

AN-1767 LME49721 Evaluation Board

1 Introduction

This application report provides information on how to use the LME49721 demonstration board for evaluation of the LME49721 Rail-to-Rail Input/Output, high performance, high fidelity operational amplifier. The LME49721 demonstration board is designed for the user to fully evaluate the LME49721 in either inverting, non-inverting, or unity gain voltage follower configuration. This board is shown in [Figure 1](#).

2 General Description

The LME49721 is a low distortion (THD + N = 0.00008%, $A_V = 2$, $V_{OUT} = 4V_{P-P}$, $f_{IN} = 1kHz$), low noise (4nV/ $\sqrt{Hz}$) Rail-to-Rail Input/Output operational amplifier optimized and fully specified for high performance, high fidelity applications. The Rail-to-Rail Input/Output operational amplifier delivers superior signal amplification for outstanding performance. The LME49721 has a slew rate of $\pm 8.5V/\mu s$, an output current capability of $\pm 9.7mA$, and an input bias current of 40fA. This operational amplifier can easily drive 10k Ω loads to within 10mV of each power supply voltage.

3 Operating Conditions

The LME49721 has a supply voltage range from +2.2V to +5.5V single supply or $\pm 1.1V$ to $\pm 2.75V$ dual supply. Please note the demonstration board is designed for dual supply operation only.

4 Demonstration Board Schematic

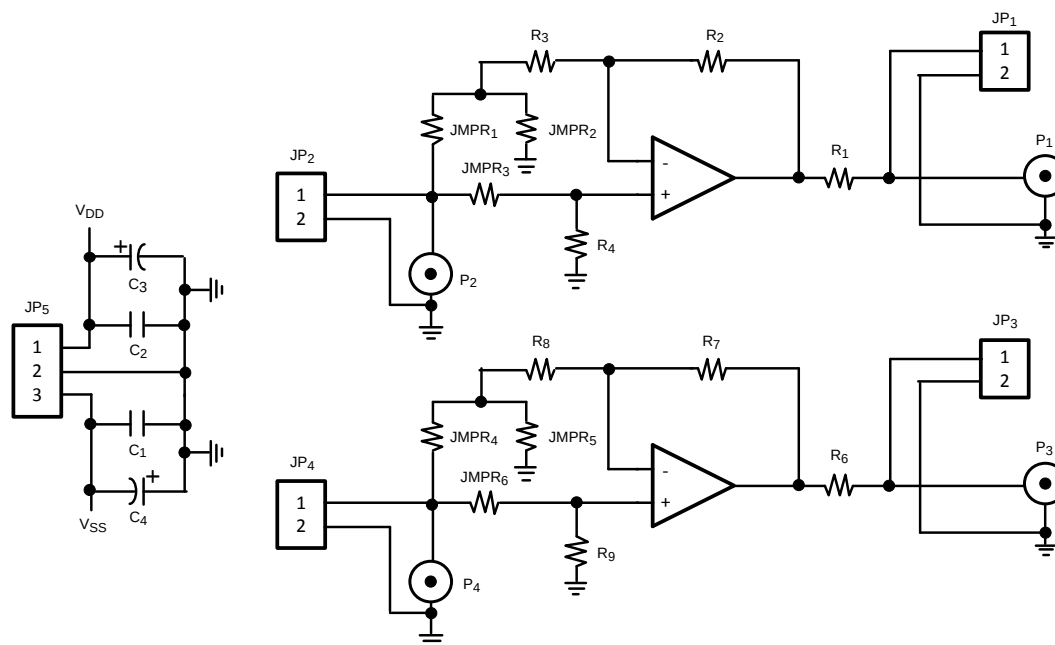


Figure 1. LME49721 Demo Board Schematic

Table 1. Demo Board Connections

Designator	Label	Function
JP1	OUT_1	Output Signal A
JP2	IN_1	Input Signal A
JP3	OUT_2	Output Signal B
JP4	IN_2	Input Signal B
JP5	+V _{DD} GND -V _{SS}	Power Supply Connections
P1	OUT_1	Output Signal A
P2	IN_1	Input Signal A
P3	OUT_2	Output Signal B
P4	IN_2	Input Signal B

5 Configuring the LME49721 Amplifier

5.1 Inverting Configuration

Figure 2 shows the typical connection for a inverting amplifier. The output voltage is centered on zero with a gain of $A_v = -R_2/R_3$. Table 2 shows the recommended Bill of Materials for an inverting amplifier.

