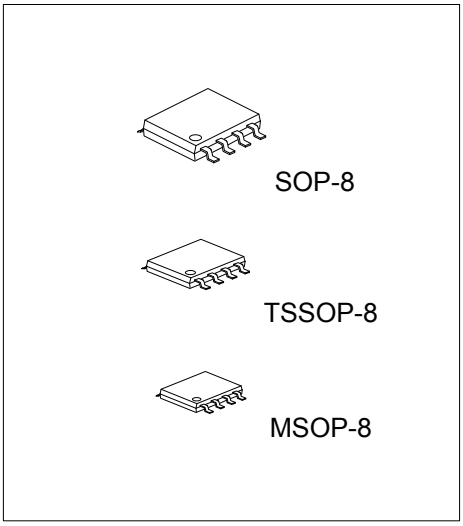
# LV358

**CMOS IC**

## GENERAL PURPOSE, LOW VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS




Lead-free: LV358L
Halogen-free:LV358G

## ■ DESCRIPTION

The UTC **LV358** is a dual op amp with low supply current and low voltage (2.7-5.5V). It brings nice performance to low voltage and low power systems. With a 1MHz unity-gain frequency. The UTC **LV358** has a guaranteed 1 V/μs slew rate and low supply current. It provides heavy rail-to-rail (R-to-R) output swing loads and the input common-mode voltage range including ground. Besides, it is also capable for comfortably driving large capacitive loads.

The UTC **LV358** has bipolar input and CMOS output for improved noise performance and higher output current drive. It's the most cost effective solution for the applications where low voltage operation, space saving and low price are required.

## ■ FEATURES

* 2.7V and 5V Performance Guaranteed
* No Crossover Distortion
* 210μA Low Supply Current
* Rail-to-Rail Output Swing
  @10kΩ Load $V^+$ -10mV
  $V^-$+65mV
* $V_{CM}$ From -0.2V to $V^+$ -0.8V

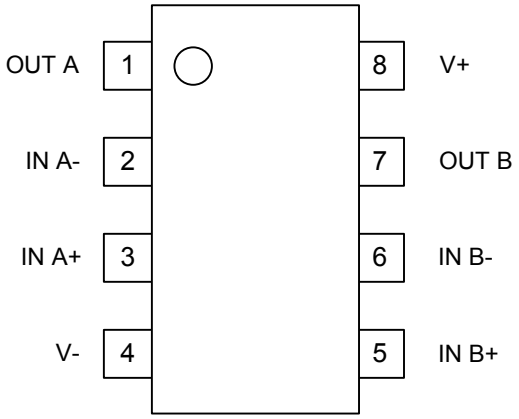
## ■ ORDERING INFORMATION

| Ordering Number | | | Package | Packing |
|---|---|---|---|---|
| Normal | Lead Free Plating | Halogen Free | | |
| LV358-S08-R | LV358L-S08-R | LV358G-S08-R | SOP-8 | Tape Reel |
| LV358-SM1-R | LV358L-SM1-R | LV358G-SM1-R | MSOP-8 | Tape Reel |
| LV358-P08-R | LV358L-P08-R | LV358G-P08-R | TSSOP-8 | Tape Reel |

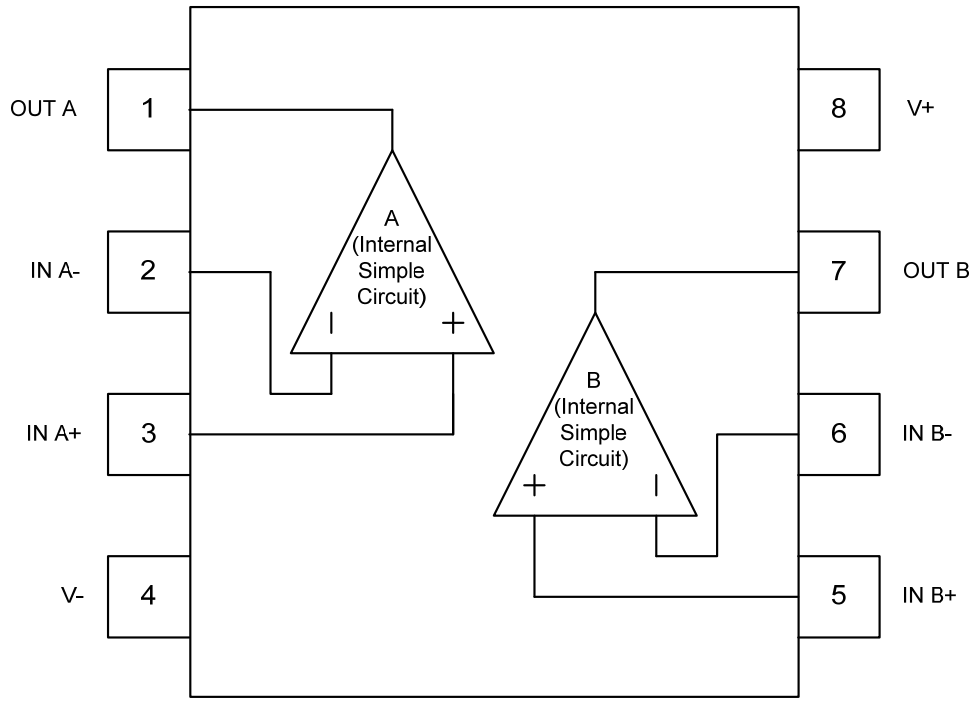
LV358L-S08-R
(1) Packing Type
(2) Package Type
(3) Lead Plating

