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.

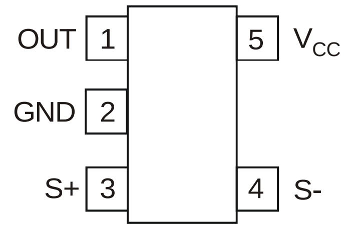
Features

- Wide supply and common-mode voltage range
  - o 2.7V to 60V ZXCT1082/84/86
  - o 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 temperate range -40 to 125°C
- Package SOT25

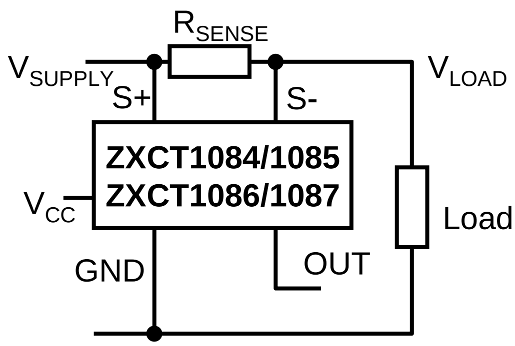
Applications

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

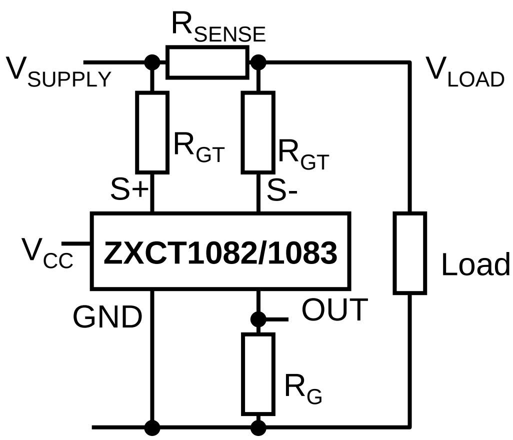
Pin Assignments



Typical Application Circuits



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



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

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-}	±800	mV
Input current into S+ or S- (†)	±12	mA
Storage Temperature	-55 to 150	°C
Maximum Junction Temperature	150	°C
Package Power Dissipation	300 at T_A = 25°C (De-rate to zero at 150°C)	mW
ESD Rating		
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.

(†) 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°C, V_{S+} = 12V, V_{CC} = 5 V, V_{SENSE}[1] = 100mV, ZXCT1082/3 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 1)			1.7		µA
I_{S+}	S+ input current	V_{SENSE} = 0mV (Note 1)	T_A = FT			5	µA
I_{S-}	S- input current	V_{SENSE} = 0mV (Note 1)			1.7		µA
I_{S-}	S- input current	V_{SENSE} = 0mV (Note 1)	T_A = FT			5	µA
V_{IO}	Input Offset Voltage (Note 2)	V_{SENSE} = 0mV			±0.2	±1	mV
V_{IO}	Input Offset Voltage (Note 2)	ZXCT1082/3/4/5	T_A = FT			±2.5	mV
V_{IO}	Input Offset Voltage (Note 2)	ZXCT1086/87	T_A = FT			±3	mV
V_{IO}	Input Offset Voltage (Note 2)	Temperature co-efficient			±4		µV/K
Output							
G_T	Transconductance	ZXCT1082/3 V_{SENSE} = 10mV to 150mV (Note 1, 3)			200		µA/V
G_{T-ERR}	Transconductance error (Note 4)	ZXCT1082/3 V_{SENSE} = 10mV to 150mV (Note 1, 3)		-1		+1	%
G_{T-ERR}	Transconductance error (Note 4)	ZXCT1082/3 V_{SENSE} = 10mV to 150mV (Note 1, 3)	T_A = FT	-2		+2	%
G_{T-TC}	Transconductance temperature co-efficient	ZXCT1082/3 V_{SENSE} = 10mV to 150mV (Note 1, 3)	T_A = FT		10		nA/K
Z_{OUT}	Output impedance	ZXCT1082/3			1‖5		GΩ‖pF
G_V	Gain	ZXCT1084/5/6/7 V_{SENSE} = 10mV to 150mV (Note 1)	1084/5		25		V/V
G_V	Gain	ZXCT1084/5/6/7 V_{SENSE} = 10mV to 150mV (Note 1)	1086/7		50		V/V
G_{V-ERR}	Gain error (Note 4)	ZXCT1084/5/6/7 V_{SENSE} = 10mV to 150mV (Note 1)		-1		+1	%
G_{V-ERR}	Gain error (Note 4)	ZXCT1084/5/6/7 V_{SENSE} = 10mV to 150mV (Note 1)	T_A = FT	-2		+2	%
G_{V-TC}	Voltage gain temperature co-efficient	ZXCT1084/5/6/7 V_{SENSE} = 10mV to 150mV (Note 1)	T_A = FT		100		ppm/K
Z_{OUT}	Output impedance	ZXCT1084/5/6/7			125		kΩ
V_{OUTH}	Output relative to common mode, V_{S-}	ZXCT1082/3		V_{LOAD} - 1	V_{LOAD} - 0.8		V
V_{OUTH}	Output relative to common mode, V_{S-}	ZXCT1084/5/6/7		V_{S-} - 1	V_{S-} - 0.8		V

Notes:

1. 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-}"
2. V_{IO} is extrapolated from measurements for the gain-error test.
3. For V_{SENSE} > 10mV, 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_{SENSE} and calculating the error of the slope vs. the ideal.

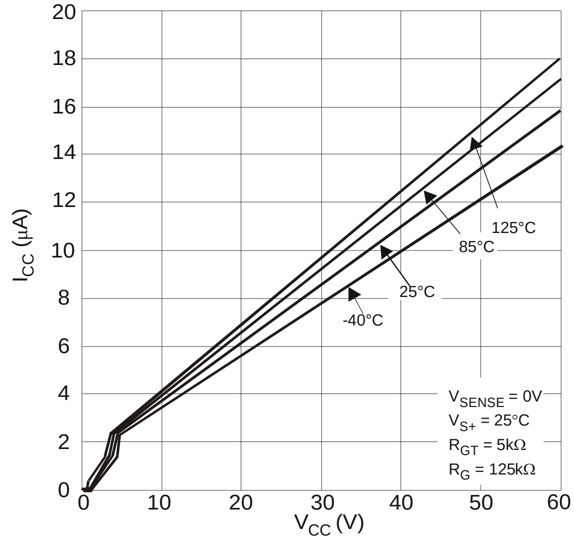
Electrical Characteristics (cont.)

