# LMH6715QML Dual Wideband Video Op Amp

**Check for Samples: LMH6715QML**

## FEATURES

- **Available with Radiation Ensured 300 krad(Si)**

  **$T_A$ = 25°C, $R_L$ = 100Ω, Typical Values Unless Specified.**
- **Very Low Diff. Gain, Phase: 0.02%, 0.02°**
- **Wide Bandwidth: 480MHz ($A_V$ = +1V/V); 400MHz ($A_V$ = +2V/V)**
- **0.1dB Gain Flatness to 100MHz**
- **Low Power: 5.8mA/Channel**
- **−70dB Channel-to-Channel Crosstalk (10MHz)**
- **Fast Slew Rate: 1300V/μs**
- **Unity Gain Stable**
- **Improved Replacement for CLC412**

## APPLICATIONS

- **HDTV, NTSC & PAL Video Systems**
- **Video Switching and Distribution**
- **IQ Amplifiers**
- **Wideband Active Filters**
- **Cable Drivers**
- **DC Coupled Single-to-Differential Conversions**

## DESCRIPTION

The LMH6715 combines Texas Instrument's VIP10™ high speed complementary bipolar process with Texas Instrument's current feedback topology to produce a very high speed dual op amp. The LMH6715 provides 400MHz small signal bandwidth at a gain of +2V/V and 1300V/μs slew rate while consuming only 5.8mA per amplifier from ±5V supplies.

The LMH6715 offers exceptional video performance with its 0.02% and 0.02° differential gain and phase errors for NTSC and PAL video signals while driving up to four back terminated 75Ω loads. The LMH6715 also offers a flat gain response of 0.1dB to 100MHz and very low channel-to-channel crosstalk of −70dB at 10MHz. Additionally, each amplifier can deliver 70mA of output current. This level of performance makes the LMH6715 an ideal dual op amp for high density, broadcast quality video systems.

The LMH6715's two very well matched amplifiers support a number of applications such as differential line drivers and receivers. In addition, the LMH6715 is well suited for Sallen Key active filters in applications such as anti-aliasing filters for high speed A/D converters. Its low power requirement, low noise and distortion allow the LMH6715 to serve portable RF applications such as IQ channels.

## Connection Diagram

**Top View**

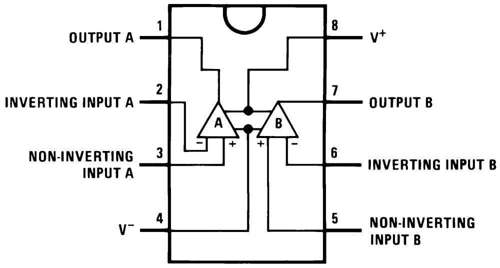


**Figure 1. 8 Lead CDIP Package**
**See Package Number NAB0008A**

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings[1]

| | | | |
|---|---|---|---|
| Supply Voltage ($V_{CC}$) | | | ±6.75V |
| Common Mode Input Voltage ($V_{CM}$) | | | $V^+ - V^-$ |
| Differential Input Voltage | | | V+ - V- |
| Power Dissipation ($P_D$)[2] | | | 1.0W |
| Lead Temperature (Soldering, 10 seconds) | | | +300°C |
| Junction Temperature ($T_J$) | | | +175°C |
| Storage Temperature Range | | | $-65°C \le T_A \le +150$ °C |
| Thermal Resistance | $\theta_{JA}$ | CDIP (Still Air) | 140°C/W |
| | | CDIP (500LF/Min Air Flow) | 80°C/W |
| | $\theta_{JC}$ | CDIP | 32°C/W |
| | | Package Weight (typical) | |
| Weight CDIP | | | 1130mg |
| ESD Tolerance[3] | | | 2000V |

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limit s. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

(2) The maximum power dissipation must be derated at elevated temperatures and is dictated by $T_{Jmax}$ (maximum junction temperature), $\theta_{JA}$ (package junction to ambient thermal resistance), and $T_A$ (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

(3) Human body model, 1.5kΩ in series with 100 pF.

## Recommended Operating Ratings

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | $\pm 5V_{DC}$ to $\pm 6V_{DC}$ |
| Ambient Operating Temperature Range ($T_A$) | $-55°C \le T_A \le +125°C$ |

## Quality Conformance Inspection

### MIL-STD-883, Method 5005 - Group A

| Subgroup | Description | Temp (°C) |
|---|---|---|
| 1 | Static tests at | +25 |
| 2 | Static tests at | +125 |
| 3 | Static tests at | -55 |
| 4 | Dynamic tests at | +25 |
| 5 | Dynamic tests at | +125 |
| 6 | Dynamic tests at | -55 |
| 7 | Functional tests at | +25 |
| 8A | Functional tests at | +125 |
| 8B | Functional tests at | -55 |
| 9 | Switching tests at | +25 |
| 10 | Switching tests at | +125 |
| 11 | Switching tests at | -55 |

## LMH6715 Electrical Characteristics DC Parameter Static and DC Tests

The following conditions apply, unless otherwise specified.
$R_L = 100\Omega$, $V_{CC} = \pm 5V_{DC}$, $A_V = +2$, $R_F = 634\Omega$, $-55°C \le T_A \le +125°C$

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-groups |
|---|---|---|---|---|---|---|---|
| $I_{BN}$ | Input Bias Current, Noninverting | | See [1] | -12 | 12 | µA | 1 |
| | | | | -12 | +12 | µA | 2 |
| | | | | -20 | +20 | µA | 3 |
| $I_{BI}$ | Input Bias Current, Inverting | | See [1] | -21 | +21 | µA | 1 |
| | | | | -25 | +25 | µA | 2 |
| | | | | -35 | +35 | µA | 3 |
| $V_{IO}$ | Input offset voltage | | See [1] | -6 | 6 | mV | 1 |
| | | | | -12 | 12 | mV | 2 |
| | | | | -10 | 10 | mV | 3 |
| $I_{CC}$ | Supply Current | $R_L = \infty$ | See [1] | | 14.0 | mA | 1 |
| | | | | | 14.0 | mA | 2 |
| | | | | | 16.0 | mA | 3 |
| PSRR | Power Supply Rejection Ration | $+V_S$ = +4.5V to +5.0V,<br>$-V_S$ = -4.5V to -5.0V | | 46 | | dB | 1 |
| | | | | 44 | | dB | 2, 3 |

(1) Pre and post irradiation limits are identical to those listed under electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD-883, Method 1019.

