

# COMLINEAR® CLC1004, CLC1014, CLC3004

## Single and Triple, 750MHz Amplifiers with Disable

### FEATURES

- 0.1dB gain flatness to 200MHz
- 0.02%/0.01° differential gain/phase
- 750MHz -3dB bandwidth at  $G = 2$
- 350MHz large signal bandwidth
- 1,400V/ $\mu$ s slew rate
- 4nV/ $\sqrt{\text{Hz}}$  input voltage noise
- 100mA output current
- 20ns enable time
- Stable for gains of 2V/V or larger
- Fully specified at 5V and  $\pm 5$ V supplies
- CLC1004: Pb-free SOT23-6
- CLC1014: Pb-free SOT23-5
- CLC3004: Pb-free SOIC-16

### APPLICATIONS

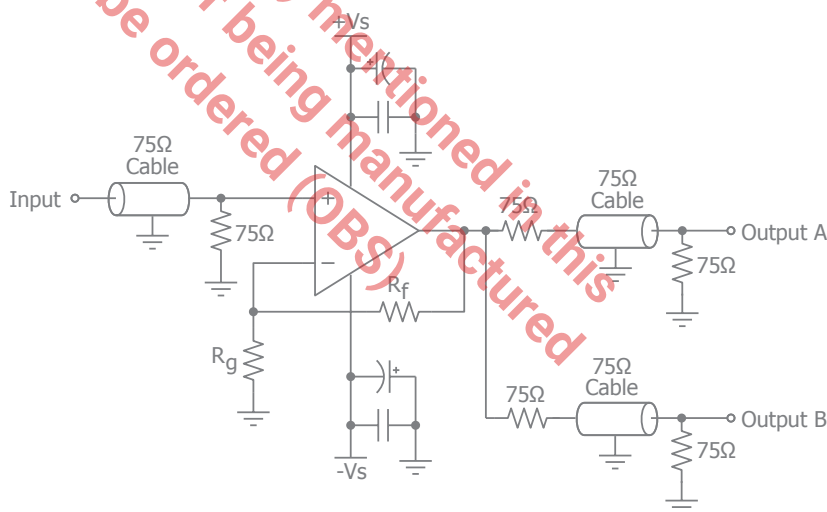
- RGB video line drivers
- High definition video driver
- Video switchers and routers
- ADC buffer
- Active filters
- Cable drivers
- Imaging applications
- Radar/communication receivers

### General Description

The COMLINEAR CLC1004 (single with disable), CLC1014 (single), and CLC3004 (triple with disable) are high-performance, voltage feedback amplifiers that provide 750MHz gain of 2 bandwidth,  $\pm 0.1$ dB gain flatness to 200MHz, and 1,400V/ $\mu$ s slew rate. This high performance exceeds the requirements of high-definition television (HDTV) and other multimedia applications. These COMLINEAR high-performance amplifiers also provide ample output current to drive multiple video loads.

The COMLINEAR CLC1004, CLC1014, and CLC3004 are designed to operate from  $\pm 5$ V or  $+5$ V supplies. The CLC1004 and CLC3004 offer a fast enable/disable feature to save power. While disabled, the outputs are in a high-impedance state to allow for multiplexing applications. The combination of high-speed, low-power, and excellent video performance make these amplifiers well suited for use in many general purpose, high-speed applications including video line driving and imaging applications.

### Typical Application - Driving Multiple Video Loads



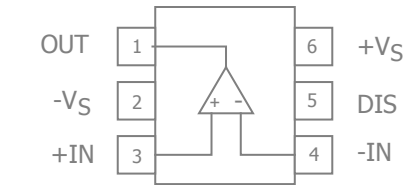
### Ordering Information

| Part Number   | Package | Pb-Free | RoHS Compliant | Operating Temperature Range | Packaging Method |
|---------------|---------|---------|----------------|-----------------------------|------------------|
| CLC1004IST6X  | SOT23-6 | Yes     | Yes            | -40°C to +85°C              | Reel             |
| CLC1014IST5X  | SOT23-5 | Yes     | Yes            | -40°C to +85°C              | Reel             |
| CLC3004ISO16X | SOIC-16 | Yes     | Yes            | -40°C to +85°C              | Reel             |

Moisture sensitivity level for all parts is MSL-1.



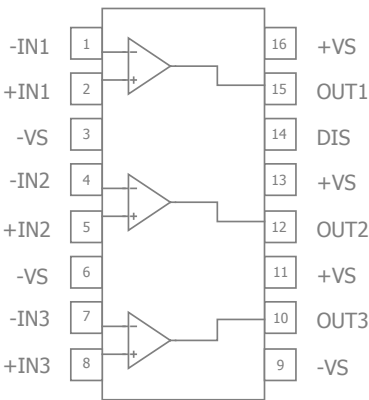
CLC1004 Pin Configuration



CLC1004 Pin Assignments

| Pin No. | Pin Name | Description                                                                                                                                 |
|---------|----------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | OUT      | Output                                                                                                                                      |
| 2       | -VS      | Negative supply                                                                                                                             |
| 3       | +IN      | Positive input                                                                                                                              |
| 4       | -IN      | Negative input                                                                                                                              |
| 5       | DIS      | Disable pin. Enabled if pin is grounded, left floating or pulled below V <sub>ON</sub> , disabled if pin is pulled above V <sub>OFF</sub> . |
| 6       | +VS      | Positive supply                                                                                                                             |

CLC3004 Pin Configuration



CLC3004 Pin Assignments

| Pin No. | Pin Name | Description                                                                                                                                 |
|---------|----------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | -IN1     | Negative input, channel 1                                                                                                                   |
| 2       | +IN1     | Positive input, channel 1                                                                                                                   |
| 3       | -VS      | Negative supply                                                                                                                             |
| 4       | -IN2     | Negative input, channel 2                                                                                                                   |
| 5       | +IN2     | Positive input, channel 2                                                                                                                   |
| 6       | -VS      | Negative supply                                                                                                                             |
| 7       | -IN3     | Negative input, channel 3                                                                                                                   |
| 8       | +IN3     | Positive input, channel 3                                                                                                                   |
| 9       | -VS      | Negative supply                                                                                                                             |
| 10      | OUT3     | Output, channel 3                                                                                                                           |
| 11      | +VS      | Positive supply                                                                                                                             |
| 12      | OUT2     | Output, channel 2                                                                                                                           |
| 13      | +VS      | Positive supply                                                                                                                             |
| 14      | DIS      | Disable pin. Enabled if pin is grounded, left floating or pulled below V <sub>ON</sub> , disabled if pin is pulled above V <sub>OFF</sub> . |
| 15      | OUT1     | Output, channel 1                                                                                                                           |
| 16      | +VS      | Positive supply                                                                                                                             |

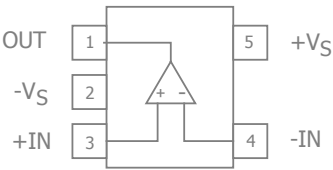
Disable Pin Truth Table

| Pin | High     | Low*    |
|-----|----------|---------|
| DIS | Disabled | Enabled |

\*Default Open State



CLC1014 Pin Configuration



CLC1014 Pin Assignments

| Pin No. | Pin Name | Description     |
|---------|----------|-----------------|
| 1       | OUT      | Output          |
| 2       | -VS      | Negative supply |
| 3       | +IN      | Positive input  |
| 4       | -IN      | Negative input  |
| 5       | +VS      | Positive supply |

The product (or products) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)



## Absolute Maximum Ratings

The safety of the device is not guaranteed when it is operated above the "Absolute Maximum Ratings". The device should not be operated at these "absolute" limits. Adhere to the "Recommended Operating Conditions" for proper device function. The information contained in the Electrical Characteristics tables and Typical Performance plots reflect the operating conditions noted on the tables and plots.

| Parameter                 | Min           | Max           | Unit |
|---------------------------|---------------|---------------|------|
| Supply Voltage            | 0             | 14            | V    |
| Input Voltage Range       | $-V_S - 0.5V$ | $+V_S + 0.5V$ | V    |
| Continuous Output Current |               | 100           | mA   |

## Reliability Information

| Parameter                         | Min | Typ | Max | Unit |
|-----------------------------------|-----|-----|-----|------|
| Junction Temperature              |     |     | 150 | °C   |
| Storage Temperature Range         | -65 |     | 150 | °C   |
| Lead Temperature (Soldering, 10s) |     |     | 260 | °C   |
| Package Thermal Resistance        |     |     |     |      |
| 5-Lead SOT23                      |     | 221 |     | °C/W |
| 6-Lead SOT23                      |     | 177 |     | °C/W |
| 16-Lead SOIC                      |     | 68  |     | °C/W |

Notes:

Package thermal resistance ( $\theta_{JA}$ ), JEDEC standard, multi-layer test boards, still air.