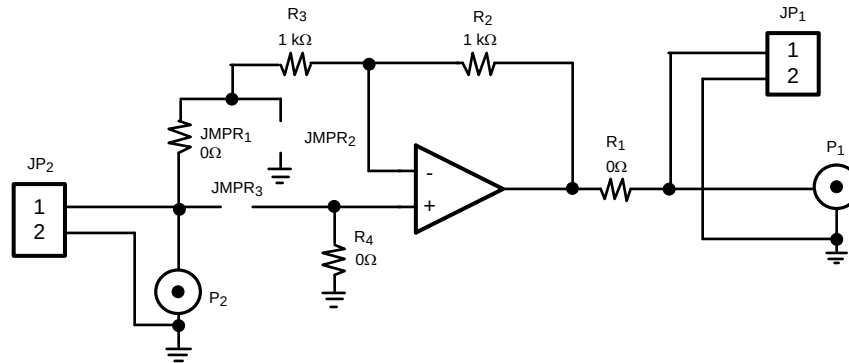


Figure 2. Inverting Amplifier

You can configure the LME49721 demonstration board in an inverting configuration by making the following changes:

1. Place 0Ω resistor (or short) JMPR₁ (JMPR₄).
2. Place 0Ω resistor (or short) R₄ (R₉).
3. Place the desired value resistor (1kΩ minimum) to set the inverting gain in R₃ (R₈) and R₂ (R₇).
4. Leave the JMPR₂ (JMPR₅) and JMPR₃ (JMPR₆) open.
5. Place 0Ω resistor (or short) R₁ (R₆).

Table 2. Example Demonstration Board Bill of Materials for Inverting Configuration

Description	Designator	Part Number	Manufacturer
Ceramic Capacitor 0.1μF, 10% 50V 0805 SMD	C1, C2	C0805C104K3RAC7533	Kemet
Tantalum Capacitor 10μF, 10% 20V, B-size	C3, C4	T491B106K025AT	Kemet
Resistor 0 Ω, 1/8W 1% 0805 SMD	JMPR ₁ , JMPR ₄ , R ₁ , R ₄ , R ₆ , R ₉	CRCW0805000020EA	Vishay
Resistor 10kΩ, 1/8W, 1% 0805 SMD	R ₂ , R ₃ , R ₈ , R ₇	CRCW080510KOFKEA	Vishay
Header, 2-Pin	JP ₁ , JP ₂ , JP ₃ , JP ₄		
Header, 3-Pin	JP ₅		
SMA standup connectors	P1–P4 (Optional)	132134	Amphenol Connex

5.2 Non-Inverting Configuration

Figure 3 shows the typical connection for a non-inverting amplifier. Again the output voltage is centered on zero but with a gain of $A_v = 1 + (R_2/R_3)$. Table 3 shows the recommended Bill of Materials for a non-inverting amplifier.

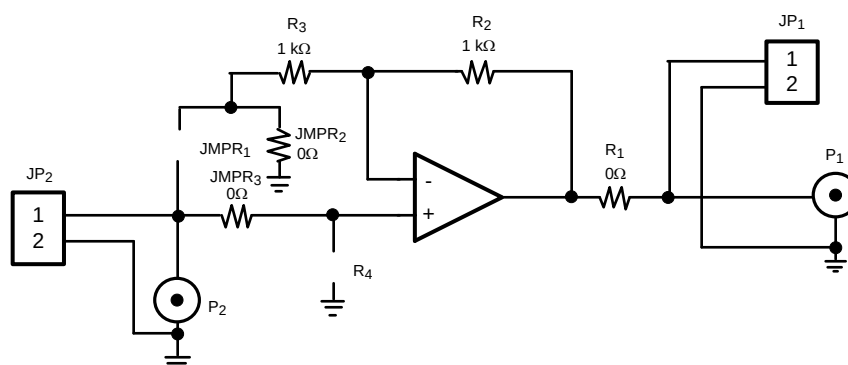


Figure 3. Non-Inverting Amplifier

You can configure the LME49721 demonstration board in Non-Inverting configuration by making the following changes:

1. Place 0Ω resistor (or short) JMPR₂ (JMPR₅) and JMPR₃ (JMPR₆).
2. Place the desired value resistors (1kΩ minimum) to set inverting gain in R₃ (R₈) and R₂ (R₇).
3. Leave the JMPR₁ (JMPR₄) and R₄ (R₉) open.
4. Place 0Ω resistor (or short) R₁ (R₆).

