National Semiconductor

LMV771/LMV772/LMV774 Single/Dual/Quad, Low Offset, Low Noise, RRO Operational Amplifiers

General Description

The LMV771/LMV772/LMV774 are Single, Dual, and Quad low noise precision operational amplifiers intended for use in a wide range of applications. Other important characteristics of the family include: an extended operating temperature range of –40°C to 125°C, the tiny SC70-5 package for the LMV771, and low input bias current.

The extended temperature range of –40°C to 125°C allows the LMV771/LMV772/LMV774 to accommodate a broad range of applications. The LMV771 expands National Semiconductor's Silicon Dust™ amplifier portfolio offering enhancements in size, speed, and power savings. The LMV771/LMV772/LMV774 are guaranteed to operate over the voltage range of 2.7V to 5.0V and all have rail-to-rail output.

The LMV771/LMV772/LMV774 family is designed for precision, low noise, low voltage, and miniature systems. These amplifiers provide rail-to-rail output swing into heavy loads. The maximum input offset voltage for the LMV771 is 850 µV at room temperature and the input common mode voltage range includes ground.

The LMV771 is offered in the tiny SC70-5 package, LMV772 in the space saving MSOP-8 and SOIC-8, and the LMV774 in TSSOP-14.

Features

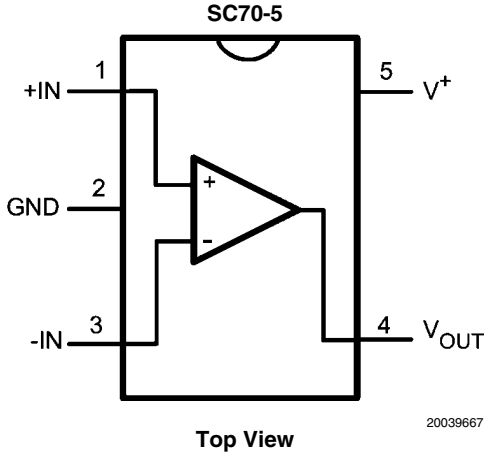
(Unless otherwise noted, typical values at V_S = 2.7V)

- Guaranteed 2.7V and 5V specifications
- Maximum V_{OS} (LMV771) 850µV (limit)
- Voltage noise
  - — f = 100 Hz 12.5nV/√Hz
  - — f = 10 kHz 7.5nV/√Hz
- Rail-to-Rail output swing
  - — R_L = 600Ω 100mV from rail
  - — R_L = 2kΩ 50mV from rail
- Open loop gain with R_L = 2kΩ 100dB
- V_{CM} 0 to V^+ –0.9V
- Supply current (per amplifier) 550µA
- Gain bandwidth product 3.5MHz
- Temperature range –40°C to 125°C

Applications

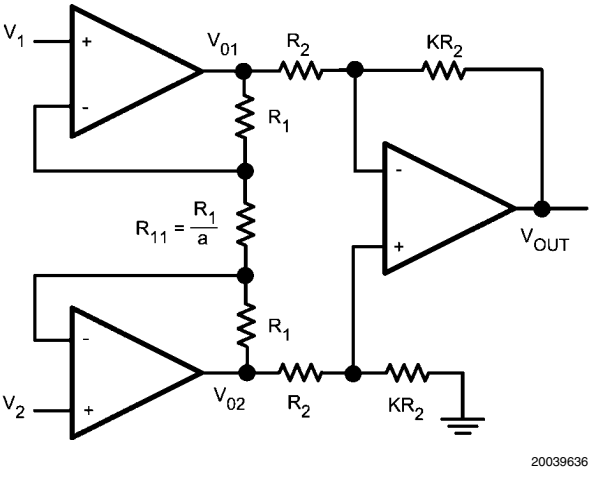
- Transducer amplifier
- Instrumentation amplifier
- Precision current sensing
- Data acquisition systems
- Active filters and buffers
- Sample and hold
- Portable/battery powered electronics