## ESD Protection

| Product                    | SOT23-5 | SOT23-6 | SOIC-16 |
|----------------------------|---------|---------|---------|
| Human Body Model (HBM)     | 2kV     | 2kV     | 2kV     |
| Charged Device Model (CDM) | 1kV     | 1kV     | 1kV     |

## Recommended Operating Conditions

| Parameter                   | Min | Typ | Max | Unit |
|-----------------------------|-----|-----|-----|------|
| Operating Temperature Range | -40 |     | +85 | °C   |
| Supply Voltage Range        | 4.5 |     | 12  | V    |



## Electrical Characteristics at +5V

$T_A = 25^\circ\text{C}$ ,  $V_S = +5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$  to  $V_S/2$ ,  $G = 2$ ; unless otherwise noted.

| Symbol                          | Parameter                    | Conditions                                                                                            | Min                                 | Typ        | Max | Units  |
|---------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------|------------|-----|--------|
| Frequency Domain Response       |                              |                                                                                                       |                                     |            |     |        |
| BW <sub>SS</sub>                | -3dB Bandwidth               | G = +2, V <sub>OUT</sub> = 0.2V <sub>pp</sub>                                                         |                                     | 600        |     | MHz    |
| BW <sub>LS</sub>                | Large Signal Bandwidth       | G = +2, V <sub>OUT</sub> = 1V <sub>pp</sub>                                                           |                                     | 400        |     | MHz    |
| BW <sub>0.1dBSS</sub>           | 0.1dB Gain Flatness          | G = +2, V <sub>OUT</sub> = 0.2V <sub>pp</sub>                                                         |                                     | 150        |     | MHz    |
| BW <sub>0.1dBLS</sub>           | 0.1dB Gain Flatness          | G = +2, V <sub>OUT</sub> = 1V <sub>pp</sub>                                                           |                                     | 120        |     | MHz    |
| Time Domain Response            |                              |                                                                                                       |                                     |            |     |        |
| t <sub>R</sub> , t <sub>F</sub> | Rise and Fall Time           | V <sub>OUT</sub> = 1V step; (10% to 90%)                                                              |                                     | 1.2        |     | ns     |
| t <sub>S</sub>                  | Settling Time to 0.1%        | V <sub>OUT</sub> = 1V step                                                                            |                                     | 10         |     | ns     |
| OS                              | Overshoot                    | V <sub>OUT</sub> = 0.2V step                                                                          |                                     | 2          |     | %      |
| SR                              | Slew Rate                    | 1V step                                                                                               |                                     | 750        |     | V/μs   |
| Distortion/Noise Response       |                              |                                                                                                       |                                     |            |     |        |
| HD2                             | 2nd Harmonic Distortion      | V <sub>OUT</sub> = 1V <sub>pp</sub> , 5MHz                                                            |                                     | -72        |     | dBc    |
| HD3                             | 3rd Harmonic Distortion      | V <sub>OUT</sub> = 1V <sub>pp</sub> , 5MHz                                                            |                                     | -85        |     | dBc    |
| THD                             | Total Harmonic Distortion    | V <sub>OUT</sub> = 1V <sub>pp</sub> , 5MHz                                                            |                                     | 70         |     | dB     |
| D <sub>G</sub>                  | Differential Gain            | NTSC (3.58MHz), AC-coupled, R <sub>L</sub> = 150Ω                                                     |                                     | 0.08       |     | %      |
| D <sub>P</sub>                  | Differential Phase           | NTSC (3.58MHz), AC-coupled, R <sub>L</sub> = 150Ω                                                     |                                     | 0.04       |     | °      |
| IP3                             | Third Order Intercept        | V <sub>OUT</sub> = 1V <sub>pp</sub> , 10MHz                                                           |                                     | 38         |     | dBm    |
| SFDR                            | Spurious Free Dynamic Range  | V <sub>OUT</sub> = 1V <sub>pp</sub> , 5MHz                                                            |                                     | 63         |     | dBc    |
| e <sub>n</sub>                  | Input Voltage Noise          | > 1MHz                                                                                                |                                     | 4          |     | nV/√Hz |
| i <sub>n</sub>                  | Input Current Noise          | > 1MHz                                                                                                |                                     | 4          |     | pA/√Hz |
| X <sub>TALK</sub>               | Crosstalk                    | Channel-to-channel 5MHz, V <sub>OUT</sub> = 1V <sub>pp</sub>                                          |                                     | 70         |     | dB     |
| DC Performance                  |                              |                                                                                                       |                                     |            |     |        |
| V <sub>IO</sub>                 | Input Offset Voltage         |                                                                                                       |                                     | 0          |     | mV     |
| dV <sub>IO</sub>                | Average Drift                |                                                                                                       |                                     | 4          |     | μV/°C  |
| I <sub>b</sub>                  | Input Bias Current           |                                                                                                       |                                     | 3.2        |     | μA     |
| dI <sub>b</sub>                 | Average Drift                |                                                                                                       |                                     | 20         |     | nA/°C  |
| PSRR                            | Power Supply Rejection Ratio | DC                                                                                                    |                                     | 56         |     | dB     |
| A <sub>OL</sub>                 | Open-Loop Gain               | V <sub>OUT</sub> = V <sub>S</sub> / 2                                                                 |                                     | 65         |     | dB     |
| I <sub>S</sub>                  | Supply Current               | per channel                                                                                           |                                     | 11         |     | mA     |
| Disable Characteristics         |                              |                                                                                                       |                                     |            |     |        |
| T <sub>ON</sub>                 | Turn On Time                 |                                                                                                       |                                     | 20         |     | ns     |
| T <sub>OFF</sub>                | Turn Off Time                |                                                                                                       |                                     | 40         |     | ns     |
| OFF <sub>IOS</sub>              | Off Isolation                | 5MHz                                                                                                  |                                     | -78        |     | dB     |
| V <sub>OFF</sub>                | Power Down Input Voltage     | DIS pin, disabled if pin is pulled above V <sub>OFF</sub> = V <sub>S</sub> - 2V                       | Disabled if > (V <sub>S</sub> - 2V) |            |     | V      |
| V <sub>ON</sub>                 | Enable Input Voltage         | DIS pin, enabled if pin is grounded, left open, or pulled below V <sub>ON</sub> = V <sub>S</sub> - 4V | Enabled if < (V <sub>S</sub> - 4V)  |            |     | V      |
| I <sub>SD</sub>                 | Disable Supply Current       | CLC1004; DIS pin is pulled to V <sub>S</sub>                                                          |                                     | 0.4        |     | mA     |
|                                 |                              | CLC3004; DIS pin is pulled to V <sub>S</sub>                                                          |                                     | 0.4        |     | mA     |
| Input Characteristics           |                              |                                                                                                       |                                     |            |     |        |
| R <sub>IN</sub>                 | Input Resistance             | Non-inverting                                                                                         |                                     | 4.5        |     | MΩ     |
| C <sub>IN</sub>                 | Input Capacitance            |                                                                                                       |                                     | 1.0        |     | pF     |
| CMIR                            | Common Mode Input Range      |                                                                                                       |                                     | 1.5 to 3.5 |     | V      |
| CMRR                            | Common Mode Rejection Ratio  | DC                                                                                                    |                                     | 50         |     | dB     |



Electrical Characteristics at +5V continued

$T_A = 25^{\circ}\text{C}$ ,  $V_S = +5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$  to  $V_S/2$ ,  $G = 2$ ; unless otherwise noted.

| Symbol                 | Parameter            | Conditions        | Min | Typ        | Max | Units    |
|------------------------|----------------------|-------------------|-----|------------|-----|----------|
| Output Characteristics |                      |                   |     |            |     |          |
| $R_O$                  | Output Resistance    | Closed Loop, DC   |     | 0.1        |     | $\Omega$ |
| $V_{OUT}$              | Output Voltage Swing | $R_L = 150\Omega$ |     | 1.5 to 3.5 |     | V        |
| $I_{OUT}$              | Output Current       |                   |     | $\pm 100$  |     | mA       |

Notes:

- 1. 100% tested at 25°C

The product (or products) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)



## Electrical Characteristics at $\pm 5V$

$T_A = 25^\circ C$ ,  $V_S = \pm 5V$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$ ,  $G = 2$ ; unless otherwise noted.

