

## LMH6718 Dual, High Output, Selectable Gain Buffer

Check for Samples: [LMH6718](#)

### FEATURES

- 200mA output current
- .04%, .03° differential gain, phase
- 5.2mA supply current for 2 amplifiers
- 130MHz bandwidth ( $A_V = +2$ )
- -88/-98dBc HD2/HD3 (1MHz)
- 16ns settling to 0.05%
- 600V/ $\mu$ s slew rate
- Nominal supply range  $\pm 2.5V$  to  $\pm 6V$
- Improved replacement for CLC5632

### APPLICATIONS

- Video line driver
- Coaxial cable driver
- Twisted pair driver
- Transformer/coil driver
- High capacitive load driver
- Portable/battery powered applications
- A/D driver
- I/Q Channel Amplifier

### DESCRIPTION

The LMH6718 is a dual, low cost high speed (130MHz) buffer which features user selectable gains of +2, +1, and -1V/V. The LMH6718 also has a new output stage that delivers high output drive current (200mA), but consumes minimal quiescent supply current (2.6mA/Amp) from a  $\pm 5V$  supply. Its current feedback architecture, fabricated in an advanced complementary bipolar process, maintains consistent performance over a wide range of signal levels, and has a linear phase response up to one half of the -3dB frequency.

The LMH6718 offers 0.1dB gain flatness to 30MHz and differential gain and phase errors of .04% and .03°. These features are ideal for professional and consumer video applications.

The LMH6718 offers superior dynamic performance with a 130MHz small-signal bandwidth, 600V/ $\mu$ s slew rate and 4.2ns rise/fall times ( $2V_{STEP}$ ). The combination of low quiescent current, high output current drive, and high speed performance makes the LMH6718 well suited for many battery powered personal communication/computing systems. The ability to drive low impedance, high capacitive loads, makes the LMH6718 ideal for single ended cable applications. It also drives low impedance loads with minimum distortion. The LMH6718 will drive a 100 $\Omega$  load with only -84/-84dBc second/third harmonic distortion ( $A_V = +2$ ,  $V_{OUT} = 2V_{PP}$ ,  $f = 1MHz$ ). It is also optimized for driving high currents into single-ended transformers and coils. When driving the input of high resolution A/D converters, the LMH6718 provides excellent -88/-98dBc second/third harmonic distortion ( $A_V = +2$ ,  $V_{OUT} = 2V_{PP}$ ,  $f = 1MHz$ ,  $R_L = 1k\Omega$ ) and fast settling time.

The LMH6718 is fabricated using National's VIP10™ complimentary bipolar process.

### Connection Diagram

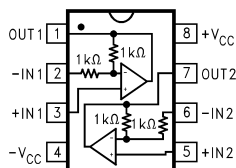


Figure 1. 8-Pin SOIC - Top View

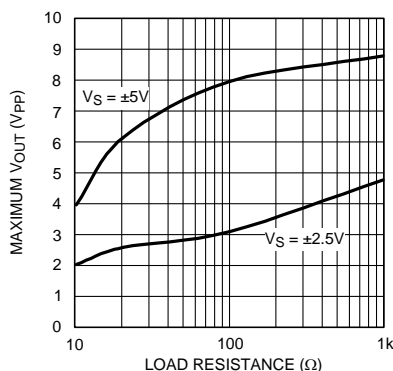


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## Maximum Output Voltage vs. Load Resistance



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 <sup>(1)</sup>

ESD Tolerance <sup>(2)</sup>		
Human Body Model		2kV
Machine Model		200V
Supply Voltage		13.5
Output Current		<sup>(3)</sup>
Common-Mode Input Voltage		V <sup>+</sup> - V <sup>-</sup>
Maximum Junction Temperature		+150°C
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering 10 sec)		+300°C

- (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, see the Electrical Characteristics tables.
- (2) Human Body Model, applicable std. MIL-STD-883, Method 3015.7. Machine Model, applicable std. JESD22-A115-A (ESD MM std. of JEDEC) Field-Induced Charge-Device Model, applicable std. JESD22-C101-C (ESD FICDM std. of JEDEC).
- (3) The maximum current is determined by device power dissipation limitations. See the Power Dissipation section of the Application Information for more details.

## Operating Ratings

Temperature Range <sup>(1)</sup>			-40°C to 85°C
Thermal Resistance			
Package	(θ <sub>JC</sub> )	(θ <sub>JA</sub> )	
SOIC	50°C/W	145°C/W	
Nominal Operating Voltage			±2.5V to ±6V
Operating Temperature Range			-40°C to +85°C

- (1) The maximum power dissipation is a function of T<sub>J(MAX)</sub>, θ<sub>JA</sub>. The maximum allowable power dissipation at any ambient temperature is P<sub>D</sub> = (T<sub>J(MAX)</sub> - T<sub>A</sub>) / θ<sub>JA</sub>. All numbers apply for packages soldered directly onto a PC Board.

## +5V Electrical Characteristics <sup>(1)</sup>

$T_A = 25^\circ\text{C}$ ,  $A_V = +2$ ,  $R_L = 100\Omega$ ,  $V_S = +5\text{V}$  <sup>(2)</sup>, unless specified. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (3)	Typ (3)	Max (3)	Units
<b>Frequency Domain Response</b>						
SSBW	-3dB Bandwidth	$V_O = 0.5V_{PP}$	70	110		MHz
		$V_O = 2.0V_{PP}$		90		
SSBW	-0.1dB Bandwidth	$V_O = 0.5V_{PP}$		23		MHz
GFP	Gain Peaking	$<200\text{MHz}$ , $V_O = 0.5V_{PP}$		0		dB
GFR	Gain Rolloff	$<30\text{MHz}$ , $V_O = 0.5V_{PP}$		0.2		dB
LPD	Linear Phase Deviation	$<30\text{MHz}$ , $V_O = 0.5V_{PP}$		0.12		deg
<b>Time Domain Response</b>						
Tr	Rise and Fall Time	2V Step		4.8		ns
Ts	Settling Time to 0.05%	1V Step		20		ns
OS	Overshoot	2V Step		5		%
SR	Slew Rate	2V Step	250	400		V/ $\mu\text{s}$
<b>Distortion And Noise Response</b>						
HD2	2nd Harmonic Distortion	$2V_{PP}$ , 1MHz		-85		dBc
		$2V_{PP}$ , 1MHz; $R_L = 1k\Omega$		-88		
		$2V_{PP}$ , 5MHz		-73		
HD3	3rd Harmonic Distortion	$2V_{PP}$ , 1MHz		-89		dBc
		$2V_{PP}$ , 1MHz, $R_L = 1k\Omega$		-91		
		$2V_{PP}$ , 5MHz		-71		
XTLKA	Crosstalk (Input Referred)	10MHz, $1V_{PP}$		-85		dB
<b>Static, DC Performance</b>						
$V_{IO}$	Input Offset Voltage			$\pm 6$	$\pm 10$ <b><math>\pm 20</math></b>	mV
$DV_{IO}$	Average Drift			10		$\mu\text{V}/^\circ\text{C}$
$I_{BN}$	Input Bias Current (Non-Inverting)			$\pm 6$	$\pm 15$ <b><math>\pm 20</math></b>	$\mu\text{A}$
$DI_{BN}$	Average Drift			20		nA/ $^\circ\text{C}$
GACC	Gain Accuracy			$\pm 0.3$	$\pm 1.5$ <b><math>\pm 2.0</math></b>	%
	Internal Resistors ( $R_F$ , $R_G$ )		750	950	1150	$\Omega$
PSRR	Power supply Rejection Ratio	DC	50	60		dB
CMRR	Common Mode Rejection Ratio	DC	50 <b>47</b>	56		dB
$I_{CC}$	Supply Current per channel	$R_L = \infty$	2.0 <b>1.9</b>	2.4	3.0 <b>3.1</b>	mA
<b>Miscellaneous Performance</b>						
$R_{IN}$	Input Resistance (Non-Inverting)			0.38		M $\Omega$
$C_{IN}$	Input Capacitance (Non-Inverting)			2.2		pF
$V_{CMH}$	Input Voltage Range, High			4.2		V
$V_{CML}$	Input Voltage Range, Low			0.8		V
$V_{ROH}$	Output Voltage Range, High	$R_L = 100\Omega$	3.6 <b>3.5</b>	4.0		V

