ZXCT1080
High voltage high-side current monitor

Description

The ZXCT1080 is a high side current sense monitor with a gain of 10 and a voltage output. Using this device eliminates the need to disrupt the ground plane when sensing a load current.

The wide input voltage range of 60V down to as low as 3V make it suitable for a range of applications; including systems operating from industrial 24-28V rails and -48V rails.

The separate supply pin (V_{CC}) allows the device to continue functioning under short circuit conditions, giving an end stop voltage at the output.

The ZXCT1080 has an extended ambient operating temperature range of -40°C to 125°C enabling it to be used in a wide range of applications including automotive.

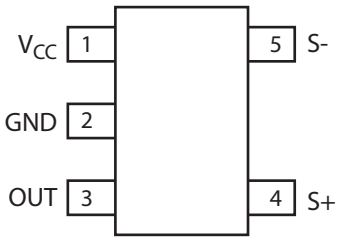
Features

- 3V to 60V continuous high side voltage
- Accurate high-side current sensing
- -40 to 125°C temperature range
- Output voltage scaling x10
- 4.5V to 12V V_{CC} range
- Low quiescent current:
  - 80µA supply pin
  - 27µA I_{S+}
- SOT23-5 package

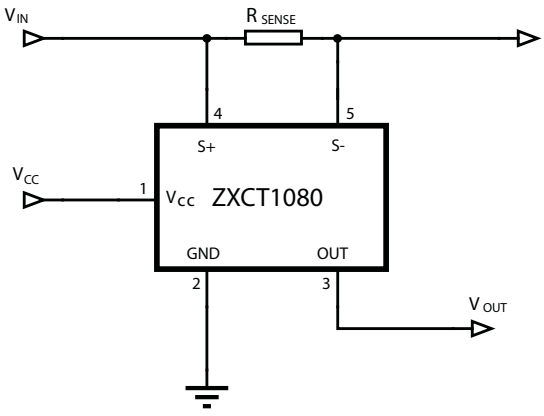
Applications

- Industrial applications current measurement
- Battery management
- Over-current measurement
- Power management
- Automotive current measurement

Pin connections



Typical application circuit



Ordering information

Device	Package	Part mark	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXCT1080E5TA	SOT23-5	1080	7	8	3000

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Absolute maximum ratings

Continuous voltage on S- and S+	-0.6 and 65V
Voltage on all other pins	-0.6V and +14V
Differential sense voltage, V_{SENSE}	800mV
Operating temperature	-40 to 125°C
Storage temperature	-55 to 150°C
Maximum junction temperature	125°C
Package power dissipation	300mW* at T_A = 25°C

Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

V_{SENSE} is defined as the differential voltage between S+ and S- pins.

* Assumes Θ_{JA} = 420°C/W

Recommended operating conditions

Parameter		Min.	Max.	Units
V_{IN}	Common-mode sense+ input range	3	60	V
V_{CC}	Supply voltage range	4.5	12	V
V_{SENSE}	Differential sense input voltage range	0	0.15	V
V_{OUT}	Output voltage range	0	1.5 (*)	V
T_A	Ambient temperature range	-40	125	°C

NOTES:
(*) Based on 10x V_{SENSE}

Pin function table

Pin	Name	Description
1	V_{CC}	This is the analogue supply and provides power to internal circuitry
2	GND	Ground pin
3	OUT	Output voltage pin. NMOS source follower with 20µA bias to ground
4	S+	This is the positive input of the current monitor and has an input range from 60V down to 3V. The current through this pin varies with differential sense voltage
5	S-	This is the negative input of the current monitor and has an input range from 60V down to 3V

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Electrical characteristics

Test conditions T_A = 25°C, V_{IN} = 12V, V_{CC} = 5 V, V_{SENSE}[a] = 100mV unless otherwise stated.