| Symbol                          | Parameter                                   | Conditions                                                                                            | Min                                 | Typ  | Max | Units  |
|---------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------|------|-----|--------|
| Frequency Domain Response       |                                             |                                                                                                       |                                     |      |     |        |
| BW <sub>SS</sub>                | -3dB Bandwidth                              | G = +2, V <sub>OUT</sub> = 0.2V <sub>pp</sub>                                                         |                                     | 750  |     | MHz    |
| BW <sub>LS</sub>                | Large Signal Bandwidth                      | G = +2, V <sub>OUT</sub> = 2V <sub>pp</sub>                                                           |                                     | 350  |     | MHz    |
| BW <sub>0.1dBSS</sub>           | 0.1dB Gain Flatness                         | G = +2, V <sub>OUT</sub> = 0.2V <sub>pp</sub>                                                         |                                     | 200  |     | MHz    |
| BW <sub>0.1dBLS</sub>           | 0.1dB Gain Flatness                         | G = +2, V <sub>OUT</sub> = 2V <sub>pp</sub>                                                           |                                     | 120  |     | MHz    |
| Time Domain Response            |                                             |                                                                                                       |                                     |      |     |        |
| t <sub>R</sub> , t <sub>F</sub> | Rise and Fall Time                          | V <sub>OUT</sub> = 2V step; (10% to 90%)                                                              |                                     | 1.3  |     | ns     |
| t <sub>S</sub>                  | Settling Time to 0.1%                       | V <sub>OUT</sub> = 2V step                                                                            |                                     | 10   |     | ns     |
| OS                              | Overshoot                                   | V <sub>OUT</sub> = 0.2V step                                                                          |                                     | 1.5  |     | %      |
| SR                              | Slew Rate                                   | 2V step                                                                                               |                                     | 1400 |     | V/μs   |
| Distortion/Noise Response       |                                             |                                                                                                       |                                     |      |     |        |
| HD2                             | 2nd Harmonic Distortion                     | V <sub>OUT</sub> = 2V <sub>pp</sub> , 5MHz                                                            |                                     | -71  |     | dBc    |
| HD3                             | 3rd Harmonic Distortion                     | V <sub>OUT</sub> = 2V <sub>pp</sub> , 5MHz                                                            |                                     | -82  |     | dBc    |
| THD                             | Total Harmonic Distortion                   | V <sub>OUT</sub> = 2V <sub>pp</sub> , 5MHz                                                            |                                     | 70   |     | dB     |
| D <sub>G</sub>                  | Differential Gain                           | NTSC (3.58MHz), AC-coupled, R <sub>L</sub> = 150Ω                                                     |                                     | 0.02 |     | %      |
| D <sub>P</sub>                  | Differential Phase                          | NTSC (3.58MHz), AC-coupled, R <sub>L</sub> = 150Ω                                                     |                                     | 0.01 |     | °      |
| IP3                             | Third Order Intercept                       | V <sub>OUT</sub> = 2V <sub>pp</sub> , 10MHz                                                           |                                     | 41   |     | dBm    |
| SFDR                            | Spurious Free Dynamic Range                 | V <sub>OUT</sub> = 1V <sub>pp</sub> , 5MHz                                                            |                                     | 65   |     | dBc    |
| e <sub>n</sub>                  | Input Voltage Noise                         | > 1MHz                                                                                                |                                     | 4    |     | nV/√Hz |
| i <sub>n</sub>                  | Input Current Noise                         | > 1MHz                                                                                                |                                     | 4    |     | pA/√Hz |
| X <sub>TALK</sub>               | Crosstalk                                   | Channel-to-channel 5MHz, V <sub>OUT</sub> = 2V <sub>pp</sub>                                          |                                     | 70   |     | dB     |
| DC Performance                  |                                             |                                                                                                       |                                     |      |     |        |
| V <sub>IO</sub>                 | Input Offset Voltage <sup>(1)</sup>         |                                                                                                       | -10                                 | 0    | 10  | mV     |
| dV <sub>IO</sub>                | Average Drift                               |                                                                                                       |                                     | 4    |     | μV/°C  |
| I <sub>b</sub>                  | Input Bias Current <sup>(1)</sup>           |                                                                                                       | -20                                 | 3.2  | 20  | μA     |
| dI <sub>b</sub>                 | Average Drift                               |                                                                                                       |                                     | 20   |     | nA/°C  |
| PSRR                            | Power Supply Rejection Ratio <sup>(1)</sup> | DC                                                                                                    | 40                                  | 56   |     | dB     |
| A <sub>OL</sub>                 | Open-Loop Gain                              | V <sub>OUT</sub> = V <sub>S</sub> / 2                                                                 |                                     | 70   |     | dB     |
| I <sub>S</sub>                  | Supply Current <sup>(1)</sup>               | per channel                                                                                           |                                     | 12   | 17  | mA     |
| Disable Characteristics         |                                             |                                                                                                       |                                     |      |     |        |
| T <sub>ON</sub>                 | Turn On Time                                |                                                                                                       |                                     | 20   |     | ns     |
| T <sub>OFF</sub>                | Turn Off Time                               |                                                                                                       |                                     | 40   |     | ns     |
| OFF <sub>IOS</sub>              | Off Isolation                               | 5MHz                                                                                                  |                                     | -78  |     | dB     |
| V <sub>OFF</sub>                | Power Down Input Voltage                    | DIS pin, disabled if pin is pulled above V <sub>OFF</sub> = V <sub>S</sub> - 1V                       | Disabled if > (V <sub>S</sub> - 1V) |      |     | V      |
| V <sub>ON</sub>                 | Enable Input Voltage                        | DIS pin, enabled if pin is grounded, left open, or pulled below V <sub>ON</sub> = V <sub>S</sub> - 2V | Enabled if < (V <sub>S</sub> - 2V)  |      |     | V      |
| I <sub>SD</sub>                 | Disable Supply Current <sup>(1)</sup>       | CLC1004; DIS pin is pulled to V <sub>S</sub>                                                          |                                     | 0.4  | 0.8 | mA     |
|                                 |                                             | CLC3004; DIS pin is pulled to V <sub>S</sub>                                                          |                                     | 0.4  | 0.9 | mA     |
| Input Characteristics           |                                             |                                                                                                       |                                     |      |     |        |
| R <sub>IN</sub>                 | Input Resistance                            | Non-inverting                                                                                         |                                     | 4.5  |     | MΩ     |
| C <sub>IN</sub>                 | Input Capacitance                           |                                                                                                       |                                     | 1.0  |     | pF     |
| CMIR                            | Common Mode Input Range                     |                                                                                                       |                                     | ±3.2 |     | V      |
| CMRR                            | Common Mode Rejection Ratio <sup>(1)</sup>  | DC                                                                                                    | 40                                  | 60   |     | dB     |



Electrical Characteristics at ±5V continued

T<sub>A</sub> = 25°C, V<sub>S</sub> = ±5V, R<sub>f</sub> = R<sub>g</sub> = 150Ω, R<sub>L</sub> = 150Ω, G = 2; unless otherwise noted.

| Symbol                 | Parameter            | Conditions                           | Min  | Typ  | Max | Units |
|------------------------|----------------------|--------------------------------------|------|------|-----|-------|
| Output Characteristics |                      |                                      |      |      |     |       |
| R <sub>O</sub>         | Output Resistance    | Closed Loop, DC                      |      | 0.1  |     | Ω     |
| V <sub>OUT</sub>       | Output Voltage Swing | R <sub>L</sub> = 150Ω <sup>(1)</sup> | ±3.0 | ±3.8 |     | V     |
| I <sub>OUT</sub>       | Output Current       |                                      |      | ±220 |     | mA    |

Notes:

- 1. 100% tested at 25°C

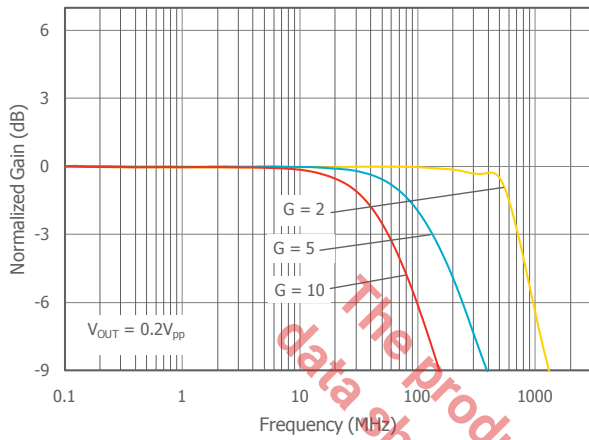
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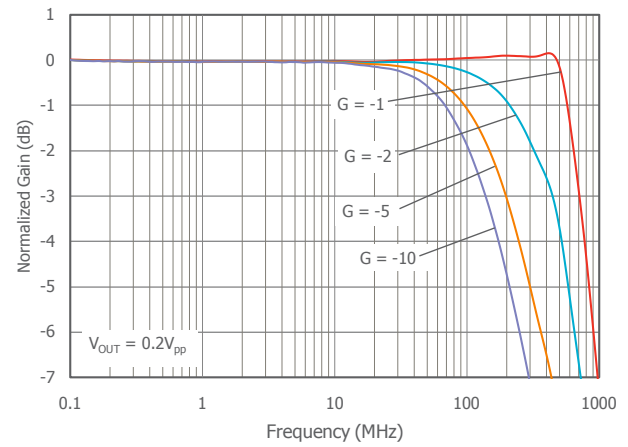
## Typical Performance Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$ ,  $G = 2$ ; unless otherwise noted.

