

Single, Dual, and Quad 40V Low Noise Precision Amplifiers

 Check for Samples: [LMP8671](#), [LMP8672](#), [LMP8674](#)

FEATURES

- Output Short Circuit Protection
- PSRR and CMRR Exceed 110dB
- Best in Class Linearity (135dB)

APPLICATIONS

- Low Noise Industrial Applications Including Test, Measurement, and Ultrasound
- Precision Active Filters
- PLL Filters
- 4-20mA Current Loops
- Motor Control

KEY SPECIFICATIONS

- Input Offset Voltage 0.4mV
- TC V_{OS} 2 μ V/ $^{\circ}$ C (max)
- Power Supply Voltage Range ± 2.5 V to ± 20 V
- Voltage Noise Density 2.5nV/ $\sqrt{\text{Hz}}$
- Slew Rate ± 20 V/ μ s
- Gain Bandwidth Product 55MHz
- Open Loop Gain 135dB
- Input Bias Current 10nA

Connection Diagrams

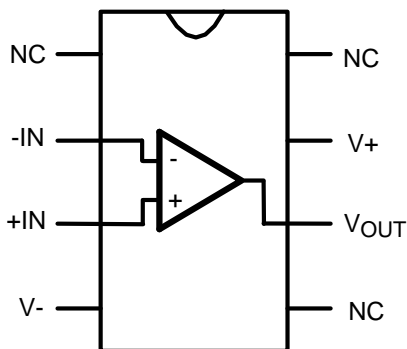


Figure 1. See Package Number — D0008A

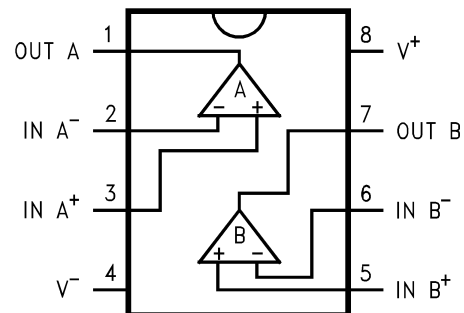


Figure 2. See Package Number — D0008A

DESCRIPTION

The LMP8671/2/4 combines great precision, low noise and a large operating voltage range to provide a high SNR and a wide dynamic range. Its AC performance allows it to be used over a wide frequency without degradation. It is the ideal choice for applications requiring DC precision and low noise such as precision PLL filters, multi feedback and multi pole active filters, GPS receivers and precision control loop systems. The LMP8671/2/4 offers an extremely high open loop gain of 135dB, low voltage noise density (2.5nV/ $\sqrt{\text{Hz}}$), and a superb linearity of 0.000009%. These characteristics drastically reduce gain error which is a challenge in accurate systems requiring higher gains such as data acquisition systems.

To ensure that the most challenging loads are driven without compromise, the LMP8671/2/4 has a high slew rate of ± 20 V/ μ s and an output current capability of ± 26 mA.

The LMP8671/2 family of high-voltage amplifiers are available in SOIC-8, the LMP8674 in SOIC-14.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