Test Conditions T_A = 25°C, V_{S+} = 12V, V_{CC} = 5 V, V_{SENSE}[1] = 100mV, ZXCT1082/3 R_{GT} = 5kΩ, R_G = 125kΩ; unless otherwise stated.
(FT = -40°C to +125°C)

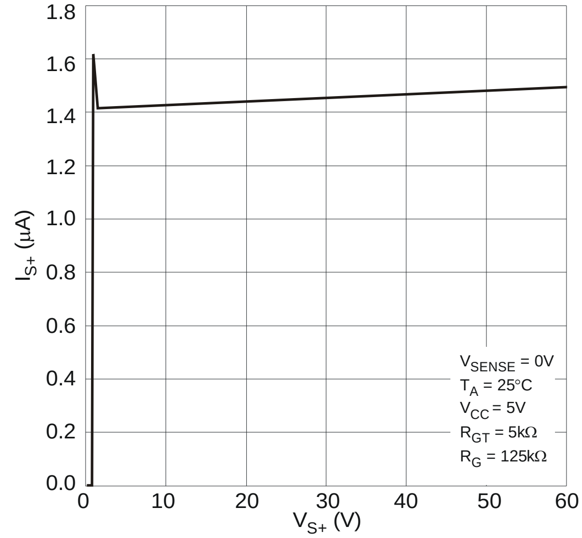
Symbol	Parameter	Conditions		Min.	Typ.	Max.	Units
AC characteristics							
BW	-3dB Small Signal Bandwidth	$V_{SENSE\ (AC)}$ = 10mV_{PP} (Note 1)	G = 25		500		kHz
			G = 50		200		
$t_{s(0.1\%)}$	Settling time (0.1%)	V_{SENSE} = 50mV to 300mV step	G = 25		5		µs
		V_{SENSE} = 50mV to 200mV step	G = 50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

Notes: 5. Measured relative to input

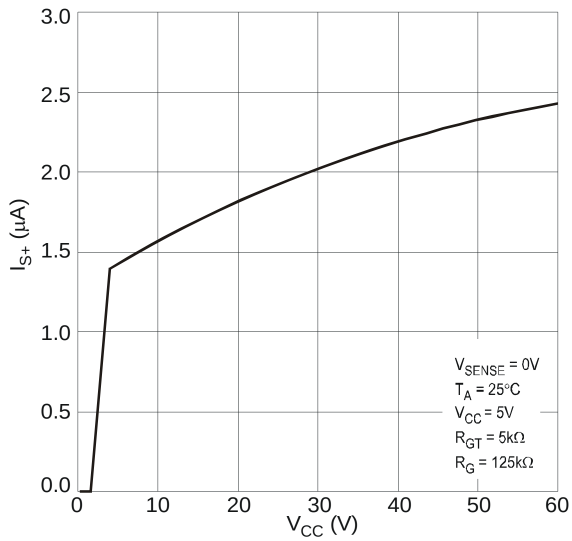
Typical Characteristics V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = 25°C unless otherwise stated



