

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.

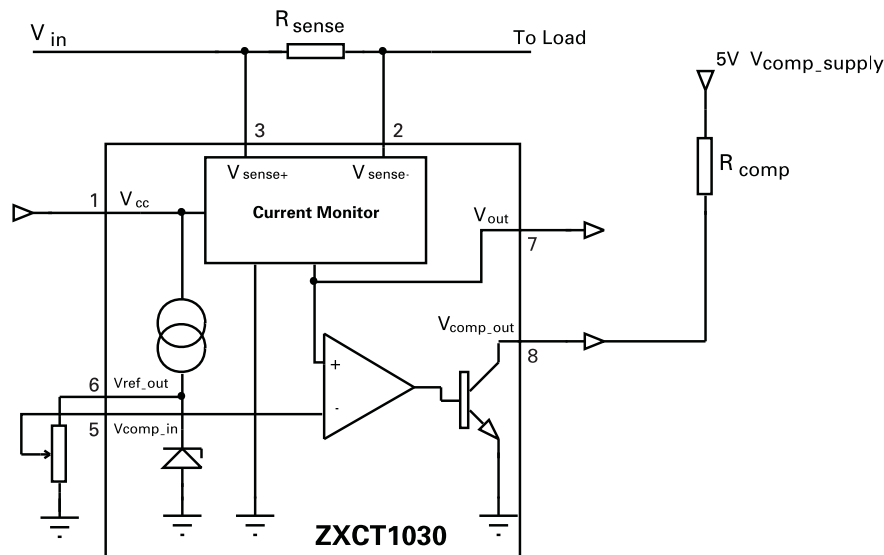
Features

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

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 | Active | SO8 | ZXCT1030 | 7 | 12 | 500 |

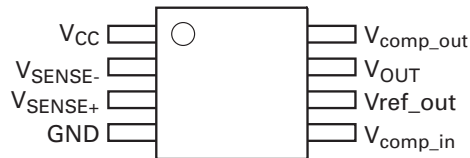
Absolute maximum ratings

| | |
|---------------------------|-----------------------------|
| 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 | ($T_{amb} = 25^{\circ}C$) |
| 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 |

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Electrical characteristics (ZXCT1030X8) - Test conditions $T_{amb} = 25^{\circ}\text{C}$, $V_{IN} = V_{CC} = 15\text{V}$, $R_{comp} = 10\text{k}\Omega$, $V_{comp_supply} = 5\text{V}$ 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 | $V_{SENSE} = 0\text{V}$ | 0 | 2 | 10 | mV |
| | | $V_{SENSE} = 10\text{mV}$ | 88 | 100 | 112 | mV |
| | | $V_{SENSE} = 30\text{mV}$ | 284 | 300 | 316 | mV |
| | | $V_{SENSE} = 50\text{mV}$ | 480 | 500 | 520 | mV |
| | | $V_{SENSE} = 100\text{mV}$ | 970 | 1000 | 1030 | mV |
| | | $V_{SENSE} = 500\text{mV}$ | 4500 | 5000 | 5500 | mV |
| R_{OUT} | Output resistance | $V_{SENSE-} = 15\text{V}$, $V_{OUT} = 1\text{V}$ | 1.2 | 1.5 | 1.8 | $\text{k}\Omega$ |
| V_{OUT} T_C | V_{OUT} temperature coefficient | | | 30 | | $\text{ppm}/^{\circ}\text{C}$ |
| I_{CC} | Supply current | $V_{SENSE-} = 15\text{V}$ | 170 | 270 | 350 | μA |
| I_{SENSE+} | V_{SENSE+} input current | | 25 | 48 | 90 | μA |
| I_{SENSE-} | V_{SENSE-} input current | $V_{SENSE-} = 14.9\text{V}$ | 25 | 70 | 220 | nA |
| $V_{CM(\text{min})}^{(b)}$ | Minimum active common mode voltage | $V_{CC} = 15\text{V}$ $V_{comp_supply} = 5\text{V}$ $V_{comp_in} = V_{REF}$ $V_{SENSE} = 10\text{mV}$ | 2.8 | | | V |
| A_{CC} | Accuracy | $V_{SENSE} = 100\text{mV}$ | -3 | | 3 | % |
| Gain | V_{OUT} / V_{SENSE} | $V_{SENSE} = 100\text{mV}$ | 9.7 | 10.0 | 10.3 | |
| BW | Bandwidth | $V_{SENSE} = 10\text{mVp-p}$ | | 3 | | MHz |
| | | $V_{SENSE} = 100\text{mVp-p}$ | | 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 | $V_{OL} = 0.4\text{V}$ | 2 | | | mA |
| I_{OH} | Output high leakage current | | | | 1.0 | μA |
| Voltage reference | | | | | | |
| V_{ref} | | Reference current = $+300\mu\text{A}$ to $-5\mu\text{A}$ | 1.200 | 1.240 | 1.280 | V |
| ΔV_{ref} | Change in V_{ref} | $I_{source} 5\mu\text{A}$ to $I_{sink} 300\mu\text{A}$ | | 10 | | mV |
| T_C | | | | 30 | | $\text{ppm}/^{\circ}\text{C}$ |
| 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'.

