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.

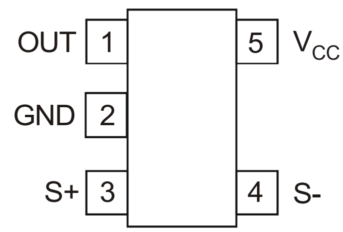
Features

- 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 temperate 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)**

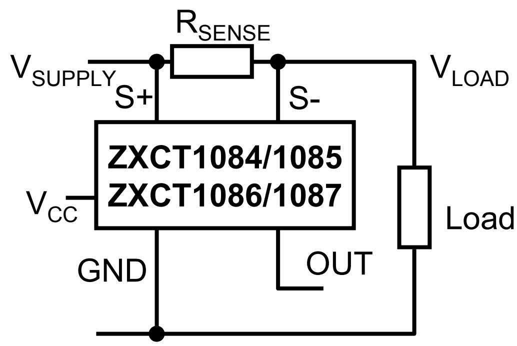
Applications

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

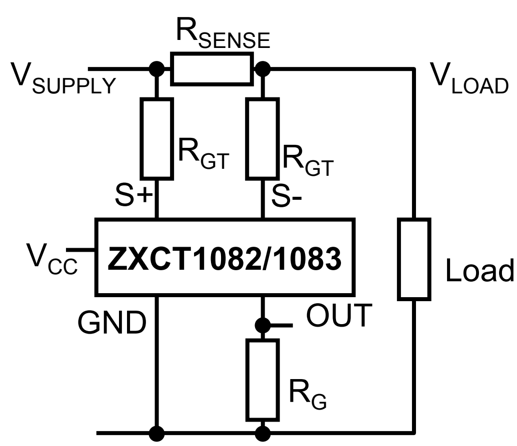
Pin Assignments



Typical Application Circuits



ZXCT1084Q/85Q: V_{OUT} = 25 x V_{SENSE}
ZXCT1086Q/87Q: V_{OUT} = 50 x V_{SENSE}



ZXCT1082Q/83Q: $V_{OUT} = V_{SENSE} \times \frac{R_G}{R_{GT}}$

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 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.

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°C		mW
ESD Rating				
HBM	Human Body Model	3		kV
MM	Machine Model	250		V
CDM	Charged Device Model	tbd		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 ZXCT1082Q/1084Q/1086Q Common-Mode Input Range	2.7 2.7	40 60	V
V_{CC}	ZXCT1083Q/1085Q/1087Q Supply Voltage Range ZXCT1082Q/1084Q/1086Q Supply Voltage Range	2.7 2.7	40 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°C, V_{S+} = 12V, V_{CC} = 5 V, V_{SENSE} = 100mV (Note 5), ZXCT1082Q/83Q R_{GT} = 5kΩ, R_G = 125kΩ; unless otherwise stated. (FT = -40°C to +125°C)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
Input							
I_{S+}	S+ input current	V_{SENSE} = 0mV (Note 5)	—	—	1.7	—	µA
			T_A = FT	—	—	5	
I_{S-}	S- input current		—	—	1.7	—	µA
			T_A = FT	—	—	5	
V_{IO}	Input Offset Voltage (Note 7)	V_{SENSE} = 0mV	—	—	±0.2	±1	mV
		ZXCT1082Q/ 83Q/ 84Q/ 85Q	T_A = FT	—	—	±2.5	
		ZXCT1086Q/ 87Q	T_A = FT	—	—	±3	
		Temperature co-efficient		—	±4	—	µV/K
Output							
G_T	Transconductance	ZXCT1082Q/83Q V_{SENSE} = 10mV to 150mV (Notes 5, 8)	—	—	200	—	µA/V
$G_{T\text{-}ERR}$	Transconductance error (Note 9)		—	-1	—	+1	%
			T_A = FT	-2	—	+2	
$G_{T\text{-}TC}$	Transconductance temperature co-efficient		T_A = FT	—	10	—	nA/K
Z_{OUT}	Output impedance	ZXCT1082Q/83Q		—	1¦¦5	—	GΩ¦¦pF
G_V	Gain	ZXCT1084Q/85Q/86Q/87Q V_{SENSE} = 10mV to 150mV (Note 5)	ZXCT1084Q/85Q	—	25	—	V/V
			ZXCT1086Q/87Q	—	50	—	
$G_{V\text{-}ERR}$	Gain error (Note 9)		—	-1	—	+1	%
			T_A = FT	-2	—	+2	
$G_{V\text{-}TC}$	Voltage gain temperature co-efficient		T_A = FT	—	100	—	ppm/K
Z_{OUT}	Output impedance	ZXCT1084Q/85Q/86Q/87Q		—	125	—	kΩ
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:
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-}"
7. V_{IO} is extrapolated from measurements for the gain-error test.
8. For V_{SENSE} > 10mV, the internal voltage-current converter is fully linear. This enables a true offset to be defined and used.
9. Gain or transconductance error is calculated by applying two values of V_{SENSE} and calculating the error of the slope vs. the ideal.

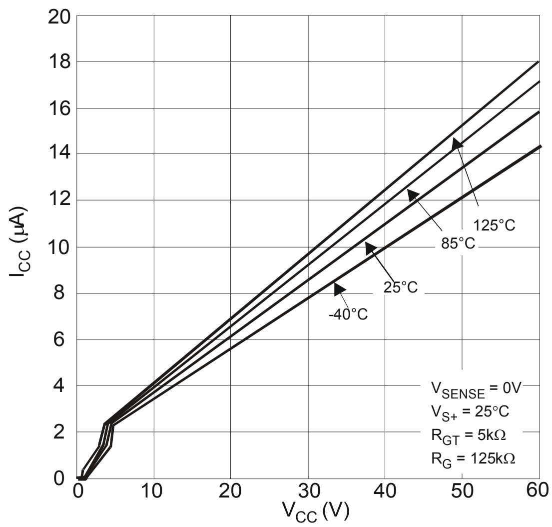
Electrical Characteristics (cont.)

