MAX14634/MAX14680

Ultra-Low On-Resistance and Compact Bidirectional Battery Switches

General Description

The MAX14634/MAX14680 bidirectional battery switches feature reverse blocking capability to isolate the battery from the system. These internal switches feature ultra-low 7mΩ (typ) on-resistance and operate from a +2.3V to +5.5V input voltage range, making these devices ideal battery-disconnect switches for high-capacity battery applications. The slew-rate controlled switches are also ideal for a large load capacitor as well as high-current load switching applications.

The devices are available in an ultra-small 12-bump (1.3mm x 1.7mm, 0.4mm pitch) WLP package. The tiny, low-profile package is suitable for space-limited portable device applications. The devices operate over the -40°C to +85°C extended temperature range.

Benefits and Features

♦ Provide Efficient System Battery Switch
  ♦ Integrated FET for Bidirectional Blocking
  ♦ Ultra-Low 7mΩ (typ) RON
  ♦ Wide +2.3V to +5.5V Input Voltage Range
  ♦ Low Quiescent Current

♦ Save Space
  ♦ Integrated Pulldown and Logic Buffer Circuits
  ♦ 12-Bump, 1.3mm x 1.7mm, 0.4mm Pitch WLP Package

Applications

Tablet PC Battery Switches
Smartphone Battery Switches
Battery Isolators

Typical Operating Circuit

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated’s website at www.maximintegrated.com.
MAX14634/MAX14680
Ultra-Low On-Resistance and Compact Bidirectional Battery Switches

ABSOLUTE MAXIMUM RATINGS
(All voltages referenced to GND.)

- Operating Temperature Range: -40°C to +85°C
- Maximum Junction Temperature: +150°C
- Continuous Power Dissipation (T_A = +70°C): 1096mW
- Storage Temperature Range: -65°C to +150°C
- Soldering Temperature (reflow): +260°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.

PACKAGE THERMAL CHARACTERISTICS (Note 1)

WLP
Junction-to-Ambient Thermal Resistance (θ_JA) ......... 73°C/W

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to www.maximintegrated.com/thermal-tutorial.

ELECTRICAL CHARACTERISTICS

(V_{PWRA}, V_{PWRB} = 2.3V to 5.5V; T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{PWRA}, V_{PWRB} = 4.2V, C_{PWRA}, C_{PWRB} = 0.1µF; T_A = +25°C.) (Note 2)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY OPERATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>V_{PWRA}, V_{PWRB}</td>
<td></td>
<td>2.3</td>
<td>5.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>I_{PWRA}, I_{PWRB}</td>
<td>V_{EN} = 0.4V (V_{EN} = 1.6V), no load</td>
<td></td>
<td>1</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Transient Supply Current</td>
<td>EN (EN) from high to low or low to high</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Shutdown Current</td>
<td>I_{SHDN}</td>
<td>V_{EN} = 5.5V (V_{EN} = 0V), (V_{PWRA} = 5.5V, V_{PWRB} = open) or (V_{PWRB} = 5.5V, V_{PWRA} = open)</td>
<td></td>
<td>1</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>INTERNAL FET</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Resistance Between PWRA and PWRB</td>
<td>R_{ON}</td>
<td>T_A = +25°C, I_{LOAD} = 100mA</td>
<td>V_{PWRA}, V_{PWRB} = 2.3V</td>
<td>8</td>
<td>13</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{PWRA}, V_{PWRB} = 3.3V</td>
<td></td>
<td>7</td>
<td>10</td>
<td>mΩ</td>
</tr>
<tr>
<td>ENABLE INPUT (Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable Input Logic-High Voltage</td>
<td>V_{IH}</td>
<td></td>
<td></td>
<td>1.6</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Enable Input Logic-Low Voltage</td>
<td>V_{IL}</td>
<td></td>
<td></td>
<td></td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>Enable Internal Pulldown Resistor</td>
<td>R_{PD}</td>
<td></td>
<td></td>
<td>500</td>
<td>700</td>
<td>kΩ</td>
</tr>
<tr>
<td>DYNAMIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-On Time</td>
<td>t_{ON}</td>
<td>Time from EN high-to-low (EN low-to-high) signal to V_{PWRB/A} = 90% of V_{PWRA/B}</td>
<td></td>
<td></td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>Turn-Off Time</td>
<td>t_{OFF}</td>
<td>Time from EN low-to-high (EN high-to-low) signal to V_{PWRB/A} = 10% of V_{PWRA/B}, R_{LOAD} = 100Ω</td>
<td></td>
<td></td>
<td></td>
<td>ms</td>
</tr>
</tbody>
</table>

Note 2: All devices are 100% production tested at T_A = +25°C. Specifications over the operating temperature range are guaranteed by design.

Note 3: EN for MAX14634, EN for MAX14680.
Ultra-Low On-Resistance and Compact Bidirectional Battery Switches

Typical Operating Characteristics

(P_{WR} = +25°C, unless otherwise noted.)
MAX14634/MAX14680
Ultra-Low On-Resistance and Compact Bidirectional Battery Switches

**Typical Operating Characteristics (continued)**

(T\(_A\) = +25°C, unless otherwise noted.)