(1) R: Tape Reel
(2) S08: SOP-8, P08: TSSOP-8, SM1: MSOP-8
(3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn

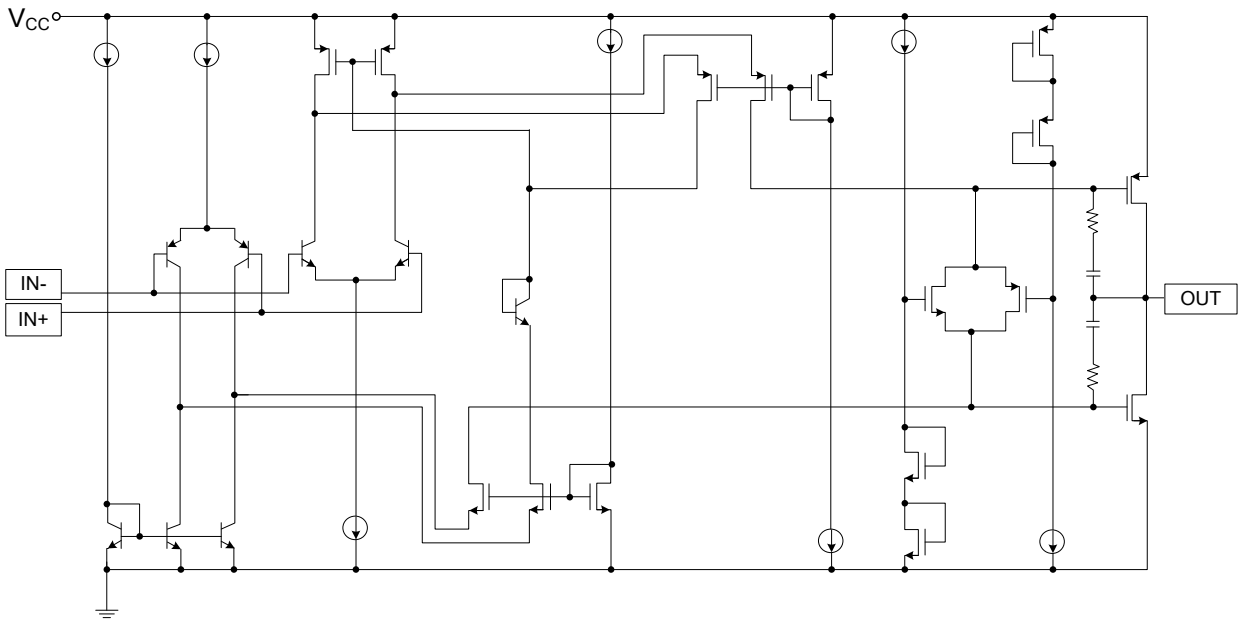
## ■ PIN CONFIGURATION



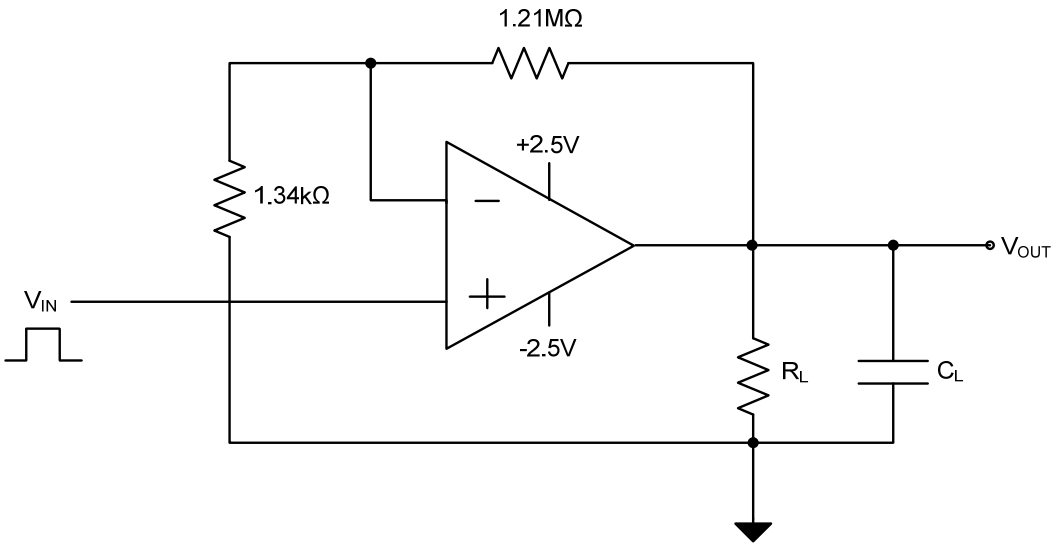
## ■ BLOCK DIAGRAM



## ■ INTERNAL SIMPLE CIRCUIT




## ■ TEST CIRCUIT FOR STABILITY VS CAPACITIVE LOAD



## ■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Supply Voltage | | $V_{SS}$ | 2.7 ~ 5.5 | V |
| Supply Voltage ($V^+$- $V^-$) | | $V_{SS}$ | 5.5 | V |
| Differential Input Voltage | | $V_{I(DIFF)}$ | ±Supply Voltage | |
| Output Short Circuit | $V^+$ | $I_{O(SC)}$ | (Note 2) | |
| | $V^-$ | | (Note 3) | |
| Infrared (15 sec) | | | 215 | °C |
| Junction Temperature | | $T_J$ | +150 | °C |
| Operation Temperature | | $T_{OPR}$ | -40~+85 | °C |
| Storage Temperature | | $T_{STG}$ | -65~+150 | °C |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Shorting output to V+ will adversely affect reliability
3. Shorting output to V- will adversely affect reliability