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No guarantee of parametric performance is indicated in the electrical tables under conditions of internal self heating where  $T_J > T_A$ . See Applications Information for information on temperature de-rating of this device." Min/Max ratings are based on product characterization and simulation. Individual parameters are tested as noted.
- (2)  $V_S = V_{CC} - V_{EE}$
- (3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.

**+5V Electrical Characteristics <sup>(1)</sup> (continued)**

$T_A = 25^\circ\text{C}$ ,  $A_V = +2$ ,  $R_L = 100\Omega$ ,  $V_S = +5\text{V}$  <sup>(2)</sup>, unless specified. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (3)	Typ (3)	Max (3)	Units
$V_{ROL}$	Output Voltage Range, Low	$R_L = 100\Omega$	1.4 <b>1.3</b>	1.0		V
$V_{ROH}$	Output Voltage Range, High	$R_L = \infty$		4.1		V
$V_{ROL}$	Output Voltage Range, Low	$R_L = \infty$		0.9		V
$I_O$	Output Current <sup>(4)</sup>			170		mA
$R_O$	Output Resistance, Closed Loop	DC		.28		$\Omega$

(4) The maximum current is determined by device power dissipation limitations. See the Power Dissipation section of the Application Information for more details.

## ±5V Electrical Characteristics <sup>(1)</sup>

$T_A = 25^\circ\text{C}$ ,  $A_V = +2$ ,  $R_L = 100\Omega$ ,  $V_{CC} = \pm 5\text{V}$ ; unless specified. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (2)	Typ (2)	Max (2)	Units
<b>Frequency Domain Response</b>						
SSBW	-3dB Bandwidth	$V_O = 1.0V_{PP}$	100	130		MHz
		$V_O = 4.0V_{PP}$		70		
SSBW	-0.1dB Bandwidth	$V_O = 1.0V_{PP}$		30		MHz
GFP	Gain Peaking	$<200\text{MHz}$ , $V_O = 1.0V_{PP}$		0		dB
GFR	Gain Rolloff	$<300\text{MHz}$ , $V_O = 1.0V_{PP}$		0.1		dB
LPD	Linear Phase Deviation	$<30\text{MHz}$ , $V_O = 1.0V_{PP}$		0.1		deg
DG	Differential Gain	NTSC, $R_L = 150\Omega$		.04		%
DP	Differential Phase	NTSC, $R_L = 150\Omega$		.03		deg
<b>Time Domain Response</b>						
Tr	Rise and Fall Time	2V Step		4.2		ns
Ts	Settling Time to 0.05%	2V Step		17		ns
OS	Overshoot	2V Step		14		%
SR	Slew Rate	2V Step	400	600		V/ $\mu\text{s}$
<b>Distortion And Noise Response</b>						
HD2	2nd Harmonic Distortion	$2V_{PP}$ , 1MHz		-84		dBc
		$2V_{PP}$ , 1MHz; $R_L = 1k\Omega$		-88		
		$2V_{PP}$ , 5MHz		-73		
HD3	3rd Harmonic Distortion	$2V_{PP}$ , 1MHz		-84		dBc
		$2V_{PP}$ , 1MHz; $R_L = 1k\Omega$		-98		
		$2V_{PP}$ , 5MHz		-76		
	Equivalent Input Noise					
$V_N$	Voltage ( $e_{ni}$ )	$>1\text{MHz}$		8		$\text{nV}/\sqrt{\text{Hz}}$
$I_{NN}$	Non-Inverting Current ( $i_{bn}$ )	$>1\text{MHz}$		9		$\text{pA}/\sqrt{\text{Hz}}$
XTLKA	Crosstalk (Input Referred)	10MHz, $1V_{PP}$		-85		dB
<b>Static, DC Performance</b>						
$V_{IO}$	Input Offset Voltage			.2	$\pm 9.5$ <b><math>\pm 15</math></b>	mV
$DV_{IO}$	Average Drift			5		$\mu\text{V}/^\circ\text{C}$
$I_{BN}$	Input Bias Current (Non-Inverting)			1.3	$\pm 15$ <b><math>\pm 20</math></b>	$\mu\text{A}$
$DI_{BN}$	Average Drift			12		$\text{nA}/^\circ\text{C}$
GACC	Gain Accuracy			$\pm 0.3$	$\pm 1.5$ <b><math>\pm 2.0</math></b>	%
	Internal Resistor ( $R_F$ , $R_G$ )		750	950	1150	$\Omega$
PSRR	Power Supply Rejection Ratio	DC	50	62		dB
CMRR	Common Mode Rejection Ratio	DC	52 <b>49</b>	57		dB
$I_{CC}$	Supply Current per channel	$R_L = \infty$	2.2 <b>2.1</b>	2.6	3.3 <b>3.4</b>	mA
<b>Miscellaneous Performance</b>						
$R_{IN}$	Input Resistance (Non-Inverting)			0.50		M $\Omega$

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No guarantee of parametric performance is indicated in the electrical tables under conditions of internal self heating where  $T_J > T_A$ . See Applications Information for information on temperature de-rating of this device." Min/Max ratings are based on product characterization and simulation. Individual parameters are tested as noted.
- (2) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.

**±5V Electrical Characteristics <sup>(1)</sup> (continued)**

$T_A = 25^\circ\text{C}$ ,  $A_V = +2$ ,  $R_L = 100\Omega$ ,  $V_{CC} = \pm 5\text{V}$ ; unless specified. **Boldface** limits apply at the temperature extremes.

