ZXCT1010

ENHANCED HIGH-SIDE CURRENT MONITOR

DESCRIPTION

The ZXCT1010 is a high side current sense monitor. Using this device eliminates the need to disrupt the ground plane when sensing a load current.

It is an enhanced version of the ZXCT1009 offering reduced typical output offset and improved accuracy at low sense voltage.

The wide input voltage range of 20V down to as low as 2.5V make it suitable for a range of applications. A minimum operating current of just 4µA, combined with its SOT23-5 package make suitable for portable battery equipment.

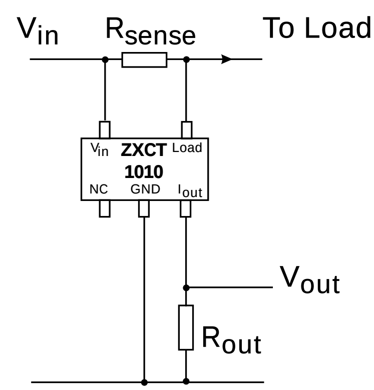
FEATURES

- Low cost, accurate high-side current sensing.
- Output voltage scaling.
- Up to 2.5V sense voltage.
- 2.5V – 20V supply range.
- 300nA typical offset current.
- 4µA 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

APPLICATION CIRCUIT



ORDERING INFORMATION

PART NUMBER	PACKAGE	PARTMARKING
ZXCT1010E	SOT23-5	1010

ABSOLUTE MAXIMUM RATINGS

Voltage on any pin	-0.6V to 20V (relative to GND)
Continuous output current	25mA
Continuous sense voltage	V_{in} + 0.5V > V_{sense}† > V_{in} – 5V
Operating Temperature	-40 to 85°C
Storage Temperature	-55 to 125°C
Package Power Dissipation	(T_A = 25°C)
SOT23-5	500mW

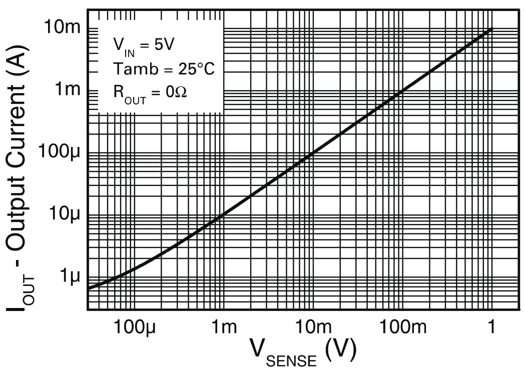
ELECTRICAL CHARACTERISTICS

Test Conditions T_A = 25°C, V_{in} = 5V, R_{out} = 100Ω.

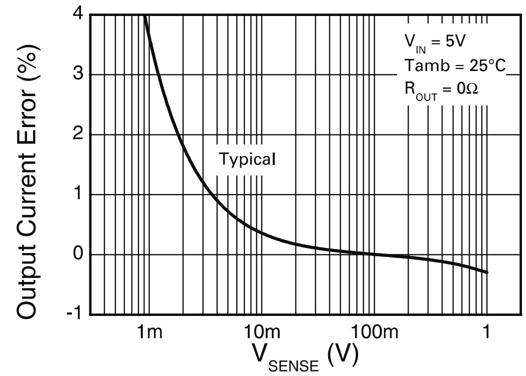
SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			Min	Typ	Max	
V_{in}	V_{CC} Range		2.5		20	V
I_{out}[1]	Output current	V_{sense}=0V	0	0.3	10	µA
		V_{sense}=10mV	85	100	115	µA
		V_{sense}=100mV	0.975	1.00	1.025	mA
		V_{sense}=200mV	1.95	2.00	2.05	mA
		V_{sense}=1V	9.7	10.0	10.3	mA
I_q	Ground pin current	V_{sense}=0V	1	4	8	µA
V_{sense}[2]	Sense Voltage		0		2500	mV
I_{sense}	Load pin input current				100	nA
Acc	Accuracy	R_{sense} = 0.1Ω V_{sense}=200mV	-2.5		2.5	%
Gm	Transconductance, I_{out} / V_{sense}			10000		µA/V
BW	Bandwidth	RF P_{in}= -20dBm[3] V_{sense} = 10mV dc		300		kHz
		V_{sense} = 100mV dc		2		MHz