Test Conditions T_A = +25°C, V_{S+} = 12V, V_{CC} = 5 V, V_{SENSE}[1] = 100mV, ZXCT1082Q/83Q R_{GT} = 5kΩ, R_G = 125kΩ; unless otherwise stated. (FT = -40°C to +125°C)

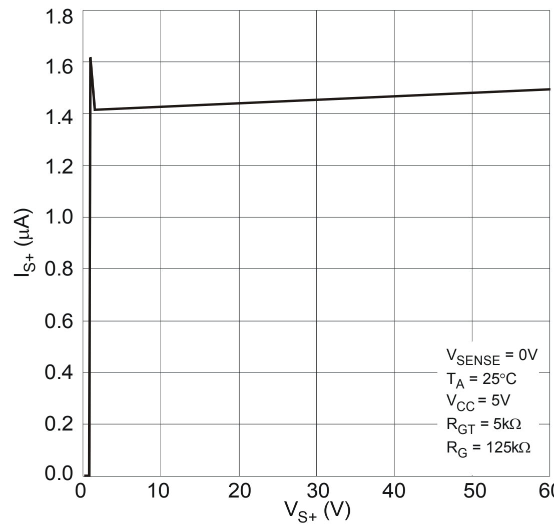
Symbol	Parameter	Conditions		Min	Typ	Max	Units
AC characteristics							
BW	-3dB Small Signal Bandwidth	$V_{SENSE\ (AC)}$ = 10mV_{PP} (Note 5)	G = 25	—	500	—	kHz
			G = 50	—	200	—	
$t_{s(0.1\%)}$	Settling time (0.1%)	V_{SENSE} = 50mV to 300mV step	G = 25	—	5	—	µs
		V_{SENSE} = 50mV to 200mV step	G =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

Note: 10. Measured relative to input

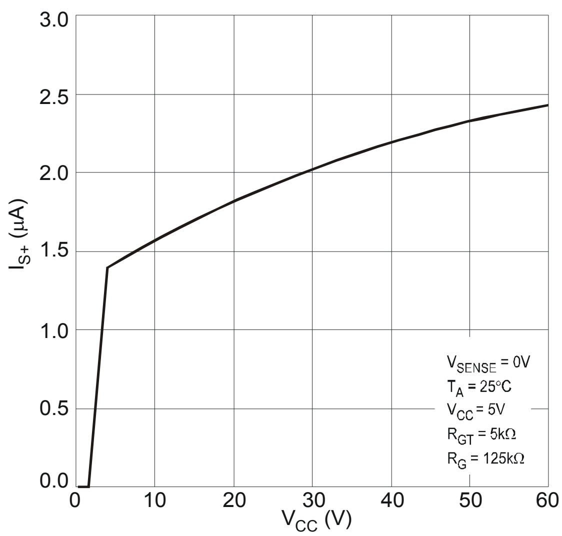
Typical Characteristics (@ V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C, unless otherwise stated.)