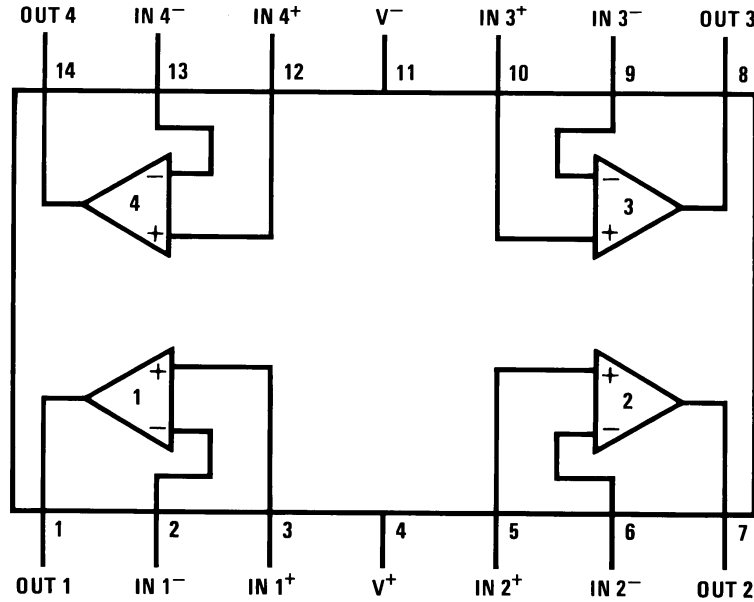


Figure 3. See Package Number — D0014A



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⁾⁽²⁾⁽³⁾

Power Supply Voltage ($V_S = V^+ - V^-$)	46V	
Storage Temperature	-65°C to 150°C	
Input Voltage	(V^-) - 0.7V to (V^+) + 0.7V	
Output Short Circuit ⁽⁴⁾	Continuous	
Power Dissipation	Internally Limited	
ESD Rating ⁽⁵⁾	2000V	
ESD Rating ⁽⁶⁾	Pins 1, 4, 7 and 8	200V
	Pins 2, 3, 5 and 6	100V
Junction Temperature	150°C	
Thermal Resistance	θ_{JA} (SO)	145°C/W

For soldering specifications, <http://www.ti.com/lit/SNOA549>

- (1) "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur, including inoperability and degradation of device reliability and/or performance. Functional operation of the device and/or non-degradation at the Absolute Maximum Ratings or other conditions beyond those indicated in the Recommended Operating Conditions is not implied. The Recommended Operating Conditions indicate conditions at which the device is functional and the device should not be operated beyond such conditions. All voltages are measured with respect to the ground pin, unless otherwise specified.
- (2) The Electrical Characteristics tables list ensured specifications under the listed Recommended Operating Conditions except as otherwise modified or specified by the Electrical Characteristics Conditions and/or Notes. Typical specifications are estimations only and are not ensured.
- (3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
- (4) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{JMAX} , θ_{JA} , and the ambient temperature, T_A . The maximum allowable power dissipation is $P_{DMAX} = (T_{JMAX} - T_A) / \theta_{JA}$ or the number given in Absolute Maximum Ratings, whichever is lower.
- (5) Human body model, applicable std. JESD22-A114C.
- (6) Machine model, applicable std. JESD22-A115-A.

Operating Ratings

Temperature Range $T_{MIN} \leq T_A \leq T_{MAX}$	$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$
Supply Voltage Range LMP8671/2/4	$\pm 2.5\text{V} \leq V_S \leq \pm 22\text{V}$

