ZXCT1030
High-side current monitor with comparator

Description

The ZXCT1030 is a high side current sense monitor containing an internal reference and comparator with a non-latching output. Using this device eliminates the need to disrupt the ground plane when sensing a load current.

The wide input voltage range of 20V down to as low as 2.2V make it suitable for a range of applications. Dynamics and supply current are optimized for the processing of fast pulses, associated with switch mode applications.

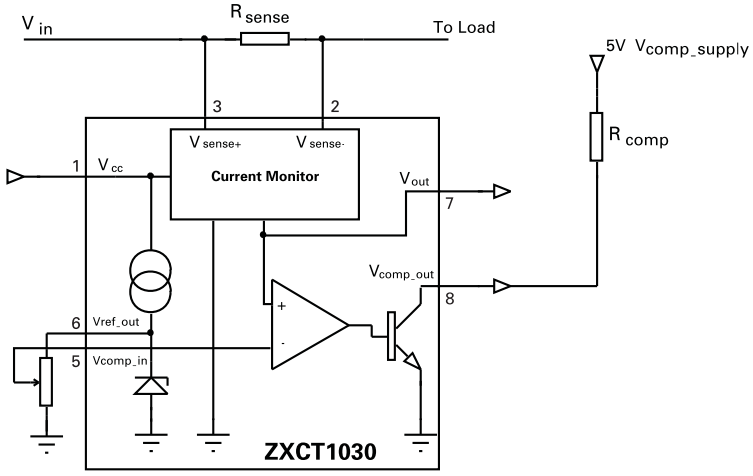
Features

- Low cost, accurate high-side current sensing
- Output voltage scaling
- Up to 18V output
- 2.2V - 20V supply range
- 270μA quiescent current
- 1.5% typical accuracy
- SO8 package
- Voltage reference on chip
- Comparator on chip

Applications

- Battery chargers
- Electronic fuse
- DC motor control
- Over current monitor
- Power management
- Inrush current limiting

Typical application circuit



Ordering information

Device	Status	Package	Device marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXCT1030X8TA	Last time buy	MSOP8	ZXCT1030	7	12	1000
ZXCT1030N8TA	Preview	SO8	ZXCT1030	7	12	500

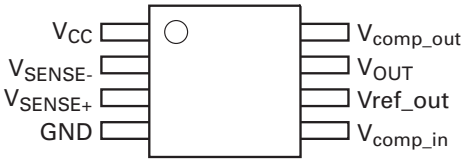
Absolute maximum ratings

Voltage on any pin	-0.6V and V_{CC} +0.6V
Operating temperature	-40 to 85°C
Storage temperature	-55 to 125°C
Package power dissipation	(T_{amb} = 25°C)
MSOP8	500mW

Recommended operating conditions

Parameter	Min.	Max.	Unit
V_{CC}	2.2	20	V
V_{SENSE+}	2.2	V_{CC}	V
V_{SENSE}[(a)]	10	500	mV
V_{OUT}	0	V_{SENSE}-1V	V
$V_{comp-in}$	0.005	10	V
T_{amb}	-40	85	°C

Pin-out connections



Pin name	Function
V_{CC}	Supply voltage
V_{SENSE-}	Negative sense input
V_{SENSE+}	Positive sense input
GND	Ground
V_{comp_in}	Comparator input, usually a ratio of the reference or other control signal
Vref_out	Reference output
V_{OUT}	Current monitor output voltage
V_{comp_out}	Open collector comparator output

Electrical characteristics (ZXCT1030X8) - Test conditions T_{amb} = 25°C, V_{IN} = V_{CC} = 15V, R_{comp} = 10kV, V_{comp_supply} = 5V unless otherwise stated.

