



**THE DATASHEET OF
ZXCT1086E5TA**



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.

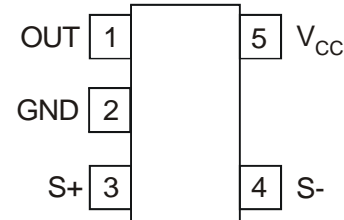
Features

- 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

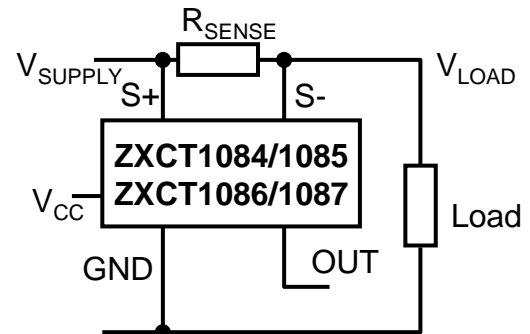
Applications

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

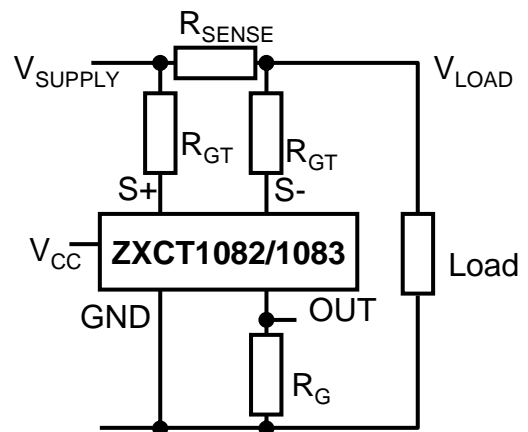
Pin Assignments



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, $V_{S+} - V_{S-}$ | ± 800 | mV |
| Input current into S+ or S- ^(f) | ± 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°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.

^(f) 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°C to $+125^\circ\text{C}$)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|--------------------|--|--|-------------------|-----------------------|-------------------------|-----------------------------|
| Input | | | | | | |
| I_{S+} | S+ input current | $V_{\text{SENSE}} = 0\text{mV}$ (Note 1) | | 1.7 | | μA |
| | | | $T_A = \text{FT}$ | | 5 | |
| I_{S-} | S- input current | $V_{\text{SENSE}} = 0\text{mV}$ (Note 1) | | 1.7 | | μA |
| | | | $T_A = \text{FT}$ | | 5 | |
| V_{IO} | Input Offset Voltage (Note 2) | $V_{\text{SENSE}} = 0\text{mV}$ | | ± 0.2 | ± 1 | mV |
| | | ZXCT1082/3/4/5 | $T_A = \text{FT}$ | | ± 2.5 | |
| | | ZXCT1086/87 | $T_A = \text{FT}$ | | ± 3 | |
| | | Temperature co-efficient | | | | ± 4 |
| Output | | | | | | |
| 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 150mV (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_{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 150mV (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 150mV (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_{OUT} | Output impedance | ZXCT1084/5/6/7 | | | 125 | k Ω |
| V_{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_{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_{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_{SENSE} and calculating the error of the slope vs. the ideal.