Electrical Characteristics for the LMP8671/2/4⁽¹⁾

The following specifications apply for $V_S = \pm 20V$, $R_L = 2k\Omega$, $R_{SOURCE} = 10\Omega$, $f_{IN} = 1kHz$, $T_A = 25^\circ C$, unless otherwise specified. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	LMP8671/2/4		Units (Limits)
			Typical ⁽²⁾	Limit ⁽³⁾	
V_{OS}	Offset Voltage		± 100	± 400 ± 750	μV (max)
$\Delta V_{OS}/\Delta Temp$	Average Input Offset Voltage Drift vs Temperature	$-40^\circ C \leq T_A \leq 125^\circ C$	0.1	2	$\mu V/^\circ C$ (max)
I_B	Input Bias Current	$V_{CM} = 0V$			
		LMP8671/4	10	± 75 ± 95	nA (max)
		$V_{CM} = 0V$			
	LMP8672	50	± 200 ± 250	nA (max)	
I_{OS}	Input Offset Current	$V_{CM} = 0V$			
		LMP8671/4	11	± 50 ± 95	nA (max)
		$V_{CM} = 0V$			
	LMP8672	25	± 100 ± 125	nA (max)	
$\Delta I_{OS}/\Delta Temp$	Input Bias Current Drift vs Temperature	$-40^\circ C \leq T_A \leq 125^\circ C$	0.2		nA/°C
V_{IN-CM}	Common-Mode Input Voltage Range		+17.1 -16.9		V (min) V (min)
Z_{IN}	Differential Input Impedance		30		k Ω
	Common Mode Input Impedance	$-10V < V_{cm} < 10V$	1000		M Ω
e_n	Equivalent Input Noise Voltage	20Hz to 20kHz	0.34	0.65	μV_{RMS} (max)
	Equivalent Input Noise Density	$f = 1kHz$	2.5	4.7	nV/ \sqrt{Hz} (max)
i_n	Current Noise Density	$f = 1kHz$ $f = 10Hz$	1.6 3.1		pA/ \sqrt{Hz}
THD+N	Total Harmonic Distortion + Noise	$A_V = 1$, $V_{OUT} = 3V_{rms}$, $R_L = 600\Omega$	0.00003	0.00009	% (max)
t_s	Settling time	$A_V = -1$, 10V step, $C_L = 100pF$ 0.1% error range	1.2		μs
GBWP	Gain Bandwidth Product		55	45	MHz (min)
SR	Slew Rate		± 20	± 15	V/ μs (min)
PSRR	Average Input Offset Voltage Shift vs Power Supply Voltage	See ⁽⁴⁾	125	110 100	dB (min)
CMRR	Common-Mode Rejection	$-15V \leq V_{cm} \leq 15V$	115	105 100	dB (min)
A_{VOL}	Open Loop Voltage Gain	$-15V \leq V_{out} \leq 15V$ $R_L = 2k\Omega$	135	125	dB (min)
V_{OUTMAX}	Maximum Output Voltage Swing	$R_L = 2k\Omega$	± 19.0	± 18.8 ± 18.6	V (min)
I_{OUT-CC}	Instantaneous Short Circuit Current		+53 -42		mA

(1) "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur, including inoperability and degradation of device reliability and/or performance. Functional operation of the device and/or non-degradation at the Absolute Maximum Ratings or other conditions beyond those indicated in the Recommended Operating Conditions is not implied. The Recommended Operating Conditions indicate conditions at which the device is functional and the device should not be operated beyond such conditions. All voltages are measured with respect to the ground pin, unless otherwise specified.

(2) Typical values represent most likely parametric norms at $T_A = +25^\circ C$, and at the Recommended Operation Conditions at the time of product characterization and are not ensured.

(3) Datasheet min/max specification limits are ensured by test or statistical analysis.

(4) PSRR is measured as follows: For V_S , V_{OS} is measured at two supply voltages, $\pm 5V$ and $\pm 20V$, $PSRR = |20 \log(\Delta V_{OS}/\Delta V_S)|$.

Electrical Characteristics for the LMP8671/2/4⁽¹⁾ (continued)

The following specifications apply for $V_S = \pm 20V$, $R_L = 2k\Omega$, $R_{SOURCE} = 10\Omega$, $f_{IN} = 1kHz$, $T_A = 25^\circ C$, unless otherwise specified. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	LMP8671/2/4		Units (Limits)
			Typical ⁽²⁾	Limit ⁽³⁾	
R_{OUT}	Output Impedance	$f_{IN} = 10kHz$ Closed-Loop Open-Loop	0.01 13		Ω
I_{OUT}	Output Current	$R_L = 2k\Omega$	9.5	9.3	mA (min)
I_S	Total Quiescent Current	$I_{OUT} = 0mA$			
		LMP8671	5	6 8	mA (max)
		LMP8672	12.5	16	mA (max)
		LMP8674	20	22	mA (max)

