

# 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 4 $\mu$ A, combined with its SOT23-5 package make suitable for portable battery equipment.

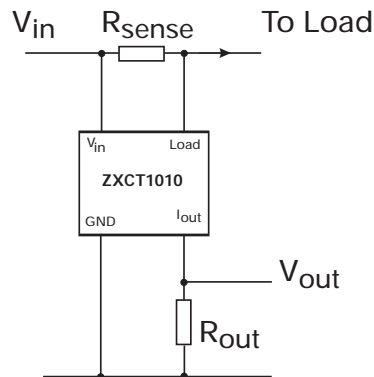
### FEATURES

- 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.
- 3.5 $\mu$ A quiescent current.
- 1% typical accuracy.
- SOT23 -5 package.

### APPLICATIONS

- Battery Chargers
- Smart Battery Packs
- DC Motor control
- Over current monitor
- Power Management
- Programmable current source

### APPLICATION CIRCUIT



### ORDERING INFORMATION

DEVICE	REEL SIZE	TAPE WIDTH	QUANTITY PER REEL
ZXCT1010E5TA	7"	8mm	3,000 units

PARTMARK 101  
PACKAGE SOT23-5

# ZXCT1010

## ABSOLUTE MAXIMUM RATINGS

Voltage on any pin	-0.6V to 20V (relative to GND)
Continuous output current	25mA
Continuous sense voltage	$V_{in} + 0.5V > V_{sense} \dagger > V_{in} - 5V$
Operating Temperature	-40 to 85°C
Storage Temperature	-55 to 150°C
Package Power Dissipation	( $T_A = 25^\circ\text{C}$ )
SOT23-5	500mW

## ELECTRICAL CHARACTERISTICS

Test Conditions  $T_A = 25^\circ\text{C}$ ,  $V_{in} = 5V$ ,  $R_{out} = 100\Omega$ .

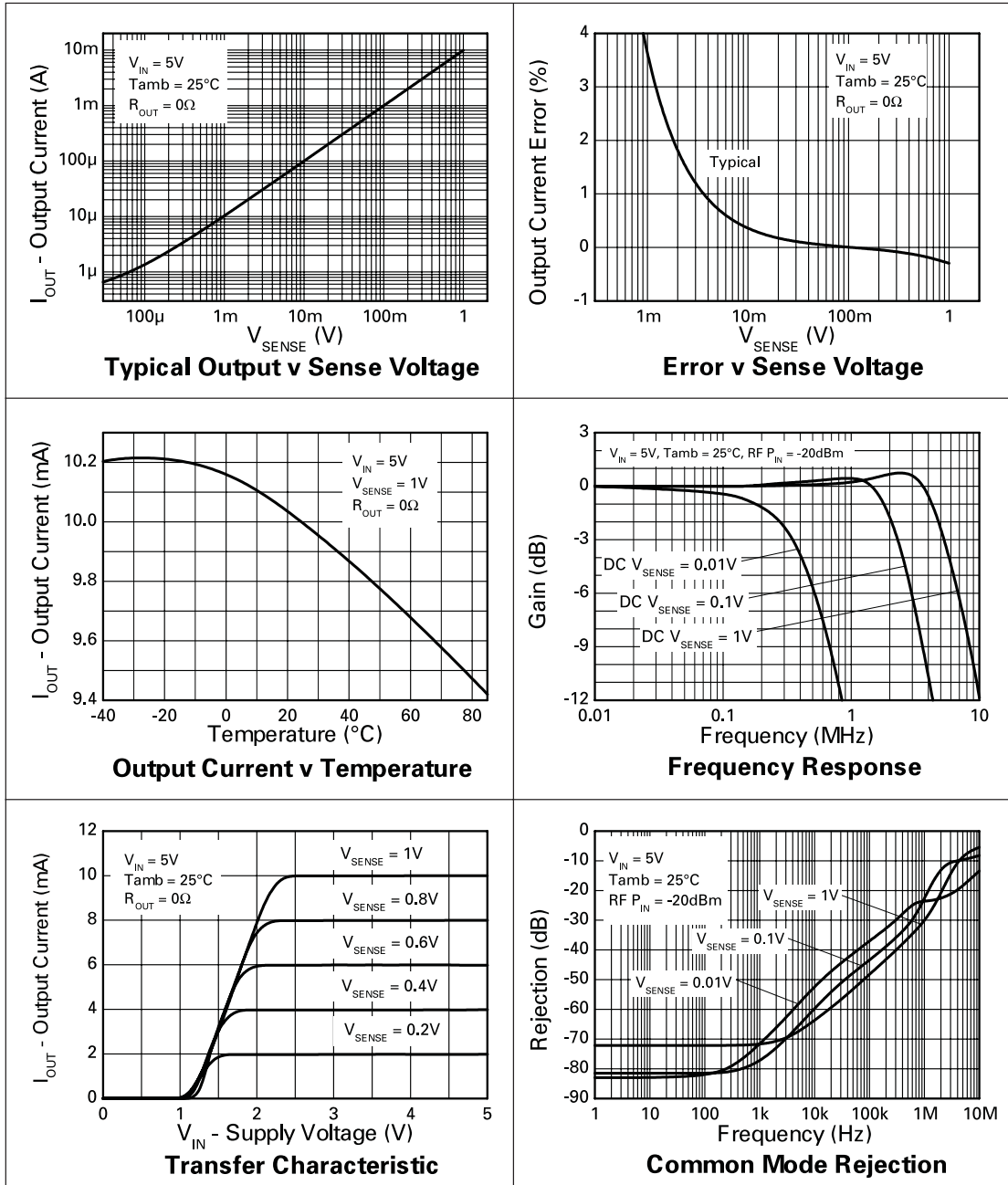
SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			Min	Typ	Max	
$V_{in}$	$V_{CC}$ Range		2.5		20	V
$I_{out}^1$	Output current	$V_{sense} = 0V$	0	0.3	10	$\mu\text{A}$
		$V_{sense} = 10\text{mV}$	85	100	115	$\mu\text{A}$
		$V_{sense} = 100\text{mV}$	0.975	1.00	1.025	mA
		$V_{sense} = 200\text{mV}$	1.95	2.00	2.05	mA
		$V_{sense} = 1V$	9.7	10.0	10.3	mA
$I_q$	Ground pin current	$V_{sense} = 0V$		3.5	8	$\mu\text{A}$
$V_{sense}^2$	Sense Voltage		0		2500	mV
$I_{sense}$	Load pin input current				100	nA
Acc	Accuracy	$R_{sense} = 0.1\Omega$ $V_{sense} = 200\text{mV}$	-2.5		2.5	%
Gm	Transconductance, $I_{out} / V_{sense}$			10000		$\mu\text{A}/\text{V}$
BW	Bandwidth	RF $P_{in} = -20\text{dBm}^3$ $V_{sense} = 10\text{mV dc}$ $V_{sense} = 100\text{mV dc}$		300		kHz
				2		MHz