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

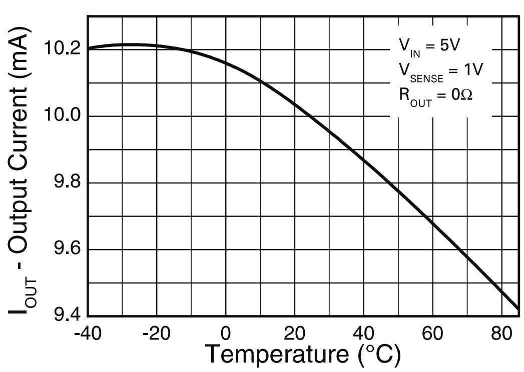
TYPICAL CHARACTERISTICS



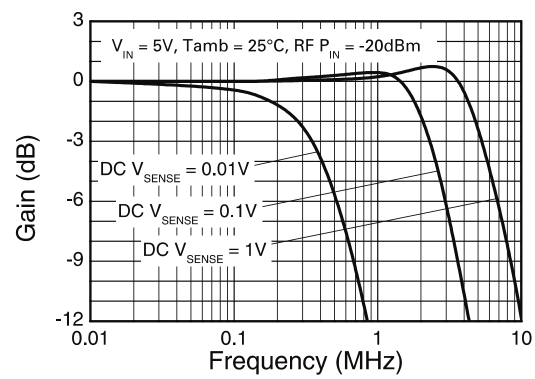
Typical Output v Sense Voltage



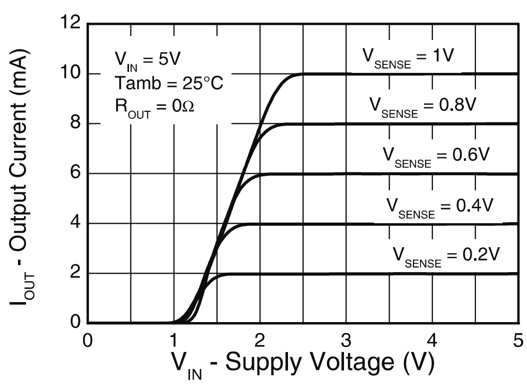
Error v Sense Voltage



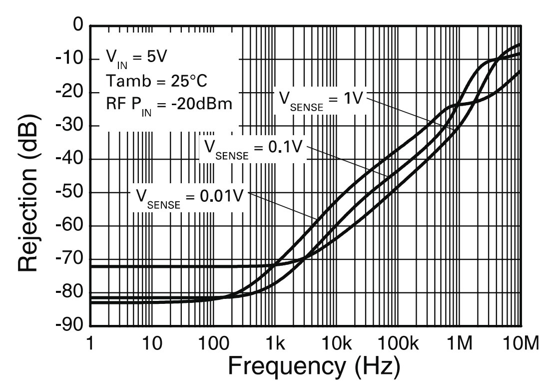
Output Current v Temperature



Frequency Response



Transfer Characteristic

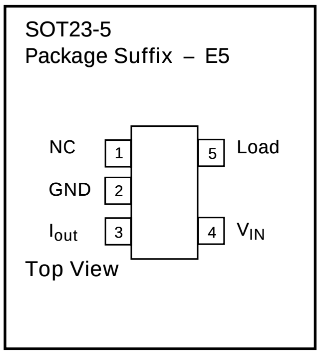


Common Mode Rejection

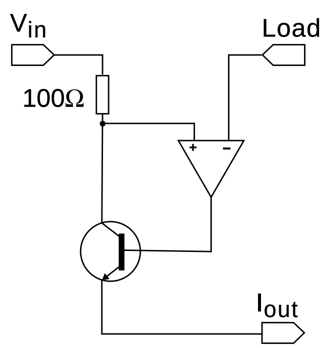
PIN DESCRIPTION

Pin Name	Pin Function
V_{in}	Supply Voltage
Load	Connection to load/battery
I_{out}	Output current, proportional to V_{in}-V_{load}
GND	Ground

