

LM7121

235 MHz Tiny Low Power Voltage Feedback Amplifier

General Description

The LM7121 is a high performance operational amplifier which addresses the increasing AC performance needs of video and imaging applications, and the size and power constraints of portable applications.

The LM7121 can operate over a wide dynamic range of supply voltages, from 5V (single supply) up to $\pm 15V$ (see the Application Information section for more details). It offers an excellent speed-power product delivering $1300V/\mu s$ and 235 MHz Bandwidth (-3 dB, $A_V = +1$). Another key feature of this operational amplifier is stability while driving unlimited capacitive loads.

Due to its Tiny SOT23-5 package, the LM7121 is ideal for designs where space and weight are the critical parameters. The benefits of the Tiny package are evident in small portable electronic devices, such as cameras, and PC video cards. Tiny amplifiers are so small that they can be placed anywhere on a board close to the signal source or near the input to an A/D converter.

Features

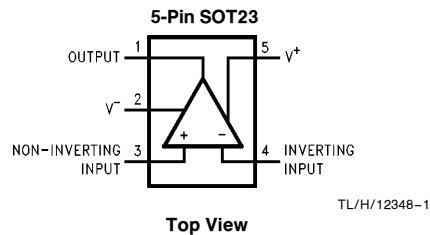
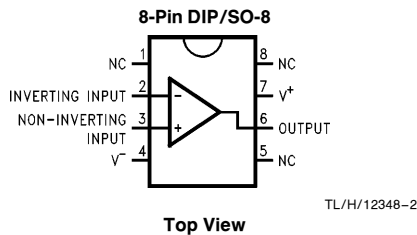
(Typical unless otherwise noted) $V_S = \pm 15V$

- Easy to use voltage feedback topology
- Stable with unlimited capacitive loads
- Tiny SOT23-5 package—typical circuit layout takes half the space of SO-8 designs
- Unity gain frequency 175 MHz
- Bandwidth (-3 dB, $A_V = +1$, $R_L = 100\Omega$) 235 MHz
- Slew rate $1300V/\mu s$
- Supply Voltages DIP/SO-8 5V to $\pm 15V$
- SOT23-5 5V to $\pm 15V$
- Characterized for $+5V$, $\pm 5V$, $\pm 15V$
- Low supply current 5.3 mA

Applications

- Scanners, color fax, digital copiers
- PC video cards
- Cable drivers
- Digital cameras
- ADC/DAC buffers
- Set-top boxes

Connection Diagram



Ordering Information

| Package | Ordering Information | NSC Drawing Number | Package Marking | Supplied As |
|------------------|----------------------|--------------------|-----------------|--------------------|
| 8-Pin Molded DIP | LM7121IN | N08E | LM7121IN | Rails |
| 8-Pin SO-8 | LM7121IM | M08A | LM7121IM | Rails |
| | LM7121IMX | M08A | LM7121IM | 2.5k Tape and Reel |
| 5-Pin SOT23-5 | LM7121IM5X | MA05A | A03A | 3k Tape and Reel |

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

| | |
|---|--|
| ESD Tolerance (Note 2) | 2000V |
| Differential Input Voltage (Note 7) | ±2V |
| Voltage at Input/Output Pin | (V ⁺) - 1.4V, (V ⁻) + 1.4V |
| Supply Voltage (V ⁺ - V ⁻) | 36V |
| Output Short Circuit to Ground (Note 3) | Continuous |
| Lead Temperature (soldering, 10 sec) | 260°C |

| | |
|-------------------------------|-----------------|
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature (Note 4) | 150°C |

Operating Ratings (Note 1)

| | |
|---------------------------------------|--------------------------------|
| Supply Voltage: DIP/SO-8 | 4.5V ≤ V _S ≤ 33V |
| SOT23-5 | 4.5V ≤ V _S ≤ 11V |
| Junction Temperature Range | -40°C ≤ T _J ≤ +85°C |
| Thermal Resistance (θ _{JA}) | |
| N Package, 8-pin Molded DIP | 115°C/W |
| M Package, 8-pin Surface Mount | 165°C/W |
| SOT23-5 Package | 325°C/W |

± 15V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for T_J = 25°C, V⁺ = +15V, V⁻ = -15V, V_{CM} = V_O = 0V and R_L > 1 MΩ. **Boldface** limits apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|-----------------|---------------------------------------|--|--------------|------------------------|-----------|
| V _{OS} | Input Offset Voltage | | 0.9 | 8 15 | mV max |
| I _B | Input Bias Current | | 5.2 | 9.5 12 | μA max |
| I _{OS} | Input Offset Current | | 0.04 | 4.3 7 | μA max |
| R _{IN} | Input Resistance | Common Mode | 10 | | MΩ |
| | | Differential Mode | 3.4 | | MΩ |
| C _{IN} | Input Capacitance | Common Mode | 2.3 | | pF |
| CMRR | Common Mode Rejection Ratio | -10V ≤ V _{CM} ≤ 10V | 93 | 73 70 | dB min |
| +PSRR | Positive Power Supply Rejection Ratio | 10V ≤ V ⁺ ≤ 15V | 86 | 70 68 | dB min |
| -PSRR | Negative Power Supply Rejection Ratio | -15V ≤ V ⁻ ≤ -10V | 81 | 68 65 | dB min |
| V _{CM} | Input Common-Mode Voltage Range | CMRR ≥ 70 dB | 13 | 11 | V min |
| | | | -13 | -11 | V max |
| A _V | Large Signal Voltage Gain | R _L = 2 kΩ, V _O = 20 V _{PP} | 72 | 65 57 | dB min |
| V _O | Output Swing | R _L = 2 kΩ | 13.4 | 11.1 10.8 | V min |
| | | | -13.4 | -11.2 -11.0 | V max |
| | | R _L = 150Ω | 10.2 | 7.75 7.0 | V min |
| | | | -7.0 | -5.0 -4.8 | V max |

± 15V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = +15\text{V}$, $V^- = -15\text{V}$, $V_{CM} = V_O = 0\text{V}$ and $R_L > 1\text{M}\Omega$. **Boldface** limits apply at the temperature extremes. (Continued)

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|----------|------------------------------|------------|--------------|------------------------|-----------|
| I_{SC} | Output Short Circuit Current | Sourcing | 71 | 54 44 | mA min |
| | | Sinking | 52 | 39 34 | mA min |
| I_S | Supply Current | | 5.3 | 6.6 7.5 | mA max |

± 15V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = 15\text{V}$, $V^- = -15\text{V}$, $V_{CM} = V_O = 0\text{V}$ and $R_L > 1\text{M}\Omega$. **Boldface** limits apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|-------------------|------------------------------|---|--------------|------------------------|--------------------------------------|
| SR | Slew Rate (Note 8) | $A_V = +2$, $R_L = 1\text{ k}\Omega$, $V_O = 20\text{ V}_{PP}$ | 1300 | | $\text{V}/\mu\text{s}$ |
| GBW | Unity Gain-Bandwidth | $R_L = 1\text{ k}\Omega$ | 175 | | MHz |
| ϕ_m | Phase Margin | | 63 | | Deg |
| $f(-3\text{ dB})$ | Bandwidth (Notes 9, 10) | $R_L = 100\Omega$, $A_V = +1$ | 235 | | MHz |
| | | $R_L = 100\Omega$, $A_V = +2$ | 50 | | |
| t_s | Settling Time | 10 V_{PP} Step, to 0.1%, $R_L = 500\Omega$ | 74 | | ns |
| t_r, t_f | Rise and Fall Time (Note 10) | $A_V = +2$, $R_L = 100\Omega$, $V_O = 0.4\text{ V}_{PP}$ | 5.3 | | ns |
| A_D | Differential Gain | $A_V = +2$, $R_L = 150\Omega$ | 0.3 | | % |
| ϕ_D | Differential Phase | $A_V = +2$, $R_L = 150\Omega$ | 0.65 | | Deg |
| e_n | Input-Referred Voltage Noise | $f = 10\text{ kHz}$ | 17 | | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| i_n | Input-Referred Current Noise | $f = 10\text{ kHz}$ | 1.9 | | $\frac{\text{pA}}{\sqrt{\text{Hz}}}$ |
| T.H.D. | Total Harmonic Distortion | 2 V_{PP} Output, $R_L = 150\Omega$, $A_V = +2$, $f = 1\text{ MHz}$ | 0.065 | | % |
| | | 2 V_{PP} Output, $R_L = 150\Omega$, $A_V = +2$, $f = 5\text{ MHz}$ | 0.52 | | |

