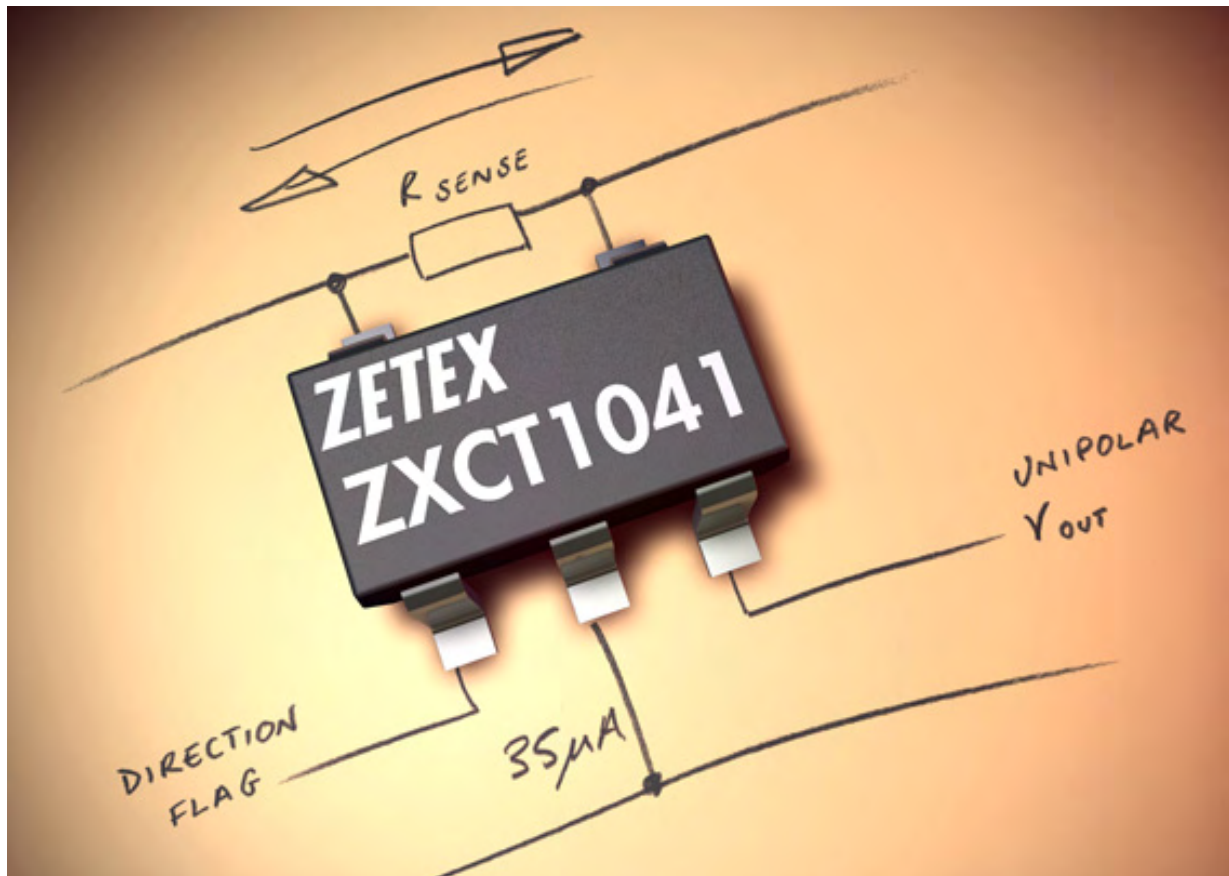


Know-how

New product information from Zetex

November 2006

ZXCT1041 micro-power current monitor for bidirectional current sensing



Features

- Bidirectional high-side measurement
- Preset V_{OUT}/V_{SENSE} gain of 10
- 2.7V to 20V high-side voltage

Benefits

- With one IC cost effective bi-directional current measurement can be attained. Only one additional sense resistor is required, coupled with the SOT23-5 package it offers a very small footprint solution
- This reduces the number of external resistors required to measure the bidirectional current, thereby reducing the size and cost of the overall solution
- Wide voltage allows the device to be used in multiple applications and with a wide number of lithium ion cells (1-4 in series) and multiple NiCd and lead acid cells

Functional description

The ZXCT1041 is a current monitor that can be used to measure current flow in two directions. Used on the high-side of the load, the ZXCT1041 eliminates the need to disrupt the ground plane.