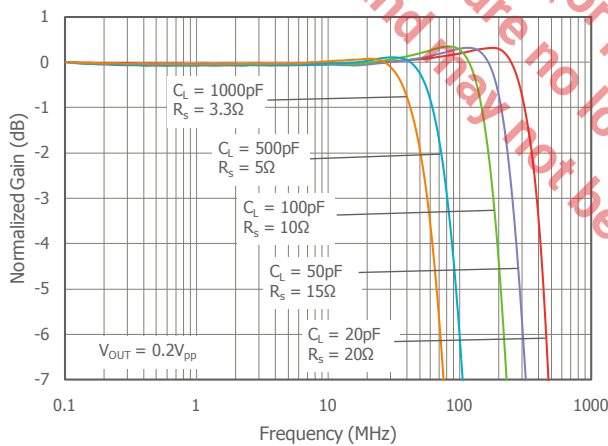
### Non-Inverting Frequency Response



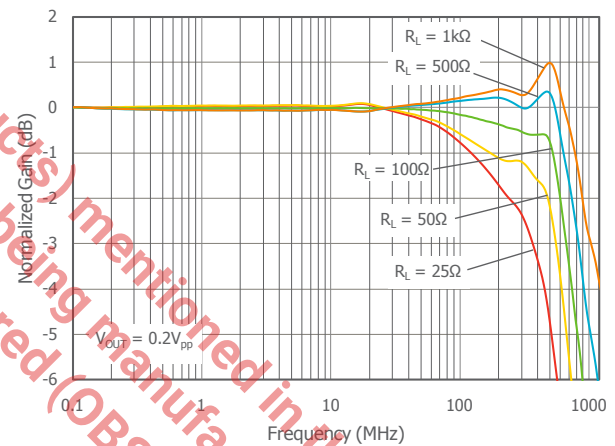
### Inverting Frequency Response



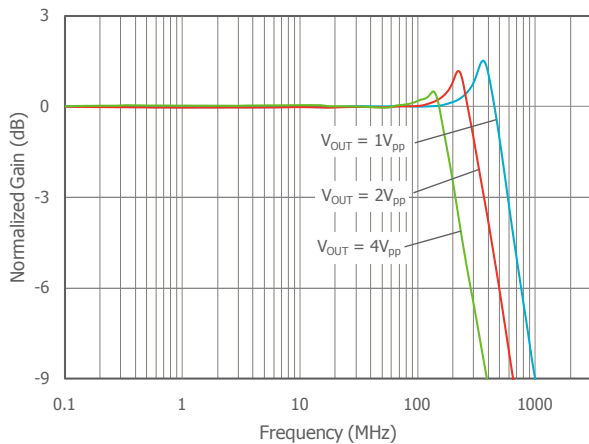
### Frequency Response vs. $C_L$



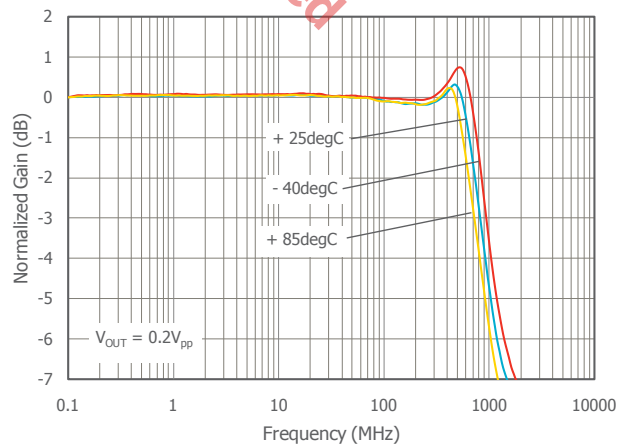
### Frequency Response vs. $R_L$



### Frequency Response vs. $V_{OUT}$



### Frequency Response vs. Temperature

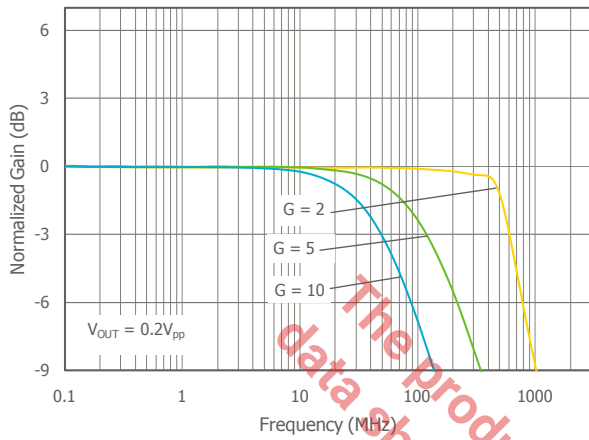




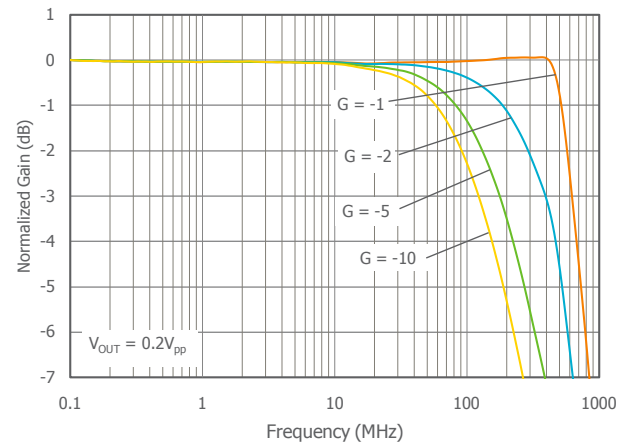
## Typical Performance Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$ ,  $G = 2$ ; unless otherwise noted.

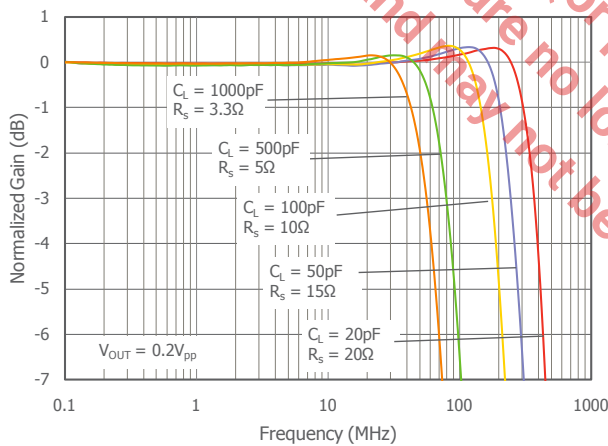
Non-Inverting Frequency Response at  $V_S = 5\text{V}$



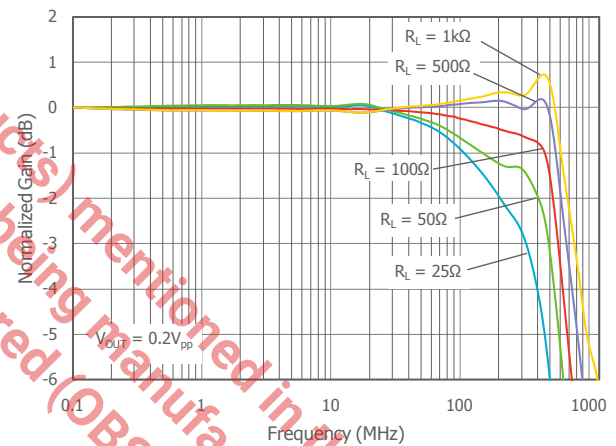
Inverting Frequency Response at  $V_S = 5\text{V}$



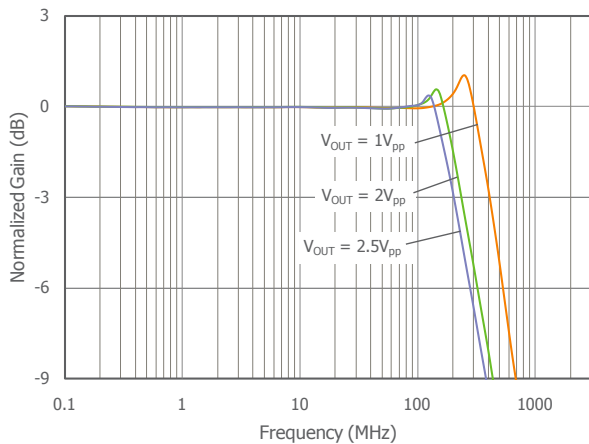
Frequency Response vs.  $C_L$  at  $V_S = 5\text{V}$



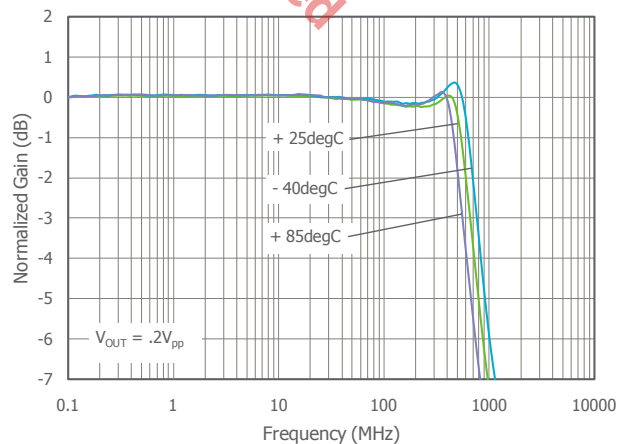
Frequency Response vs.  $R_L$  at  $V_S = 5\text{V}$



Frequency Response vs.  $V_{OUT}$  at  $V_S = 5\text{V}$



Frequency Response vs. Temperature at  $V_S = 5\text{V}$

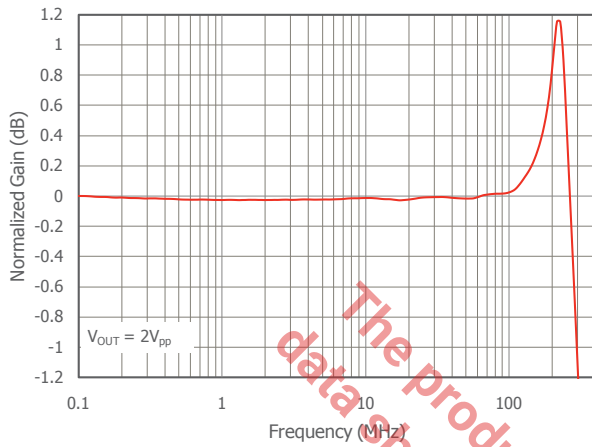




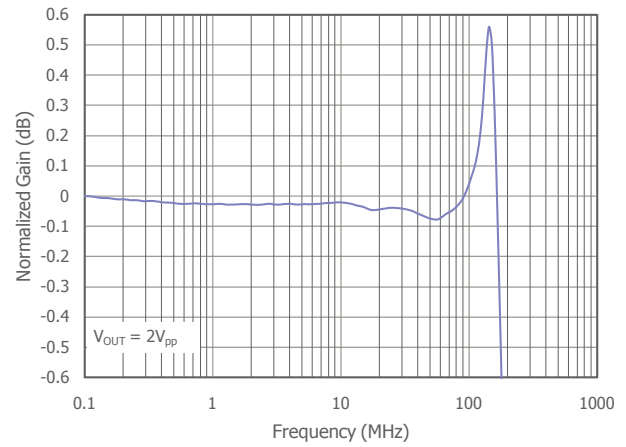
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$ ,  $G = 2$ ; unless otherwise noted.

