

**ZXCT1082/83/84/85/86/87**  
**PRECISION HIGH VOLTAGE HIGH-SIDE CURRENT MONITORS**

### Description

The ZXCT1082 and ZXCT1083 are high side unipolar current sense monitors. These devices eliminate the need to disrupt the ground plane when sensing a load current.

The ZXCT1082/1084/1086 have 60V maximum operating voltage and ZXCT1083/1085/1087 have 40V maximum operating voltage.

The wide common-mode input voltage range and low quiescent currents coupled with SOT25 packages make them suitable for a range of applications; including automotive and systems operating from industrial 24-28V rails.

Their quiescent current is only 0.6µA thereby minimizing current sensing error.

The ZXCT1082 and ZXCT1083 use three external transconductance/gain setting resistors which increase versatility by permitting wide gain ranges and optimization of bandwidths.

The ZXCT1084/5/6/7 are fixed gain voltage output counterparts of the ZXCT1082/3.

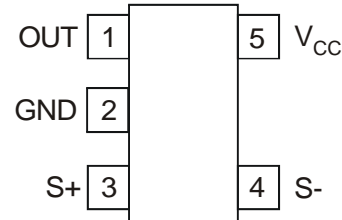
### Features

- Wide supply and common-mode voltage range
  - 2.7V to 60V ZXCT1082/84/86
  - 2.7V to 40V ZXCT1083/85/87
- Independent supply and input common-mode voltage
- Low quiescent current (0.6µA).
- AEC-Q100 Grade 1 qualified
- Extended industrial temperature range -40 to 125°C
- Package SOT25

### Applications

- Automotive current measurement
- Industrial applications current measurement
- Battery management
- Over current monitor
- Power Management
- Current sources

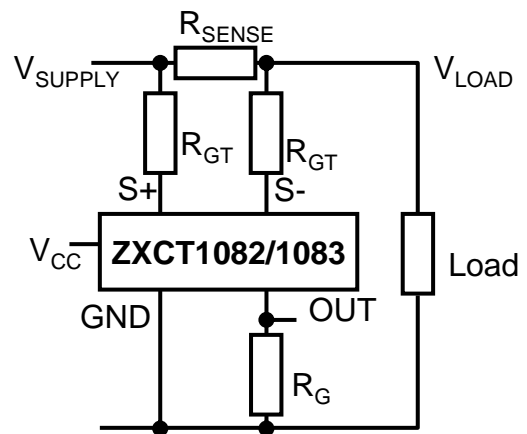
### Pin Assignments



### Typical Application Circuits



ZXCT1084/85:  $V_{OUT} = 25 \times V_{SENSE}$   
 ZXCT1086/87:  $V_{OUT} = 50 \times V_{SENSE}$



ZXCT1082/83:  $V_{OUT} = V_{SENSE} \times \frac{R_G}{R_{GT}}$

## Pin Description

PIN	Name	Description		
		Common	ZXCT1082/3	ZXCT1084/5/6/7
1	OUT	Output pin.	Current output.	Voltage output
2	GND	Ground pin.		
3	S+	This is the positive input of the current monitor. It has a wide common-mode input range. The current through this pin varies with differential sense voltage.	An external resistor, $R_{GT}$ , should be connected from S+ to the input side ( $V_{SUPPLY}$ ) of the sense resistor	Should be directly connected to the input side ( $V_{SUPPLY}$ ) of the sense resistor.
4	S-	This is the negative input of the current monitor. It has a wide common-mode input range.	An external resistor, $R_{GT}$ , should be connected from S- to the load side ( $V_{LOAD}$ ) of the sense resistor.	Should be directly connected to the load side ( $V_{LOAD}$ ) of the sense resistor.
5	$V_{CC}$	This is the analogue supply and provides power to internal circuitry.		

## Absolute Maximum Ratings

Parameter	Rating	Unit
Voltage on S- and S+		
ZXCT1082, ZXCT1084, ZXCT1086	-0.3 to 65	V
ZXCT1083, ZXCT1085, ZXCT1087	-0.3 to 45	
Voltage on $V_{CC}$		
ZXCT1082, ZXCT1084, ZXCT1086	-0.3 to 65	V
ZXCT1083, ZXCT1085, ZXCT1087	-0.3 to 45	
Voltage on OUT	-0.3 to $V_{S-}$	V
Differential Input Voltage, $V_{S+} - V_{S-}$	$\pm 800$	mV
Input current into S+ or S- <sup>(f)</sup>	$\pm 12$	mA
Storage Temperature	-55 to 150	°C
Maximum Junction Temperature	150	°C
Package Power Dissipation	300 at $T_A = 25^\circ\text{C}$ (De-rate to zero at $150^\circ\text{C}$ )	mW
<b>ESD Rating</b>		
Human Body Model	2	kV
Machine Model	200	V

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

<sup>(f)</sup> The differential input voltage limit,  $V_{S+} - V_{S-}$ , may be exceeded provided that the input current limit into S+ or S- is not exceeded

## Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
$V_{IN}$	ZXCT1083/1085/1087 Common-Mode Input Range	2.7	40	V
	ZXCT1082/1084/1086 Common-Mode Input Range	2.7	60	
$V_{CC}$	ZXCT1083/1085/1087 Supply Voltage Range	2.7	40	V
	ZXCT1082/1084/1086 Supply Voltage Range	2.7	60	
$V_{SENSE}$	Differential Sense Input Voltage Range	0	0.5	V
$V_{OUT}$	Output Voltage Range	0	$V_{S-} - 1$	V
$T_A$	Ambient Temperature Range	-40	125	°C

## Electrical Characteristics

Test Conditions  $T_A = 25^\circ\text{C}$ ,  $V_{S+} = 12\text{V}$ ,  $V_{CC} = 5\text{V}$ ,  $V_{\text{SENSE}}^1 = 100\text{mV}$ , ZXCT1082/3  $R_{GT} = 5\text{k}\Omega$ ,  $R_G = 125\text{k}\Omega$ ; unless otherwise stated.  
(FT =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ )

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>Input</b>						
$I_{S+}$	S+ input current	$V_{\text{SENSE}} = 0\text{mV}$ (Note 1)		1.7		$\mu\text{A}$
			$T_A = \text{FT}$		5	
$I_{S-}$	S- input current	$V_{\text{SENSE}} = 0\text{mV}$ (Note 1)		1.7		$\mu\text{A}$
			$T_A = \text{FT}$		5	
$V_{\text{IO}}$	Input Offset Voltage (Note 2)	$V_{\text{SENSE}} = 0\text{mV}$		$\pm 0.2$	$\pm 1$	mV
		ZXCT1082/3/4/5	$T_A = \text{FT}$		$\pm 2.5$	
		ZXCT1086/87	$T_A = \text{FT}$		$\pm 3$	
		Temperature co-efficient			$\pm 4$	
<b>Output</b>						
$G_T$	Transconductance			200		$\mu\text{A/V}$
$G_{T-\text{ERR}}$	Transconductance error (Note 4)	ZXCT1082/3 $V_{\text{SENSE}} = 10\text{mV}$ to $150\text{mV}$ (Note 1, 3)		-1	+1	%
			$T_A = \text{FT}$	-2	+2	
$G_{T-\text{TC}}$	Transconductance temperature co-efficient		$T_A = \text{FT}$	10		nA/K
$Z_{\text{OUT}}$	Output impedance	ZXCT1082/3			1  5	$\text{G}\Omega  \text{pF}$
$G_V$	Gain	ZXCT1084/5/6/7 $V_{\text{SENSE}} = 10\text{mV}$ to $150\text{mV}$ (Note 1)	1084/5		25	V/V
			1086/7		50	
$G_{V-\text{ERR}}$	Gain error (Note 4)	ZXCT1084/5/6/7 $V_{\text{SENSE}} = 10\text{mV}$ to $150\text{mV}$ (Note 1)		-1	+1	%
			$T_A = \text{FT}$	-2	+2	
$G_{V-\text{TC}}$	Voltage gain temperature co-efficient		$T_A = \text{FT}$	100		ppm/K
$Z_{\text{OUT}}$	Output impedance	ZXCT1084/5/6/7			125	k $\Omega$
$V_{\text{OUTH}}$	Output relative to common mode, $V_{S-}$	ZXCT1082/3	$V_{\text{LOAD}} - 1$	$V_{\text{LOAD}}$ - 0.8		V
		ZXCT1084/5/6/7	$V_{S-} - 1$	$V_{S-} - 0.8$		

- Notes:
1. For the ZXCT1082/83  $V_{\text{SENSE}} = "V_{\text{SUPPLY}}" - "V_{\text{LOAD}}"$  where  $V_{\text{LOAD}}$  is the load voltage or the lower potential side of the sense resistor.  
For the ZXCT1083/84/85/86  $V_{\text{SENSE}} = "V_{S+}" - "V_{S-}"$
  2.  $V_{\text{IO}}$  is extrapolated from measurements for the gain-error test.
  3. For  $V_{\text{SENSE}} > 10\text{mV}$ , the internal voltage-current converter is fully linear. This enables a true offset to be defined and used.
  4. Gain or transconductance error is calculated by applying two values of  $V_{\text{SENSE}}$  and calculating the error of the slope vs. the ideal.