±5V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = 5\text{V}$, $V^- = -5\text{V}$, $V_{CM} = V_O = 0\text{V}$ and $R_L > 1\text{M}\Omega$. **Boldface** limits apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|----------|---------------------------------------|--|-----------------|------------------------------|----------------------|
| V_{OS} | Input Offset Voltage | | 1.6 | 8 15 | mV max |
| I_B | Input Bias Current | | 5.5 | 9.5 12 | μA max |
| I_{OS} | Input Offset Current | | 0.07 | 4.3 7.0 | μA max |
| R_{IN} | Input Resistance | Common Mode | 6.8 | | $\text{M}\Omega$ |
| | | Differential Mode | 3.4 | | $\text{M}\Omega$ |
| C_{IN} | Input Capacitance | Common Mode | 2.3 | | pF |
| CMRR | Common Mode Rejection Ratio | $-2\text{V} \leq V_{CM} \leq 2\text{V}$ | 75 | 65 60 | dB min |
| +PSRR | Positive Power Supply Rejection Ratio | $3\text{V} \leq V^+ \leq 5\text{V}$ | 89 | 65 60 | dB min |
| -PSRR | Negative Power Supply Rejection Ratio | $-5\text{V} \leq V^- \leq -3\text{V}$ | 78 | 65 60 | dB min |
| V_{CM} | Input Common Mode Voltage Range | CMRR $\geq 60\text{ dB}$ | 3 | 2.5 | V min |
| | | | -3 | -2.5 | V max |
| A_V | Large Signal Voltage Gain | $R_L = 2\text{ k}\Omega$, $V_O = 3\text{ V}_{PP}$ | 66 | 60 58 | dB min |
| V_O | Output Swing | $R_L = 2\text{ k}\Omega$ | 3.62 | 3.0 2.75 | V min |
| | | | -3.62 | -3.0 -2.70 | V max |
| | | $R_L = 150\Omega$ | 3.1 | 2.5 2.3 | V min |
| | | | -2.8 | -2.15 -2.00 | V max |
| I_{SC} | Output Short Circuit Current | Sourcing | 53 | 38 33 | mA min |
| | | Sinking | 29 | 21 19 | mA min |
| I_S | Supply Current | | 5.1 | 6.4 7.2 | mA max |

± 5V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = 5\text{V}$, $V^- = -5\text{V}$, $V_{CM} = V_O = 0\text{V}$ and $R_L > 1\text{M}\Omega$. **Boldface** limits apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|-------------------|---------------------------------|---|-----------------|------------------------------|--------------------------------------|
| SR | Slew Rate (Note 8) | $A_V = +2$, $R_L = 1\text{ k}\Omega$, $V_O = 6\text{ V}_{PP}$ | 520 | | $\text{V}/\mu\text{s}$ |
| GBW | Unity Gain-Bandwidth | $R_L = 1\text{ k}\Omega$ | 105 | | MHz |
| ϕ_m | Phase Margin | $R_L = 1\text{ k}\Omega$ | 74 | | Deg |
| $f(-3\text{ dB})$ | Bandwidth (Notes 9, 10) | $R_L = 100\Omega$, $A_V = +1$ | 160 | | MHz |
| | | $R_L = 100\Omega$, $A_V = +2$ | 50 | | |
| t_s | Settling Time | 5 V_{PP} Step, to 0.1%, $R_L = 500\Omega$ | 65 | | ns |
| t_r, t_f | Rise and Fall Time (Note 10) | $A_V = +2$, $R_L = 100\Omega$, $V_O = 0.4\text{ V}_{PP}$ | 5.8 | | ns |
| A_D | Differential Gain | $A_V = +2$, $R_L = 150\Omega$ | 0.3 | | % |
| ϕ_D | Differential Phase | $A_V = +2$, $R_L = 150\Omega$ | 0.65 | | Deg |
| e_n | Input-Referred Voltage Noise | $f = 10\text{ kHz}$ | 17 | | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| i_n | Input-Referred Current Noise | $f = 10\text{ kHz}$ | 2 | | $\frac{\text{pA}}{\sqrt{\text{Hz}}}$ |
| T.H.D. | Total Harmonic Distortion | 2 V_{PP} Output, $R_L = 150\Omega$, $A_V = +2$, $f = 1\text{ MHz}$ | 0.1 | | % |
| | | 2 V_{PP} Output, $R_L = 150\Omega$, $A_V = +2$, $f = 5\text{ MHz}$ | 0.6 | | |

+ 5V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = +5\text{V}$, $V^- = 0\text{V}$, $V_{CM} = V_O = V^+/2$ and $R_L > 1\text{M}\Omega$. **Boldface** limits apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|----------|--|--|-----------------|------------------------------|------------------|
| V_{OS} | Input Offset Voltage | | 2.4 | | mV |
| I_B | Input Bias Current | | 4 | | μA |
| I_{OS} | Input Offset Current | | 0.04 | | μA |
| R_{IN} | Input Resistance | Common Mode | 2.6 | | $\text{M}\Omega$ |
| | | Differential Mode | 3.4 | | $\text{M}\Omega$ |
| C_{IN} | Input Capacitance | Common Mode | 2.3 | | pF |
| CMRR | Common Mode Rejection Ratio | $2\text{V} \leq V_{CM} \leq 3\text{V}$ | 65 | | dB |
| +PSRR | Positive Power Supply Rejection Ratio | $4.6\text{V} \leq V^+ \leq 5\text{V}$ | 85 | | dB |
| -PSRR | Negative Power Supply Rejection Ratio | $0\text{V} \leq V^- \leq 0.4\text{V}$ | 61 | | dB |
| V_{CM} | Input Common-Mode Voltage Range | CMRR $\geq 45\text{ dB}$ | 3.5 | | V min |
| | | | 1.5 | | V max |

+ 5V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = +5\text{V}$, $V^- = 0\text{V}$, $V_{\text{CM}} = V_O = V^+ / 2$ and $R_L > 1\text{ M}\Omega$. **Boldface** limits apply at the temperature extremes. (Continued)

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|-----------------|------------------------------|--|--------------|------------------------|-------|
| A_V | Large Signal Voltage Gain | $R_L = 2\text{ k}\Omega$ to $V^+ / 2$ | 64 | | dB |
| V_O | Output Swing | $R_L = 2\text{ k}\Omega$ to $V^+ / 2$, High | 3.7 | | V |
| | | $R_L = 2\text{ k}\Omega$ to $V^+ / 2$, Low | 1.3 | | |
| | | $R_L = 150\Omega$ to $V^+ / 2$, High | 3.48 | | |
| | | $R_L = 150\Omega$ to $V^+ / 2$, Low | 1.59 | | |
| I_{SC} | Output Short Circuit Current | Sourcing | 33 | | mA |
| | | Sinking | 20 | | mA |
| I_S | Supply Current | | 4.8 | | mA |