<sup>1</sup> Includes input offset voltage contribution

<sup>2</sup>  $V_{sense} = V_{in} - V_{load}$

<sup>3</sup>  $-20\text{dBm} = 63\text{mVp-p}$  into  $50\Omega$

TYPICAL CHARACTERISTICS

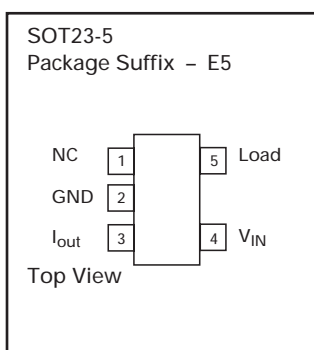


# ZXCT1010

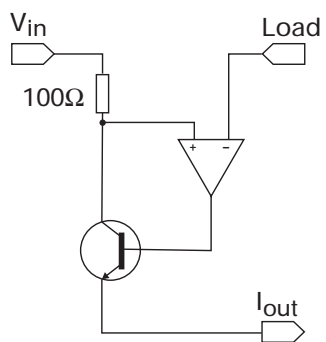
## PIN DESCRIPTION

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



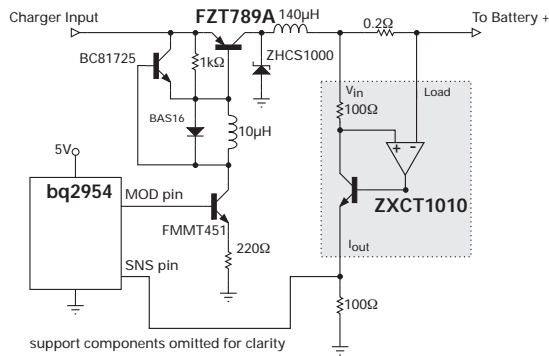
## SCHEMATIC DIAGRAM





# ZXCT1010

## APPLICATIONS INFORMATION (Continued)

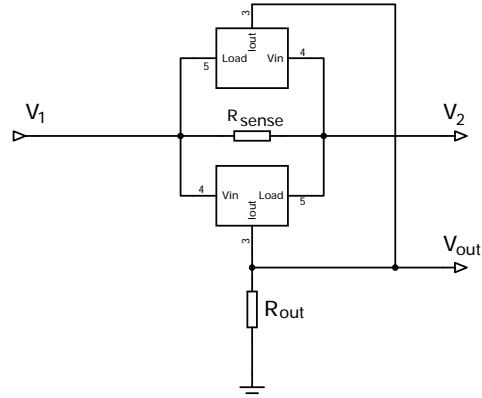


### Li-Ion Charger Circuit

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 FM451 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

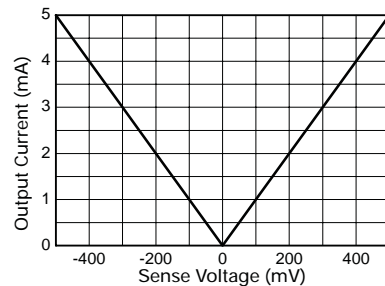
The ZXCT1010 can be used to measure current bi-directionally, if two devices are connected as shown below.