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	V_{CC} range		2.2		20	V
V_{SENSE+}	Sense+ range		2.2		V_{CC}	
V_{OUT}	Output voltage	V_{SENSE} = 0V	0	2	10	mV
		V_{SENSE} = 10mV	88	100	112	mV
		V_{SENSE} = 30mV	284	300	316	mV
		V_{SENSE} = 50mV	480	500	520	mV
		V_{SENSE} = 100mV	970	1000	1030	mV
		V_{SENSE} = 500mV	4500	5000	5500	mV
R_{OUT}	Output resistance	V_{SENSE-} = 15V, V_{OUT} = 1V	1.2	1.5	1.8	kΩ
$\frac{V_{OUT}}{T_C}$	V_{OUT} temperature coefficient			30		ppm/°C
I_{CC}	Supply current	V_{SENSE-} = 15V	170	270	350	µA
I_{SENSE+}	V_{SENSE+} input current			48	90	µA
I_{SENSE-}	V_{SENSE-} input current	V_{SENSE-} = 14.9V		70	220	nA
$V_{CM(min)}$ [b]	Minimum active common mode voltage	V_{CC} =15V V_{comp_supply} = 5V V_{comp_in} = V_{REF} V_{SENSE} = 10mV	2.8			V
A_{CC}	Accuracy	V_{SENSE} =100mV	-3		3	%
Gain	V_{OUT} /V_{SENSE}	V_{SENSE} = 100mV	9.7	10.0	10.3	
BW	Bandwidth	V_{SENSE} =10mVp-p		3		MHz
		V_{SENSE} = 100mVp-p		6		MHz
Comparator						
V_{comp_in}	Input voltage		0.005		10	V
V_H	Hysteresis			15		mV
I_B	Input bias		5	80	150	nA
T_D	Propagation delay			100		ns
V_{OL}	Output voltage low		30	150	200	mV
V_{OH}	Output voltage high				V_{comp_supply}	V
I_{OL}	Output sink current	V_{OL} = 0.4V	2			mA
I_{OH}	Output high leakage current				1.0	µA
Voltage reference						
V_{ref}		Reference current = +300µA to -5µA	1.200	1.240	1.280	V
delta V_{ref}	Change in V_{ref}	Isource 5µA to Isink 300µA		10		mV
T_C				30		ppm/°C
PSR	Supply rejection			0.01		%/V

NOTES:
(a) V_{SENSE} = (V_{SENSE+}) - (V_{SENSE-})
(b) Level of V_{SENSE+} where comparator output defaults to 'off'.

Electrical characteristics (ZXCT1030N8) - Test conditions T_{amb} = 25°C, V_{IN} = V_{CC} = 15V, R_{comp} = 10kV, V_{comp_supply} = 5V unless otherwise stated.

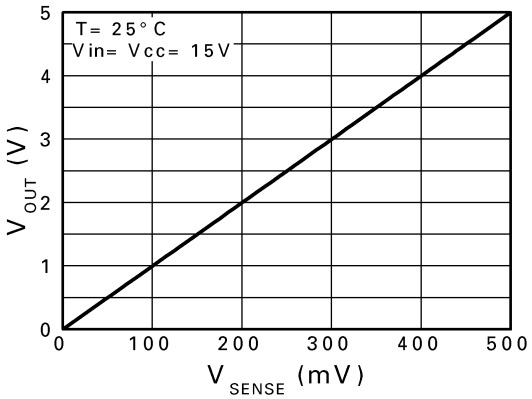
Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	V_{CC} range		2.2		20	V
V_{SENSE+}	Sense+ range		2.2		V_{CC}	
V_{OUT}	Output voltage	V_{SENSE} = 0V	0	2	10	mV
		V_{SENSE} = 10mV	88	100	112	mV
		V_{SENSE} = 30mV	284	300	316	mV
		V_{SENSE} = 50mV	480	500	520	mV
		V_{SENSE} = 100mV	970	1000	1030	mV
		V_{SENSE} = 500mV	4500	5000	5500	mV
R_{OUT}	Output resistance	V_{SENSE-} = 15V, V_{OUT} = 1V	1.2	1.5	1.8	kΩ
$\frac{V_{OUT}}{T_C}$	V_{OUT} temperature coefficient			30		ppm/°C
I_{CC}	Supply current	V_{SENSE-} = 15V	170	270	350	µA
I_{SENSE+}	V_{SENSE+} input current			48	90	µA
I_{SENSE-}	V_{SENSE-} input current	V_{SENSE-} = 14.9V		70	220	nA
$V_{CM(min)}$ [b]	Minimum active common mode voltage	V_{CC} =15V V_{comp_supply} = 5V V_{comp_in} = V_{REF} V_{SENSE} = 10mV	2.8			V
A_{CC}	Accuracy	V_{SENSE} =100mV	-3		3	%
Gain	V_{OUT} /V_{SENSE}	V_{SENSE} = 100mV	9.7	10.0	10.3	
BW	Bandwidth	V_{SENSE} =10mVp-p		3		MHz
		V_{SENSE} = 100mVp-p		6		MHz
Comparator						
V_{comp_in}	Input voltage		0.005		10	V
V_H	Hysteresis			15		mV
I_B	Input bias		5	80	150	nA
T_D	Propagation delay			100		ns
V_{OL}	Output voltage low		30	150	200	mV
V_{OH}	Output voltage high				V_{comp_supply}	V
I_{OL}	Output sink current	V_{OL} = 0.4V	2			mA
I_{OH}	Output high leakage current				1.0	µA
Voltage reference						
V_{ref}		Reference current = +300µA to -5µA	1.200	1.240	1.280	V
delta V_{ref}	Change in V_{ref}	Isource 5µA to Isink 300µA		10		mV
T_C				30		ppm/°C
PSR	Supply rejection			0.01		%/V