+ 5V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^\circ\text{C}$, $V^+ = +5\text{V}$, $V^- = 0\text{V}$, $V_{\text{CM}} = V_O = V^+ / 2$ and $R_L > 1\text{ M}\Omega$. **Boldface** limits apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM71211 Limit (Note 6) | Units |
|---------------|------------------------------|--|--------------|------------------------|------------------------|
| SR | Slew Rate (Note 8) | $A_V = +2$, $R_L = 1\text{ k}\Omega$ to $V^+ / 2$, $V_O = 1.8\text{ V}_{\text{PP}}$ | 145 | | $\text{V}/\mu\text{s}$ |
| GBW | Unity Gain-Bandwidth | $R_L = 1\text{ k}\Omega$ to $V^+ / 2$ | 80 | | MHz |
| ϕ_m | Phase Margin | $R_L = 1\text{ k}\Omega$ to $V^+ / 2$ | 70 | | Deg |
| f (-3 dB) | Bandwidth (Notes 9, 10) | $R_L = 100\Omega$ to $V^+ / 2$, $A_V = +1$ | 200 | | MHz |
| | | $R_L = 100\Omega$ to $V^+ / 2$, $A_V = +2$ | 45 | | |
| t_r , t_f | Rise and Fall Time (Note 10) | $A_V = +2$, $R_L = 100\Omega$, $V_O = 0.2\text{ V}_{\text{PP}}$ | 8 | | ns |
| T.H.D. | Total Harmonic Distortion | 0.6 V_{PP} Output, $R_L = 150\Omega$, $A_V = +2$, $f = 1\text{ MHz}$ | 0.067 | | % |
| | | 0.6 V_{PP} Output, $R_L = 150\Omega$, $A_V = +2$, $f = 5\text{ MHz}$ | 0.33 | | |

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: Human body model, 1.5 k Ω in series with 100 pF.

Note 3: Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C.

Note 4: The maximum power dissipation is a function of $T_{\text{J(max)}}$, θ_{JA} , and T_{A} . The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{\text{J(max)}} - T_{\text{A}}) / \theta_{\text{JA}}$. All numbers apply for packages soldered directly into a PC board.

Note 5: Typical Values represent the most likely parametric norm.

Note 6: All limits are guaranteed by testing or statistical analysis.

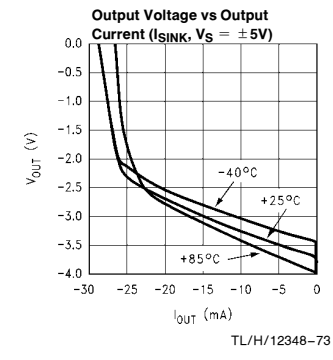
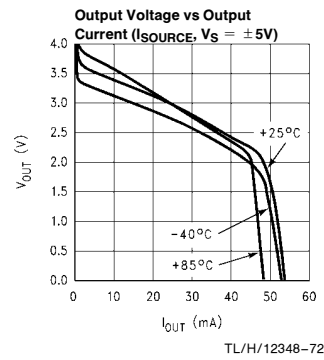
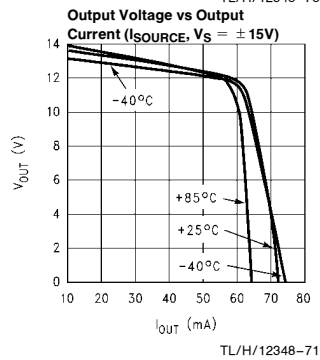
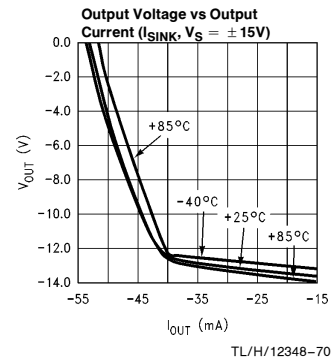
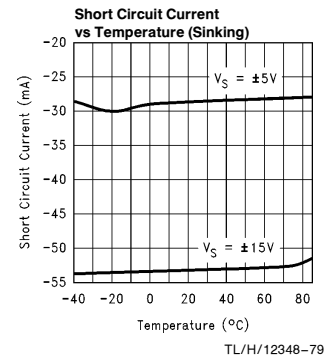
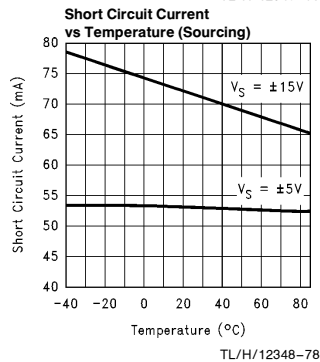
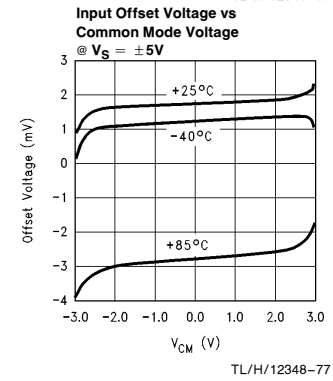
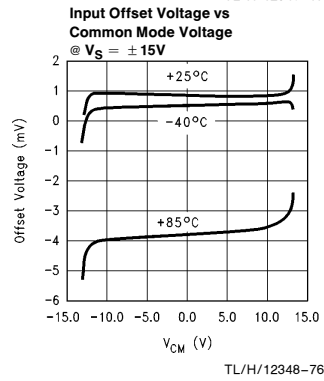
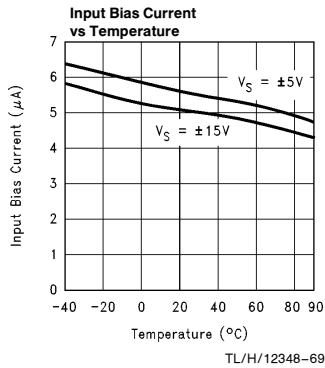
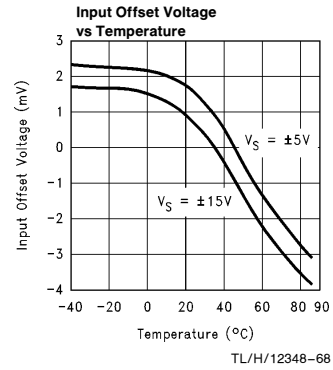
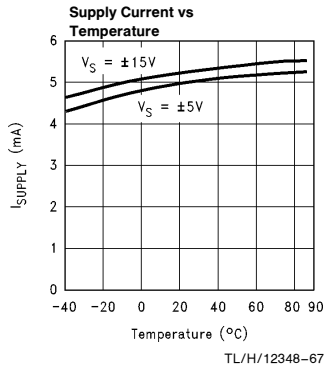
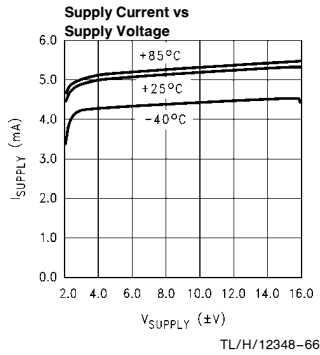
Note 7: Differential input voltage is measured at $V_S = \pm 15\text{V}$.

Note 8: Slew rate is the average of the rising and falling slew rates.

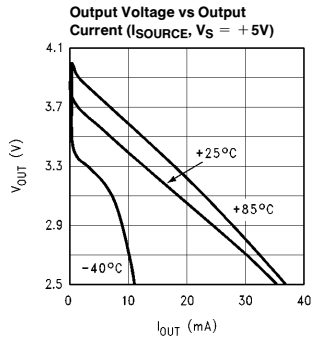
Note 9: Unity gain operation for $\pm 5\text{V}$ and $\pm 15\text{V}$ supplies is with a feedback network of 510 Ω and 3 pF in parallel (see the Application Information section). For +5V single supply operation, feedback is a direct short from the output to the inverting input.

