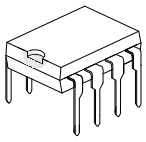
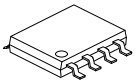
MC34072

*LINEAR INTEGRATED CIRCUIT*

# HIGH SLEW RATE, WIDE BANDWIDTH , SINGLE SUPPLY OPERATIONAL AMPLIFIER



DIP-8



SOP-8

MSOP-8

TSSOP-8

## ■ DESCRIPTION

The UTC **MC34072** offer 4.5MHz of gain bandwidth product, 13V/μs slew rate and fast setting time without the use of JFET device technology. Although it can be operated from split supplies, it is particularly suited for single supply operation, since the common mode input voltage range includes ground potential ($V_{EE}$). With A Darlington input stage, it exhibits high input resistance, low input offset voltage and high gain. The all NPN output stage, characterized by no deadband crossover distortion and large output voltage swing, provides high capacitance drive capability, excellent phase and gain margins, low open loop high frequency output impedance and symmetrical source/sink AC frequency response.

## ■ FEATURES

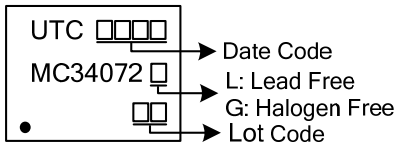
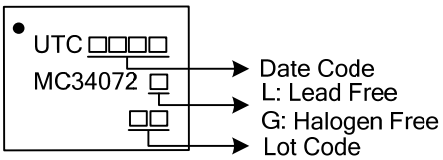
* Wide bandwidth: 4.5 MHz
* High slew rate: 13V/μs
* Fast settling time:1.1μs to 0.1%
* Wide single supply operation: 3.0V to 44V
* Wide input common mode voltage range:
  Includes ground ($V_{EE}$)
* Low input offset voltage: 3.0mV maximum
* Large output voltage swing: -14.7V to +14V
  (with +-15V supplies)
* Large capacitance drive Capability: 0pF to 10,000 pF
* Low total harmonic distortion: 0.02%
* Excellent phase margin: 60°
* Excellent gain margin: 12dB
* Output short circuit protection

## ■ ORDERING INFORMATION

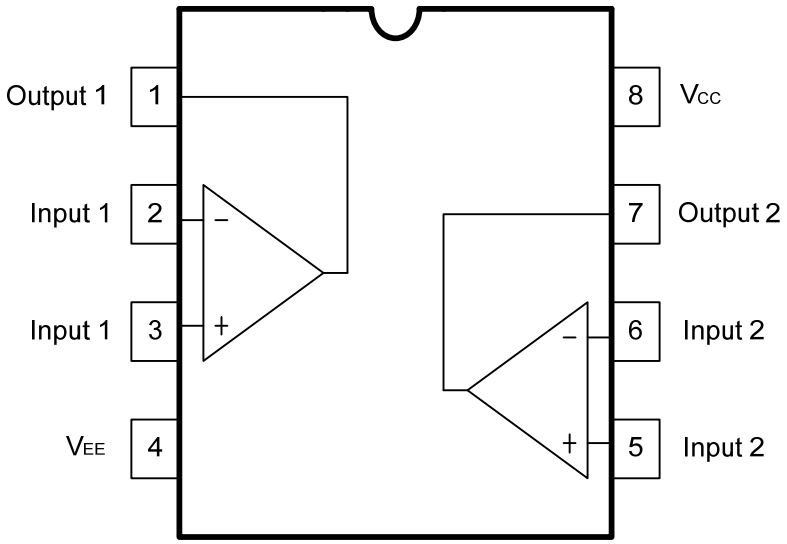
| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free Plating | Halogen Free | | |
| MC34072L-D08-T | MC34072G-D08-T | DIP-8 | Tube |
| MC34072L-S08-R | MC34072G-S08-R | SOP-8 | Tape Reel |
| MC34072L-SM1-R | MC34072G-SM1-R | MSOP-8 | Tape Reel |
| MC34072L-P08-R | MC34072G-P08-R | TSSOP-8 | Tape Reel |

| | |
|---|---|
| MC34072G-D08-T<br>(1)Packing Type<br>(2)Package Type<br>(3)Green Package | (1) T: Tube, R: Tape Reel<br>(2) D08: DIP-8, S08: SOP-8, SM1: MSOP-8<br>P08: TSSOP-8<br>(3) G: Halogen Free and Lead Free, L: Lead Free |

