National Semiconductor

LMH6624/LMH6626
Single/Dual Ultra Low Noise Wideband Operational Amplifier

General Description

The LMH6624/LMH6626 offer wide bandwidth (1.5GHz for single, 1.3GHz for dual) with very low input noise (0.92nV/$\sqrt{Hz}$, 2.3pA/$\sqrt{Hz}$) and ultra low dc errors (100µV V_{OS}, ±0.1µV/˚C drift) providing very precise operational amplifiers with wide dynamic range. This enables the user to achieve closed-loop gains of greater than 10, in both inverting and non-inverting configurations.

The LMH6624 (single) and LMH6626's (dual) traditional voltage feedback topology provide the following benefits: balanced inputs, low offset voltage and offset current, very low offset drift, 81dB open loop gain, 95dB common mode rejection ratio, and 88dB power supply rejection ratio.

The LMH6624/LMH6626 operate from ± 2.5V to ± 6V in dual supply mode and from +5V to +12V in single supply configuration.

LMH6624 is offered in SOT23-5 and SOIC-8 packages.

The LMH6626 is offered in SOIC-8 and MSOP-8 packages.

Features

V_S = ±6V, T_A = 25˚C, A_V = 20, (Typical values unless specified)

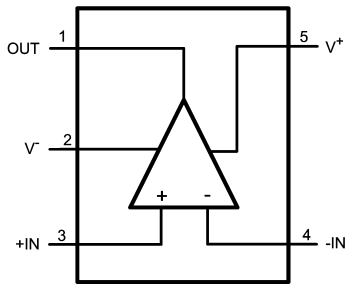
- Gain bandwidth (LMH6624) 1.5GHz
- Input voltage noise 0.92nV/$\sqrt{Hz}$
- Input offset voltage (limit over temp) 700uV
- Slew rate 350V/µs
- Slew rate (A_V = 10) 400V/µs
- HD2 @ f = 10MHz, R_L = 100Ω –63dBc
- HD3 @ f = 10MHz, R_L = 100Ω –80dBc
- Supply voltage range (dual supply) ±2.5V to ±6V
- Supply voltage range (single supply) +5V to +12V
- Improved replacement for the CLC425 (LMH6624)
- Stable for closed loop $|A_V| \geq 10$

Applications

- Instrumentation sense amplifiers
- Ultrasound pre-amps
- Magnetic tape & disk pre-amps
- Wide band active filters
- Professional Audio Systems
- Opto-electronics
- Medical diagnostic systems

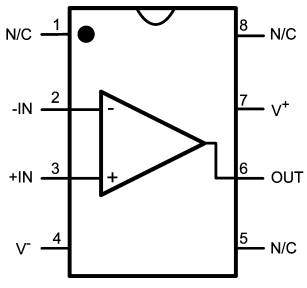
Connection Diagrams

5-Pin SOT23



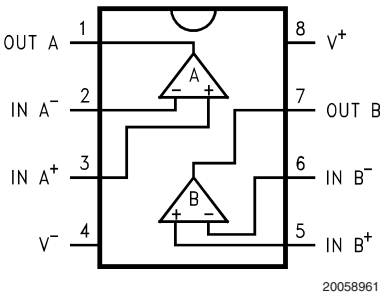
Top View

8–Pin SOIC



Top View

8–Pin SOIC/MSOP



Top View

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

ESD Tolerance	
Human Body Model	2000V (Note 2)
Machine Model	200V (Note 9)
V_{IN} Differential	±1.2V
Supply Voltage (V^+ - V^-)	13.2V
Voltage at Input pins	V^+ +0.5V, V^- –0.5V
Soldering Information	
Infrared or Convection (20 sec.)	235˚C
Wave Soldering (10 sec.)	260˚C
Storage Temperature Range	–65˚C to +150˚C
Junction Temperature (Note 3), (Note 4)	+150˚C

Operating Ratings (Note 1)

Operating Temperature Range (Note 3), (Note 4)	–40˚C to +125˚C
Package Thermal Resistance (θ_{JA})(Note 4)	
SOIC-8	166˚C/W
SOT23–5	265˚C/W
MSOP-8	235˚C/W

±2.5V Electrical Characteristics

Unless otherwise specified, all limits guaranteed at T_A = 25˚C, V^+ = 2.5V, V^- = –2.5V, V_{CM} = 0V, A_V = +20, R_F = 500Ω, R_L = 100Ω. **Boldface** limits apply at the temperature extremes. See (Note 12).

