

**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

**AUTOMOTIVE GRADE PRECISION HIGH VOLTAGE HIGH-SIDE CURRENT MONITORS**

**Description**

The ZXCT1082Q/83Q/84Q/85Q/86Q/87Q are high side unipolar current sense monitors. These devices eliminate the need to disrupt the ground plane when sensing a load current.

The ZXCT1082Q/1084Q/1086Q have 60V maximum operating voltages and ZXCT1083Q/1085Q/1087Q have 40V maximum operating voltages.

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 ZXCT1082Q and ZXCT1083Q use three external transconductance/gain setting resistors which increase versatility by permitting wide gain ranges and optimization of bandwidths.

The ZXCT1084Q/85Q/86Q/87Q are fixed gain voltage output counterparts of the ZXCT1082Q/83.

The ZXCT1082Q/3Q/4Q/5Q/6Q/7Q have been qualified to AEC-Q100 Grade 1 and are Automotive Grade supporting PPAPs.

**Features**

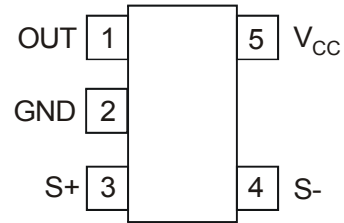
- Wide supply and common-mode voltage range
  - 2.7V to 60V ZXCT1082Q/84Q/86Q
  - 2.7V to 40V ZXCT1083Q/85Q/87Q
- Independent supply and input common-mode voltage
- Low quiescent current (0.6µA).
- AEC-Q100 Grade 1 qualified
- Extended industrial temperature range -40 to +125°C
- SOT25 package in Green Molding
  - **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
  - **Halogen and Antimony Free. "Green" Device (Note 3)**
- Automotive Grade
  - **Qualified to AEC-Q100 Standards for High Reliability**
  - **PPAP Capable (Note 4)**

**Applications**

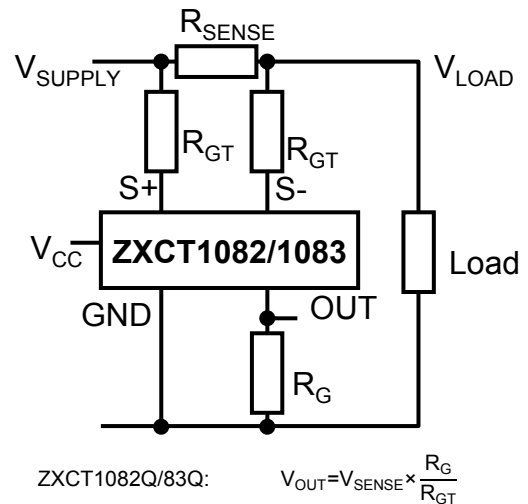
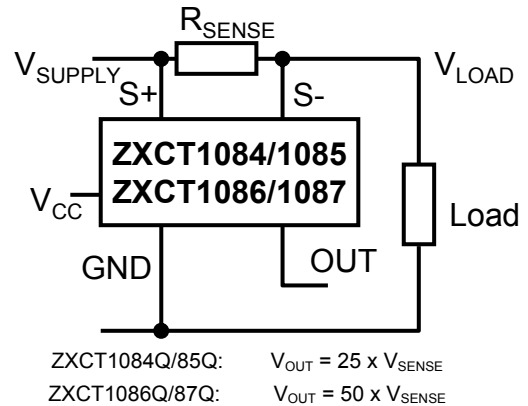
- Automotive current measurement
- Automotive battery management
- Automotive over current monitor

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.  
 2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.  
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.  
 4. Automotive products are AEC-Q100 qualified and are PPAP capable. Automotive, AEC-Q100 and standard products are electrically and thermally the same, except where specified. For more information, please refer to [http://www.diodes.com/quality/product\\_compliance\\_definitions](http://www.diodes.com/quality/product_compliance_definitions).

**Pin Assignments**



**Typical Application Circuits**



**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

### Pin Description

PIN	Name	Function		
		Common	ZXCT1082Q/83Q	ZXCT1084Q/85Q/86Q/87Q
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
	ZXCT1082Q/84Q/86Q	ZXCT1083Q/85Q/87Q	
Voltage on S- and S+	-0.3 to 65	-0.3 to 45	V
Voltage on $V_{CC}$	-0.3 to 65	-0.3 to 45	V
Voltage on OUT	-0.3 to $V_{S-}$		V
Differential Input Voltage, $V_{S+} - V_{S-}$ (Notes 5, and 6)	±800		mV
Input current into S+ or S- (Notes 5, and 6)	±12		mA
Storage Temperature	-55 to +150		°C
Maximum Junction Temperature	+150		°C
Package Power Dissipation (De-rate to zero at +150°C)	300 at $T_A = +25^\circ\text{C}$		mW
<b>ESD Rating</b>			
HBM	Human Body Model	3	kV
MM	Machine Model	250	V
CDM	Charged Device Model	tdb	kV

Caution: Stresses greater than the 'Absolute Maximum Ratings' specified above, may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.

Semiconductor devices are ESD sensitive and may be damaged by exposure to ESD events. Suitable ESD precautions should be taken when handling and transporting these devices.

Notes: 5. For the ZXCT1082/83  $V_{SENSE} = "V_{SUPPLY}" - "V_{LOAD}"$  where  $V_{LOAD}$  is the load voltage or the lower potential side of the sense resistor.

For the ZXCT1083/84/85/86  $V_{SENSE} = "V_{S+}" - "V_{S-}"$

6. 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
$V_{IN}$	ZXCT1083Q/1085Q/1087Q Common-Mode Input Range	2.7	40	V
	ZXCT1082Q/1084Q/1086Q Common-Mode Input Range	2.7	60	V
$V_{CC}$	ZXCT1083Q/1085Q/1087Q Supply Voltage Range	2.7	40	V
	ZXCT1082Q/1084Q/1086Q Supply Voltage Range	2.7	60	V
$V_{SENSE}$	Differential Sense Input Voltage Range	0	0.5	V
$V_{OUT}$	Output Voltage Range (Note 5)	0	$V_{S-} - 1$	V
$T_A$	Ambient Temperature Range	-40	+125	°C