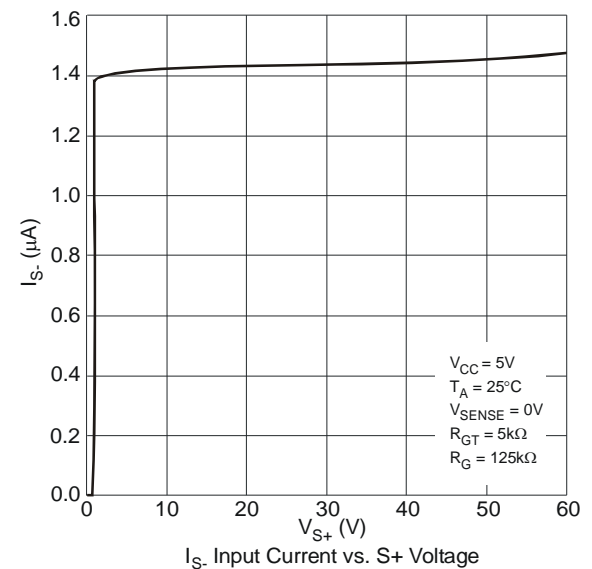
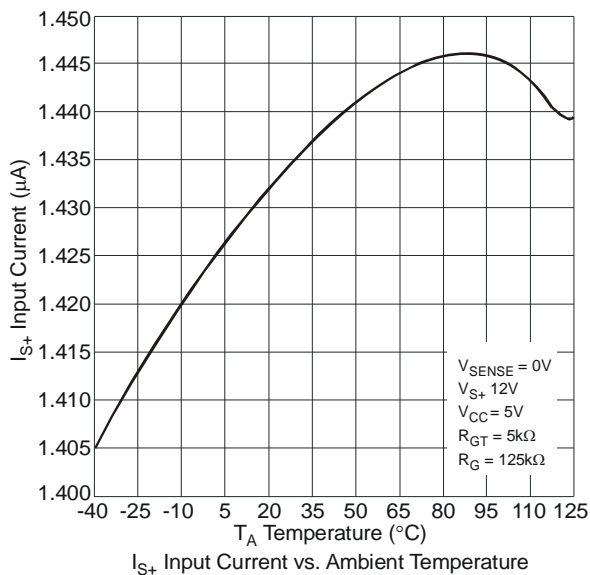
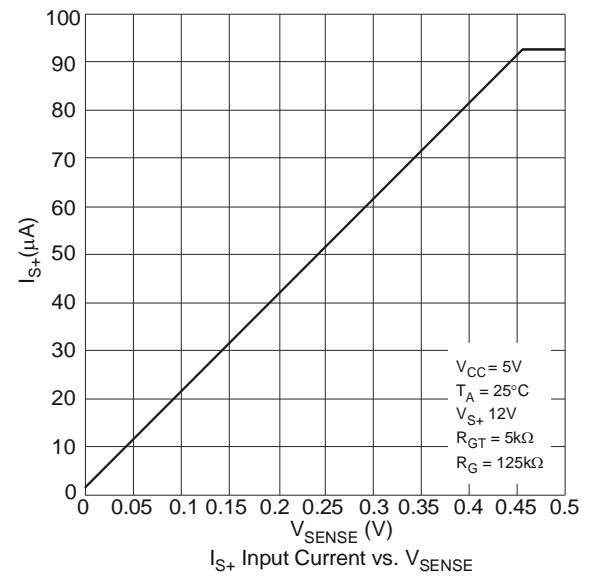
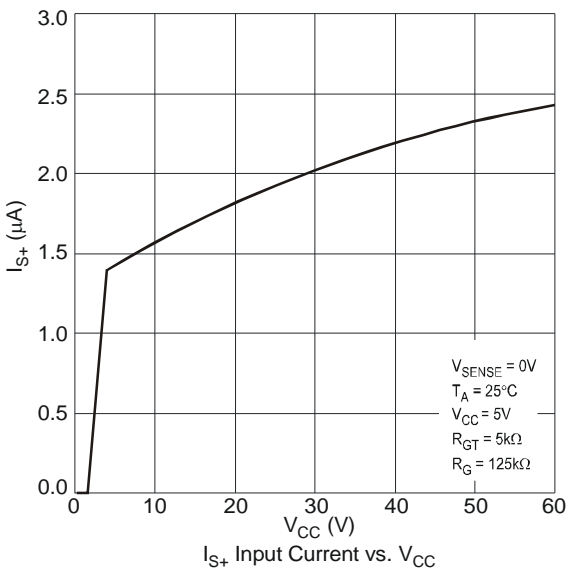
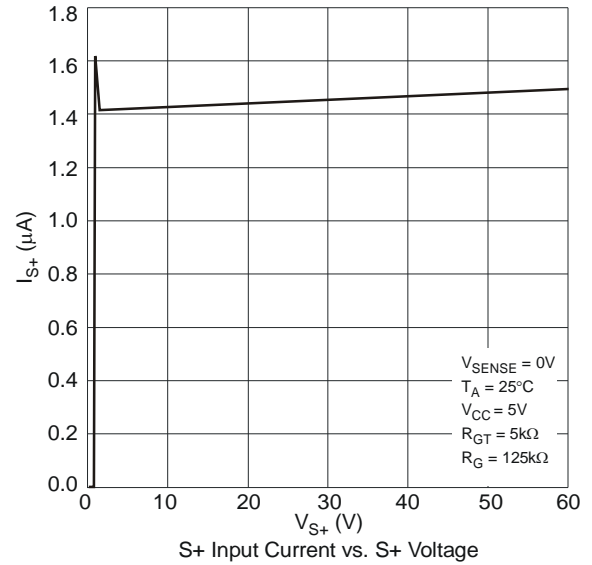
**Electrical Characteristics (cont.)**