Typical Performance Characteristics

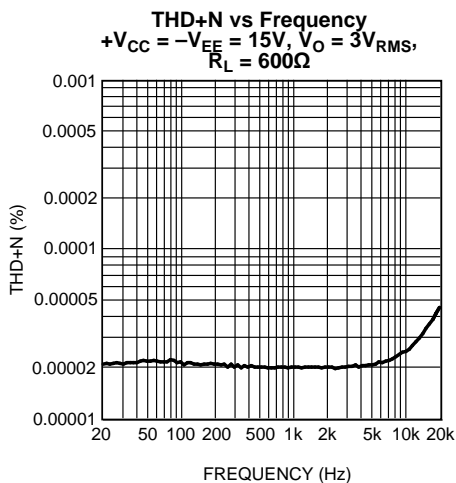


Figure 4.

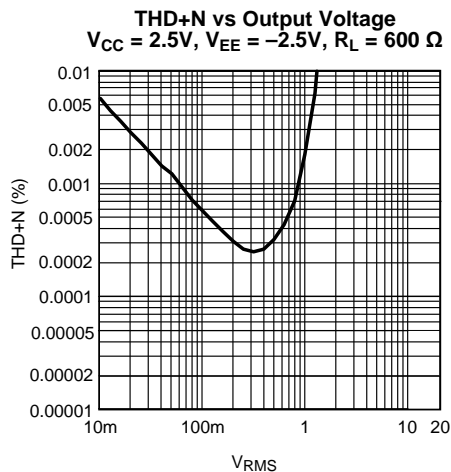


Figure 5.

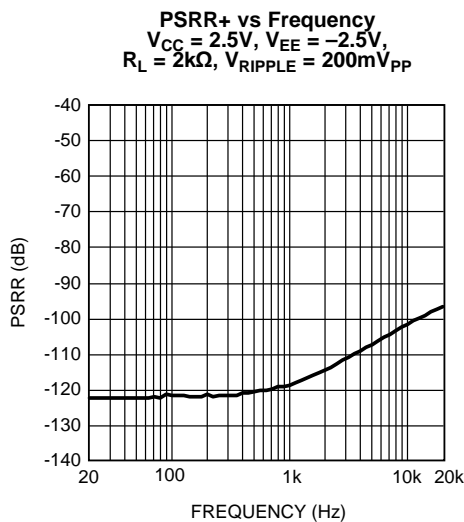


Figure 6.

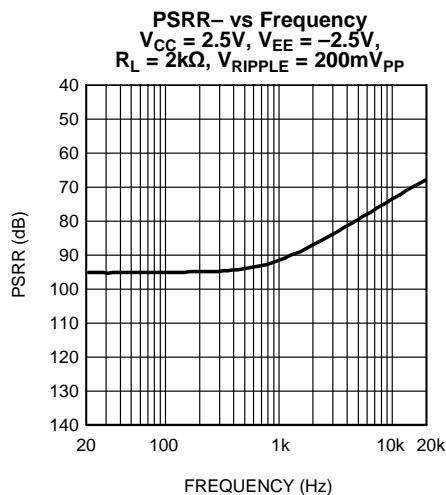


Figure 7.

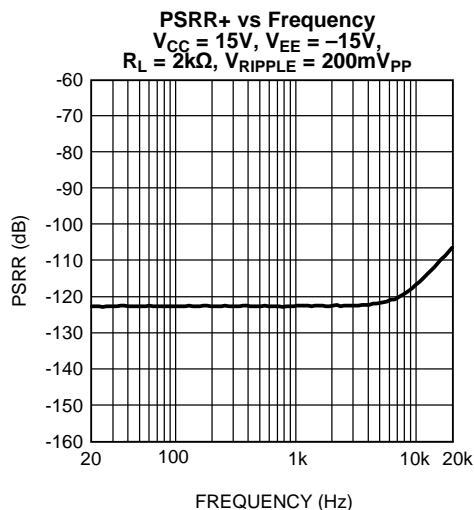


Figure 8.