### NORMALIZED ON-RESISTANCE vs. PWRA VOLTAGE

![Graph showing NORMALIZED ON-RESISTANCE vs. PWRA VOLTAGE][1]

- Normalized \( R_{ON} \) vs. \( V_{PWRA} \) and \( I_{LOAD} = 100\text{mA} \)

### NORMALIZED ON-RESISTANCE vs. PWRB VOLTAGE

![Graph showing NORMALIZED ON-RESISTANCE vs. PWRB VOLTAGE][2]

- Normalized \( R_{ON} \) vs. \( V_{PWRB} \) and \( I_{LOAD} = 100\text{mA} \)

### NORMALIZED ON-RESISTANCE vs. TEMPERATURE

![Graph showing NORMALIZED ON-RESISTANCE vs. TEMPERATURE][3]

- Normalized \( R_{ON} \) vs. \( \text{TEMPERATURE} \) and \( V_{PWRA} = 4.2\text{V} \)

### SWITCH TURN ON-TIME vs. TEMPERATURE

![Graph showing SWITCH TURN ON-TIME vs. TEMPERATURE][4]

- Turn-On Time (ms) vs. \( \text{TEMPERATURE} \) and \( R_{LOAD} = 10\Omega \)

### SWITCH TURN OFF-TIME vs. TEMPERATURE

![Graph showing SWITCH TURN OFF-TIME vs. TEMPERATURE][5]

- Turn-Off Time (ms) vs. \( \text{TEMPERATURE} \) and \( R_{LOAD} = 10\Omega \)

### SWITCH-ON WAVEFORM

![Graph showing SWITCH-ON WAVEFORM][6]

- Waveform for \( R_{LOAD} = 10\Omega \), \( V_{IN} \), \( V_{PWRA} \), and \( I_{PWRA} \) at 2ms/div

### SWITCH-OFF WAVEFORM

![Graph showing SWITCH-OFF WAVEFORM][7]

- Waveform for \( R_{LOAD} = 10\Omega \), \( V_{IN} \), \( V_{PWRA} \), and \( I_{PWRA} \) at 2ms/div
MAX14634/MAX14680
Ultra-Low On-Resistance and Compact Bidirectional Battery Switches

**Bump Configuration**

**Bump Description**

<table>
<thead>
<tr>
<th>MAX14634 NAME</th>
<th>MAX14680 NAME</th>
<th>NAME</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1, A3, B1, B3, C3</td>
<td>A1, A3, B1, B3, C3</td>
<td>PWRB</td>
<td>Power I/O</td>
</tr>
<tr>
<td>A2, B2, B4, C2, C4</td>
<td>A2, B2, B4, C2, C4</td>
<td>PWRA</td>
<td>Power I/O</td>
</tr>
<tr>
<td>A4</td>
<td>—</td>
<td>EN</td>
<td>Active-Low Enable Input. Drive EN low to turn on the switch.</td>
</tr>
<tr>
<td>—</td>
<td>A4</td>
<td>EN</td>
<td>Active-High Enable Input. Drive EN high to turn on the switch.</td>
</tr>
<tr>
<td>C1</td>
<td>C1</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>
Detailed Description

The MAX14634/MAX14680 bidirectional battery switches feature reverse blocking capability to isolate the battery from the system. These internal switches feature ultra-low 7mΩ (typ) on-resistance and operate from a +2.3V to +5.5V input voltage range, making these devices ideal as battery-disconnect switches for high-capacity battery applications. The slew-rate controlled switches are also ideal for a large load capacitor as well as high-current load switching applications.

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Reverse-Current Blocking

The bidirectional FET switch prevents current flowing from either power input to the other when the switch is disabled.

EN/EN Input

The MAX14634's switch position is controlled by an EN active-low logic input. The switch is on when EN is logic-low and off when EN is logic-high. EN is internally pulled down to ground by R_PD.

The MAX14680's switch position is controlled by an EN active-high logic input. The switch is on when EN is logic-high and off when EN is logic-low. EN is internally pulled down to ground by R_PD.

Ordering Information

<table>
<thead>
<tr>
<th>PART</th>
<th>TEMP RANGE</th>
<th>TOP MARK</th>
<th>PIN-PACKAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX14634EWC+T</td>
<td>-40°C to +85°C</td>
<td>ACO</td>
<td>12 WLP</td>
</tr>
<tr>
<td>MAX14680EWC+T</td>
<td>-40°C to +85°C</td>
<td>ACV</td>
<td>12 WLP</td>
</tr>
</tbody>
</table>

+Denotes a lead(Pb)-free/RoHS-compliant package.
T = Tape and reel

Chip Information

PROCESS: BiCMOS

Package Information

For the latest package outline information and land patterns (footprints), go to 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.

<table>
<thead>
<tr>
<th>PACKAGE TYPE</th>
<th>PACKAGE CODE</th>
<th>OUTLINE NO.</th>
<th>LAND PATTERN NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 WLP</td>
<td>W121F1+1</td>
<td>21-0542</td>
<td>Refer to Application Note 1891</td>
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</tbody>
</table>
MAX14634/MAX14680
Ultra-Low On-Resistance and Compact
Bidirectional Battery Switches

Revision History

<table>
<thead>
<tr>
<th>REVISION NUMBER</th>
<th>REVISION DATE</th>
<th>DESCRIPTION</th>
<th>PAGES CHANGED</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5/12</td>
<td>Initial release</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>1/13</td>
<td>Updated Absolute Maximum Ratings section</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4/13</td>
<td>Added MAX14680 active-high part information to data sheet</td>
<td>1, 2, 3, 5, 6</td>
</tr>
</tbody>
</table>

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