The ZXCT1041 takes the voltage developed across an external sense resistor (R_{SENSE}) and translates it into a proportional ground referred output voltage. The output voltage is always positive even though V_{SENSE} can be positive and negative.

The direction of current flow is denoted by the digital signal at the flag output; which can be interfaced to a standard I/O pin. This means that only one standard ADC is required whereas other solutions require ADC channels that swing about a reference point.

The ZXCT1041 is the first Zetex current monitor to provide bidirectional current measurement.

The wide supply voltage range of 20V down to as low as 2.5V makes it suitable for a range of applications.

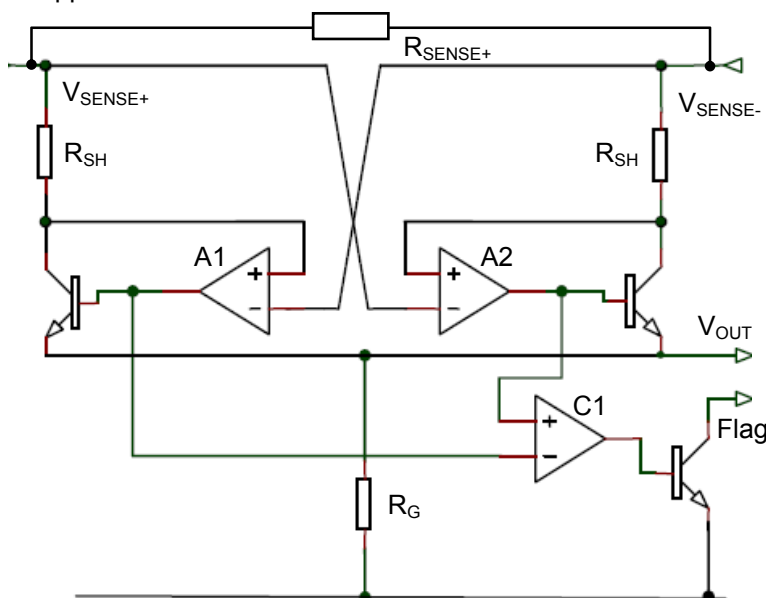
Except for its flag pin, the pin-out of the ZXCT1041 matches the ZXCT1021.

Description	V_{in} (V)	V_{CC} (V)	Accuracy @ V_{SENSE} Typ	Typical quiescent current (μA)	Gain Output	Output temp. co-efficient (ppm)	Bandwidth (MHz)	Package
ZXCT1041E5	2.7 to 20V	2.7 to 20V	<1% @ 100mV	35	10 V/V	30	0.3	SOT23-5

Applications information

The ZXCT1041 works in the same way as most of Zetex' other current monitors in that they get their power from the rail being monitored. This places strict limits on the voltage range of the rails being monitored.

The largest difference to other Zetex current monitors is that the ZXCT1041 has integrated two current monitors within the IC; one of which measures current in one direction while the second current monitor measures current in the opposite direction.



ZXCT1041 block diagram

The above diagram shows the effective block diagram; the current flowing through R_{SENSE} develops a voltage across it (V_{SENSE}). The feedback loop around A1 causes the same voltage (subject to offset and loop gain errors) to appear across R_{SH} .

This results in a current flowing through the PNP transistor and the output resistor equal to:

$$I_{ROUT} = \frac{V_{SENSE}}{R_{SH}} = \frac{I_{LOAD} \times R_{SENSE}}{R_{SH}}$$

The output voltage will be:

$$V_{OUT} = R_G \times I_{OUT} = R_G \times \frac{I_{LOAD} \times R_{SENSE}}{R_{SH}}$$

R_G and R_{SH} are accurately matched to give a ratio of 10 yielding:

$$V_{OUT} = 10 \times I_{LOAD} \times R_{SENSE}$$

The flag output is derived by comparing the outputs of amplifiers A1 and A2.