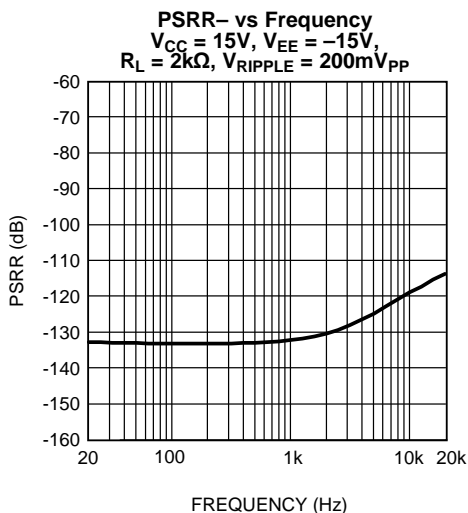


Figure 9.

Typical Performance Characteristics (continued)

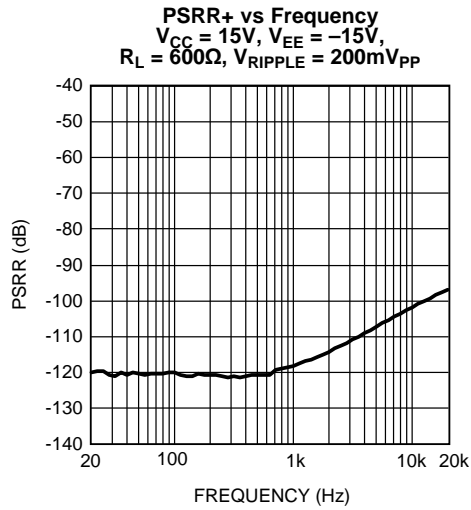


Figure 10.

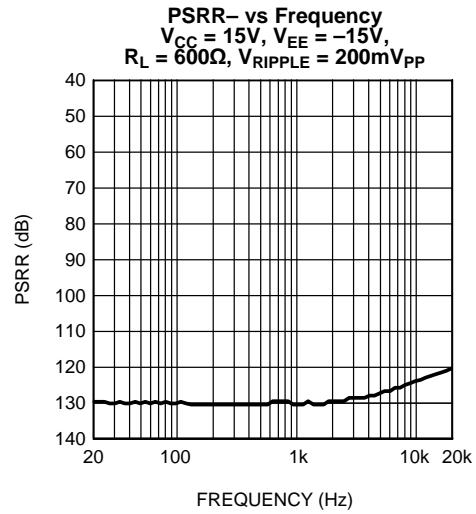


Figure 11.

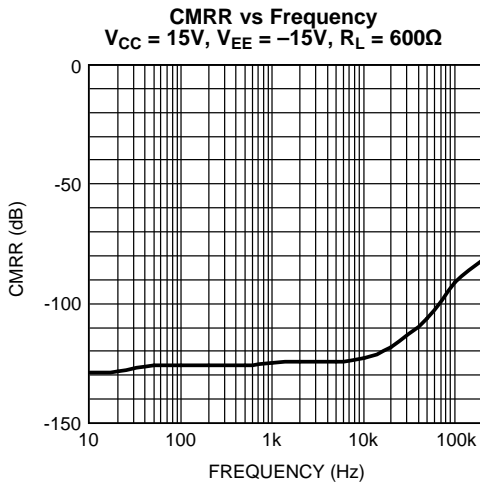


Figure 12.

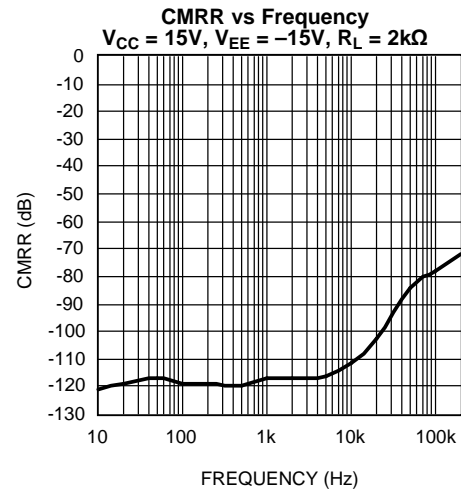


Figure 13.