## LMH6715 Electrical Characteristics AC Parameter Frequeuncy Domain Response

The following conditions apply, unless otherwise specified.
$R_L = 100\Omega$, $V_{CC} = \pm 5V_{DC}$, $A_V = +2$, $R_F = 634\Omega$, $-55°C \le T_A \le +125°C$

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-groups |
|---|---|---|---|---|---|---|---|
| $SS_{BW}$ | Small signal bandwith | −3dB BW, $V_{OUT} < 0.5\ V_{PP}$ | See [1] | 175 | | MHz | 4 |
| GFP | Gain flatness peaking high | 0.1MHz to 30 MHz,<br>$V_{OUT} \le 0.5V_{PP}$ | See [1] | | 0.1 | dB | 4 |
| GFR | Gain flatness rolloff | 0.1MHz to 30 MHz,<br>$V_{OUT} \le 0.5V_{PP}$ | See [1] | | 0.3 | dB | 4 |

(1) Group A testing only.

## LMH6715 Electrical Characteristics AC Parameter Distortion and Noise Response

The following conditions apply, unless otherwise specified.
$R_L = 100\Omega$, $V_{CC} = \pm 5V_{DC}$, $A_V = +2$, $R_F = 634\Omega$, $-55°C \le T_A \le +125°C$

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-groups |
|---|---|---|---|---|---|---|---|
| $HD_2$ | Second harmonic distortion | $2V_{PP}$ at 20 MHz | See [1] | | -42 | dBc | 4 |
| $HD_3$ | Third harmonic distortion | $2V_{PP}$ at 20 MHz | See [1] | | -46 | dBc | 4 |

(1) Group A testing only.

## LMH6715 Electrical Characteristics DC Parameter Drift Values

The following conditions apply, unless otherwise specified.
Deltas not required on B Level product. Deltas required for S Level product at Group B5 only, or as specified on the Internal Processing Instructions (IPI).

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit | Sub-groups |
|---|---|---|---|---|---|---|---|
| $I_{BN}$ | Input Bias Current, Noninverting | | See [1] | -1.2 | +1.2 | μA | 1 |
| $I_{BI}$ | Input Bias Current, Inverting | | See [1] | -2.0 | +2.0 | μA | 1 |
| $V_{IO}$ | Input Offset Voltage | | See [1] | -1.0 | +1.0 | mV | 1 |
| $I_{CC}$ | Supply Current | $R_L = \infty$ | See [1] | -1.0 | +1.0 | mA | 1 |

(1) If not tested, shall be specified to the limits specified.

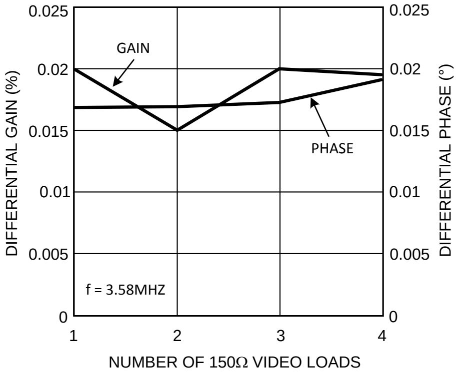


**Figure 2. Differential Gain and Phase with Multiple Video Loads**

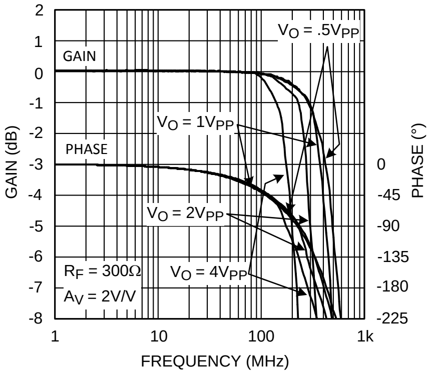
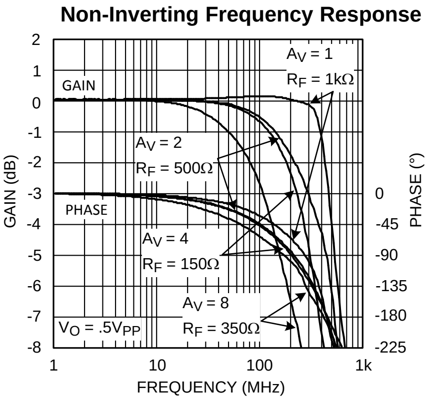


**Figure 3. Frequency Response vs. $V_{OUT}$**

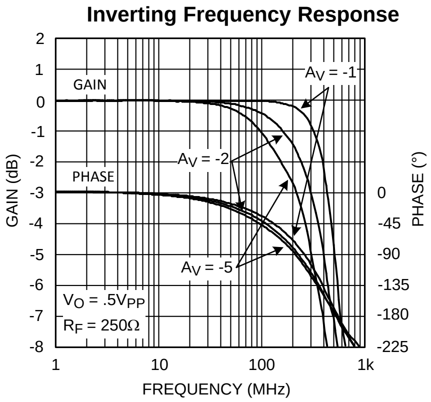
## Typical Performance Characteristics

($T_A$ = 25°C, $V_{CC}$ = ±5V, $A_V$ = ±2V/V, $R_F$ = 500Ω, $R_L$ = 100Ω, unless otherwise specified).



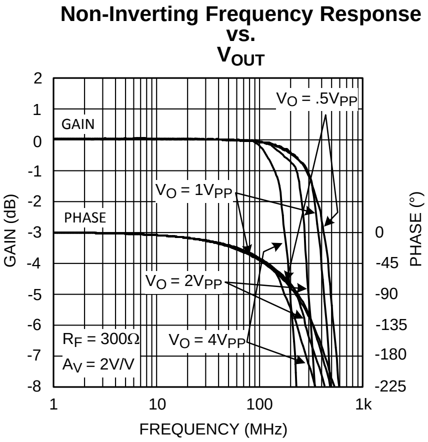
**Non-Inverting Frequency Response**

Figure 4.



