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

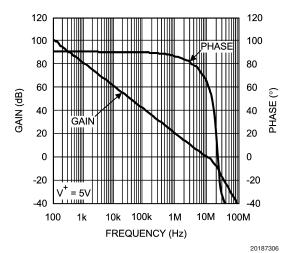
(Typical 5V supply, unless otherwise noted)

- Guaranteed 3.0V and 5.0V performance
- High unity gain bandwidth
- Low power supply current
- Max input offset voltage
- CMRR
- PSRR
- Input referred voltage noise
- Output swing with 2 kΩ load
- Total harmonic distortion
- Temperature range

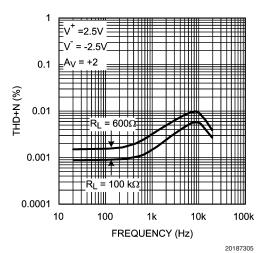
- 12 MHz
- 119 µA per amplifier
 - 1.8 mV
 - 100 dB
 - 95 dB 17nV/√Hz
 - 120 mV from rail
- 0.003% @ 1 kHz, 600Ω
 - -40°C to 125°C

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) 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 VID ±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)

-40°C to 125°C Temperature Range 2.7V to 5.5V Supply Voltage

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 $T_A = 25^{\circ}C$, $V^+ = 3V$, $V^- = 0V$, $V_O = V_{CM} = V^+/2$, and $R_L > 1$ M Ω . 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		(232 2)	-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 ≤ V _{CM} ≤ 2.0 V	87	100		dB
PSRR	Power Supply Rejection Ratio	$3.0 \le V^{+} \le 5V, V_{CM} = 0.5$	87	95		dB
		$2.7 \le V^{+} \le 5.5V, V_{CM} = 0.5$	87	95		1
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 75 dB	0		2.1	V
A _{VOL}	Large Signal Voltage Gain	$0.3 \le V_O \le 2.7$, $R_L = 2 \text{ k}\Omega$ to $V^+/2$	80	85		dB
		$0.3 \le V_O \le 2.7$, $R_L = 10 \text{ k}\Omega$ to $V^+/2$	86	93		
V _O	Output Swing High	$R_L = 2 k\Omega$ to $V^+/2$		80	95	mV from
		$R_L = 10 \text{ k}\Omega \text{ to V}^+/2$		45	50	
	Output Swing Low	$R_L = 2 k\Omega$ to $V^+/2$		95	110	rail
		$R_L = 10 \text{ k}\Omega \text{ to V}^+/2$		60	65]
I _{sc}	Output Short Circuit Current	Sourcing to V ⁺ /2 V _{ID} = 100 mV (Note 8)	14	17		
		Sinking from V ⁺ /2 $V_{ID} = -100 \text{ mV (Note 8)}$	45	50		- mA
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/ √Hz
		f = 1 kHz		17		
i _n	Input-Referred Current Noise	f = 100 kHz		0.15		pA/√Hz
		f = 1 kHz		0.1		pav v Hz
THD	Total Harmonic Distortion	$f = 1 \text{ kHz}, A_V = 2, R_L = 600\Omega$		0.003		%

www.national.com 2

5V DC Electrical Characteristics

United Type 1 M Ω (5.54" High mits are guaranteed for Type 25°C, V+ = 5V, V- = 0V, V_O = V_{CM} = V+/2, and R_L > 1 M Ω . Bold-face limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min	Тур	Max	Units	
			(Note 5)	(Note 4)	(Note 5)		
Vos	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	
Ios	Input Offset Current			2.2	15	nA	
CMRR	Common Mode Rejection Ratio	0 ≤ V _{CM} ≤ 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	$0.3 \le V_O \le 4.7V$, $R_L = 2 \text{ k}\Omega$ to $V^+/2$	79	84		dB	
		$0.3 \le V_O \le 4.7V$, $R_L = 10 \text{ k}\Omega$ to $V^+/2$	87	94			
Vo	Output Swing High	$R_L = 2 k\Omega$ to V+/2		120	140		
		$R_L = 10 \text{ k}\Omega \text{ to V}^+/2$		75	90	mV from	
	Output Swing Low	$R_L = 2 k\Omega$ to $V^+/2$		110	130	rail	
		$R_L = 10 \text{ k}\Omega \text{ to V}^+/2$		70	80]	
I _{sc}	Output Short Circuit Current	Sourcing to V ⁺ /2	15	18.5			
		V _{ID} = 100 mV (Note 8)				mA	
		Sinking from V ⁺ /2	45	50		""	
		$V_{ID} = -100 \text{ mV (Note 8)}$					
Is	Supply Current per Amplifier			119		μΑ	
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/ √Hz	
		f = 1 kHz		17			
i _n	Input-Referred Current Noise	f = 100 kHz		0.1		pA/ √Hz	
		f = 1 kHz		0.15			
THD	Total Harmonic Distortion	$f = 1 \text{ kHz}, A_V = 2, R_L = 600\Omega$		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 k Ω 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.

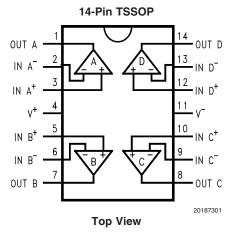
Note 5: Limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlations using Statistical Quality Control (SQC) method.

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 算询"LMV654"供应商

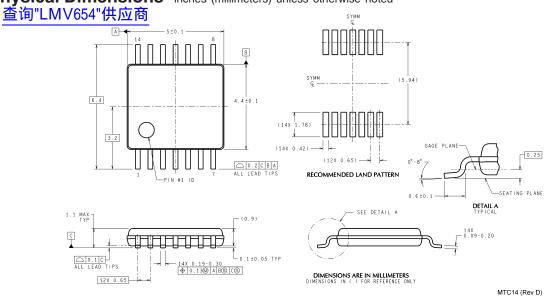


Ordering Information

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	

www.national.com

Physical Dimensions inches (millimeters) unless otherwise noted



14-Pin TSSOP NS Package Number MTC14

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
- A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor manufactures products and uses packing materials that meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.

Leadfree products are RoHS compliant.



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