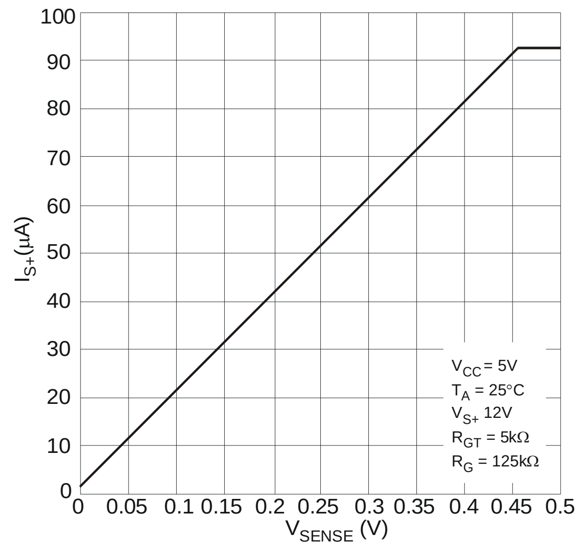
Supply Current vs. Supply Voltage



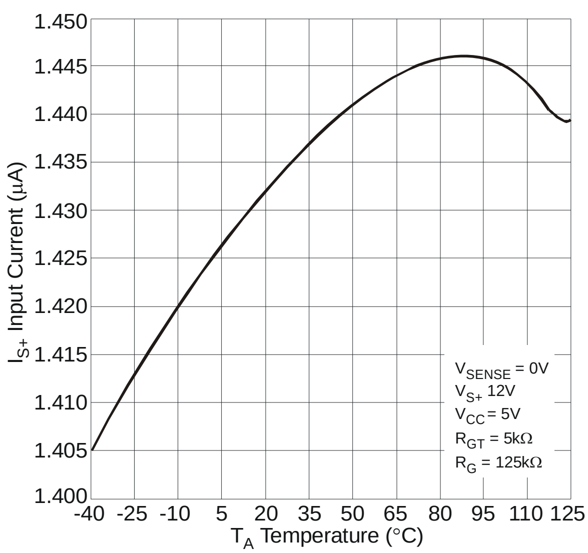
S+ Input Current vs. S+ Voltage



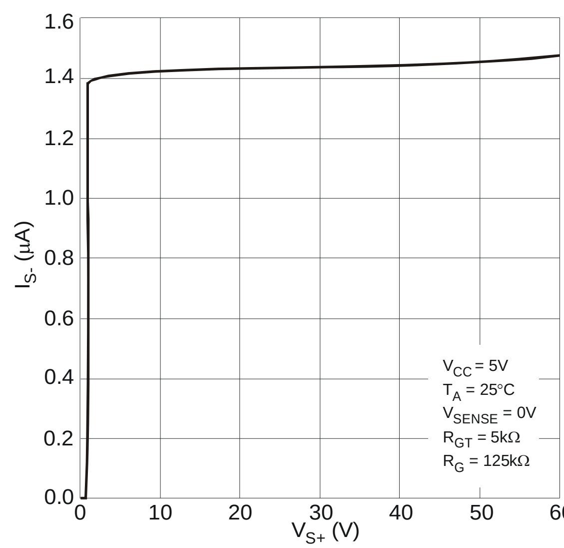
I_{S+} Input Current vs. V_{CC}



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

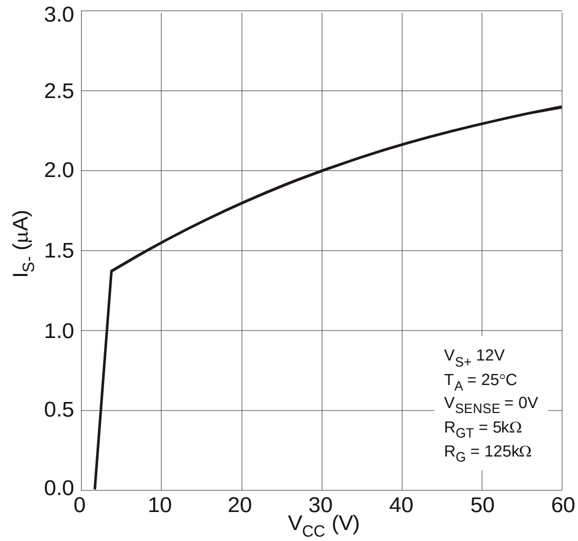


I_{S+} Input Current vs. Ambient Temperature

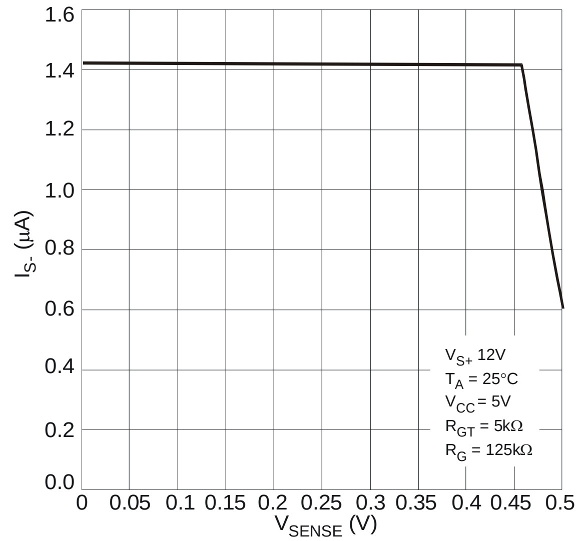


I_{S-} Input Current vs. S+ Voltage

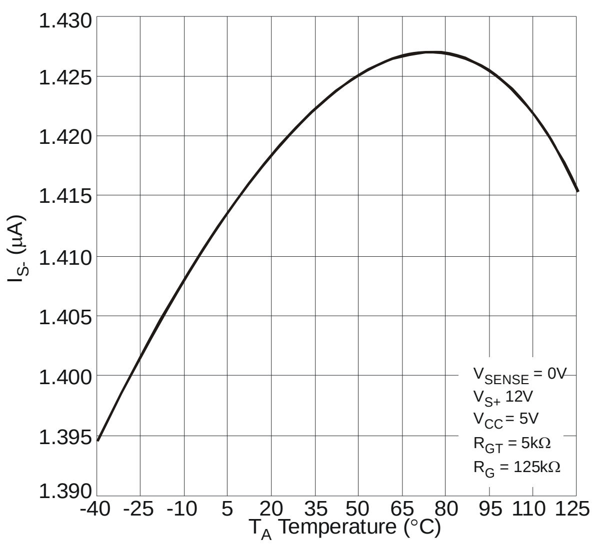
Typical Characteristics (cont.) V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = 25°C



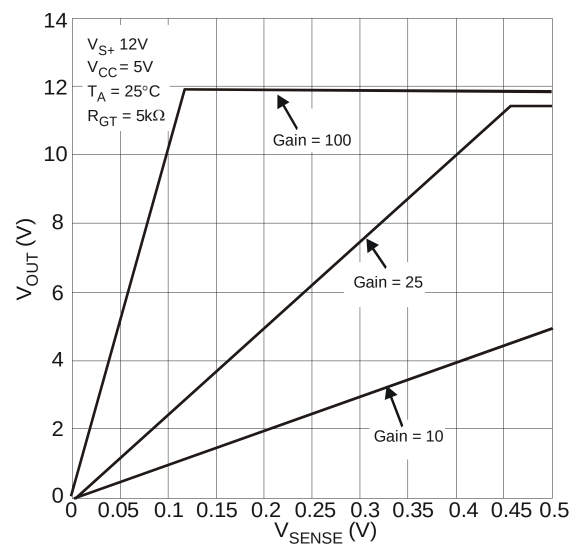
I_{S-} Input Current vs. Supply Voltage



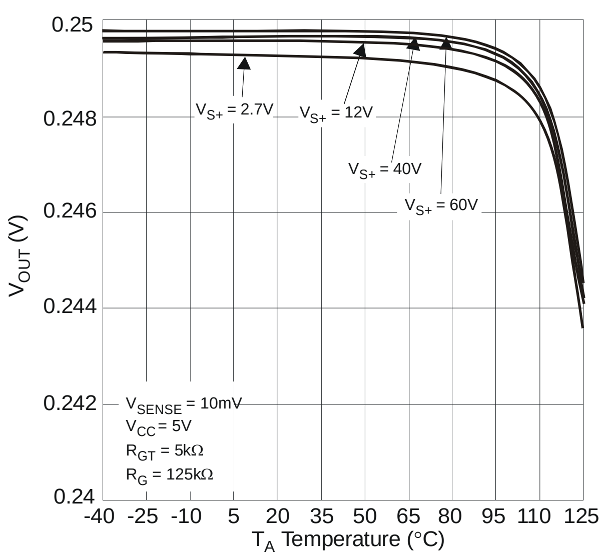
I_{S-} Input Current vs. V_{SENSE} Different Voltage



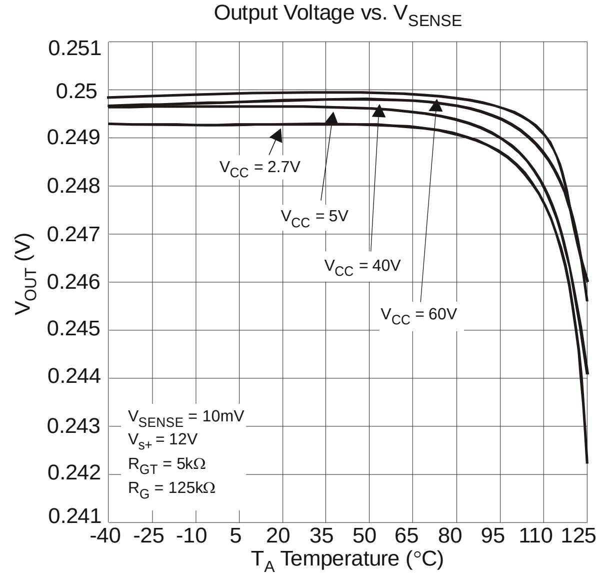
I_{S-} Input Current vs. Ambient Temperature