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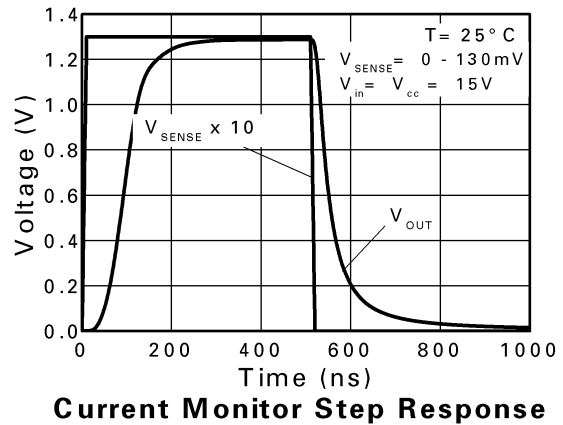
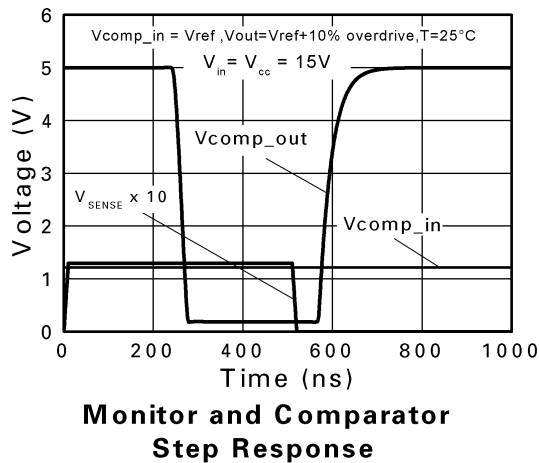
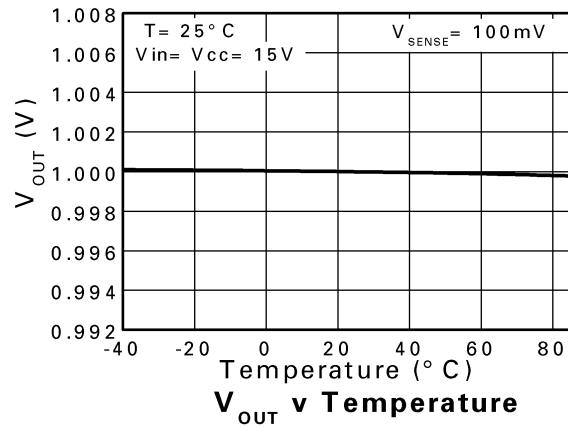
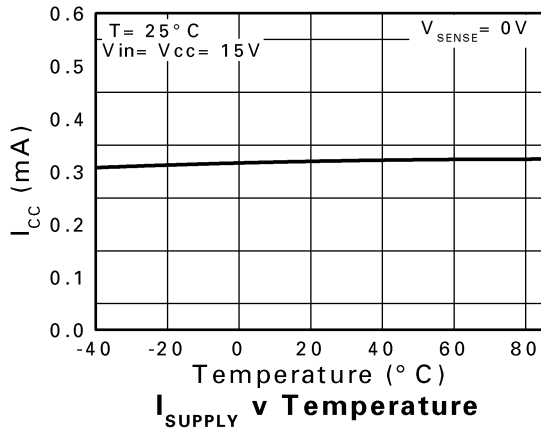
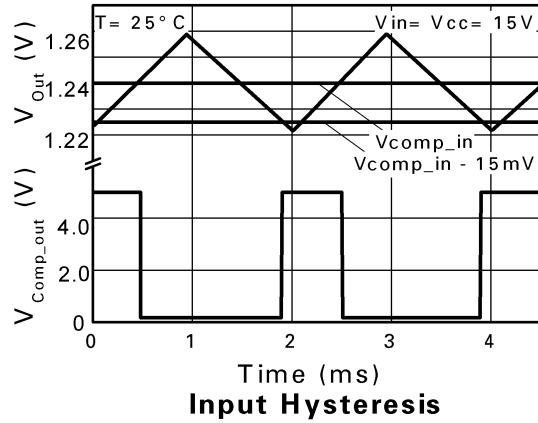
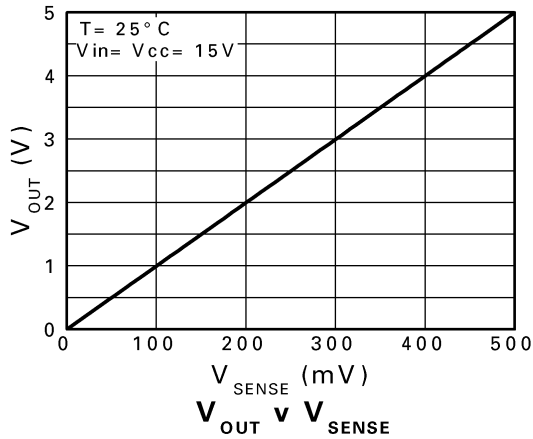
| Symbol | Parameter | Conditions | Limits | | | Unit |
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| T_C | | | | 30 | | $\text{ppm}/^{\circ}\text{C}$ |
| PSR | Supply rejection | | | 0.01 | | $\%/V$ |