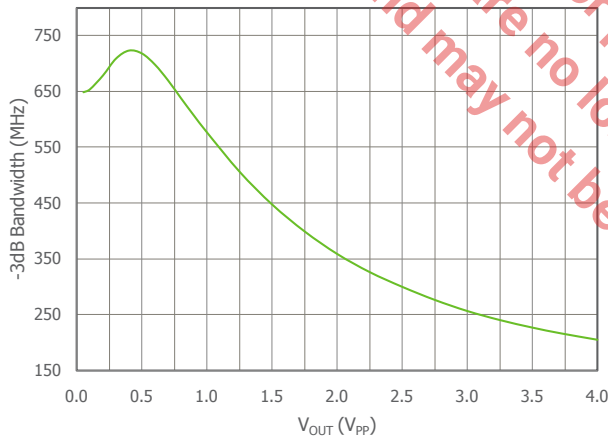
### Gain Flatness



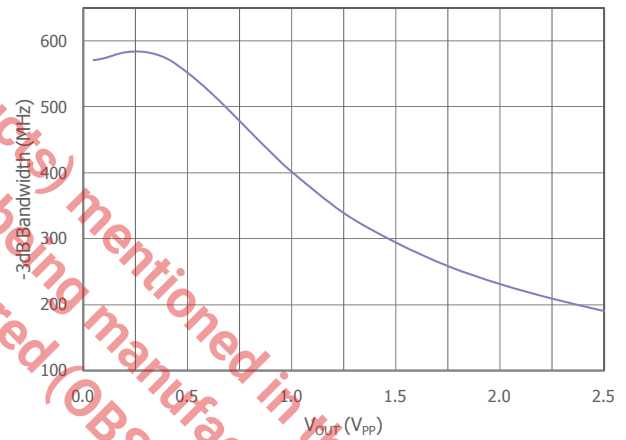
### Gain Flatness at $V_S = 5\text{V}$



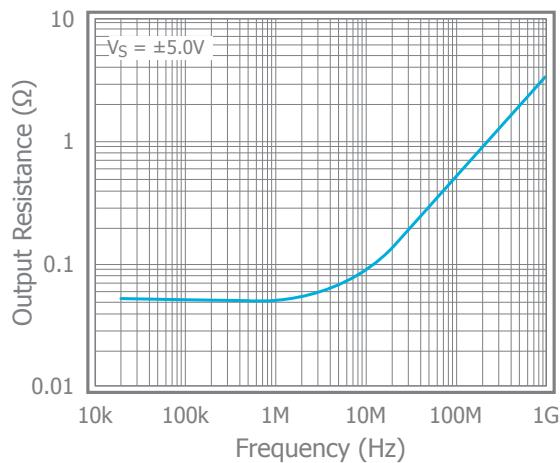
### -3dB Bandwidth vs. $V_{OUT}$



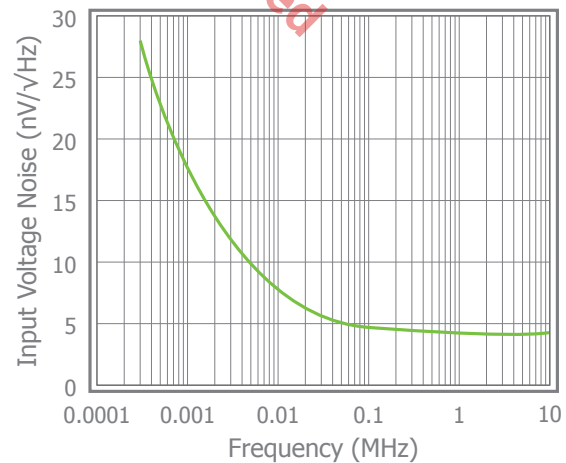
### -3dB Bandwidth vs. $V_{OUT}$ at $V_S = 5\text{V}$



### Closed Loop Output Impedance vs. Frequency



### Input Voltage Noise

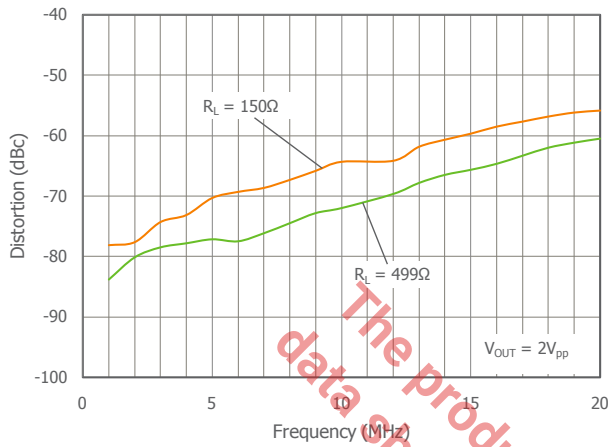




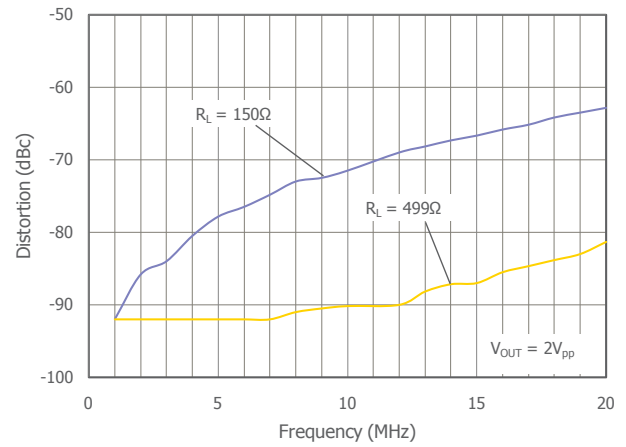
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$ ,  $G = 2$ ; unless otherwise noted.

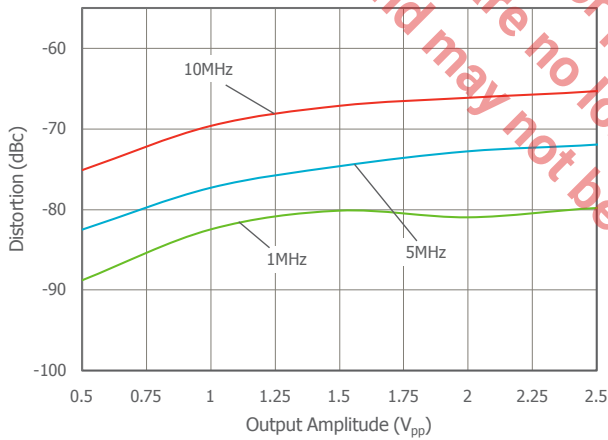
### 2nd Harmonic Distortion vs. $R_L$



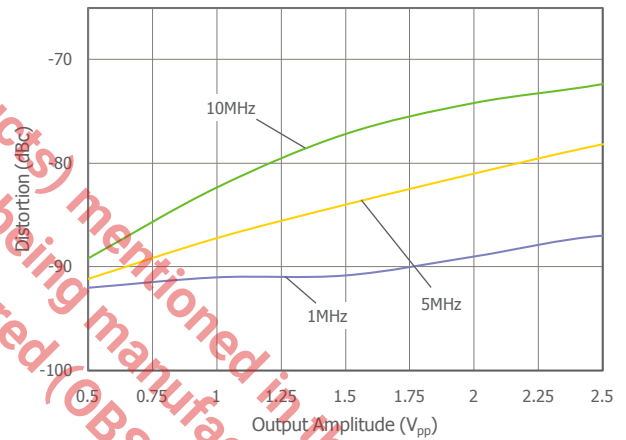
### 3rd Harmonic Distortion vs. $R_L$



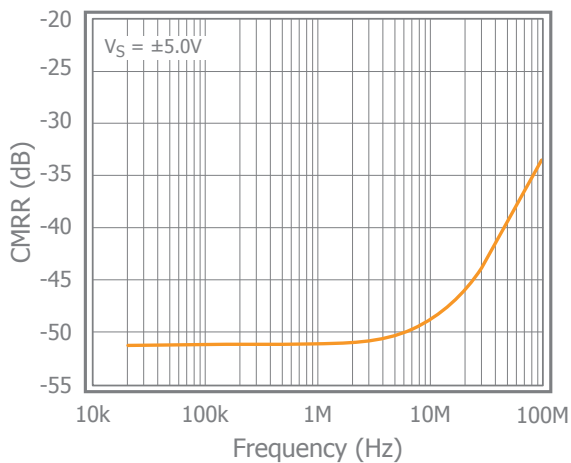
### 2nd Harmonic Distortion vs. $V_{OUT}$



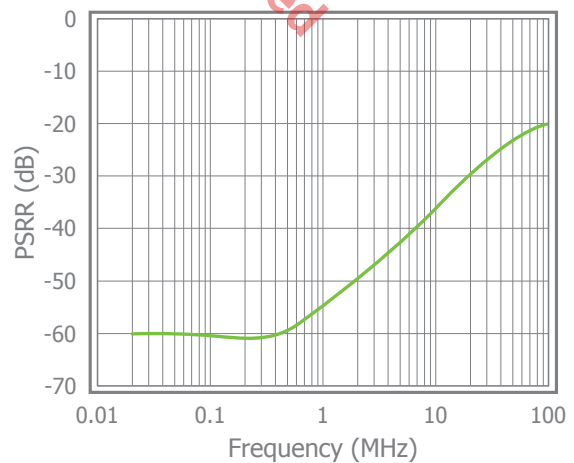
### 3rd Harmonic Distortion vs. $V_{OUT}$



### CMRR vs. Frequency



### PSRR vs. Frequency

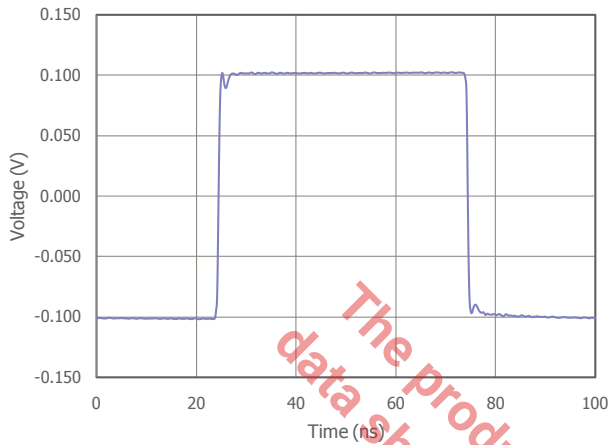




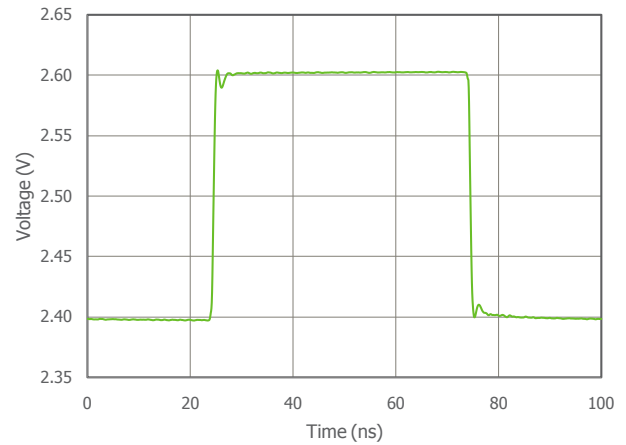
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = R_g = 150\Omega$ ,  $R_L = 150\Omega$ ,  $G = 2$ ; unless otherwise noted.

