National Semiconductor

PRELIMINARY
September 2005

LMP7711
Precision, 17 MHz, Low Noise, CMOS Input Amplifier

General Description

The LMP7711 is a low noise, low offset, CMOS input, rail-to-rail output precision amplifier with a high gain bandwidth and an enable pin. The LMP7711 is part of the LMP™ precision amplifier family and is ideal for a variety of instrumentation applications.

Utilizing a CMOS input stage, the LMP7711 achieves an input bias current of 100 fA, input referred voltage noise of 5.8 nV/ $\sqrt{Hz}$, and an input offset voltage of less than ±150 µV. These features make the LMP7711 a superior choice for precision applications.

Consuming only 1.15 mA of supply current, the LMP7711 offers a high gain bandwidth of 17 MHz, enabling accurate amplification at high closed loop gains.

The LMP7711 has a supply voltage range of 1.8V to 5.5V; which makes this an ideal choice for portable low power applications with low supply voltage requirements. In order to reduce the already low power consumption of the LMP7711, an enable function is available. Once in shutdown, the LMP7711 draws only 140 nA of supply current.

The LMP7711 is built with National's advanced VIP50 process technology. The LMP7711 is available in a 6-pin TSOT23 package.

Features

Unless otherwise noted, typical values at V_S = 5V.

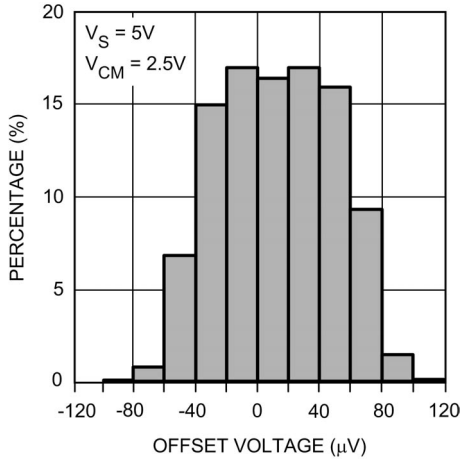
- Input offset voltage ±150 µV (max)
- Input bias current 100 fA
- Input voltage noise 5.8 nV/ $\sqrt{Hz}$
- Unity gain bandwidth 17 MHz
- Supply current 1.15 mA
- Supply voltage range 1.8V to 5.5V
- Total harmonic distortion 0.001% @1 kHz, 600Ω
- Operating temperature range –40°C to 125°C
- Rail-to-rail output swing
- Space saving TSOT23 package

Applications

- Active filters and buffers
- Sensor interface applications
- Transimpedance amplifiers

Typical Performance

Offset Voltage Distribution



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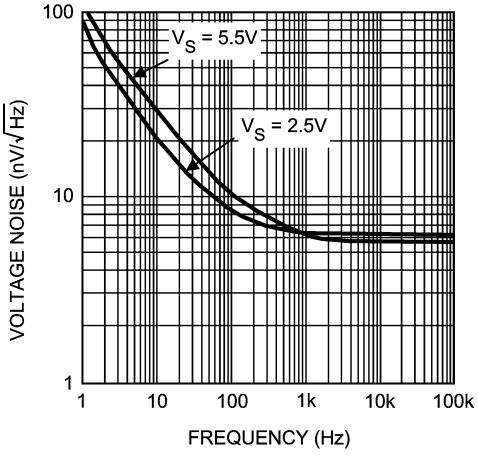
Input Referred Voltage Noise



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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)	
Human Body	2000V
Machine Model	200V
V_{IN} Differential	0.3V
Supply Voltage ($V_S = V^+ - V^-$)	6.0V
Voltage on Input/Ouput 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 ($V_S = V^+ - V^-$)	
$0˚C \le T_A \le 125˚C$	1.8V to 5.5V
$-40˚C \le T_A \le 125˚C$	2V to 5.5V
Package Thermal Resistance (θJA (Note 3))	
6-Pin TSOT23	170˚C/W