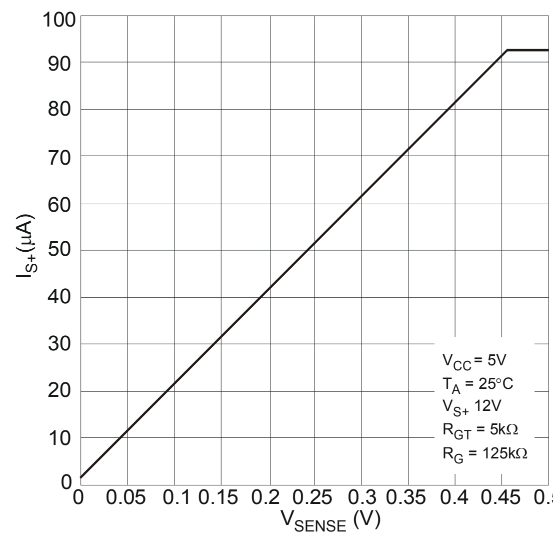
Supply Current vs. Supply Voltage



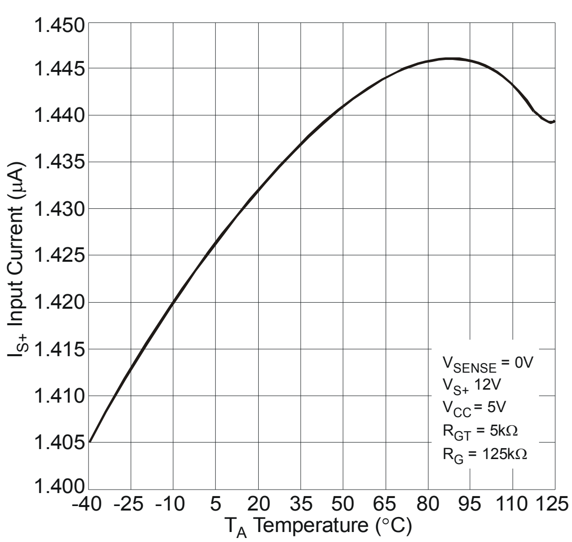
S+ Input Current vs. S+ Voltage



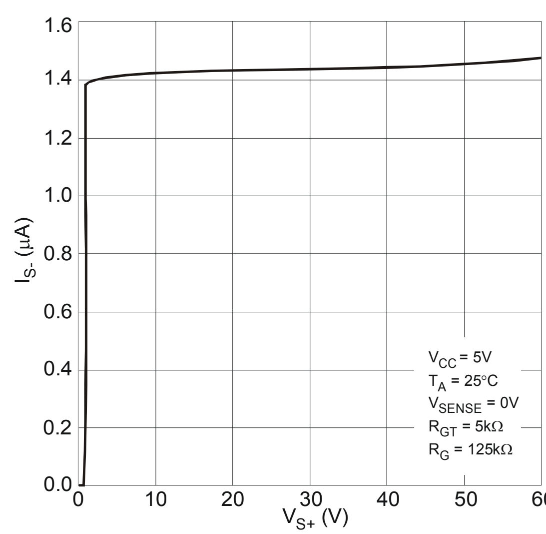
I_{S+} Input Current vs. V_{CC}



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

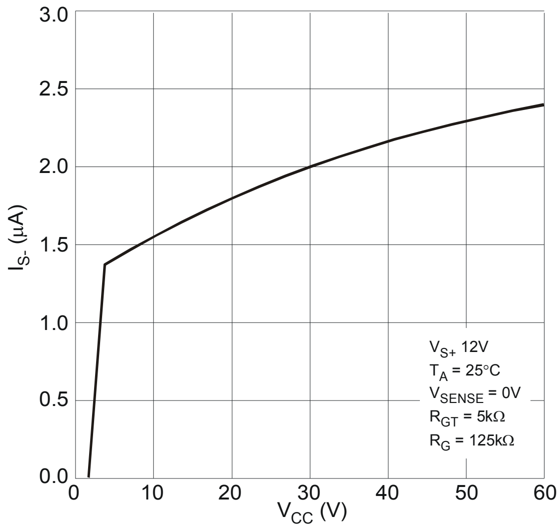


I_{S+} Input Current vs. Ambient Temperature

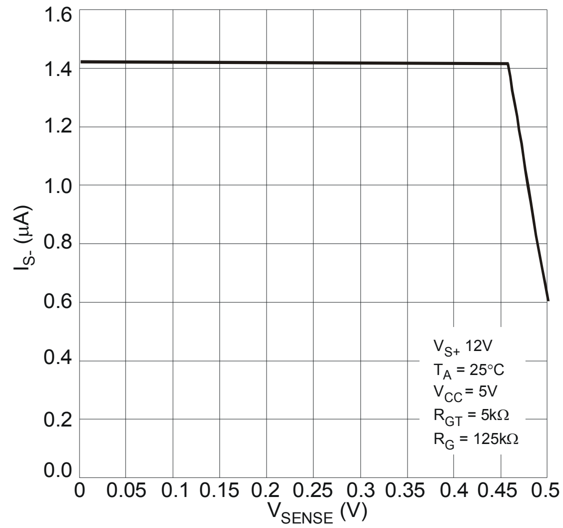


I_{S-} Input Current vs. S+ Voltage

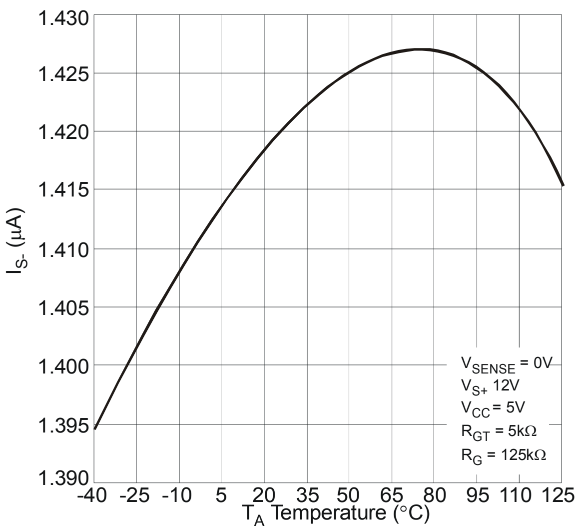
Typical Characteristics (cont.) (@ V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C)



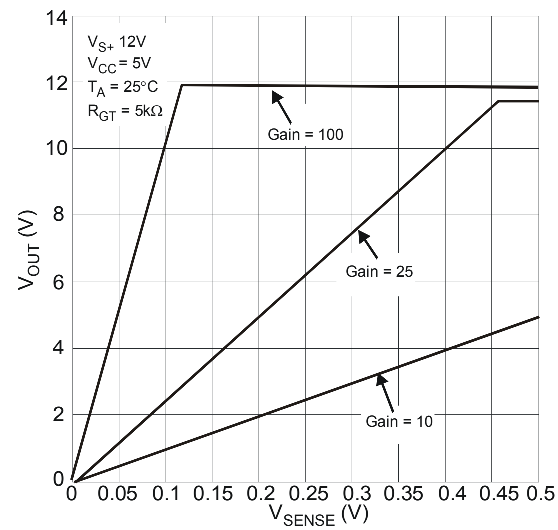
I_{S-} Input Current vs. Supply Voltage



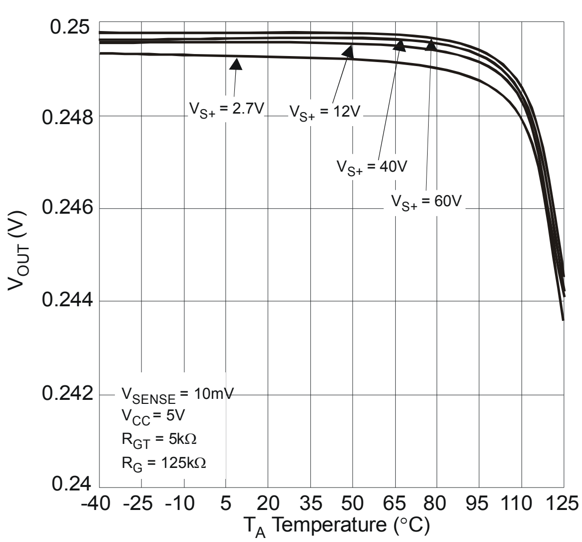
I_{S-} Input Current vs. V_{SENSE} Different Voltage



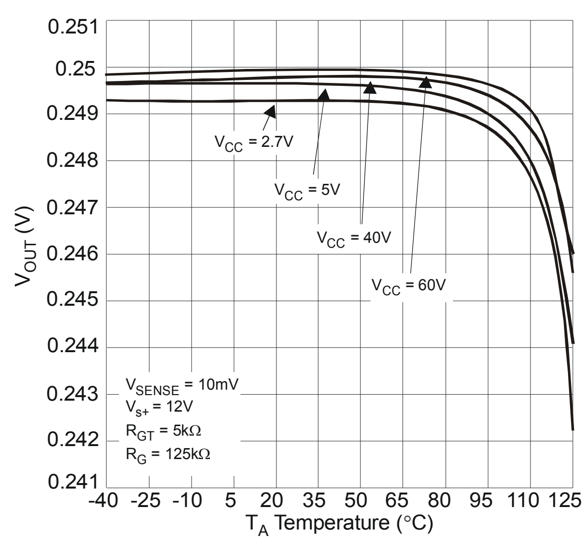
I_{S-} Input Current vs. Ambient Temperature