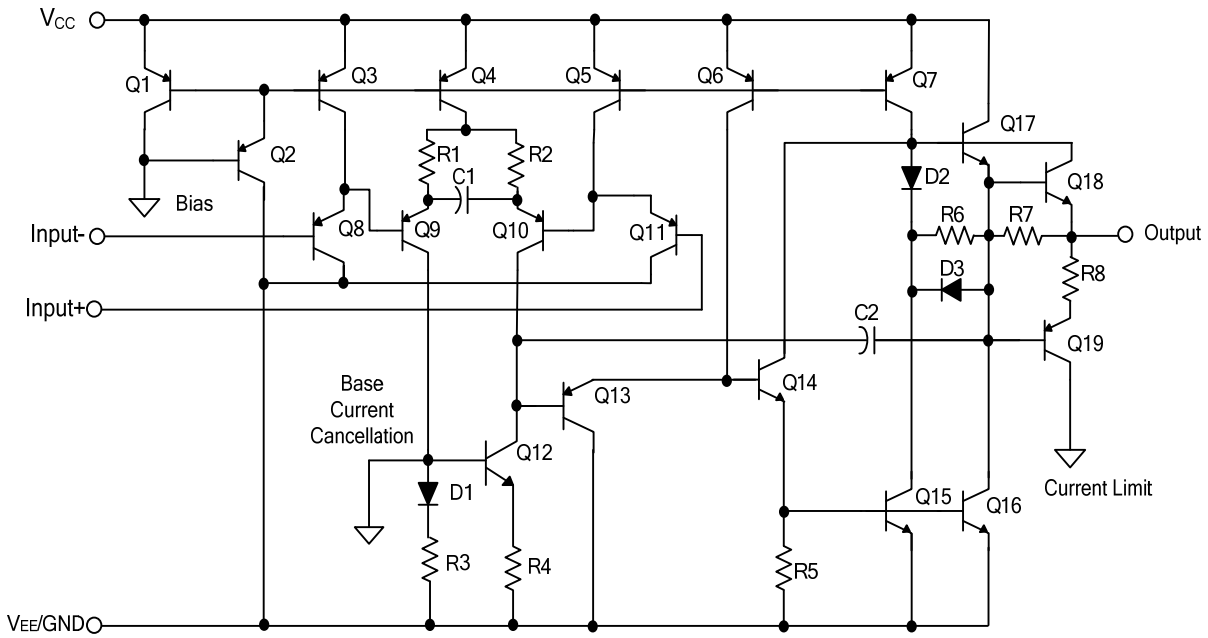
## ■ MARKING

| DIP-8 / SOP-8 / MSOP-8 | TSSOP-8 |
|---|---|
|  |  |

## ■ PIN DESCRIPTION




## ■ REPRESENTATIVE SCHEMATIC DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS ($T_A$=25°C, unless otherwise specified)

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage (from $V_{EE}$ to $V_{CC}$) | $V_S$ | +44 or ±22 | V |
| Differential Input Voltage | $V_{I(DIFF)}$ | (Note 3) | V |
| Input Voltage | $V_{IN}$ | (Note 3) | V |
| Output Short Circuit Duration (Note 2) | $t_{SC}$ | Indefinite | sec |
| Junction Temperature | $T_J$ | +150 | °C |
| Operating Temperature (Note 4) | $T_{OPR}$ | -40 ~ +85 | °C |
| Storage Temperature Range | $T_{STG}$ | -40~ +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. Power dissipation must be considered to ensure maximum junction temperature ($T_J$) is not exceeded.
3. Either or both input voltages should not exceed the magnitude of $V_{CC}$ or $V_{EE}$.
4. It is guarantee by design, not 100% be tested.

## ■ ELECTRICAL CHARACTERISTICS

($V_{CC}$=+15V, $V_{EE}$=-15V, $R_L$=connected to ground, unless otherwise specified)

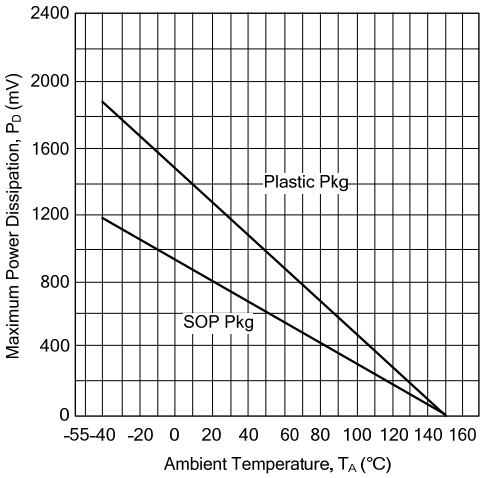
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{I(OFF)}$ | $R_S$=100Ω, $V_{CM}$=0V, $V_{OUT}$=0V | $V_{CC}$=+15V,$V_{EE}$=-15V,$T_A$=+25°C | | 0.5 | 3.0 | mV |
| | | | $V_{CC}$=+5V,$V_{EE}$=0V, $T_A$=+25°C | | 0.5 | 3.0 | mV |
| | | | $V_{CC}$=+15V,$V_{EE}$=-15V,$T_A$=0°C to 70°C | | | 5.0 | mV |
| Average Temperature Coefficient of Input Offset Voltage | $\Delta V_{IO}/\Delta T$ | $R_S$=10Ω,$V_{CM}$=0V, $V_{OUT}$ =0V, Ta=0°C to 70°C | | | 10 | | μV/°C |
| Input Bias Current | $I_{I(BIAS)}$ | $V_{CM}$=0V, $V_{OUT}$ =0V | $T_A$=+25°C | | 100 | 500 | nA |
| | | | $T_A$=0°C to 70°C | | | 700 | nA |
| Input Offset Current | $I_{I(OFF)}$ | $V_{CM}$=0V, $V_{OUT}$ =0V | $T_A$=+25°C | | 6.0 | 50 | nA |
| | | | $T_A$=0°C to 70°C | | | 300 | nA |
| Input Common Mode Voltage | $V_{ICR}$ | $T_A$=+25°C | | $V_{EE}$ to ($V_{CC}$ –1.8) | | | V |
| | | $T_A$=0°C to 70°C | | $V_{EE}$ to ($V_{CC}$ –2.2) | | | V |
| Large Signal Voltage Gain | $G_V$ | $V_{OUT}$ =±10V, RL=2.0kΩ | $T_A$=+25°C | 50 | 100 | | V/mV |
| | | | $T_A$=0°C to 70°C | 25 | | | |
| Output Voltage Swing ($V_{ID}$=+-1.0V) | $V_{OH}$ | $V_{CC}$=+5.0V,$V_{EE}$=0V,$R_L$=2.0kΩ, $T_A$=+25°C | | 3.7 | 4.0 | | V |
| | | $V_{CC}$=+15.0V,$V_{EE}$=-15V, $R_L$=10kΩ, Ta=+25°C | | 13.6 | 14 | | V |
| | | $V_{CC}$=+15.0V,$V_{EE}$=-15V, $R_L$=2.0kΩ, Ta=0°C to 70°C | | 13.4 | | | V |
| Output Voltage Swing ($V_{ID}$=+-1.0V) | $V_{OL}$ | $V_{CC}$=+5.0V,$V_{EE}$=0V,$R_L$=2.0kΩ, $T_A$=+25°C | | | 0.1 | 0.3 | V |
| | | $V_{CC}$=+15.0V,$V_{EE}$=-15V, $R_L$=10kΩ,TA=+25°C | | | -14.7 | -14.3 | V |
| | | $V_{CC}$=+15.0V,$V_{EE}$=-15V, $R_L$=2.0kΩ, $T_A$=0°C to 70°C | | | | -13.5 | V |
| Output Short Circuit current | $I_{SC}$ | $V_{I(DIFF)}$=1.0V,$V_{OUT}$=0V, $T_A$=25°C | Source | 10 | 30 | | mA |
| | | | Sink | 20 | 30 | | |
| Common Mode Rejection | CMR | $R_S$<=10kΩ,$V_{CM}$=$V_{ICR}$, $T_A$=25°C | | 80 | 97 | | dB |
| Power Supply Rejection ($R_S$=100Ω) | SVR | $V_{CC}$/$V_{EE}$=+16.5V/-16.5V to +13.5/-13.5V, $T_A$=25°C | | 80 | 97 | | dB |