NOTES:

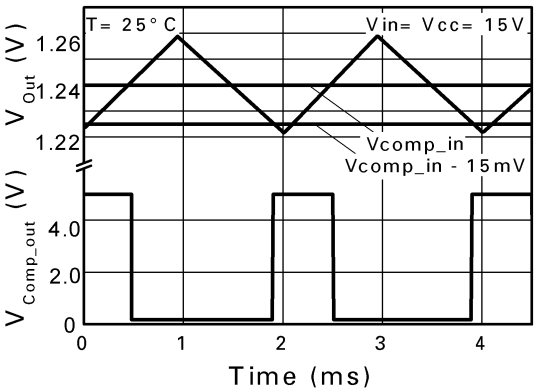
(c) V_{SENSE} = (V_{SENSE+}) - (V_{SENSE-})

(d) Level of V_{SENSE+} where comparator output defaults to 'off'.

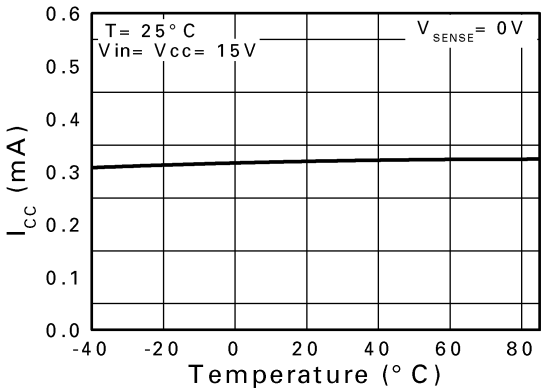
Typical characteristics



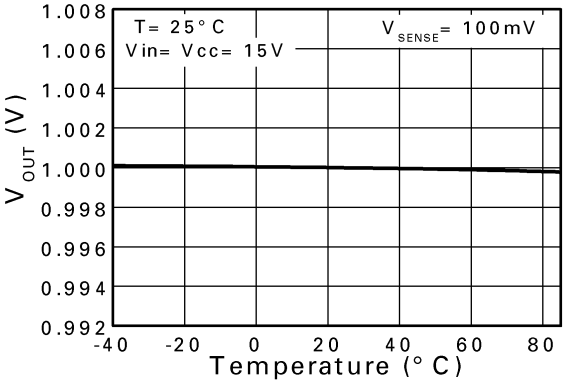
V_{OUT} v V_{SENSE}



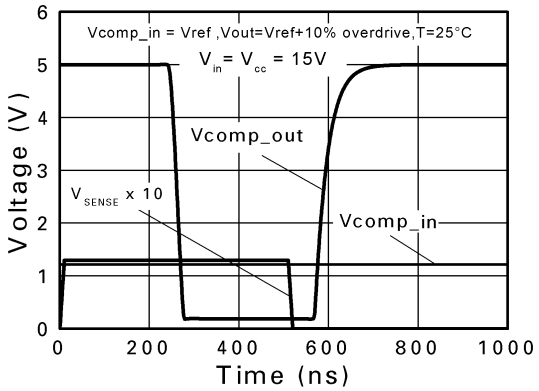
Input Hysteresis



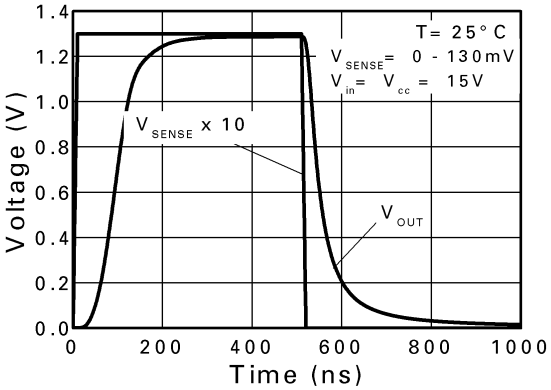
I_{SUPPLY} v Temperature



V_{OUT} v Temperature



Monitor and Comparator Step Response



Current Monitor Step Response

Voltage output current monitor

Referring to the block diagram, the current monitor takes the small voltage developed across the sense resistor (V_{SENSE}) and transfers it from the large common mode supply voltage to a ground-referenced signal with a gain of 10. The sense input common mode range is 2.2V to 20V. In this range, a linear output voltage is delivered.

Reference

The bandgap reference allows the comparator to compare the translated Vsense with threshold value chosen by the user which can be any voltage from 0 to 1.24V, configured by two external resistors which forms V_{comp_in}.

