DESCRIPTION
The ZXCT1008 is a high side current sense monitor. Using this device eliminates the need to disrupt the ground plane when sensing a load current.

It takes a high side voltage developed across a current shunt resistor and translates it into a proportional output current.

A user defined output resistor scales the output current into a ground-referenced voltage.

The wide input voltage range of 20V down to as low as 2.5V make it suitable for a range of applications. The ability to withstand high voltage transients and reverse polarity connection, makes this part very suitable for automotive and other transient rich environments.

FEATURES
• Low cost, accurate high-side current sensing
• -40 to +125°C temperature range
• Up to 500mV sense voltage
• 2.5V – 20V supply range
• 4µA quiescent current
• 1% typical accuracy
• SOT23

APPLICATIONS
• Automotive current measurement
• DC motor and solenoid control
• Over current monitor
• Power management

APPLICATION CIRCUIT

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>ZXCT1008FTA</td>
<td>7”</td>
<td>8mm</td>
<td>3,000 units</td>
</tr>
</tbody>
</table>

DEVICE MARKING
• 108
ABSOLUTE MAXIMUM RATINGS

Voltage on any pin -0.6V to 20V (relative to Iout)
Continuous output current 10mA
Continuous sense voltage Vin +0.5V >Vsense†>Vin – 5V
Operating temperature -40 to 125°C
Storage temperature -55 to 150°C
Package power dissipation (TA = 25°C) 450mW Derate to zero at 150°C

Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

ELECTRICAL CHARACTERISTICS

Test Conditions TA = 25°C, Vin = 5V, Rout = 100Ω.

<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>I_{out}</td>
<td>Output current</td>
<td>V_{sense}=0V</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense}=10mV</td>
<td>90</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense}=100mV</td>
<td>0.975</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense}=200mV</td>
<td>1.95</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{sense}=500mV</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Sense voltage</td>
<td></td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>Input current</td>
<td>V_{sense}=0V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acc</td>
<td>Accuracy</td>
<td>R_{sense} = 0.1Ω</td>
<td>-2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Gm</td>
<td>Transconductance, I_{out} / V_{sense}</td>
<td></td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>BW</td>
<td>Bandwidth</td>
<td></td>
<td>300</td>
<td>2</td>
</tr>
</tbody>
</table>

\[1\] Includes input offset voltage contribution
\[2\] V_{sense}=Vin-V_{load}
\[3\] -20dBm=63mVp-p into 50Ω

ISSUE 2 - JULY 2004
**PIN DESCRIPTION**

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Pin Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{sense}}^+$</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>$V_{\text{sense}}^-$</td>
<td>Connection to load/battery</td>
</tr>
<tr>
<td>$I_{\text{out}}$</td>
<td>Output current, proportional to $V_{\text{in}} \cdot V_{\text{load}}$</td>
</tr>
</tbody>
</table>

**CONNECTION DIAGRAM**

SOT23
Package Suffix – F

$V_{\text{sense}}^+$

$I_{\text{out}}$

$V_{\text{sense}}^-$

Top View
The following lines describe how to scale a load current to an output voltage.

\[ V_{\text{sense}} = V_{\text{in}} - V_{\text{load}} \]

\[ V_{\text{out}} = 0.01 \times V_{\text{sense}} \times R_{\text{out}} \]

E.g.
A 1A current is to be represented by a 100mV output voltage:

1) Choose the value of \( R_{\text{sense}} \) to give 50mV > \( V_{\text{sense}} > 500\)mV at full load.
For example \( V_{\text{sense}} = 100\)mV at 1.0A.
\[ R_{\text{sense}} = \frac{0.1}{1.0} = 0.1 \, \Omega \]

2) Choose \( R_{\text{out}} \) to give \( V_{\text{out}} = 100\)mV, when \( V_{\text{sense}} = 100\)mV.

Rearranging for \( R_{\text{out}} \) gives:
\[ R_{\text{out}} = \frac{V_{\text{out}}}{V_{\text{sense}} \times 0.01} \]
\[ R_{\text{out}} = 0.1 / (0.1 \times 0.01) = 100 \, \Omega \]
Where $R_{\text{load}}$ represents any load including DC motors, a charging battery or further circuitry that requires monitoring, $R_{\text{sense}}$ can be selected on specific requirements of accuracy, size and power rating.