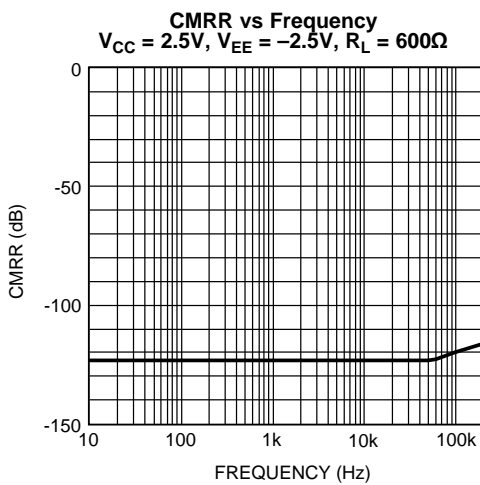


Figure 14.

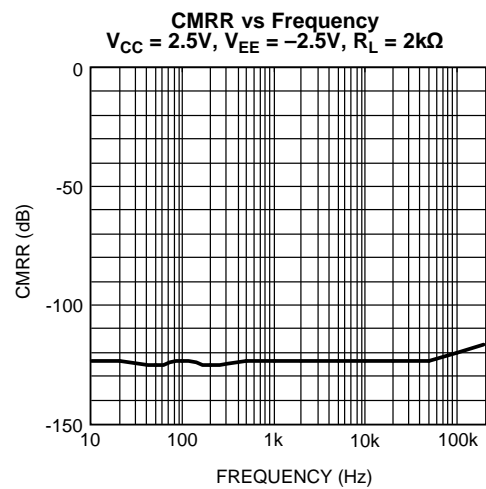


Figure 15.

Typical Performance Characteristics (continued)

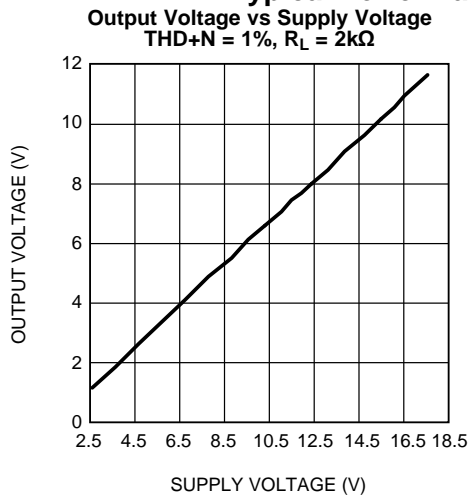


Figure 16.

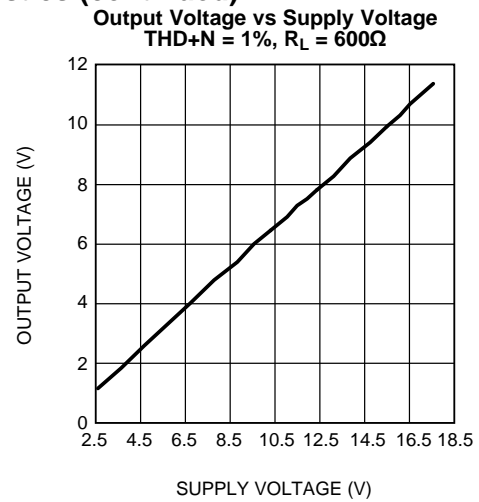


Figure 17.