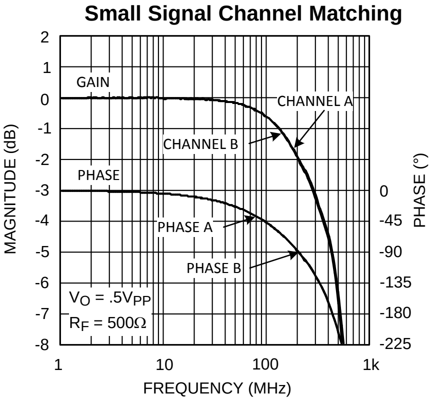
**Inverting Frequency Response**

Figure 5.



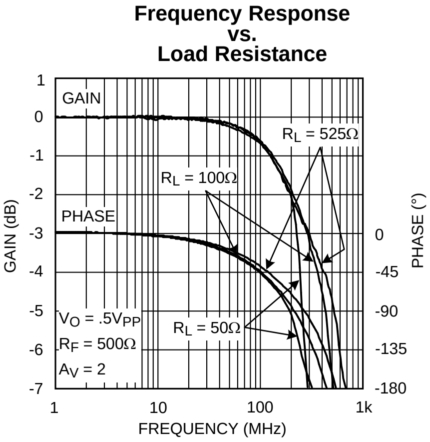
**Non-Inverting Frequency Response vs. $V_{OUT}$**

Figure 6.



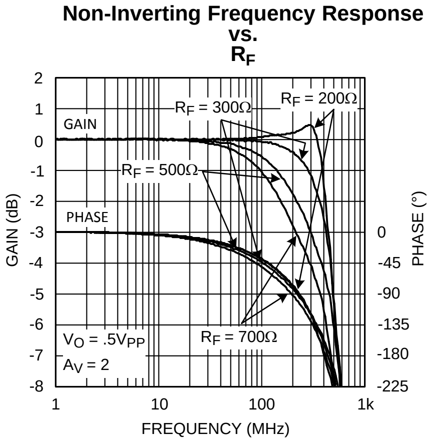
**Small Signal Channel Matching**

Figure 7.



**Frequency Response vs. Load Resistance**

Figure 8.



**Non-Inverting Frequency Response vs. $R_F$**

Figure 9.

## Typical Performance Characteristics (continued)

($T_A$ = 25°C, $V_{CC}$ = ±5V, $A_V$ = ±2V/V, $R_F$ = 500Ω, $R_L$ = 100Ω, unless otherwise specified).

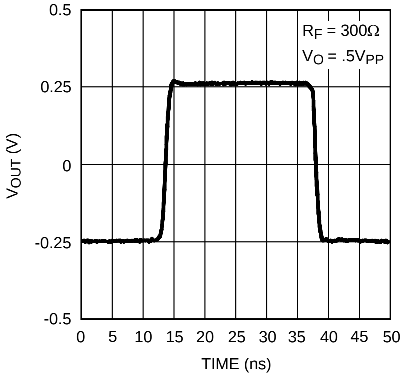

**Small Signal Pulse Response**

**Figure 10.**

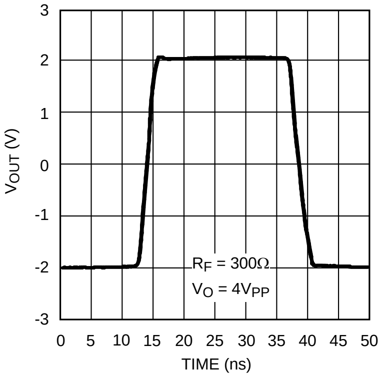

**Large Signal Pulse Response**

**Figure 11.**

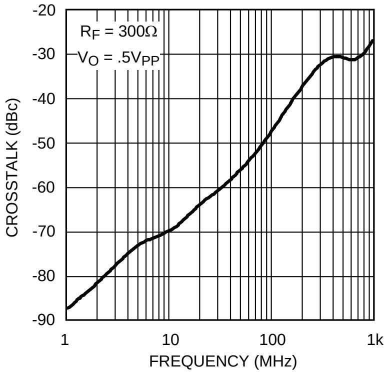

**Input-Referred Crosstalk**

**Figure 12.**

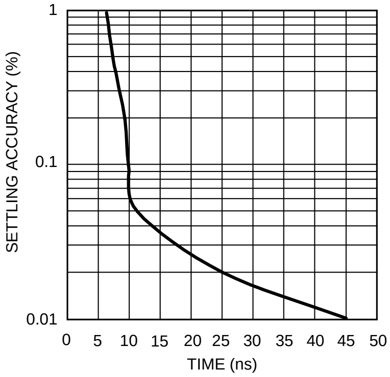

**Settling Time vs. Accuracy**

**Figure 13.**

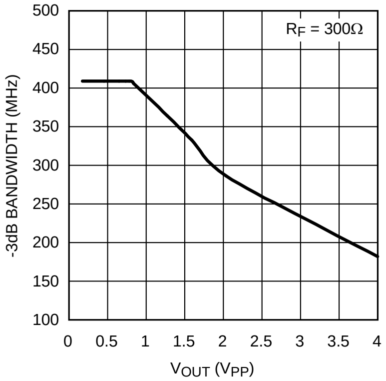

**−3dB Bandwidth vs. $V_{OUT}$**

**Figure 14.**

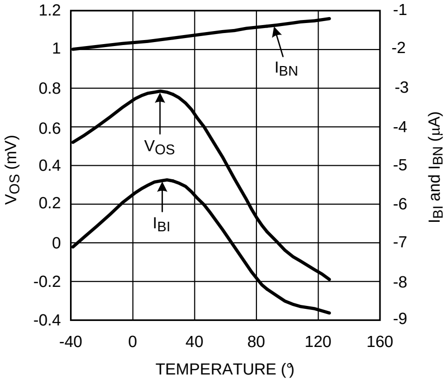

**DC Errors vs. Temperature**

**Figure 15.**

## Typical Performance Characteristics (continued)

($T_A$ = 25°C, $V_{CC}$ = ±5V, $A_V$ = ±2V/V, $R_F$ = 500Ω, $R_L$ = 100Ω, unless otherwise specified).

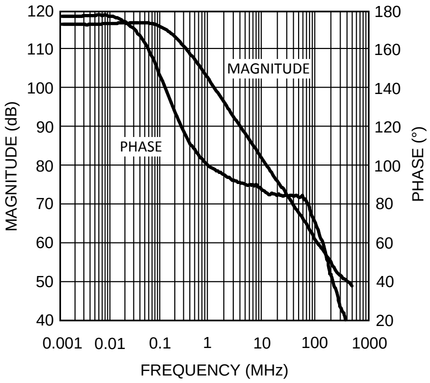

**Open Loop Transimpedance, Z(s)**

Figure 16.