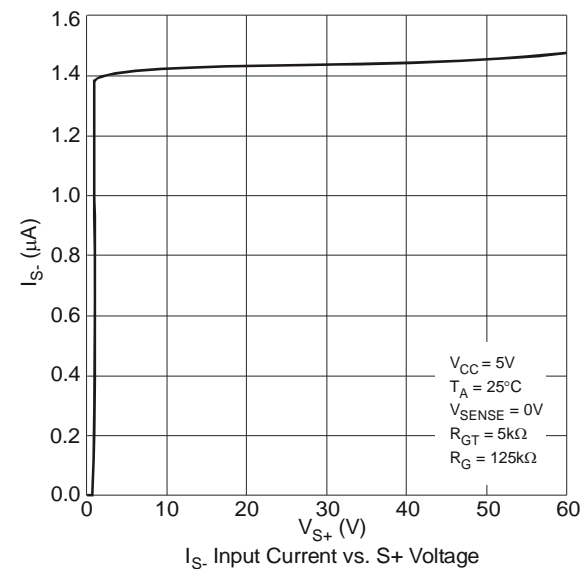
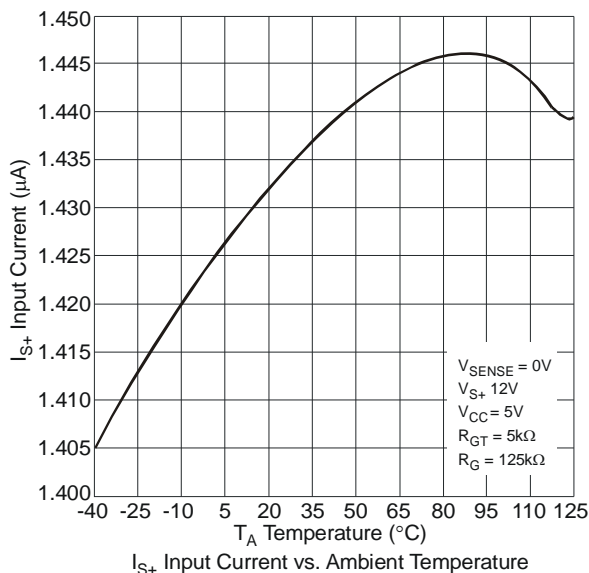
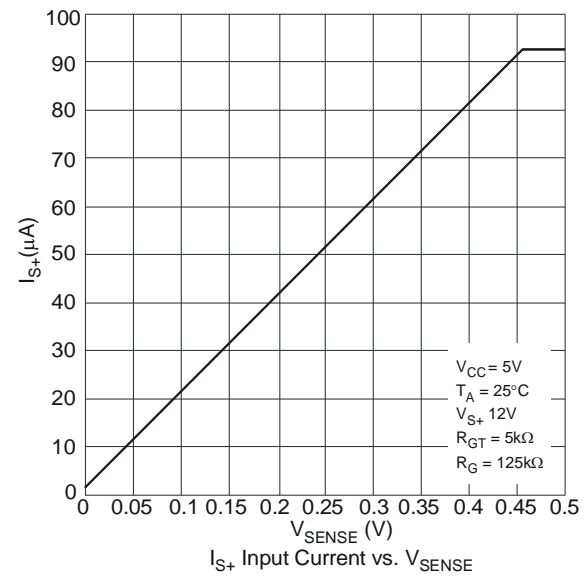
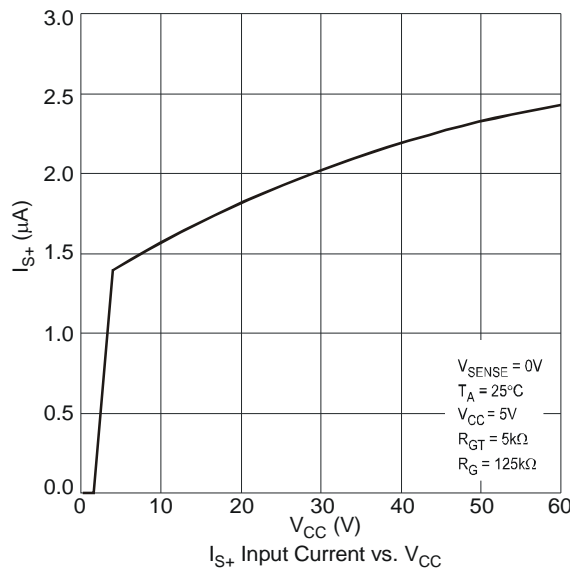
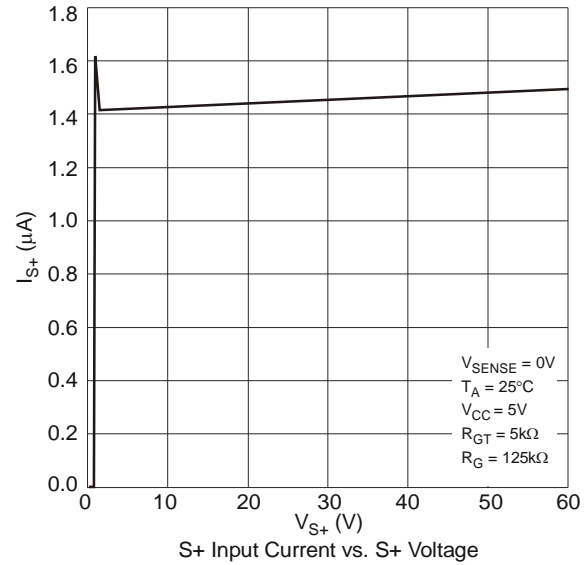
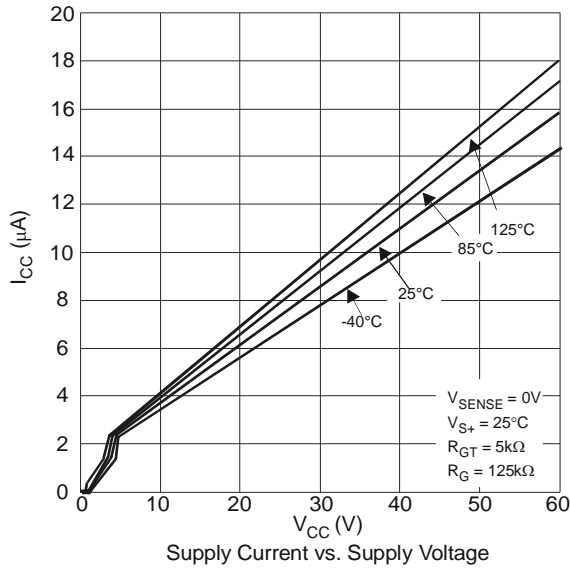
Electrical Characteristics (cont.)

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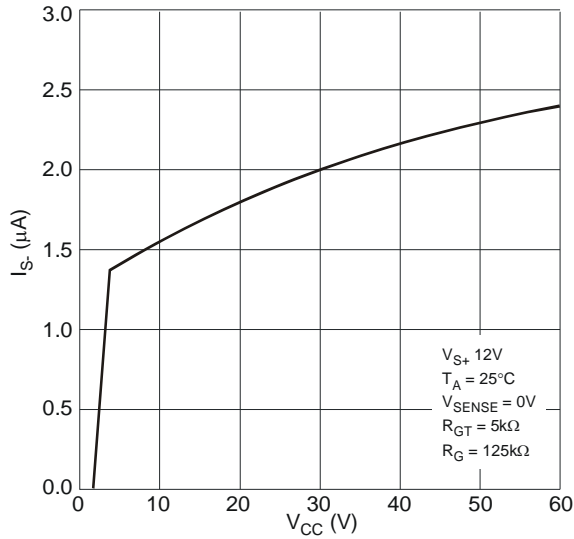
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|----------------------------|--|---|--|--------|------|--------------------------------|
| AC characteristics | | | | | | |
| BW | -3dB Small Signal Bandwidth | $V_{\text{SENSE}}(\text{AC}) = 10\text{mV}_{\text{PP}}$ (Note 1) | G = 25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

Notes: 5. Measured relative to input

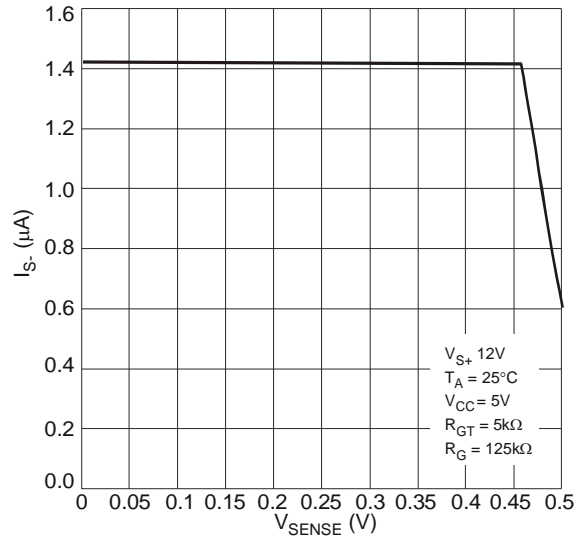
Typical Characteristics $V_{S+} = 12V$, $V_{CC} = 5V$, $V_{SENSE} = 100mV$, $R_{GT} = 5k\Omega$, $R_G = 125k\Omega$, $T_A = 25^\circ C$ unless otherwise stated