Output Voltage vs. V_{SENSE}

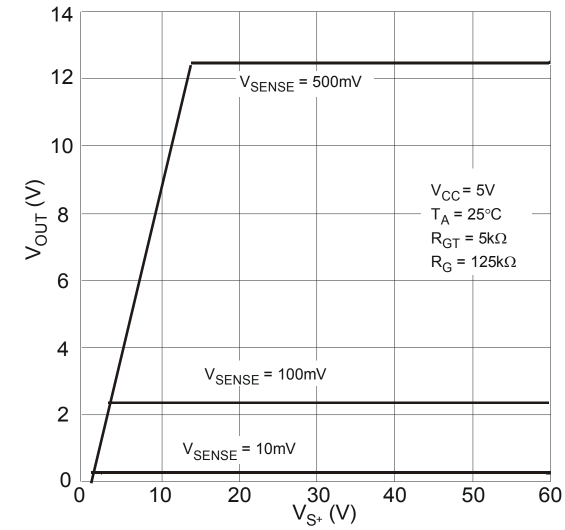


V_{OUT} vs. Ambient Temperature

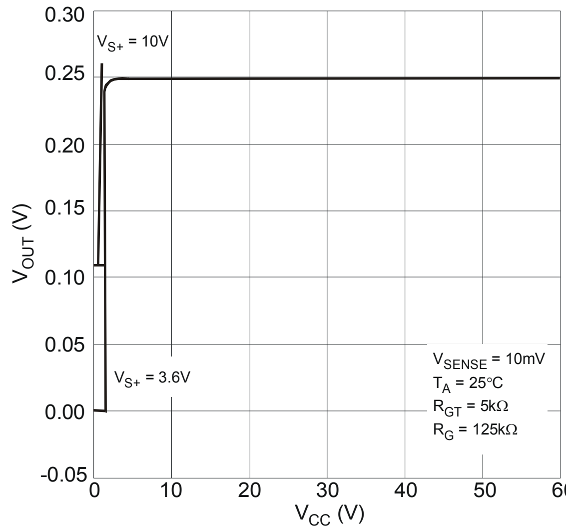


V_{OUT} vs. Ambient Temperature

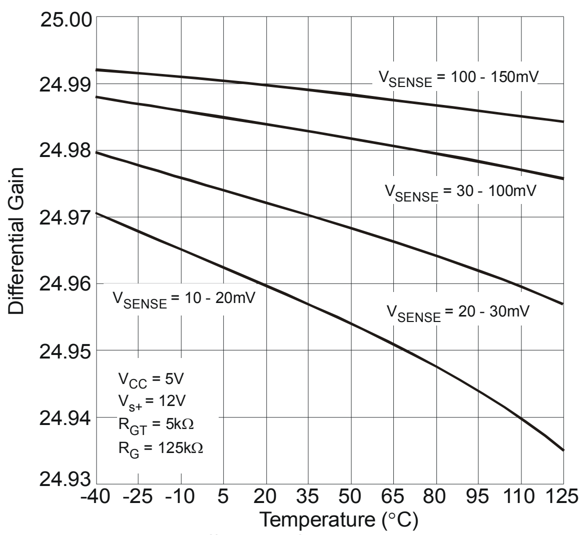
Typical Characteristics (cont.) (@ V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C)



