National Semiconductor

LMV551/LMV552/LMV554
3 MHz, Micropower RRO Amplifiers

General Description

The LMV551/LMV552/LMV554 are high performance, low power operational amplifiers implemented with National's advanced VIP50 process. They feature 3 MHz of bandwidth while consuming only 37 µA of current per amplifier, which is an exceptional bandwidth to power ratio in this op amp class. These amplifiers are unity gain stable and provide an excellent solution for low power applications requiring a wide bandwidth.

The LMV551/LMV552/LMV554 have a rail-to-rail output stage and an input common mode range that extends below ground.

The LMV551/LMV552/LMV554 have an operating supply voltage range from 2.7V to 5.5V. These amplifiers can operate over a wide temperature range (–40°C to 125°C) making them a great choice for automotive applications, sensor applications as well as portable instrumentation applications. The LMV551 is offered in the ultra tiny 5-Pin SC70 and 5-Pin SOT-23 package. The LMV552 is offered in an 8-Pin MSOP package. The LMV554 is offered in the 14-Pin TSSOP.

Features

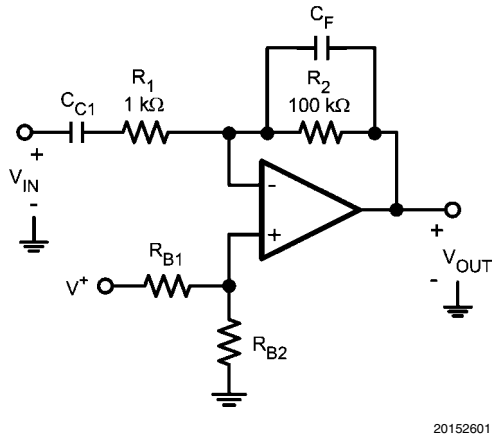
(Typical 5V supply, unless otherwise noted.)

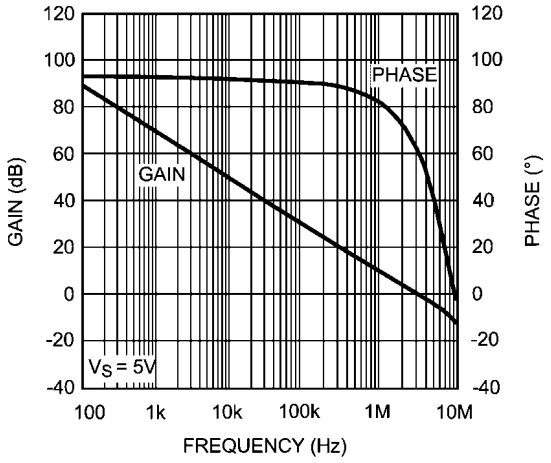
- Guaranteed 3V and 5.0V performance
- High unity gain bandwidth 3 MHz
- Supply current (per amplifier) 37 µA
- CMRR 93 dB
- PSRR 90 dB
- Slew rate 1 V/µs
- Output swing with 100 kΩ load 70 mV from rail
- Total harmonic distortion 0.003% @ 1 kHz, 2 kΩ
- Temperature range –40°C to 125°C

Applications

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

Typical Application





Open Loop Gain and Phase 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	
LMV551/LMV552/LMV554	2 KV
Machine Model	
LMV551	100V
LMV552/LMV554	250V
V_{IN} Differential (@ V^+ = 5V)	±2.5V
Supply Voltage (V^+ - V^-)	6V
Voltage at Input/Output pins	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 (Note 3)	−40°C to 125°C
Supply Voltage (V^+ – V^-)	2.7V to 5.5V
Package Thermal Resistance (θ_{JA} (Note 3))	
5-Pin SC70	456°C/W
5-Pin SOT-23	234°C/W
8-Pin MSOP	235°C/W
14-Pin TSSOP	160°C/W

3V Electrical Characteristics

Unless otherwise specified, all limits are guaranteed for T_A = 25°C, V^+ = 3V, V^- = 0V, V_{CM} = $V^+/2$ = V_O. **Boldface** limits apply at the temperature extremes. (Note 4)