Table 3. Example Demonstration Board Bill of Materials for Non-Inverting Configuration

Description	Designator	Part Number	Manufacturer
Ceramic Capacitor 0.1μF, 10% 50V 0805 SMD	C1, C2	C0805C104K3RAC7533	Kemet
Tantalum Capacitor 10μF, 10% 20V, B-size	C3, C4	T491B106K025AT	Kemet
Resistor 0 Ω, 1/8W 1% 0805 SMD	JMPR ₂ , JMPR ₃ , JMPR ₅ , JMPR ₆ , R ₁ , R ₆	CRCW0805000020EA	Vishay
Resistor 10kΩ, 1/8W, 1% 0805 SMD	R ₂ , R ₃ , R ₇ , R ₈	CRCW080510K0FKEA	Vishay
Header, 2-Pin	JP ₁ , JP ₂ , JP ₃ , JP ₄		
Header, 3-Pin	JP ₅		
SMA standup connectors	P1–P4 (Optional)	132134	Amphenol Connex

5.3 Voltage Follower Configuration

Figure 4 shows the typical connection for a Voltage Follower amplifier or also called a Buffer. A Voltage Follower Amplifier can be used to solve impedance matching problems, to reduce power consumption in the source, or to drive heavy loads. The input impedance of the LME49721 is very high. Therefore, the input of the LME49721 does not load down the source. The Voltage Follower is a unity stable amplifier, 1V/V. Table 4 shows the recommended Bill of Materials for an inverting amplifier.

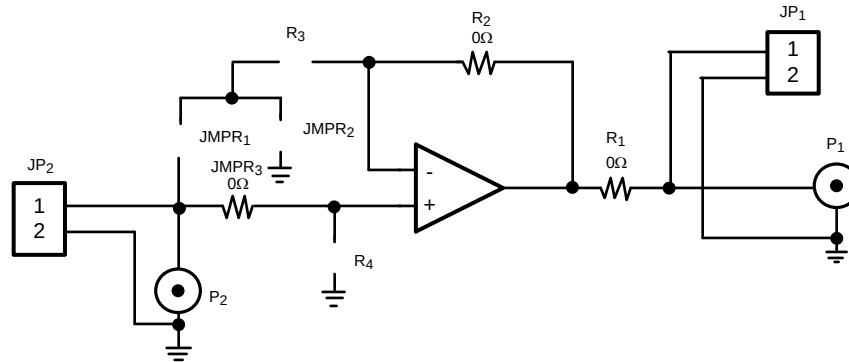


Figure 4. Voltage Follower Amplifier

You can configure the LME49721 demonstration board in a Voltage Follower configuration by making the following changes:

1. Place 0Ω resistor (or short) R₂ (R₇) and R₁ (R₆).
2. Place 0Ω resistor (or short) JMPR₃ (JMPR₆).
3. Leave R₃ (R₈) and R₄ (R₉) open.
4. Leave JMPR₁ (JMPR₄) and JMPR₂ (JMPR₅) open.

Table 4. Example Demonstration Board Bill of Materials for Voltage Follower Configuration

Description	Designator	Part Number	Manufacturer
Ceramic Capacitor 0.1μF, 10% 50V 0805 SMD	C1, C2	C0805C104K3RAC7533	Kemet
Tantalum Capacitor 10μF, 10% 20V, B-size	C3, C4	T491B106K025AT	Kemet
Resistor 0 Ω, 1/8W 1% 0805 SMD	JMPR ₃ , JMPR ₆ , R ₁ , R ₂ , R ₆ , R ₇	CRCW0805000020EA	Vishay
Header, 2-Pin	JP ₁ , JP ₂ , JP ₃ , JP ₄		
Header, 3-Pin	JP ₅		
SMA standup connectors	P1–P4 (Optional)	132134	Amphenol Connex