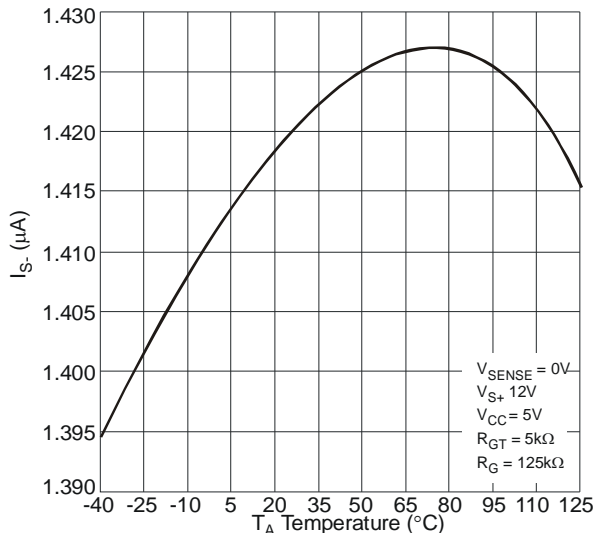
Typical Characteristics (cont.) $V_{S+} = 12V$, $V_{CC} = 5V$, $V_{SENSE} = 100mV$, $R_{GT} = 5k\Omega$, $R_G = 125k\Omega$, $T_A = 25^\circ C$



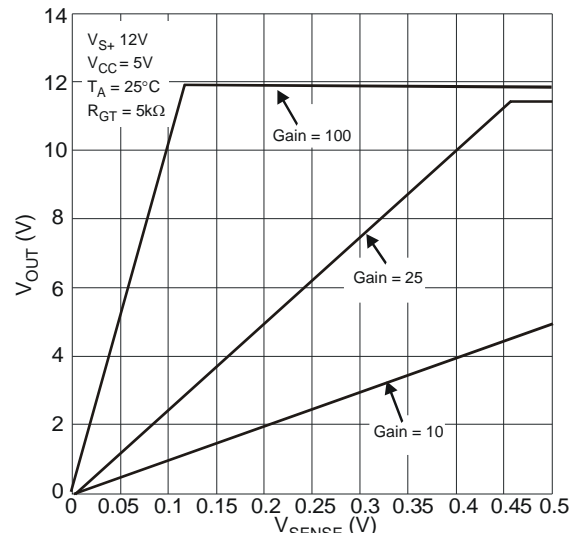
I_S . Input Current vs. Supply Voltage



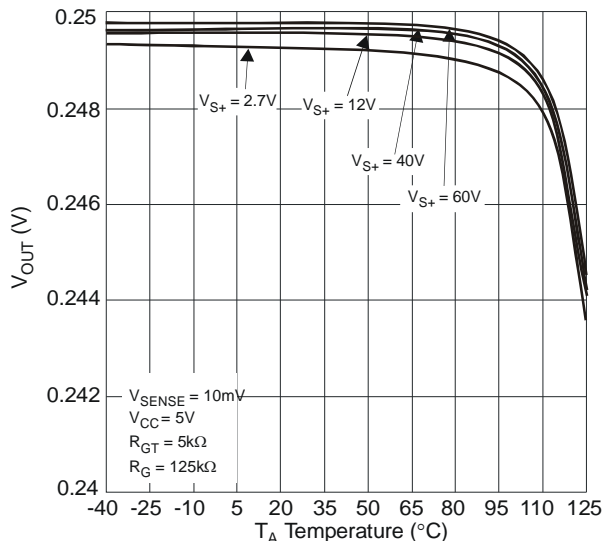
I_S . Input Current vs. V_{SENSE} Different Voltage



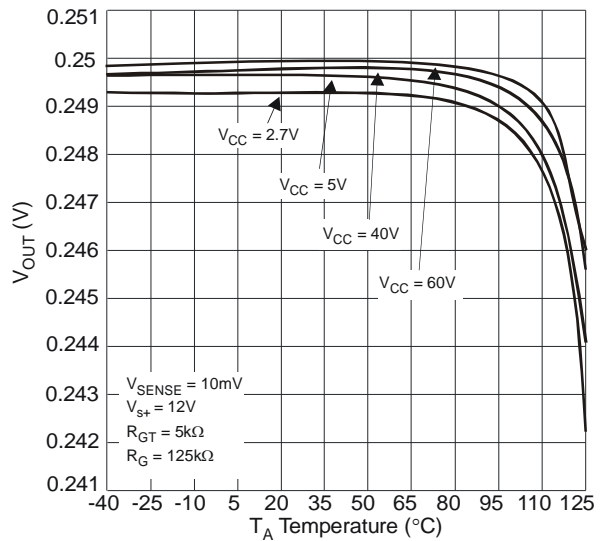
I_S . Input Current vs. Ambient Temperature