Symbol	Parameter	Conditions	T_A	Min[e].	Typ.	Max[e].	Units
I_{CC}	V_{CC} supply current	V_{CC} = 12V, V_{SENSE}[a] = 0V	25°C	40	80	120	µA
			full range			145	
I_{S+}	S+ input current	V_{SENSE}[a] = 0V	25°C	15	27	42	µA
			full range			60	
I_{S-}	S- input current		25°C	15	40	80	nA
$V_{O(0)}$	Zero V_{SENSE}[a] error[b]		25°C	0		35	mV
$V_{O(10)}$	Output offset voltage[c]	V_{SENSE}[a] = 10mV	25°C	-25		+25	mV
			full range	-55		+55	
Gain	$\Delta V_{OUT}/\Delta V_{SENSE}$[a]	V_{SENSE}[a] = 10mV to 150mV	25°C	9.9	10	10.1	V/V
			full range	9.8		10.2	
V_{OUT} TC[d]	V_{OUT} variation with temperature				30		ppm/°C
Acc	Total output error			-3		3	%
I_{OH}	Output source current	ΔV_{OUT} = -30mV			1		mA
I_{OL}	Output sink current	ΔV_{OUT} = +30mV			20		µA
PSRR	V_{CC} supply rejection ratio	V_{CC} = 4.5V to 12V		54	60		dB
CMRR	Common-mode sense rejection ratio	V_{IN} = 60V to 3V		68	80		dB
BW	-3dB small signal bandwidth	V_{SENSE}[a] (AC) = $10mV_{PP}$			500		kHz

NOTES:

(a) V_{SENSE} = "V_{S+}" - "V_{S-}"

(b) The ZXCT1080 operates from a positive power rail and the internal voltage-current converter current flow is unidirectional; these result in the output offset voltage for V_{SENSE} = 0V always being positive.

(c) For V_{SENSE} > 10mV, the internal voltage-current converter is fully linear. This enables a true offset to be defined and used. $V_{O(10)}$ is expressed as the variance about an output voltage of 100mV>

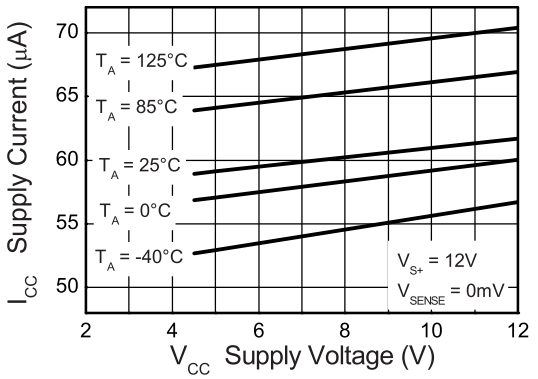
(d) Temperature dependent measurements are extracted from characterization and simulation results.

(e) All Min and Max specifications over full temperature range are guaranteed by design and characterisation

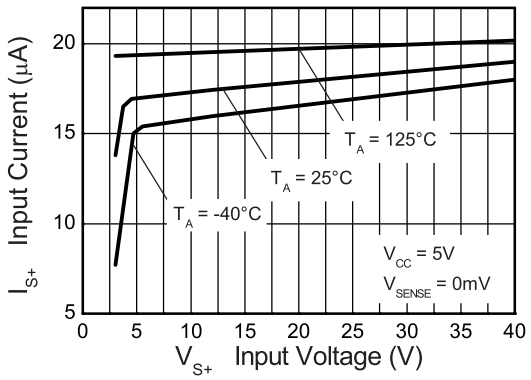
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Typical characteristics

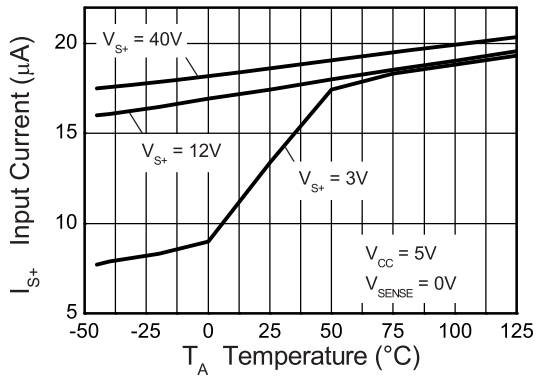
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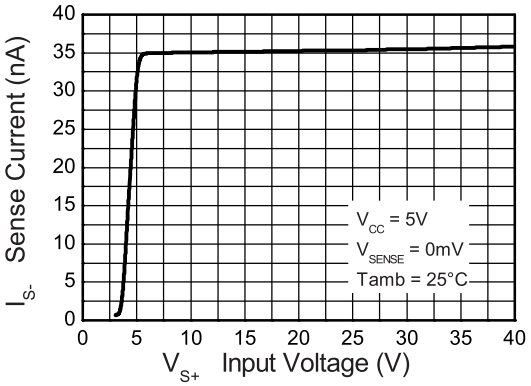
Supply Current



