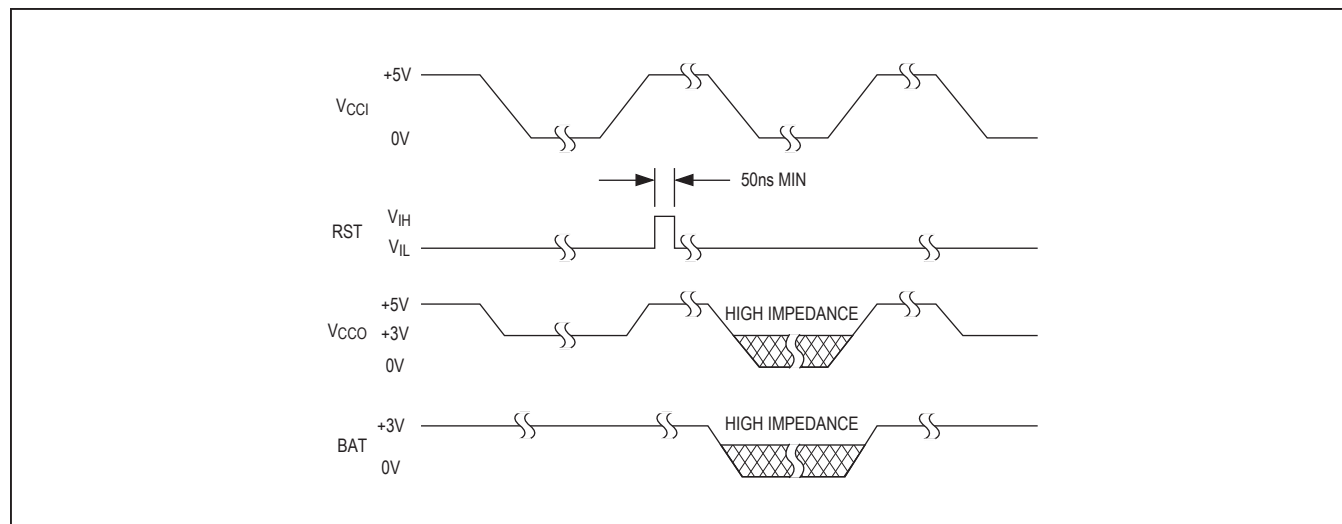


Figure 4. Reset Timing

To achieve rated performance, the  $V_{CC}$  input should be connected to both  $V_{CCI}$  pins (pins 15 and 16). As well, the switched output should be connected to both  $V_{CCO}$  pins (pins 12 and 13).

### Power Fail

The power-fail ( $\overline{PF}$ ) output is high for  $V_{CCI}$  greater than  $1.26 \times V_{BATT}$  ( $V_{TP}$ ), indicating a valid  $V_{CCI}$  voltage.

### Battery Fail

If  $V_{CCI}$  is at or above the voltage trip threshold ( $V_{TP}$ ) and the backup battery is greater than 2V, the battery-fail ( $\overline{BF}$ ) output will be held high, indicating a charged battery. If the backup battery drops below 2V or  $V_{CCI}$  falls below  $V_{TP}$ ,  $\overline{BF}$  will be driven low.

### BAT Output

During normal operation, the BAT output stays at the battery voltage, regardless of the  $V_{CCI}$  level. This provides 1mA battery current.

### RESET (Digitally Controlled Battery Disconnect)

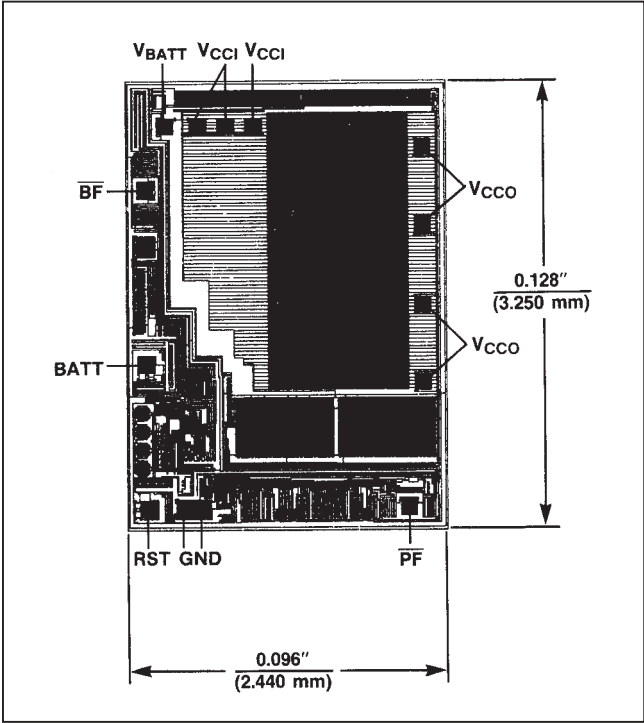
To prevent battery discharge during shipping, the backup battery can be disconnected from  $V_{CCO}$  to BAT.

This disconnect feature is activated by pulsing the reset (RST) input high for a minimum of 50ns with  $V_{CCI}$  greater than  $V_{TP}$  (Figure 4). When primary power is removed, the  $V_{CCO}$  and BAT outputs will go high impedance. The next time primary power is applied with  $V_{CCI}$  greater than  $1.26 \times V_{BATT}$  ( $V_{TP}$ ), normal operation resumes. Note that when the MAX1259 is first powered up,  $V_{CCI}$  must be brought above  $1.26 \times V_{BATT}$ . This resets an internal flip-flop, ensuring that the part is in normal  $V_{CC}$  mode and not in shipping mode.

### Applications Information

If a protection diode is placed in series with the backup battery, pin 2 must be bypassed with at least a 0.01 $\mu$ F capacitor to ground.

Chip Topography



Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | OUTLINE NO.             | LAND PATTERN NO.        |
|--------------|--------------|-------------------------|-------------------------|
| 16 PDIP      | P16+2        | <a href="#">21-0043</a> | —                       |
| 16 Wide SO   | W16+2        | <a href="#">21-0042</a> | <a href="#">90-0107</a> |
| 16 Cerdip    | J16-3        | <a href="#">21-0045</a> | —                       |

## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                                           | PAGES<br>CHANGED |
|--------------------|------------------|-------------------------------------------------------|------------------|
| 3                  | 9/14             | Removed automotive reference from <i>Applications</i> | 1                |

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