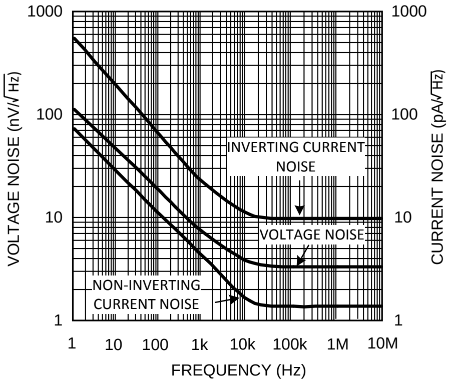

**Equivalent Input Noise vs. Frequency**

Figure 17.

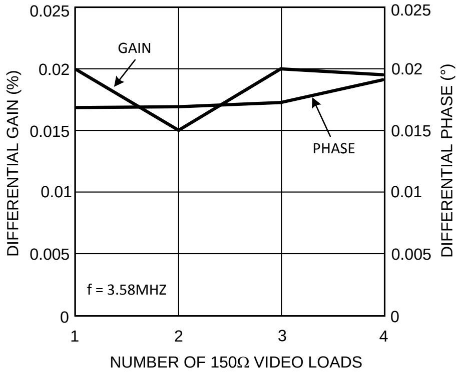

**Differential Gain & Phase vs. Load**

Figure 18.

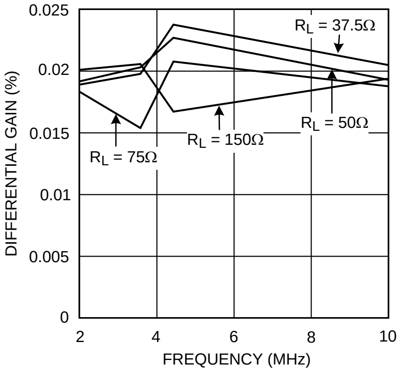

**Differential Gain vs. Frequency**

Figure 19.

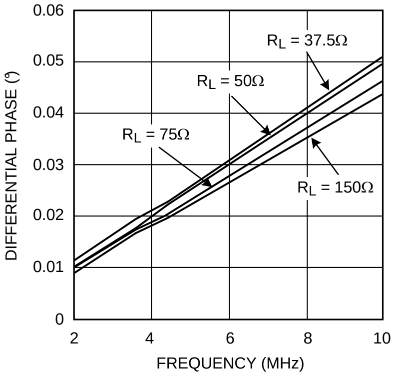

**Differential Phase vs. Frequency**

Figure 20.

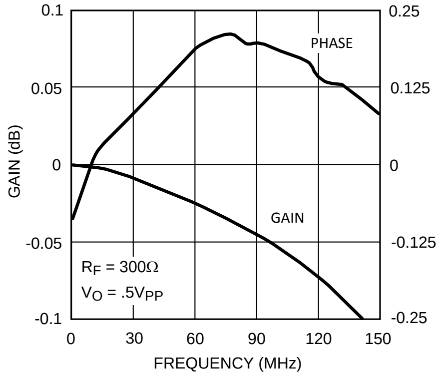

**Gain Flatness & Linear Phase Deviation**

Figure 21.

## Typical Performance Characteristics (continued)

($T_A$ = 25°C, $V_{CC}$ = ±5V, $A_V$ = ±2V/V, $R_F$ = 500Ω, $R_L$ = 100Ω, unless otherwise specified).

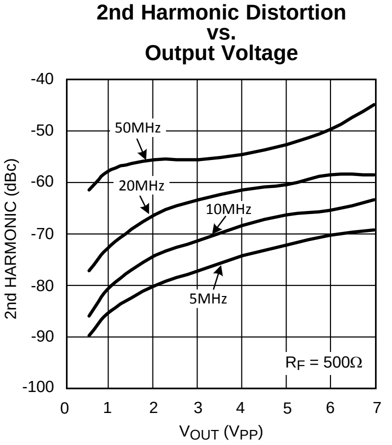


Figure 22.

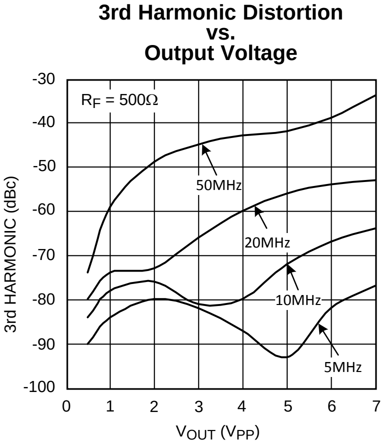


Figure 23.

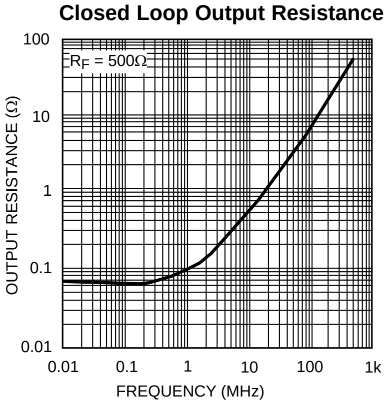


Figure 24.

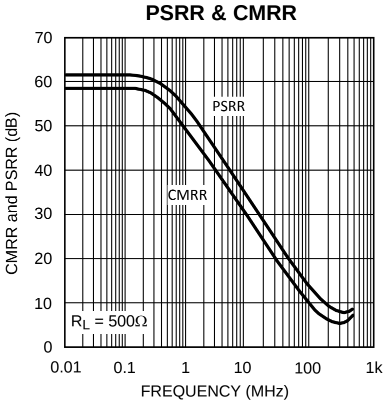


Figure 25.

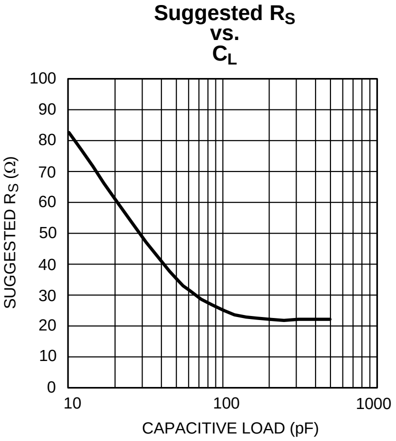


Figure 26.