6 Demonstration Board Layout

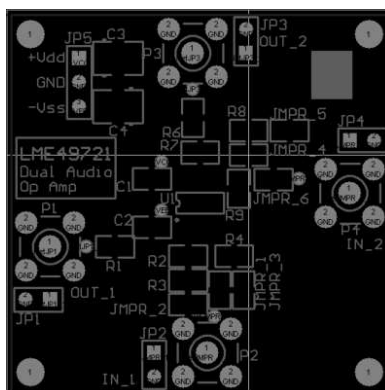


Figure 5. Top Silkscreen

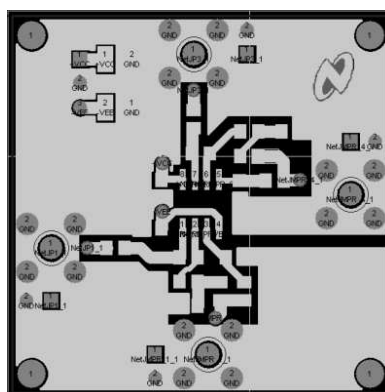


Figure 6. Top Layer

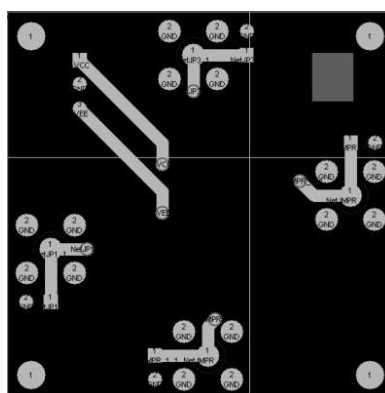
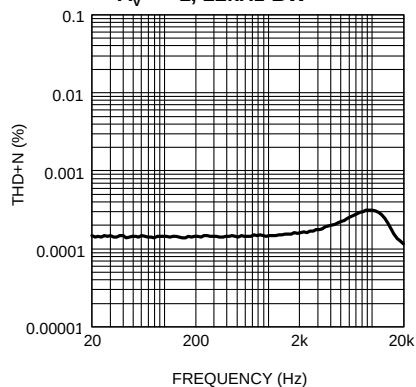


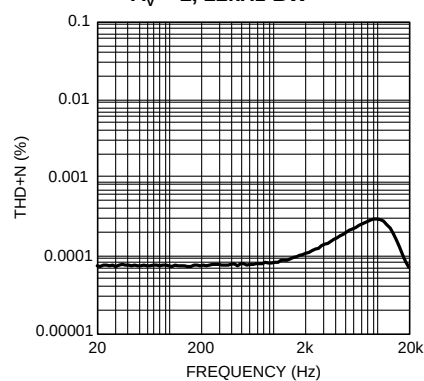
Figure 7. Bottom Layer

7 Typical Performance Characteristics

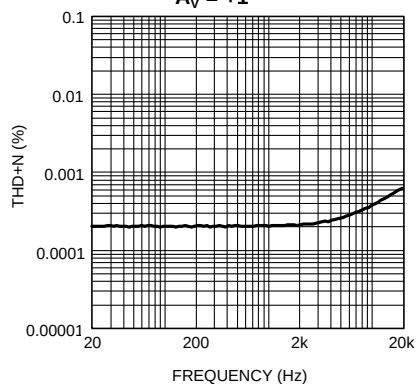
THD+N vs Frequency
 $V_S = 2.5V$, $V_{OUT} = 2V_{P-P}$, $R_L = 2k\Omega$
 $A_V = +1$, 22kHz BW



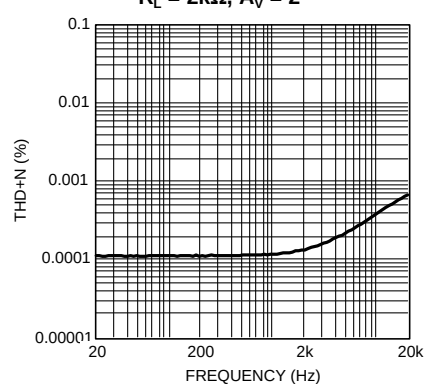
THD+N vs Frequency
 $V_S = \pm 2.5V$, $V_{OUT} = 4V_{P-P}$, $R_L = 2k\Omega$
 $A_V = 2$, 22kHz BW



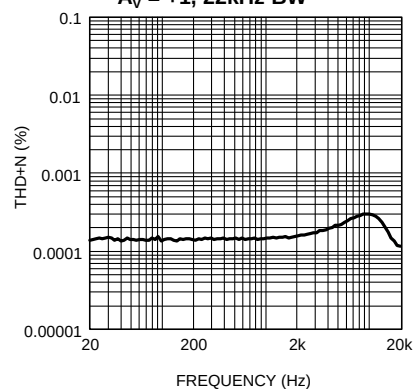
THD+N vs Frequency
 $V_S = 2.5V$, $V_{OUT} = 2V_{P-P}$, $R_L = 2k\Omega$
 $A_V = +1$