Output Voltage vs. V_{SENSE}

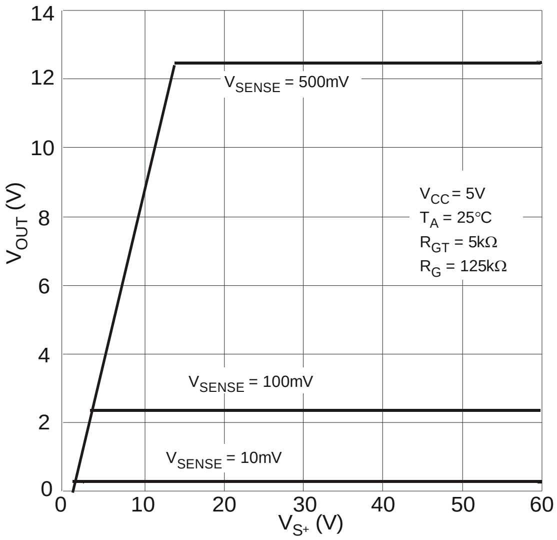


V_{OUT} vs. Ambient Temperature

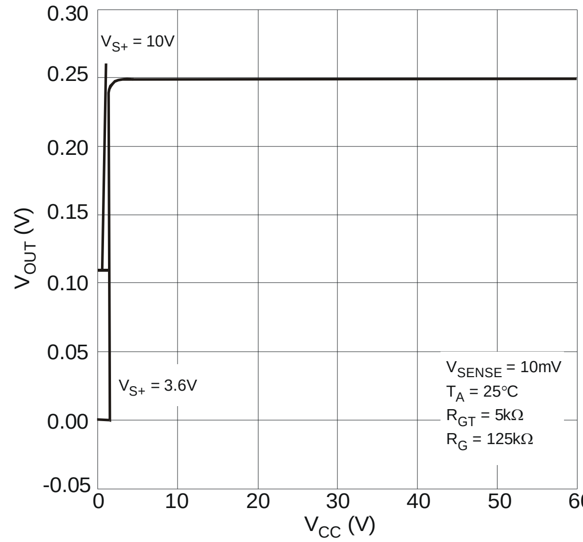


V_{OUT} vs. Ambient Temperature

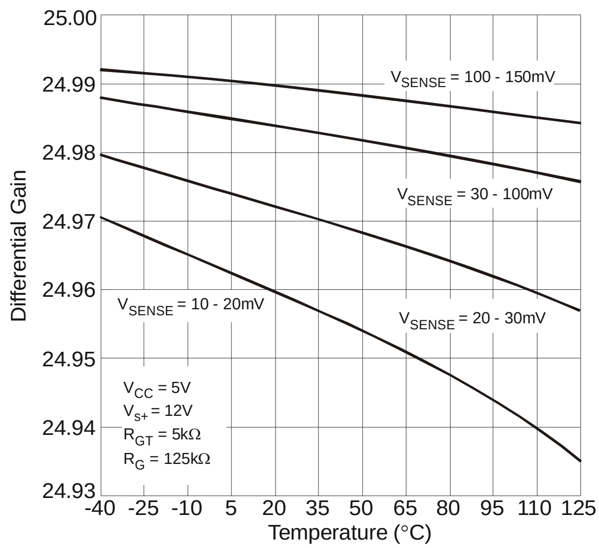
Typical Characteristics (cont.) V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ, T_A = 25°C