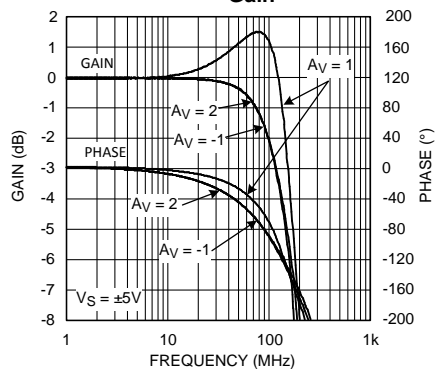
Symbol	Parameter	Conditions	Min (2)	Typ (2)	Max (2)	Units
$C_{IN}$	Input Capacitance (Non-Inverting)			1.9		pF
CMVR	Common-Mode Voltage Range			$\pm 4.2$		V
$V_{RO}$	Output Voltage Range	$R_L = 100\Omega$	3.6 <b>3.5</b>	$\pm 3.8$		V
$V_{RO}$	Output Voltage Range	$R_L = \infty$		$\pm 4.0$		V
$I_O$	Output Current <sup>(3)</sup>			200		mA
$R_O$	Output Resistance, Closed Loop	DC		.28		$\Omega$

(3) The maximum current is determined by device power dissipation limitations. See the Power Dissipation section of the Application Information for more details.

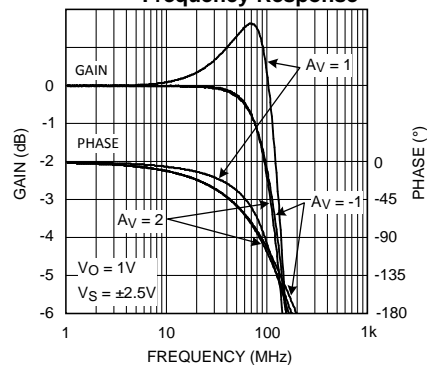
## Typical Performance Characteristics

( $A_V = +2$ ,  $R_L = 100\Omega$ , Unless Specified).

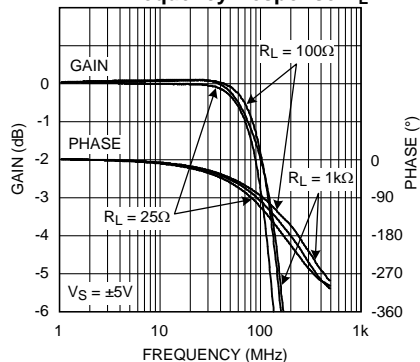
Frequency Response  
vs.  
Gain



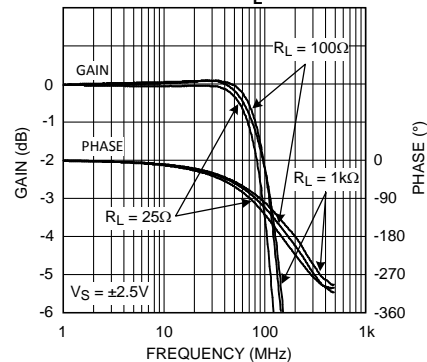
Frequency Response



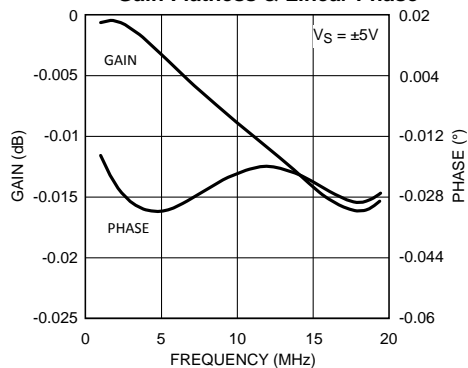
Frequency Response  $R_L$



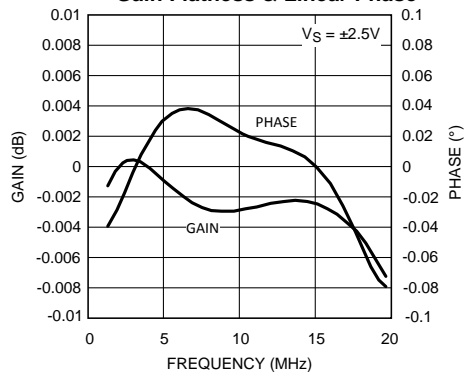
Frequency Response  
vs.  
 $R_L$



Gain Flatness & Linear Phase

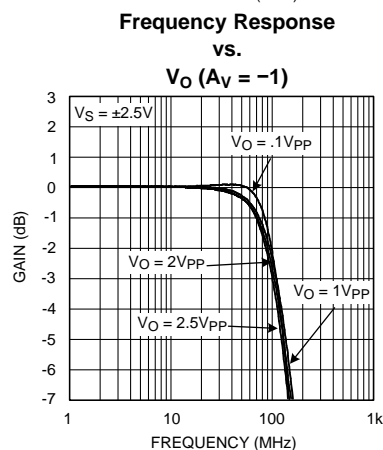
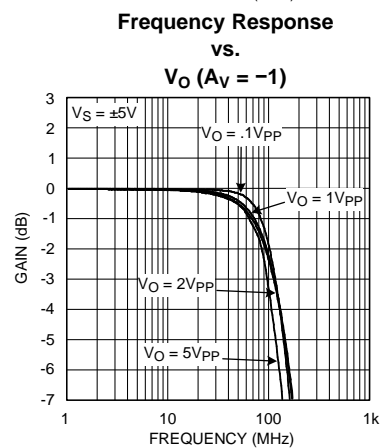
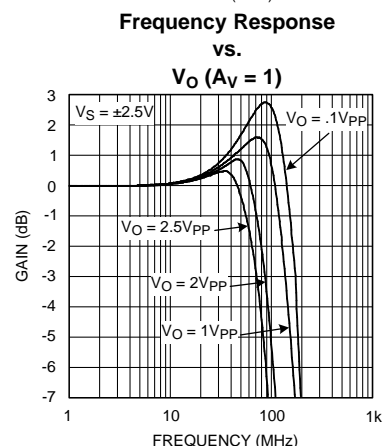
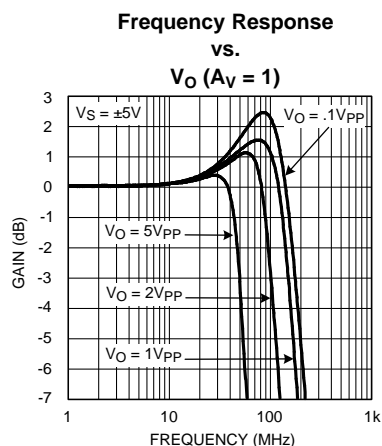
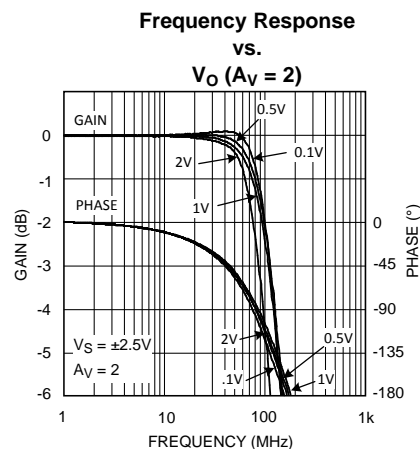
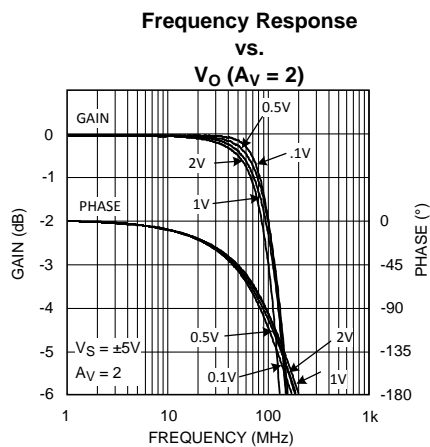