## Electrical Characteristics

Test Conditions  $T_A = +25^\circ\text{C}$ ,  $V_{S+} = 12\text{V}$ ,  $V_{CC} = 5\text{V}$ ,  $V_{\text{SENSE}} = 100\text{mV}$  (Note 5), ZXCT1082Q/83Q  $R_{GT} = 5\text{k}\Omega$ ,  $R_G = 125\text{k}\Omega$ ; 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 5)	—	1.7	—	$\mu\text{A}$
			$T_A = \text{FT}$	—	5	
$I_{S-}$	S- input current	$V_{\text{SENSE}} = 0\text{mV}$ (Note 5)	—	1.7	—	$\mu\text{A}$
			$T_A = \text{FT}$	—	5	
$V_{IO}$	Input Offset Voltage (Note 7)	$V_{\text{SENSE}} = 0\text{mV}$	—	$\pm 0.2$	$\pm 1$	mV
		ZXCT1082Q/ 83Q/ 84Q/ 85Q	$T_A = \text{FT}$	—	$\pm 2.5$	
		ZXCT1086Q/ 87Q	$T_A = \text{FT}$	—	$\pm 3$	
		Temperature co-efficient	—	$\pm 4$	—	$\mu\text{V}/\text{K}$
<b>Output</b>						
$G_T$	Transconductance		—	200	—	$\mu\text{A}/\text{V}$
$G_{T-ERR}$	Transconductance error (Note 9)	ZXCT1082Q/83Q $V_{\text{SENSE}} = 10\text{mV}$ to $150\text{mV}$ (Notes 5, 8)	—	—	+1	%
			$T_A = \text{FT}$	-2	—	
$G_{T-TC}$	Transconductance temperature co-efficient		$T_A = \text{FT}$	10	—	nA/K
$Z_{OUT}$	Output impedance	ZXCT1082Q/83Q	—	$1 \parallel 5$	—	$\text{G}\Omega \parallel \text{pF}$
$G_V$	Gain		ZXCT1084Q/85Q	—	25	V/V
			ZXCT1086Q/87Q	—	50	
$G_{V-ERR}$	Gain error (Note 9)	ZXCT1084Q/85Q/86Q/87Q $V_{\text{SENSE}} = 10\text{mV}$ to $150\text{mV}$ (Note 5)	—	—	+1	%
			$T_A = \text{FT}$	-2	—	
$G_{V-TC}$	Voltage gain temperature co-efficient		$T_A = \text{FT}$	100	—	ppm/K
$Z_{OUT}$	Output impedance	ZXCT1084Q/85Q/86Q/87Q	—	125	—	k $\Omega$
$V_{OUTH}$	Output relative to common mode, $V_{S-}$	ZXCT1082Q/83Q	$V_{LOAD} - 1$	$V_{LOAD} - 0.8$	—	V
		ZXCT1084Q/85Q/86Q/87Q	$V_{S-} - 1$	$V_{S-} - 0.8$	—	

- Notes:
- 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  $V_{\text{SENSE}} = "V_{S+}" - "V_{S-}"$
  - $V_{IO}$  is extrapolated from measurements for the gain-error test.
  - 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.
  - Gain or transconductance error is calculated by applying two values of  $V_{\text{SENSE}}$  and calculating the error of the slope vs. the ideal.

**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

**Electrical Characteristics** (cont.)

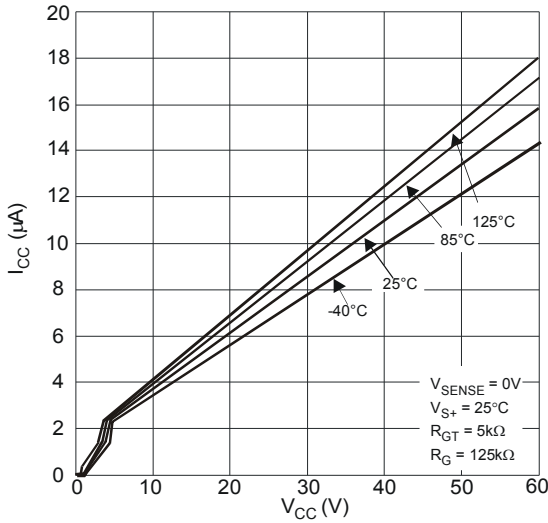
Test Conditions  $T_A = +25^\circ\text{C}$ ,  $V_{S+} = 12\text{V}$ ,  $V_{CC} = 5\text{V}$ ,  $V_{SENSE}^1 = 100\text{mV}$ , ZXCT1082Q/83Q  $R_{GT} = 5\text{k}\Omega$ ,  $R_G = 125\text{k}\Omega$ ; unless otherwise stated. (FT =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ )

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
<b>AC characteristics</b>							
BW	-3dB Small Signal Bandwidth	$V_{SENSE(AC)} = 10\text{mV}_{PP}$ (Note 5)	G = 25	—	500	—	kHz
			G = 50	—	200	—	
$t_{s(0.1\%)}$	Settling time (0.1%)	$V_{SENSE} = 50\text{mV}$ to 300mV step	G = 25	—	5	—	$\mu\text{s}$
		$V_{SENSE} = 50\text{mV}$ to 200mV step	G = 50	—	7	—	
$i_{N-OUT}$	Output noise current density	f = 1kHz	ZXCT1082Q/83Q	—	12	—	$\text{pA}/\sqrt{\text{Hz}}$
		f = 10kHz		—	10	—	
	Total output noise current	f = 0.1Hz to 100kHz		—	3	—	$\text{nA}_{RMS}$
$V_{N-OUT}$	Output noise voltage density	f = 1kHz	ZXCT1084Q/85Q	—	1.5	—	$\mu\text{V}/\sqrt{\text{Hz}}$
			ZXCT1086Q/87Q	—	2.9	—	
		f = 10kHz	ZXCT1084Q/85Q	—	1.2	—	
			ZXCT1086Q/87Q	—	2.3	—	
	Total output noise voltage	f = 0.1Hz to 100kHz	ZXCT1084Q/85Q	—	390	—	$\mu\text{V}_{RMS}$
		ZXCT1086Q/87Q	—	730	—		
<b>Power Supply</b>							
$I_{CC}$	$V_{CC}$ Supply current	$V_{SENSE} = 0\text{V}$	—	—	0.6	—	$\mu\text{A}$
			$T_A = FT$	—	—	2	—
PSRR (Note 10)	$V_{CC}$ Supply rejection ratio	ZXCT1083Q/85Q: $V_{SENSE} = 60\text{mV}$ ; $V_{CC} = 2.7\text{V}$ to 40V	—	80	100	—	dB
			$T_A = FT$	75	—	—	
		ZXCT1087Q: $V_{SENSE} = 30\text{mV}$ ; $V_{CC} = 2.7\text{V}$ to 40V	—	80	100	—	
			$T_A = FT$	75	—	—	
		ZXCT1082Q/84Q: $V_{SENSE} = 60\text{mV}$ ; $V_{CC} = 2.7\text{V}$ to 60V	—	80	100	—	
		$T_A = FT$	75	—	—		
CMRR (Note 10)	Common-mode sense rejection ratio	ZXCT1083Q/85Q: $V_{SENSE} = 60\text{mV}$ ; $V_{S+} = 2.7\text{V}$ to 40V	—	80	100	—	dB
			$T_A = FT$	80	—	—	
		ZXCT1087Q: $V_{SENSE} = 30\text{mV}$ ; $V_{S+} = 2.7\text{V}$ to 40V	—	80	100	—	
			$T_A = FT$	80	—	—	
		ZXCT1082Q/84Q: $V_{SENSE} = 60\text{mV}$ ; $V_{S+} = 2.7\text{V}$ to 60V	—	80	100	—	
		$T_A = FT$	80	—	—		
		ZXCT1086Q: $V_{SENSE} = 30\text{mV}$ ; $V_{S+} = 2.7\text{V}$ to 60V	—	80	100	—	
			$T_A = FT$	80	—	—	