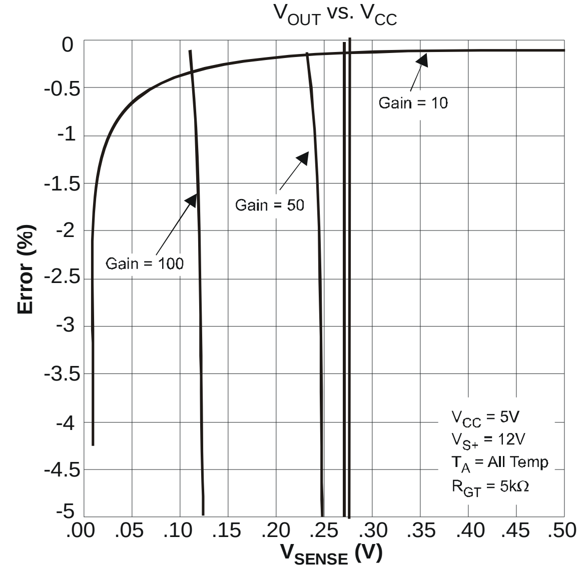
V_{OUT} vs. V_{S+}



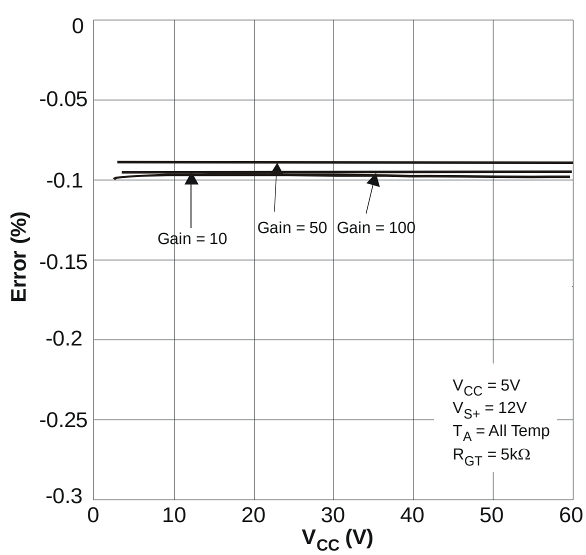
V_{OUT} vs. V_{CC}



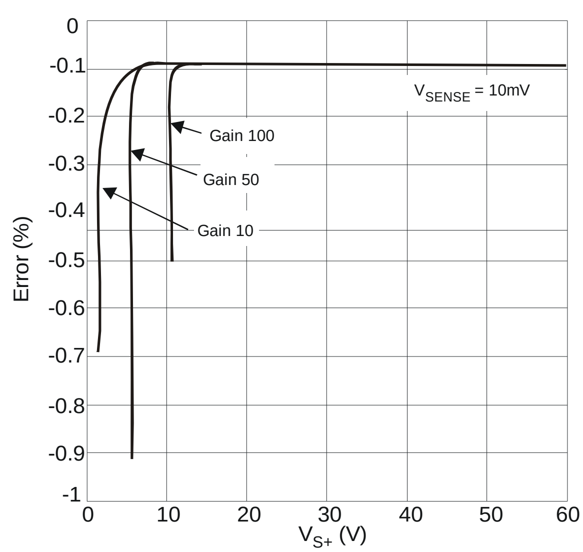
Differential Gain vs. Temperature



Error vs. V_{SENSE}

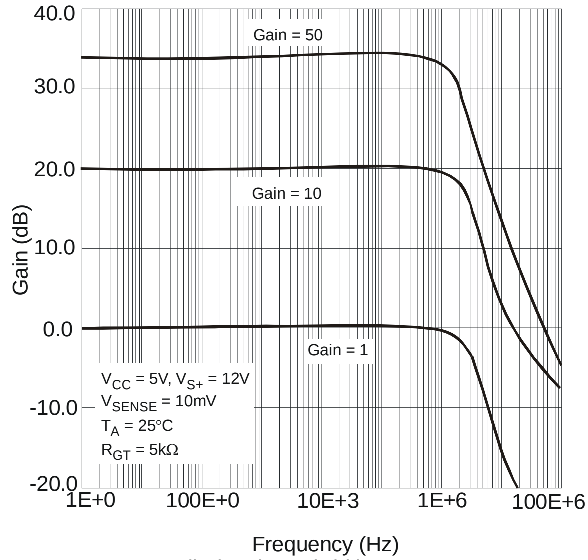


Error vs. V_{CC}

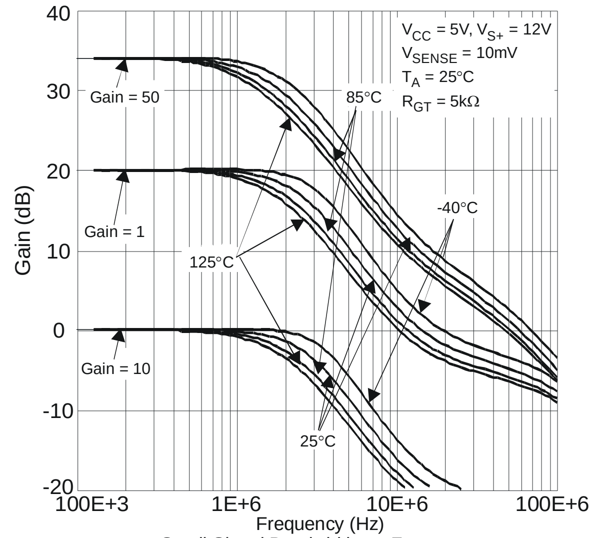


Error vs. V_{S+}

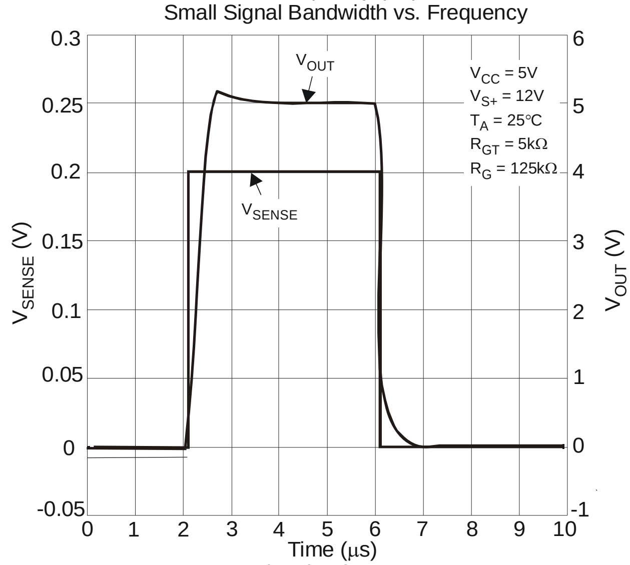
Typical Characteristics (cont.) V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ , T_A = 25°C