2.5V Electrical Characteristics

Unless otherwise specified, all limits are guaranteed for T_A = 25˚C, V^+ = 2.5V, V^- = 0V, $V_{CM} = V^+/2$, $V_{EN} = V^+$. **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			±20	±180 **±580**	µV
TC V_{OS}	Input Offset Voltage Drift	(Note 6)		±1	±4	µV/˚C
I_B	Input Bias Current	(Notes 7, 8) V_{CM} = 1V		0.05	0.5 **50**	pA
I_{OS}	Input Offset Current	(Note 8)		6	100	fA
CMRR	Common Mode Rejection Ratio	$0V \le V_{CM} \le 1.4V$	83 **80**	97		dB
PSRR	Power Supply Rejection Ratio	$2V \le V^+ \le 5.5V$, V^- = 0V, V_{CM} = 0	85 **80**	100		dB
		$1.8V \le V^+ \le 5.5V$, V^- = 0V, V_{CM} = 0	85	98		
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 80 dB **CMRR ≥ 78 dB**	−0.3 **-0.3**		1.5 **1.5**	V
A_{VOL}	Large Signal Voltage Gain	V_O = 0.15 to 2.2V, R_L = 2 kΩ to $V^+/2$	88 **82**	98		dB
		V_O = 0.15 to 2.2V, R_L = 10 kΩ to $V^+/2$	92 **88**	110		
V_O	Output Swing High	R_L = 2 kΩ to $V^+/2$	70 **77**	25		mV from V^+
		R_L = 10 kΩ to $V^+/2$	60 **66**	20		
	Output Swing Low	R_L = 2 kΩ to $V^+/2$		30	70 **73**	mV
		R_L = 10 kΩ to $V^+/2$		15	60 **62**	
I_O	Output Short Circuit Current	Sourcing to V^- V_{IN} = 200 mV (Note 9)	36 **30**	47		mA
		Sinking to V^+ V_{IN} = −200 mV (Note 9)	7.5 **5.0**	15		
I_S	Supply Current	Enable Mode $V_{EN} > 2.1$		0.95	1.3 **1.6**	mA
		Shutdown Mode $V_{EN} < 0.4$		0.03	1 **4**	µA

2.5V Electrical Characteristics (Continued)

Unless otherwise specified, all limits are guaranteed for T_A = 25˚C, V^+ = 2.5V, V^- = 0V, V_{CM} = $V^+/2$, V_{EN} = V^+. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
SR	Slew Rate	A_V = +1, Rising (10% to 90%)				V/µs
		A_V = +1, Falling (90% to 10%)		10.5		
GBW	Gain Bandwidth Product			14		MHz
e_n	Input-Referred Voltage Noise	f = 400 Hz		7		nV/ $\sqrt{Hz}$
		f = 1 kHz		6.2		
i_n	Input-Referred Current Noise	f = 1 kHz		0.01		pA/ $\sqrt{Hz}$
t_{on}	Turn-on Time			140		ns
t_{off}	Turn-off Time			1000		ns
V_{EN}	Shutdown Pin Voltage Range	Enable Mode	2.1 to 2.5	2 to 2.5		V
		Shutdown Mode	0 to 0.4	0 to 0.5		
I_{EN}	Shutdown Pin Input Current	V_{EN} > 2.1V (Note 7)		1.5	3.0	µA
		V_{EN} < 0.4V (Note 7)		0.003	0.1	
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 1, R_L = 600Ω		0.01		%

5V Electrical Characteristics

Unless otherwise specified, all limits are guaranteed for T_A = 25˚C, V^+ = 5V, V^- = 0V, V_{CM} = $V^+/2$, V_{EN} = V^+. **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			±10	±150 **±550**	µV
TC V_{OS}	Input Offset Average Drift	(Note 6)		±1	±4	µV/˚C
I_B	Input Bias Current	(Notes 7, 8) V_{CM} = 2V		0.1	1 **100**	pA
I_{OS}	Input Offset Current	(Note 8)		11	150	fA
CMRR	Common Mode Rejection Ratio	0V ≤ V_{CM} ≤ 3.7V	85 **82**	100		dB
PSRR	Power Supply Rejection Ratio	2V ≤ V^+ ≤ 5.5V, V^- = 0V, V_{CM} = 0	85 **80**	100		dB
		1.8V ≤ V^+ ≤ 5.5V, V^- = 0V, V_{CM} = 0	85	98		
CMVR	Input Common-Mode Voltage Range	CMRR ≥ 80 dB **CMRR ≥ 78 dB**	–0.3 **-0.3**		4 **4**	V
A_{VOL}	Large Signal Voltage Gain	V_O = 0.3 to 4.7V, R_L = 2 kΩ to $V^+/2$	88 **82**	107		dB
		V_O = 0.3 to 4.7V, R_L = 10 kΩ to $V^+/2$	92 **88**	110		
V_O	Output Swing High	R_L = 2 kΩ to $V^+/2$	70 **77**	35		mV from V^+
		R_L = 10 kΩ to $V^+/2$	60 **66**	25		
	Output Swing Low	R_L = 2 kΩ to $V^+/2$		50	70 **73**	mV
		R_L = 10 kΩ to $V^+/2$		20	60 **62**	
I_O	Output Short Circuit Current	Sourcing to V^- V_{IN} = 200 mV (Note 9)	46 **38**	60		mA
		Sinking to V^+ V_{IN} = –200 mV (Note 9)	10.5 **6.5**	20		

5V Electrical Characteristics (Continued)