## ■ ELECTRICAL CHARACTERISTICS (Cont.)

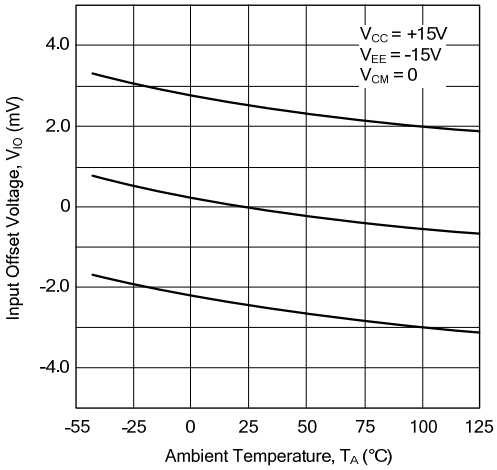
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Power Supply Current (Per Amplifier, No Load) | $I_D$ | $V_{CC}$=+5.0V,$V_{EE}$=0V, $V_{OUT}$ =+2.5V, $T_A$=+25°C | | | 1.6 | 2.0 | mA |
| | | $V_{CC}$=+15.0V,$V_{EE}$=-15V, $V_{OUT}$ =0V,Ta=+25°C | | | 1.9 | 2.5 | mA |
| | | $V_{CC}$=+15.0V,$V_{EE}$=-15V, $V_{OUT}$ =0V, Ta=0°C to 70°C | | | | 2.8 | mA |
| Slew Rate | SR | $V_{IN}$=-10V to +10V, $R_L$=2.0kΩ, $C_L$=500pF | Av=+1.0 | 8.0 | 10 | | V/μs |
| | | | Av=-1.0 | | 13 | | |
| Setting Time | ts | 10 Setp, Av=-1.0<br>to 0.1% (+1/2 LSB of 9-Bits)<br>to 0.01% (+1/2 LSB of 12-Bits) | | | <br>1.1<br>2.2 | | μs |
| Gain Bandwidth Product | $GB_W$ | f=100kHz | | 3.5 | 4.5 | | MHz |
| Power Bandwidth | $B_W$ | Av=+1.0, $R_L$=2kΩ, $V_{OUT}$=20Vpp, THD=5.0% | | | 160 | | kHz |
| Phase Margin | fm | $R_L$=2kΩ | | | 60 | | Deg |
| | | $R_L$=2kΩ, $C_L$=300pF | | | 40 | | Deg |
| Gain Margin | Am | $R_L$=2kΩ | | | 12 | | dB |
| | | $R_L$=2kΩ, $C_L$=300pF | | | 4 | | dB |
| Equivalent Input Noise Voltage | eN | Rs=100Ω, f=1.0kHz | | | 32 | | nV/√Hz |
| Equivalent Input Noise Current | eN | f=1.0kHz | | | 0.22 | | pA/√Hz |
| Differential Input Resistance | $R_{IN}$ | $V_{CM}$=0V | | | 150 | | MΩ |
| Differential Input Capacitance | $C_{IN}$ | $V_{CM}$=0V | | | 2.5 | | pF |
| Total Harmonic distortion | THD | Av=+10,$R_L$=2.0kHz, 2.0Vpp≤$V_{OUT}$≤20Vpp, f=10kHz | | | 0.02 | | % |
| Channel Separation | | f=10kHz | | | 120 | | dB |
| Open Loop Output Impedance | IZoI | f=1.0MHz | | | 30 | | W |