Connection Diagram



Top View

Instrumentation Amplifier



$$V_O = -K(2a + 1)(V_1 - V_2)$$

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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)	
Machine Model	200V
Human Body Model	2000V
Differential Input Voltage	± Supply Voltage
Voltage at Input Pins	(V^+) + 0.3V, (V^-) – 0.3V
Current at Input Pins	±10 mA
Supply Voltage $(V^+ – V^-)$	5.75V
Output Short Circuit to V^+	(Note 3)
Output Short Circuit to V^-	(Note 4)
Mounting Temperture	
Infrared or Convection (20 sec)	235°C
Wave Soldering Lead Temp (10 sec)	260°C
Storage Temperature Range	–65°C to 150°C
Junction Temperature (Note 5)	150°C

Operating Ratings (Note 1)

Supply Voltage	2.7V to 5.5V
Temperature Range	–40°C to 125°C
Thermal Resistance (θ_{JA})	
SC70-5 Package	440 °C/W
8-Pin MSOP	235°C/W
8-Pin SOIC	190°C/W
14-Pin TSSOP	155°C/W

2.7V DC Electrical Characteristics (Note 13)

Unless otherwise specified, all limits are guaranteed for T_A = 25°C. V^+ = 2.7V, V^- = 0V, $V_{CM} = V^+/2$, $V_O = V^+/2$ and R_L > 1MΩ. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Condition	Min (Note 7)	Typ (Note 6)	Max (Note 7)	Units
V_{OS}	Input Offset Voltage	LMV771		0.3	0.85 **1.0**	mV
		LMV772/LMV774		0.3	1.0 **1.2**	
TCV_{OS}	Input Offset Voltage Average Drift			–0.45		µV/°C
I_B	Input Bias Current (Note 8)	V_{CM} = 1V		–0.1	100 **250**	pA
I_{OS}	Input Offset Current (Note 8)			0.004	100	pA
I_S	Supply Current (Per Amplifier)			550	900 **910**	µA
CMRR	Common Mode Rejection Ratio	0.5 ≤ V_{CM} ≤ 1.2V	74 **72**	80		dB
PSSR	Power Supply Rejection Ratio	2.7V ≤ V^+ ≤ 5V	82 **76**	90		dB
V_{CM}	Input Common-Mode Voltage Range	For CMRR ≥ 50dB	0		1.8	V
A_V	Large Signal Voltage Gain (Note 9)	R_L = 600Ω to 1.35V, V_O = 0.2V to 2.5V, (Note 10)	92 **80**	100		dB
		R_L = 2kΩ to 1.35V, V_O = 0.2V to 2.5V, (Note 11)	98 **86**	100		
V_O	Output Swing	R_L = 600Ω to 1.35V V_{IN} = ± 100mV, (Note 10)	0.11 **0.14**	0.084 to 2.62	2.59 **2.56**	V
		R_L = 2kΩ to 1.35V V_{IN} = ± 100mV, (Note 11)	0.05 **0.06**	0.026 to 2.68	2.65 **2.64**	
I_O	Output Short Circuit Current	Sourcing, V_O = 0V V_{IN} = 100mV	18 **11**	24		mA
		Sinking, V_O = 2.7V V_{IN} = –100mV	18 **11**	22		

2.7V AC Electrical Characteristics (Note 13)

Unless otherwise specified, all limits are guaranteed for T_A = 25°C. V^+ = 5.0V, V^- = 0V, V_{CM} = V^+/2, V_O = V^+/2 and R_L > 1MΩ. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 7)	Typ (Note 6)	Max (Note 7)	Units
SR	Slew Rate (Note 12)	A_V = +1, R_L = 10 kΩ		1.4		V/µs
GBW	Gain-Bandwidth Product			3.5		MHz
Φ_m	Phase Margin			79		Deg
G_m	Gain Margin			−15		dB
e_n	Input-Referred Voltage Noise (Flatband)	f = 10kHz		7.5		$nV/\sqrt{Hz}$
e_n	Input-Referred Voltage Noise (l/f)	f = 100Hz		12.5		$nV/\sqrt{Hz}$
i_n	Input-Referred Current Noise	f = 1kHz		0.001		$pA/\sqrt{Hz}$
THD	Total Harmonic Distortion	f = 1kHz, A_V = +1 R_L = 600Ω, V_{IN} = 1 V_{PP}		0.007		%

