National Semiconductor

PRELIMINARY
March 2006

LMV654
Quad, 12 MHz, Low Voltage, Low Power Amplifier

General Description

National's LMV654 is a high performance, low power quad operational amplifier IC implemented with National's advanced VIP50 process. The LMV654 features 12 MHz of bandwidth while consuming only 119 µA of current per amplifier, which is an exceptional bandwidth to power ratio in this op amp class. The LMV654 is unity gain stable and provides an excellent solution for general purpose amplification in low voltage, low power applications.

The LMV654 provides superior performance and economy in terms of power and space usage. The LMV654 has a maximum input offset voltage of 1.8 mV, a rail-to-rail output stage and an input common-mode voltage range that includes ground. The LMV654 provides a PSRR of 95 dB, a CMRR of 100 dB and a total harmonic distortion (THD) of 0.003% at 1 kHz frequency and 600Ω load

The LMV654 has an operating supply voltage range from 2.7V to 5.5V. The LMV654 can operate over a wide temperature range (–40˚C to +125˚C) making the op amp ideal for automotive applications, sensor applications and portable equipment applications. The LMV654 is offered in the 14-pin TSSOP package

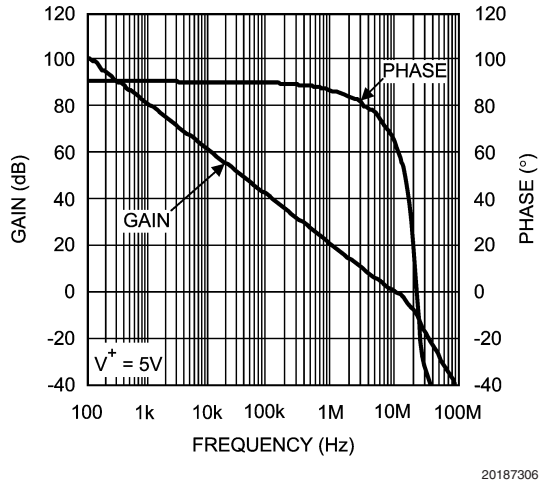
Features

(Typical 5V supply, unless otherwise noted)

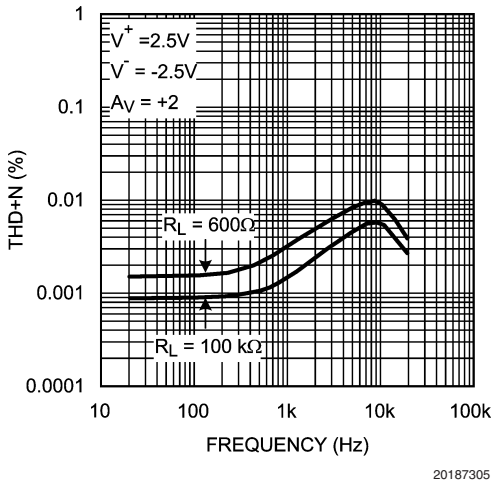
- Guaranteed 3.0V and 5.0V performance
- High unity gain bandwidth — 12 MHz
- Low power supply current — 119 µA per amplifier
- Max input offset voltage — 1.8 mV
- CMRR — 100 dB
- PSRR — 95 dB
- Input referred voltage noise — 17nV/$\sqrt{\text{Hz}}$
- Output swing with 2 kΩ load — 120 mV from rail
- Total harmonic distortion — 0.003% @ 1 kHz, 600Ω
- Temperature range — –40˚C to 125˚C

Applications

- Portable equipment
- Automotive
- Battery powered systems
- Sensors and Instrumentation



Open Loop Gain and phase vs. Frequency



THD+N vs. Frequency

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 (Note 2)	
Human Body Model	2000V
Machine Model	100V
Differential Input V_{ID}	±0.3V
Supply Voltage ($V_S = V^+ - V^-$)	6V
Input/Output Pin Voltage	V^+ +0.3V, V^- −0.3V
Storage Temperature Range	−65˚C to +150˚C
Junction Temperature (Note 3)	+150˚C
Soldering Information	
Infrared or Convection (20 sec)	235˚C
Wave Soldering Lead Temp (10 sec)	260˚C

Operating Ratings (Note 1)