Gain Flatness & Linear Phase



### Typical Performance Characteristics (continued)

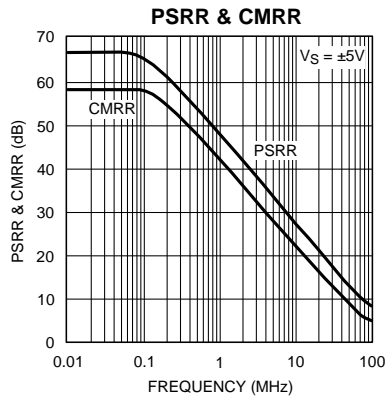
( $A_V = +2$ ,  $R_L = 100\Omega$ , Unless Specified).



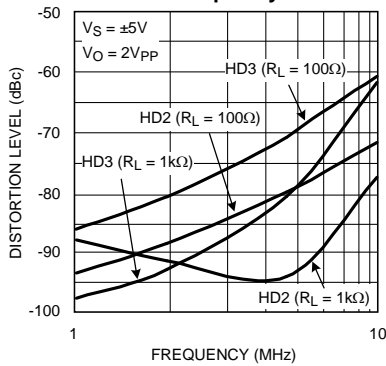


## Typical Performance Characteristics (continued)

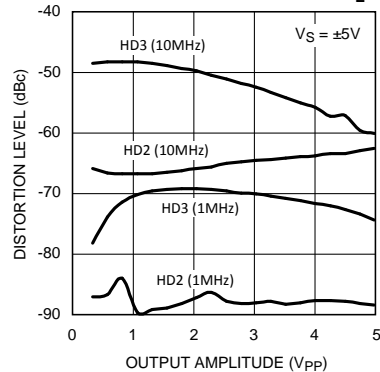
( $A_V = +2$ ,  $R_L = 100\Omega$ , Unless Specified).



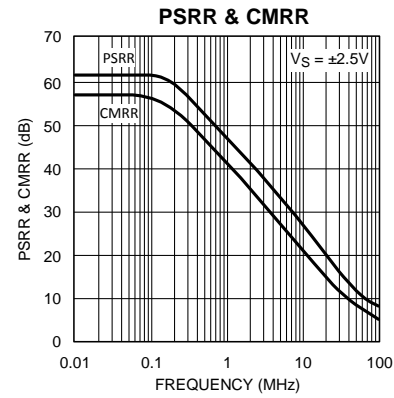
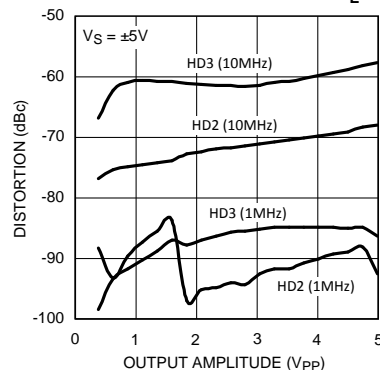
**2nd & 3rd Harmonic Distortion  
vs.  
Frequency**



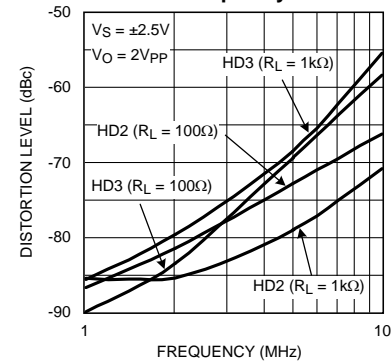
**2nd & 3rd Harmonic Distortion  $R_L = 25\Omega$**



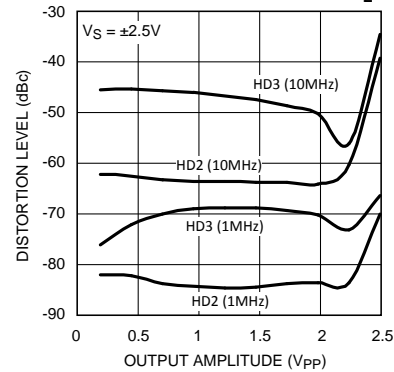
**2nd & 3rd Harmonic Distortion  $R_L = 100\Omega$**



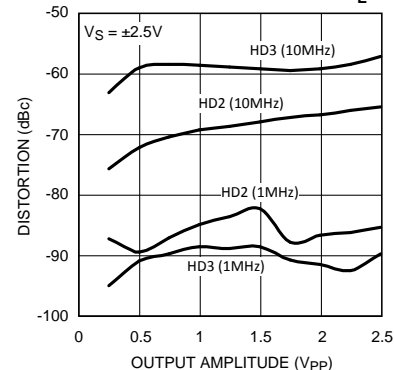
**2nd & 3rd Harmonic Distortion  
vs.  
Frequency**



**2nd & 3rd Harmonic Distortion  $R_L = 25\Omega$**



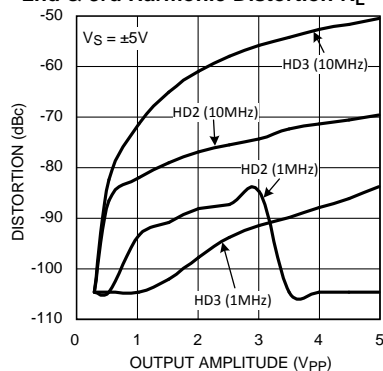
**2nd & 3rd Harmonic Distortion  $R_L = 100\Omega$**



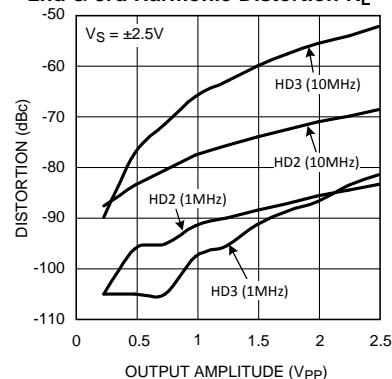
### Typical Performance Characteristics (continued)

( $A_V = +2$ ,  $R_L = 100\Omega$ , Unless Specified).