Test Conditions  $T_A = 25^\circ\text{C}$ ,  $V_{S+} = 12\text{V}$ ,  $V_{CC} = 5\text{V}$ ,  $V_{\text{SENSE}}^1 = 100\text{mV}$ , ZXCT1082/3  $R_{GT} = 5\text{k}\Omega$ ,  $R_G = 125\text{k}\Omega$ ; unless otherwise stated.  
(FT =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ )

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>AC characteristics</b>						
BW	-3dB Small Signal Bandwidth	$V_{\text{SENSE}}(\text{AC}) = 10\text{mV}_{\text{PP}}$ (Note 1)	G = 25	500		kHz
			G = 50	200		
$t_{s(0.1\%)}$	Settling time (0.1%)	$V_{\text{SENSE}} = 50\text{mV}$ to $300\text{mV}$ step	G = 25	5		$\mu\text{s}$
		$V_{\text{SENSE}} = 50\text{mV}$ to $200\text{mV}$ step	G = 50	7		
$i_{\text{N-OUT}}$	Output noise current density	f = 1kHz f = 10kHz	ZXCT1082/3	12 10		$\text{pA}/\sqrt{\text{Hz}}$
	Total output noise current	f = 0.1Hz to 100kHz		3		$\text{nA}_{\text{RMS}}$
$V_{\text{N-OUT}}$	Output noise voltage density	f = 1kHz	ZXCT1084/5	1.5		$\mu\text{V}/\sqrt{\text{Hz}}$
			ZXCT1086/7	2.9		
		f = 10kHz	ZXCT1084/5	1.2		$\mu\text{V}_{\text{RMS}}$
			ZXCT1086/7	2.3		
Total output noise voltage	f = 0.1Hz to 100kHz	ZXCT1084/5	390		$\mu\text{V}_{\text{RMS}}$	
		ZXCT1086/7	730			
<b>Power Supply</b>						
$I_{\text{CC}}$	$V_{\text{CC}}$ Supply current	$V_{\text{SENSE}} = 0\text{V}$			0.6	$\mu\text{A}$
			$T_A = \text{FT}$		2	
PSRR (Note 5)	$V_{\text{CC}}$ Supply rejection ratio	ZXCT1083/5: $V_{\text{SENSE}} = 60\text{mV}$ ; $V_{\text{CC}} = 2.7\text{V}$ to $40\text{V}$	$T_A = \text{FT}$	80	100	dB
		ZXCT1087: $V_{\text{SENSE}} = 30\text{mV}$ ; $V_{\text{CC}} = 2.7\text{V}$ to $40\text{V}$	$T_A = \text{FT}$	75	100	
		ZXCT1082/4: $V_{\text{SENSE}} = 60\text{mV}$ ; $V_{\text{CC}} = 2.7\text{V}$ to $60\text{V}$	$T_A = \text{FT}$	80	100	
		ZXCT1086: $V_{\text{SENSE}} = 30\text{mV}$ ; $V_{\text{CC}} = 2.7\text{V}$ to $60\text{V}$	$T_A = \text{FT}$	75	100	
		ZXCT1083/5: $V_{\text{SENSE}} = 60\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $40\text{V}$	$T_A = \text{FT}$	80	100	
		ZXCT1087: $V_{\text{SENSE}} = 30\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $40\text{V}$	$T_A = \text{FT}$	80	100	
CMRR (Note 5)	Common-mode sense rejection ratio	ZXCT1082/4: $V_{\text{SENSE}} = 60\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $60\text{V}$	$T_A = \text{FT}$	80	100	dB
		ZXCT1086: $V_{\text{SENSE}} = 30\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $60\text{V}$	$T_A = \text{FT}$	80	100	
		ZXCT1083/5: $V_{\text{SENSE}} = 60\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $40\text{V}$	$T_A = \text{FT}$	80	100	
		ZXCT1087: $V_{\text{SENSE}} = 30\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $40\text{V}$	$T_A = \text{FT}$	80	100	
		ZXCT1082/4: $V_{\text{SENSE}} = 60\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $60\text{V}$	$T_A = \text{FT}$	80	100	
		ZXCT1086: $V_{\text{SENSE}} = 30\text{mV}$ ; $V_{\text{S}+} = 2.7\text{V}$ to $60\text{V}$	$T_A = \text{FT}$	80	100	