Temperature Range	−40˚C to 125˚C
Supply Voltage	2.7V to 5.5V
Package Thermal Resistance (θ_{JA})(Note 3)	
14-Pin TSSOP	TBD˚C/W

3V DC Electrical Characteristics

Unless otherwise specified, all limits are guaranteed for T_A = 25˚C, V^+ = 3V, V^- = 0V, $V_O = V_{CM} = V^+/2$, and R_L > 1 MΩ. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
V_{OS}	Input Offset Voltage			−0.1	±1.8	mV
TC V_{OS}	Input Offset Average Drift			6.6		µV/˚C
I_B	Input Bias Current	(Note 6)		80	120	nA
I_{OS}	Input Offset Current			2.2	15	nA
CMRR	Common Mode Rejection Ratio	$0 \le V_{CM} \le 2.0$ V	87	100		dB
PSRR	Power Supply Rejection Ratio	$3.0 \le V^+ \le 5$V, V_{CM} = 0.5	87	95		dB
		$2.7 \le V^+ \le 5.5$V, V_{CM} = 0.5	87	95		
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 75 dB	0		2.1	V
A_{VOL}	Large Signal Voltage Gain	$0.3 \le V_O \le 2.7$, R_L = 2 kΩ to $V^+/2$	80	85		dB
		$0.3 \le V_O \le 2.7$, R_L = 10 kΩ to $V^+/2$	86	93		
V_O	Output Swing High	R_L = 2 kΩ to $V^+/2$		80	95	mV from rail
		R_L = 10 kΩ to $V^+/2$		45	50	
	Output Swing Low	R_L = 2 kΩ to $V^+/2$		95	110	
		R_L = 10 kΩ to $V^+/2$		60	65	
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$ V_{ID}= 100 mV (Note 8)	14	17		mA
		Sinking from $V^+/2$ V_{ID} = −100 mV (Note 8)	45	50		
I_S	Supply Current per Amplifier			119		µA
SR	Slew Rate	A_V = +1, 10% to 90% (Note 7)		3.3		V/µs
GBW	Gain Bandwidth Product			12		MHz
e_n	Input-Referred Voltage Noise	f = 100 kHz		17		nV/$\sqrt{Hz}$
		f = 1 kHz		17		
i_n	Input-Referred Current Noise	f = 100 kHz		0.15		pA/$\sqrt{Hz}$
		f = 1 kHz		0.1		
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 2, R_L = 600Ω		0.003		%

5V DC Electrical Characteristics

Unless otherwise specified, all limits are guaranteed for T_J = 25˚C, V^+ = 5V, V^- = 0V, $V_O = V_{CM} = V^+/2$, and R_L > 1 MΩ. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
V_{OS}	Input Offset Voltage			−0.1	±1.8	mV
TC V_{OS}	Input Offset Average Drift			6.6		µV/˚C
I_B	Input Bias Current	(Note 6)		80	120	nA
I_{OS}	Input Offset Current			2.2	15	nA
CMRR	Common Mode Rejection Ratio	$0 \le V_{CM} \le 4.0$ V	90	100		dB
PSRR	Power Supply Rejection Ratio	$3V \le V^+ \le 5V$, V_{CM} = 0.5V	87	95		dB
		$2.7V \le V^+ \le 5.5V$, V_{CM} = 0.5V	87	95		
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 80 dB	0		4.1	V
A_{VOL}	Large Signal Voltage Gain	$0.3 \le V_O \le 4.7V$, R_L = 2 kΩ to $V^+/2$	79	84		dB
		$0.3 \le V_O \le 4.7V$, R_L = 10 kΩ to $V^+/2$	87	94		
V_O	Output Swing High	R_L = 2 kΩ to $V^+/2$		120	140	mV from rail
		R_L = 10 kΩ to $V^+/2$		75	90	
	Output Swing Low	R_L = 2 kΩ to $V^+/2$		110	130	
		R_L = 10 kΩ to $V^+/2$		70	80	
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$ V_{ID} = 100 mV (Note 8)	15	18.5		mA
		Sinking from $V^+/2$ V_{ID} = −100 mV (Note 8)	45	50		
I_S	Supply Current per Amplifier			119		µA
SR	Slew Rate	A_V = +1, V_O = 1 V_{PP} 10% to 90% (Note 7)		3.2		V/µs
GBW	Gain Bandwidth Product			12		MHz
e_n	Input-Referred Voltage Noise	f = 100 kHz		17		nV/$\sqrt{\text{Hz}}$
		f = 1 kHz		17		
i_n	Input-Referred Current Noise	f = 100 kHz		0.1		pA/$\sqrt{\text{Hz}}$
		f = 1 kHz		0.15		
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 2, R_L = 600Ω		0.003		%

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 Tables.