## ■ THERMAL DATA

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Thermal Resistance (Note 1) | SOP-8 | $\theta_{JA}$ | 190 | °C/W |
| | MSOP-8 | | 235 | °C/W |
| | TSSOP-8 | | 155 | °C/W |

## ■ 2.7V ELECTRICAL CHARACTERISTICS

All limits guaranteed for $T_J$ =25°C, $V^+$=2.7V, $V^-$=0V, $V_{CM}$=1.0V, $V_{OUT}$ =$V^+$/2 and $R_L$>1MΩ, unless otherwise specified.

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| Input Offset Voltage | $V_{OS}$ | | | 1.7 | 7 | mV |
| Input Common Mode Voltage Range | $V_{CM}$ | For CMRR≥50dB | 0 | -0.2 | | V |
| | | | | 1.9 | 1.7 | V |
| Output Swing | $V_{OUT}$ | $R_L$=10kΩ to 1.35V | $V^+$-100 | $V^+$-10 | | mV |
| | | | | 60 | 180 | mV |
| Input Offset Voltage Average Drift | TCVos | | | 5 | | μV/°C |
| Input Bias Current | $I_{I(BIAS)}$ | | | 11 | 250 | nA |
| Input Offset Current | $I_{I(OFF)}$ | | | 5 | 50 | nA |
| Common Mode Rejection Ratio | CMRR | 0V≤$V_{CM}$≤1.7V | 50 | 63 | | dB |
| Power Supply Rejection Ratio | PSRR | 2.7V≤$V^+$ ≤5V, $V_{OUT}$ =1V | 50 | 60 | | dB |
| Supply Current | $I_{SS}$ | Both amplifiers | | 140 | 340 | μA |
| **AC CHARACTERISTICS** | | | | | | |
| Gain Bandwidth Product | GBWP | $C_L$=200pF | | 1 | | MHz |
| Phase Margin | $\Phi_m$ | | | 60 | | Deg |
| Gain Margin | $G_m$ | | | 10 | | dB |
| Input Referred Voltage Noise | eN | F=1kHz | | 46 | | $\frac{nV}{\sqrt{Hz}}$ |
| Input Referred Current Noise | $i_n$ | F=1kHz | | 0.17 | | $\frac{pA}{\sqrt{Hz}}$ |

## ■ 5V ELECTRICAL CHARACTERISTICS

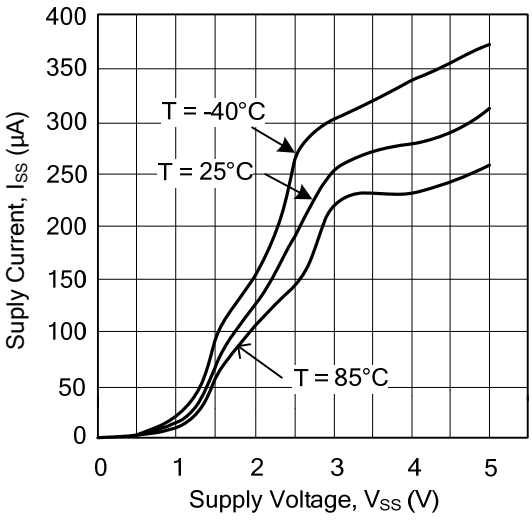
All limits guaranteed for $T_J$ =25°C, $V^+$=5V, $V^-$=0V, $V_{CM}$=2.0V, $V_{OUT}$=$V^+$/2 and $R_L$>1MΩ, unless otherwise specified.

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| Input Offset Voltage | $V_{OS}$ | | | | 1.7 | 7 | mV |
| Input Common-Mode Voltage Range | $V_{CM}$ | For CMRR≥50dB | | 0 | -0.2 | | V |
| | | | | | 4.2 | 4 | V |
| Output Swing | $V_{OUT}$ | $R_L$=2kΩ to2.5V | $V_{OH}$ | $V^+$-300 | $V^+$-40 | | mV |
| | | | $V_{OL}$ | | 120 | 300 | mV |
| | | $R_L$=10kΩ to 2.5V | $V_{OH}$ | $V^+$-100 | $V^+$-10 | | mV |
| | | | $V_{OL}$ | | 65 | 180 | mV |
| Input Offset Voltage Average Drift | TCVos | | | | 5 | | μV/°C |
| Input Bias Current | $I_{I(BIAS)}$ | | | | 15 | 300 | nA |
| Input Offset Current | $I_{I(OFF)}$ | | | | 5 | 50 | nA |
| Common Mode Rejection Ratio | CMRR | 0V≤$V_{CM}$≤4V | | 50 | 65 | | dB |
| Power Supply Rejection Ratio | PSRR | 2.7V≤$V^+$≤5V<br>$V_{OUT}$=1V, $V_{CM}$=1V | | 50 | 60 | | dB |
| Large Signal Voltage Gain(Note 1) | $G_V$ | $R_L$=2kΩ | | 15 | 100 | | V/mV |
| Output Short Circuit Current | $I_{OUT}$ | Sourcing, $V_{OUT}$ =0V | | 5 | 230 | | mA |
| | | Sinking, $V_{OUT}$ =5V | | 10 | 160 | | mA |
| Supply Current | $I_{SS}$ | Both Amplifiers | | | 210 | 440 | μA |
| **AC CHARACTERISTICS** | | | | | | | |
| Slew Rate | SR | (Note 2) | | | 1 | | V/μs |
| Gain Bandwidth Product | GBWP | $C_L$=200pF | | | 1 | | MHz |
| Phase Margin | $\Phi_m$ | | | | 60 | | Deg |
| Gain Margin | $G_m$ | | | | 10 | | dB |
| Input Referred Voltage Noise | eN | f=1kHz | | | 39 | | $\frac{nV}{\sqrt{Hz}}$ |
| Input Referred Current Noise | $i_n$ | f=1kHz | | | 0.21 | | $\frac{pA}{\sqrt{Hz}}$ |