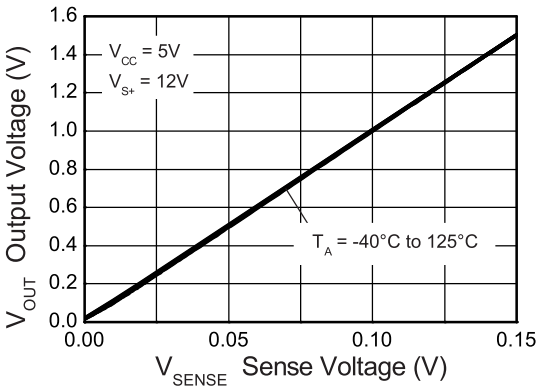
Input Current



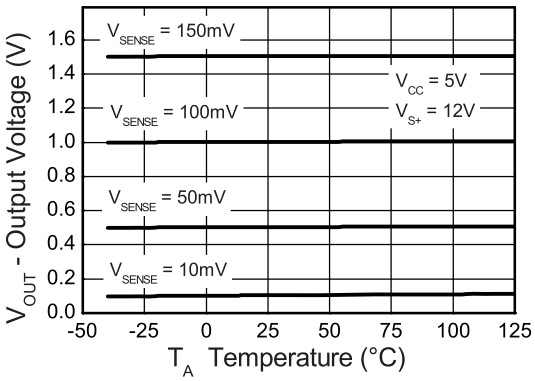
Input Current



Sense- Current



Output Voltage

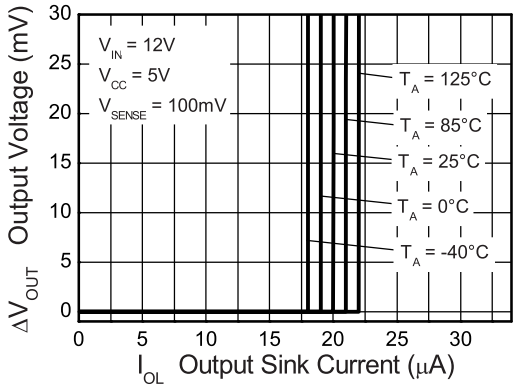


Output Voltage

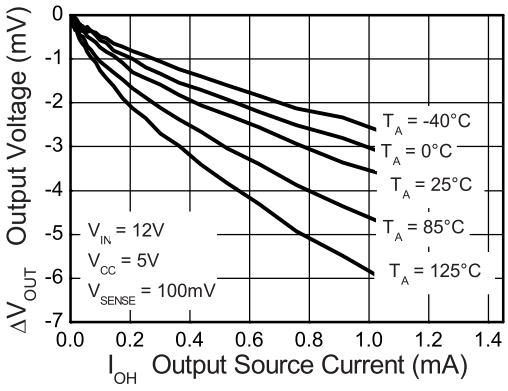
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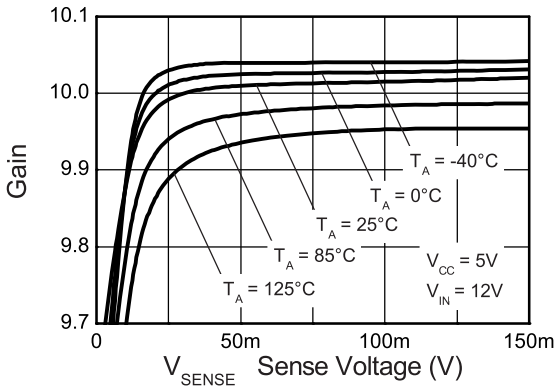
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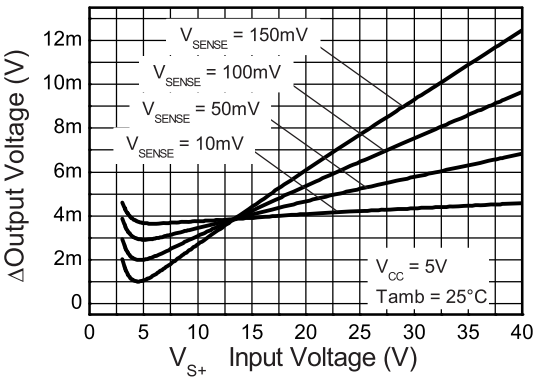
Output Current Sink