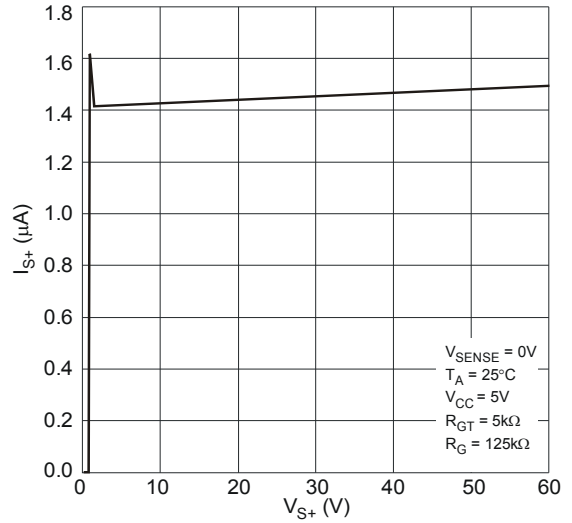
Note: 10. Measured relative to input

**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

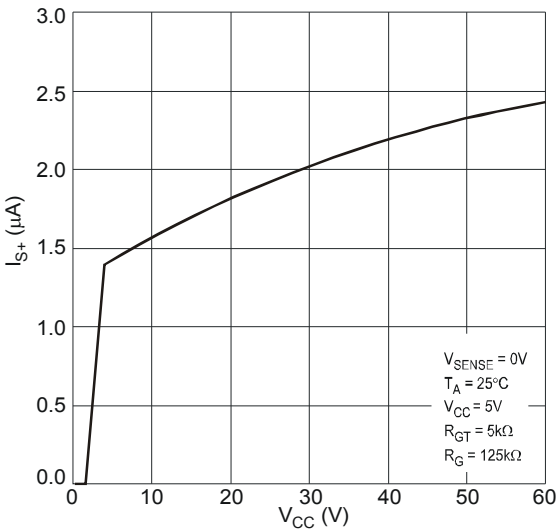
**Typical Characteristics** (@  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise stated.)



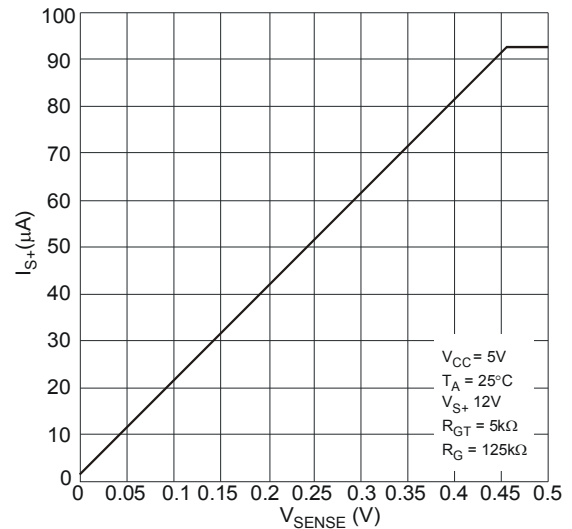
Supply Current vs. Supply Voltage



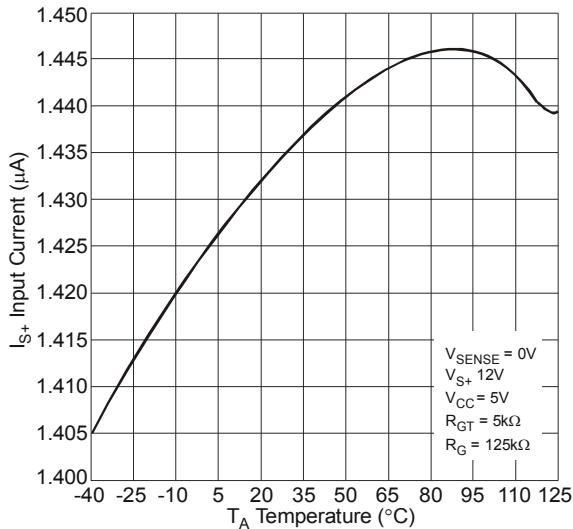
S+ Input Current vs. S+ Voltage



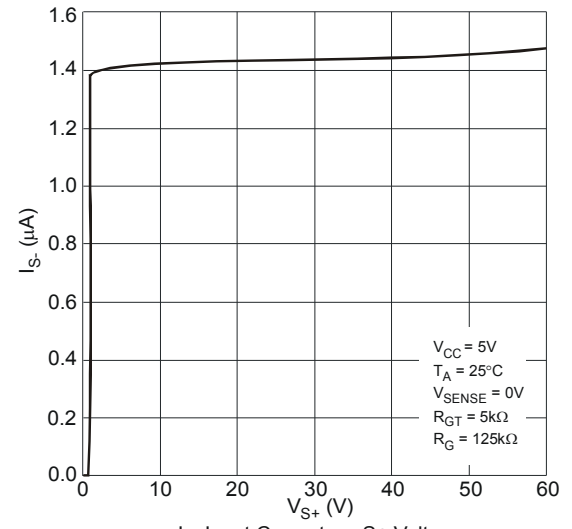
$I_{S+}$  Input Current vs.  $V_{CC}$



$I_{S+}$  Input Current vs.  $V_{SENSE}$



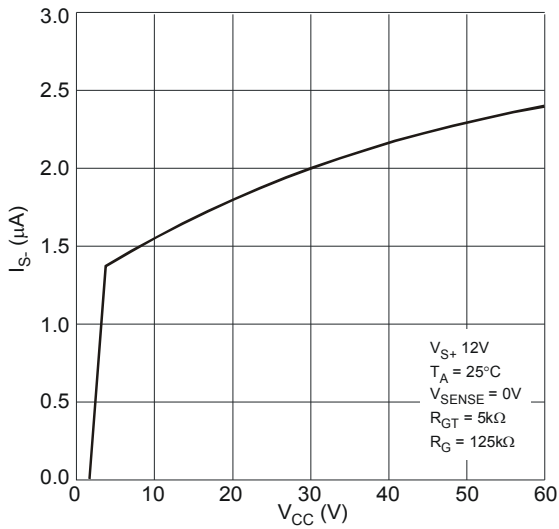
$I_{S+}$  Input Current vs. Ambient Temperature



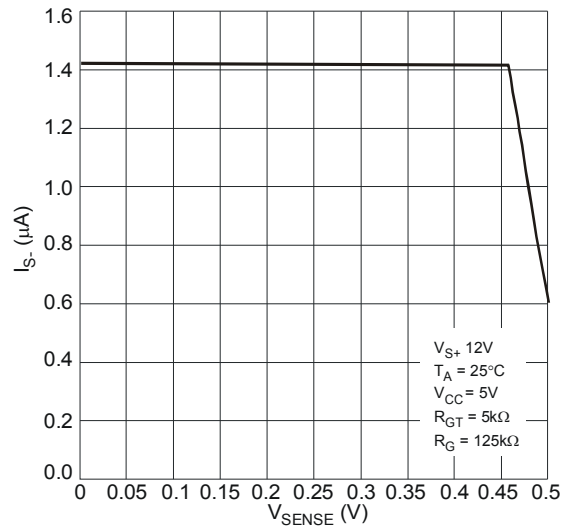
$I_{S-}$  Input Current vs. S+ Voltage

**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

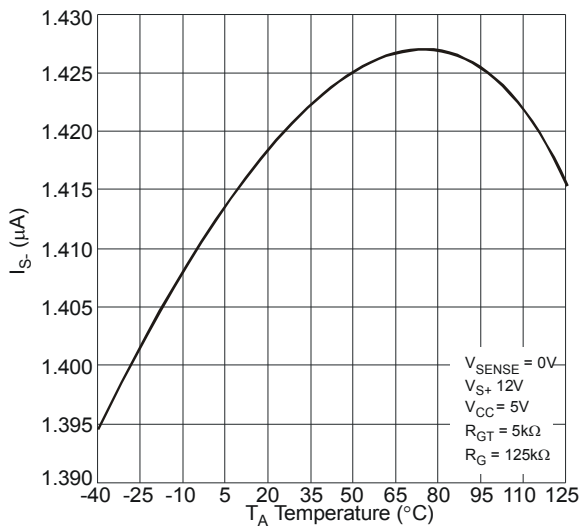
**Typical Characteristics (cont.)** (@  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = +25^\circ C$ )