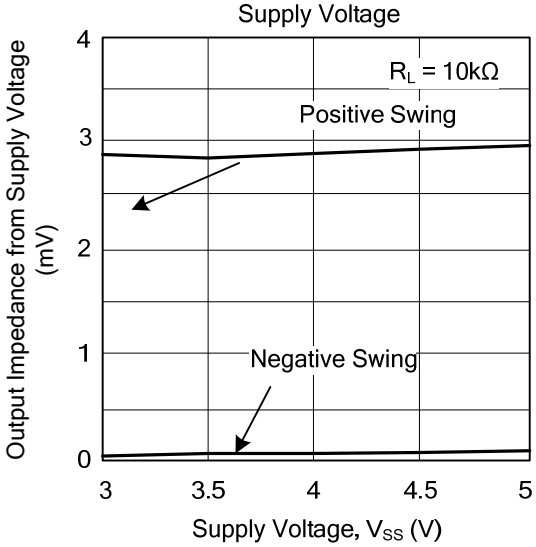
Notes: 1. $R_L$ is connected to $V^-$. The output voltage is 0.5V≤$V_{OUT}$≤4.5V.
2. Connected as voltage follower with 3V step input. Number specified is these lower of the positive and negative slew rates
3. All numbers are typical, and apply for packages soldered directly note a PC board is still air.