Output Voltage vs. V_{SENSE}

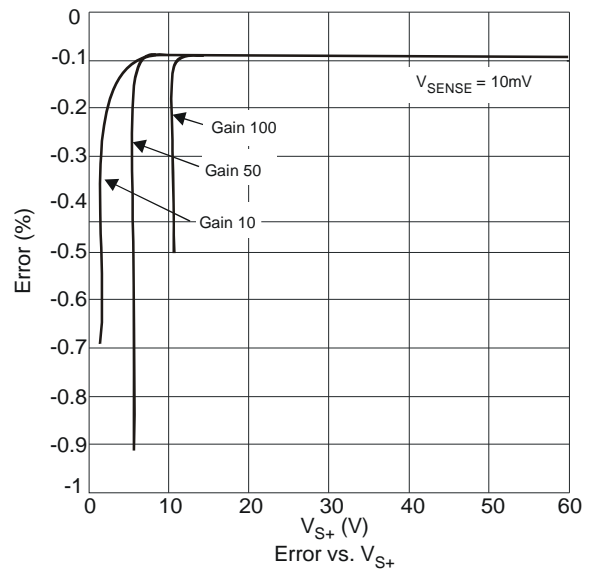
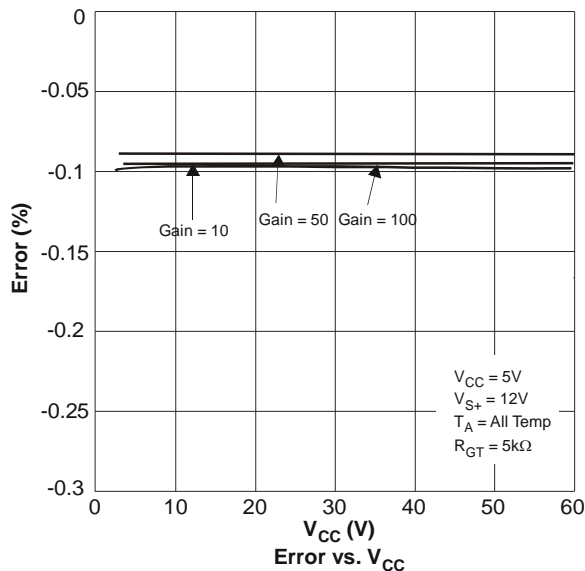
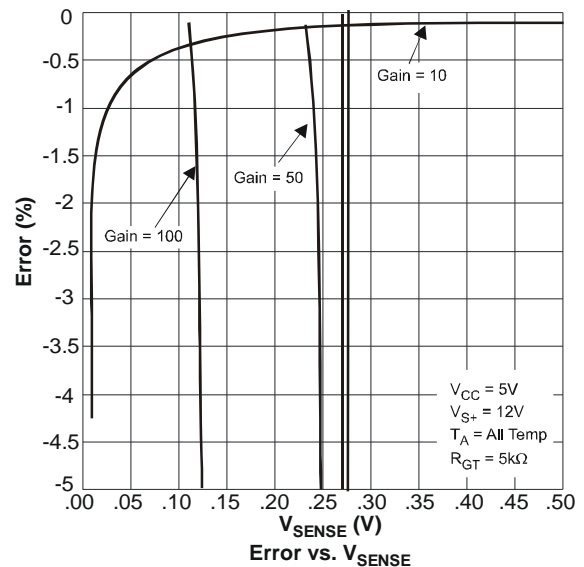
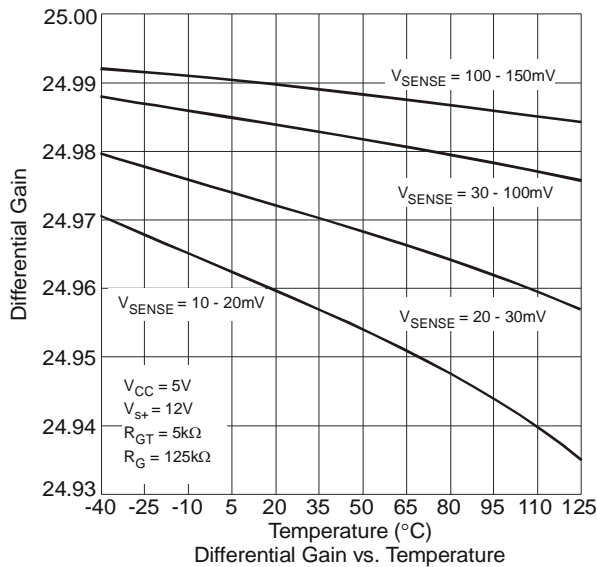
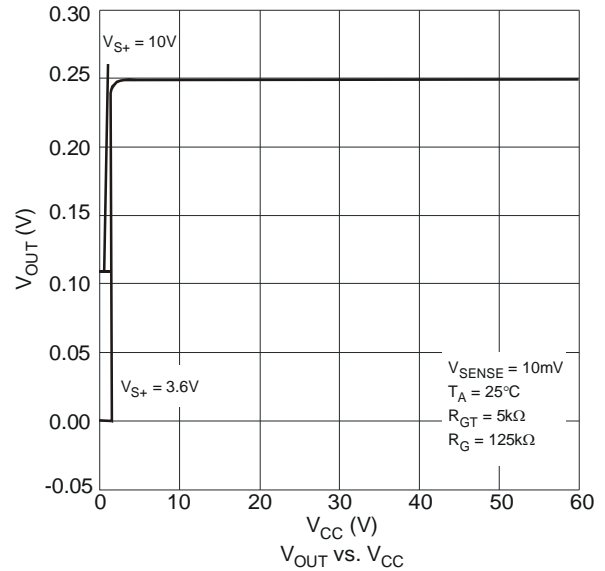
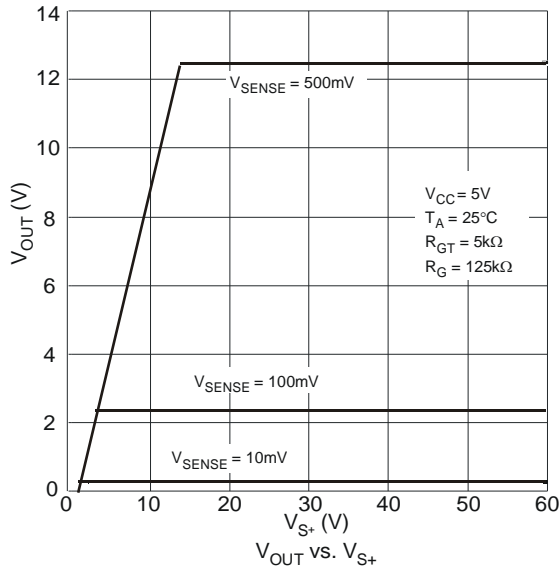