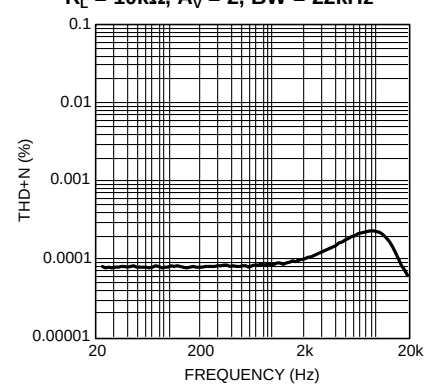
THD+N vs Frequency
 $V_S = \pm 2.5V$, $V_{OUT} = 4V_{P-P}$
 $R_L = 2k\Omega$, $A_V = 2$

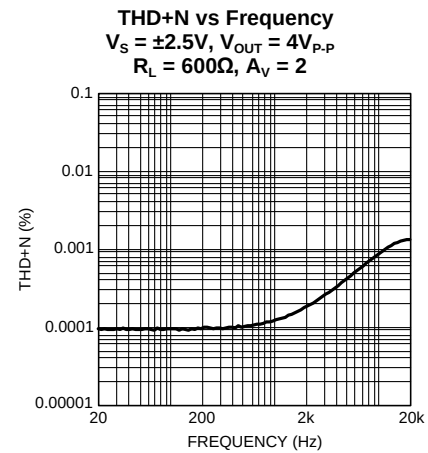
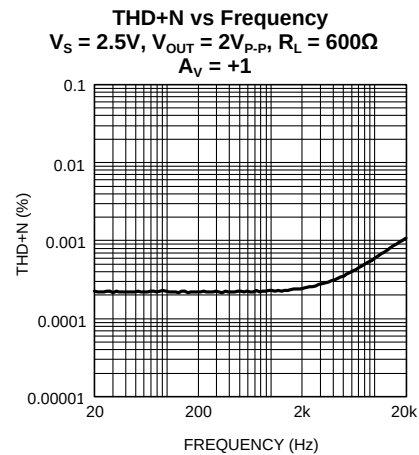
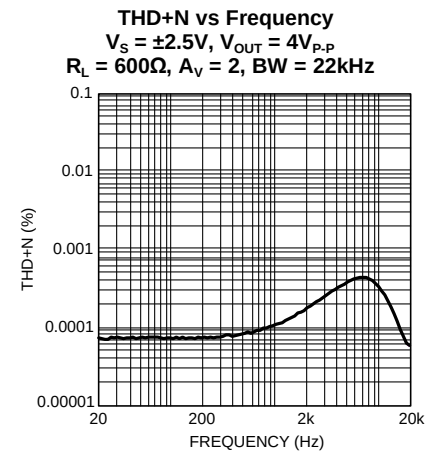
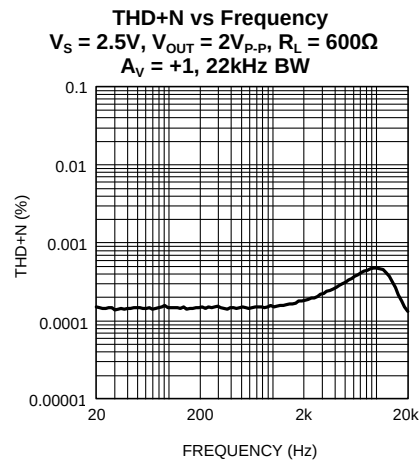
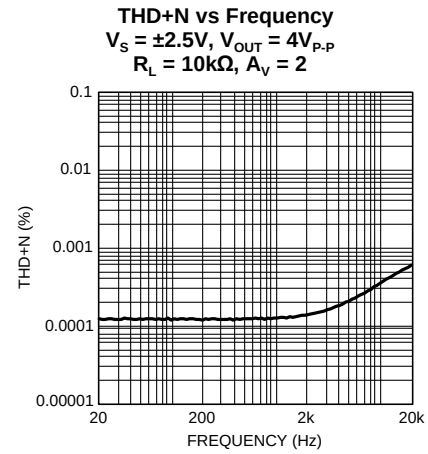
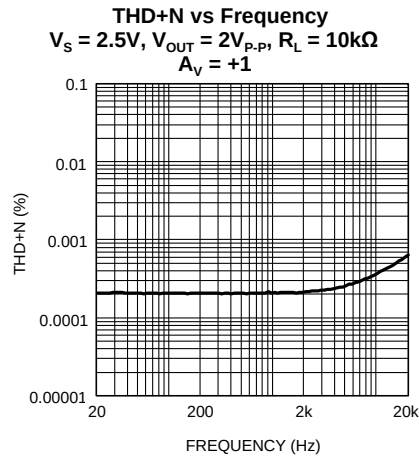