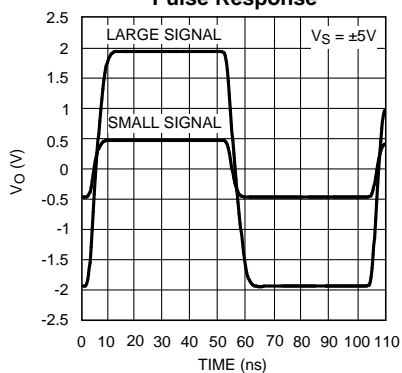
**2nd & 3rd Harmonic Distortion  $R_L = 1k\Omega$**



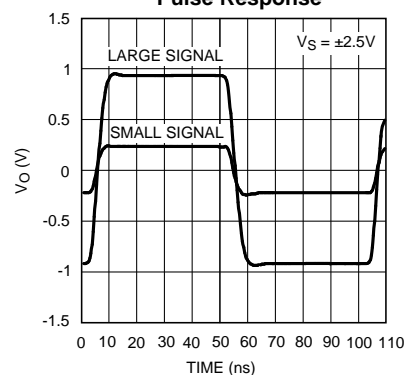
**2nd & 3rd Harmonic Distortion  $R_L = 1k\Omega$**



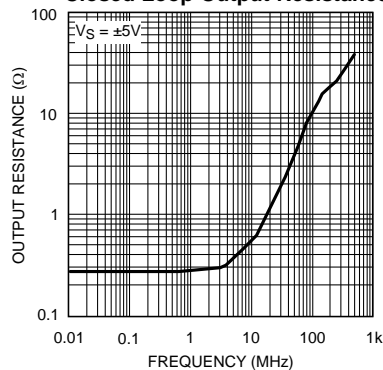
**Pulse Response**



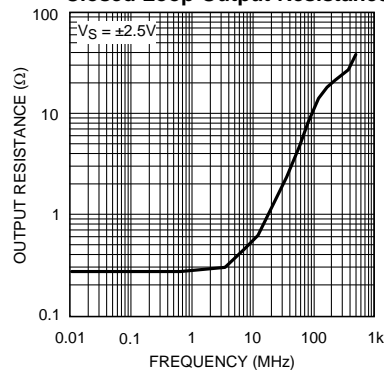
**Pulse Response**



**Closed Loop Output Resistance**

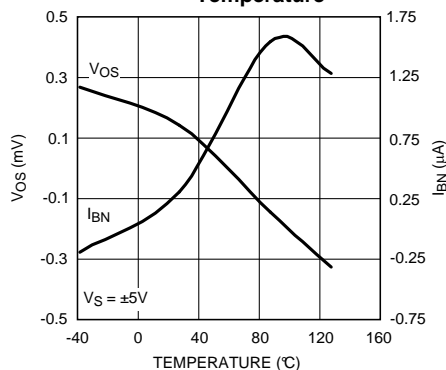


**Closed Loop Output Resistance**



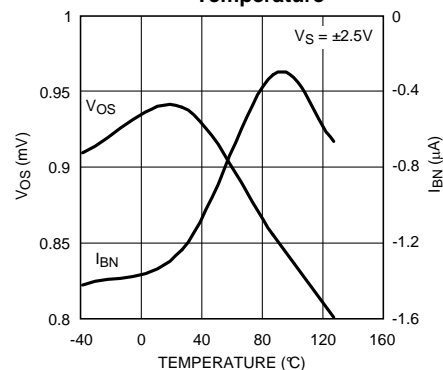
**$I_{BN}$  &  $V_{IO}$   
vs.**

**Temperature**



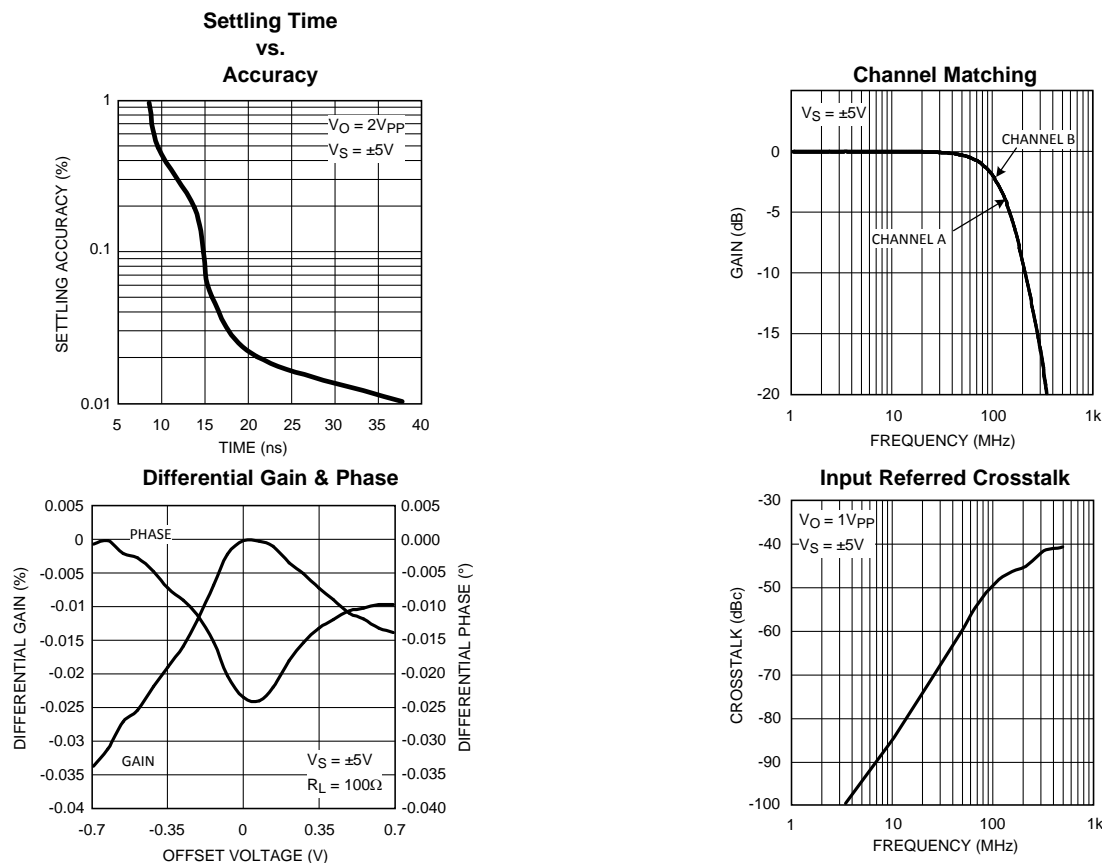
**$I_{BN}$  &  $V_{IO}$   
vs.**

**Temperature**



## Typical Performance Characteristics (continued)

( $A_V = +2$ ,  $R_L = 100\Omega$ , Unless Specified).