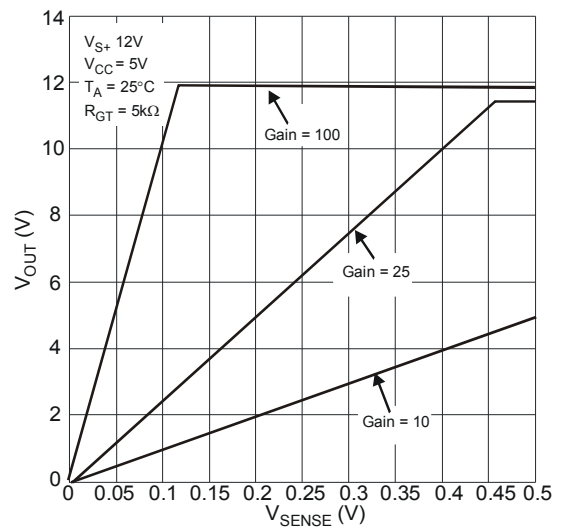
$I_{S-}$  Input Current vs. Supply Voltage



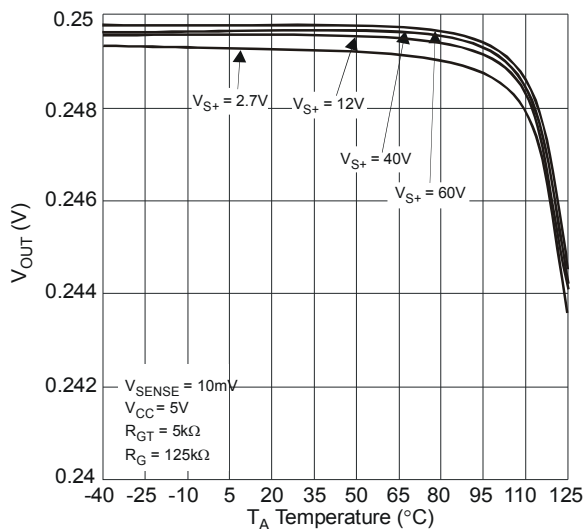
$I_{S-}$  Input Current vs.  $V_{SENSE}$  Different Voltage



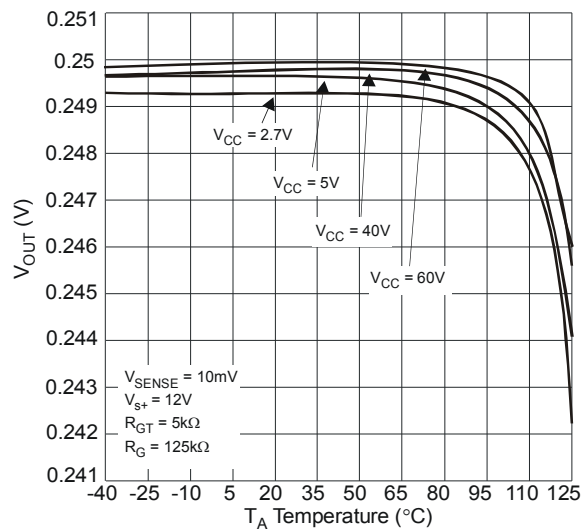
$I_{S-}$  Input Current vs. Ambient Temperature



Output Voltage vs.  $V_{SENSE}$



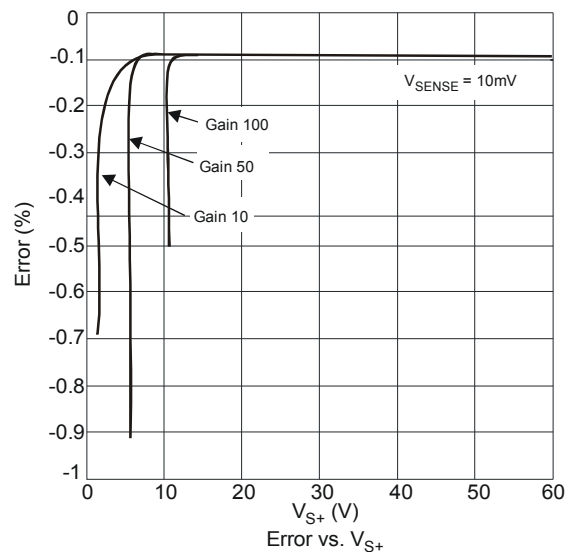
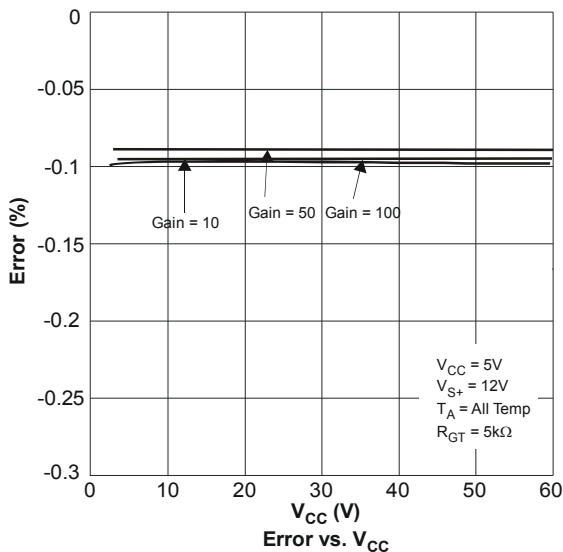
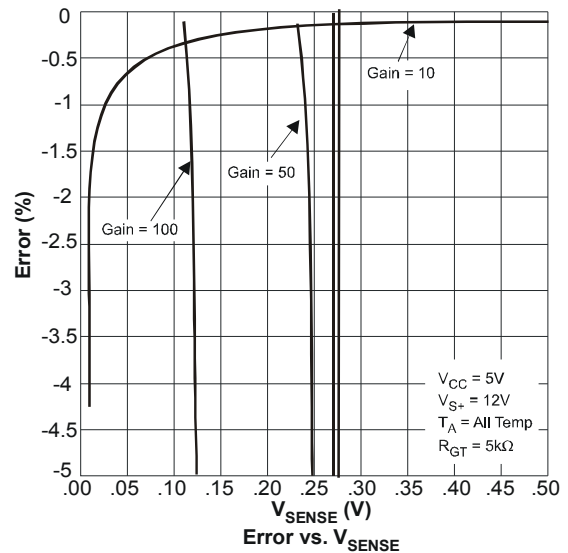
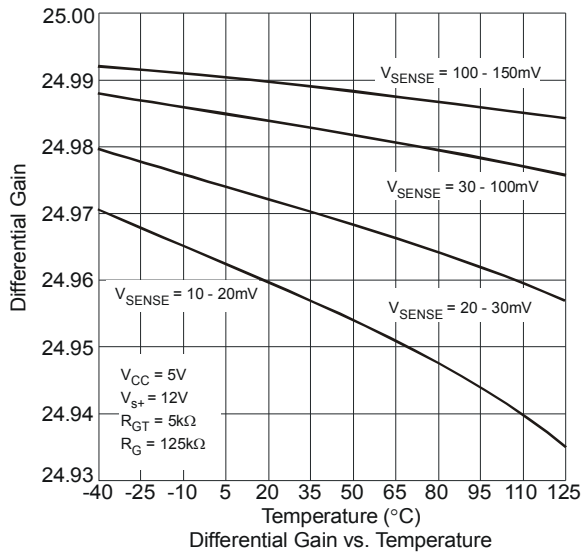
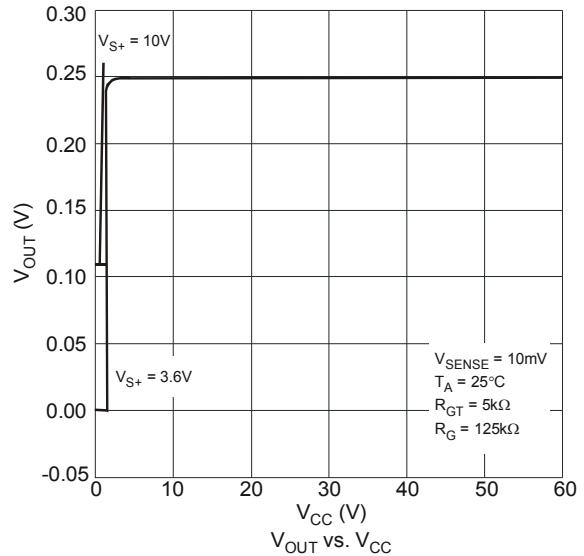
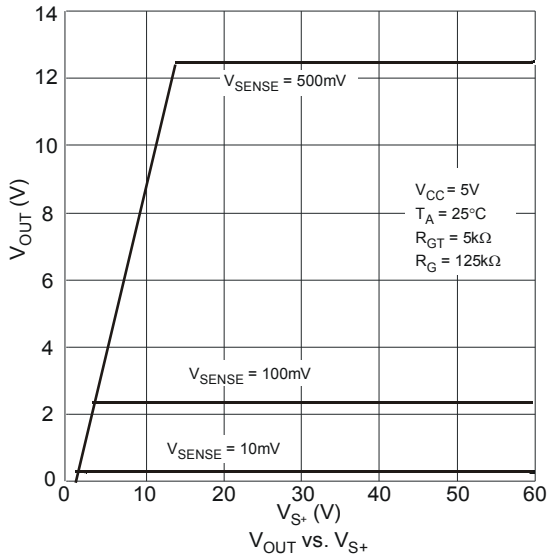
$V_{OUT}$  vs. Ambient Temperature