V_{OUT} vs. Ambient Temperature

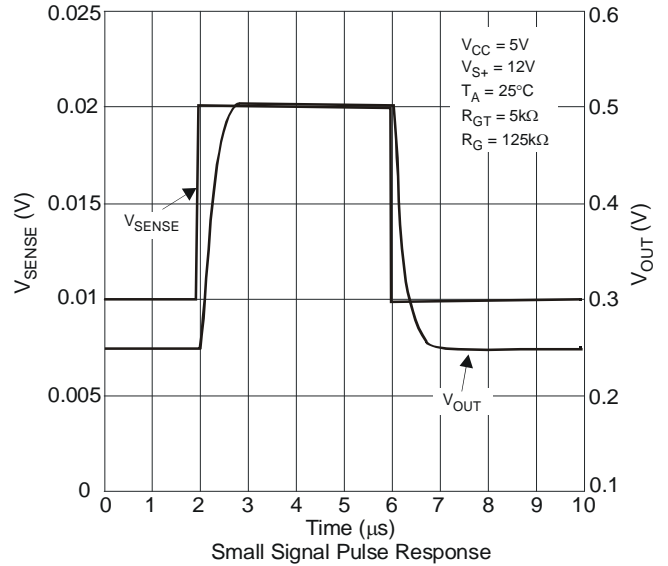
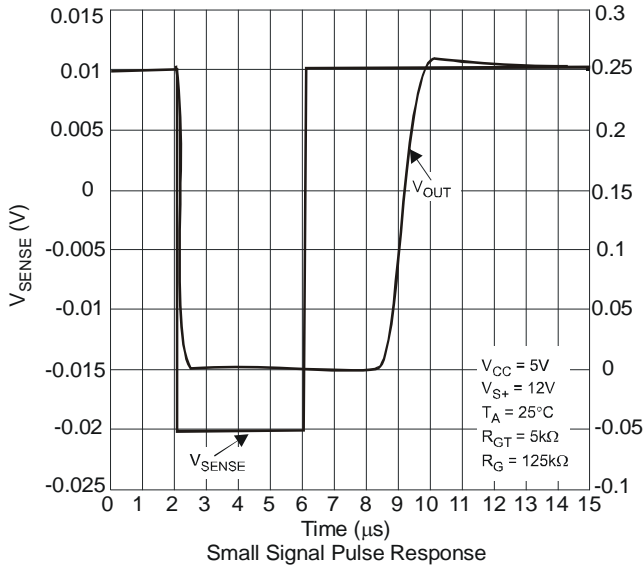
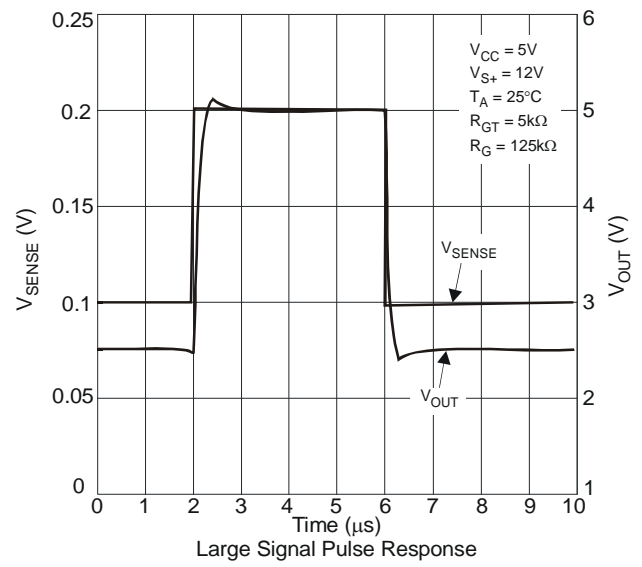
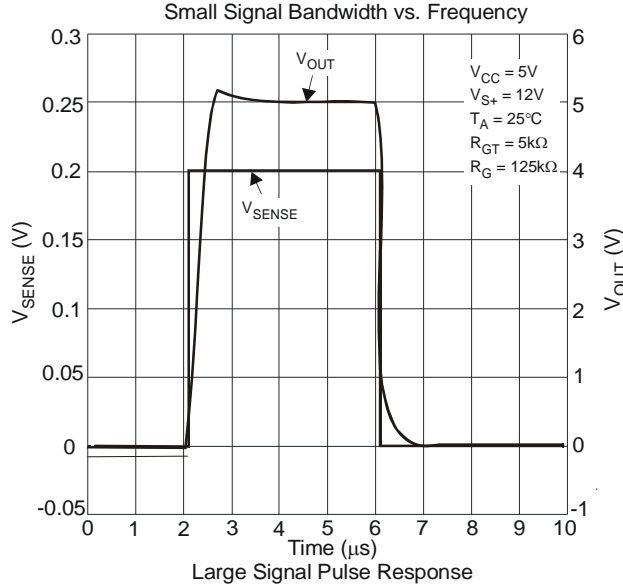
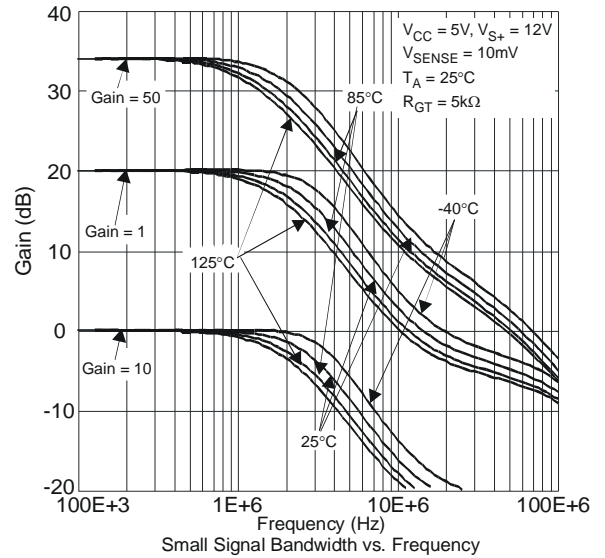
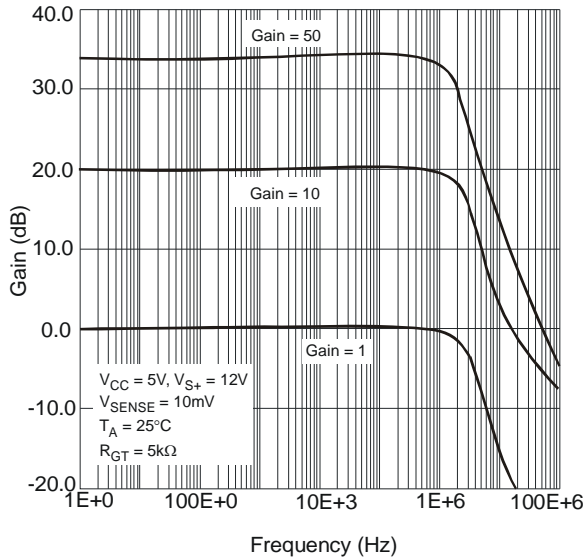


