ZXCT1021
Low offset high-side current monitor

Description
The ZXCT1021 is a precision high-side current sense monitor. Using this type of device eliminates the need to disrupt the ground plane when sensing a load current.

The ZXCT1021 provides a fixed gain of 10 for applications where minimal sense voltage is required.

The very low offset voltage enables a typical accuracy of 3% for sense voltages of only 10mV, giving better tolerances for small sense resistors necessary at higher currents.

The wide input voltage range of 20V down to as low as 2.5V make it suitable for a range of applications. With a minimum operating current of just 25µA, combined with its SOT23-5 package make it suitable for portable battery equipment too.

Features
• Accurate high-side current sensing
• Output voltage scaling
• 2.5V – 20V supply range
• 25µA quiescent current
• 1% typical accuracy
• SOT23-5 package

Applications
• Battery chargers
• Smart battery packs
• DC motor control
• Over current monitor
• Power management
• Level translating
• Programmable current source

Pinout information

Typical application circuit

Ordering information

<table>
<thead>
<tr>
<th>Order reference</th>
<th>Package</th>
<th>Device marking</th>
<th>Status</th>
<th>Reel size (inches)</th>
<th>Quantity per reel</th>
<th>Tape width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZXCT1021E5TA</td>
<td>SOT23-5</td>
<td>1021</td>
<td>Released</td>
<td>7</td>
<td>3000</td>
<td>8</td>
</tr>
</tbody>
</table>
**Absolute maximum ratings**

Voltage on any pin with respect to END pin -0.6V to 20V

V\textsubscript{SENSE} -0.6V to \(V\text{IN} +0.5V\)

Operating temperature -40 to 85°C

Storage temperature -55 to 150°C

Package power dissipation (\(T\text{amb} = 25°C\)) 300mW

**Pinout information**

<table>
<thead>
<tr>
<th>Pin name</th>
<th>Pin function</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/C</td>
<td>Not internally connected</td>
</tr>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>V\text{OUT}</td>
<td>Voltage output referenced to GND. Intended to drive high impedance loads</td>
</tr>
<tr>
<td>V\textsubscript{SENSE}-</td>
<td>High impedance negative sense voltage input</td>
</tr>
<tr>
<td>V\textsubscript{SENSE}+</td>
<td>Supply and positive sense voltage input</td>
</tr>
</tbody>
</table>
### Electrical characteristics test conditions $T_{amb} = 25^\circ C$, $V_{IN} = 15V$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Limits</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IN}$</td>
<td>$V_{CC}$ range</td>
<td></td>
<td>Min.</td>
<td>Typ.</td>
</tr>
<tr>
<td>$V_{OUT}$</td>
<td>Output voltage</td>
<td>$V_{SENSE} = 30mV$</td>
<td>291</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{SENSE} = 100mV$</td>
<td>0.98</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{SENSE} = 150mV$</td>
<td>1.47</td>
<td>1.50</td>
</tr>
<tr>
<td>$R_{OUT}$</td>
<td>Output resistance</td>
<td></td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>$T_C$ (*)</td>
<td>Output voltage temperature coefficient</td>
<td></td>
<td>50</td>
<td>300</td>
</tr>
<tr>
<td>$I_Q$</td>
<td>Ground pin current</td>
<td>$V_{SENSE} = 0V$</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>$V_{SENSE}$ (†)</td>
<td>Sense voltage</td>
<td>$V_{IN} = 20V$</td>
<td>0</td>
<td>1.5 (‡)</td>
</tr>
<tr>
<td>$I_{LOAD}$</td>
<td>$V_{SENSE}$, load pin input current</td>
<td>$V_{SENSE} = 0V$</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Acc</td>
<td>Accuracy</td>
<td>$V_{SENSE} = 100mV$</td>
<td>-2</td>
<td>2</td>
</tr>
<tr>
<td>Gain</td>
<td>$V_{OUT} / V_{SENSE}$</td>
<td>$V_{SENSE} = 100mV$</td>
<td>9.8</td>
<td>10</td>
</tr>
<tr>
<td>BW</td>
<td>Bandwidth</td>
<td>$V_{SENSE} = 10mV$</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{SENSE} = 100mV$</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

### NOTES:

(*) $T_C$ limits are determined by characterization

(†) $V_{SENSE} = V_{IN} - V_{LOAD}$

(‡) This will be reduced at lower $V_{IN}$ voltages due to clipping of output voltage.
Typical characteristics

**Typical Output vs Sense Voltage**

**Output Voltage vs Temperature**

**Frequency Response**

**Transfer Characteristic**

**Common Mode Rejection**
Typical characteristics

Small Signal Step Response

Large Signal Step Response

Isupply v Temperature

Isupply v Vtemp

Supply Current (μA)

Temperature °C

Supply Current (μA)

V SENSE (mV)

T = 25 °C
### Application information

The ZXCT1021 has a fixed dc voltage gain of 100. No external scaling resistors are required for the output. Output voltage is simply defined as:

\[
V_{\text{OUT}} = 10 \times V_{\text{SENSE}} \text{ (V)}
\]

Where \( V_{\text{SENSE}} = V_{\text{IN}} - V_{\text{LOAD}} \)

### PCB trace shunt resistor for low cost solution

Figure 1 shows a PCB layout suggestion for a low cost solution where a PCB resistive trace in replacement for a conventional shunt resistor, can be used. The resistor section is 25mm x 0.25mm giving approximately 150m\(\Omega\) using 1 oz copper. Smaller resistances can be used if required.

Total circuit solution: 1 component. Shows area of 150m\(\Omega\) sense resistor compared to SOT23 package.

Practical tolerance of the PCB resistor will be around 5% depending on manufacturing methods.
## Package outline - SOT23-5

<table>
<thead>
<tr>
<th>DIM</th>
<th>Millimeters</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>A</td>
<td>0.90</td>
<td>1.45</td>
</tr>
<tr>
<td>A1</td>
<td>0.00</td>
<td>0.15</td>
</tr>
<tr>
<td>A2</td>
<td>0.90</td>
<td>1.30</td>
</tr>
<tr>
<td>b</td>
<td>0.20</td>
<td>0.50</td>
</tr>
<tr>
<td>C</td>
<td>0.09</td>
<td>0.26</td>
</tr>
<tr>
<td>D</td>
<td>2.70</td>
<td>3.10</td>
</tr>
<tr>
<td>E</td>
<td>2.20</td>
<td>3.20</td>
</tr>
<tr>
<td>E1</td>
<td>1.30</td>
<td>1.80</td>
</tr>
<tr>
<td>e</td>
<td>0.95 REF</td>
<td>0.0374 REF</td>
</tr>
<tr>
<td>e1</td>
<td>1.90 REF</td>
<td>0.0748 REF</td>
</tr>
<tr>
<td>L</td>
<td>0.10</td>
<td>0.60</td>
</tr>
<tr>
<td>a°</td>
<td>0°</td>
<td>30°</td>
</tr>
</tbody>
</table>

**Note:** Controlling dimensions are in millimeters. Approximate dimensions are provided in inches.
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