Symbol	Parameter	Conditions		Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
V_{OS}	Input Offset Voltage				1	3 **4.5**	mV
TC V_{OS}	Input Offset Average Drift				3.3		µV/°C
I_B	Input Bias Current	(Note 7)			20	38	nA
I_{OS}	Input Offset Current				1	20	nA
CMRR	Common Mode Rejection Ratio	0V ≤ V_{CM} 2.0V		74 **72**	92		dB
PSRR	Power Supply Rejection Ratio	3.0 ≤ V^+ ≤ 5V, V_{CM} = 0.5V	LMV551/LMV552	80 **78**	92		dB
			LMV554	78 **76**			
		2.7 ≤ V^+ ≤ 5.5V, V_{CM} = 0.5V	LMV551/LMV552	80 **78**	92		
			LMV554	78 **76**			
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 68 dB **CMRR ≥ 60 dB**		0 **0**		2.1 **2.1**	V
A_{VOL}	Large Signal Voltage Gain	0.4 ≤ V_O ≤ 2.6, R_L = 100 kΩ to $V^+/2$	LMV551/LMV552	81 **78**	90		dB
			LMV554	79 **77**			
		0.4 ≤ V_O ≤ 2.6, R_L = 10 kΩ to $V^+/2$		71 **68**	80		
V_O	Output Swing High	R_L = 100 kΩ to $V^+/2$			40	48 **58**	mV from rail
		R_L = 10 kΩ to $V^+/2$			85	100 **120**	
	Output Swing Low	R_L = 100 kΩ to $V^+/2$			50	65 **77**	
		R_L = 10 kΩ to $V^+/2$			95	110 **130**	
I_{SC}	Output Short Circuit Current	Sourcing (Note 9)			10		mA
		Sinking (Note 9)			25		

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
I_S	Supply Current per Amplifier			34	42 **52**	µA
SR	Slew Rate	A_V = +1, 10% to 90% (Note 8)		1		V/µs
Φm	Phase Margin	R_L = 10 kΩ, C_L = 20 pF		75		Deg
GBW	Gain Bandwidth Product			3		MHz
e_n	Input-Referred Voltage Noise	f = 100 kHz		70		$nV/\sqrt{Hz}$
		f = 1 kHz		70		
i_n	Input-Referred Current Noise	f = 100 kHz		0.1		$pA/\sqrt{Hz}$
		f = 1 kHz		0.15		
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 2, R_L = 2 kΩ		0.003		%

5V Electrical Characteristics

Unless otherwise specified, all limits are guaranteed for T_A = 25°C, V^+ = 5V, V^- = 0V, $V_{CM} = V^+/2 = V_O$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
V_{OS}	Input Offset Voltage			1	3.0 **4.5**	mV
TC V_{OS}	Input Offset Average Drift			3.3		µV/°C
I_B	Input Bias Current	(Note 7)		20	38	nA
I_{OS}	Input Offset Current			1	20	nA
CMRR	Common Mode Rejection Ratio	0 ≤ V_{CM} ≤ 4.0V	76 **74**	93		dB
PSRR	Power Supply Rejection Ratio	3V ≤ V^+ ≤ 5V to V_{CM} = 0.5V	78 **75**	90		dB
		2.7V ≤ V^+ ≤ 5.5V to V_{CM} = 0.5V	78 **75**	90		
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 68 dB CMRR ≥ 60 dB	0 **0**		4.1 **4.1**	V
A_{VOL}	Large Signal Voltage Gain	0.4 ≤ V_O ≤ 4.6, R_L = 100 kΩ to $V^+/2$	78 **75**	90		dB
		0.4 ≤ V_O ≤ 4.6, R_L = 10 kΩ to $V^+/2$	75 **72**	80		
V_O	Output Swing High	R_L = 100 kΩ to $V^+/2$		70	92 **122**	mV from rail
		R_L = 10 kΩ to $V^+/2$		125	155 **210**	
	Output Swing Low	R_L = 100 kΩ to $V^+/2$		60	70 **82**	
		R_L = 10 kΩ to $V^+/2$		110	130 **155**	
I_{SC}	Output Short Circuit Current	Sourcing (Note 9)		10		mA
		Sinking (Note 9)		25		
I_S	Supply Current Per Amplifier			37	46 **54**	µA
SR	Slew Rate	A_V = +1, V_O = 1 V_{PP} 10% to 90% (Note 8)		1		V/µs
Φm	Phase Margin	R_L = 10 kΩ, C_L = 20 pF		75		Deg
GBW	Gain Bandwidth Product			3		MHz

Symbol	Parameter	Conditions	Min (Note 6)	Typ (Note 5)	Max (Note 6)	Units
e_n	Input-Referred Voltage Noise	f = 100 kHz		70		$nV/\sqrt{Hz}$
		f = 1 kHz		70		
i_n	Input-Referred Current Noise	f = 100 kHz		0.1		$pA/\sqrt{Hz}$
		f = 1 kHz		0.15		
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 2, R_L = 2 kΩ		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, applicable std. MIL-STD-883, Method 3015.7. Machine Model, applicable std. JESD22-A115-A (ESD MM std. of JEDEC) Field-Induced Charge-Device Model, applicable std. JESD22-C101-C (ESD FICDM std. of JEDEC).