I_S	Supply Current	Enable Mode V_{EN} > 4.6		1.15	1.40 **1.75**	mA
		Shutdown Mode V_{EN} < 0.4		0.14	1 **4**	µA
SR	Slew Rate	A_V = +1, Rising (10% to 90%)	6.0	9.5		V/µs
		A_V = +1, Falling (90% to 10%)	7.5	11.5		
GBW	Gain Bandwidth Product			17		MHz
e_n	Input-Referred Voltage Noise	f = 400 Hz		6.8		nV/ $\sqrt{Hz}$
		f = 1 kHz		5.8		
i_n	Input-Referred Current Noise	f = 1 kHz		0.01		pA/ $\sqrt{Hz}$
t_{on}	Turn-on Time					ns
t_{off}	Turn-off Time					ns
V_{EN}	Enable Pin Voltage Range	Enable Mode	4.6 to 5.0	4.5 to 5.0		V
		Shutdown Mode	0 to 0.4	0 to 0.5		
I_{EN}	Enable Pin Input Current	V_{EN} > 4.6V (Note 7)		5.6	10	µA
		V_{EN} < 0.4V (Note 7)		0.005	0.2	
THD	Total Harmonic Distortion	f = 1 kHz, A_V = 1, R_L = 600Ω		0.01		%

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}. 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 the Statistical Quality Control (SQC) method.

Note 6: Offset voltage average drift is determined by dividing the change in V_{OS} at the temperature extremes by the total temperature change.

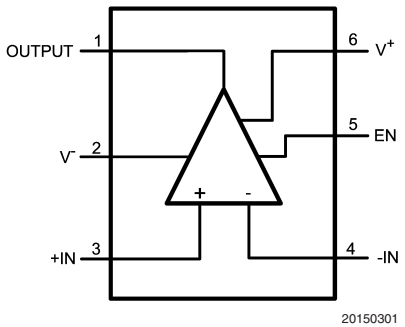
Note 7: Positive current corresponds to current flowing into the device.

Note 8: Guaranteed by design.

Note 9: The short circuit test is a momentary test.

Connection Diagram

6-Pin TSOT23

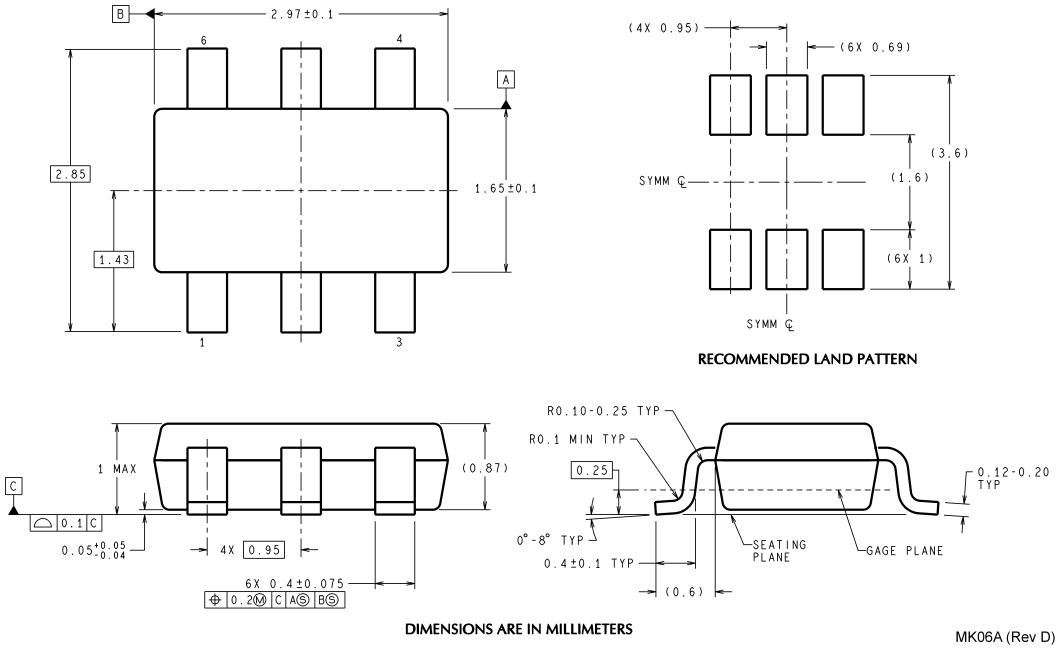


Top View

Ordering Information

Package	Part Number	Package Marking	Transport Media	NSC Drawing
6-Pin TSOT23	LMP7711MK	AC3A	1k Units Tape and Reel	MK06A
	LMP7711MKX		3k Units Tape and Reel	

Physical Dimensions inches (millimeters) unless otherwise noted



6-Pin TSOT23
NS Package Number MK06A

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