An additional resistor, $R_{\text{lim}}$ can be added in series with $R_{\text{out}}$ (figure 1.0), to limit the current from $I_{\text{out}}$. Any circuit connected to $V_{\text{out}}$ will be protected from input voltage transients. This can be of particular use in automotive applications where load dump and other common transients need to be considered. The zener $Z_1$ provides additional protection for local dump, reverse battery and high voltage transient incidents.

Assuming the worst case condition of $V_{\text{out}} = 0\text{V}$; providing a low impedance to a transient, the minimum value of $R_{\text{lim}}$ is given by:

$$R_{\text{lim}}(\text{min}) = \frac{V_{\text{pk}} - V_{\text{max}}}{I_{\text{pk}}}$$

$V_{\text{pk}}$ = Peak transient voltage to be withstood
$V_{\text{max}}$ = Maximum working Voltage = 20V
$I_{\text{pk}}$ = Peak output current = 40mA

The maximum value of $R_{\text{lim}}$ is set by $V_{\text{in}}(\text{min})$, $V_{\text{out}}(\text{max})$ and the dropout voltage (see transfer characteristic on page 3) of the ZXCT1009 :-

$$R_{\text{lim}}(\text{max}) = \frac{R_{\text{out}}[V_{\text{in}}(\text{min}) - (V_{\text{dp}} + V_{\text{out}}(\text{max}))]}{V_{\text{out}}(\text{max})}$$

$V_{\text{in}}(\text{min})$ = Minimum Supply Operating Voltage
$V_{\text{dp}}$ = Dropout Voltage
$V_{\text{out}}(\text{max})$ = Maximum Operating Output Voltage

Figure 1.0
ZXCT1009 with additional current limiting Resistor $R_{\text{lim}}$ and zener $Z_1$
APPLICATIONS INFORMATION

PCB trace shunt resistor for low cost solution.

The figure below shows output characteristics of the device when using a PCB resistive trace for a low cost solution in replacement for a conventional shunt resistor. The graph shows the linear rise in voltage across the resistor due to the PTC of the material and demonstrates how this rise in resistance value over temperature compensates for the NTC of the device.

The figure opposite shows a PCB layout suggestion. The resistor section is 25mm x 0.25mm giving approximately 150mΩ using 1oz copper. The data for the normalised graph was obtained using a 1A load current and a 100Ω output resistor. An electronic version of the PCB layout is available at www.zetex.com/isense.

Effect of Sense Resistor Material on Temperature Performance
Controlling dimensions are in millimeters. Approximate conversions are given in inches

**PACKAGE DIMENSIONS**

<table>
<thead>
<tr>
<th>DIM</th>
<th>Millimeters</th>
<th>Inches</th>
<th>DIM</th>
<th>Millimeters</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.67 - 3.05</td>
<td>0.105 - 0.120</td>
<td>H</td>
<td>0.33 - 0.51</td>
<td>0.013 - 0.020</td>
</tr>
<tr>
<td>B</td>
<td>1.20 - 1.40</td>
<td>0.047 - 0.055</td>
<td>K</td>
<td>0.01 - 0.10</td>
<td>0.0004 - 0.004</td>
</tr>
<tr>
<td>C</td>
<td>1.10</td>
<td>0.043</td>
<td>L</td>
<td>2.10 - 2.50</td>
<td>0.083 - 0.0985</td>
</tr>
<tr>
<td>D</td>
<td>0.37 - 0.53</td>
<td>0.015 - 0.021</td>
<td>M</td>
<td>0.45 - 0.64</td>
<td>0.018 - 0.025</td>
</tr>
<tr>
<td>F</td>
<td>0.085 - 0.15</td>
<td>0.0034 - 0.0059</td>
<td>N</td>
<td>0.95 NOM</td>
<td>0.0375 NOM</td>
</tr>
<tr>
<td>G</td>
<td>1.90 NOM</td>
<td>0.075 NOM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>