## Application Information

### LMH6718 OPERATION

The LMH6718 is a current feedback buffer fabricated in an advanced complementary bipolar process. The LMH6718 operates from a single 5V supply or dual  $\pm 5V$  supplies. Operating from a single 5V supply, the LMH6718 has the following features:

- Gains of  $\pm 1$ ,  $-1$ , and  $2V/V$  are achievable without external resistors
- Provides 170mA of output current
- Offers low  $-88/-91$ dBc 2nd & 3rd harmonic distortion
- Provides BW > 110MHz

The LMH6718 performance is further enhanced in  $\pm 5V$  supply applications as indicated in the  **$\pm 5V$  Electrical Characteristics** table and the  **$\pm 5V$  Typical Performance** plots.

### LMH6718 DESIGN INFORMATION CLOSED LOOP GAIN SELECTION

The LMH6718 is a current feedback op amp with  $R_F = R_G = 1k\Omega$  on chip (in the package). Select from three closed loop gains without using any external gain or feedback resistors. Implement gains of  $+2$ ,  $+1$ , and  $-1V/V$  by connecting pins 2 and 3 (or 5 and 6) as described in the chart below.

Gain $A_V$	Input Connections	
	Non-Inverting (pins 3, 5)	Inverting (pins 2, 6)
$-1V/V$	ground	input signal
$+1V/V$	input signal	NC (open)

Gain $A_V$	Input Connections	
	Non-Inverting (pins 3, 5)	Inverting (pins 2, 6)
+2V/V	input signal	ground

The gain accuracy of the LMH6718 is excellent and stable over temperature change. The internal gain setting resistors,  $R_F$  and  $R_G$  are poly silicon resistors. Although their absolute values change with processing and temperature, their ratio ( $R_F/R_G$ ) remains constant. If an external resistor is used in series with  $R_G$ , gain accuracy over temperature will suffer.

### SINGLE SUPPLY OPERATION ( $V_{CC} = +5V$ , $V_{EE} = GND$ )

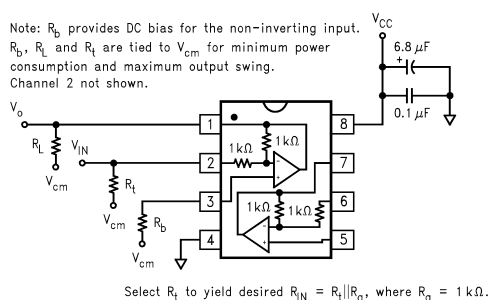
The specifications given in the **+5V Electrical Characteristics** table for single supply operation are measured with a common mode voltage ( $V_{CM}$ ) of 2.5V.  $V_{CM}$  is the voltage around which the inputs are applied and the output voltages are specified.

Operating from a single +5V supply, the Common Mode Voltage Range (CMVR) of the LMH6718 is typically +0.8V to +4.2V. The typical output range with  $R_L = 100\Omega$  is +1.0V to +4.0V.

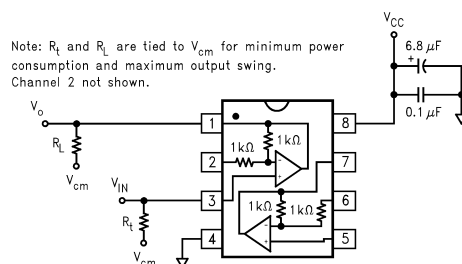
For single supply DC coupled operation, keep input signal levels above 0.8V DC, AC coupling and level shifting the signal are recommended. The non-inverting and inverting configurations for both input conditions are illustrated in the following 2 sections.

### DC COUPLED SINGLE SUPPLY OPERATION

Figure 2, Figure 3, and Figure 4 on the following page, show the recommended configurations for input signals that remain above 0.8V DC.



**Figure 2. DC Coupled,  $A_V = -1V/V$  Configuration**



**Figure 3. DC Coupled,  $A_V = +1V/V$  Configuration**

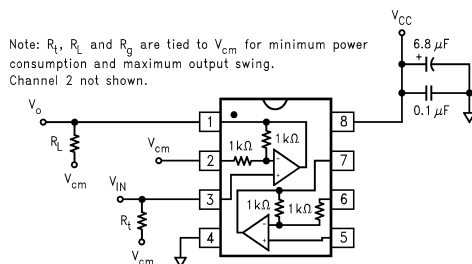


Figure 4. DC Coupled,  $A_V = +2V/V$  Configuration

## AC COUPLED SINGLE SUPPLY OPERATION

Figure 5, Figure 6, and Figure 7 show possible non-inverting and inverting configurations for input signals that go below 0.8V DC.

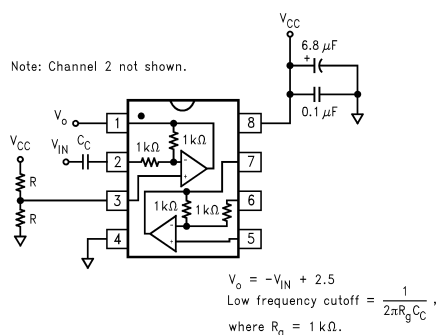


Figure 5. AC Coupled,  $A_V = -1V/V$  Configuration

The input is AC coupled to prevent the need for level shifting the input signal at the source. The resistive voltage divider biases the non-inverting input to  $V_{CC} \div 2 = 2.5V$  (For  $V_{CC} = +5V$ )

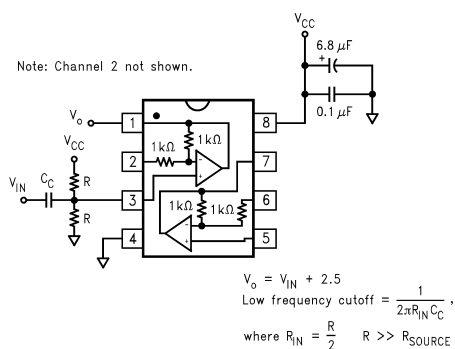
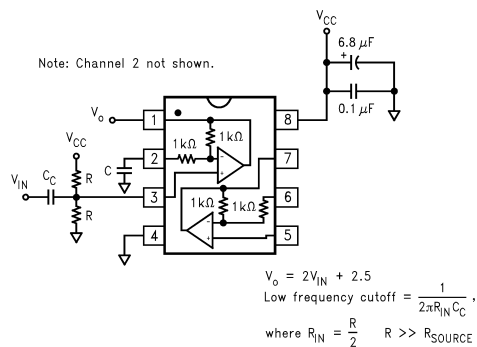
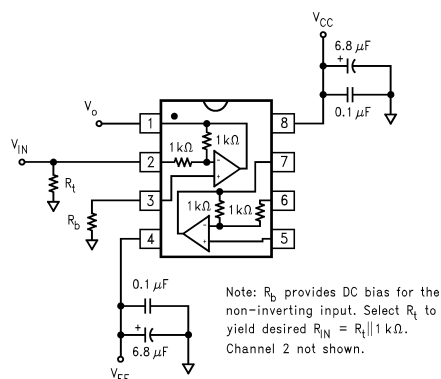
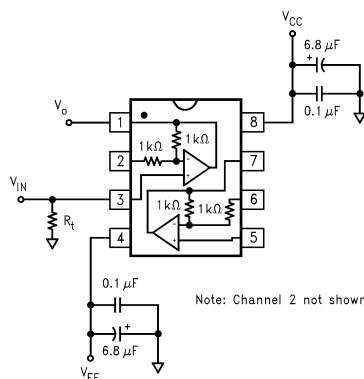