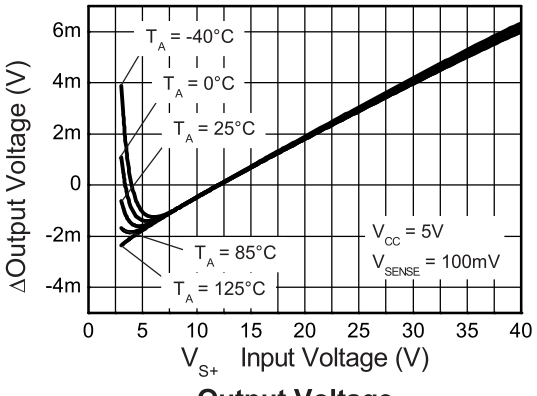
Output Current Source



Differential Gain



Output Voltage

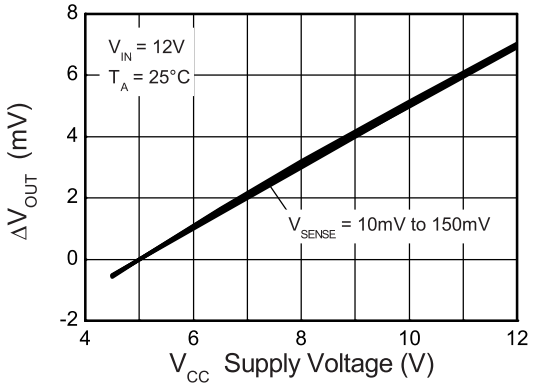


Output Voltage

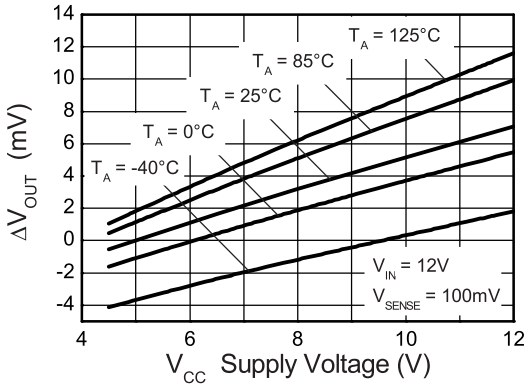
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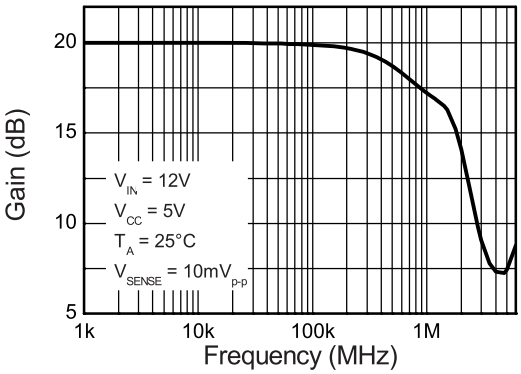
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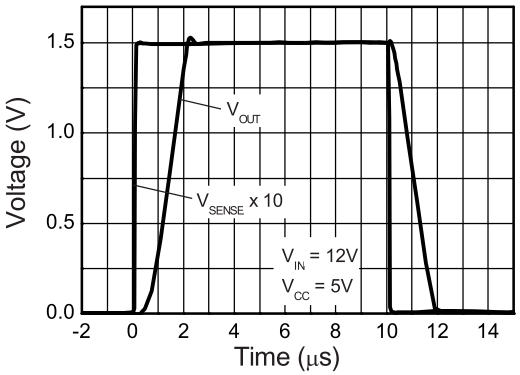
Normalised Output Voltage