## ■ TYPICAL CHARACTERISTICS

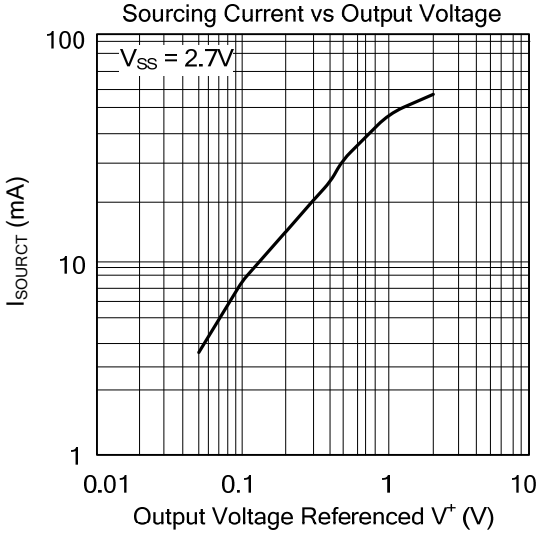
Supply Current vs Supply Voltage



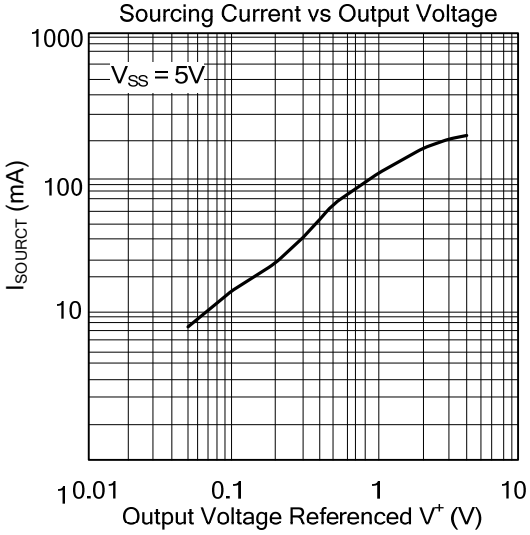

Output Voltage Swing vs Supply Voltage



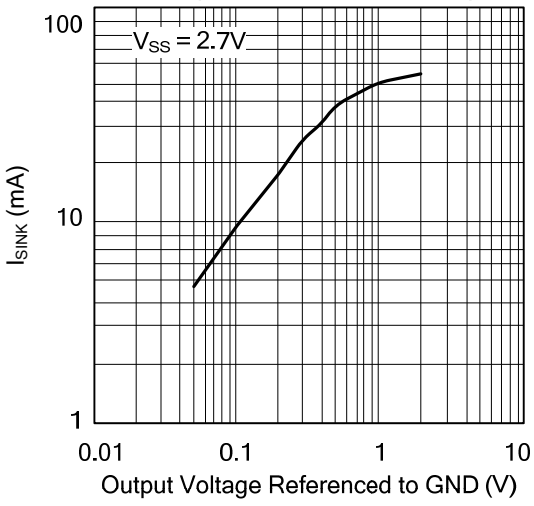

Sourcing Current vs Output Voltage



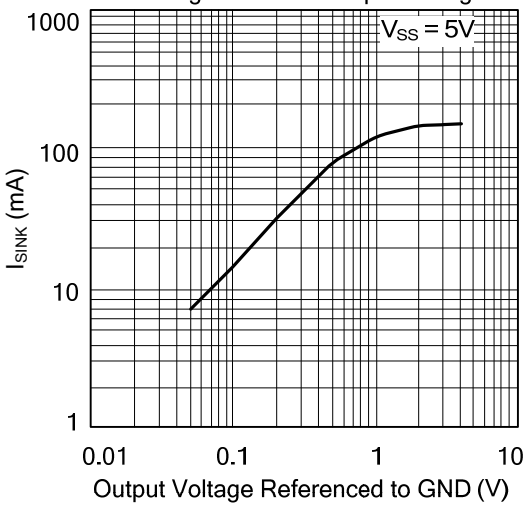

Sourcing Current vs Output Voltage