For further information about the operation of the current monitor, please view the datasheet. This also includes additional application information on selecting sense, shunt, limiting and output resistors.

Competition

There are a few competitive solutions available for bidirectional high-side current sensing. Maxim and TI (Burr Brown) have current monitoring devices but these are in MSOP8 packages. The competition also requires their output voltages to be offset thereby requiring an ADC that uses 2's complement and also reduces the effective range of the ADC.

Maxim and TI devices use more current which will affect the accuracy of the current being measured. This is important when measuring small currents.

The main performance attributes of the ZXCT1041 compared with competition are shown in the table.

Zetex' largest differentiators are:

- Smaller quiescent current
- Smaller package
- Single ended output with direction flag
- Solution cost

Company	Zetex	Maxim	TI/Burr-Brown
Part number	ZXCT1041	MAX4072	INA170
Supply voltage (V)	2.7 to 20	2.7 to 24	2.7 to 60
Common mode range (V)	2.7 to 20	1.35 to 24	2.7 to 60
Typical quiescent current (μ A)	30	100	75
Gain	10	50, 100	1mA/V
Accuracy at 100mV max (%)	+2/-5	± 1 (excluding V_{REF} error)	± 2
Bandwidth at 100mV (MHz)	0.3	0.1	0.4
V_{SENSE} (mV)	± 800	$\pm 50/70$	± 500
Package	SOT23-5	MSOP8	MSOP8
Operating temperature ($^{\circ}$ C)	-40 to 125	-40 to 125	-40 to 85
Temperature co-efficient (PPM/ $^{\circ}$ C)	30	Not defined	110 (with offsetting amplifier error)
Output type	Voltage	Voltage	Current
Price – 1k (USD)	0.575	0.92	1.25

Potential customers

Potential customers for the ZXCT1041 include:

Battery charger and UPS manufacturers.

Motor control design and manufacturers.

Typical applications include:

Battery charge and discharge current measurement

Motor control sensing/protection

Power supply over-current and return current protection

Pricing

The price list contains the full pricing matrix.

As a guide:

ZXCT1041E5TA is \$0.575 at 1k and \$0.51 at 10k.

Ordering Information

- ZXCT1041E5TA – sample
- ZXCT1041E5TA – 3000 per reel

Both are unleaded as standard. NB no U prefix.

ZXCT1041EV1 – evaluation board

**Do you have a key customer
you'd like to send samples to?
Contact us at:**

europa.sales@zetex.com

asia.sales@zetex.com

usa.sales@zetex.com

Support

- Datasheet – the ZXCT1041 datasheet is available now on the Zetex website, **www.zetex.com/ZXCT1041**
- Application note – The datasheet also includes extensive discussion of choice of component values and other applications information.
- SPICE macro-models can be made available upon request.

Conclusion

As with many Zetex products, what we show on our collateral is not the limit of what we can achieve. If you see other product opportunities, please let us know. Your local Zetex office will be pleased to offer any technical support, pricing and sample requests.

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www.zetex.com

Europe

Zetex GmbH
Kustermann-park
Balanstraße 59
D-81541 München
Germany
Tel: (49) 89 45 49 49 0
Fax: (49) 89 45 49 49 49
europa.sales@zetex.com

Americas

Zetex Inc
700 Veterans Memorial Hwy
Hauppauge
NY 11788
USA
Tel: 631 360 2222
Fax: 631 360 8222
usa.sales@zetex.com

Asia Pacific

Zetex (Asia) Ltd
3701-04 Metroplaza Tower 1
Hing Fong Road
Kwai Fong
Hong Kong
Tel: (852) 26100 611
Fax: (852) 24250 494
asia.sales@zetex.com

Corporate HQ

Zetex plc
Zetex Technology Park
Chadderton
Oldham, OL9 9LL
United Kingdom
44 161 622 4444
44 161 622 4446
hq@zetex.com