The output current which can be drawn from the comparator reference (I_{ref} source) is limited to 5µA, making potentiometers $\geq$250kΩ suitable for setting a threshold level. Where a lower potentiometer resistor value is used, an additional resistor value should be inserted between V_{ref} and V_{CC} to maintain sufficient current for the reference. (as shown in Figure 1).

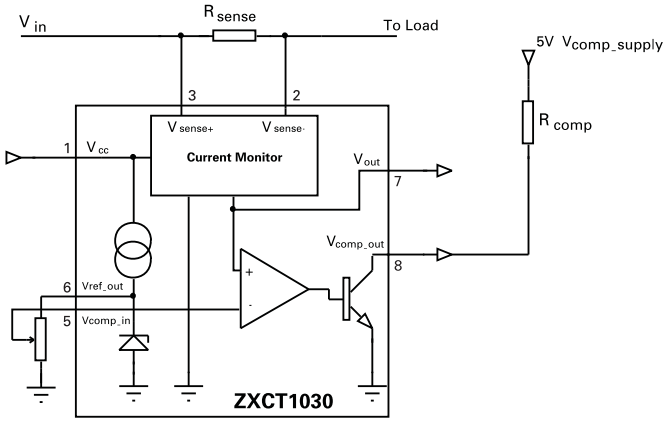


Figure 1: External resistor for reference level

The voltage reference has a maximum current sink capability. This magnitude of current will be influenced by the value of R1 which is inserted between V_{ref} and V_{CC}. The value of current flowing through R1 can be expressed as:

$$I = (V_{CC} - V_{ref}) / R1$$

Comparator

The open collector output is active low and is asserted when V_{SENSE} x 10 (V_{OUT}) > V_{comp_in}.

It can be connected to any voltage rail up to Vin via a pull-up resistor. Suggest values for the resistor are in the range of 10-100kΩ.

In the case where high load currents or a short circuit occurs, thus reducing the common mode signals (V+, V-) typically below 2.2V, the comparator will default to the asserted state. This can eliminate a closed loop system 'latch-up' condition, allowing the controller to remove the applied power.