Note 10: $A_V = +2$ operation with 2 k Ω resistors and 2 pF capacitor from summing node to ground.

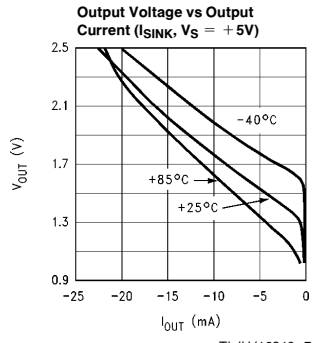
Typical Performance Characteristics $T_A = 25^\circ\text{C}$, $R_L = 1\text{ M}\Omega$ unless otherwise specified



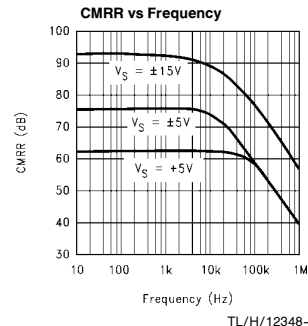
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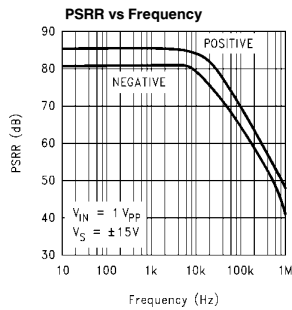
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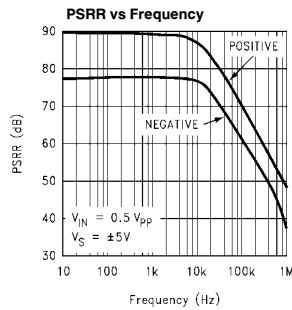
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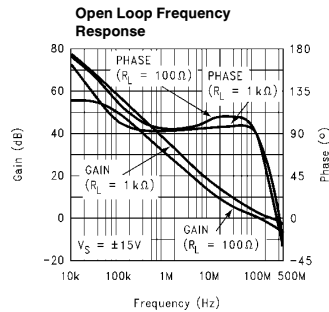
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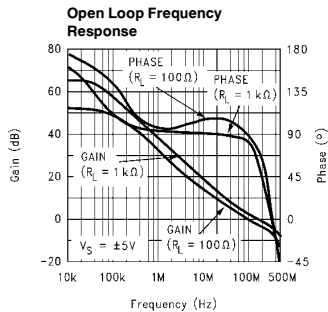
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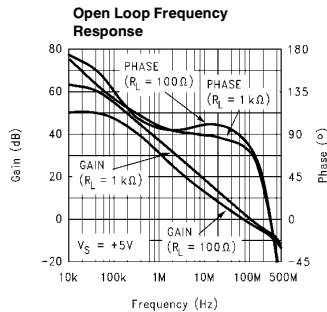
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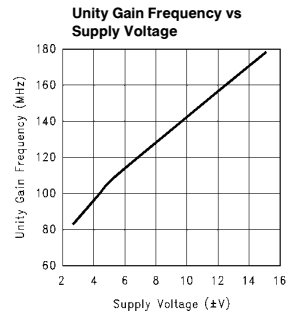
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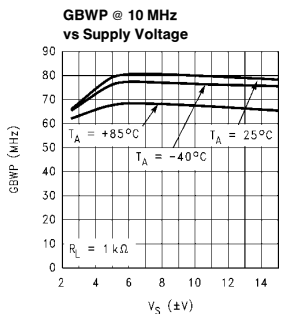
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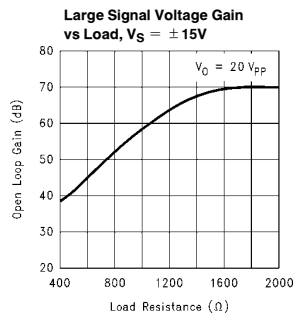
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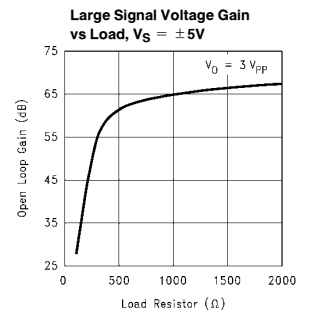
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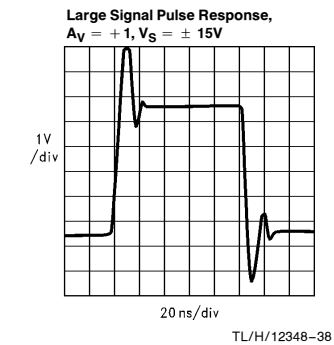
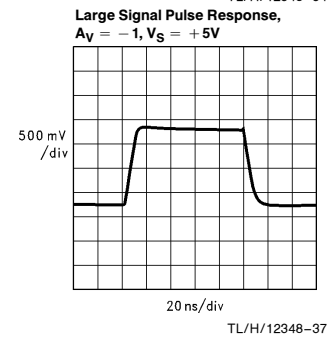
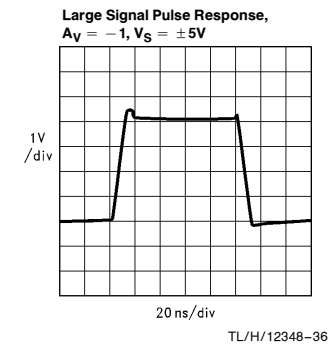
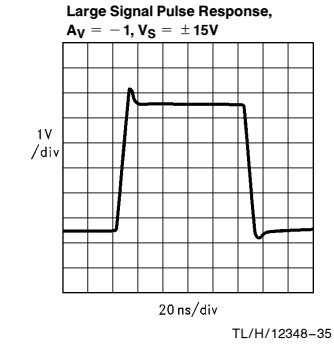
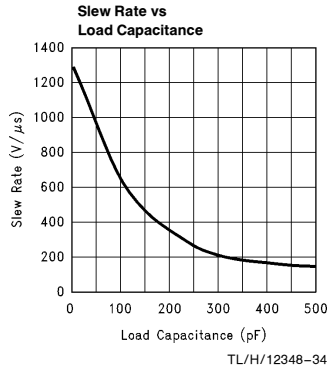
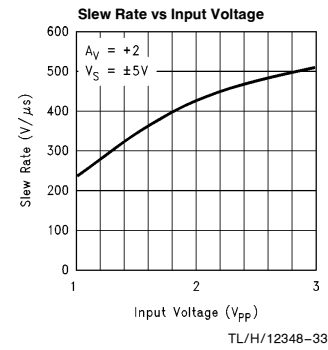
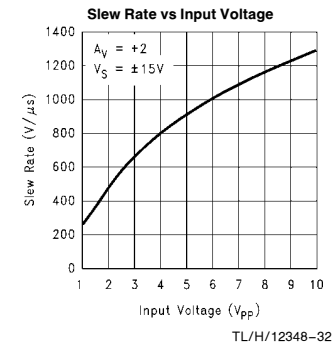
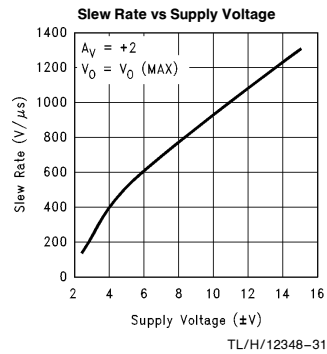
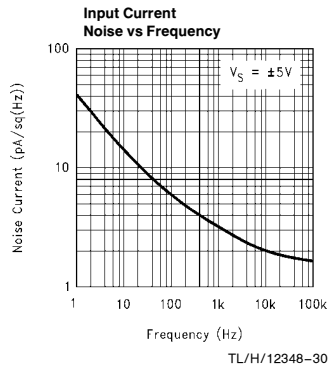
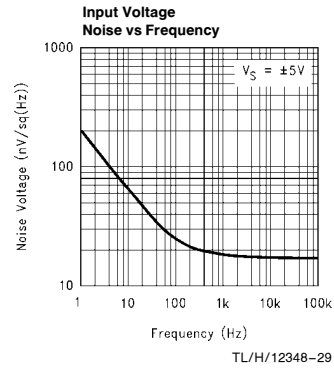
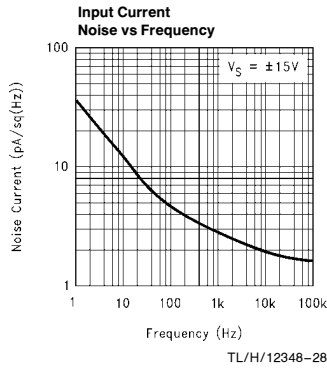
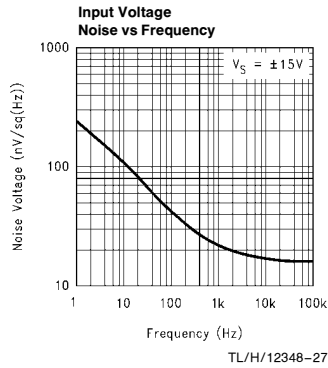