## ■ TYPICAL CHARACTERISTICS

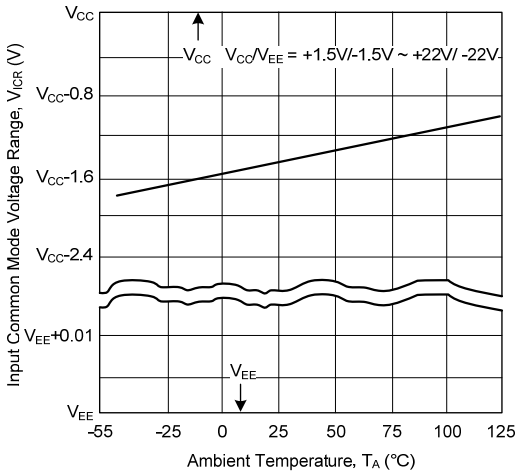
Maximum Power Dissipation vs. Temperature for Package Types



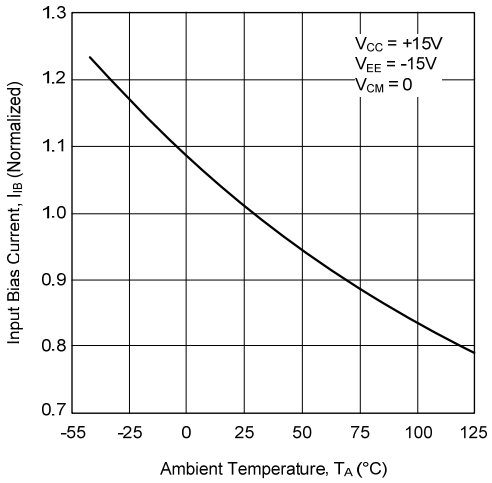

Input Offset Voltage vs. Temperature for Representative Units



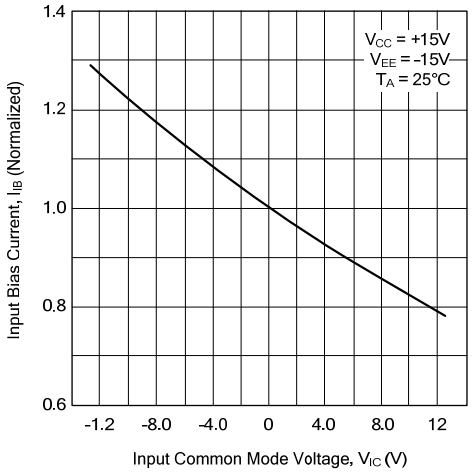

Input Common Mode Voltage Range vs. Temperature



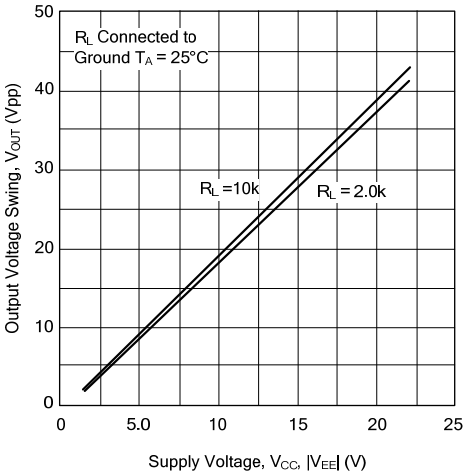

Normalized Input Bias Current vs. Temperature




Normalized Input Bias Current vs. Input Common Mode Voltage

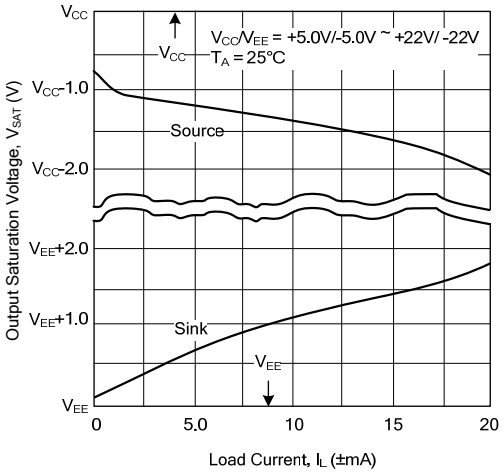



Split Supply Output Voltage Swing vs. Supply Voltage

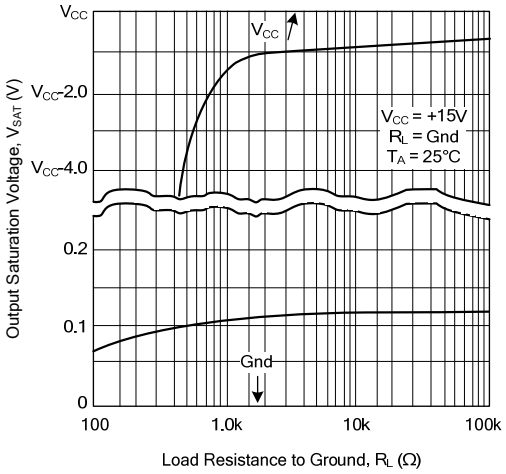


## ■ TYPICAL CHARACTERISTICS (Cont)

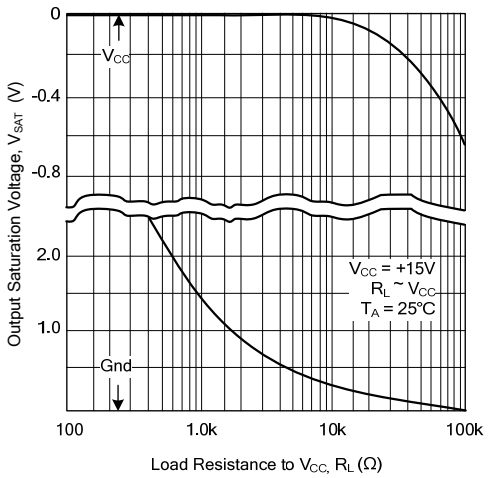
Single Supply Output Saturation vs. Load Resistance to $V_{CC}$



