National Semiconductor

PRELIMINARY
September 2005

LMV651
12 MHz, Low Voltage, Low Power Amplifier

General Description

National's LMV651 is a high performance, low power op amp IC implemented in National's advanced VIP50 process. The unity gain stable LMV651 features 12 MHz of bandwidth while consuming only 110 uA of current, an exceptional bandwidth to power ratio in this op amp class, and maintains stability for capacitive loads as large as 500 pF.

The LMV651 provides superior performance and economy in terms of power and space usage. The LMV651 has a maximum input offset voltage of 1 mV, a rail to rail output stage and an input common-mode voltage range that includes ground. The LMV651 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 LMV651 has an operating supply voltage range from 2.7V to 5.5V. The LMV651 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 LMV651 is available in the ultra tiny SC70-5 package, which is about half the size of the SOT23-5.

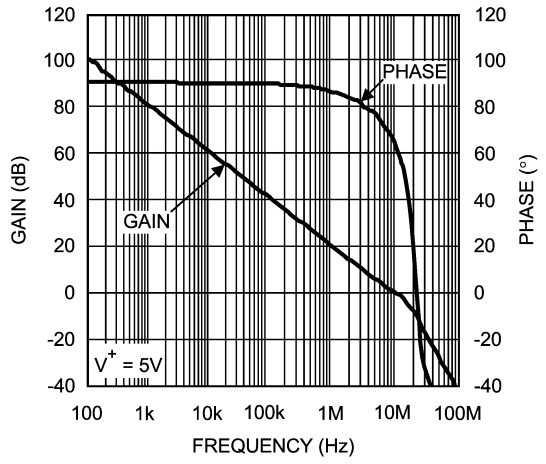
Features

(Typical 5V supply, unless otherwise noted)

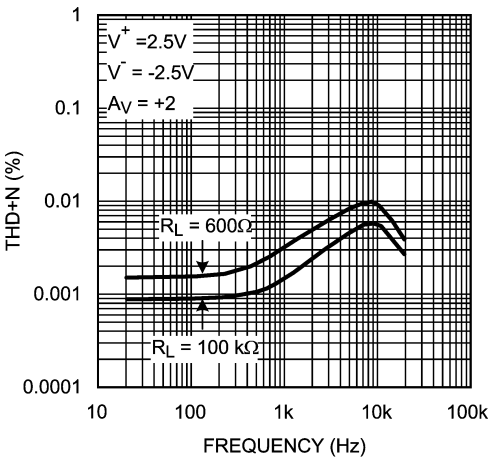
- Guaranteed 3.0V and 5.0V performance
- High unity gain bandwidth — 12 MHz
- Low power supply current — 110 µA
- Max input offset voltage — 1 mV
- Capacitive load drive capability — 500 pF
- CMRR — 100 dB
- PSRR — 95 dB
- Input referred voltage noise — 17nV/ $\sqrt{Hz}$
- Output swing with 2 kΩ load — 50 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	2 KV
Machine Model	200V
V_{IN} Differential	±0.3V
Supply Voltage (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)	
5-Pin SC70	456˚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	mV
I_B	Input Bias Current	(Note 6)		80		nA
I_{OS}	Input Offset Current			2.2		nA
CMRR	Common Mode Rejection Ratio	$0 \le V_{CM} \le 1.5V$	90	100		dB
PSRR	Power Supply Rejection Ratio	$3.0 \le V^+ \le 5V$, V_O = 1.5V, V_{CM} = 0.5	85	95		dB
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 50 dB	0		2	V
A_{VOL}	Large Signal Voltage Gain	$0.5 \le V_O \le 2.5$, R_L = 2 kΩ		83		dB
		$0.5 \le V_O \le 2.5$, R_L = 10 kΩ		93		
V_O	Output Swing High	R_L = 2 kΩ to $V^+/2$		50		mV from rail
		R_L = 10 kΩ to $V^+/2$		30		
	Output Swing Low	R_L = 2 kΩ to $V^+/2$		50		
		R_L = 10 kΩ to $V^+/2$		30		
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$, V_{IN} Differential = 100 mV (Note 8)	14	17		mA
		Sinking from $V^+/2$, V_{IN} Differential = −100 mV (Note 8)	50	53		
I_S	Supply Current per Amplifier			110	125	µA
SR	Slew Rate	A_V = +1, 10% to 90% (Note 7)		2.8		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	mV
I_B	Input Bias Current	(Note 6)		80		nA
I_{OS}	Input Offset Current			2.2		nA
CMRR	Common Mode Rejection Ratio	V_{CM} Step from 0V to 3.5V	90	100		dB
PSRR	Power Supply Rejection Ratio	V^+ = 3V to 5V, V_O = 1.5V, V_{CM} = 0.5V	85	95		dB
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 50 dB	0		4	V
A_{VOL}	Large Signal Voltage Gain	V_O = 0.5V to 4.5V, R_L = 2 kΩ		83		dB
		V_O = 0.5V to 4.5V, R_L = 10 kΩ		93		
V_O	Output Swing High	R_L = 2 kΩ to $V^+/2$		50		mV from rail
		R_L = 10 kΩ to $V^+/2$		30		
	Output Swing Low	R_L = 2 kΩ to $V^+/2$		50		
		R_L = 10 kΩ to $V^+/2$		30		
I_{SC}	Output Short Circuit Current	Sourcing to $V^+/2$ V_{IN} Differential = 100 mV (Note 8)	15	18.5		mA
		Sinking from $V^+/2$ V_{IN} Differential = –100 mV (Note 8)	50	52		
I_S	Supply Current per Amplifier			110	125	µA
SR	Slew Rate	A_V = +1, V_O = 1 V_{PP} 10% to 90% (Note 7)		2.8		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		0.1		$pA/\sqrt{Hz}$
		f = 1 kHz		0.15		
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 2, R_L = 600 Ω		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: 1.5 kΩ in series with 100 pF. Machine Model: 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.