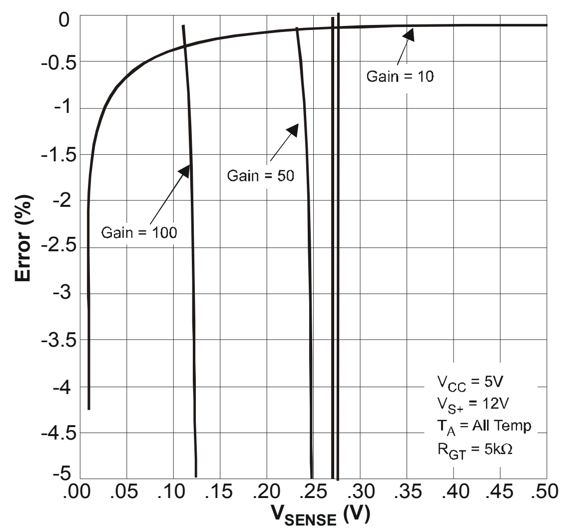
V_{OUT} vs. V_{S+}



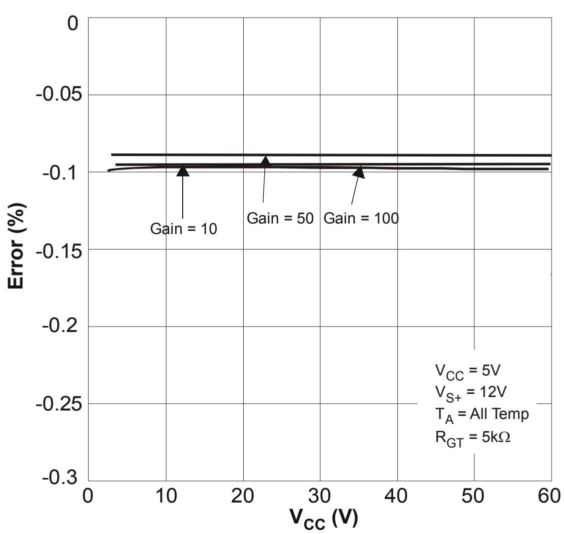
V_{OUT} vs. V_{CC}



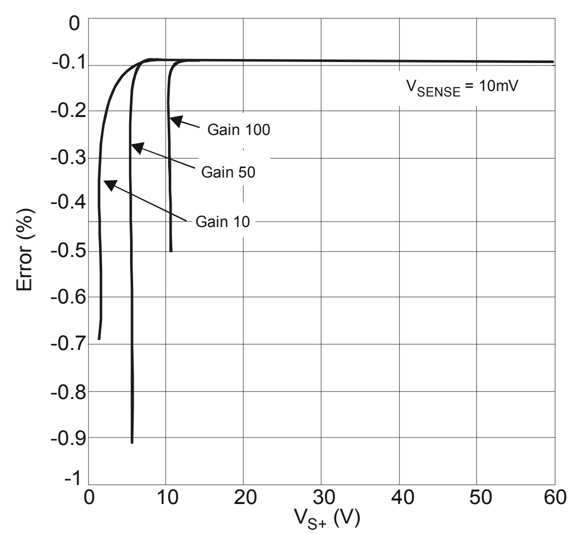
Differential Gain vs. Temperature



Error vs. V_{SENSE}

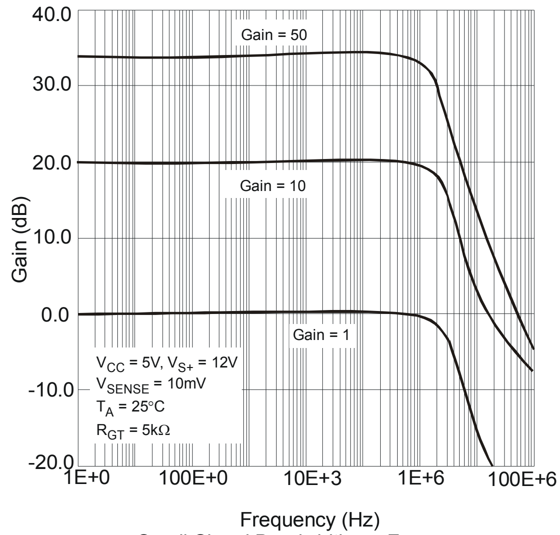


Error vs. V_{CC}

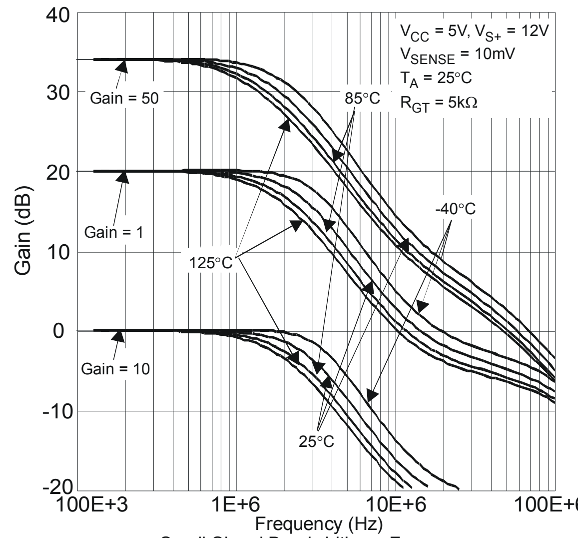


Error vs. V_{S+}

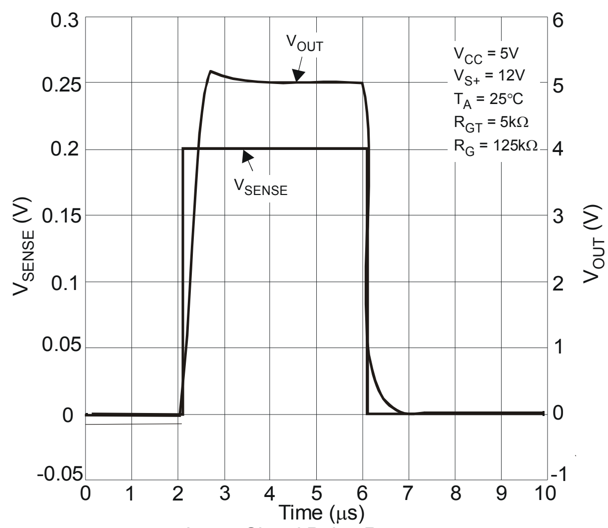
Typical Characteristics (cont.) (@ V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C)