Figure 6. AC Coupled,  $A_V = +1V/V$  Configuration

Figure 7. AC Coupled,  $A_V = +2V/V$  Configuration

## DUAL SUPPLY OPERATION

The LMH6718 operates on dual supplies as well as single supplies. The non-inverting and inverting configurations are shown in Figure 8, Figure 9, and Figure 10.

Figure 8. Dual Supply,  $A_V = -1V/V$  ConfigurationFigure 9. Dual Supply,  $A_V = +1V/V$  Configuration

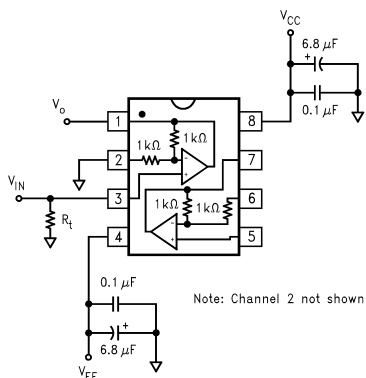


Figure 10. Dual Supply,  $A_v = +2V/V$  Configuration

## LOAD TERMINATION

The LMH6718 can source and sink nearly equal amounts of current.

## DRIVING CABLES AND CAPACITIVE LOADS

When driving cables, double termination is used to prevent reflections. For capacitive load applications, a small series resistor at the output of the LMH6718 will improve stability and settling performance. The **Suggested  $R_s$  vs.  $C_L$**  plot, shown below in Figure 11, gives the recommended series resistance value for optimum flatness at various capacitive loads.

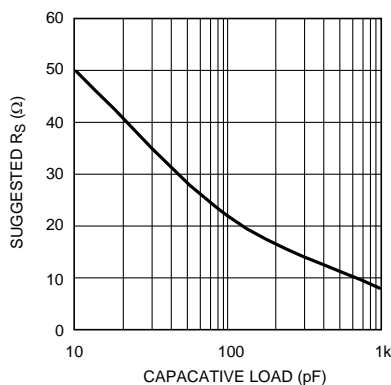


Figure 11. Suggested  $R_s$  vs.  $C_L$

## TRANSMISSION LINE MATCHING

One method for matching the characteristic impedance ( $Z_O$ ) of a transmission line or cable is to place the appropriate resistor at the input or output of the amplifier. Figure 12 shows typical inverting and non-inverting circuit configurations for matching transmission lines.

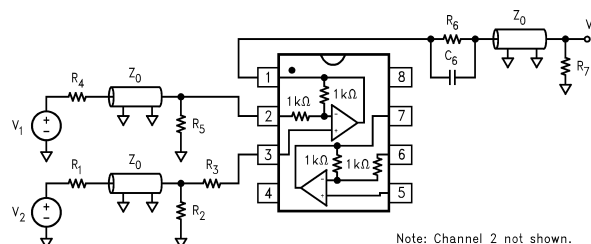
Non-Inverting gain applications:

- Connect pin 2 as indicated in the table in the **Closed Loop Gain Selection** section.
- Make  $R_1$ ,  $R_2$ ,  $R_6$ , and  $R_7$  equal to  $Z_O$ .
- Use  $R_3$  to isolate the amplifier from reactive loading caused by the transmission line, or by parasitics.

Inverting gain applications:

- Connect  $R_3$  directly to ground.
- Make the resistors  $R_4$ ,  $R_6$ , and  $R_7$  equal to  $Z_O$ .
- Make  $R_5 \parallel R_9 = Z_O$ .

The input and output matching resistors attenuate the signal by a factor of 2, therefore additional gain is needed. Use C6 to match the output transmission line over a greater frequency range. C6 compensates for the increase of the amplifier's output impedance with frequency.



**Figure 12. Transmission Line Matching**

## POWER DISSIPATION

Follow these steps to determine the power consumption of the LMH6718:

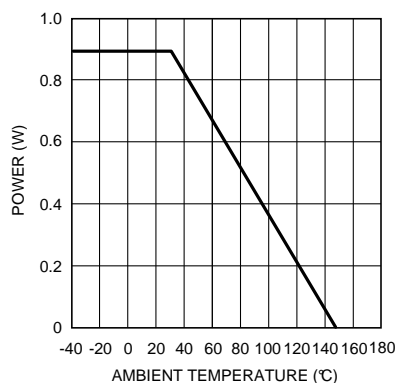
1. Calculate the quiescent (no-load) power:  $P_{amp} = I_{CC} (V_{CC} - V_{EE})$
2. Calculate the RMS power at the output stage:  $P_O = (V_{CC} - V_{LOAD}) (I_{LOAD})$ , where  $V_{LOAD}$  and  $I_{LOAD}$  are the voltage and current across the external load.
3. Calculate the total RMS power:  $P_t = P_{amp} + P_O$ . The maximum power that the SOIC package can dissipate at a given temperature is illustrated in [Figure 13](#). The power derating curve for any LMH6718 package can be derived by utilizing the following equation:

$$\frac{(150^\circ - T_{amb})}{\theta_{JA}} \quad (1)$$

where

$T_{amb}$  = Ambient temperature ( $^\circ\text{C}$ )

$\theta_{JA}$  = Thermal resistance, from junction to ambient, for a given package ( $^\circ\text{C/W}$ )



**Figure 13. Power Derating Curve**

## LAYOUT CONSIDERATIONS

A proper printed circuit layout is essential for achieving high frequency performance. National provides evaluation boards for the LMH6718 (CLC730036-SOIC) and suggests their use as a guide for high frequency layout and as an aid for device testing and characterization.

General layout and supply bypassing play major roles in high frequency performance. Follow the steps below as a basis for high frequency layout:

- Include 6.8 $\mu\text{F}$  tantalum and 0.1 $\mu\text{F}$  ceramic capacitors on both supplies.
- Place the 6.8 $\mu\text{F}$  capacitors within 0.75 inches of the power pins.