Note 2: Human Body Model is 1.5 kΩ in series with 100 pF. Machine Model is 0Ω in series with 200 pF

Note 3: 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 4: Typical values represent the most likely parametric norm at the time of characterization.

Note 5: Limits are 100% production tested at 25˚C. Limits over the operating temperature range are guaranteed through correlations using Statistical Quality Control (SQC) method.

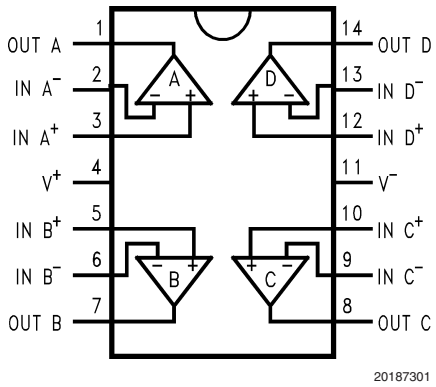
Note 6: Positive current corresponds to current flowing into the device.

Note 7: Slew rate is the average of the rising and falling slew rates.

Note 8: Short circuit test is a momentary test. Continuous source or sink currents higher than 10 mA are not recommended as they might permanently disable the part.

Connection Diagram

14-Pin TSSOP

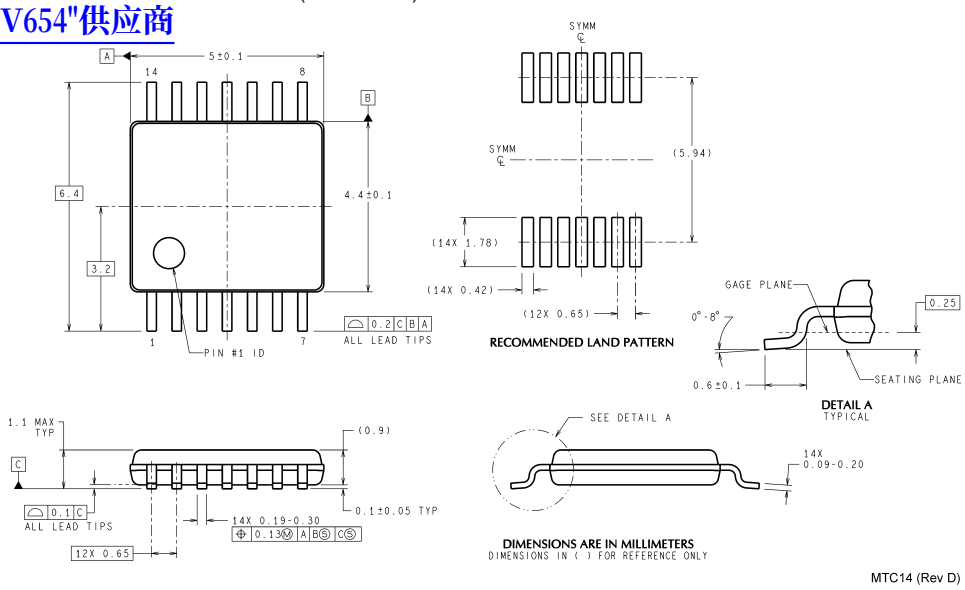


Top View

Ordering Information

Package	Part Number	Package marking	Transport Media	NSC Drawing
14-Pin TSSOP	LMV654MT	LMV654MT	94 Units/Rail	MTC14
	LMV654MTX		2.5k Units Tape and Reel	

Physical Dimensions inches (millimeters) unless otherwise noted



MTC14 (Rev D)

14-Pin TSSOP
NS Package Number MTC14

National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

www.national.com

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560