## APPLICATION SECTION

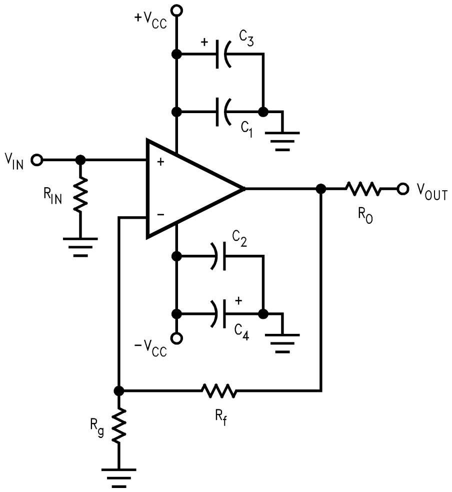


**Figure 27. Non-Inverting Configuration with Power Supply Bypassing**

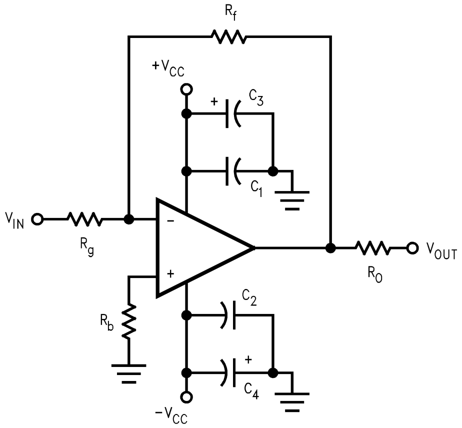


**Figure 28. Inverting Configuration with Power Supply Bypassing**

## Application Introduction

Offered in an 8-pin package for reduced space and cost, the wideband LMH6715 dual current-feedback op amp provides closely matched DC and AC electrical performance characteristics making the part an ideal choice for wideband signal processing. Applications such as broadcast quality video systems, IQ amplifiers, filter blocks, high speed peak detectors, integrators and transimpedance amplifiers will all find superior performance in the LMH6715 dual op amp.

### FEEDBACK RESISTOR SELECTION

One of the key benefits of a current feedback operational amplifier is the ability to maintain optimum frequency response independent of gain by using appropriate values for the feedback resistor ($R_F$). The Electrical Characteristics and Typical Performance plots specify an $R_F$ of 500Ω, a gain of +2V/V and ±5V power supplies (unless otherwise specified). Generally, lowering $R_F$ from it's recommended value will peak the frequency response and extend the bandwidth while increasing the value of $R_F$ will cause the frequency response to roll off faster. Reducing the value of $R_F$ too far below it's recommended value will cause overshoot, ringing and, eventually, oscillation.

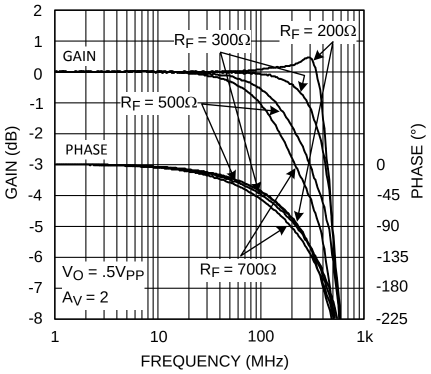


**Figure 29. Frequency Response vs. $R_F$**

The plot labeled “Frequency Response vs. $R_F$” shows the LMH6715's frequency response as $R_F$ is varied ($R_L$ = 100Ω, $A_V$ = +2). This plot shows that an $R_F$ of 200Ω results in peaking and marginal stability. An $R_F$ of 300Ω gives near maximal bandwidth and gain flatness with good stability, but with very light loads ($R_L$ > 300Ω) the device may show some peaking. An $R_F$ of 500Ω gives excellent stability with good bandwidth and is the recommended value for most applications. Since all applications are slightly different it is worth some experimentation to find the optimal $R_F$ for a given circuit. For more information see Application Note OA-13 which describes the relationship between $R_F$ and closed-loop frequency response for current feedback operational amplifiers.

When configuring the LMH6715 for gains other than +2V/V, it is usually necessary to adjust the value of the feedback resistor. The two plots labeled “$R_F$ vs. Non-inverting Gain” and “$R_F$ vs. Inverting Gain” provide recommended feedback resistor values for a number of gain selections.

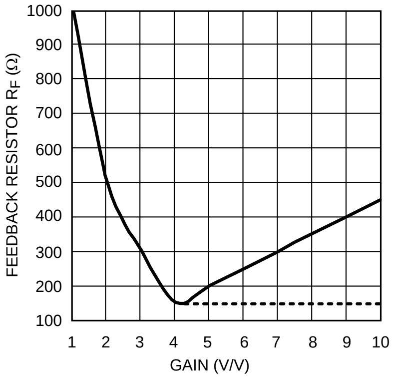


**Figure 30. $R_F$ vs. Non-Inverting Gain**

Both plots show the value of $R_F$ approaching a minimum value (dashed line) at high gains. Reducing the feedback resistor below this value will result in instability and possibly oscillation. The recommended value of $R_F$ is depicted by the solid line, which begins to increase at higher gains. The reason that a higher $R_F$ is required at higher gains is the need to keep $R_G$ from decreasing too far below the output impedance of the input buffer. For the LMH6715 the output resistance of the input buffer is approximately 160Ω and 50Ω is a practical lower limit for $R_G$. Due to the limitations on $R_G$ the LMH6715 begins to operate in a gain bandwidth limited fashion for gains of ±5V/V or greater.

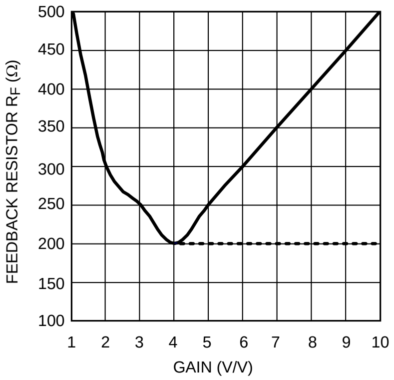


**Figure 31. $R_F$ vs. Inverting Gain**

When using the LMH6715 as a replacement for the CLC412, identical bandwidth can be obtained by using an appropriate value of $R_F$ . The chart “Frequency Response vs. $R_F$” shows that an $R_F$ of approximately 700Ω will provide bandwidth very close to that of the CLC412. At other gains a similar increase in $R_F$ can be used to match the new and old parts.