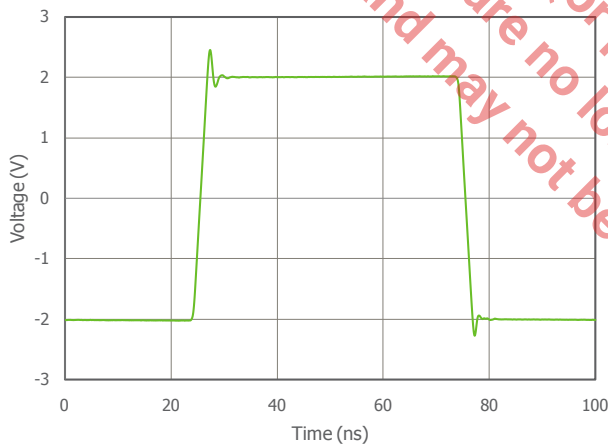
### Small Signal Pulse Response



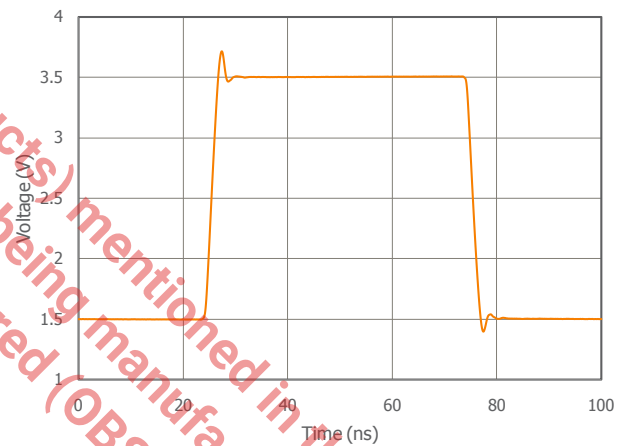
### Small Signal Pulse Response at $V_S = 5\text{V}$



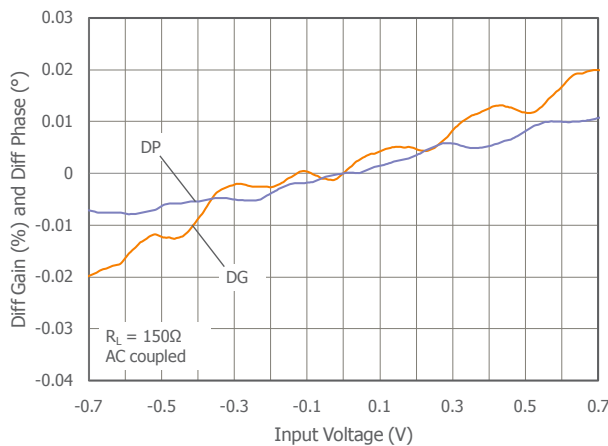
### Large Signal Pulse Response



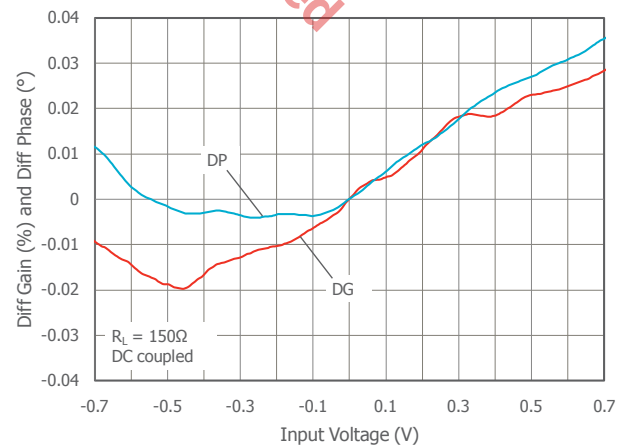
### Large Signal Pulse Response at $V_S = 5\text{V}$



### Differential Gain & Phase AC Coupled Output



### Differential Gain & Phase DC Coupled Output

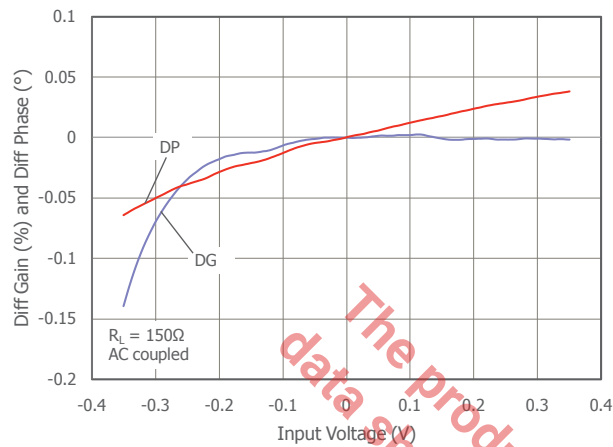




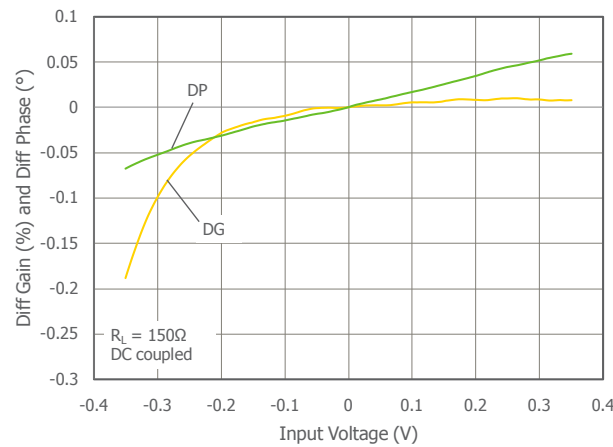
Typical Performance Characteristics - Continued

T<sub>A</sub> = 25°C, V<sub>S</sub> = ±5V, R<sub>f</sub> = R<sub>g</sub> = 150Ω, R<sub>L</sub> = 150Ω, G = 2; unless otherwise noted.

Differential Gain & Phase AC Coupled Output at V<sub>S</sub> = ±2.5V



Differential Gain & Phase DC Coupled at V<sub>S</sub> = ±2.5V



The product (or products) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)

COMLINEAR CLC1004, CLC1014, CLC3004 Single and Triple, 750MHz Amplifiers with Disable Rev 1C



## Application Information

### Basic Operation

Figures 1 and 2 illustrate typical circuit configurations for non-inverting, inverting, and unity gain topologies for dual supply applications. They show the recommended bypass capacitor values and overall closed loop gain equations.

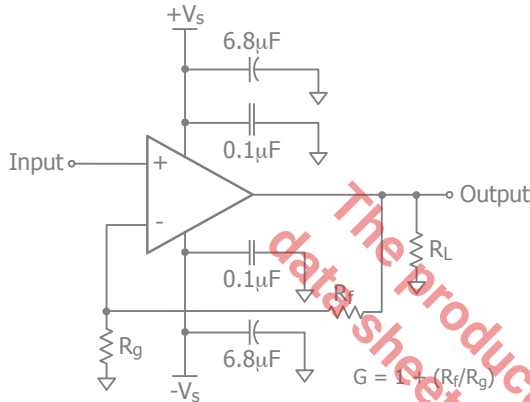


Figure 1. Typical Non-Inverting Gain Circuit

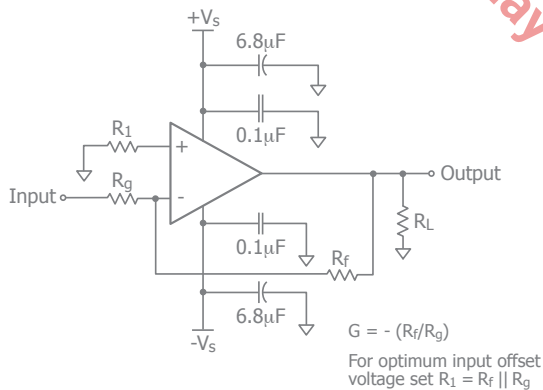


Figure 2. Typical Inverting Gain Circuit

### Power Dissipation

Power dissipation should not be a factor when operating under the stated 1000 ohm load condition. However, applications with low impedance, DC coupled loads should be analyzed to ensure that maximum allowed junction temperature is not exceeded. Guidelines listed below can be used to verify that the particular application will not cause the device to operate beyond its intended operating range.