5.0V DC Electrical Characteristics (Note 13)

Unless otherwise specified, all limits are guaranteed for T_A = 25°C. V^+ = 5.0V, V^- = 0V, V_{CM} = V^+/2, V_O = V^+/2 and R_L > 1MΩ. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Condition	Min (Note 7)	Typ (Note 6)	Max (Note 7)	Units
V_{OS}	Input Offset Voltage	LMV771		0.25	0.85 **1.0**	mV
		LMV772/LMV774		0.25	1.0 **1.2**	
TCV_{OS}	Input Offset Voltage Average Drift			−0.35		µV/°C
I_B	Input Bias Current (Note 8)	V_{CM} = 1V		−0.23	100 **250**	pA
I_{OS}	Input Offset Current (Note 8)			0.017	100	pA
I_S	Supply Current (Per Amplifier)			600	950 **960**	µA
CMRR	Common Mode Rejection Ratio	0.5 ≤ V_{CM} ≤ 3.5V	80 **79**	90		dB
PSRR	Power Supply Rejection Ratio	2.7V ≤ V^+ ≤ 5V	82 **76**	90		dB
V_{CM}	Input Common-Mode Voltage Range	For CMRR ≥ 50dB	0		4.1	V
A_V	Large Signal Voltage Gain (Note 9)	R_L = 600Ω to 2.5V, V_O = 0.2V to 4.8V, (Note 10)	92 **89**	100		dB
		R_L = 2kΩ to 2.5V, V_O = 0.2V to 4.8V, (Note 11)	98 **95**	100		
V_O	Output Swing	R_L = 600Ω to 2.5V V_{IN} = ± 100mV, (Note 10)	0.15 **0.23**	0.112 to 4.9	4.85 **4.77**	V
		R_L = 2kΩ to 2.5V V_{IN} = ± 100mV, (Note 11)	0.06 **0.07**	0.035 to 4.97	4.94 **4.93**	
I_O	Output Short Circuit Current (Note 8),(Note 14)	Sourcing, V_O = 0V V_{IN} = 100mV	35 **35**	75		mA
		Sinking, V_O = 2.7V V_{IN} = −100mV	35 **35**	66		

5.0V AC Electrical Characteristics (Note 13)

Unless otherwise specified, all limits are guaranteed for T_A = 25°C. V^+ = 5.0V, V^- = 0V, $V_{CM} = V^+/2$, $V_O = V^+/2$ and $R_L > 1M\Omega$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 7)	Typ (Note 6)	Max (Note 7)	Units
SR	Slew Rate (Note 12)	A_V = +1, R_L = 10 kΩ		1.4		V/µs
GBW	Gain-Bandwidth Product			3.5		MHz
Φ_m	Phase Margin			79		Deg
G_m	Gain Margin			–15		dB
e_n	Input-Referred Voltage Noise (Flatband)	f = 10kHz		6.5		$nV/\sqrt{Hz}$
e_n	Input-Referred Voltage Noise (l/f)	f = 100Hz		12		$nV/\sqrt{Hz}$
i_n	Input-Referred Current Noise	f = 1kHz		0.001		$pA/\sqrt{Hz}$
THD	Total Harmonic Distortion	f = 1kHz, A_V = +1 R_L = 600Ω, V_{IN} = 1 V_{PP}		0.007		%

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 is 1.5 kΩ in series with 100 pF. Machine Model is 0Ω in series with 20 pF.

Note 3: Shorting output to V^+ will adversely affect reliability.

Note 4: Shorting output to V^- will adversely affect reliability.

Note 5: 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 into a PC board.

Note 6: Typical values represent the most likely parametric norm.

Note 7: All limits are guaranteed by testing or statistical analysis.

Note 8: Limits guaranteed by design.

Note 9: R_L is connected to mid-supply. The output voltage is set at 200mV from the rails. V_O = GND + 0.2V and $V_O = V^+ - 0.2V$

Note 10: For LMV772/LMV774, temperature limits apply to –40°C to 85°C.