V_{OUT} vs. Ambient Temperature

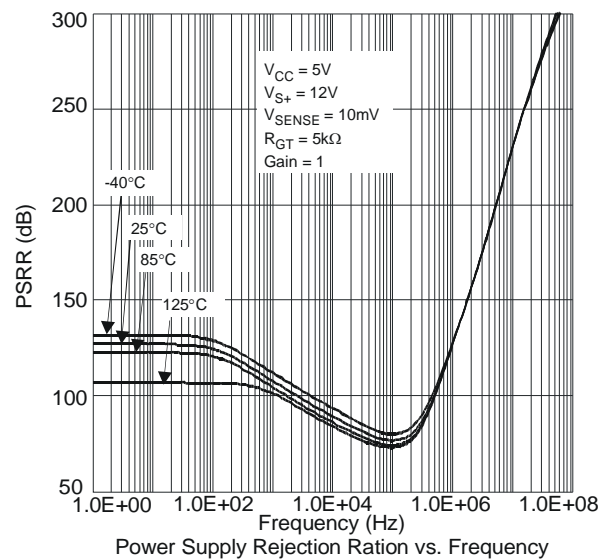
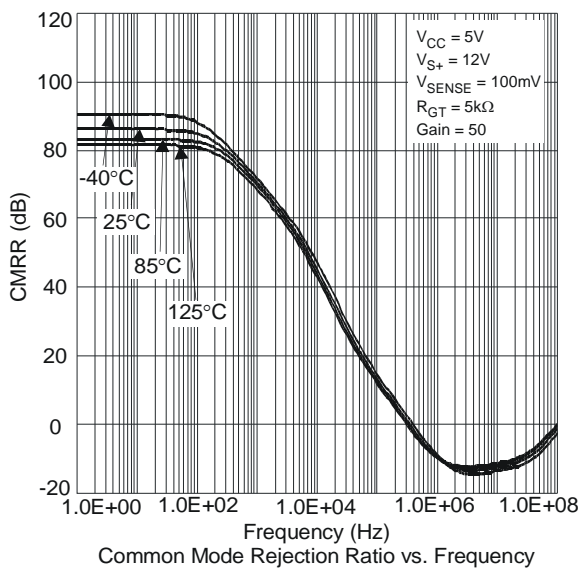
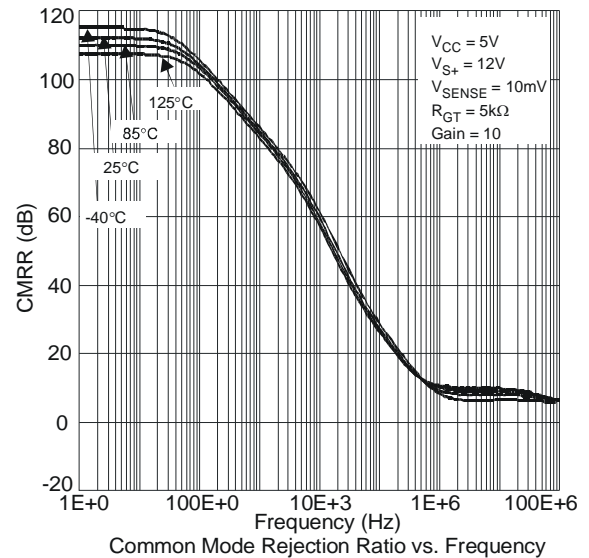
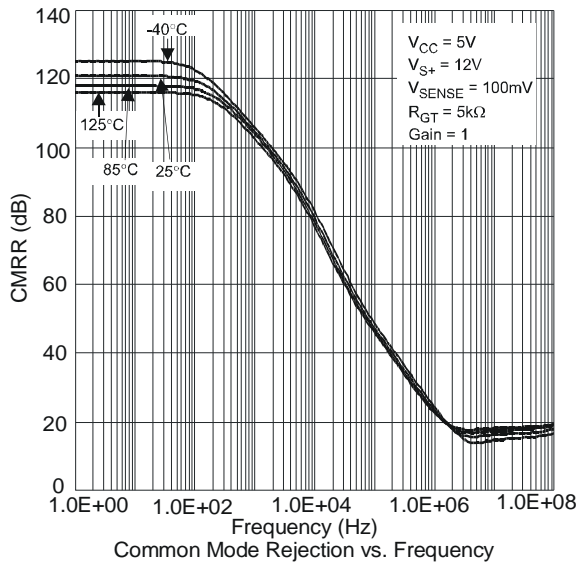
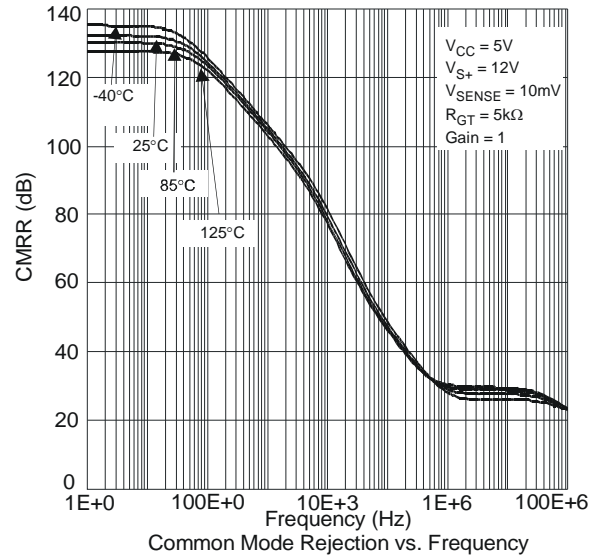
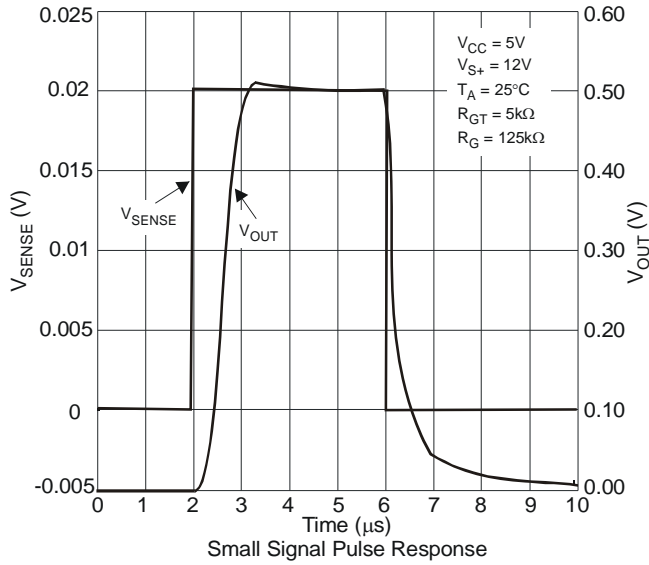
Typical Characteristics (cont.) $V_{S+} = 12V$, $V_{CC} = 5V$, $V_{SENSE} = 100mV$, $R_{GT} = 5k\Omega$, $R_G = 125k\Omega$, $T_A = 25^\circ C$