## CIRCUIT LAYOUT

With all high frequency devices, board layouts with stray capacitances have a strong influence over AC performance. The LMH6715 is no exception and its input and output pins are particularly sensitive to the coupling of parasitic capacitances (to AC ground) arising from traces or pads placed too closely (<0.1”) to power or ground planes. In some cases, due to the frequency response peaking caused by these parasitics, a small adjustment of the feedback resistor value will serve to compensate the frequency response. Also, it is very important to keep the parasitic capacitance across the feedback resistor to an absolute minimum.

The performance plots in the data sheet can be reproduced using the evaluation boards available from Texas Instruments. The LMH730036 board uses all SMT parts for the evaluation of the LMH6715. The board can serve as an example layout for the final production printed circuit board.

Care must also be taken with the LMH6715's layout in order to achieve the best circuit performance, particularly channel-to-channel isolation. The decoupling capacitors (both tantalum and ceramic) must be chosen with good high frequency characteristics to decouple the power supplies and the physical placement of the LMH6715's external components is critical. Grouping each amplifier's external components with their own ground connection and separating them from the external components of the opposing channel with the maximum possible distance is recommended. The input ($R_{IN}$) and gain setting resistors ($R_F$) are the most critical. It is also recommended that the ceramic decoupling capacitor (0.1μF chip or radial-leaded with low ESR) should be placed as closely to the power pins as possible.

## POWER DISSIPATION

Follow these steps to determine the Maximum power dissipation for the LMH6715:

1. Calculate the quiescent (no-load) power: $P_{AMP} = I_{CC} (V_{CC} - V_{EE})$

2. Calculate the RMS power at the output stage: $P_O = (V_{CC} - V_{LOAD})(I_{LOAD})$, where $V_{LOAD}$ and $I_{LOAD}$ are the voltage and current across the external load.

3. Calculate the total RMS power: $Pt = P_{AMP} + P_O$

The maximum power that the LMH6715, package can dissipate at a given temperature can be derived with the following equation:

$$Pmax = (150^o - Tamb)/ \theta_{JA}$$

where

- Tamb = Ambient temperature (°C)
- $\theta_{JA}$ = Thermal resistance, from junction to ambient, for a given package (°C/W) (1)

For the CDIP package $\theta_{JA}$ is 140°C/W.

## MATCHING PERFORMANCE

With proper board layout, the AC performance match between the two LMH6715's amplifiers can be tightly controlled as shown in Typical Performance plot labeled “Small-Signal Channel Matching”.

The measurements were performed with SMT components using a feedback resistor of 300Ω at a gain of +2V/V.

The LMH6715's amplifiers, built on the same die, provide the advantage of having tightly matched DC characteristics.

## SLEW RATE AND SETTLING TIME

One of the advantages of current-feedback topology is an inherently high slew rate which produces a wider full power bandwidth. The LMH6715 has a typical slew rate of 1300V/µs. The required slew rate for a design can be calculated by the following equation:

$$SR = 2\pi f V_{pk} \tag{2}$$

Careful attention to parasitic capacitances is critical to achieving the best settling time performance. The LMH6715 has a typical short term settling time to 0.05% of 12ns for a 2V step. Also, the amplifier is virtually free of any long term thermal tail effects at low gains.

When measuring settling time, a solid ground plane should be used in order to reduce ground inductance which can cause common-ground-impedance coupling. Power supply and ground trace parasitic capacitances and the load capacitance will also affect settling time.

Placing a series resistor ($R_s$) at the output pin is recommended for optimal settling time performance when driving a capacitive load. The Typical Performance plot labeled “$R_S$ and Settling Time vs. Capacitive Load” provides a means for selecting a value of $R_s$ for a given capacitive load.

## DC AND NOISE PERFORMANCE

A current-feedback amplifier's input stage does not have equal nor correlated bias currents, therefore they cannot be canceled and each contributes to the total DC offset voltage at the output by the following equation:

$$V_{OFFSET} = \pm \left[ I_{BN} \times R_S \left[ 1 + \frac{R_f}{R_g} \right] + V_{IO} \left[ 1 + \frac{R_f}{R_g} \right] + I_{BI} \times R_f \right] \tag{3}$$

The input resistance is the resistance looking from the non-inverting input back toward the source. For inverting DC-offset calculations, the source resistance seen by the input resistor $R_g$ must be included in the output offset calculation as a part of the non-inverting gain equation. Application Note OA-7 gives several circuits for DC offset correction. The noise currents for the inverting and non-inverting inputs are graphed in the Typical Performance plot labeled “Equivalent Input Noise”. A more complete discussion of amplifier input-referred noise and external resistor noise contribution can be found in Application Note OA-12.

## DIFFERENTIAL GAIN & PHASE

The LMH6715 can drive multiple video loads with very low differential gain and phase errors. The Typical Performance plots labeled “Differential Gain vs. Frequency” and “Differential Phase vs. Frequency” show performance for loads from 1 to 4. The Electrical Characteristics table also specifies performance for one 150Ω load at 4.43MHz. For NTSC video, the performance specifications also apply. Application Note OA-24 “Measuring and Improving Differential Gain & Differential Phase for Video”, describes in detail the techniques used to measure differential gain and phase.

## I/O VOLTAGE & OUTPUT CURRENT

The usable common-mode input voltage range (CMIR) of the LMH6715 specified in the Electrical Characteristics table of the data sheet shows a range of ±2.2 volts. Exceeding this range will cause the input stage to saturate and clip the output signal.

The output voltage range is determined by the load resistor and the choice of power supplies. With ±5 volts the class A/B output driver will typically drive ±3.9V into a load resistance of 100Ω. Increasing the supply voltages will change the common-mode input and output voltage swings while at the same time increase the internal junction temperature.