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
Dynamic Performance						
f_{CL}	–3dB BW	V_O = 400mV$_{PP}$ (LMH6624)		90		MHz
		V_O = 400mV$_{PP}$ (LMH6626)		80		
SR	Slew Rate(Note 8)	V_O = 2V$_{PP}$, A_V = +20 (LMH6624)		300		V/µs
		V_O = 2V$_{PP}$, A_V = +20 (LMH6626)		290		
		V_O = 2V$_{PP}$, A_V = +10 (LMH6624)		360		
		V_O = 2V$_{PP}$, A_V = +10 (LMH6626)		340		
t_r	Rise Time	V_O = 400mV Step, 10% to 90%		4.1		ns
t_f	Fall Time	V_O = 400mV Step, 10% to 90%		4.1		ns
t_s	Settling Time 0.1%	V_O = 2V$_{PP}$ (Step)		20		ns
Distortion and Noise Response						
e_n	Input Referred Voltage Noise	f = 1MHz (LMH6624)		0.92		nV/$\sqrt{Hz}$
		f = 1MHz (LMH6626)		1.0		
i_n	Input Referred Current Noise	f = 1MHz (LMH6624)		2.3		pA/$\sqrt{Hz}$
		f = 1MHz (LMH6626)		1.8		
HD2	2nd Harmonic Distortion	f_C = 10MHz, V_O = 1V$_{PP}$, R_L 100Ω		–60		dBc
HD3	3rd Harmonic Distortion	f_C = 10MHz, V_O = 1V$_{PP}$, R_L 100Ω		–76		dBc
Input Characteristics						
V_{OS}	Input Offset Voltage	V_{CM} = 0V	–0.75 **–0.95**	–0.25	+0.75 **+0.95**	mV
	Average Drift (Note 7)	V_{CM} = 0V		±0.25		µV/˚C
I_{OS}	Input Offset Current	V_{CM} = 0V	–1.5 **–2.0**	–0.05	+1.5 **+2.0**	µA
	Average Drift (Note 7)	V_{CM} = 0V		2		nA/˚C
I_B	Input Bias Current	V_{CM} = 0V		13	+20 **+25**	µA
	Average Drift (Note 7)	V_{CM} = 0V		12		nA/˚C
R_{IN}	Input Resistance (Note 10)	Common Mode		6.6		MΩ
		Differential Mode		4.6		kΩ
C_{IN}	Input Capacitance (Note 10)	Common Mode		0.9		pF
		Differential Mode		2.0		
CMRR	Common Mode Rejection Ratio	Input Referred, V_{CM} = –0.5 to +1.9V **V_{CM} = –0.5 to +1.75V**	 87 **85**	 90		dB

±2.5V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed at T_A = 25˚C, V^+ = 2.5V, V^- = −2.5V, V_{CM} = 0V, A_V = +20, R_F = 500Ω, R_L = 100Ω. **Boldface** limits apply at the temperature extremes. See (Note 12).