Note 3: The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA}. 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: 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 $T_J > T_A$.

Note 5: Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.

Note 6: Limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlations using statistical quality control (SQC) method.

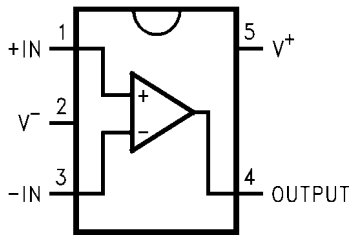
Note 7: Positive current corresponds to current flowing into the device.

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

Note 9: The part is not short circuit protected and is not recommended for operation with heavy resistive loads.

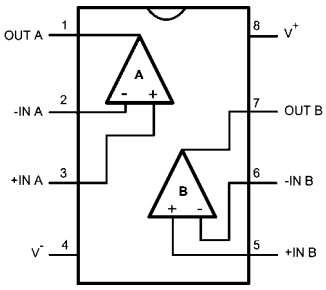
Connection Diagrams

5-Pin SC70/ SOT-23



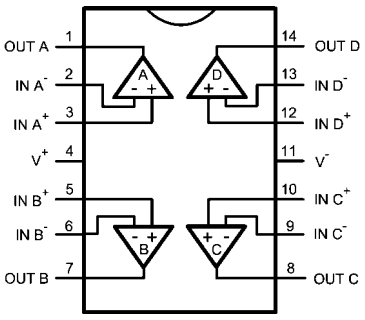
Top View

8-Pin MSOP



Top View

14-Pin TSSOP

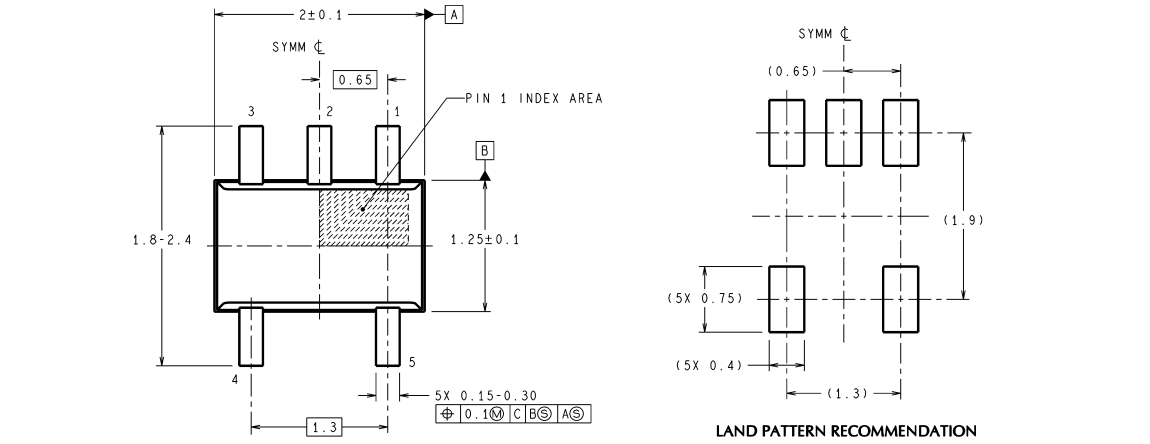


Top View

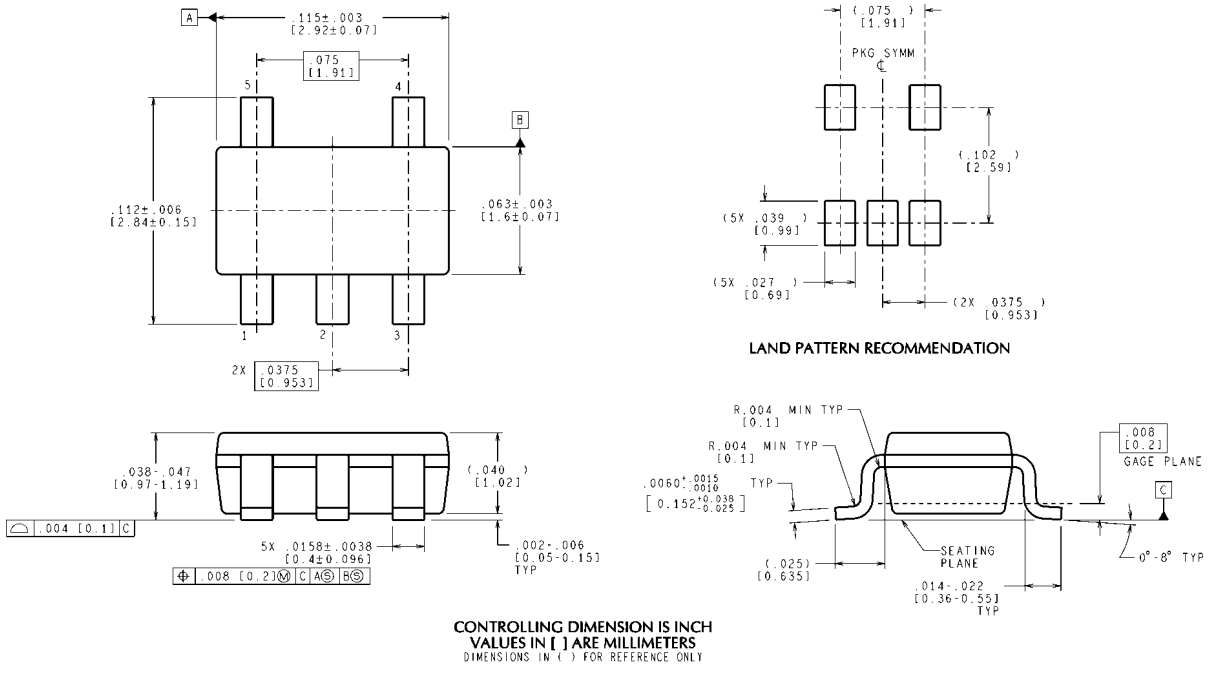
Ordering Information

Package	Part Number	Package Marking	Transport Media	NSC Drawing
5-Pin SC70	LMV551MG	A94	1k Units Tape and Reel	MAA05A
	LMV551MGX		3k Units Tape and Reel	
5-Pin SOT-23	LMV551MF	AF3A	1k Units Tape and Reel	MF05A
	LMV551MFX		3k Units Tape and Reel	
8-Pin MSOP	LMV552MM	AH3A	1k Units Tape and Reel	MUA08A
	LMV552MMX		3.5k Units Tape and Reel	
14-Pin TSSOP	LMV554MT	LMV554MT	94 Units/Rail	MTC14
	LMV554MTX		2.5k Units Tape and Reel	

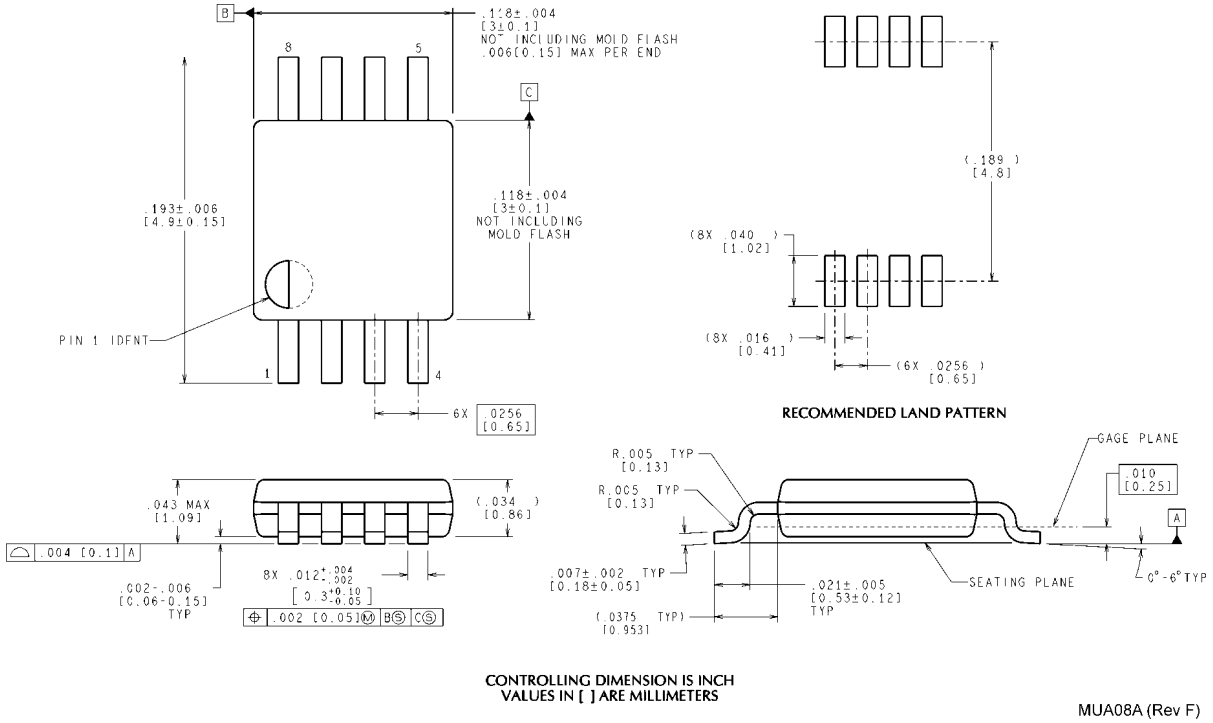
Physical Dimensions inches (millimeters) unless otherwise noted