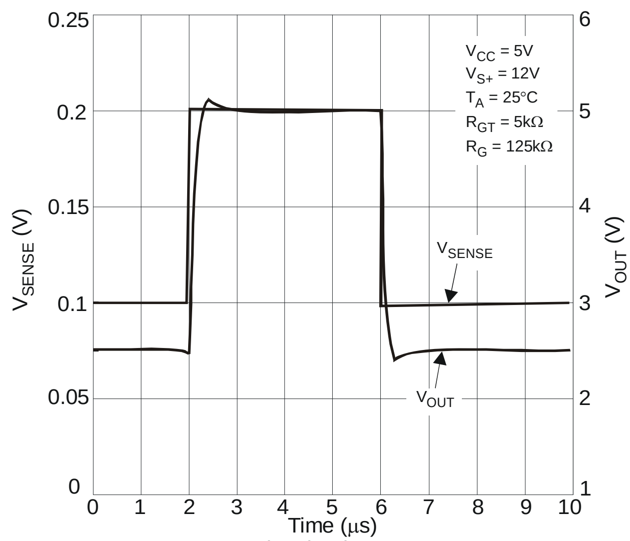
Small Signal Bandwidth vs. Frequency



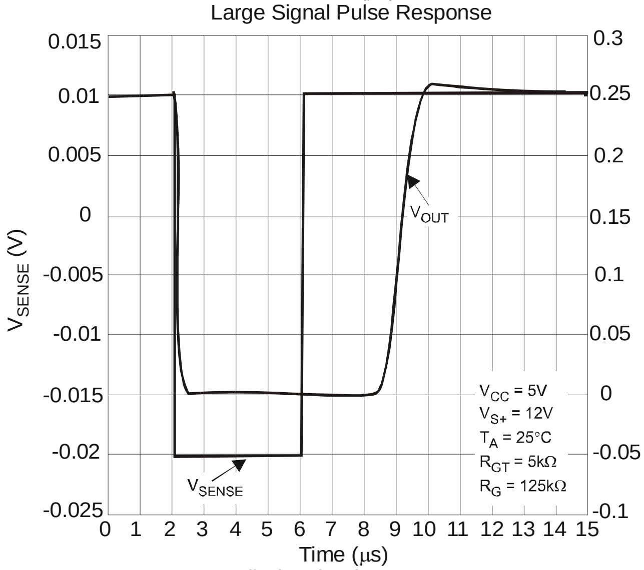
Small Signal Bandwidth vs. Frequency



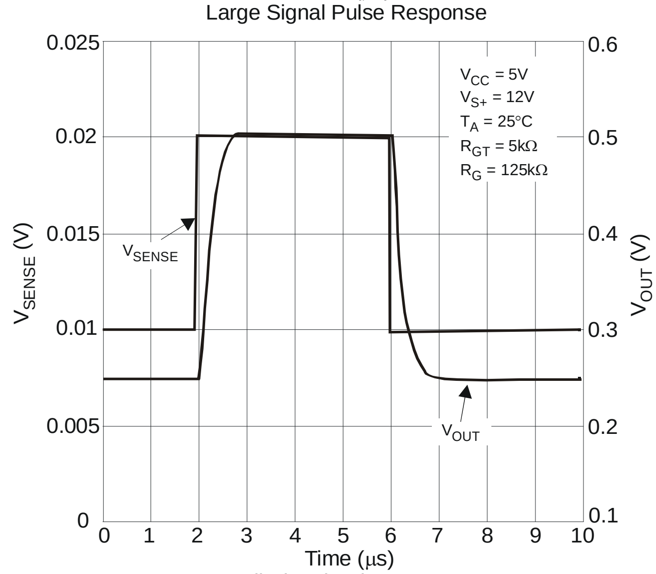
Large Signal Pulse Response



Large Signal Pulse Response

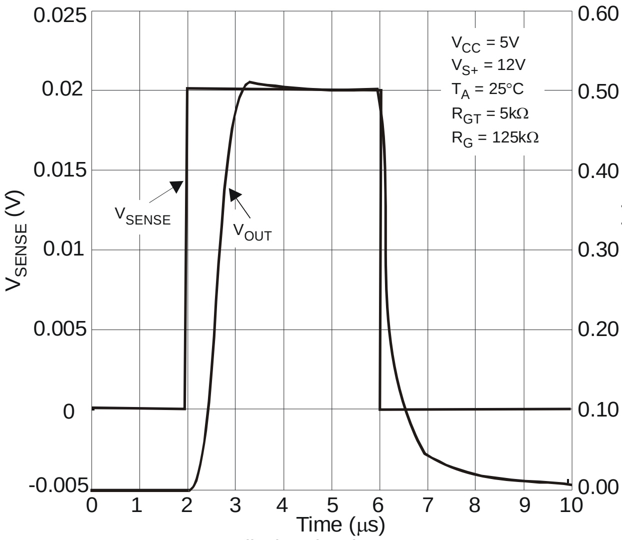


Small Signal Pulse Response

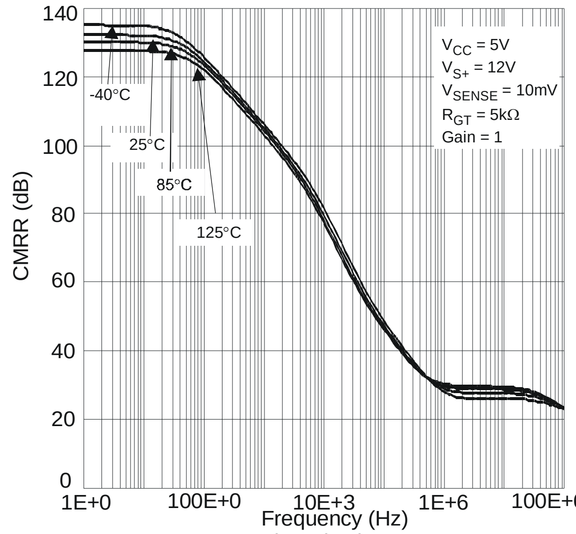


Small Signal Pulse Response

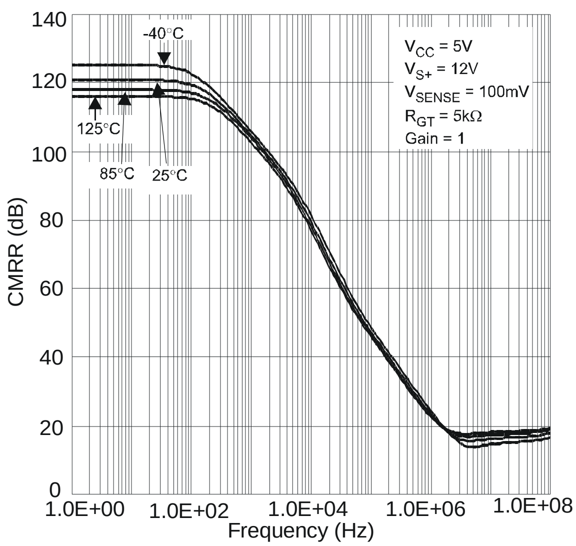
Typical Characteristics (cont.) V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ , T_A = 25°C