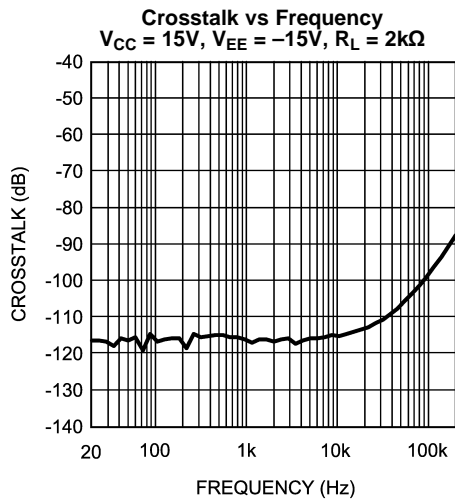


Figure 18.

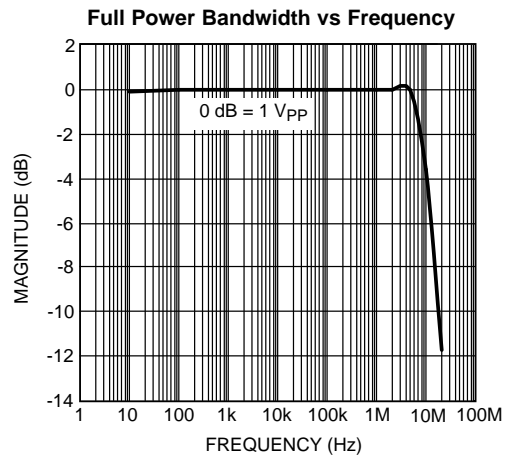


Figure 19.

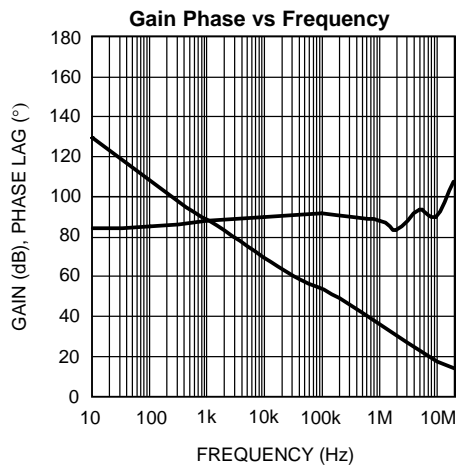


Figure 20.

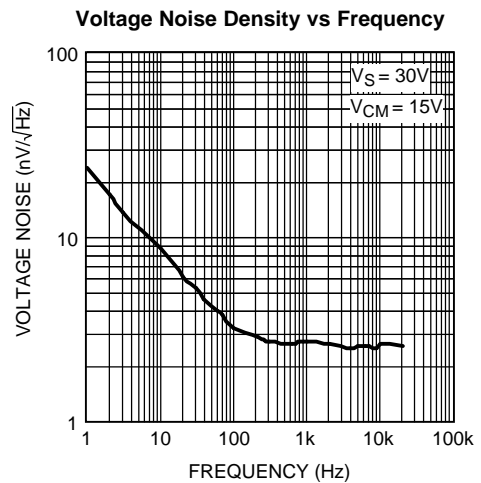


Figure 21.

Typical Performance Characteristics (continued)

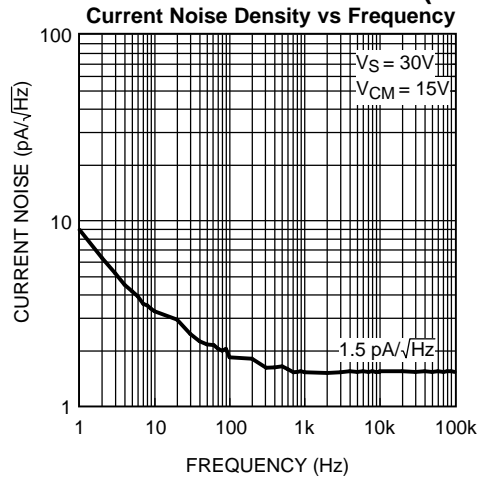


Figure 22.