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
Transfer Characteristics						
A_{VOL}	Large Signal Voltage Gain	(LMH6624) R_L = 100Ω, V_O = −1V to +1V	75 **70**	79		dB
		(LMH6626) R_L = 100Ω, V_O = −1V to +1V	72 **67**	79		
X_t	Crosstalk Rejection	f = 1MHz (LMH6626)		−75		dB
Output Characteristics						
V_O	Output Swing	R_L = 100Ω	±1.1 **±1.0**	±1.5		V
		No Load	±1.4 **±1.25**	±1.7		
R_O	Output Impedance	f ≤ 100KHz		10		mΩ
I_{SC}	Output Short Circuit Current	(LMH6624) Sourcing to Ground ΔV_{IN} = 200mV (Note 3), (Note 11)	90 **75**	145		mA
		(LMH6624) Sinking to Ground ΔV_{IN} = −200mV (Note 3), (Note 11)	90 **75**	145		
		(LMH6626) Sourcing to Ground ΔV_{IN} = 200mV (Note 3),(Note 11)	60 **50**	120		
		(LMH6626) Sinking to Ground ΔV_{IN} = −200mV (Note 3),(Note 11)	60 **50**	120		
I_{OUT}	Output Current	(LMH6624) Sourcing, V_O = +0.8V Sinking, V_O = −0.8V		100		mA
		(LMH6626) Sourcing, V_O = +0.8V Sinking, V_O = −0.8V		75		
Power Supply						
PSRR	Power Supply Rejection Ratio	V_S = ±2.0V to ±3.0V	82 **80**	90		dB
I_S	Supply Current (per channel)	No Load		11.4	16 **18**	mA

±6V Electrical Characteristics

Unless otherwise specified, all limits guaranteed at T_A = 25˚C, V^+ = 6V, V^- = −6V, V_{CM} = 0V, A_V = +20, R_F = 500Ω, R_L = 100Ω. **Boldface** limits apply at the temperature extremes. See (Note 12).

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
Dynamic Performance						
f_{CL}	−3dB BW	V_O = 400mV$_{PP}$ (LMH6624)		95		MHz
		V_O = 400mV$_{PP}$ (LMH6626)		85		
SR	Slew Rate (Note 8)	V_O = 2V$_{PP}$, A_V = +20 (LMH6624)		350		V/µs
		V_O = 2V$_{PP}$, A_V = +20 (LMH6626)		320		
		V_O = 2V$_{PP}$, A_V = +10 (LMH6624)		400		
		V_O = 2V$_{PP}$, A_V = +10 (LMH6626)		360		
t_r	Rise Time	V_O = 400mV Step, 10% to 90%		3.7		ns

±6V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed at T_A = 25˚C, V^+ = 6V, V^- = −6V, V_{CM} = 0V, A_V = +20, R_F = 500Ω, R_L = 100Ω. **Boldface** limits apply at the temperature extremes. See (Note 12).