Maximum power levels are set by the absolute maximum junction rating of 150°C. To calculate the junction tem-

perature, the package thermal resistance value  $\Theta_{JA}$  ( $\Theta_{JA}$ ) is used along with the total die power dissipation.

$$T_{\text{Junction}} = T_{\text{Ambient}} + (\Theta_{JA} \times P_D)$$

Where  $T_{\text{Ambient}}$  is the temperature of the working environment.

In order to determine  $P_D$ , the power dissipated in the load needs to be subtracted from the total power delivered by the supplies.

$$P_D = P_{\text{supply}} - P_{\text{load}}$$

Supply power is calculated by the standard power equation.

$$P_{\text{supply}} = V_{\text{supply}} \times I_{\text{RMS supply}}$$

$$V_{\text{supply}} = V_{S+} - V_{S-}$$

Power delivered to a purely resistive load is:

$$P_{\text{load}} = ((V_{\text{LOAD}})_{\text{RMS}}^2) / R_{\text{load eff}}$$

The effective load resistor ( $R_{\text{load eff}}$ ) will need to include the effect of the feedback network. For instance,

$R_{\text{load eff}}$  in figure 3 would be calculated as:

$$R_L || (R_f + R_g)$$

These measurements are basic and are relatively easy to perform with standard lab equipment. For design purposes however, prior knowledge of actual signal levels and load impedance is needed to determine the dissipated power. Here,  $P_D$  can be found from

$$P_D = P_{\text{Quiescent}} + P_{\text{Dynamic}} - P_{\text{Load}}$$

Quiescent power can be derived from the specified  $I_S$  values along with known supply voltage,  $V_{\text{Supply}}$ . Load power can be calculated as above with the desired signal amplitudes using:

$$(V_{\text{LOAD}})_{\text{RMS}} = V_{\text{PEAK}} / \sqrt{2}$$

$$(I_{\text{LOAD}})_{\text{RMS}} = (V_{\text{LOAD}})_{\text{RMS}} / R_{\text{load eff}}$$

The dynamic power is focused primarily within the output stage driving the load. This value can be calculated as:

$$P_{\text{DYNAMIC}} = (V_{S+} - V_{\text{LOAD}})_{\text{RMS}} \times (I_{\text{LOAD}})_{\text{RMS}}$$

Assuming the load is referenced in the middle of the power rails or  $V_{\text{supply}}/2$ .

Figure 3 shows the maximum safe power dissipation in the package vs. the ambient temperature for the packages available.

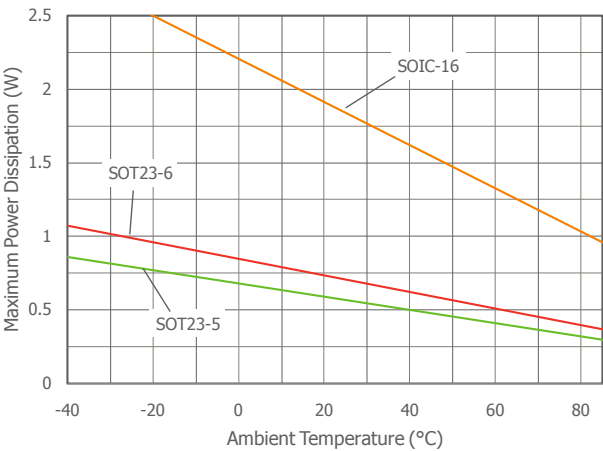


Figure 3. Maximum Power Derating

Driving Capacitive Loads

Increased phase delay at the output due to capacitive loading can cause ringing, peaking in the frequency response, and possible unstable behavior. Use a series resistance  $R_S$  between the amplifier and the load to help improve stability and settling performance. Refer to Figure 4.

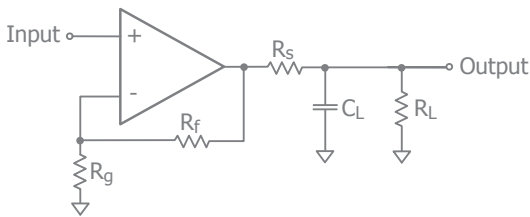


Figure 4. Addition of  $R_S$  for Driving Capacitive Loads

Table 1 provides the recommended  $R_S$  for various capacitive loads. The recommended  $R_S$  values result in  $\leq 1$ dB peaking in the frequency response. The Frequency Response vs.  $C_L$  plots, on page 7, illustrates the response of the CLCx004.

| $C_L$ (pF) | $R_S$ ( $\Omega$ ) | -3dB BW (MHz) |
|------------|--------------------|---------------|
| 20         | 20                 | 400           |
| 50         | 15                 | 270           |
| 100        | 10                 | 195           |
| 500        | 5                  | 80            |
| 1000       | 3.3                | 58            |

Table 1: Recommended  $R_S$  vs.  $C_L$

For a given load capacitance, adjust  $R_S$  to optimize the tradeoff between settling time and bandwidth. In general,

reducing  $R_S$  will increase bandwidth at the expense of additional overshoot and ringing.

Overdrive Recovery

An overdrive condition is defined as the point when either one of the inputs or the output exceed their specified voltage range. Overdrive recovery is the time needed for the amplifier to return to its normal or linear operating point. The recovery time varies, based on whether the input or output is overdriven and by how much the range is exceeded. The CLCx004 will typically recover in less than 20ns from an overdrive condition. Figure 5 shows the CLC1004 in an overdriven condition.

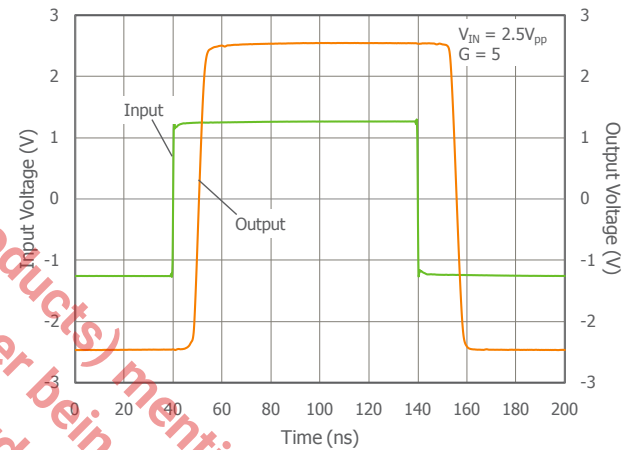


Figure 5. Overdrive Recovery

Layout Considerations

General layout and supply bypassing play major roles in high frequency performance. Exar has evaluation boards to use as a guide for high frequency layout and as aid in device testing and characterization. Follow the steps below as a basis for high frequency layout:

- Include 6.8 $\mu$ F and 0.1 $\mu$ F ceramic capacitors for power supply decoupling
- Place the 6.8 $\mu$ F capacitor within 0.75 inches of the power pin
- Place the 0.1 $\mu$ F capacitor within 0.1 inches of the power pin
- Remove the ground plane under and around the part, especially near the input and output pins to reduce parasitic capacitance
- Minimize all trace lengths to reduce series inductances

Refer to the evaluation board layouts below for more information.



Evaluation Board Information

The following evaluation boards are available to aid in the testing and layout of these devices:

| Evaluation Board | Products         |
|------------------|------------------|
| CEB002           | CLC1004, CLC1014 |
| CEB012           | CLC3004          |

Evaluation Board Schematics

Evaluation board schematics and layouts are shown in Figures 9-14. These evaluation boards are built for dual-supply operation. Follow these steps to use the board in a single-supply application:

- 1. Short -Vs to ground.
- 2. Use C3 and C4, if the -Vs pin of the amplifier is not directly connected to the ground plane.