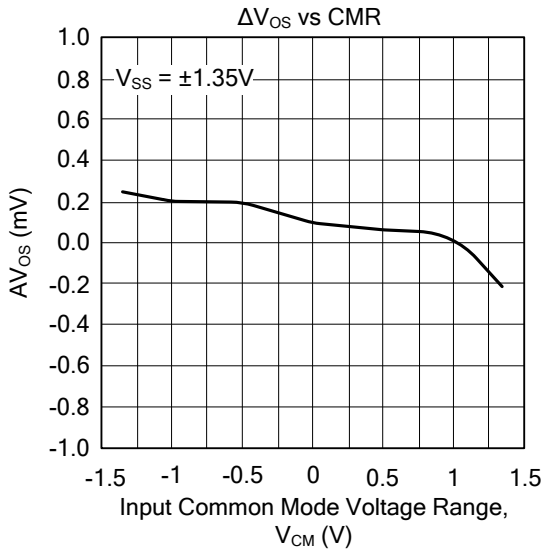

Sinking Current vs Output Voltage

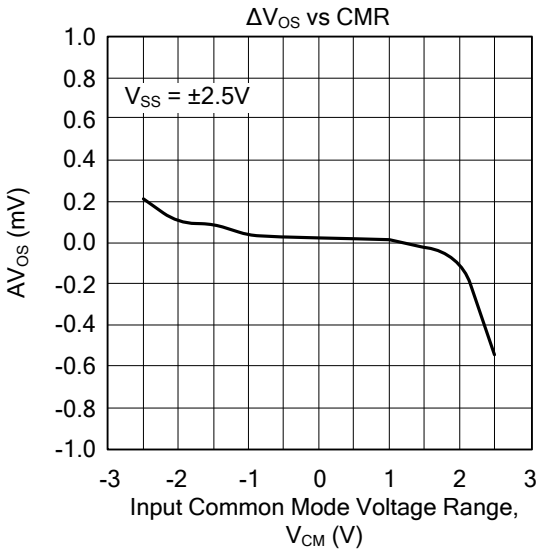


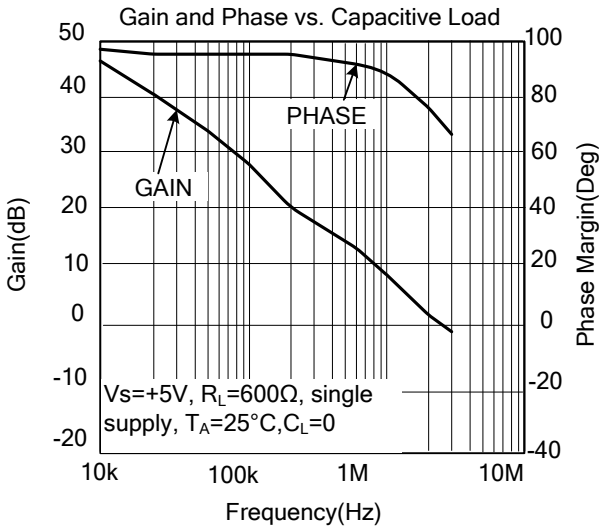

Sinking Current vs Output Voltage

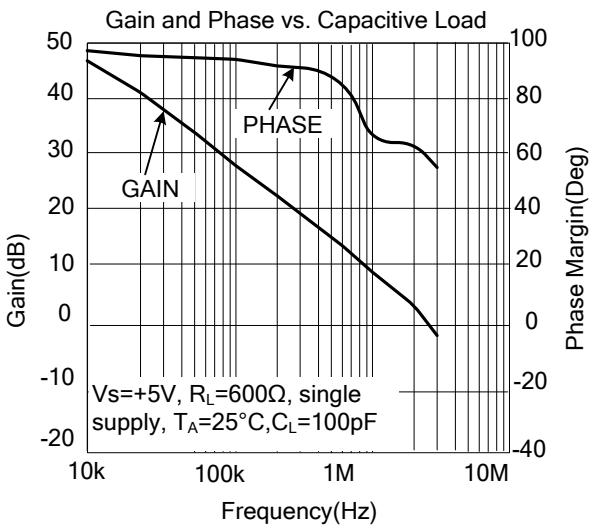


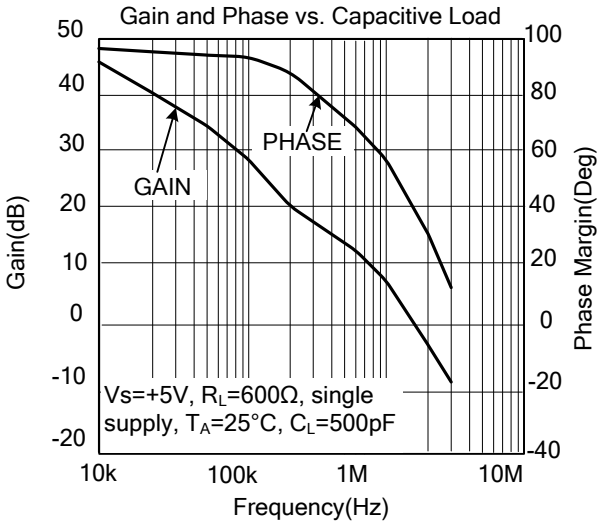
■ TYPICAL CHARACTERISTICS(Cont.)