Notes: 5. Measured relative to input

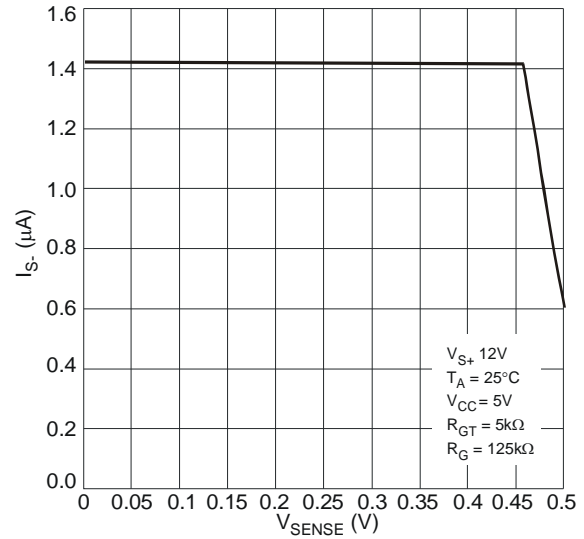
**Typical Characteristics**  $V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5k\Omega, R_G = 125k\Omega, T_A = 25^\circ C$  unless otherwise stated



**Typical Characteristics (cont.)**  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = 25^\circ C$



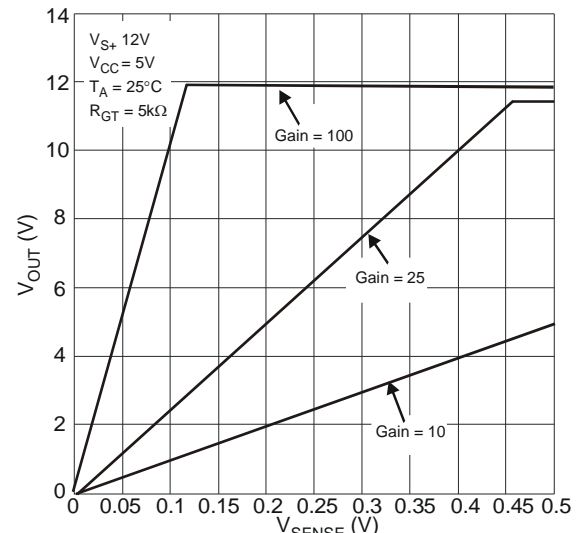
$I_S$ . Input Current vs. Supply Voltage



$I_S$ . Input Current vs.  $V_{SENSE}$  Different Voltage



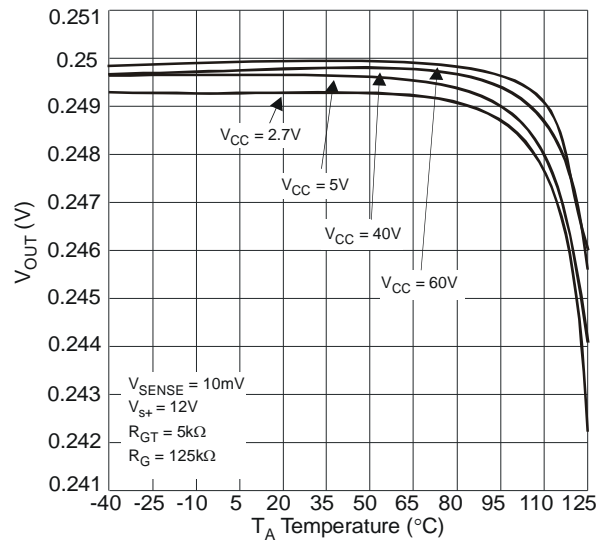
$I_S$ . Input Current vs. Ambient Temperature



Output Voltage vs.  $V_{SENSE}$

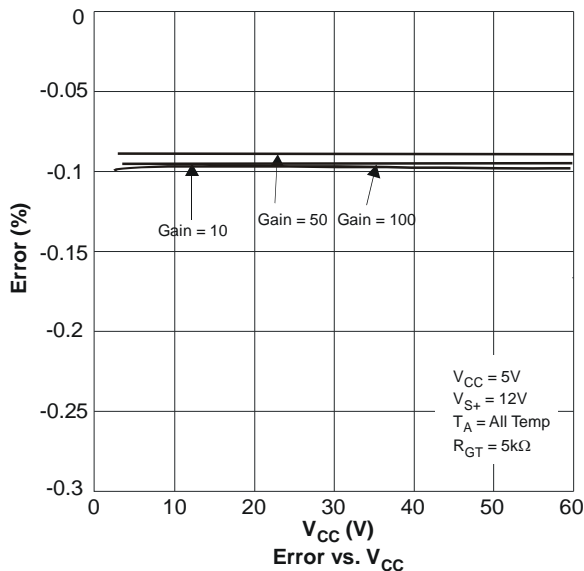
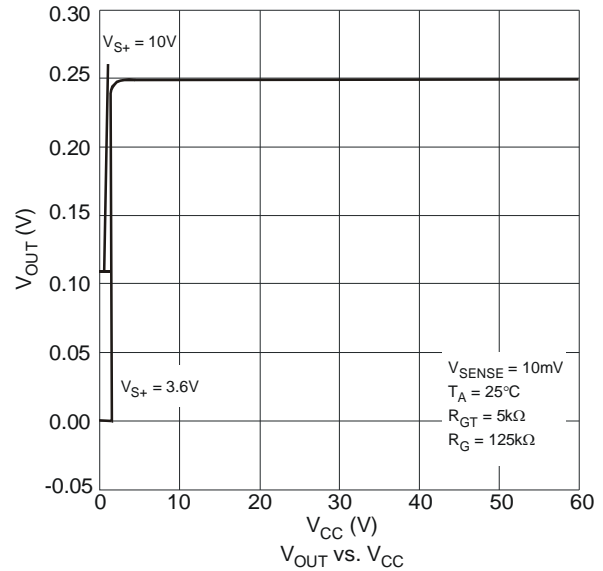