Note 11: For LMV772/LMV774, temperature limits apply to –40°C to 85°C. If R_L is relaxed to 10 kΩ, then for LMV772/LMV774 temperature limits apply to –40° C to 125°C.

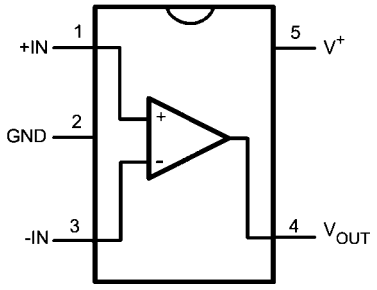
Note 12: The number specified is the slower of positive and negative slew rates.

Note 13: 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 $T_J = T_A$.

Note 14: Continuous operation of the device with an output short circuit current larger than 35mA may cause permanent damage to the device.

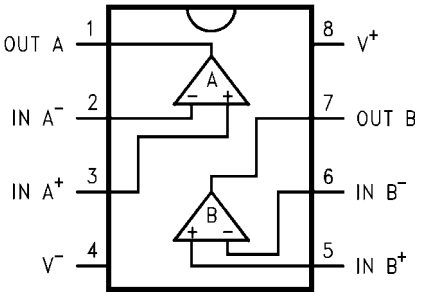
Connection Diagrams

SC70-5



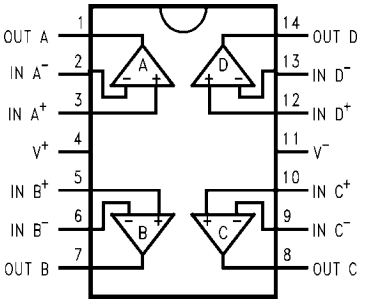
Top View

8-Pin MSOP/SOIC



Top View