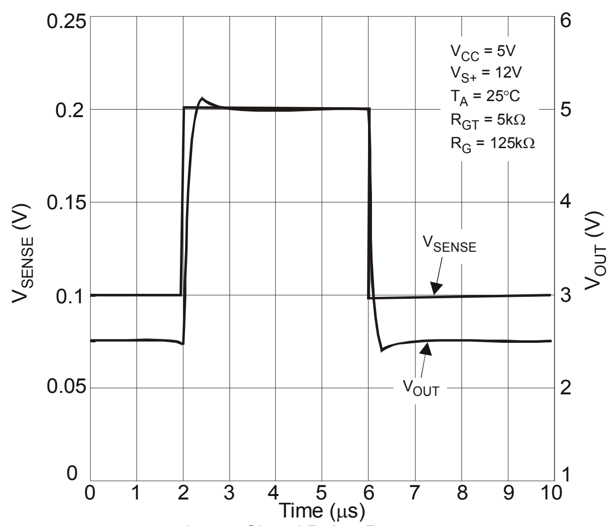
Small Signal Bandwidth vs. Frequency



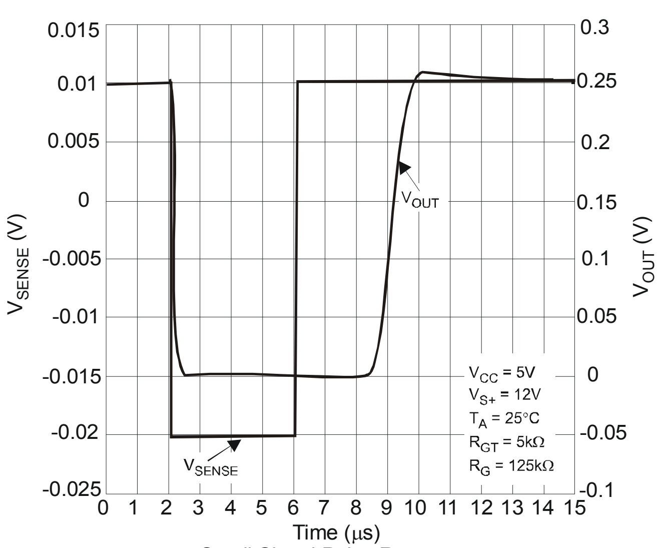
Small Signal Bandwidth vs. Frequency



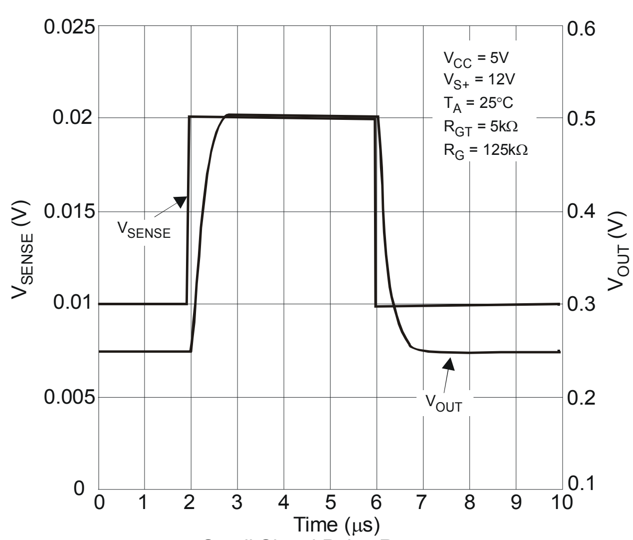
Large Signal Pulse Response



Large Signal Pulse Response

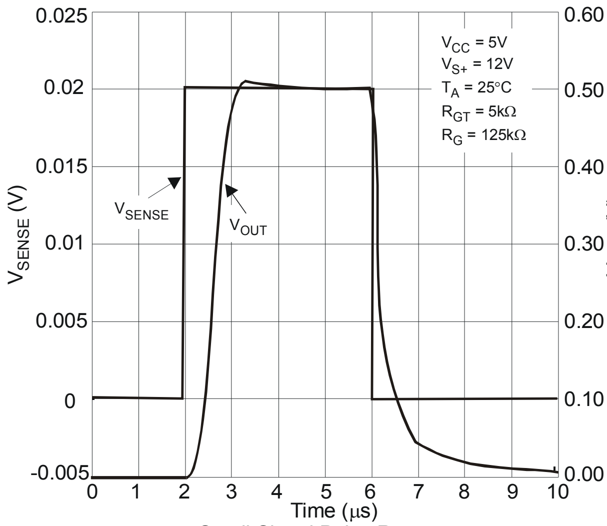


Small Signal Pulse Response

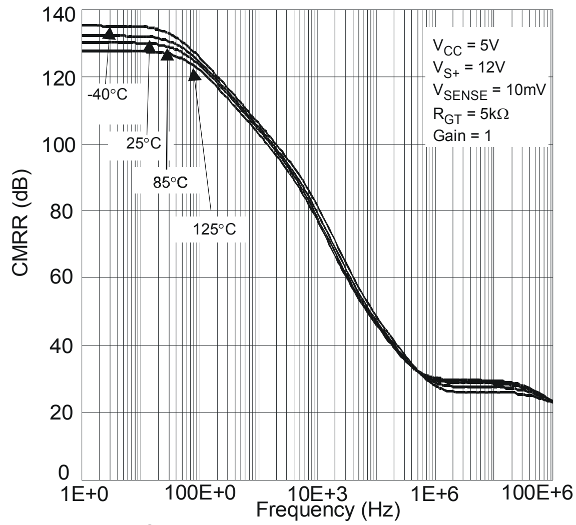


Small Signal Pulse Response

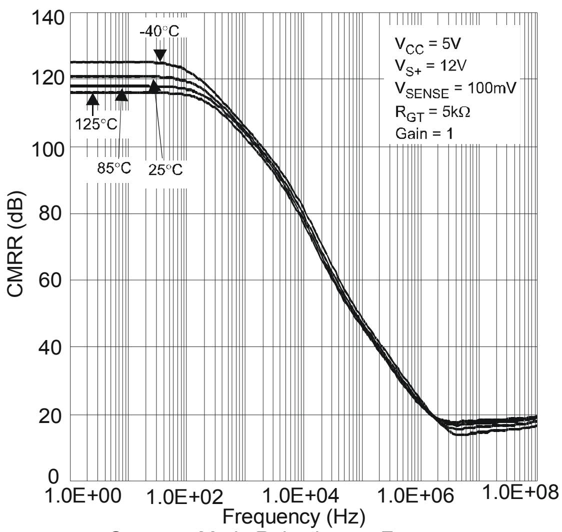
Typical Characteristics (cont.) (@ V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C)