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
t_f	Fall Time	V_O = 400mV Step, 10% to 90%		3.7		ns
t_s	Settling Time 0.1%	V_O = $2V_{PP}$ (Step)		18		ns
Distortion and Noise Response						
e_n	Input Referred Voltage Noise	f = 1MHz (LMH6624)		0.92		$nV/\sqrt{Hz}$
		f = 1MHz (LMH6626)		1.0		
i_n	Input Referred Current Noise	f = 1MHz (LMH6624)		2.3		$pA/\sqrt{Hz}$
		f = 1MHz (LMH6626)		1.8		
HD2	2nd Harmonic Distortion	f_C = 10MHz, V_O = $1V_{PP}$, R_L 100Ω		−63		dBc
HD3	3rd Harmonic Distortion	f_C = 10MHz, V_O = $1V_{PP}$, R_L 100Ω		−80		dBc
Input Characteristics						
V_{OS}	Input Offset Voltage	V_{CM} = 0V	−0.5 **−0.7**	±0.10	+0.5 **+0.7**	mV
	Average Drift (Note 7)	V_{CM} = 0V		±0.2		µV/˚C
I_{OS}	Input Offset Current Average Drift (Note 7)	(LMH6624) V_{CM} = 0V	−1.1 **−2.5**	0.05	1.1 **2.5**	µA
		(LMH6626) V_{CM} = 0V	−2.0 **−2.5**	0.1	2.0 **2.5**	
		V_{CM} = 0V		0.7		nA/˚C
I_B	Input Bias Current	V_{CM} = 0V		13	+20 **+25**	µA
	Average Drift (Note 7)	V_{CM} = 0V		12		nA/˚C
R_{IN}	Input Resistance (Note 10)	Common Mode		6.6		MΩ
		Differential Mode		4.6		kΩ
C_{IN}	Input Capacitance (Note 10)	Common Mode		0.9		pF
		Differential Mode		2.0		
CMRR	Common Mode Rejection Ratio	Input Referred, V_{CM} = −4.5 to +5.25V **V_{CM} = −4.5 to +5.0V**	 90 **87**	 95		dB
Transfer Characteristics						
A_{VOL}	Large Signal Voltage Gain	(LMH6624) R_L = 100Ω, V_O = −3V to +3V	77 **72**	81		dB
		(LMH6626) R_L = 100Ω, V_O = −3V to +3V	74 **70**	80		
X_t	Crosstalk Rejection	f = 1MHz (LMH6626)		−75		dB
Output Characteristics						
V_O	Output Swing	(LMH6624) R_L = 100Ω	±4.4 **±4.3**	±4.9		V
		(LMH6624) No Load	±4.8 **±4.65**	±5.2		
		(LMH6626) R_L = 100Ω	±4.3 **±4.2**	±4.8		
		(LMH6626) No Load	±4.8 **±4.65**	±5.2		
R_O	Output Impedance	f ≤ 100KHz		10		mΩ

±6V Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed at T_A = 25˚C, V^+ = 6V, V^- = −6V, V_{CM} = 0V, A_V = +20, R_F = 500Ω, R_L = 100Ω. **Boldface** limits apply at the temperature extremes. See (Note 12).

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
I_{SC}	Output Short Circuit Current	(LMH6624) Sourcing to Ground ΔV_{IN} = 200mV (Note 3), (Note 11)	100 **85**	156		mA
		(LMH6624) Sinking to Ground ΔV_{IN} = −200mV (Note 3), (Note 11)	100 **85**	156		
		(LMH6626) Sourcing to Ground ΔV_{IN} = 200mV (Note 3), (Note 11)	65 **55**	120		
		(LMH6626) Sinking to Ground ΔV_{IN} = −200mV (Note 3), (Note 11)	65 **55**	120		
I_{OUT}	Output Current	(LMH6624) Sourcing, V_O = +4.3V Sinking, V_O = −4.3V		100		mA
		(LMH6626) Sourcing, V_O = +4.3V Sinking, V_O = −4.3V		80		
Power Supply						
PSRR	Power Supply Rejection Ratio	V_S = ±5.4V to ±6.6V	82 **80**	88		dB
I_S	Supply Current (per channel)	No Load		12	16 **18**	mA

Note 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 and the test conditions, see the Electrical Characteristics.

Note 2: Human body model, 1.5kΩ in series with 100pF.

Note 3: Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150˚C.

Note 4: The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/\theta_{JA}$. All numbers apply for packages soldered directly onto a PC board.

Note 5: Typical Values represent the most likely parametric norm.

Note 6: All limits are guaranteed by testing or statistical analysis.

Note 7: Average drift is determined by dividing the change in parameter at temperature extremes into the total temperature change.

Note 8: Slew rate is the slowest of the rising and falling slew rates.

Note 9: Machine Model, 0Ω in series with 200pF.

Note 10: Simulation results.