$V_{OUT}$  vs. Ambient Temperature

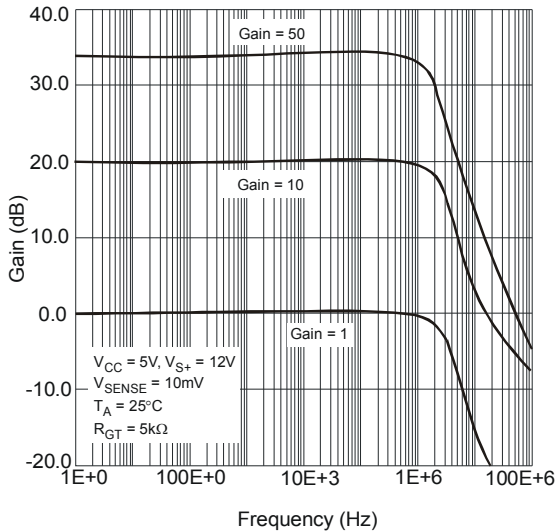
**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

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

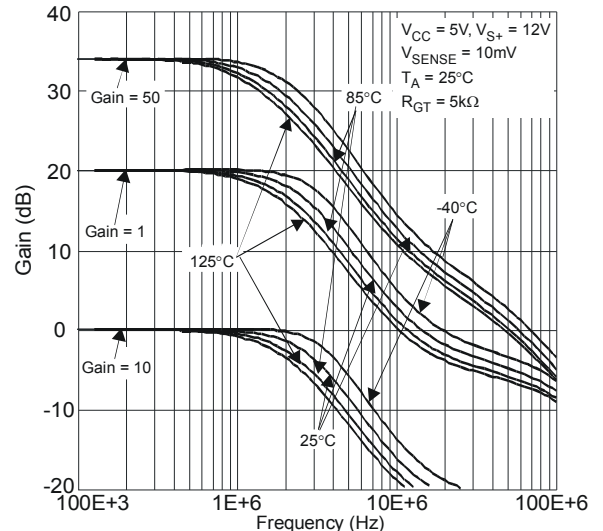


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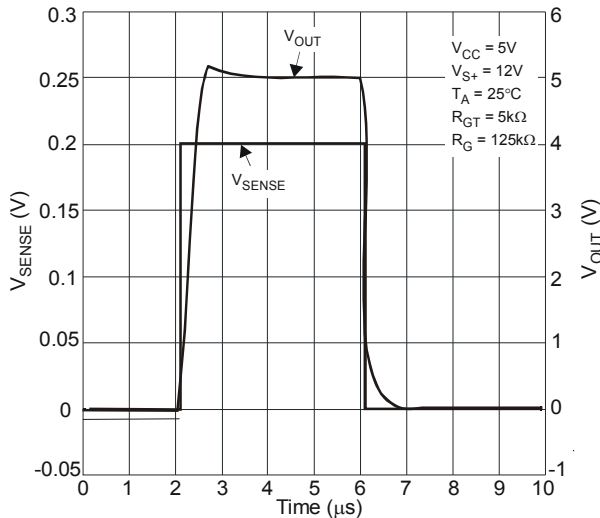
**Typical Characteristics (cont.)** @  $V_{S+} = 12V$ ,  $V_{CC} = 5V$ ,  $V_{SENSE} = 100mV$ ,  $R_{GT} = 5k\Omega$ ,  $R_G = 125k\Omega$ ,  $T_A = +25^\circ C$