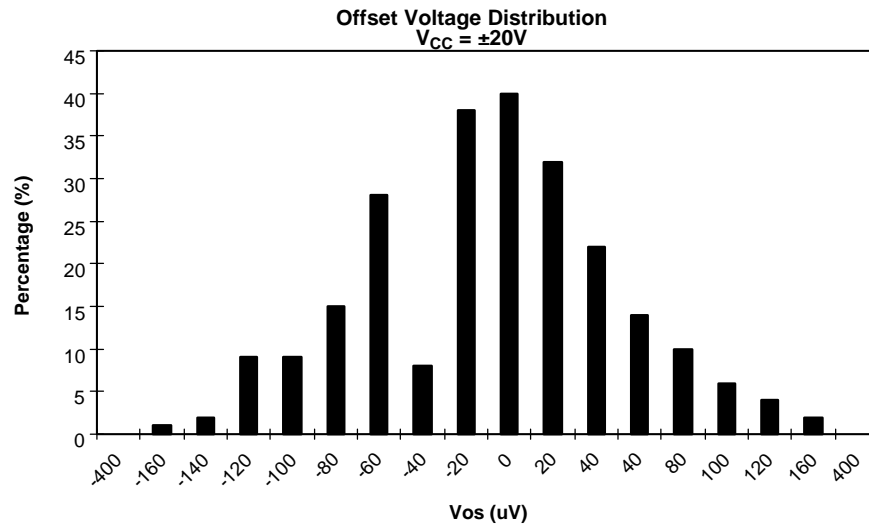


Figure 23.

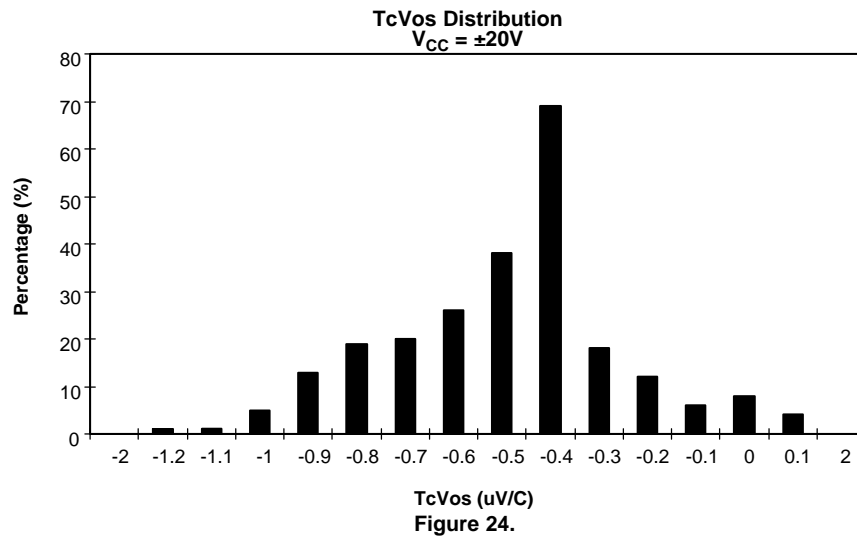


Figure 24.

REVISION HISTORY

Changes from Revision A (March 2013) to Revision B	Page
<hr/> <ul style="list-style-type: none">• Changed layout of National Data Sheet to TI format <hr/>	<hr/> 8 <hr/>

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LMP8671MA/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LMP86 71MA	Samples
LMP8671MAX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LMP86 71MA	Samples
LMP8672MA/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LMP86 72MA	Samples
LMP8672MAX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LMP86 72MA	Samples
LMP8674MA/NOPB	ACTIVE	SOIC	D	14	55	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LMP8674 MA	Samples
LMP8674MAX/NOPB	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LMP8674 MA	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.

OBSELETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMP8671MAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LMP8672MAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LMP8674MAX/NOPB	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMP8671MAX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LMP8672MAX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LMP8674MAX/NOPB	SOIC	D	14	2500	367.0	367.0	35.0

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

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