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

TYPICAL CIRCUIT APPLICATION

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>REEL SIZE</th>
<th>TAPE WIDTH</th>
<th>QUANTITY PER REEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZXCT1021E5TA</td>
<td>7&quot;</td>
<td>8mm</td>
<td>3,000 units</td>
</tr>
</tbody>
</table>

PARTMARK
1021
ZXCT1021

Absolute Maximum Ratings
- Voltage on any pin: -0.6V to 20V
- V_{sense}: -0.6V to V_{in} +0.5V
- Operating Temperature: -40 to 85°C
- Storage Temperature: -55 to 150°C
- Package Power Dissipation: (T_A = 25°C) 450mW

ELECTRICAL CHARACTERISTICS Test Conditions T_A = 25°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 2.5 Typ 20 Max V</td>
<td></td>
</tr>
<tr>
<td>V_{out}</td>
<td>Output voltage (ZXCT1021)</td>
<td>V_{sense} = 30mV</td>
<td>291 Typ 300 Max 309 mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense} = 100mV</td>
<td>0.98 Typ 1.00 Max 1.02 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense} = 150mV</td>
<td>1.47 Typ 1.50 Max 1.53 V</td>
<td></td>
</tr>
<tr>
<td>R_{out}</td>
<td>Output resistance</td>
<td></td>
<td>10 Typ 15 Max 20 KΩ</td>
<td></td>
</tr>
<tr>
<td>T_{c}</td>
<td>Output temperature coefficient</td>
<td></td>
<td>50 Typ 300 Max ppm</td>
<td></td>
</tr>
<tr>
<td>I_{q}</td>
<td>Ground pin current</td>
<td>V_{sense} = 0V</td>
<td>25 Typ 35 Max μA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sense voltage</td>
<td>0 Typ 1.5 Max V</td>
<td></td>
</tr>
<tr>
<td>I_{sense}</td>
<td>Load pin input current</td>
<td></td>
<td>100 Max nA</td>
<td></td>
</tr>
<tr>
<td>Acc</td>
<td>Accuracy</td>
<td>V_{sense} = 100mV</td>
<td>-2 Typ 2 Max %</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>V_{out} / V_{sense}</td>
<td>V_{sense} = 100mV</td>
<td>98 Typ 100 Max 102 mV</td>
<td></td>
</tr>
<tr>
<td>BW</td>
<td>Bandwidth</td>
<td>V_{sense} = 10mV</td>
<td>300 Typ 2 Max kHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense} = 100mV</td>
<td>2 Max MHz</td>
<td></td>
</tr>
</tbody>
</table>

NOTES
(2) V_{sense} = V_{in} - V_{load}
TYPICAL CHARACTERISTICS

- **Typical Output v Sense Voltage**
- **Vout v Sense Voltage**
- **Output Voltage v Temperature**
- **Frequency Response**
- **Transfer Characteristic**
- **Common Mode Rejection**
TYPICAL CHARACTERISTICS

**Small Signal Step Response**

- $V_{in} = 15V$
- $V_{sense} = 20-21mV$
- $C_{load} = 5pF$
- $V_{out} \times 10$

**Large Signal Step Response**

- $V_{in} = 15V$
- $V_{sense} = 5-50mV$
- $C_{load} = 5pF$
- $V_{out} \times 10$

**Isupply v Temperature**

- $V_{sense} = 15V$
- $V_{sense}$ values:
  - 100mV
  - 80mV
  - 60mV
  - 40mV
  - 20mV
  - 0mV

**Isupply v Vtemp**

- $T_a = 25^\circ C$
- $V_{sense}$

BLOCK DIAGRAM

- $V_{in}$
- ZXCT1021 1kΩ
- Load
- $V_{out}$
- 15kΩ
Application Information

The devices have fixed dc voltage gains of 10, 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

The figure below 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 150Ω using 1 oz copper. Smaller resistances can be used if required.

Total circuit solution: 1 component. Shows area of 150Ω sense resistor compared to SOT23 package.

Practical tolerance of the PCB resistor will be around 5% depending on manufacturing methods.

<table>
<thead>
<tr>
<th>PIN OUT</th>
<th>PIN NAME</th>
<th>PIN FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/C</td>
<td>1</td>
<td>Not internally connected</td>
</tr>
<tr>
<td>GND</td>
<td>2</td>
<td>Ground</td>
</tr>
<tr>
<td>Vout</td>
<td>3</td>
<td>Voltage output referenced to GND. Intended to drive high impedance loads</td>
</tr>
<tr>
<td>Load</td>
<td>4</td>
<td>High impedance negative sense voltage input</td>
</tr>
<tr>
<td>Vin</td>
<td>5</td>
<td>Supply and positive sense voltage input</td>
</tr>
</tbody>
</table>
PACKAGE DIMENSIONS SOT23-5

DIM | Millimetres | Inches
--- | --- | ---
A | 0.90 | 0.035 | 0.057
A1 | 0.00 | 0.00 | 0.006
A2 | 0.90 | 0.035 | 0.051
b | 0.35 | 0.014 | 0.020
C | 0.09 | 0.0035 | 0.008
D | 2.80 | 0.110 | 0.118
E | 2.60 | 0.102 | 0.118
E1 | 1.50 | 0.059 | 0.069
e | 0.95 REF | 0.037 REF
e1 | 1.90 REF | 0.075 REF
L | 0.10 | 0.004 | 0.024

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