TL/H/12348-96

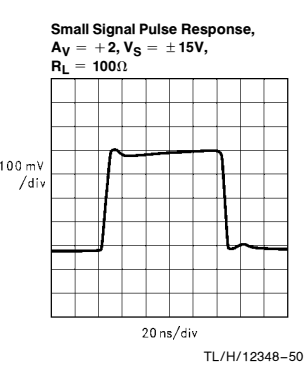
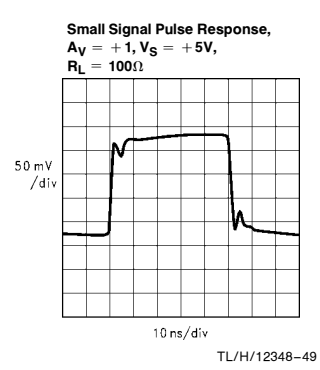
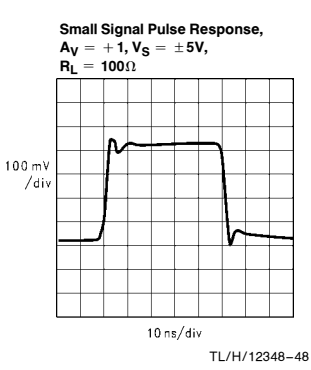
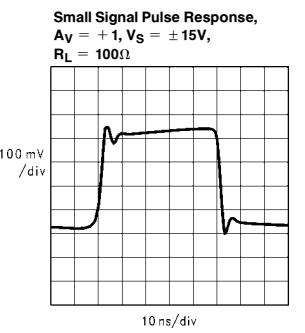
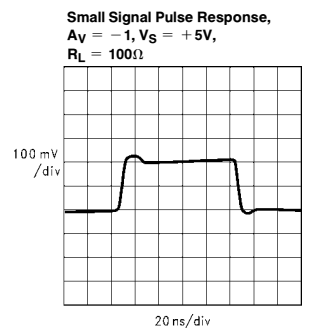
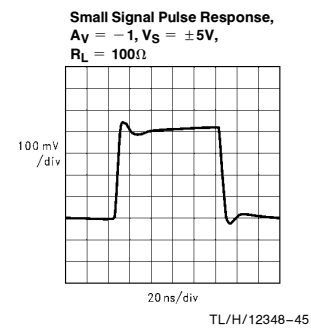
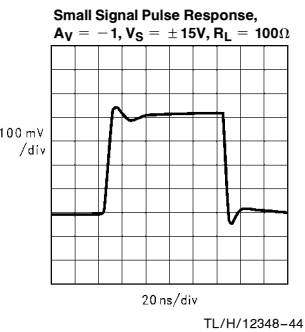
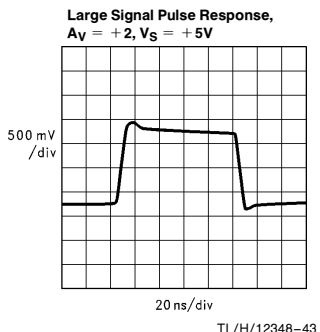
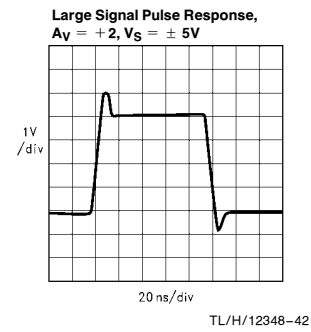
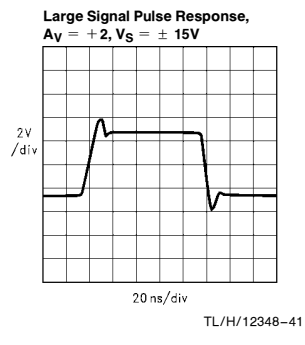
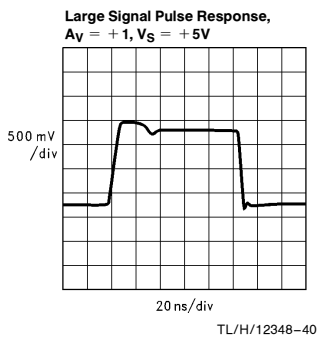
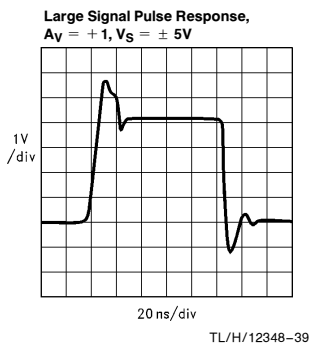


TL/H/12348-97

Typical Performance Characteristics $T_A = 25^\circ\text{C}$, $R_L = 1\text{ M}\Omega$ unless otherwise specified (Continued)

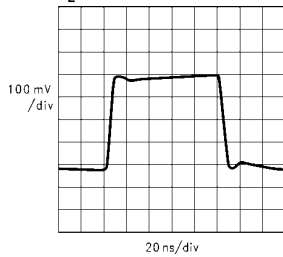


Typical Performance Characteristics $T_A = 25^\circ\text{C}$, $R_L = 1\text{ M}\Omega$ unless otherwise specified (Continued)



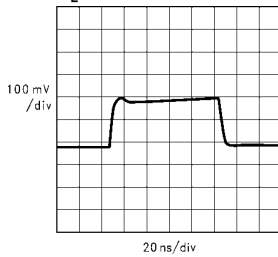
Typical Performance Characteristics $T_A = 25^\circ\text{C}$, $R_L = 1\text{ M}\Omega$ unless otherwise specified (Continued)

Small Signal Pulse Response,
 $A_V = +2$, $V_S = \pm 5\text{V}$,
 $R_L = 100\Omega$



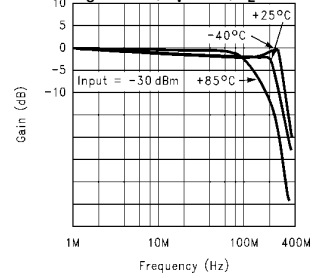
TL/H/12348-51

Small Signal Pulse Response,
 $A_V = +2$, $V_S = +5\text{V}$,
 $R_L = 100\Omega$



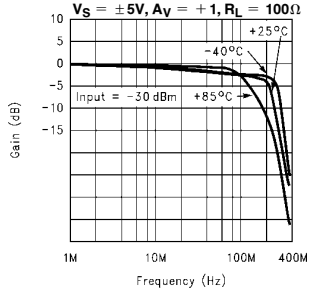
TL/H/12348-52

Closed Loop Frequency Response vs Temperature
 $V_S = \pm 15\text{V}$, $A_V = +1$, $R_L = 100\Omega$