NOTES:

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

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

Typical characteristics



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 V_{sense} 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 $5\mu A$, making potentiometers $\geq 250k\Omega$ 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).

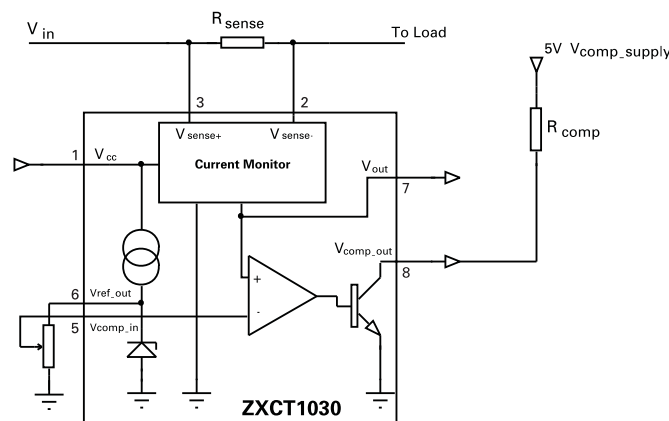


Figure 1: External resistor for reference level

The voltage reference has a maximum current sink capability. This magnitude of current will be influenced by the value of R_1 which is inserted between V_{ref} and V_{CC} . The value of current flowing through R_1 can be expressed as:

$$I = (V_{CC} - V_{ref}) / R_1$$

Comparator

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

It can be connected to any voltage rail up to V_{in} via a pull-up resistor. Suggest values for the resistor are in the range of 10-100k Ω .