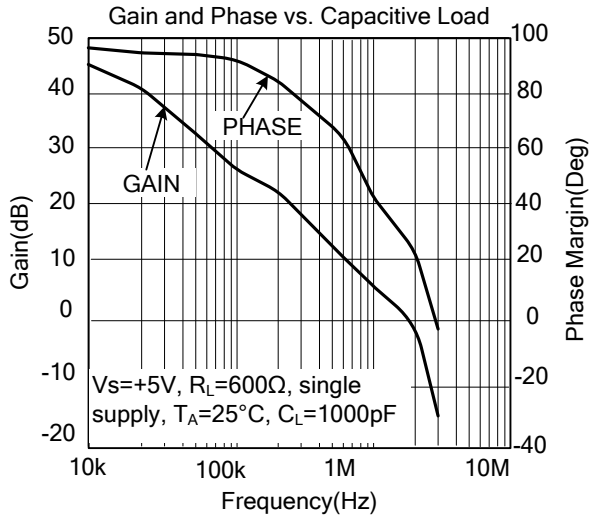


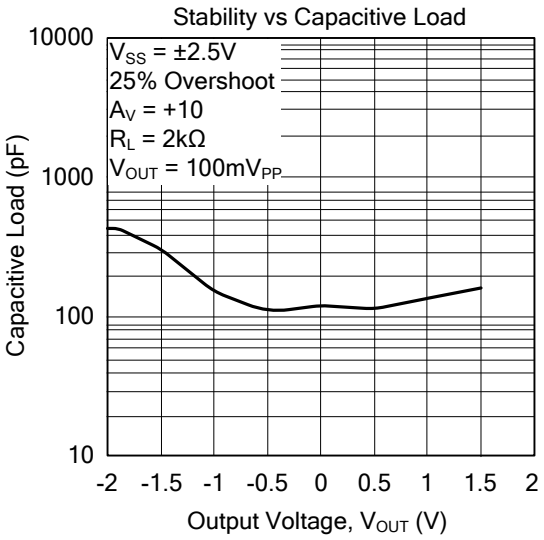



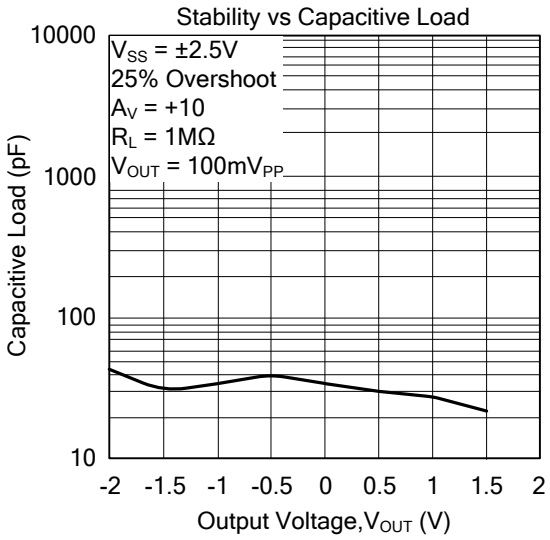



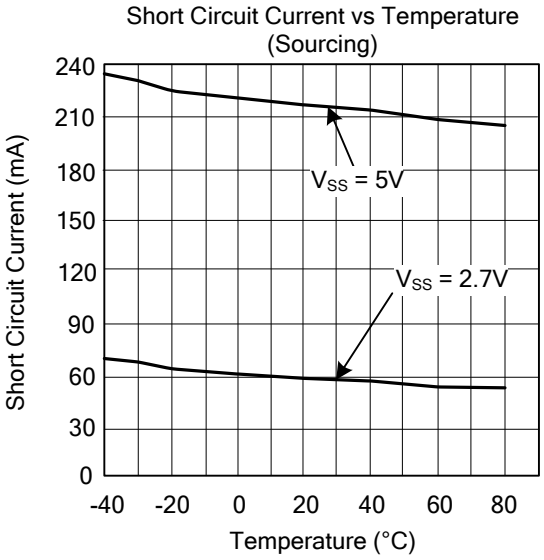



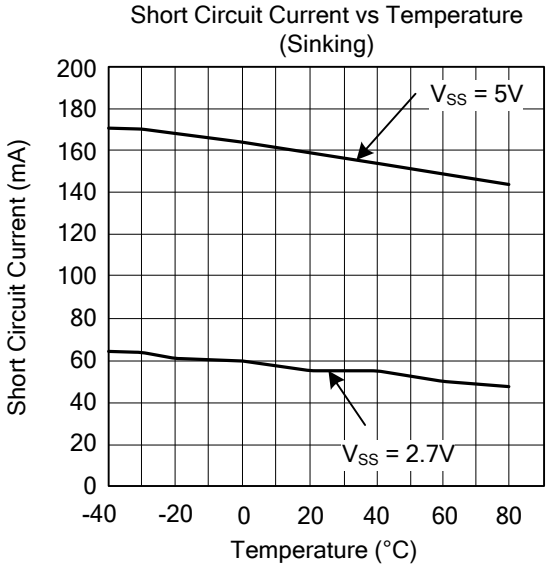



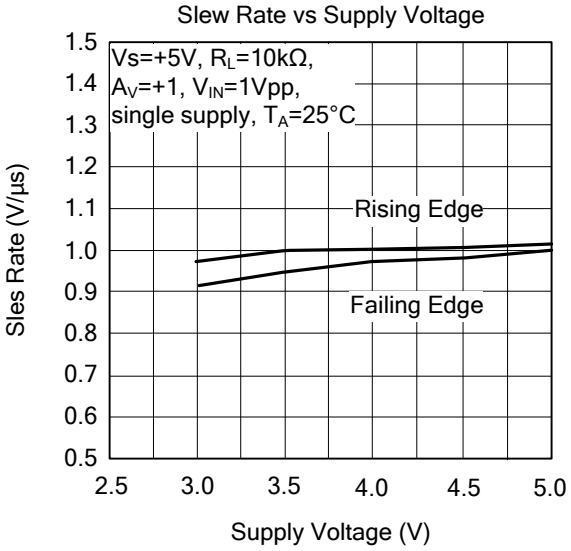
## ■ TYPICAL CHARACTERISTICS(Cont.)



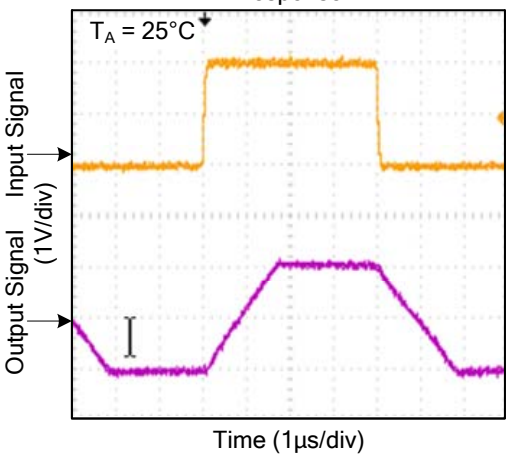



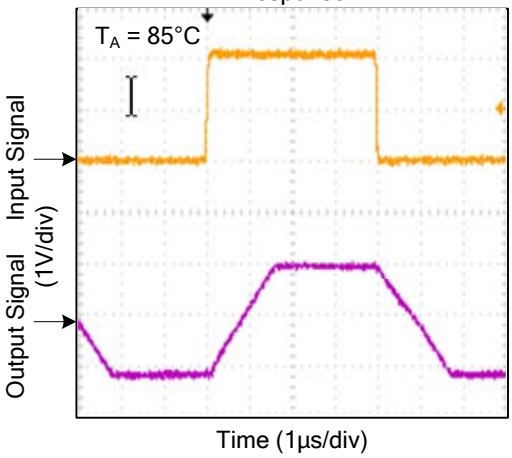



■ TYPICAL CHARACTERISTICS(Cont.)

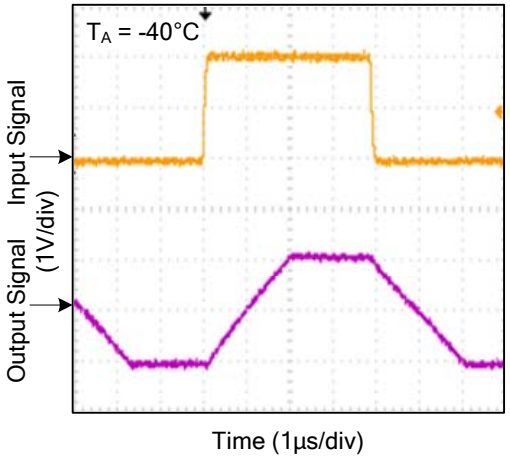
Non-Inverting Large Signal Pulse Response