Stability

To ensure stable operation of the ZXCT1030, it is recommended a decoupling capacitor is placed across the V_{CC} and ground connections. A ceramic 10µF will be adequate.

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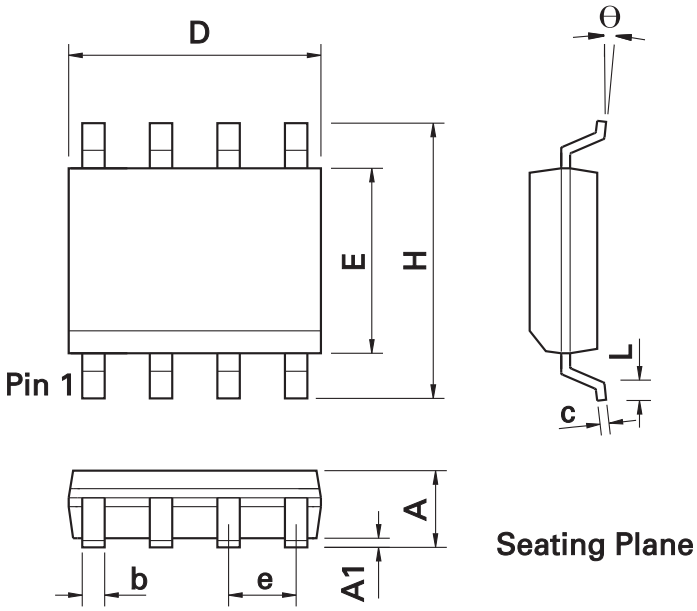
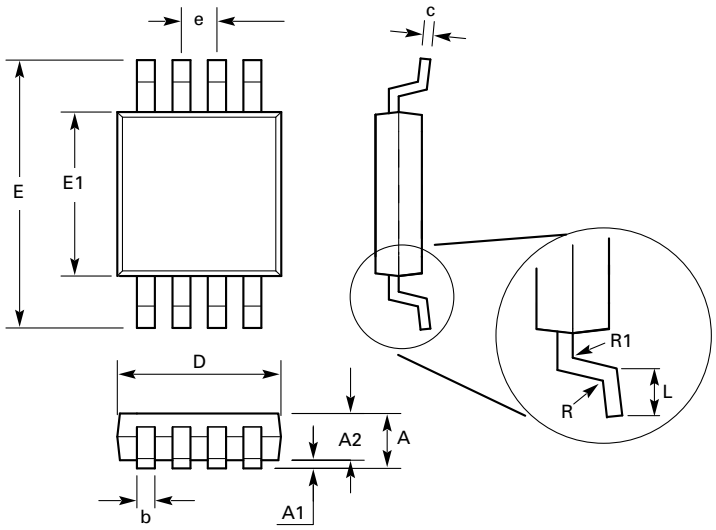
Package outline - SO8



DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.053	0.069	1.35	1.75	e	0.050 BSC		1.27 BSC	
A1	0.004	0.010	0.10	0.25	b	0.013	0.020	0.33	0.51
D	0.189	0.197	4.80	5.00	c	0.008	0.010	0.19	0.25
H	0.228	0.244	5.80	6.20	θ	0°	8°	0°	8°
E	0.150	0.157	3.80	4.00	h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27	-	-	-	-	-

Note: Controlling dimensions are in inches. Approximate dimensions are provided in millimeters

Package outline - MSOP8



DIM	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	-	1.10	-	0.0433
A1	0.05	0.15	0.002	0.006
A2	0.75	0.95	0.0295	0.0374
b	0.25	0.40	0.010	0.0157
c	0.13	0.23	0.005	0.009
D	2.90	3.10	0.114	0.122
E	4.90 BSC		0.193 BSC	
E1	2.90	3.10	0.114	0.122
e	0.65 BSC		0.025 BSC	
L	0.40	0.70	0.0157	0.0192
R	0.07	-	0.0027	-
R1	0.07	-	0.0027	-

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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