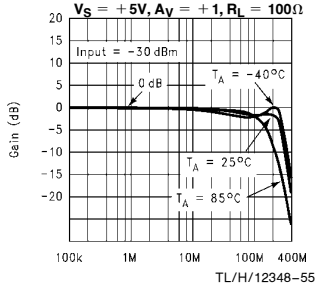
TL/H/12348-53

Closed Loop Frequency Response vs Temperature
 $V_S = \pm 5\text{V}$, $A_V = +1$, $R_L = 100\Omega$



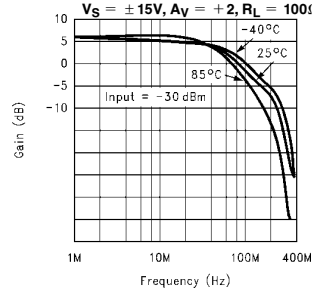
TL/H/12348-54

Closed Loop Frequency Response vs Temperature
 $V_S = +5\text{V}$, $A_V = +1$, $R_L = 100\Omega$



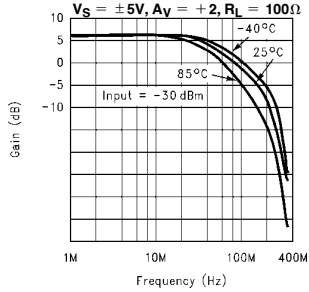
TL/H/12348-55

Closed Loop Frequency Response vs Temperature
 $V_S = \pm 15\text{V}$, $A_V = +2$, $R_L = 100\Omega$



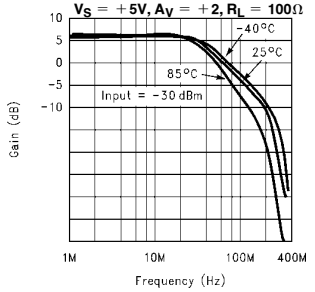
TL/H/12348-58

Closed Loop Frequency Response vs Temperature
 $V_S = \pm 5\text{V}$, $A_V = +2$, $R_L = 100\Omega$



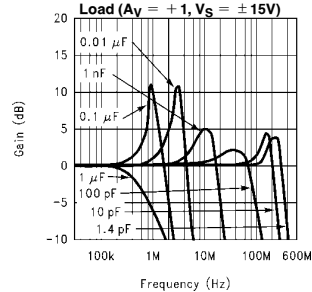
TL/H/12348-59

Closed Loop Frequency Response vs Temperature
 $V_S = +5\text{V}$, $A_V = +2$, $R_L = 100\Omega$



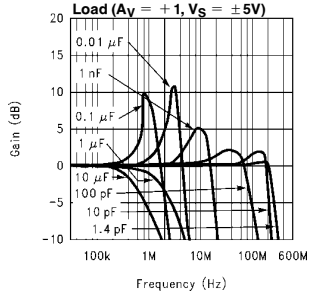
TL/H/12348-60

Closed Loop Frequency Response vs Capacitive Load
 $A_V = +1$, $V_S = \pm 15\text{V}$



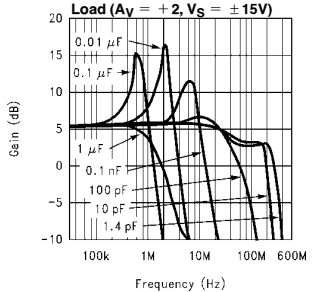
TL/H/12348-61

Closed Loop Frequency Response vs Capacitive Load
 $A_V = +1$, $V_S = \pm 5\text{V}$



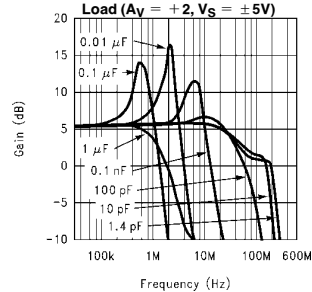
TL/H/12348-62

Closed Loop Frequency Response vs Capacitive Load
 $A_V = +2$, $V_S = \pm 15\text{V}$



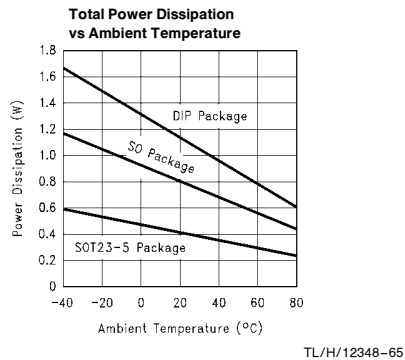
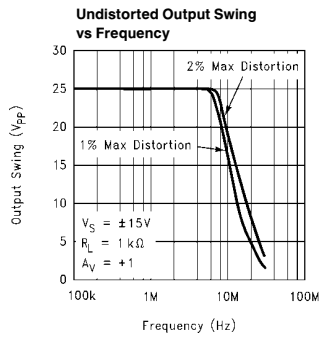
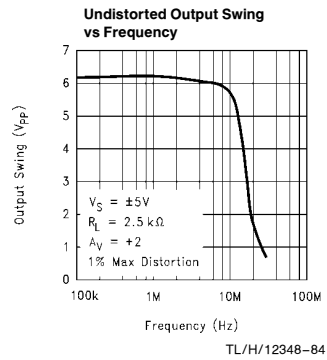
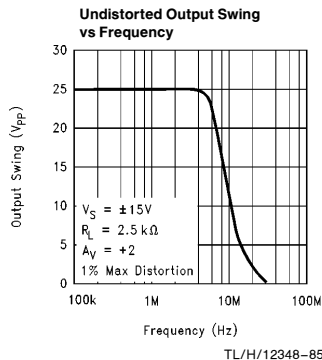
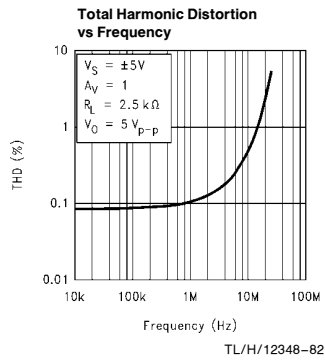
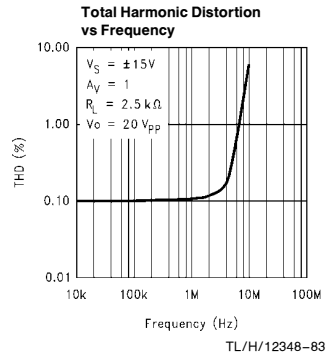
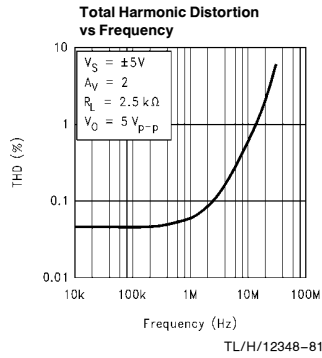
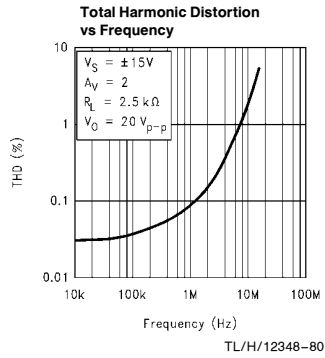
TL/H/12348-63

Closed Loop Frequency Response vs Capacitive Load
 $A_V = +2$, $V_S = \pm 5\text{V}$



TL/H/12348-64

Typical Performance Characteristics $T_A = 25^\circ\text{C}$, $R_L = 1\text{ M}\Omega$ unless otherwise specified (Continued)



Application Information

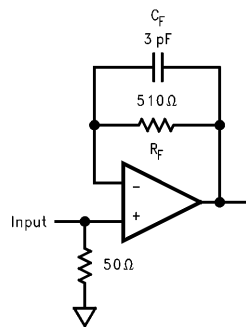
The table below, depicts the maximum operating supply voltage for each package type:

TABLE I. Maximum Supply Voltage Values

| | SOT23-5 | SO-8 | DIP |
|---------------|---------|-------|-------|
| Single Supply | 10V | 30V | 30V |
| Dual Supplies | ± 5V | ± 15V | ± 15V |

Stable unity gain operation is possible with supply voltage of 5V for all capacitive loads. This allows the possibility of using the device in portable applications with low supply voltages with minimum components around it.