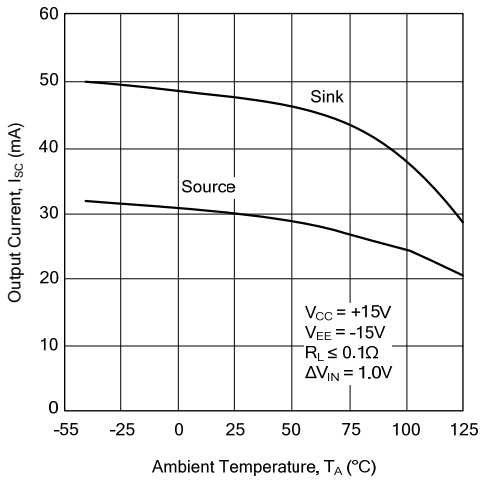

Split Supply Output Saturation vs. Load Current



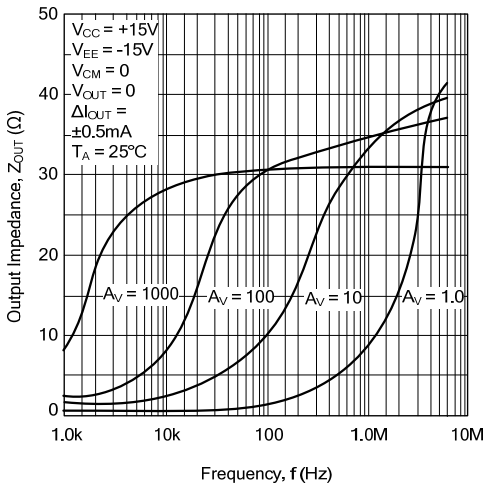

Single Supply Output Saturation vs. Load Resistance to Ground



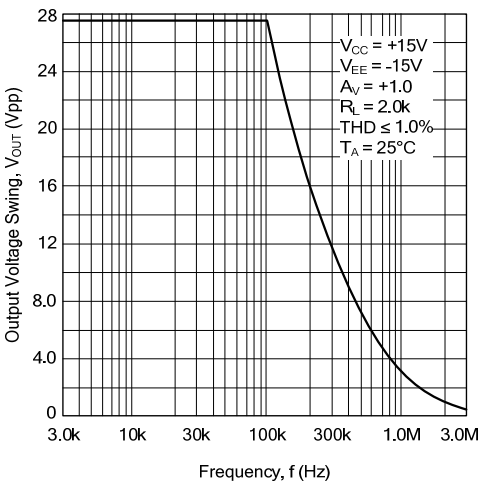

Output Short Circuit Current vs. Temperature




Output Impedance vs. Frequency

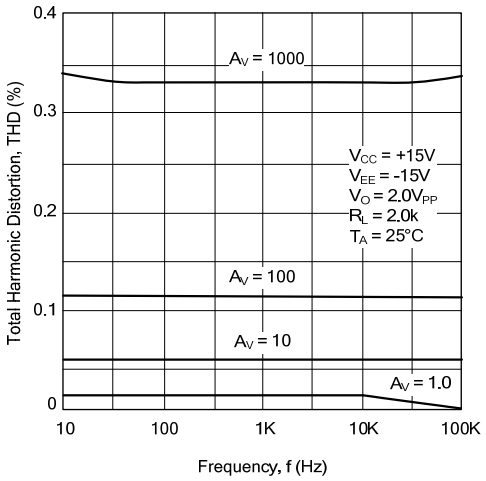



Output Voltage Swing vs. Frequency

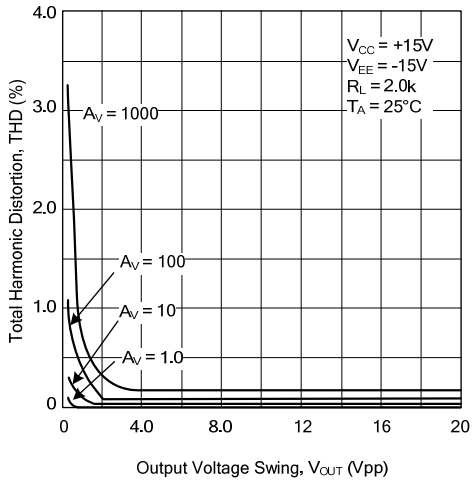


## ■ TYPICAL CHARACTERISTICS(Cont.)

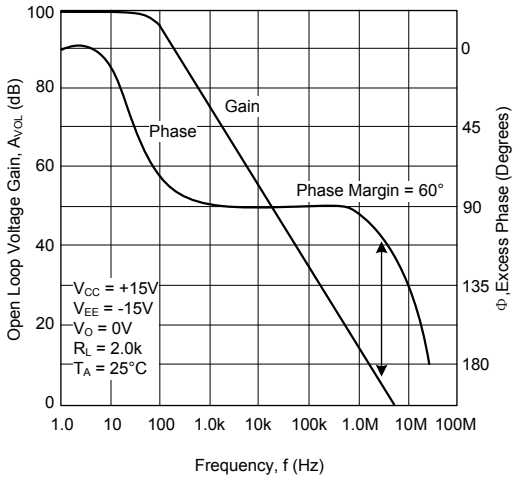
Total Harmonic Distortion vs. Frequency