14-Pin TSSOP

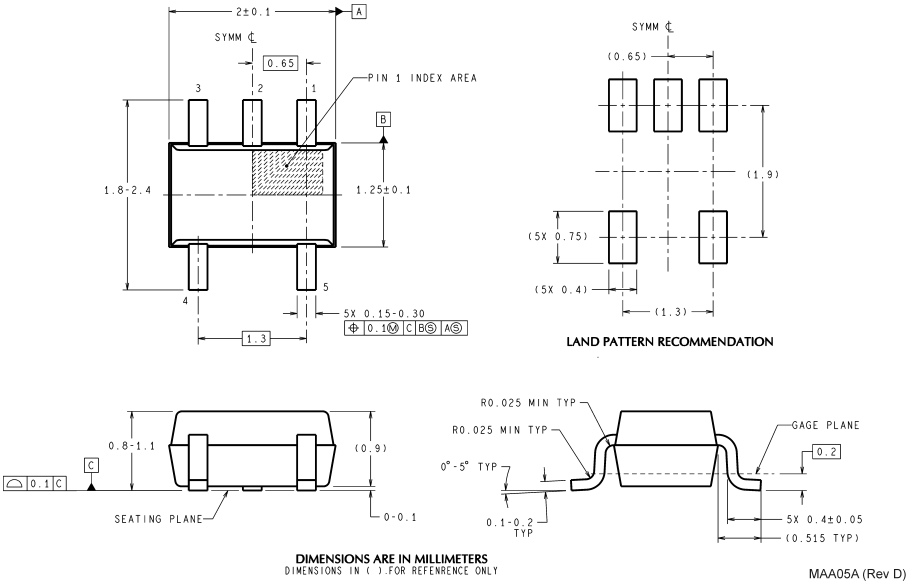


Top View

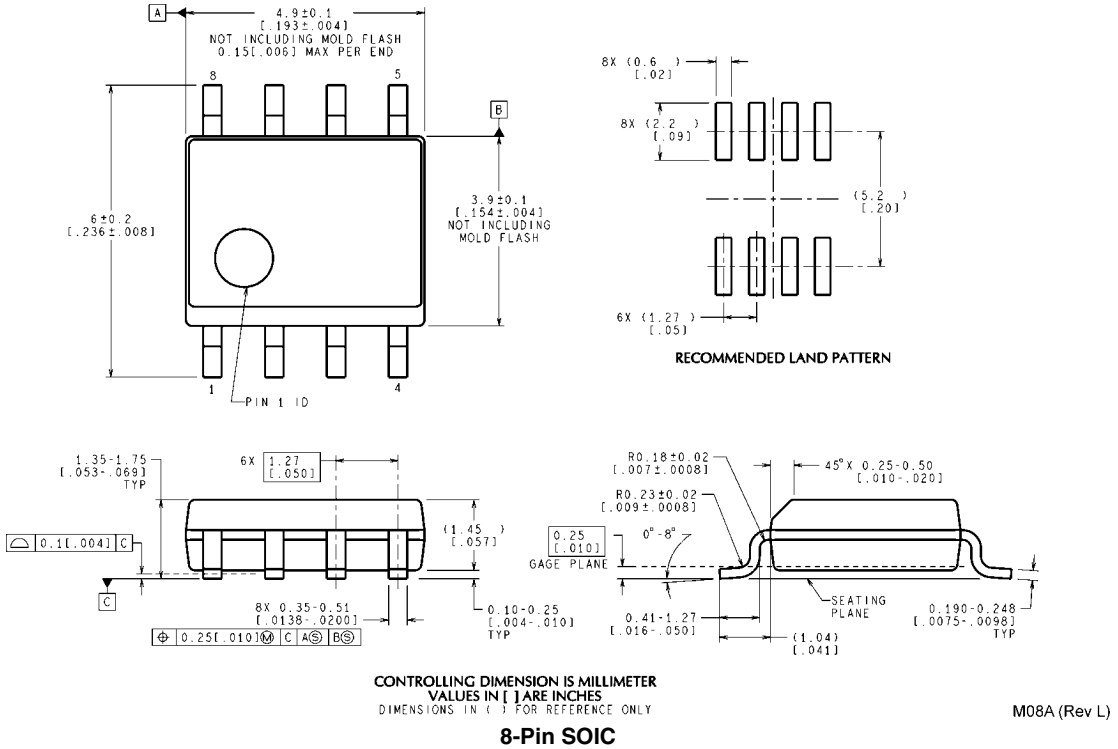
Ordering Information

Package	Part Number	Package Marking	Transport Media	NSC Drawing
SC70-5	LMV771MG	A75	1k Units Tape and Reel	MAA05A
	LMV771MGX		3k Units Tape and Reel	
8-Pin SOIC	LMV772MA	LMV772MA	95 Units/Rail	M08A
	LMV772MAX		2.5k Units Tape and Reel	
8-Pin MSOP	LMV772MM	A91A	1k Units Tape and Reel	MUA08A
	LMV772MMX		3.5k Units Tape and Reel	
14-Pin TSSOP	LMV774MT	LMV774MT	94 Units/Rail	MTC14
	LMV774MTX		2.5k Units Tape and Reel	

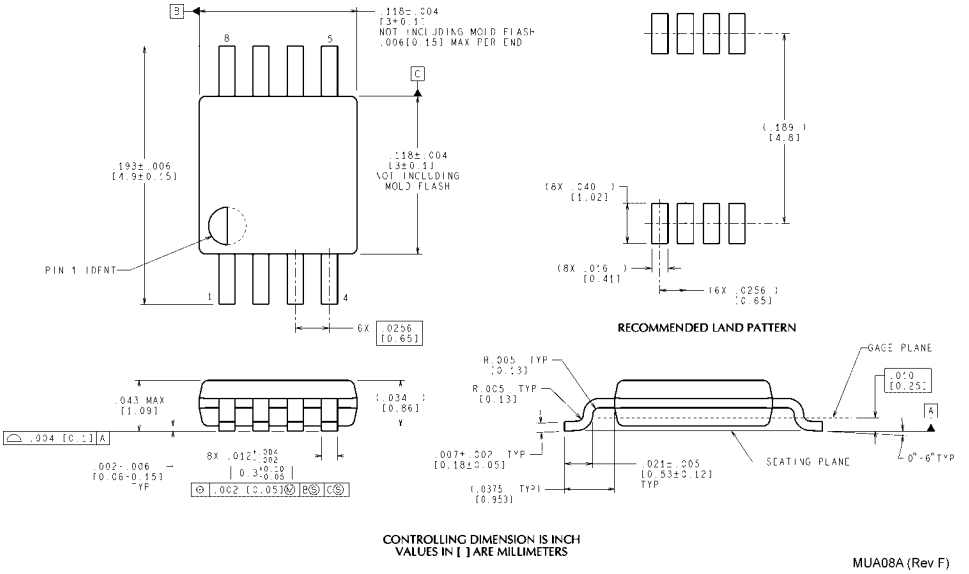
Physical Dimensions inches (millimeters) unless otherwise noted