5-Pin SC70
NS Package Number MAA05A



5-Pin SOT-23
NS Package Number MF05A



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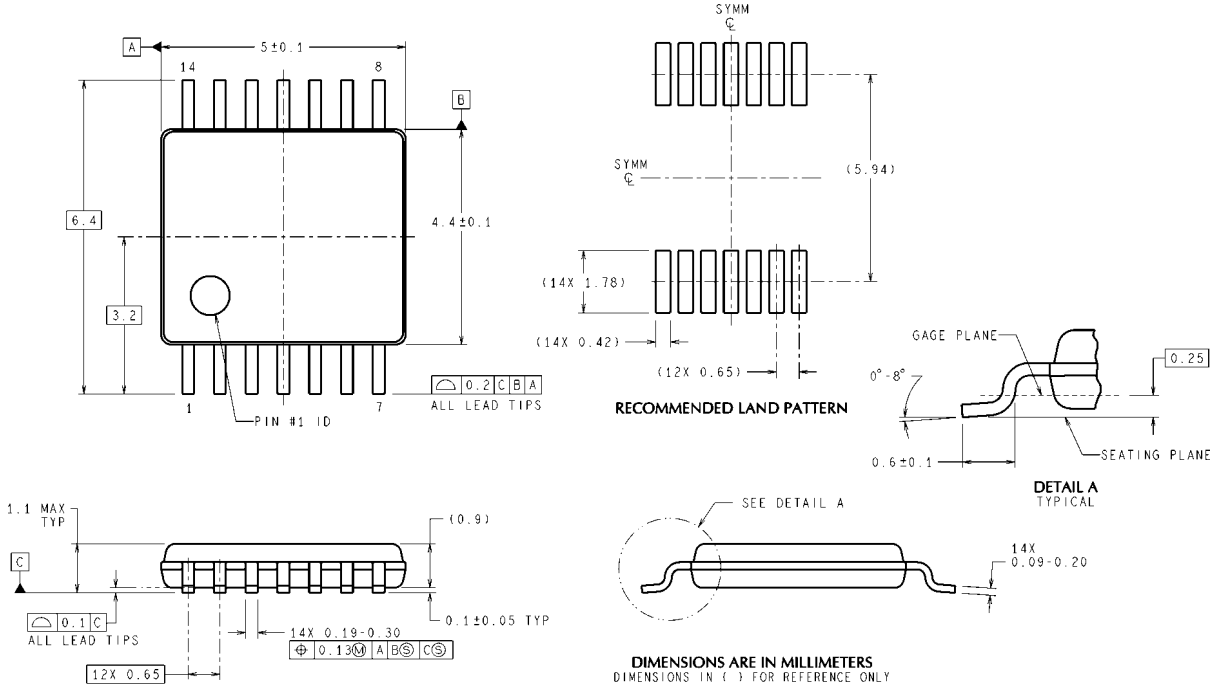
MUA08A (Rev F)

8-Pin MSOP
NS Package Number MUA08A



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MTC14 (Rev D)

14-Pin TSSOP
NS Package Number MTC14