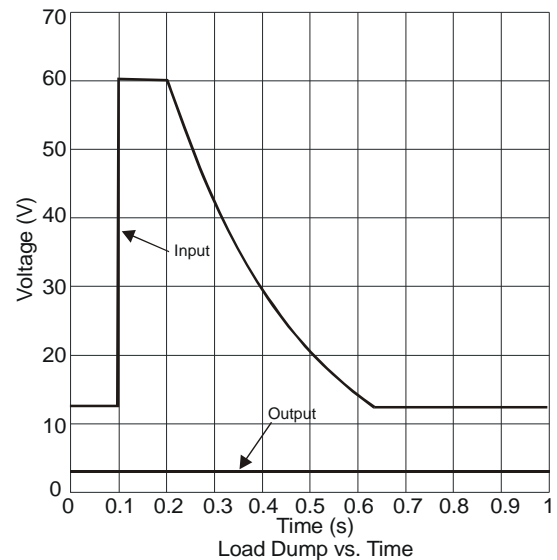
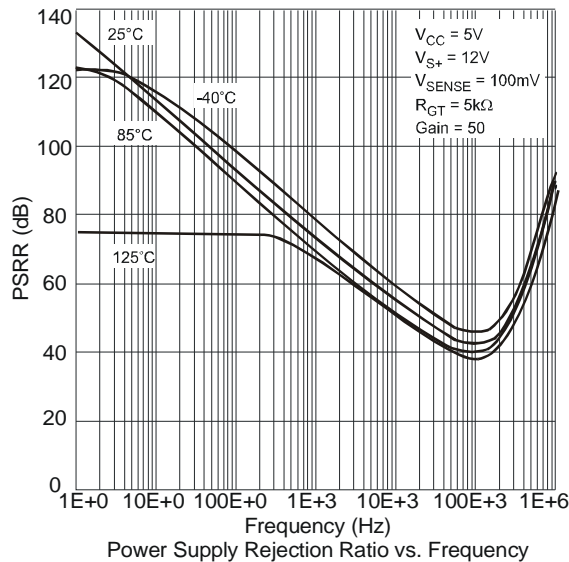
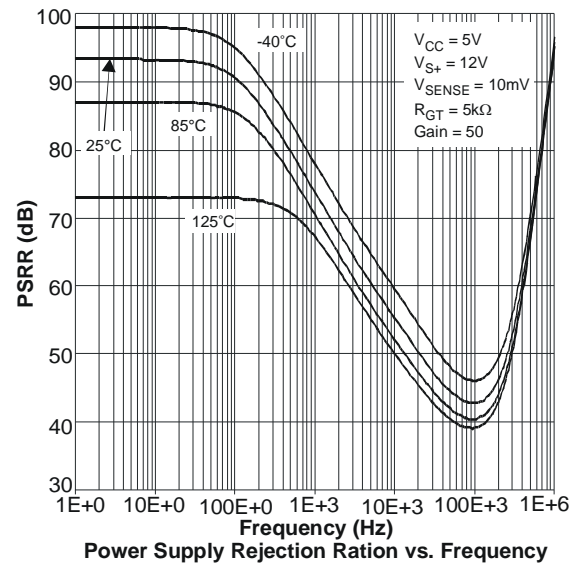
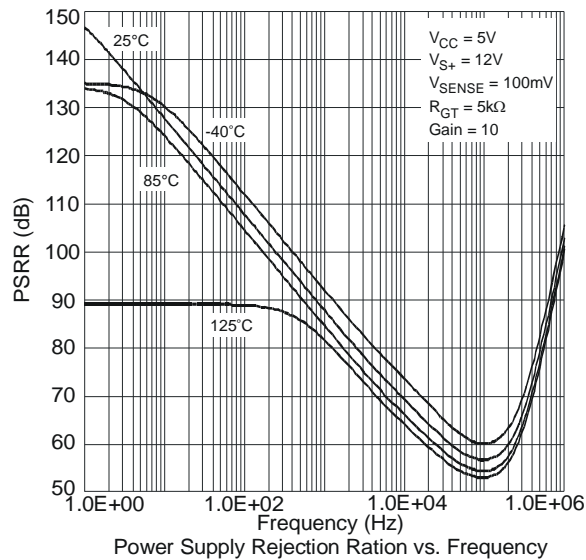
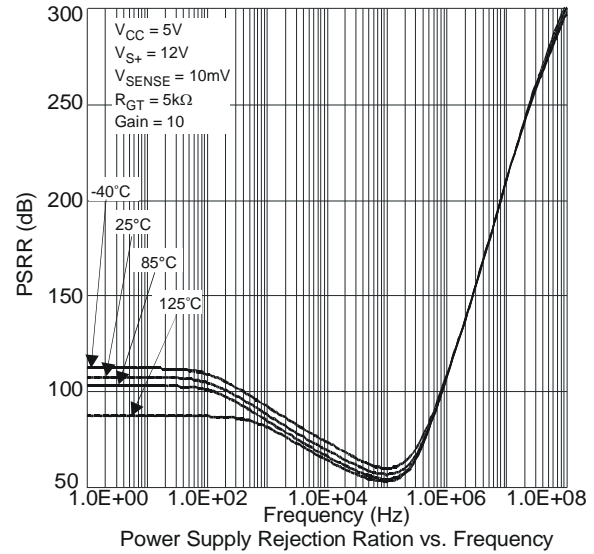
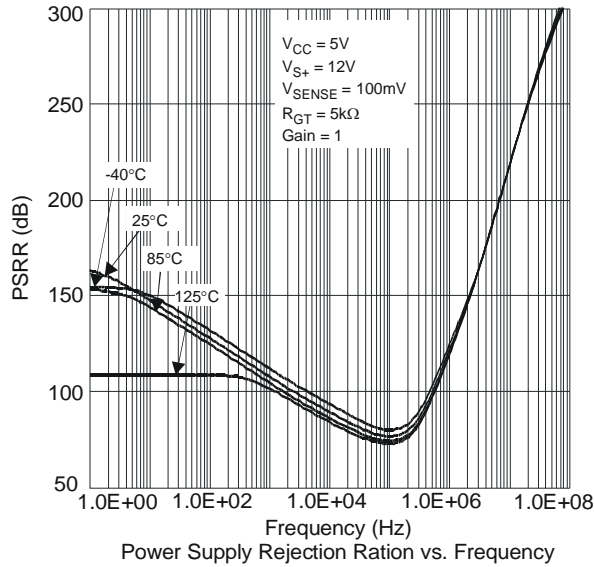
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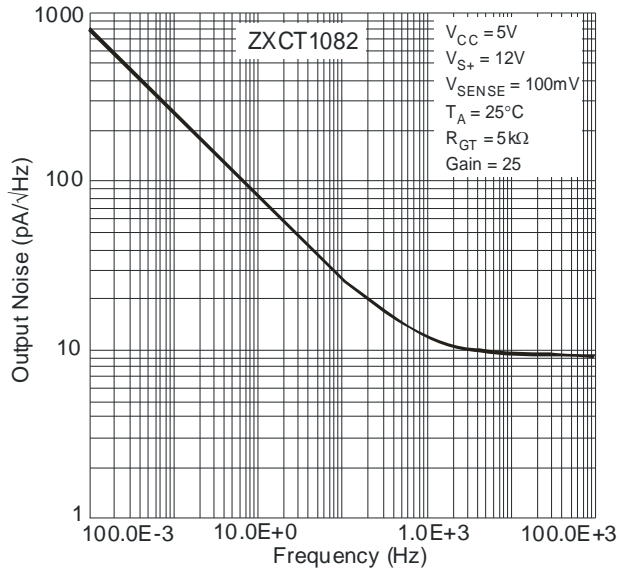
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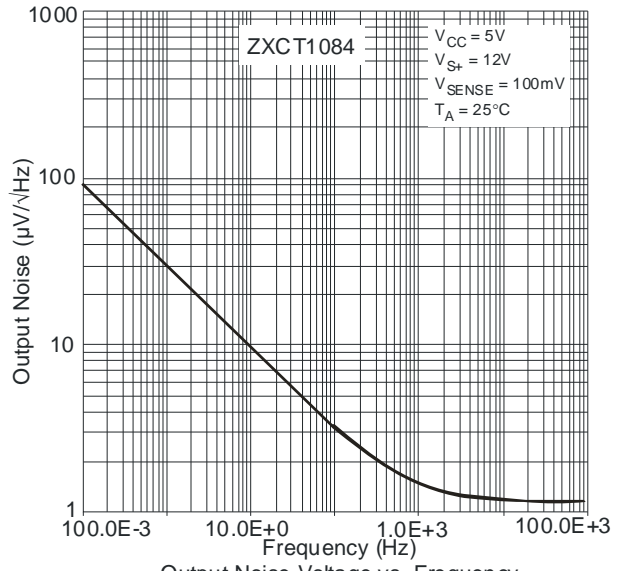
Typical Characteristics (cont.) $V_{S+} = 12V$, $V_{CC} = 5V$, $V_{SENSE} = 100mV$, $R_{GT} = 5k\Omega$, $R_G = 125k\Omega$, $T_A = 25^\circ C$