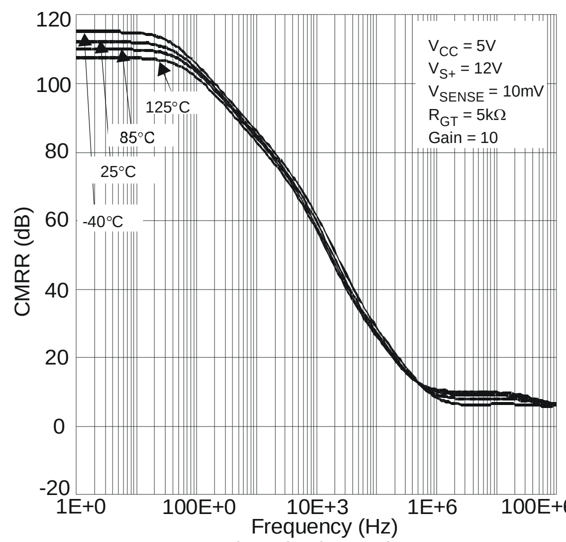
Small Signal Pulse Response



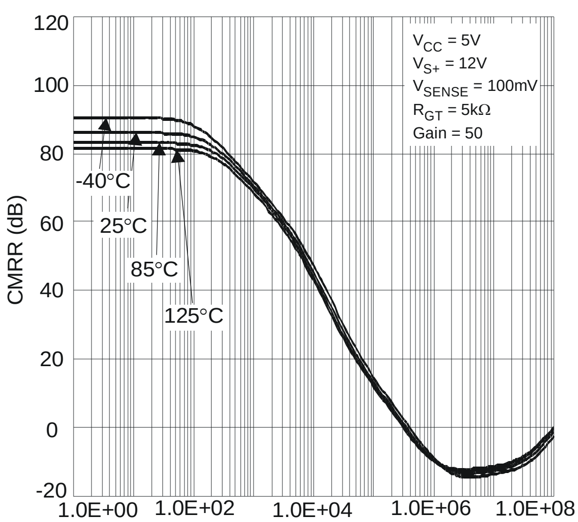
Common Mode Rejection vs. Frequency



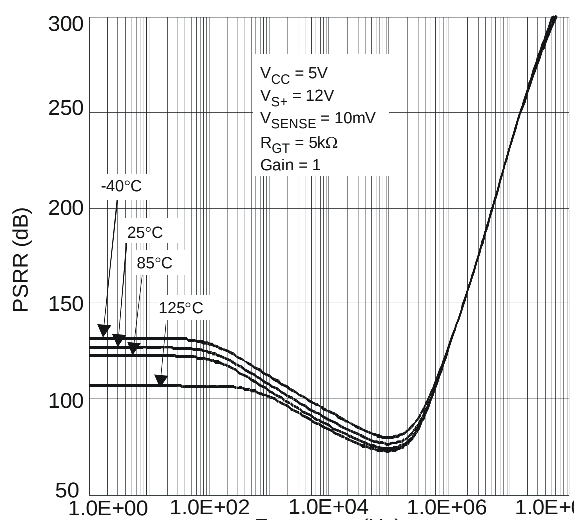
Common Mode Rejection vs. Frequency



Common Mode Rejection Ratio vs. Frequency

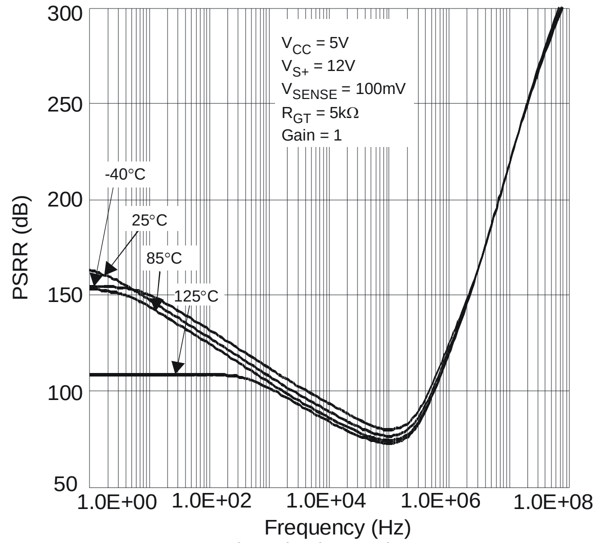


Common Mode Rejection Ratio vs. Frequency

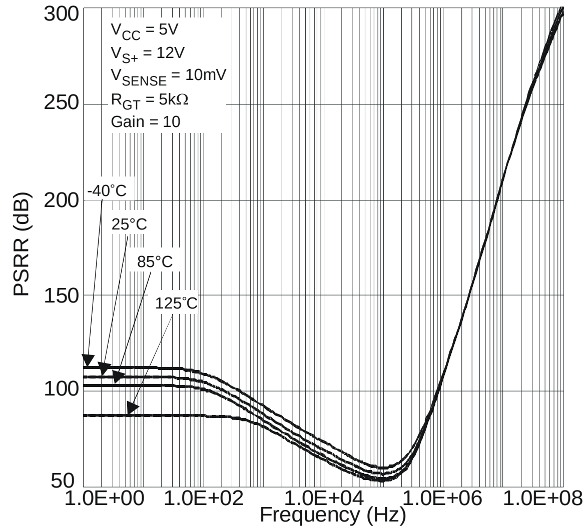


Power Supply Rejection Ration vs. Frequency

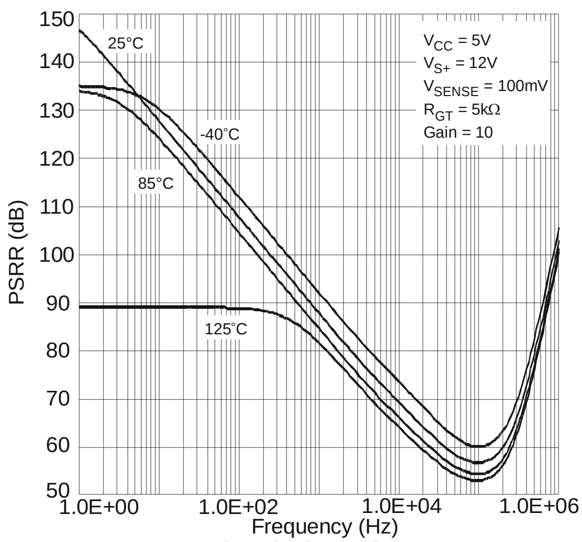
Typical Characteristics (cont.) V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ , T_A = 25°C



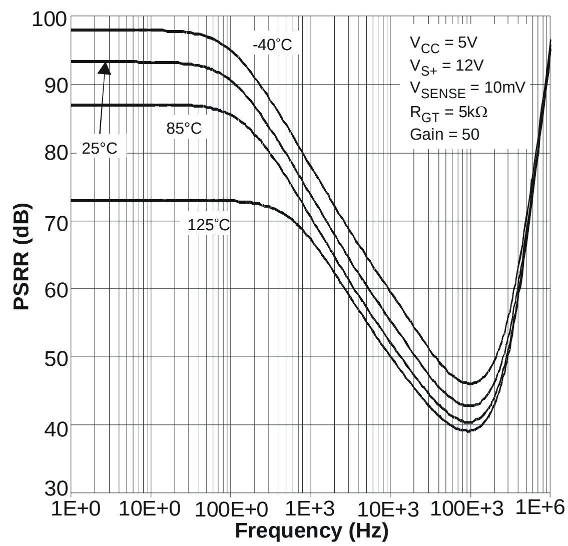
Power Supply Rejection Ration vs. Frequency