$V_{OUT}$  vs. Ambient Temperature

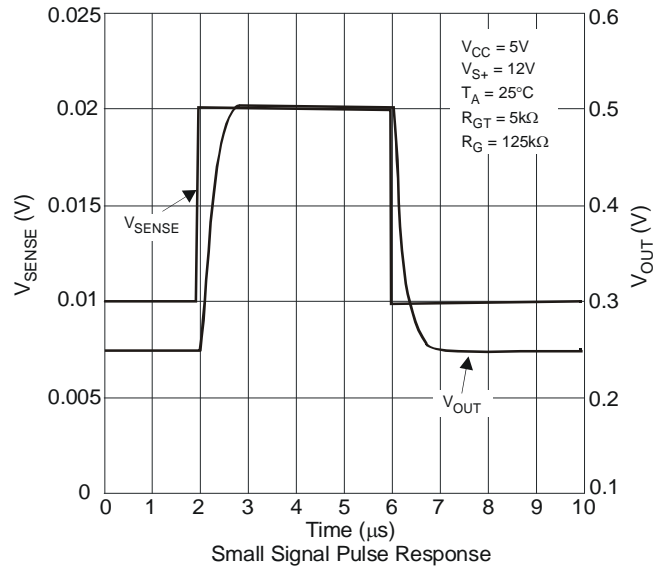
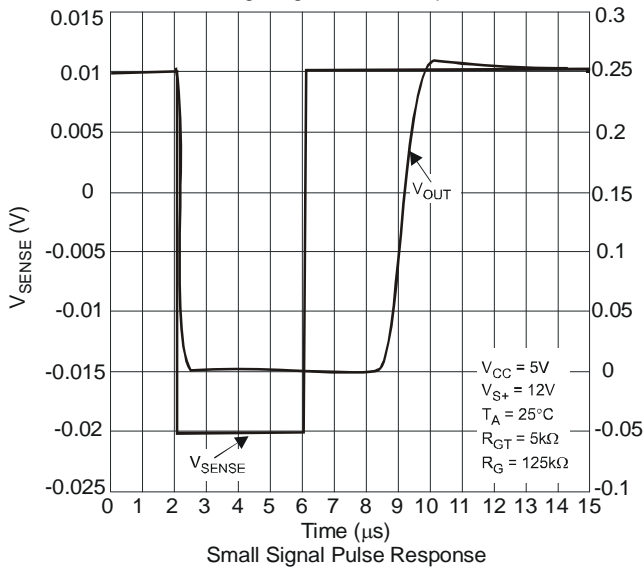
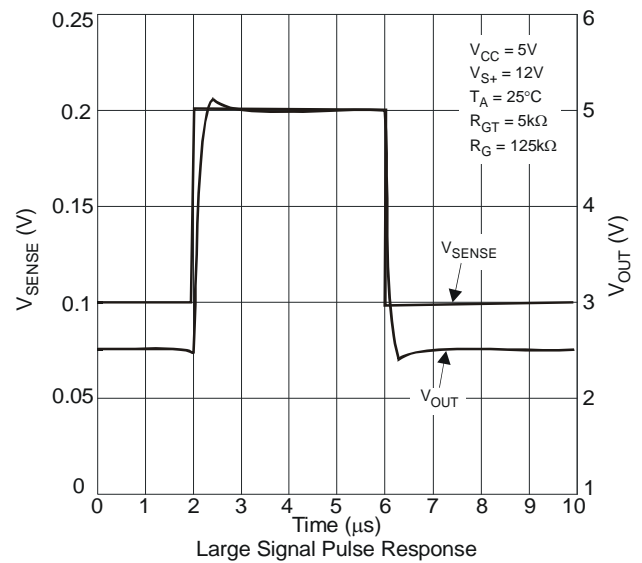
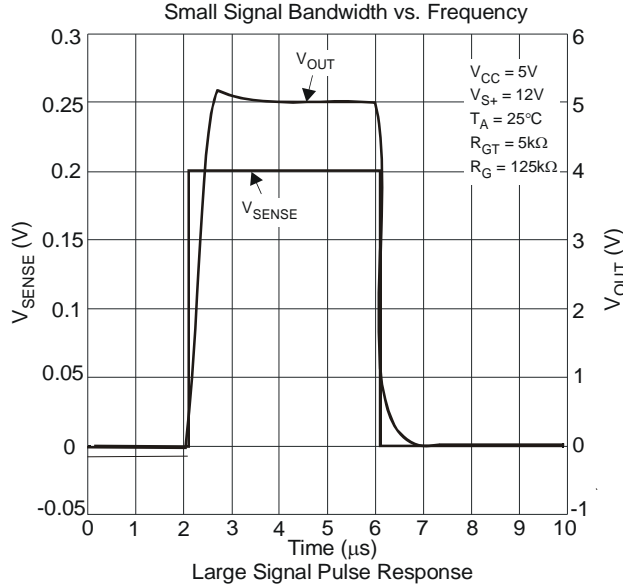
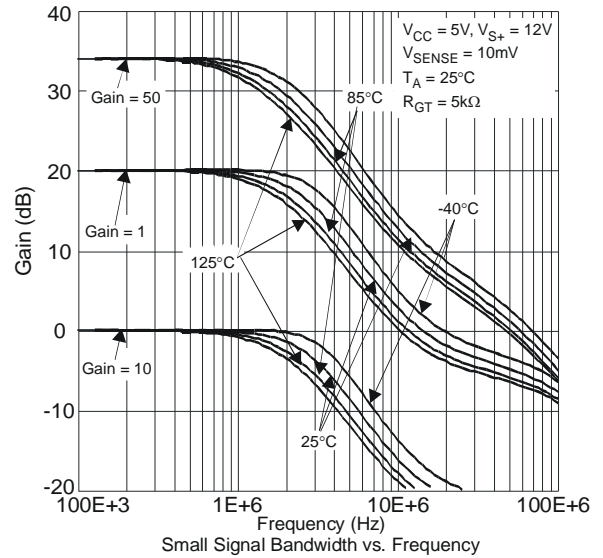