CONNECTION DIAGRAM



SCHEMATIC DIAGRAM



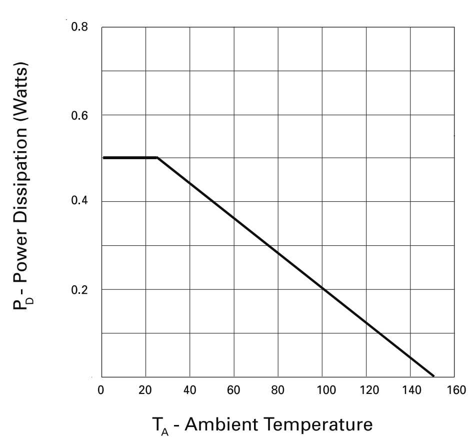
POWER DISSIPATION

The maximum allowable power dissipation of the device for normal operation (Pmax), is a function of the package junction to ambient thermal resistance (θja), maximum junction temperature (Tjmax), and ambient temperature (Tamb), according to the expression:

$P_{max} = (Tj_{max} - T_{amb}) / \theta_{ja}$

The device power dissipation, P_D is given by the expression:

$P_D = I_{out}.(V_{in} - V_{out})$ Watts



APPLICATIONS INFORMATION

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

$$V_{sense} = V_{in} - V_{load}$$

$$\mathbf{V_{out} = 0.01 \times V_{sense} \times R_{out}}^{1}$$

E.g.

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

1)Choose the value of R_{sense} to give 50mV > V_{sense} > 500mV at full load.

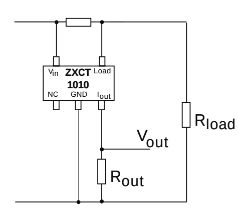
For example V_{sense} = 100mV at 1.0A. R_{sense} = 0.1/1.0 => 0.1 ohms.

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

Rearranging ^{1} for R_{out} gives:
$R_{out} = V_{out} / (V_{sense} \times 0.01)$

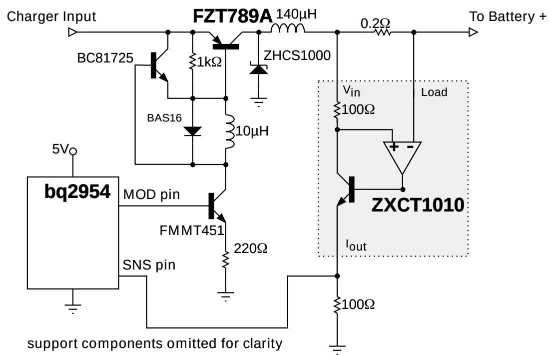
$R_{out} = 0.1 / (0.1 \times 0.01) = 100\ \Omega$

TYPICAL CIRCUIT APPLICATION



Where R_{load} represents any load including DC motors, a charging battery or further circuitry that requires monitoring, R_{sense} can be selected on specific requirements of accuracy, size and power rating.

APPLICATIONS INFORMATION (Continued)

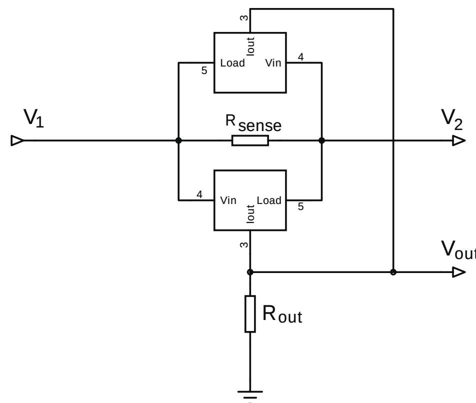


Li-Ion Charger Circuit

The above figure shows the ZXCT1010 supporting the Benchmarq bq2954 Charge Management IC. Most of the support components for the bq2954 are omitted for clarity. This design also uses the Zetex FZT789A high current Super-β PNP as the switching transistor in the DC-DC step down converter and the FMMT451 as the drive NPN for the FZT789A. The circuit can be configured to charge up to four Li-Ion cells at a charge current of 1.25A. Charge can be terminated on maximum voltage, selectable minimum current, or maximum time out. Switching frequency of the PWM loop is approximately 120kHz.