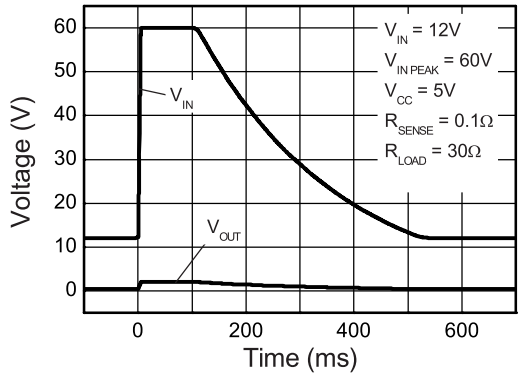
Normalised Output Voltage



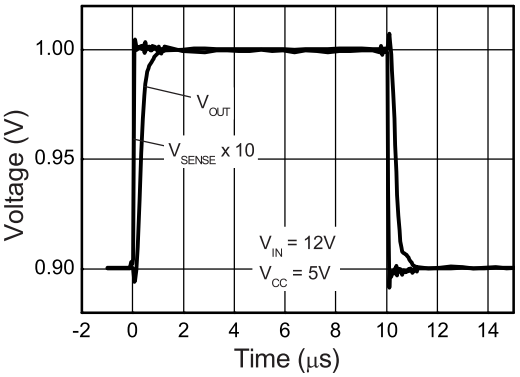
Small Signal Bandwidth



Large Signal Pulse Response



Load Dump Waveform

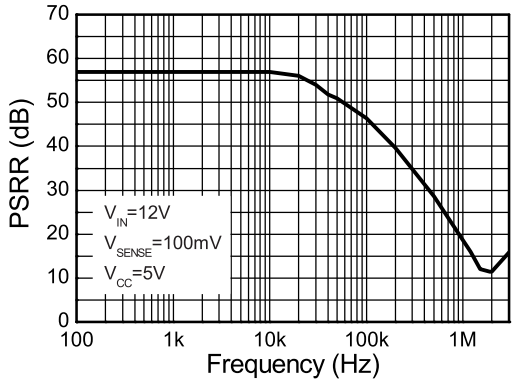


Small Signal Pulse Response

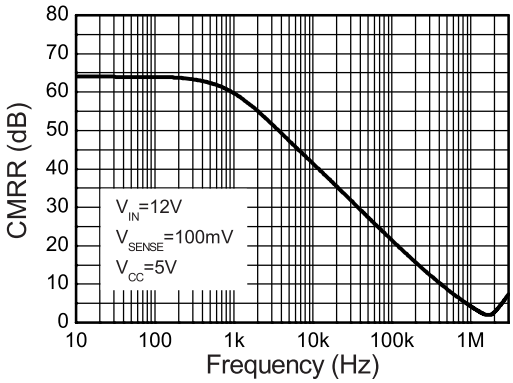
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Typical characteristics

Test conditions unless otherwise stated: T_A = 25°C, V_{CC} = 5V, V_{SENSE+} =12V, V_{SENSE} = 100mV



Supply Rejection



Common Mode Rejection

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Application information

The ZXCT1080 has been designed to allow it to operate with 5V supply rails while sensing common mode signals up to 60V. This makes it well suited to a wide range of industrial and power supply monitoring applications that require the interface to 5V systems while sensing much higher voltages.

To allow this its V_{CC} pin can be used independently of S+.

Figure 1 shows the basic configuration of the ZXCT1080.

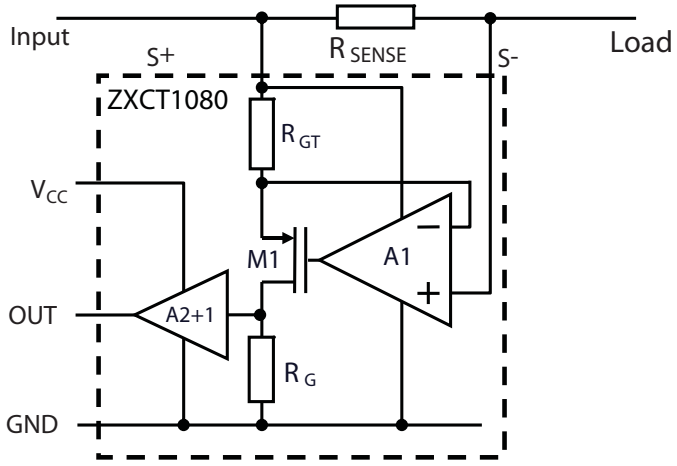


Figure 1 Typical configuration of ZXCT1080

Load current from the input is drawn through R_{SENSE} developing a voltage V_{SENSE} across the inputs of the ZXCT1080.

The internal amplifier forces V_{SENSE} across internal resistance R_{GT} causing a current to flow through MOSFET M1. This current is then converted to a voltage by R_G. A ratio of 10:1 between R_G and R_{GT} creates the fixed gain of 10. The output is then buffered by the unity gain buffer.