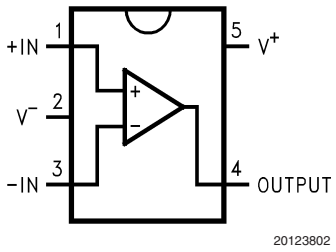
Note 6: Positive current corresponds to current flowing into the device.

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

Note 8: Short circuit test is a momentary test.

Connection Diagram

5-Pin SC70/SOT23



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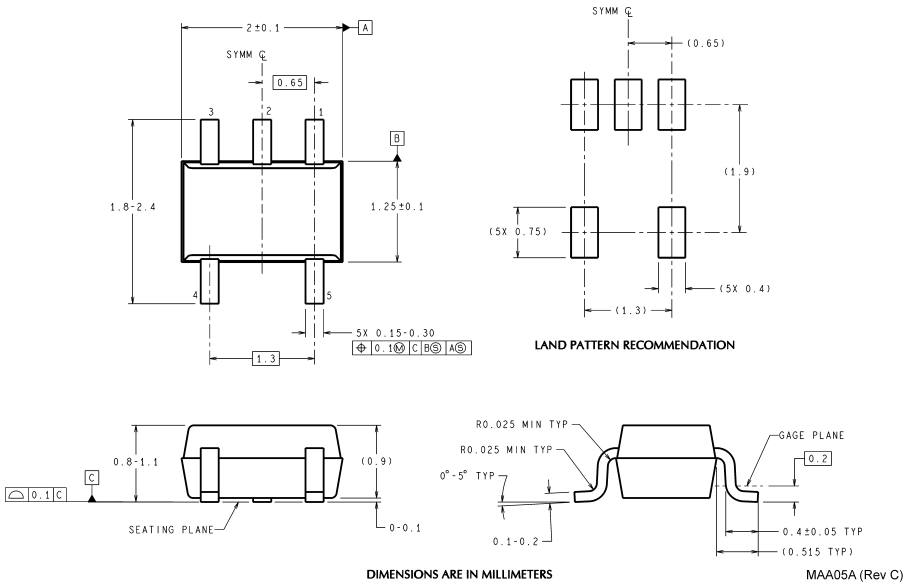
Top View

Ordering Information

Package	Part Number	Package marking	Transport Media	NSC Drawing
5-Pin SC70	LMV651MG	A93	1k Units Tape and Reel	MA005A
	LMV651MGX		3 k Units Tape and Reel	

Physical Dimensions inches (millimeters) unless otherwise noted



5-Pin SC70
NS Package Number MAA05A

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