Above a supply voltage of 6V ($\pm 3V$ Dual supplies), an additional resistor and capacitor (shown below) should be placed in the feedback path to achieve stability at unity gain over the full temperature range.



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FIGURE 1. Typical Circuit for $A_V = +1$ Operation ($V_S \geq 6V$)

The package power dissipation should be taken into account when operating at high ambient temperatures and/or high power dissipative conditions. Refer to the power derating curves in the data sheet for each type of package.

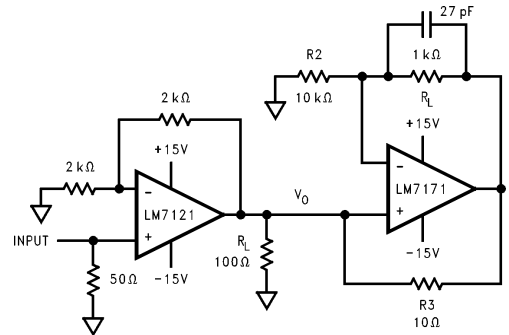
In determining maximum operable temperature of the device, make sure the total power dissipation of the device is considered; this includes the power dissipated in the device with a load connected to the output as well as the nominal dissipation of the op amp.

The device is capable of tolerating momentary short circuits from its output to ground but prolonged operation in this mode will damage the device, if the maximum allowed junction temperature is exceeded.

APPLICATION CIRCUITS

Current Boost Circuit

The circuit in Figure 2 can be used to achieve good linearity along with high output current capability.



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FIGURE 2. Simple Circuit to Improve Linearity and Output Drive Current

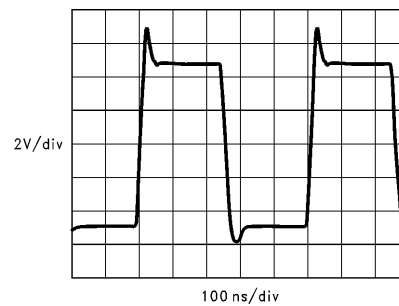
By proper choice of R_3 , the LM7121 output can be set to supply a minimal amount of current, thereby improving its output linearity.

R_3 can be adjusted to allow for different loads:

$$R_3 = 0.1 R_L$$

The circuit above has been set for a load of 100 Ω .

Reasonable speeds (< 30 ns rise and fall times) can be expected up to 120 mA_{PP} of load current (see Figure 3 for step response across the load).



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FIGURE 3. Waveform across a 100 Ω Load

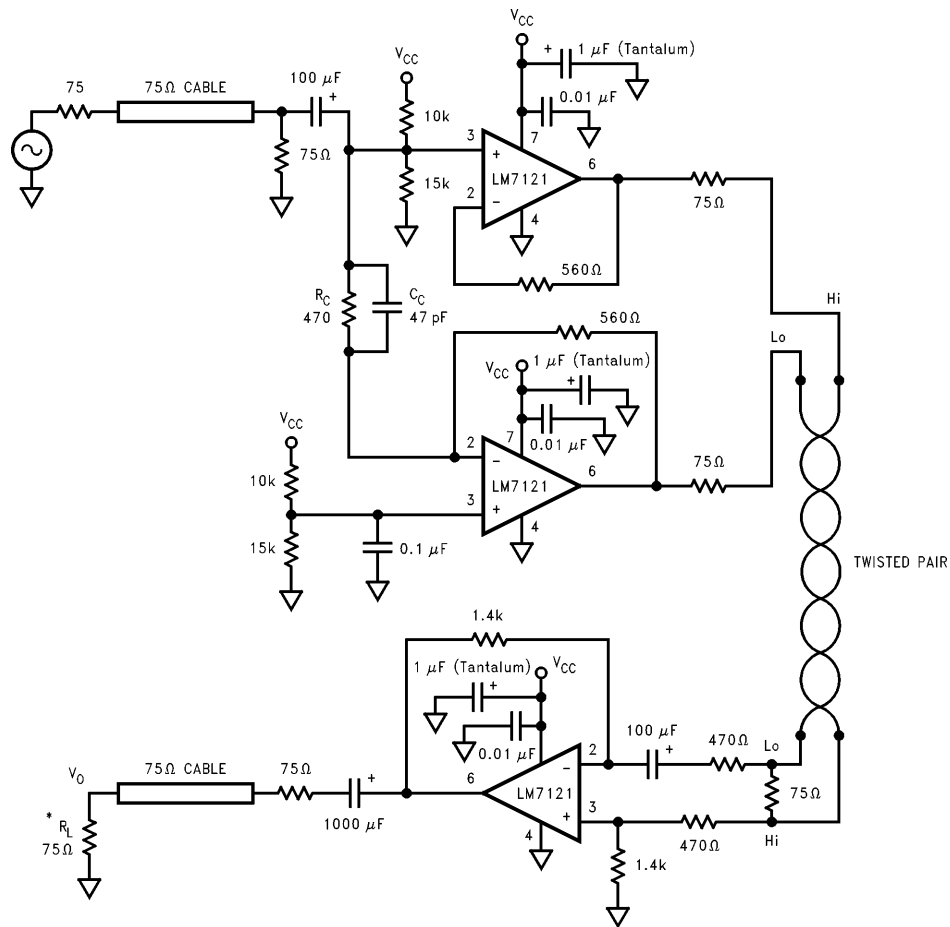
It is very important to keep the lead lengths to a minimum and to provide a low impedance current path by using a ground-plane on the board.

Caution: If R_L is removed, the current balance at the output of LM7121 would be disturbed and it would have to supply the full amount of load current. This might damage the part if power dissipation limit is exceeded.

Application Information (Continued)

Color Video on Twisted Pairs Using Single Supply

The circuit shown in *Figure 4* can be used to drive in excess of 25 meters length of twisted pair cable with no loss of resolution or picture definition when driving a NTSC monitor at the load end.



Note: Pin numbers shown are for DIP/SO-8 packages.

*Input termination of NTSC monitor.

FIGURE 4. Single Supply Differential Twisted Pair Cable Transmitter/Receiver
 $8.5V \leq V_{CC} \leq 30V$

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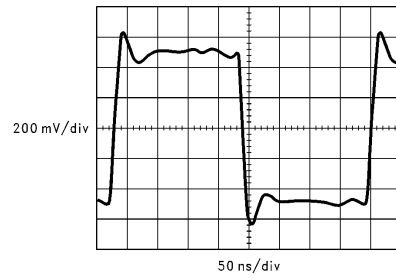
Application Information (Continued)

Differential Gain and Differential Phase errors measured at the load are less than 1% and 1° respectively.

R_G and C_C can be adjusted for various cable lengths to compensate for the line losses and for proper response at the output. Values shown correspond to a twisted pair cable length of 25 meters with about 3 turns/inch (see Figure 5 for step response).

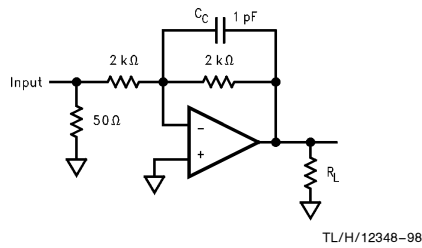
The supply voltage can vary from 8.5V up to 30V with the output rise and fall times under 12 ns. With the component values shown, the overall gain from the input to the output is about 1.