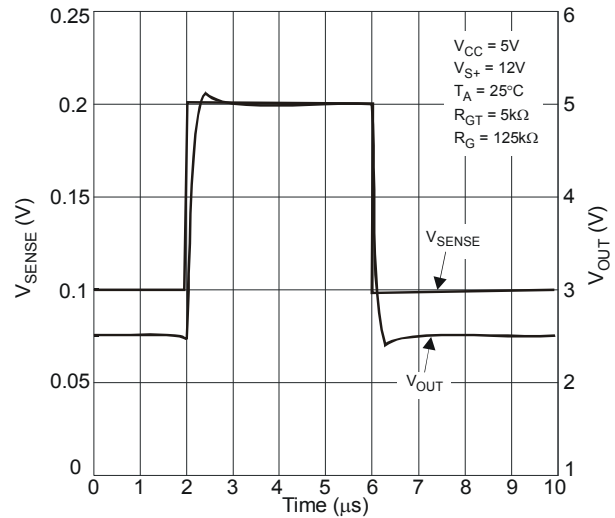
Small Signal Bandwidth vs. Frequency



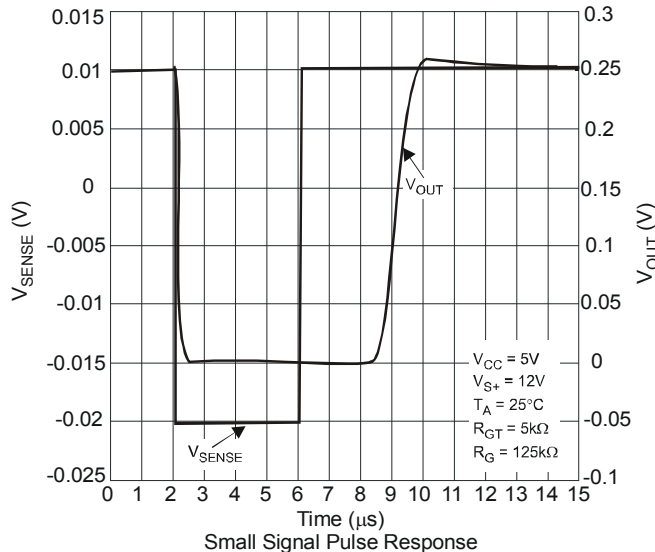
Small Signal Bandwidth vs. Frequency



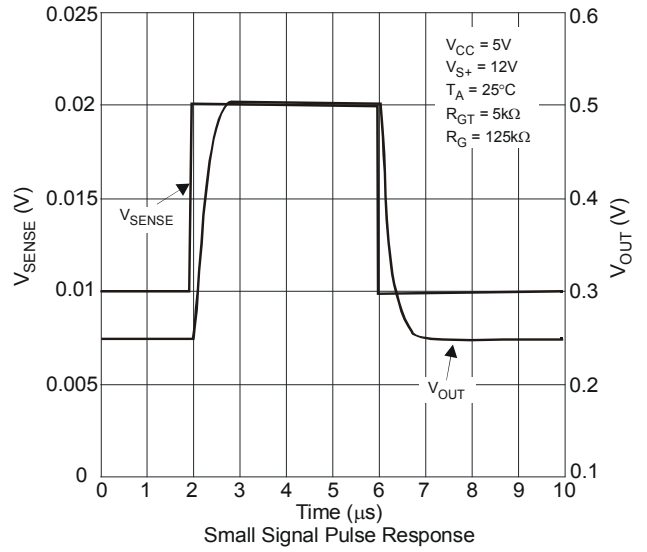
Large Signal Pulse Response



Large Signal Pulse Response



Small Signal Pulse Response

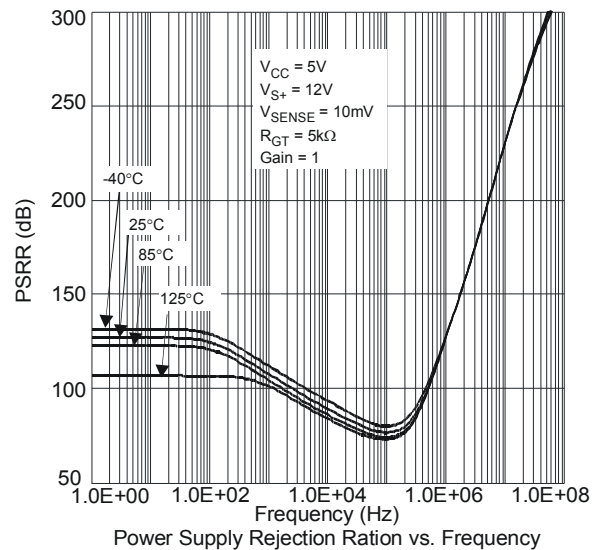
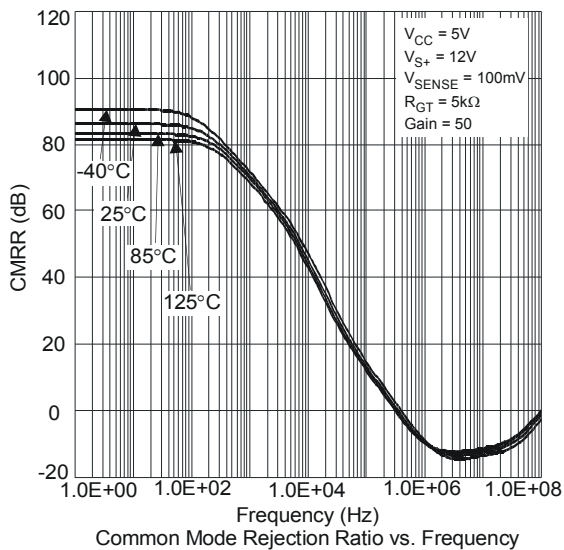
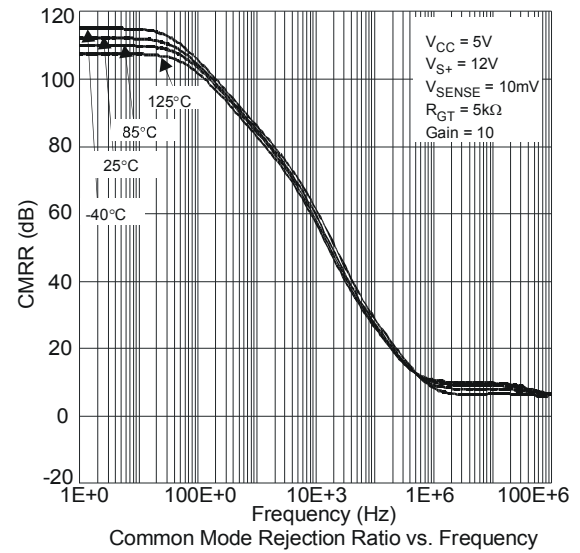
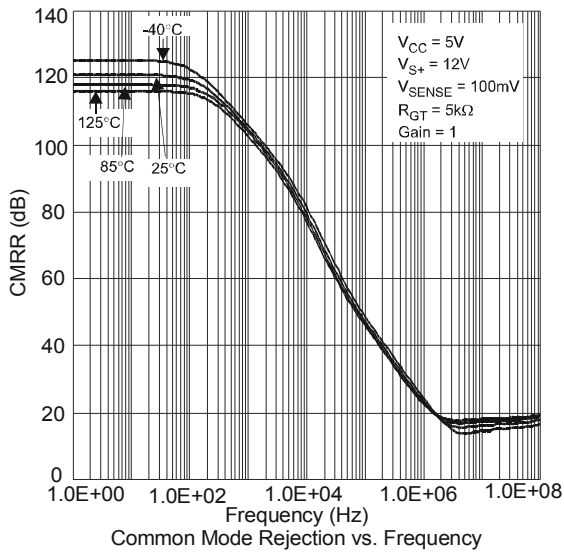
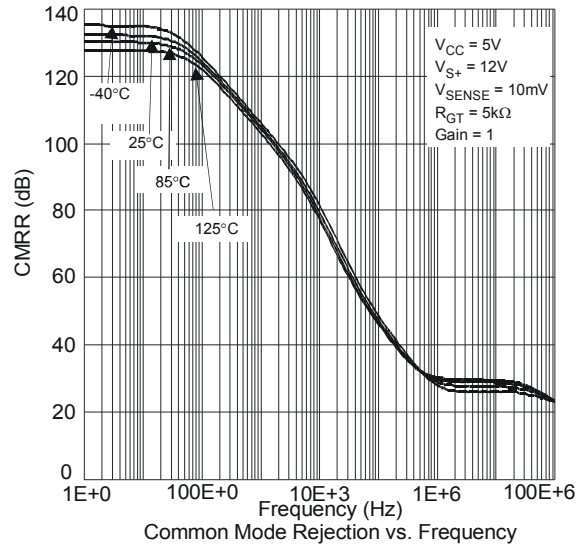
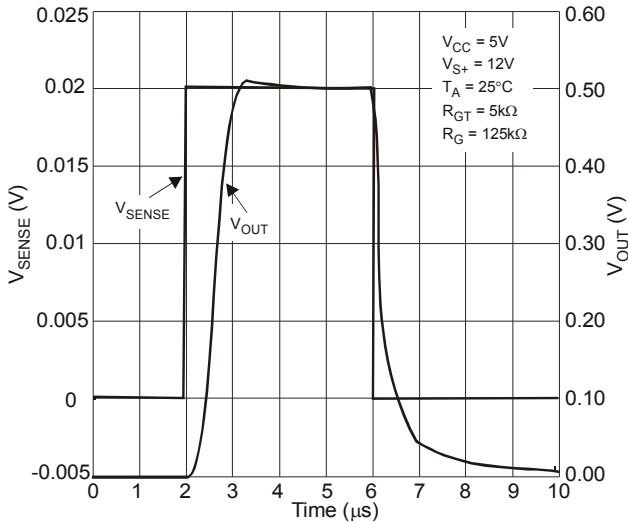