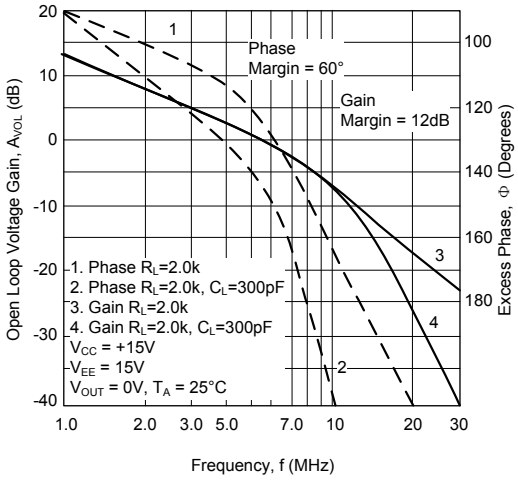

Total Harmonic Distortion vs. Output Voltage Swing



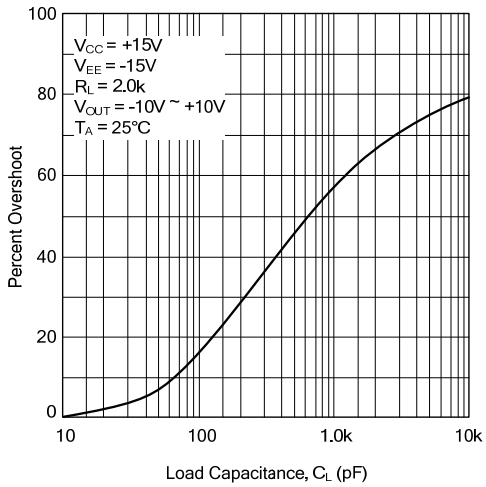

Open Loop Voltage Gain and Phase vs. Frequency



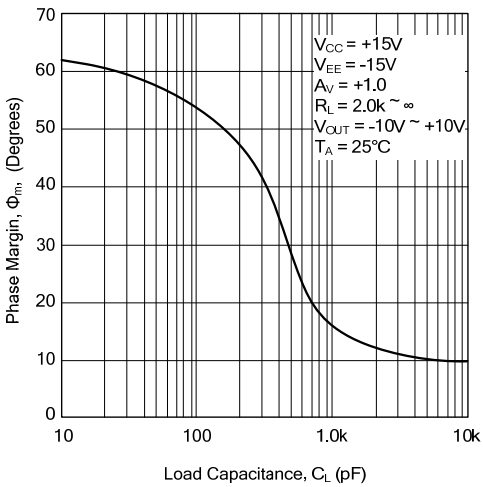

Open Loop Voltage Gain and Phase vs. Frequency




Percent Overshoot vs. Load Capacitance

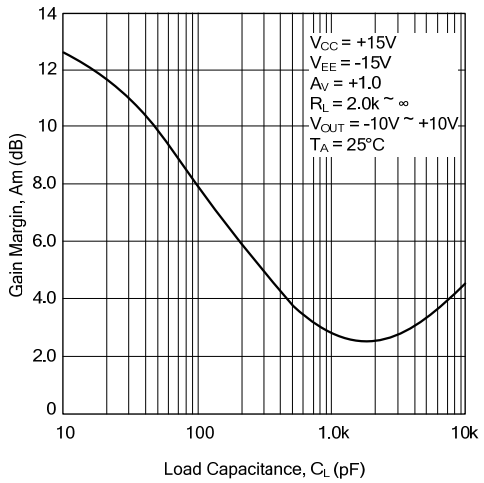



Phase Margin vs. Load Capacitance

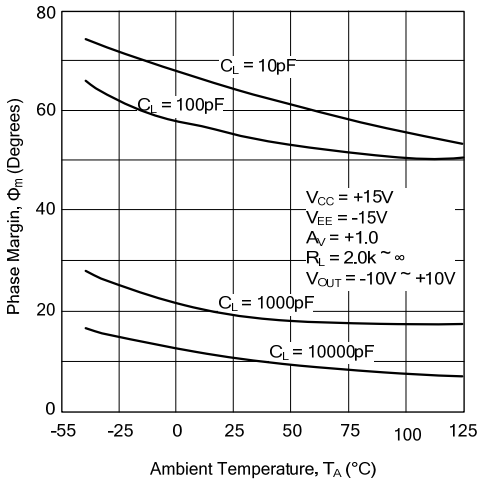


## ■ TYPICAL CHARACTERISTICS (Cont.)

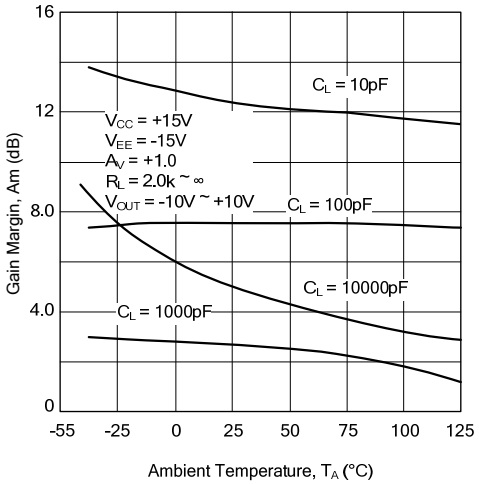