## Applications Circuits

### SINGLE-TO-DIFFERENTIAL LINE DRIVER

The LMH6715's well matched AC channel-response allows a single-ended input to be transformed to highly matched push-pull driver. From a 1V single-ended input the circuit of Figure 32 produces 1V differential signal between the two outputs. For larger signals the input voltage divider ($R_1 = 2R_2$) is necessary to limit the input voltage on channel 2.

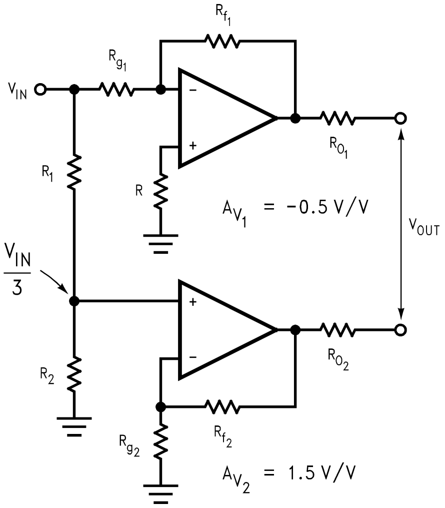


**Figure 32. Single-to-Differential Line Driver**

### DIFFERENTIAL LINE RECEIVER

Figure 33 and Figure 34 show two different implementations of an instrumentation amplifier which convert differential signals to single-ended. Figure 34 allows CMRR adjustment through $R_2$.

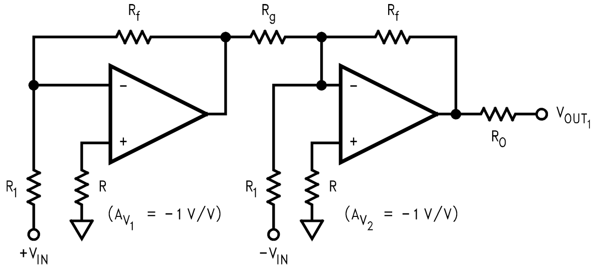


**Figure 33. Differential Line Receiver**

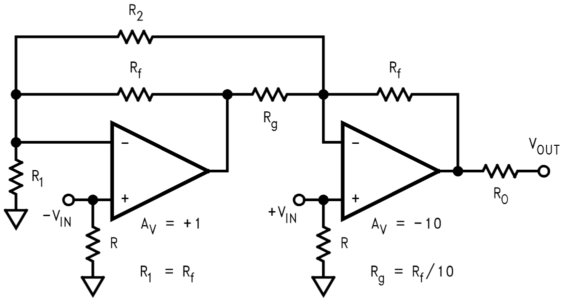


**Figure 34. Differential Line Receiver with CMRR Adjustment**

### NON-INVERTING CURRENT-FEEDBACK INTEGRATOR

The circuit of Figure 35 achieves its high speed integration by placing one of the LMH6715's amplifiers in the feedback loop of the second amplifier configured as shown.

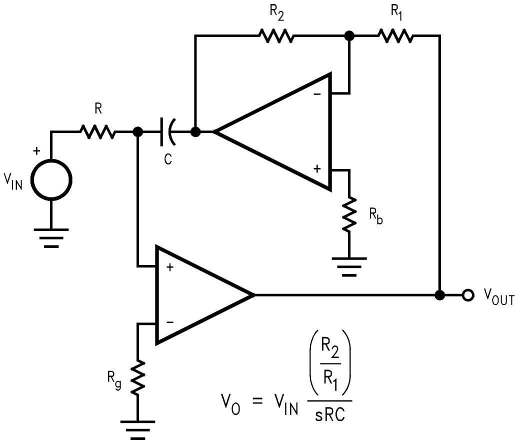


Figure 35. Current Feedback Integrator

### LOW NOISE WIDE-BANDWIDTH TRANSIMPEDANCE AMPLIFIER

Figure 36 implements a low noise transimpedance amplifier using both channels of the LMH6715. This circuit takes advantage of the lower input bias current noise of the non-inverting input and achieves negative feedback through the second LMH6715 channel. The output voltage is set by the value of $R_F$ while frequency compensation is achieved through the adjustment of $R_T$.

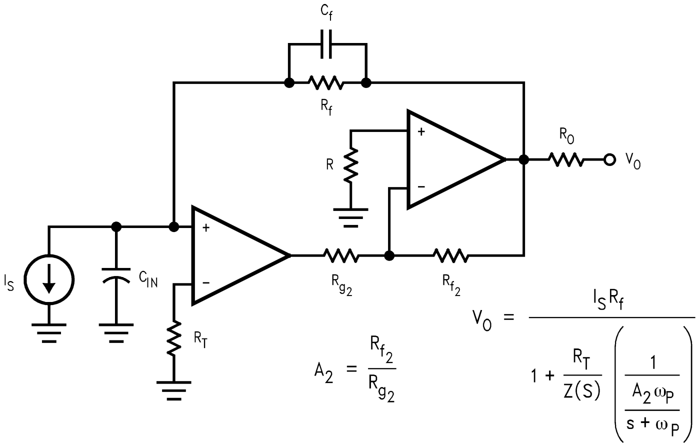


Figure 36. Low-Noise, Wide Bandwidth, Transimpedance Amp.

## Revision History

| Date Released | Revision | Section | Changes |
|---|---|---|---|
| 11/30/2010 | A | New Corporate Format Release | 1 MDS data sheets converted into a Corp. data sheet format. Following MDS data sheet will be Archived MNLMH6715-X-RH, Rev. 0A0 |
| 07/12/2011 | B | Connection Diagrams | Replaced 8 Lead CDIP (NAB0008A) diagram depicting single Op Amp with diagram depicting dual Op Amp. |

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5962-0254701QPA | ACTIVE | CDIP | NAB | 8 | 40 | Non-RoHS & Green | Call TI | Level-1-NA-UNLIM | -55 to 125 | LMH6715J-QML<br>5962-02547<br>01QPA Q ACO<br>01QPA Q >T | Samples |
| 5962F0254701VPA | ACTIVE | CDIP | NAB | 8 | 40 | Non-RoHS & Green | Call TI | Level-1-NA-UNLIM | -55 to 125 | LMH6715JFQV<br>5962F02547<br>01VPA Q ACO<br>01VPA Q >T | Samples |
| LMH6715J-QML | ACTIVE | CDIP | NAB | 8 | 40 | Non-RoHS & Green | Call TI | Level-1-NA-UNLIM | -55 to 125 | LMH6715J-QML<br>5962-02547<br>01QPA Q ACO<br>01QPA Q >T | Samples |
| LMH6715JFQMLV | ACTIVE | CDIP | NAB | 8 | 40 | Non-RoHS & Green | Call TI | Level-1-NA-UNLIM | -55 to 125 | LMH6715JFQV<br>5962F02547<br>01VPA Q ACO<br>01VPA Q >T | Samples |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