$V_{OUT}$  vs. Ambient Temperature

**Typical Characteristics (cont.)**  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = 25^\circ C$

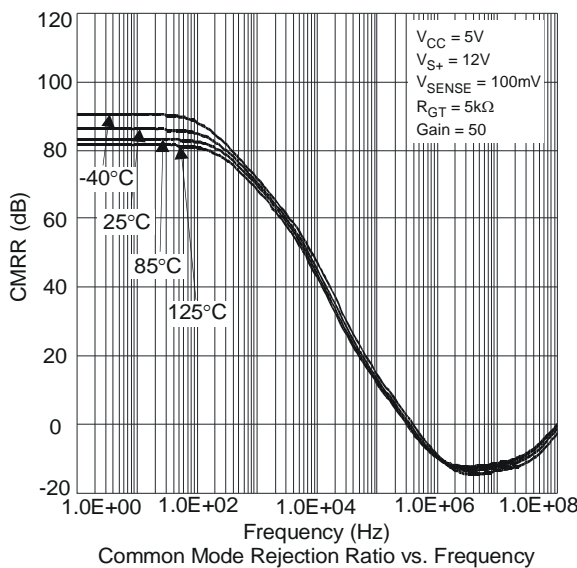
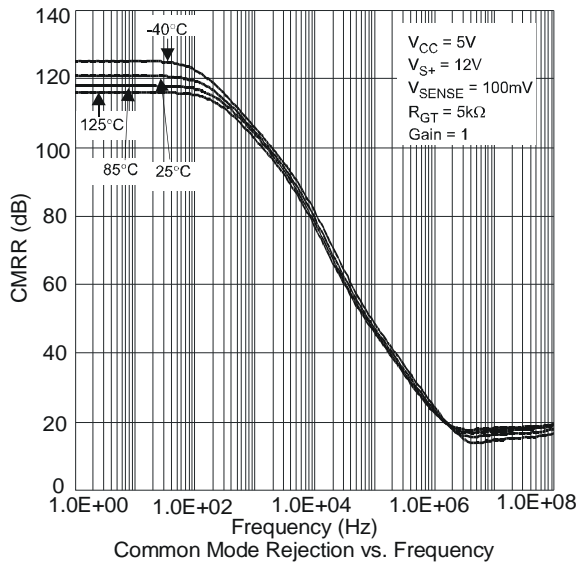
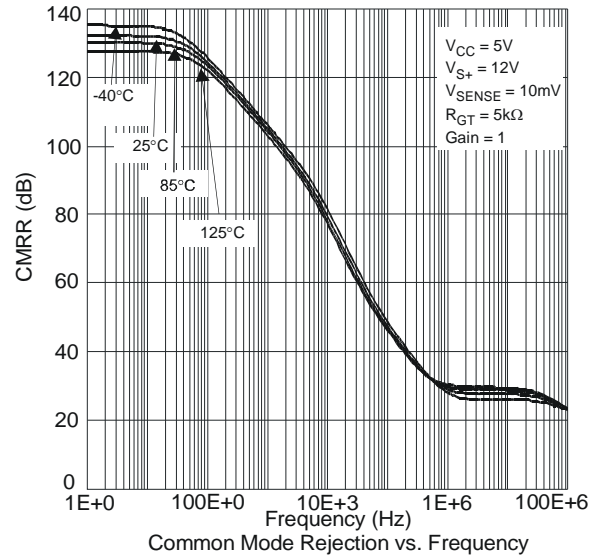