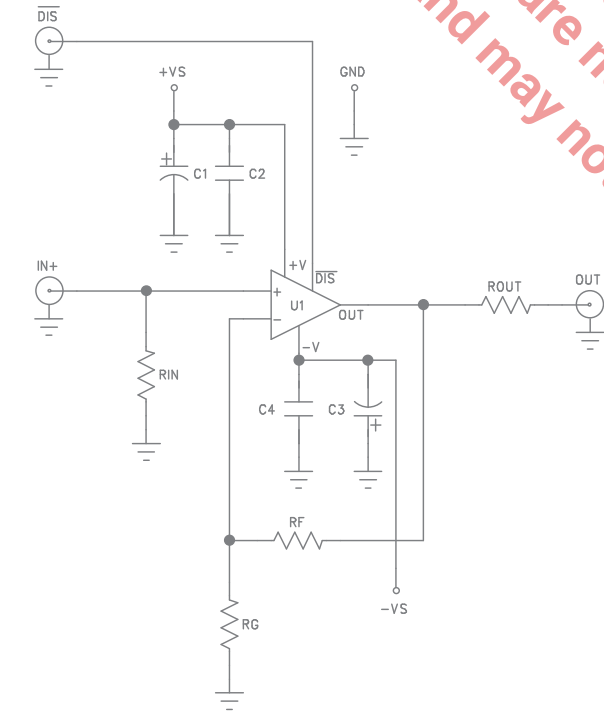


Figure 9. CEB002 Schematic

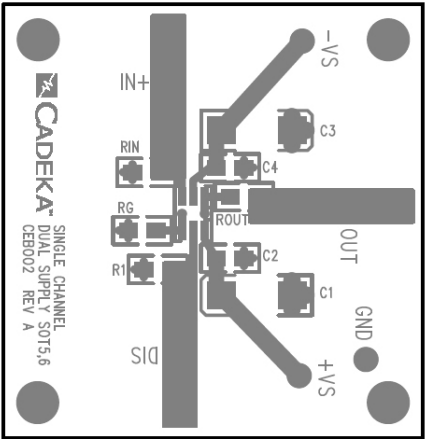


Figure 10. CEB002 Top View

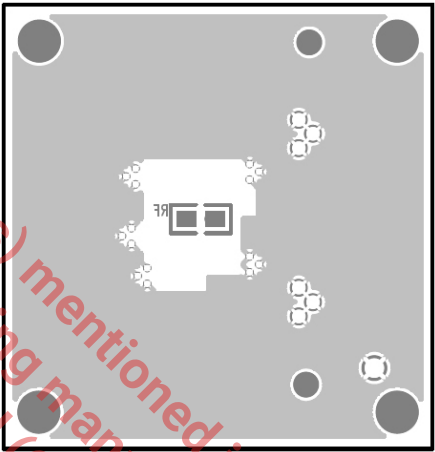


Figure 11. CEB002 Bottom View

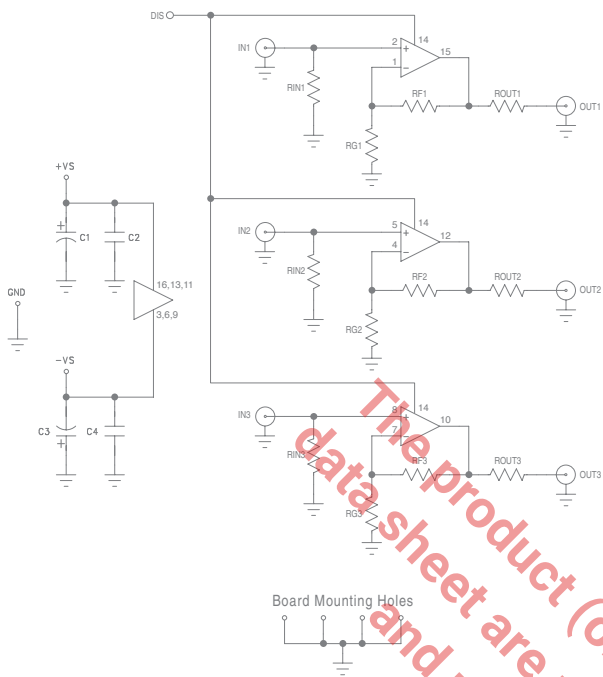


Figure 12. CEB012 Schematic

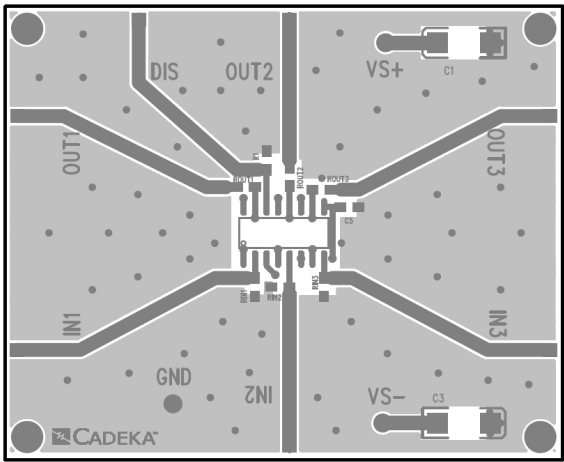


Figure 13. CEB012 Top View

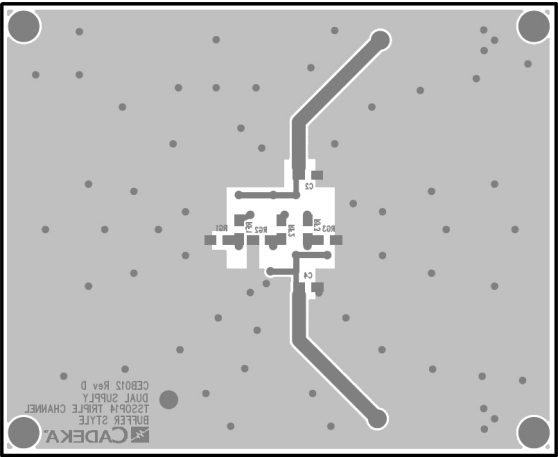
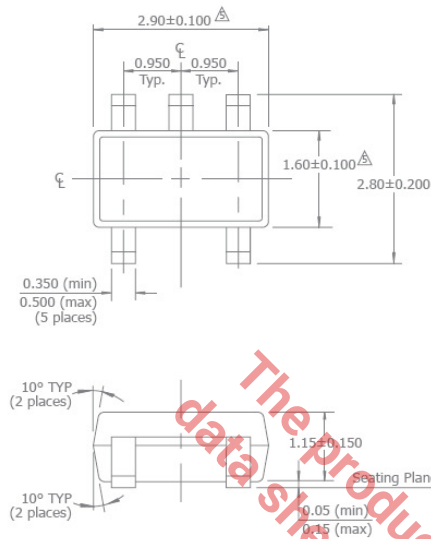


Figure 14. CEB012 Bottom View



## Mechanical Dimensions

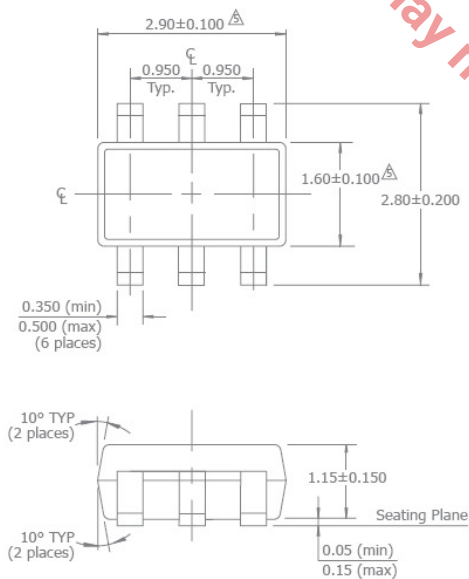
### SOT23-5 Package



#### NOTES:

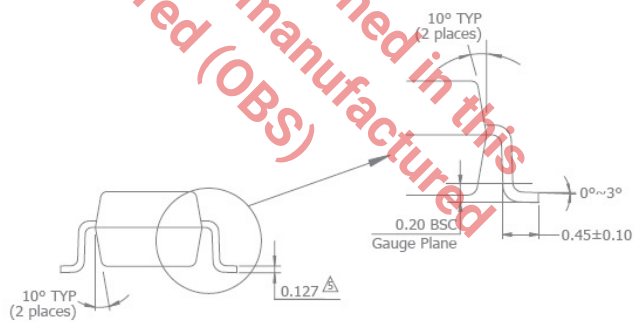
1. Dimensions and tolerances are as per ANSI Y14.5M-1982.
  2. Package surface to be matte finish VDI 11~13.
  3. Die is facing up for mold. Die is facing down for trim/form, ie. reverse trim/form.
  4. The footlength measuring is based on the gauge plane method.
- △ Dimension are exclusive of mold flash and gate burr.  
 △ Dimension are exclusive of solder plating.

### SOT23-6 Package



#### NOTES:

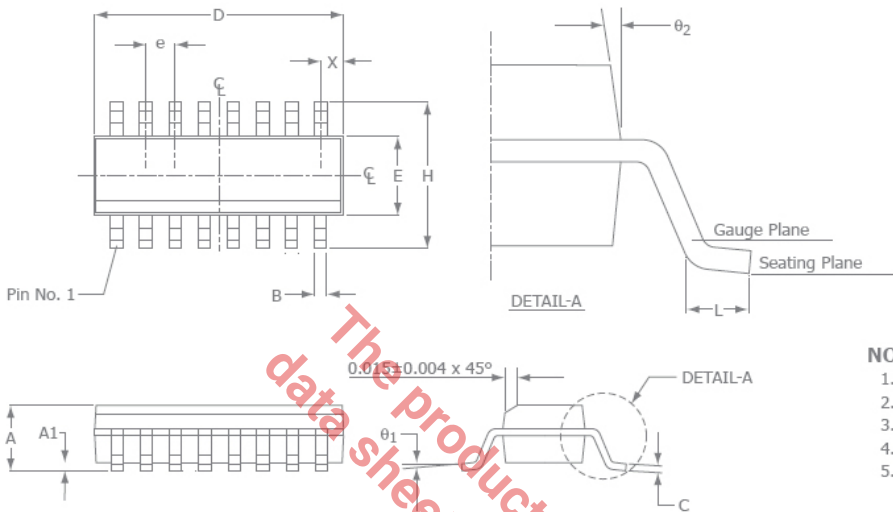
1. Dimensions and tolerances are as per ANSI Y14.5M-1982.
  2. Package surface to be matte finish VDI 11~13.
  3. Die is facing up for mold. Die is facing down for trim/form, ie. reverse trim/form.
  4. The footlength measuring is based on the gauge plane method.
  5. Dimension are exclusive of mold flash and gate burr.
- △ Dimension are exclusive of solder plating.





Mechanical Dimensions

SOIC-16 Package



| SOIC-16 |           |        |
|---------|-----------|--------|
| SYMBOL  | MIN       | MAX    |
| A       | 0.054     | 0.068  |
| A1      | 0.004     | 0.0098 |
| B       | 0.014     | 0.019  |
| D       | 0.386     | 0.393  |
| E       | 0.150     | 0.157  |
| H       | 0.229     | 0.244  |
| e       | 0.050 BSC |        |
| C       | 0.0075    | 0.0098 |
| L       | 0.016     | 0.034  |
| X       | 0.020 Ref |        |
| theta1  | 0°        | 8°     |
| theta2  | 7° BSC    |        |

- NOTE:
- 1. All dimensions are in inches.
  - 2. Lead coplanarity should be 0" to 0.004" max.
  - 3. Package surface finishing: VDI 24~27
  - 4. All dimension excluding mold flashes.
  - 5. The lead width, B to be determined at 0.0075" from the lead tip.

The product (or products) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)

For Further Assistance:

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