The gain equation of the ZXCT1080 is:

$$V_{OUT} = I_L R_{SENSE} \frac{R_G}{R_{GT}} \times 1 = I_L \times R_{SENSE} \times 10$$

The maximum recommended differential input voltage, V_{SENSE}, is 150mV; it will however withstand voltages up to 800mΩ. This can be increased further by the inclusion of a resistor, R_{LIM}, between S- pin and the load; typical value is of the order of 10k .

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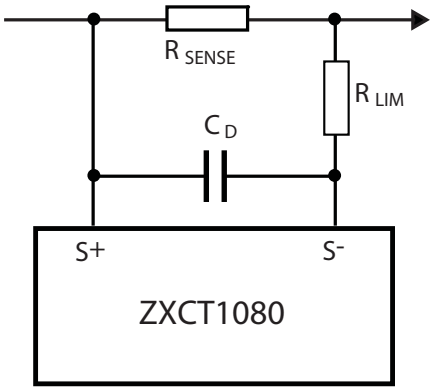


Figure 2 Protection/error sources for ZXCT1080

Capacitor C_D provides high frequency transient decoupling when used with R_{LIM}; typical values are of the order 10pF

For best performance R_{SENSE} should be connected as close to the S+ (and SENSE) pins; minimizing any series resistance with R_{SENSE}.

When choosing appropriate values for R_{SENSE} a compromise must be reached between in-line signal loss (including potential power dissipation effects) and small signal accuracy.

Higher values for R_{SENSE} gives better accuracy at low load currents by reducing the inaccuracies due to internal offsets. For best operation the ZXCT1080 has been designed to operate with V_{SENSE} of the order of 50mV to 150mV.

Current monitors' basic configuration is that of a unipolar voltage to current to voltage converter powered from a single supply rail. The internal amplifier at the heart of the current monitor may well have a bipolar offset voltage but the output cannot go negative; this results in current monitors saturating at very low sense voltages.

As a result of this phenomenon the ZXCT1080 has been specified to operate in a linear manner over a V_{SENSE} range of 10mV to 150mV range, however it will still be monotonic down to $_{VSENSE}$ of 0V.

It is for this very reason that Zetex has specified an input offset voltage ($V_{O(10)}$) at 10mV. The output voltage for any V_{SENSE} voltage from 10mV to 150mV can be calculated as follows:

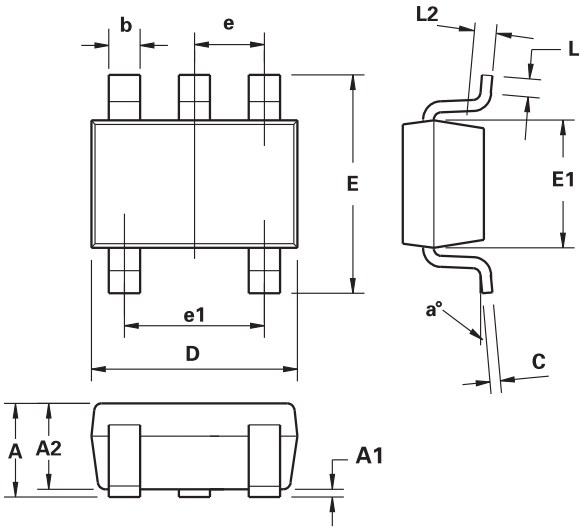
$$V_{OUT} = (V_{SENSE}) \times G + V_{O(10)}$$

Alternatively the load current can be expressed as:

$$I_L = \frac{(V_{OUT} - V_{O(10)})}{G \times R_{SENSE}}$$

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Package details - SOT23-5



DIM	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.90	1.45	0.0354	0.0570
A1	0.00	0.15	0.00	0.0059
A2	0.90	1.30	0.0354	0.0511
b	0.20	0.50	0.0078	0.0196
c	0.09	0.26	0.0035	0.0102
D	2.70	3.10	0.1062	0.1220
E	2.20	3.20	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95 REF		0.0374 REF	
e1	1.90 REF		0.0748 REF	
L	0.10	0.60	0.0039	0.0236
a°	0°	30°	0°	30°

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

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"Obsolete"	Production has been discontinued

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