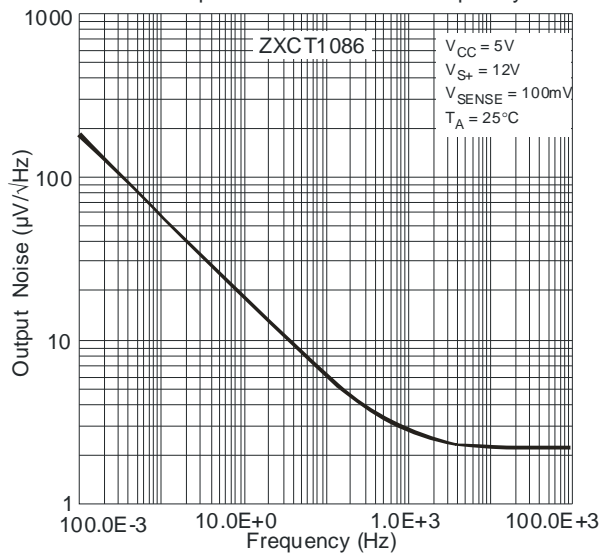
Typical Characteristics (cont.) $V_{S+} = 12V$, $V_{CC} = 5V$, $V_{SENSE} = 100mV$, $R_{GT} = 5k\Omega$, $R_G = 125k\Omega$, $T_A = 25^\circ C$



Output Noise Current vs. Frequency



Output Noise Voltage vs. Frequency



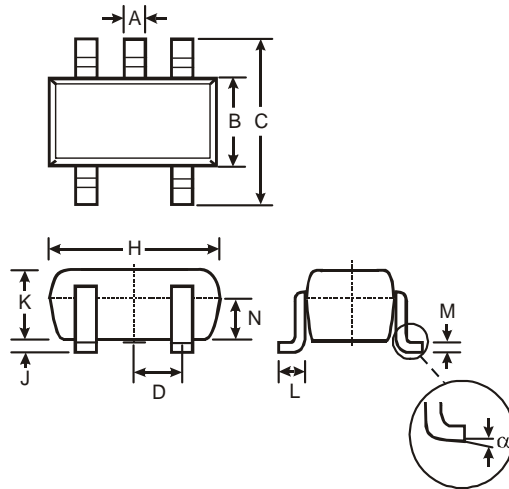
Output Noise Voltage vs. Frequency

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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