**Typical Characteristics (cont.)**  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = 25^\circ C$

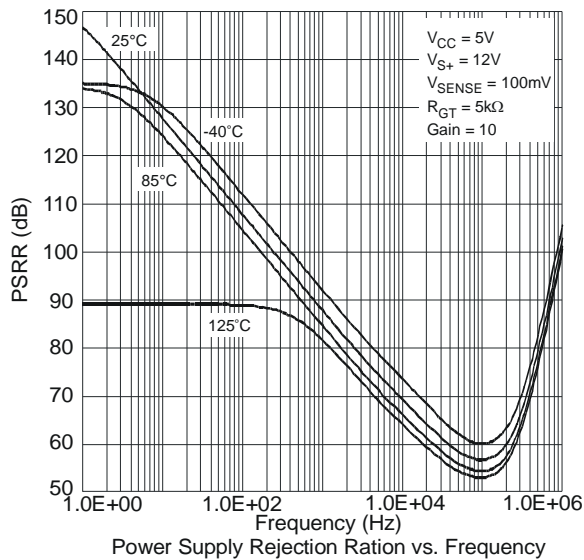




**Typical Characteristics (cont.)**  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = 25^\circ C$



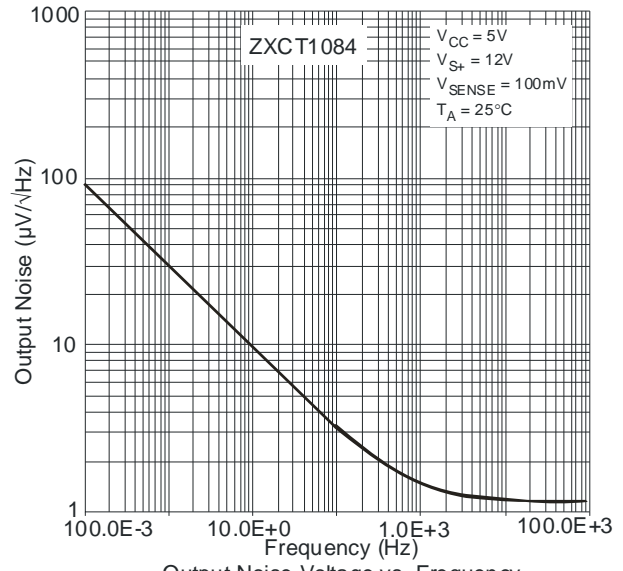
**Typical Characteristics (cont.)**  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = 25^\circ C$



**Typical Characteristics (cont.)**  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = 25^\circ C$



Output Noise Current vs. Frequency



Output Noise Voltage vs. Frequency



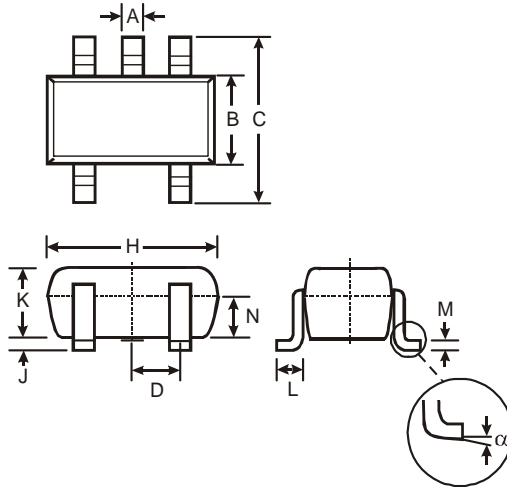
Output Noise Voltage vs. Frequency

**Ordering Information**

Part Number	AEC-Q100	Pack	Part mark	Reel Size	Tape width	Quantity per reel
ZXCT1082E5TA	Grade 1	SOT25	1082	7", 180mm	8mm	3000
ZXCT1083E5TA	Grade 1	SOT25	1083	7", 180mm	8mm	3000
ZXCT1084E5TA	Grade 1	SOT25	1084	7", 180mm	8mm	3000
ZXCT1085E5TA	Grade 1	SOT25	1085	7", 180mm	8mm	3000
ZXCT1086E5TA	Grade 1	SOT25	1086	7", 180mm	8mm	3000
ZXCT1087E5TA	Grade 1	SOT25	1087	7", 180mm	8mm	3000

**Package Outline Dimensions**

**SOT25**



SOT25			
Dim	Min	Max	Typ
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	—	—	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	—
All Dimensions in mm			

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