- Place the 0.1 $\mu$ F capacitors less than 0.1 inches from the power pins.
- 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.
- Use flush-mount printed circuit board pins for prototyping, never use high profile DIP sockets.

## EVALUATION BOARD INFORMATION

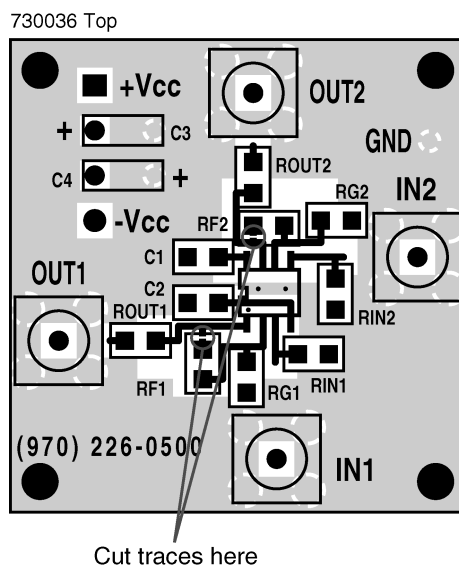
A datasheet is available for the CLC730036 evaluation board. The evaluation board data sheets provide:

- Evaluation board schematics
- Evaluation board layouts
- General information about the boards

The evaluation boards are designed to accommodate dual supplies. The boards can be modified to provide single supply operation. For best performance; 1) do not connect the unused supply, 2) ground the unused supply pin.

## SPECIAL EVALUATION BOARD CONSIDERATION FOR THE LMH6718

To optimize off-isolation of the LMH6718, cut the  $R_f$  trace on the CLC730036 evaluation boards. This cut minimizes capacitive feedthrough between the input and the output. [Figure 14](#) shows where to cut both evaluation boards for improved off-isolation.

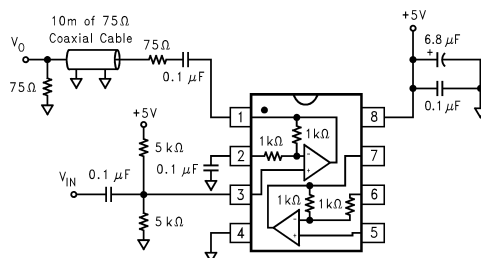


**Figure 14. Evaluation Board Changes**

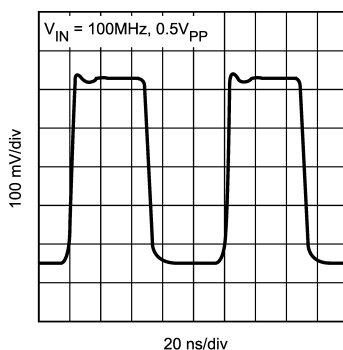
## Application Circuits

### SINGLE SUPPLY CABLE DRIVER

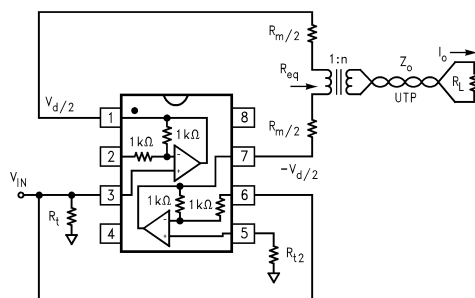
[Figure 15](#) below shows the LMH6718 driving 10m of 75 $\Omega$  coaxial cable. The LMH6718 is set for a gain of +2V/V to compensate for the divide-by-two voltage drop at  $V_O$ . The response after 10m of cable is illustrated in [Figure 16](#)



NOTE: Channel 2 not shown.

**Figure 15. Single Supply Cable Driver****Figure 16. Response After 10m of Cable****DIFFERENTIAL LINE DRIVER WITH LOAD IMPEDANCE CONVERSION**

The circuit shown in Figure 17, operates as a differential line driver. The transformer converts the load impedance to a value that best matches the LMH6718's output capabilities. The single-ended input signal is converted to a differential signal by the LMH6718. The line's characteristic impedance is matched at both the input and the output. The schematic shows Unshielded Twisted Pair for the transmission line; other types of lines can also be driven.



Note: Supplies and bypassing not shown.

**Figure 17. Differential Line Driver with Load Impedance Conversion**

Set up the LMH6718 as a difference amplifier:

- Set the Channel 1 amplifier to a gain of +1V/V
- Set the Channel 2 amplifier to a gain of -1V/V

Make the best use of the LMH6718's output drive capability as follows:

$$R_m + R_{eq} = \frac{2 \cdot V_{max}}{I_{max}}$$

(2)

where  $R_{eq}$  is the transformed value of the load impedance,  $V_{max}$  is the output Voltage Range, and  $I_{max}$  is the maximum Output Current.

Match the line's characteristic impedance:

$$\begin{aligned} R_L &= Z_O \\ R_M &= R_{EQ} \\ N &= \sqrt{\frac{R_L}{R_{EQ}}} \end{aligned} \quad (3)$$

Select the transformer so that it loads the line with a value very near  $Z_O$  over frequency range. The output impedance of the LMH6718 also affects the match. With an ideal transformer we obtain:

$$\text{Return Loss} = -20 \cdot \log_{10} \left| \frac{n^2 \cdot Z_O(j\omega)}{Z_0} \right|, \text{ dB} \quad (4)$$

where  $Z_O(6718)(j\omega)$  is the output impedance of the LMH6718 and  $|Z_O(6718)(j\omega)| \ll R_m$ .

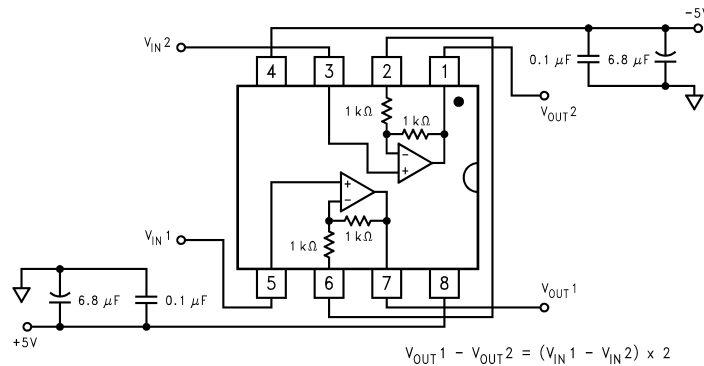
The load voltage and current will fall in the ranges:

$$\begin{aligned} |V_O| &\leq n \cdot V_{max} \\ |I_O| &\leq \frac{I_{max}}{n} \end{aligned} \quad (5)$$

The LMH6718's high output drive current and low distortion make it a good choice for this application.

### DIFFERENTIAL INPUT/DIFFERENTIAL OUTPUT AMPLIFIER

Figure 18 below illustrates a differential input/differential output configuration. The bypass capacitors are the only external components required.



**Figure 18. Differential Input/Differential Output Amplifier**

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