Bi-Directional Current Sensing

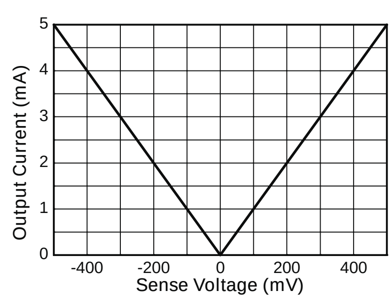
The ZXCT1010 can be used to measure current bi-directionally, if two devices are connected as shown below.



If the voltage V1 is positive with respect to the voltage V2 the lower device will be active, delivering a proportional output current to Rout. Due to the polarity of the voltage across Rsense, the upper device will be inactive and will not contribute to the current delivered to Rout. When V2 is more positive than V1, current will be flowing in the opposite direction, causing the upper device to be active instead.

Non-linearity will be apparent at small values of Vsense due to offset current contribution. Devices can use separate output resistors if the current direction is to be monitored independently.

Bi-directional Transfer Function



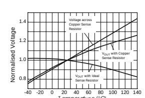
Output Current v Sense Voltage

APPLICATIONS INFORMATION (Continued)

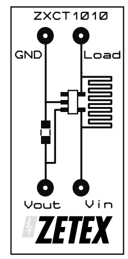
PCB trace shunt resistor for low cost solution.

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.

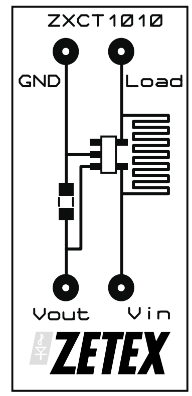
The figure opposite shows a PCB layout suggestion. The resistor section is 25mm x 0.25mm giving approximately 150mΩ using 1oz copper. The data for the normalised graph was obtained using a 1A load current and a 100Ω output resistor. An electronic version of the PCB layout is available at www.zetex.com/isense



Effect of Sense Resistor Material on Temperature Performance

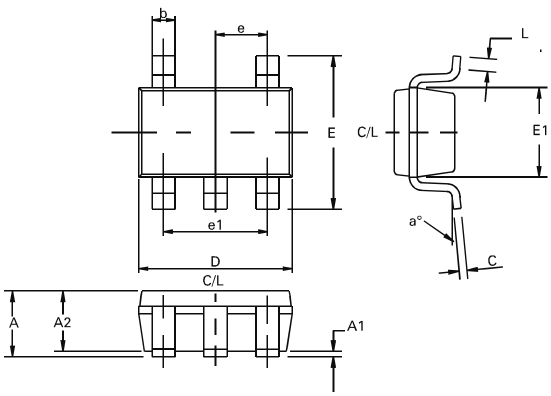


Actual Size



Layout shows area of shunt resistor compared to SOT23-5 package. Not actual size

PACKAGE DIMENSIONS SOT23-5



DIM	Millimetres		Inches	
	MIN	MAX	MIN	MAX
A	0.90	1.45	0.035	0.057
A1	0.00	0.15	0.00	0.006
A2	0.90	1.3	0.035	0.051
b	0.35	0.50	0.014	0.020
C	0.09	0.20	0.0035	0.008
D	2.80	3.00	0.110	0.118
E	2.60	3.00	0.102	0.118
E1	1.50	1.75	0.059	0.069
e	0.95 REF		0.037 REF	
e1	1.90 REF		0.075 REF	
L	0.10	0.60	0.004	0.024
a°	0	10	0	10

ZETEX

Zetex plc.
Fields New Road, Chadderton, Oldham, OL9-8NP, United Kingdom.
Telephone: (44)161 622 4422 (Sales), (44)161 622 4444 (General Enquiries)
Fax: (44)161 622 4420

Zetex GmbH	Zetex Inc.	Zetex (Asia) Ltd.	These are supported by
Streitfeldstraße 19	47 Mall Drive, Unit 4	3701-04 Metroplaza, Tower 1	agents and distributors in
D-81673 München	Commack NY 11725	Hing Fong Road,	major countries world-wide
Germany	USA	Kwai Fong, Hong Kong	© Zetex plc 2000
Telefon: (49) 89 45 49 49 0	Telephone: (631) 543-7100	Telephone:(852) 26100 611	
Fax: (49) 89 45 49 49 49	Fax: (631) 864-7630	Fax: (852) 24250 494	**Internet**http://www.zetex.com

Publication Ref. SCZXCT1010DS