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.

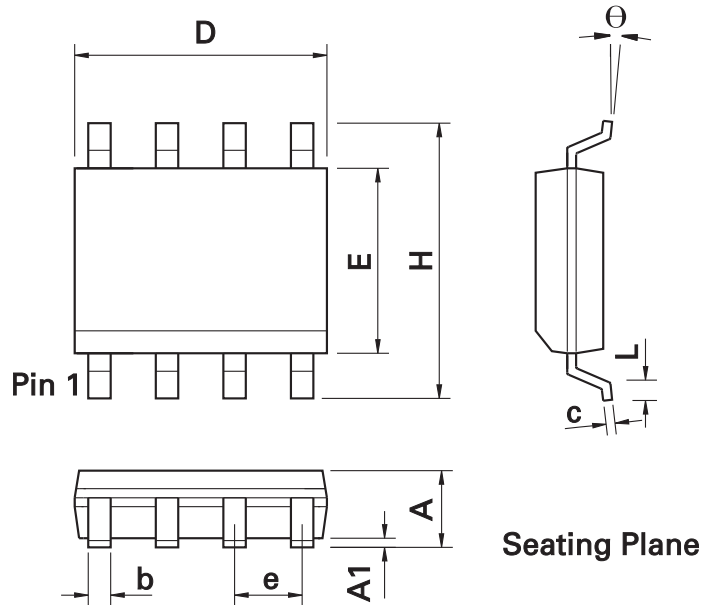
Stability

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

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ZXCT1030

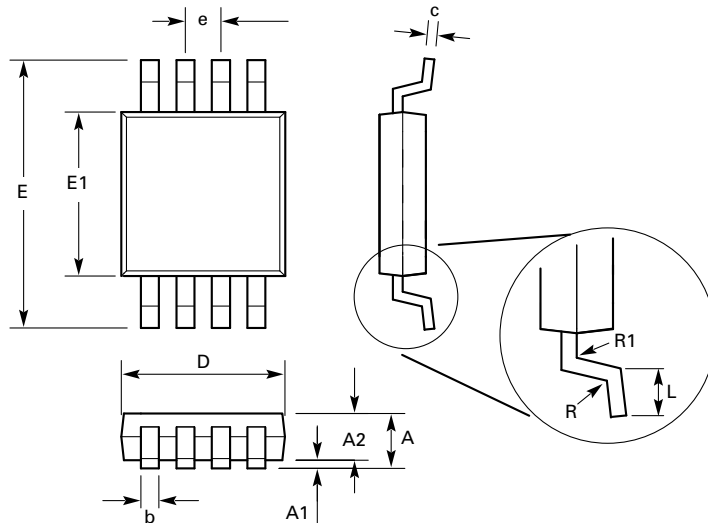
Package outline - SO8



| 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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or

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Product status key:

| | |
|-----------------------------------|--|
| "Preview" | Future device intended for production at some point. Samples may be available |
| "Active" | Product status recommended for new designs |
| "Last time buy (LTB)" | Device will be discontinued and last time buy period and delivery is in effect |
| "Not recommended for new designs" | Device is still in production to support existing designs and production |
| "Obsolete" | Production has been discontinued |

Datasheet status key:

| | |
|-----------------------|---|
| "Draft version" | This term denotes a very early datasheet version and contains highly provisional information, which may change in any manner without notice. |
| "Provisional version" | This term denotes a pre-release datasheet. It provides a clear indication of anticipated performance. However, changes to the test conditions and specifications may occur, at any time and without notice. |
| "Issue" | This term denotes an issued datasheet containing finalized specifications. However, changes to specifications may occur, at any time and without notice. |

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