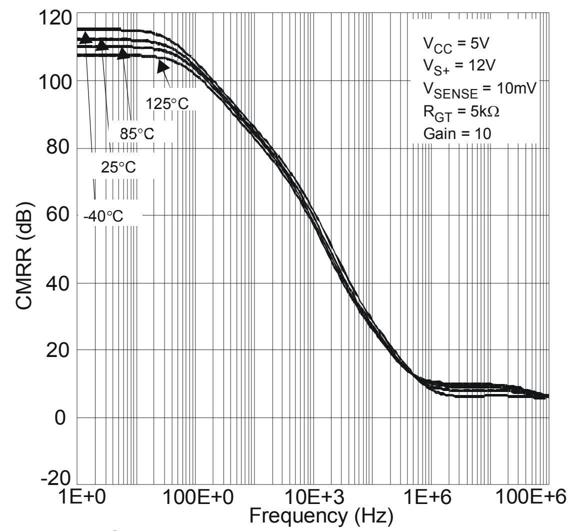
Small Signal Pulse Response



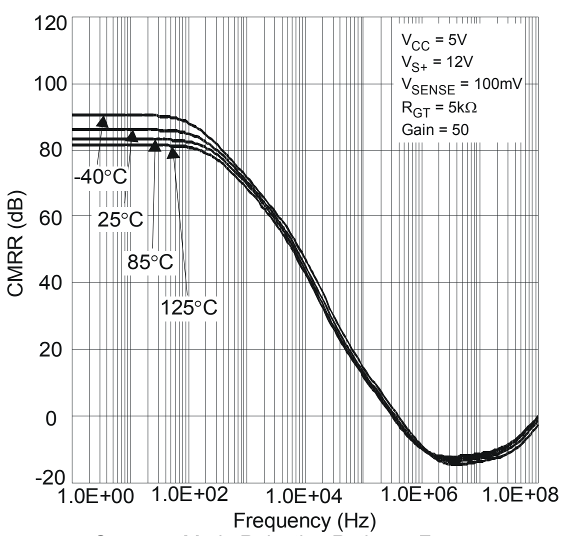
Common Mode Rejection vs. Frequency



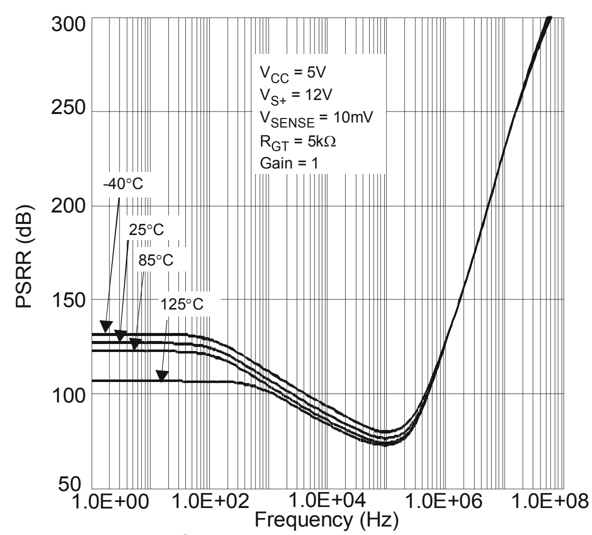
Common Mode Rejection vs. Frequency



Common Mode Rejection Ratio vs. Frequency

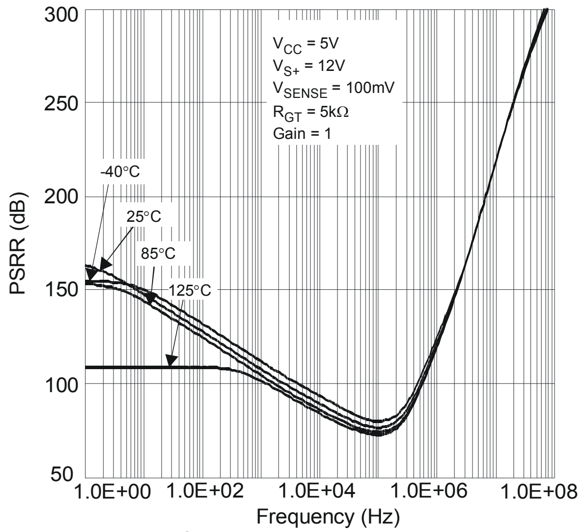


Common Mode Rejection Ratio vs. Frequency

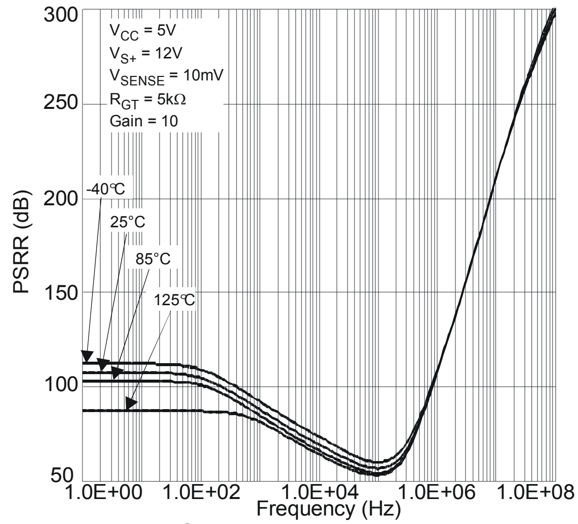


Power Supply Rejection Ration vs. Frequency

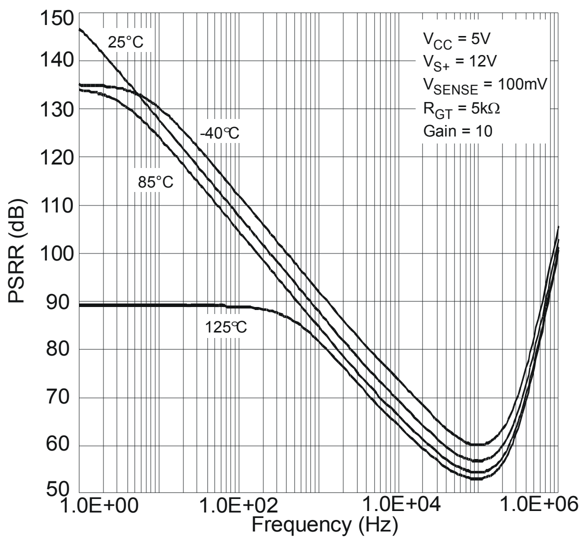
Typical Characteristics (cont.) (@ V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C)



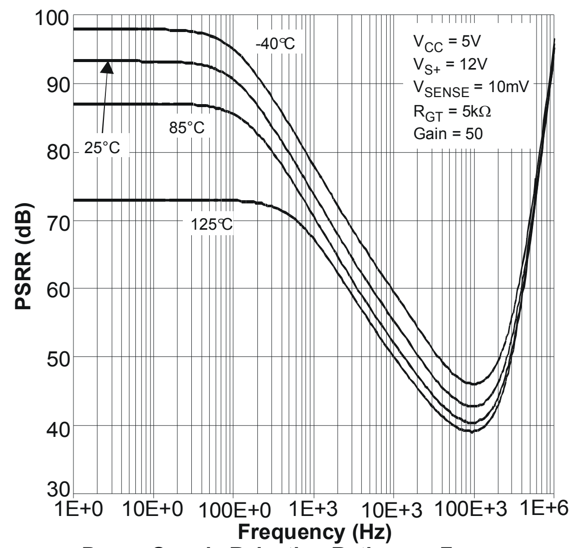
Power Supply Rejection Ration vs. Frequency



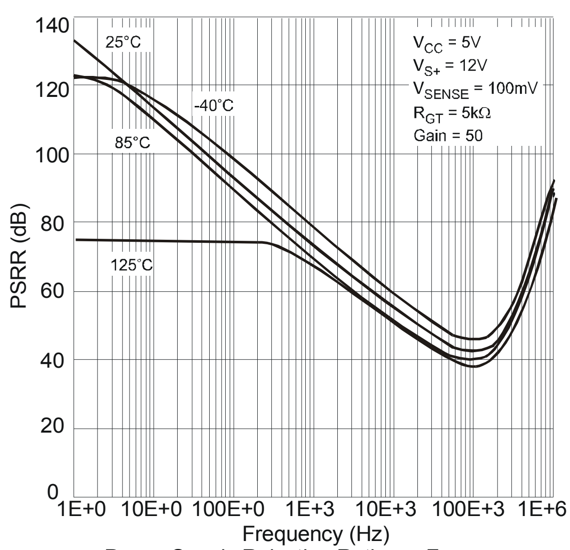
Power Supply Rejection Ration vs. Frequency



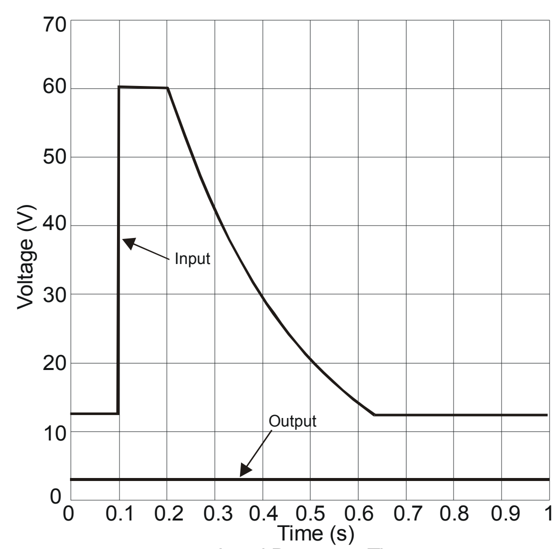
Power Supply Rejection Ration vs. Frequency