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

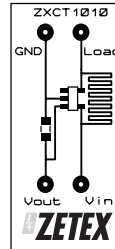
# ZXCT1010

## APPLICATIONS INFORMATION (Continued)

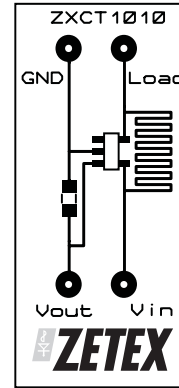
### PCB trace shunt resistor for low cost solution.

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.

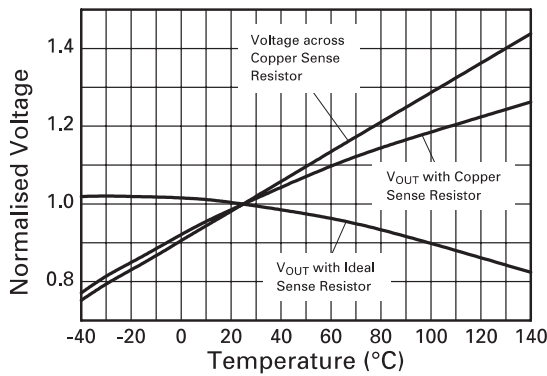
The figure opposite shows a PCB layout suggestion. The resistor section is 25mm x 0.25mm giving approximately 150mΩ using 1oz copper. The data for the normalised graph was obtained using a 1A load current and a 100Ω output resistor. An electronic version of the PCB layout is available at [www.zetex.com/isense](http://www.zetex.com/isense)



Actual Size



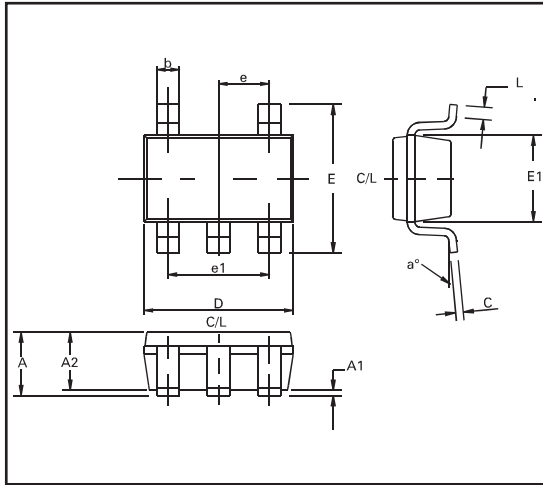
Layout shows area of shunt resistor compared to SOT23-5 package. Not actual size



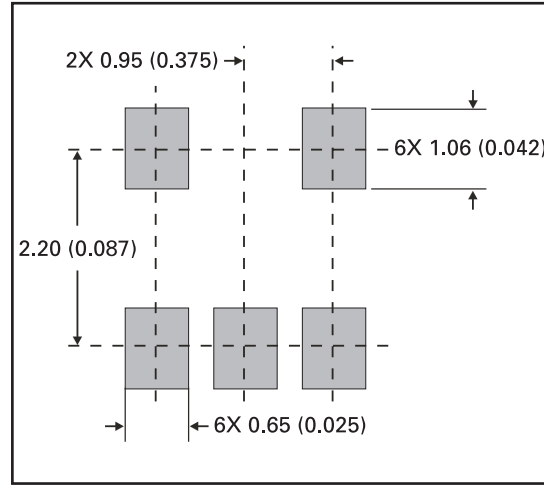
Effect of Sense Resistor Material on Temperature Performance

# ZXCT1010

## PACKAGE DIMENSIONS



## PAD LAYOUT DETAILS



Controlling dimensions are in millimeters. Approximate conversions are given in inches

## PACKAGE DIMENSIONS

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

© Zetex plc 2003

Europe	Americas	Asia Pacific
Zetex plc Fields New Road Chadderton Oldham, OL9 8NP United Kingdom Telephone: (44) 161 622 4444 Fax: (44) 161 622 4446 hq@zetex.com	Zetex GmbH Streitfeldstraße 19 D-81673 München Germany Telefon: (49) 89 45 49 49 0 Fax: (49) 89 45 49 49 49 europe.sales@zetex.com	Zetex (Asia) Ltd 3701-04 Metroplaza Tower 1 Hing Fong Road Kwai Fong Hong Kong Telephone: (852) 26100 611 Fax: (852) 24250 494 asia.sales@zetex.com

These offices are supported by agents and distributors in major countries world-wide.

This publication is issued to provide outline information only which (unless agreed by the Company in writing) may not be used, applied or reproduced for any purpose or form part of any order or contract or be regarded as a representation relating to the products or services concerned. The Company reserves the right to alter without notice the specification, design, price or conditions of supply of any product or service.

For the latest product information, log on to [www.zetex.com](http://www.zetex.com)



ISSUE 8 - JANUARY 2004