Even though the transmission line is not terminated in its nominal characteristic impedance of about 600Ω, the resulting reflection at the load is only about 5% of the total signal and in most cases can be neglected. Using 75Ω termination instead, has the advantage of operating at a low impedance and results in a higher realizable bandwidth and signal fidelity.

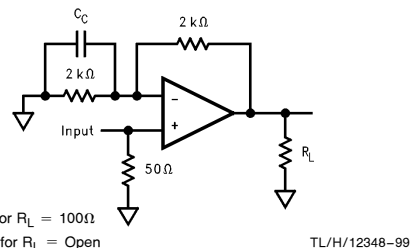


TL/H/12348-95

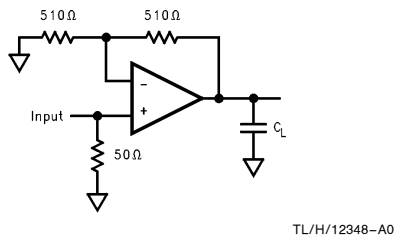
FIGURE 5. Step Response to a 1 V_{pp} Input Signal Measured across the 75Ω Load



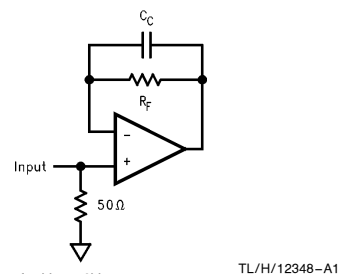
(a) $A_V = -1$



(b) $A_V = +2$

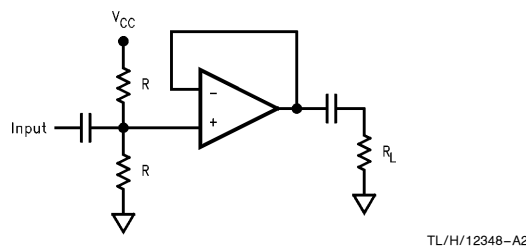


(c) $A_V = +2$, Capacitive Load



$R_F = 0\Omega$, $C_C = \text{Open}$ for $V_S < 6V$
 $R_F = 510\Omega$, $C_C = 3\text{ pF}$ for $V_S \geq 6V$

(d) $A_V = +1$

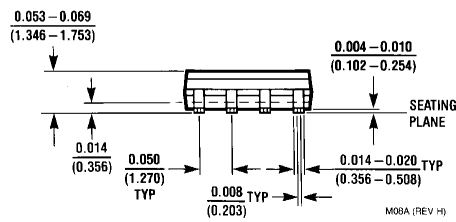
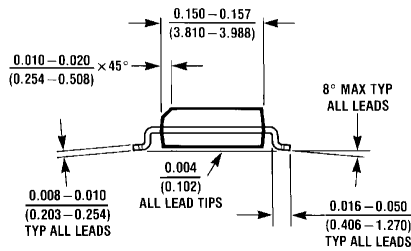
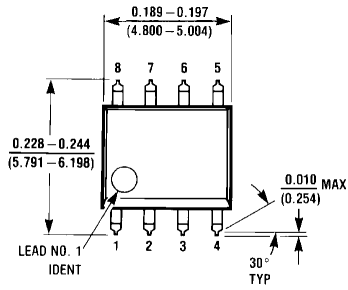


(e) $A_V = +1$, $V_S = +5V$, Single Supply Operation

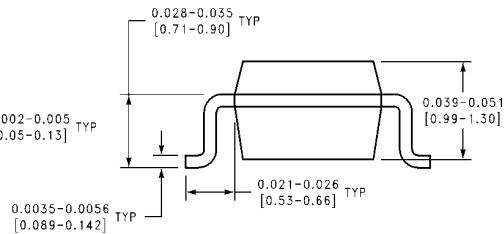
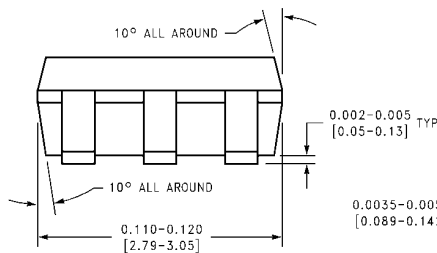
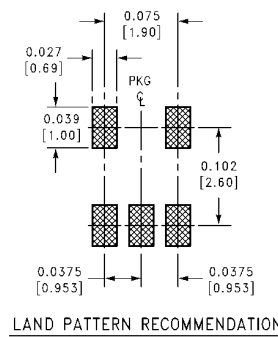
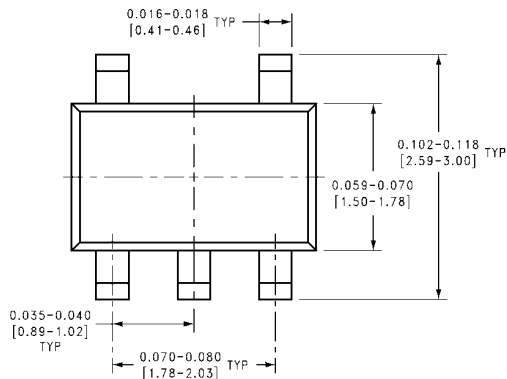
FIGURE 6. Application Test Circuits



Physical Dimensions inches (millimeters) unless otherwise noted



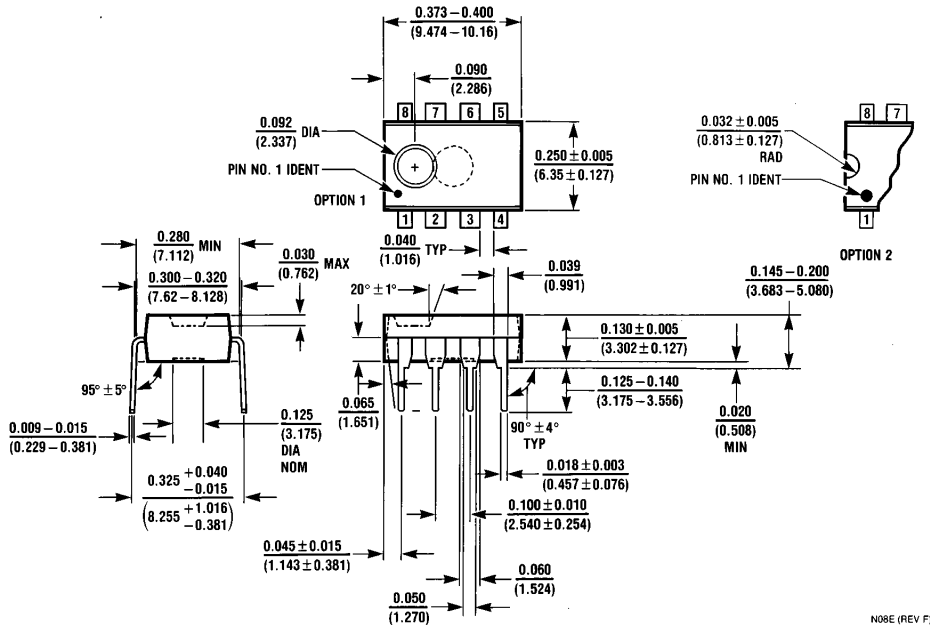
8-Lead (0.150" Wide) Small Outline Package, JEDEC
Order Number LM7121IM or LM7121IMX
NS Package Number M08A



5-Lead Molded SOT23-5
Order Number LM7121IM5X
NS Package Number MA05A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

Lit. # 108303-001




8-Lead (0.300" Wide) Molded Dual-In-Line Package
Order Number LM7121IN
NS Package Number N08E

N08E (REV F)

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