Gain Margin vs. Load Capacitance



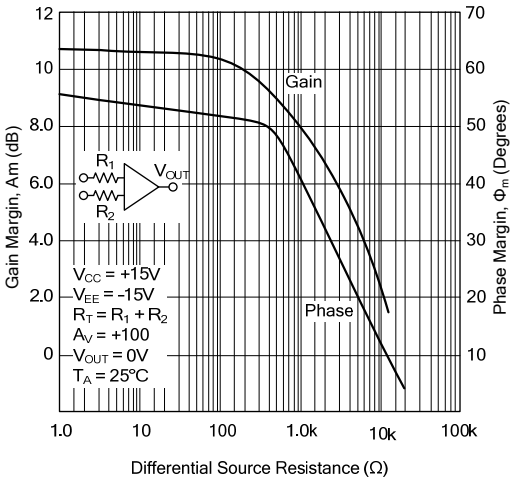

Phase Margin vs. Temperature



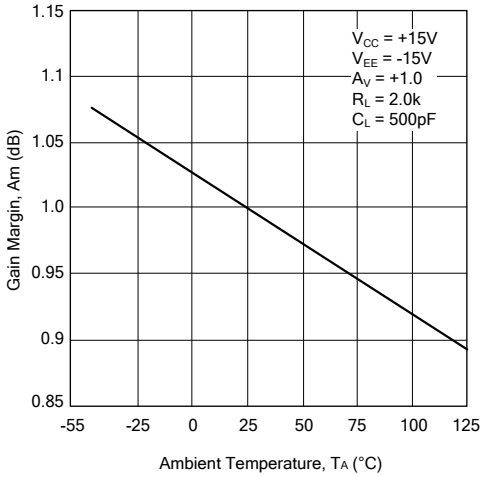

Gain Margin vs. Temperature



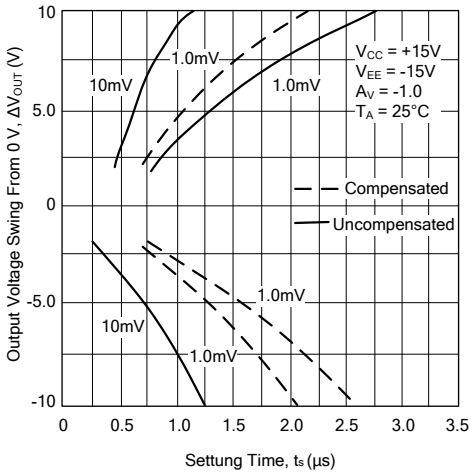

Phase Margin and Gain Margin vs. Differential Source Resistance




Normalized Slew Rate vs. Temperature

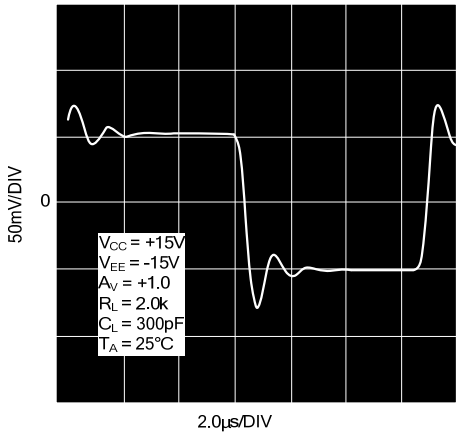



Output Setting Time

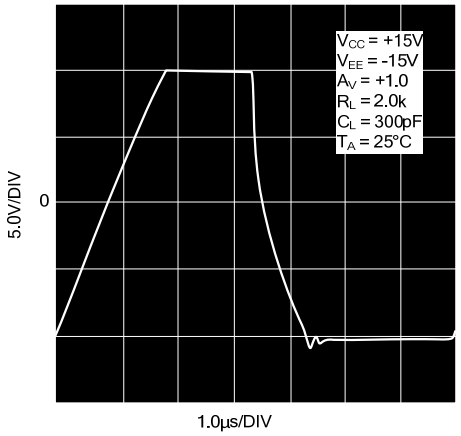


## ■ TYPICAL CHARACTERISTICS (Cont.)

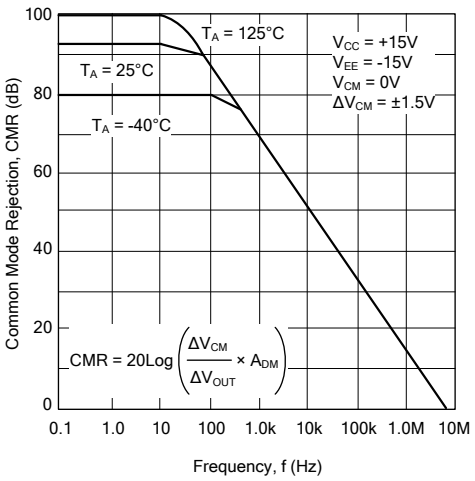
Small Signal Transient Response