Small Signal Pulse Response



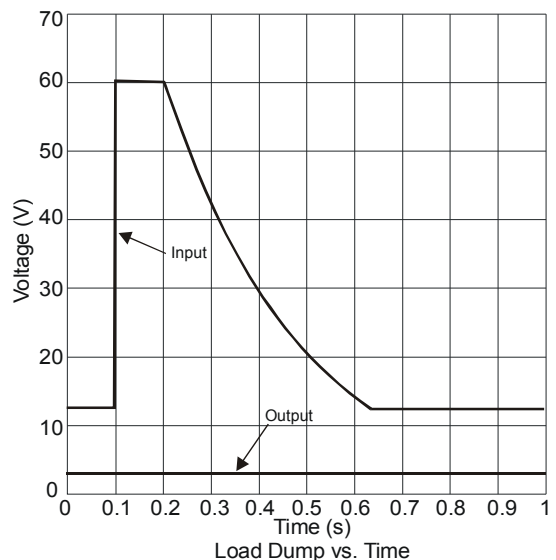
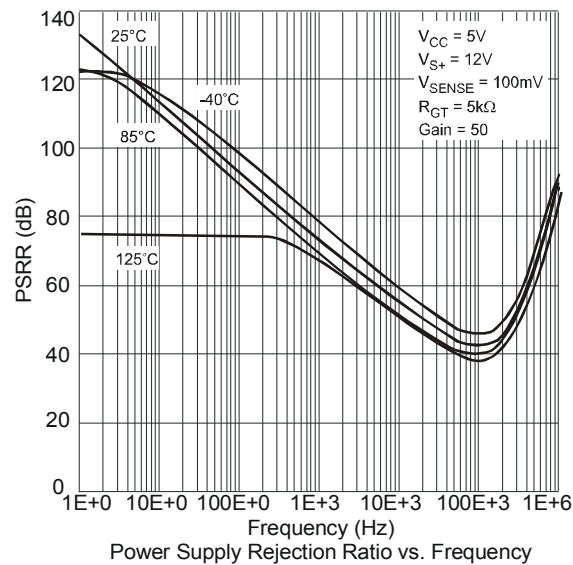
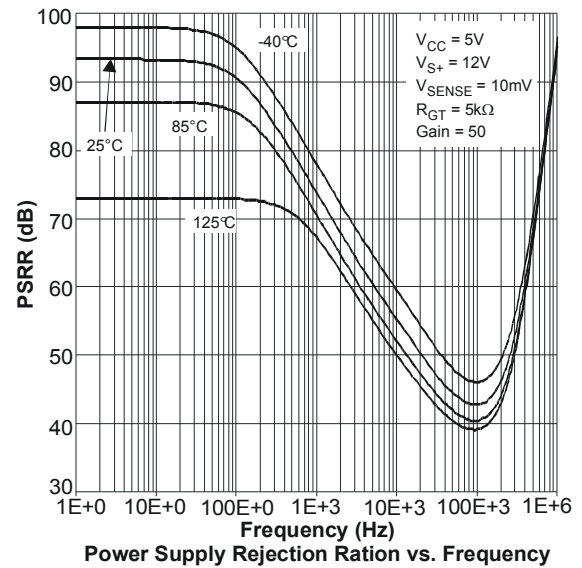
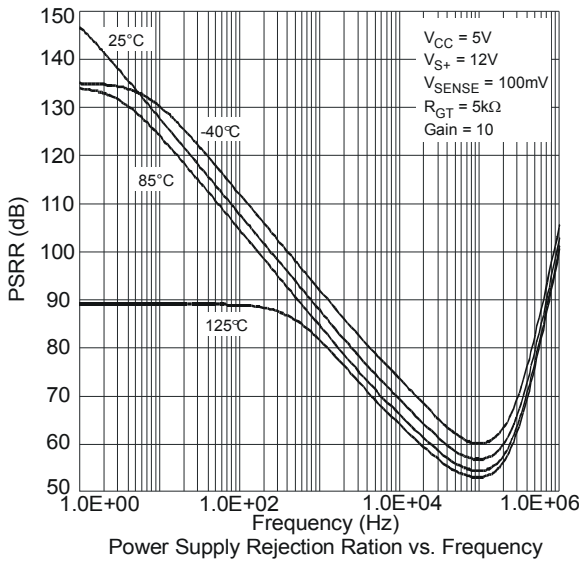
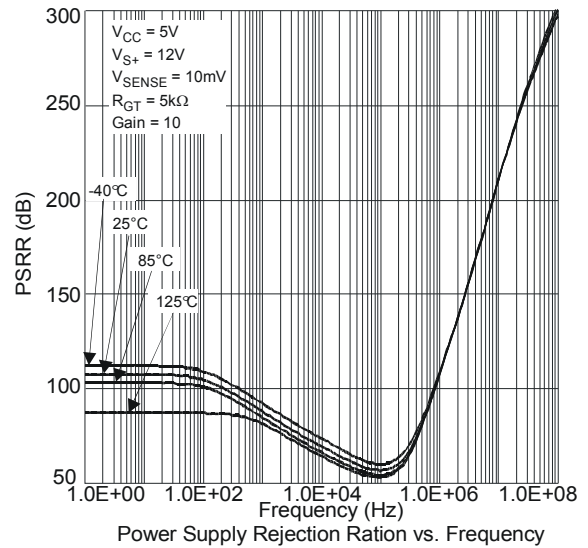
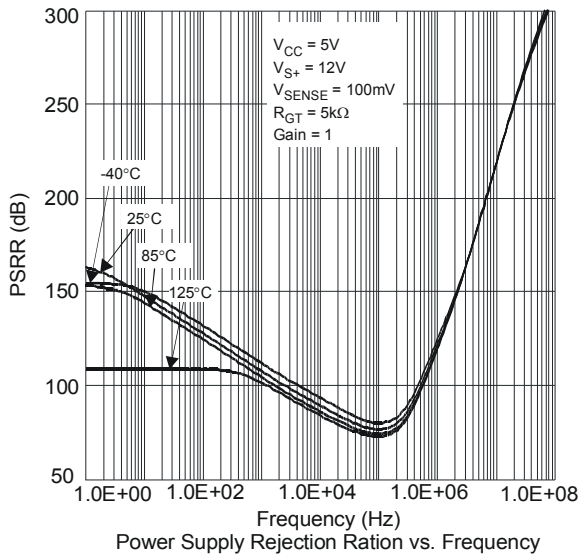
**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