Power Supply Rejection Ration vs. Frequency

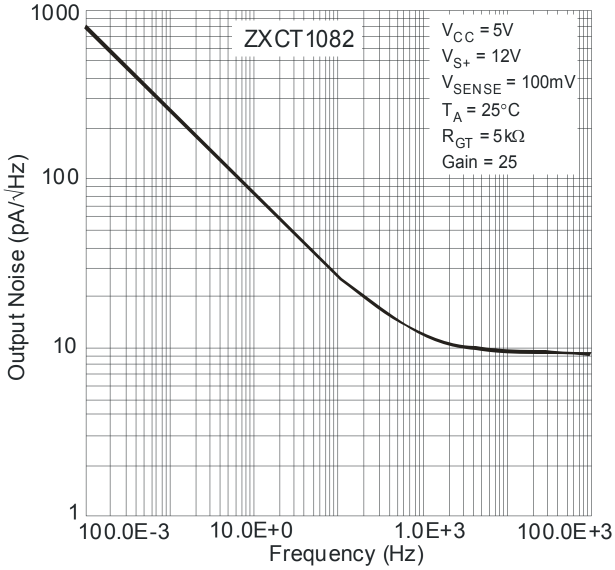


Power Supply Rejection Ratio vs. Frequency

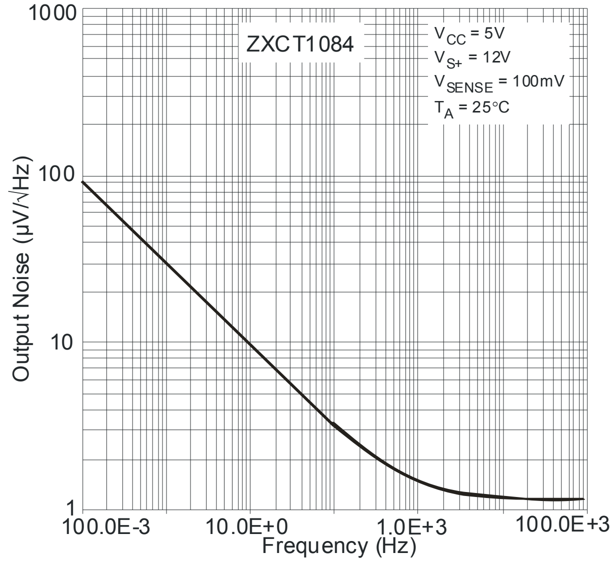


Load Dump vs. Time

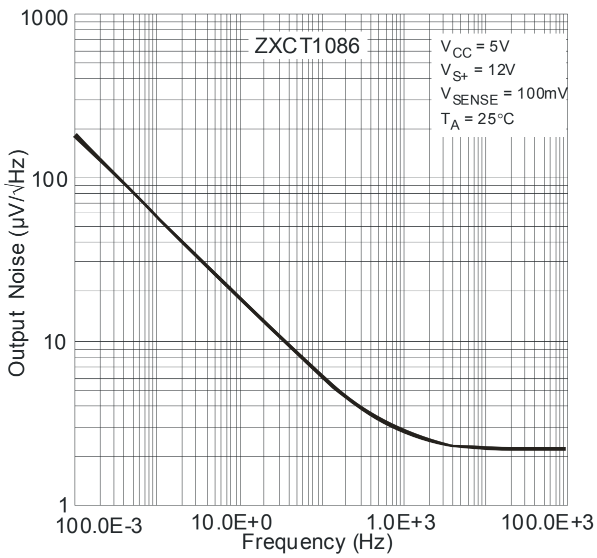
Typical Characteristics (cont.) (@ V_{S+} = 12V, V_{CC} = 5V, V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = +25°C)



Output Noise Current vs. Frequency

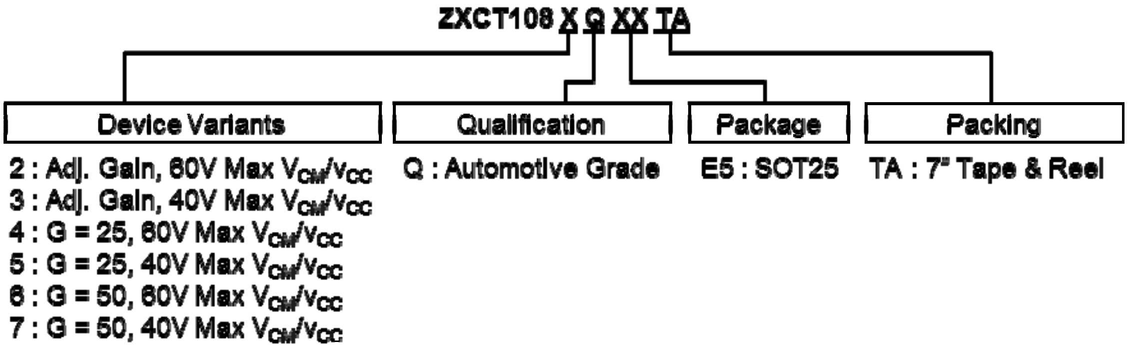


Output Noise Voltage vs. Frequency



Output Noise Voltage vs. Frequency

Ordering Information

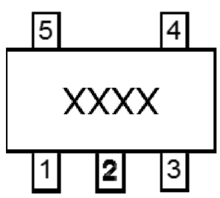


Part Number	Packaging (Note 11)	Package Code	Identification Code	Packing: 7” Tape and Reel			Qualification Grade (Note 12)
				Quantity	Tape width	Part Number Suffix	
ZXCT1082QE5TA	SOT25	E5	1082	3000 Units	8mm	TA	Automotive Grade
ZXCT1083QE5TA	SOT25	E5	1083	3000 Units	8mm	TA	Automotive Grade
ZXCT1084QE5TA	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.

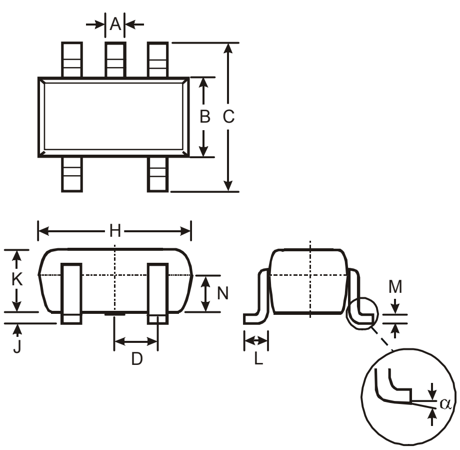
Marking Information



: Identification code : XXXX

Package Outline Dimensions

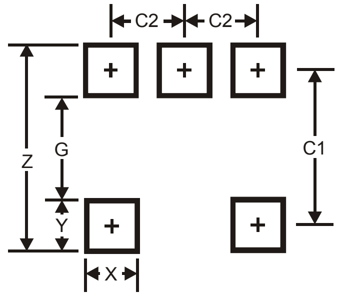
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.



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
α	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