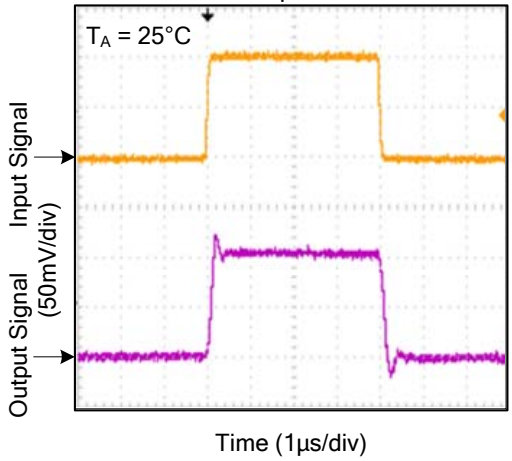

Non-Inverting Large Signal Pulse Response




Non-Inverting Large Signal Pulse Response




Non-Inverting Small Signal Pulse Response

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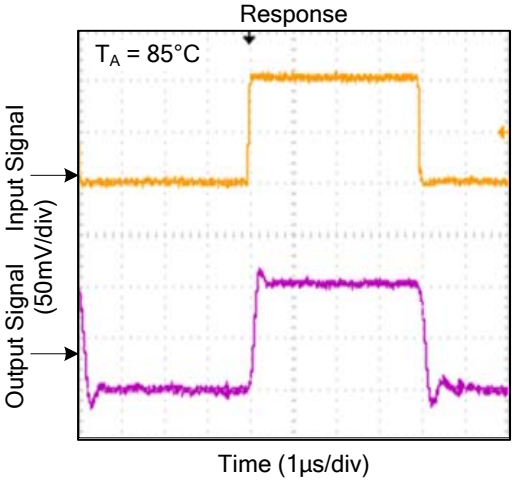
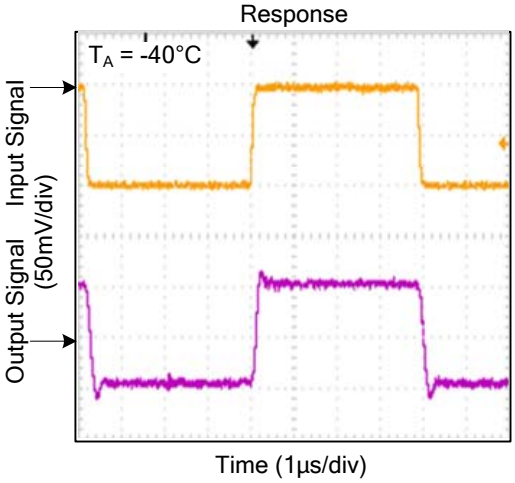
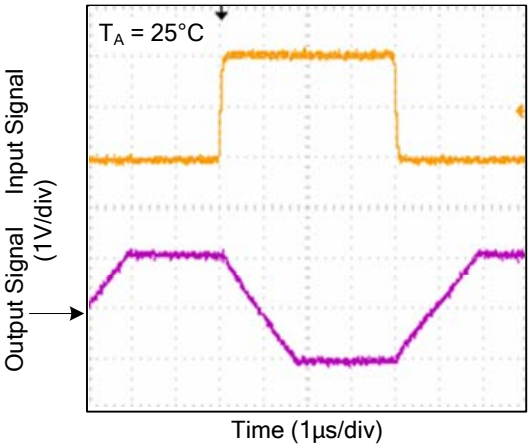



Non-Inverting Small Signal Pulse Response

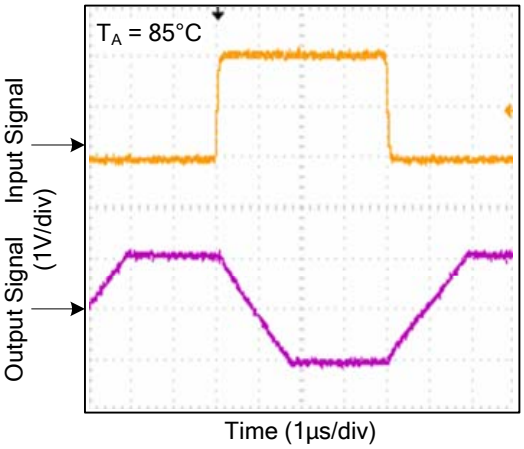


■ TYPICAL CHARACTERISTICS(Cont.)

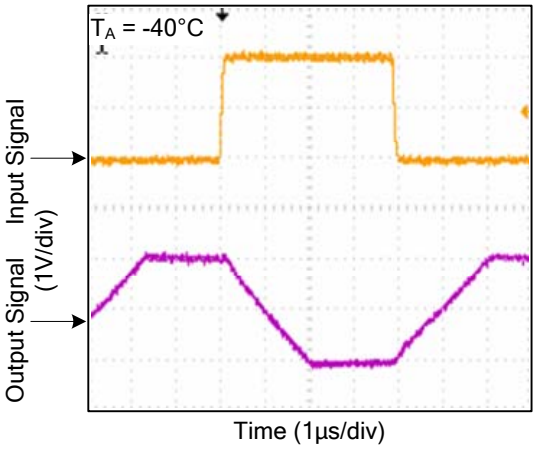
Inverting Large Signal Pulse Response




Inverting Large Signal Pulse Response




Inverting Large Signal Pulse Response

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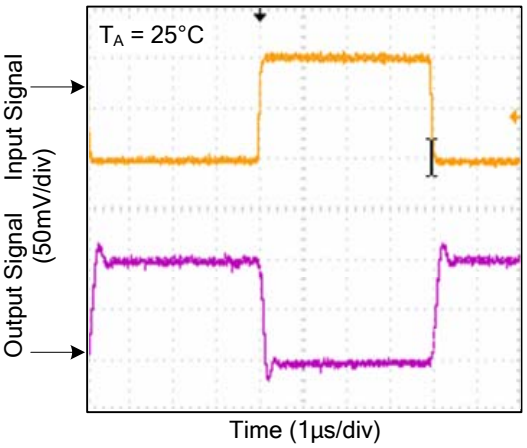


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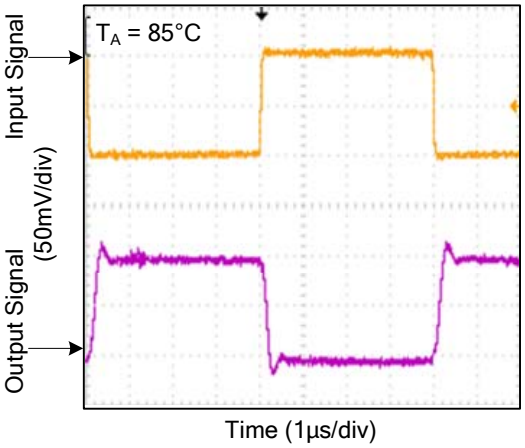


Inverting Small Signal Pulse Response