[5] Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

[6] Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF LMH6715QML, LMH6715QML-SP :**

- Military : LMH6715QML

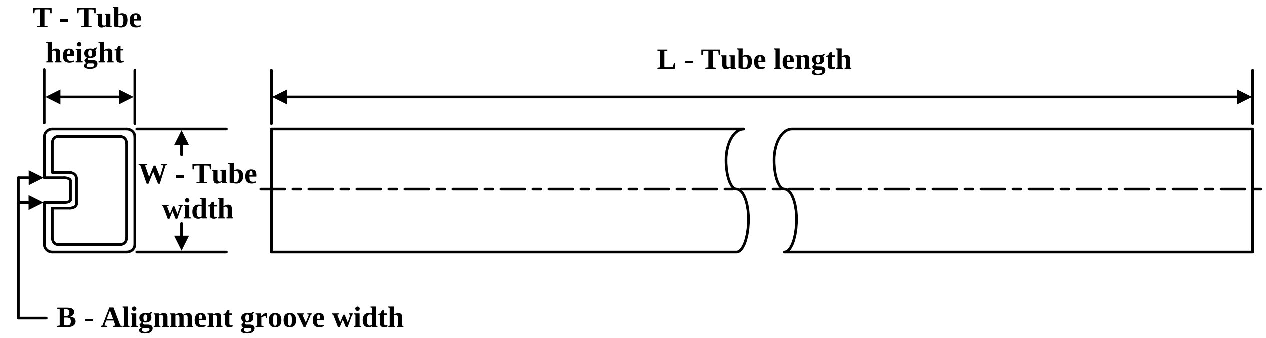
- Space : LMH6715QML-SP

NOTE: Qualified Version Definitions:

  - Military - QML certified for Military and Defense Applications

  - Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

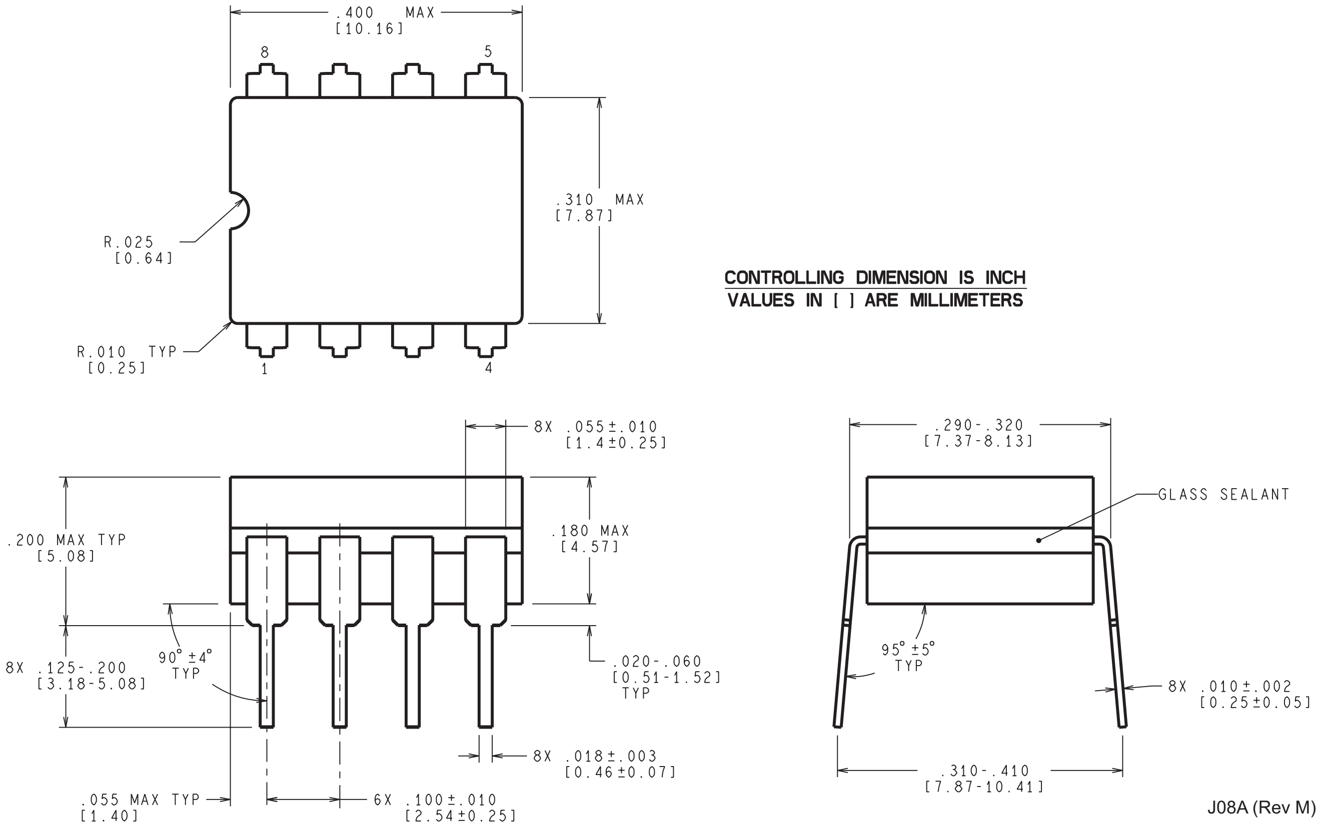
## TUBE



*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| 5962-0254701QPA | NAB | CDIP | 8 | 40 | 506.98 | 15.24 | 13440 | NA |
| 5962F0254701VPA | NAB | CDIP | 8 | 40 | 506.98 | 15.24 | 13440 | NA |
| LMH6715J-QML | NAB | CDIP | 8 | 40 | 506.98 | 15.24 | 13440 | NA |
| LMH6715JFQMLV | NAB | CDIP | 8 | 40 | 506.98 | 15.24 | 13440 | NA |

# NAB0008A



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