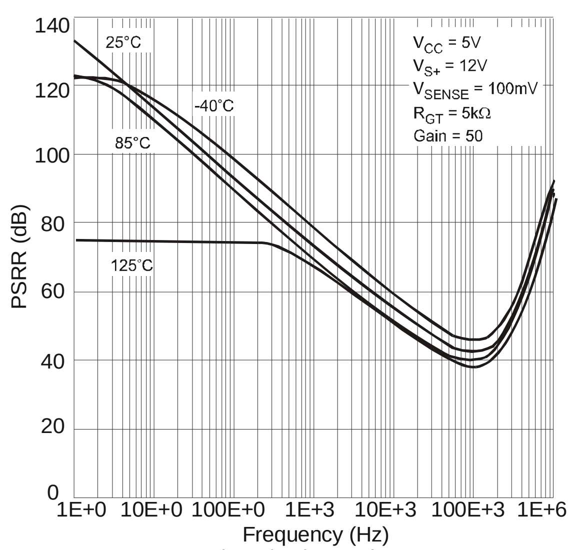
Power Supply Rejection Ration vs. Frequency



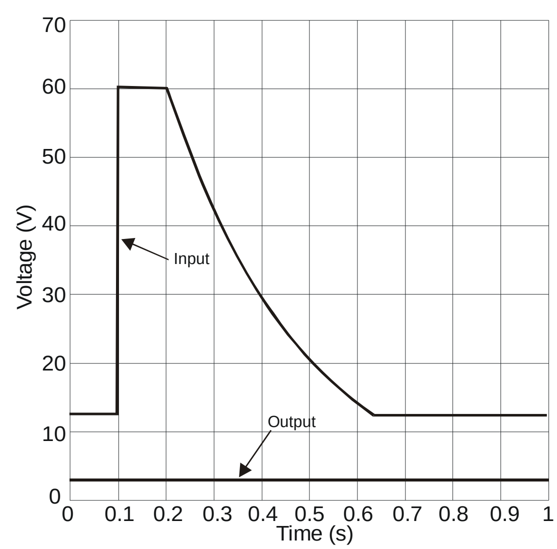
Power Supply Rejection Ration vs. Frequency



Power Supply Rejection Ration vs. Frequency

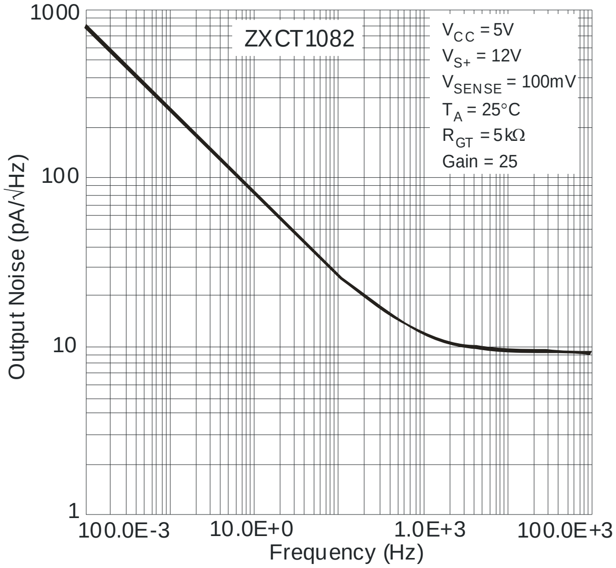


Power Supply Rejection Ratio vs. Frequency

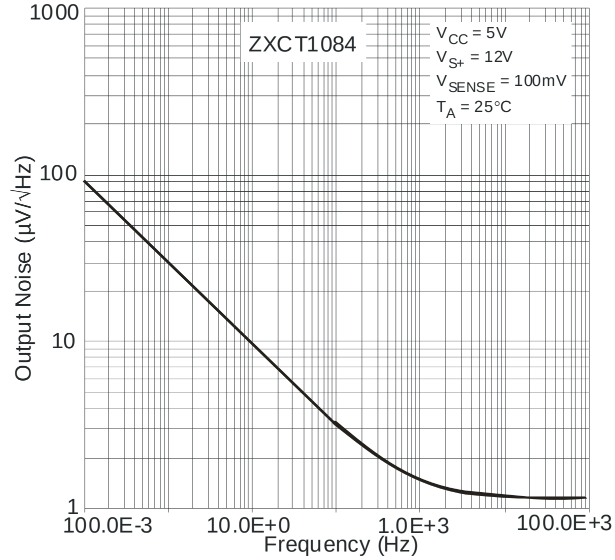


Load Dump vs. Time

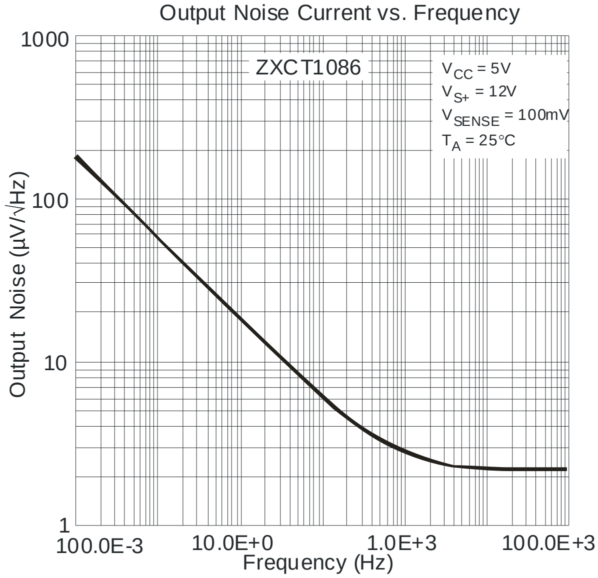
Typical Characteristics (cont.) V_{S+} = 12V, V_{CC} = 5V V_{SENSE} = 100mV, R_{GT} = 5kΩ, R_G = 125kΩ , T_A = 25°C



Output Noise Current vs. Frequency



Output Noise Voltage vs. Frequency



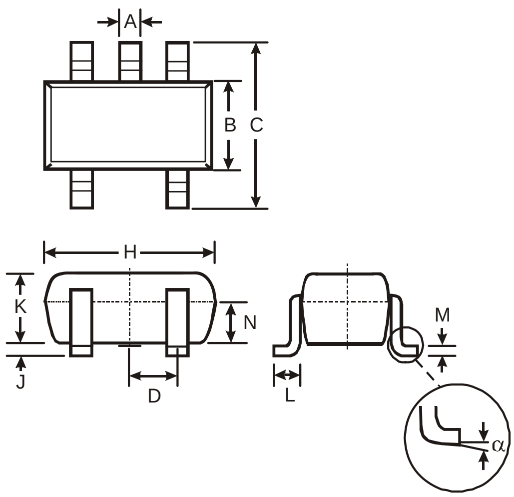
Output Noise Voltage vs. Frequency

Ordering Information

Part Number	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			