SC70-5
NS Package Number MAA05A

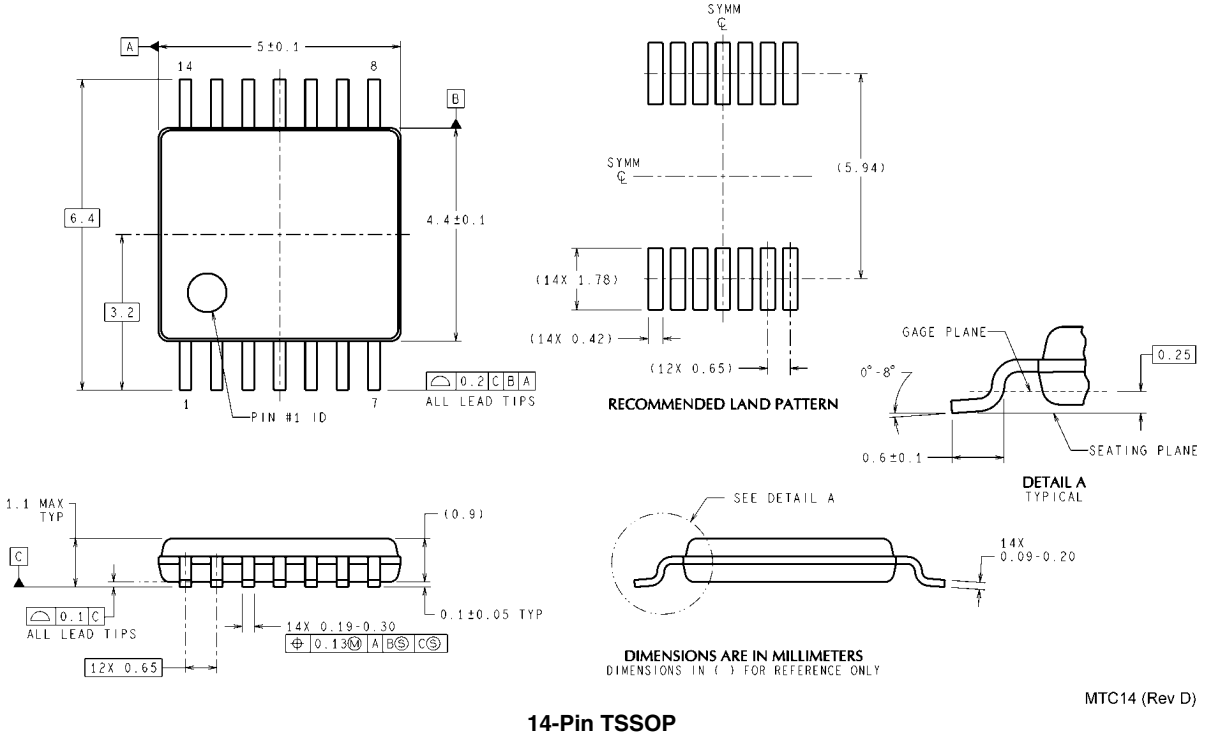


8-Pin SOIC
NS Package Number M08A



MUA08A (Rev F)

8-Pin MSOP
NS Package Number MUA08A



MTC14 (Rev D)

14-Pin TSSOP
NS Package Number MTC14