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



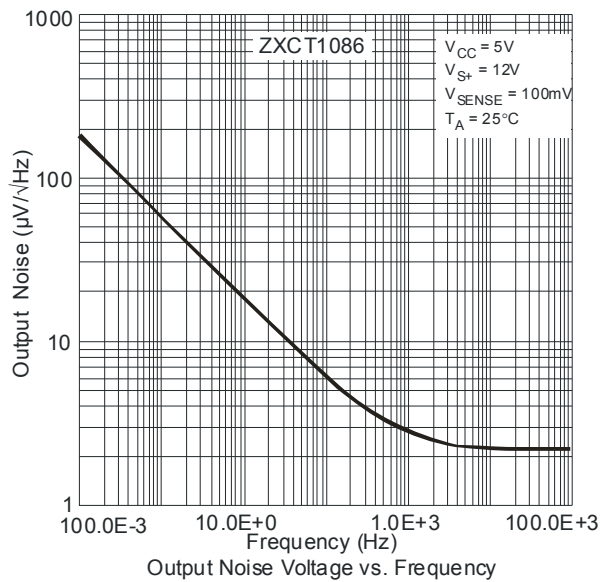
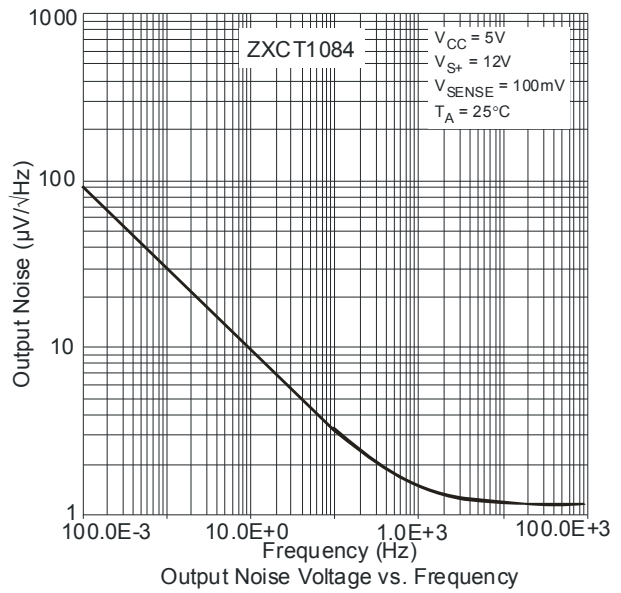
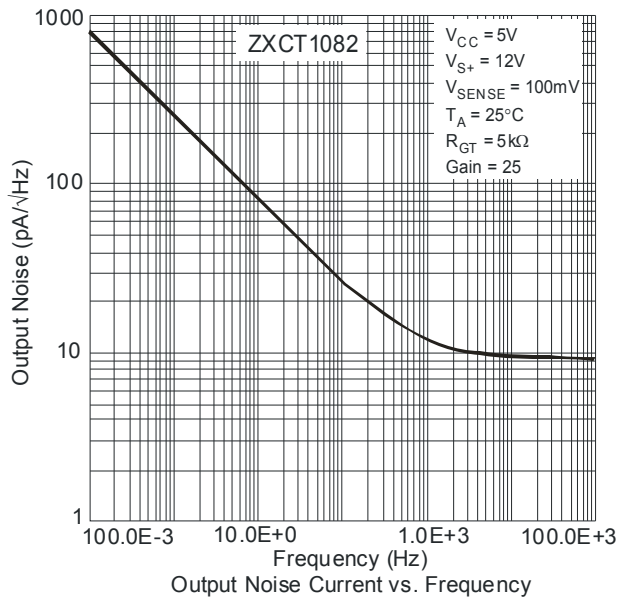
**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

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

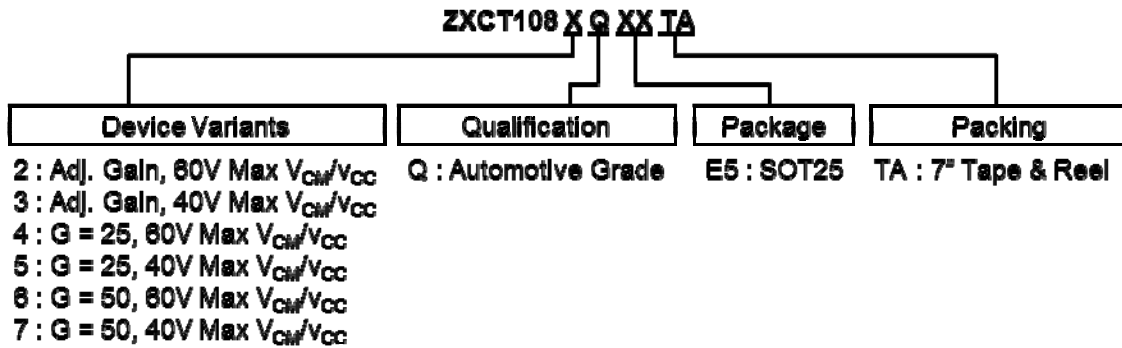


**ZXCT1082Q/83Q/84Q/85Q/86Q/87Q**

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



## Ordering Information

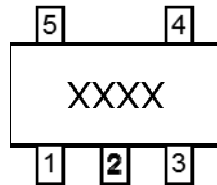


Part Number	Packaging (Note 11)	Package Code	Identification Code	Packing: 7" Tape and Reel			Qualification Grade (Note 12)
				Quantity	Tape width	Part Number Suffix	
ZXCT1082QE5TA	SOT25	E5	1082	3000 Units	8mm	TA	Automotive Grade
ZXCT1083QE5TA	SOT25	E5	1083	3000 Units	8mm	TA	Automotive Grade
ZXCT1084QE5TA	SOT25	E5	1084	3000 Units	8mm	TA	Automotive Grade
ZXCT1085QE5TA	SOT25	E5	1085	3000 Units	8mm	TA	Automotive Grade
ZXCT1086QE5TA	SOT25	E5	1086	3000 Units	8mm	TA	Automotive Grade
ZXCT1087QE5TA	SOT25	E5	1087	3000 Units	8mm	TA	Automotive Grade

Note: 11. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>

12. ZXCT1082Q/83Q/84Q/85Q/86Q/87Q have been qualified to AEC-Q100 grade 1 and is classified as "Automotive Grade" which supports PPAP documentation. See ZXCT1082/82/84/85/86/87 datasheet for commercial qualified version.

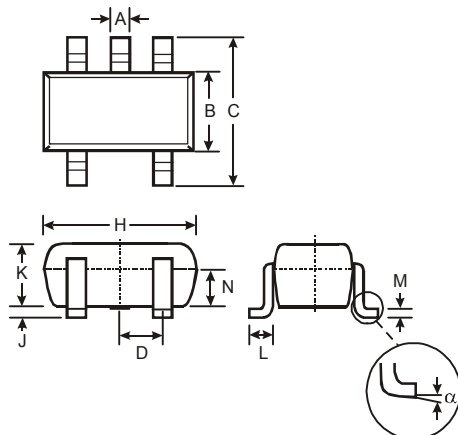
## Marking Information



: Identification code : XXXX

## Package Outline Dimensions

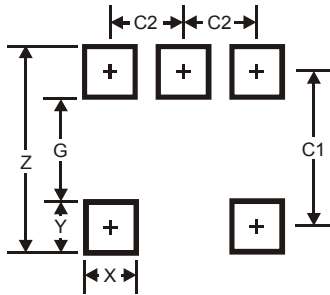
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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
$\alpha$	0°	8°	—
All Dimensions in mm			

## Suggested Pad Layout

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



Dimensions	Value (in mm)
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95

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