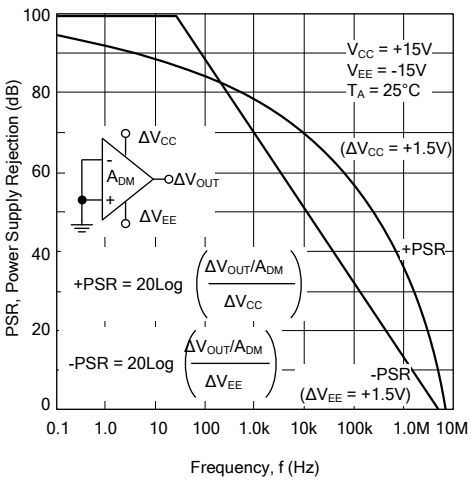

Large Signal Transient Response



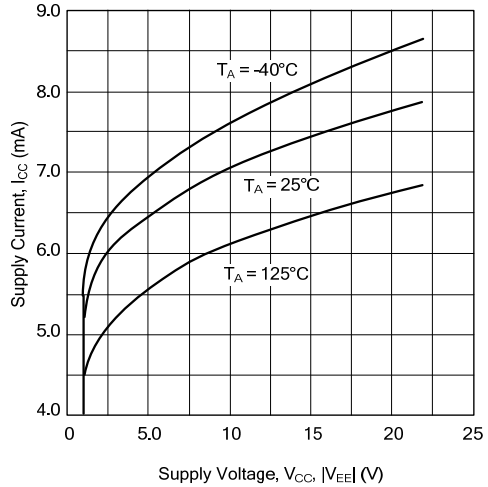

Common Mode Rejection vs. Frequency



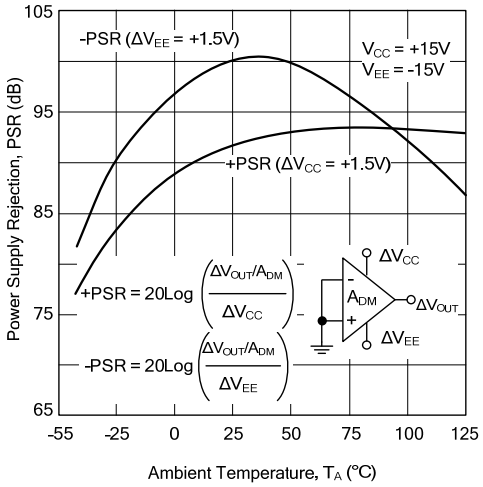

Power Supply Rejection vs. Frequency




Supply Current vs. Supply Voltage

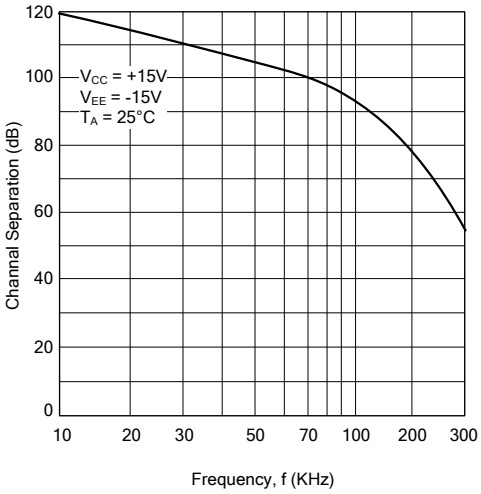



Power Supply Rejection vs. Temperature

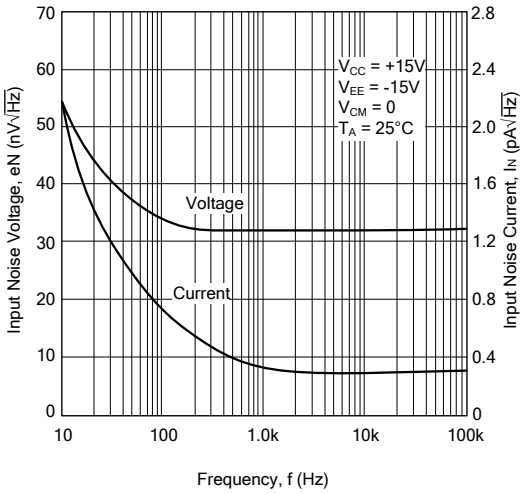


## ■ TYPICAL CHARACTERISTICS (Cont.)

Channel Separation vs. Frequency




Input Noise vs. Frequency




Normalized Gain Bandwidth Product vs. Temperature