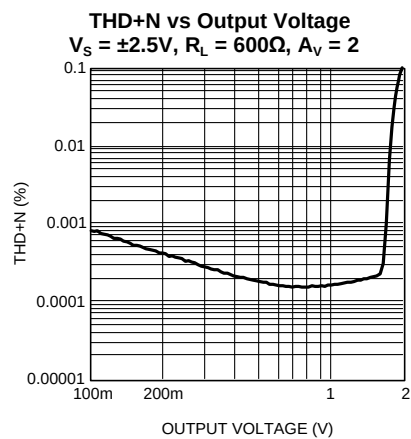
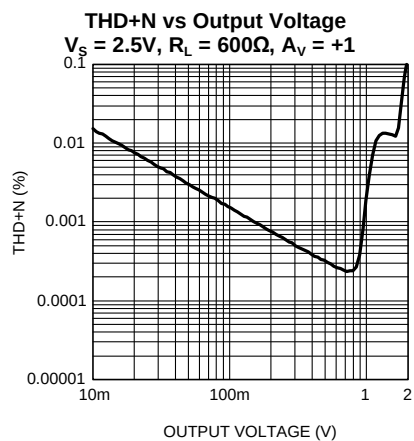
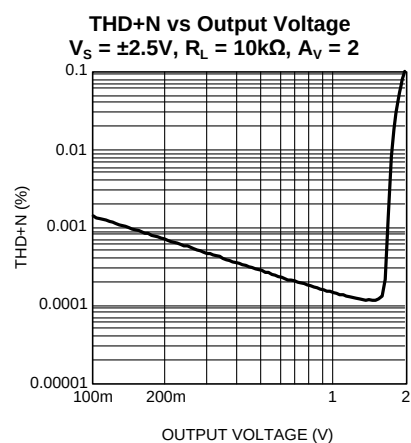
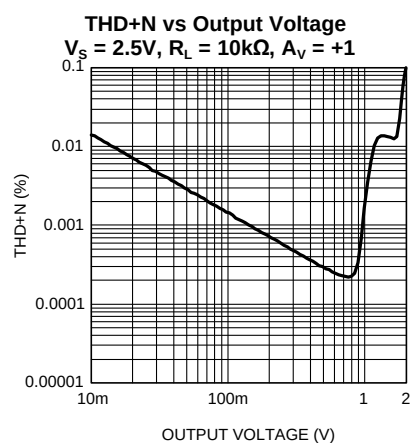
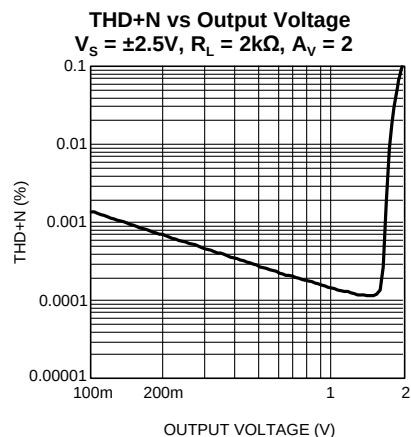
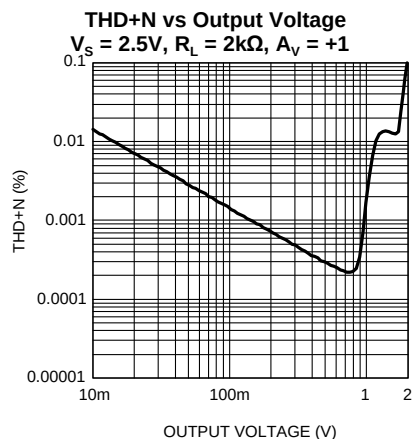
THD+N vs Frequency
 $V_S = 2.5V$, $V_{OUT} = 2V_{P-P}$, $R_L = 10k\Omega$
 $A_V = +1$, 22kHz BW



THD+N vs Frequency
 $V_S = \pm 2.5V$, $V_{OUT} = 4V_{P-P}$
 $R_L = 10k\Omega$, $A_V = 2$, BW = 22kHz







8 Revision Table

Rev	Date	Description
1.0	02/22/08	Initial release.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com