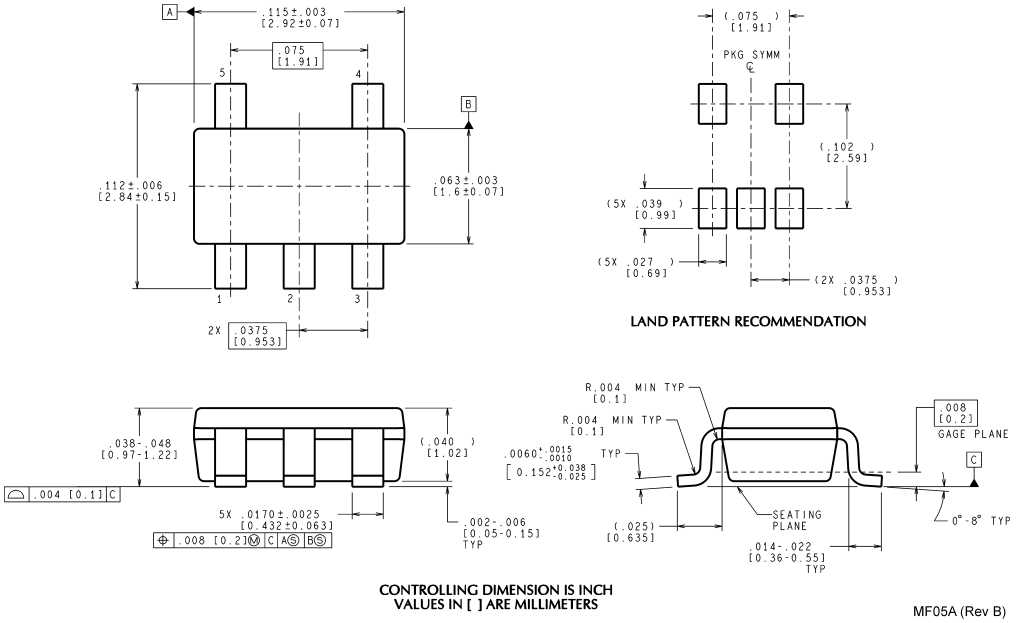
Note 11: Short circuit test is a momentary test. Output short circuit duration is 1.5ms.

Note 12: 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 $T_J > T_A$. Absolute maximum ratings indicate junction temperature limits beyond which the device may be permanently degraded, either mechanically or electrically.

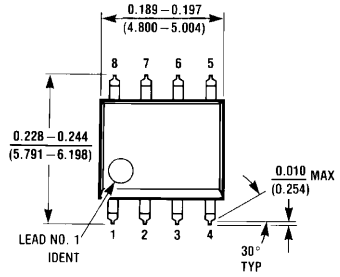
Ordering Information

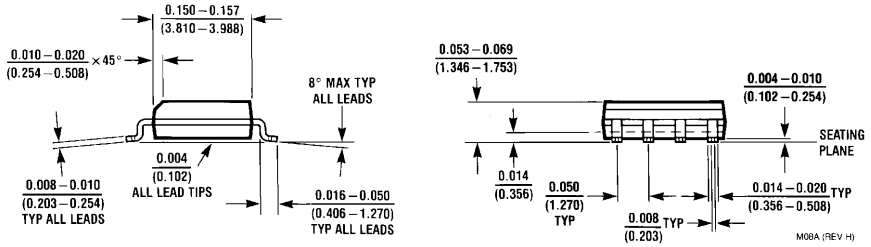
Package	Part Number	Package Marking	Transport Media	NSC Drawing
SOT23-5	LMH6624MF	A94A	1k Units Tape and Reel	MF05A
	LMH6624MFX		3k Units Tape and Reel	
SOIC-8	LMH6624MA	LMH6624MA	95 Units/Rail	M08A
	LMH6624MAX		2.5k Units Tape and Reel	
SOIC-8	LMH6626MA	LMH6626MA	95 Units/Rail	M08A
	LMH6626MAX		2.5k Units Tape and Reel	
MSOP-8	LMH6626MM	A98A	1k Units Tape and Reel	MUA08A
	LMH6626MMX		3.5k Units Tape and Reel	

Physical Dimensions inches (millimeters) unless otherwise noted



5-Pin SOT23
NS Package Number MF05A





8-Pin SOIC
NS Package Number M08A