

## 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  $5.8 \text{ nV}/\sqrt{\text{Hz}}$ , and an input offset voltage of less than  $\pm 150 \mu\text{V}$ . 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

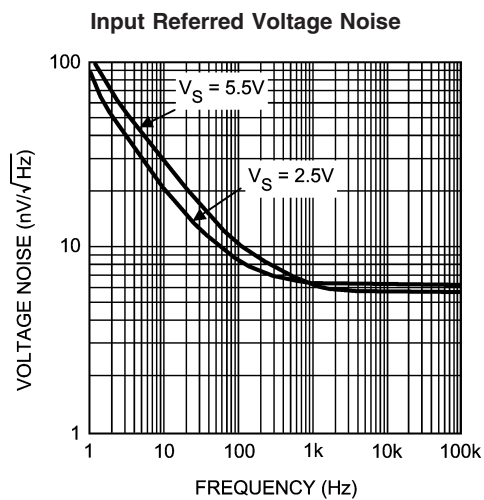
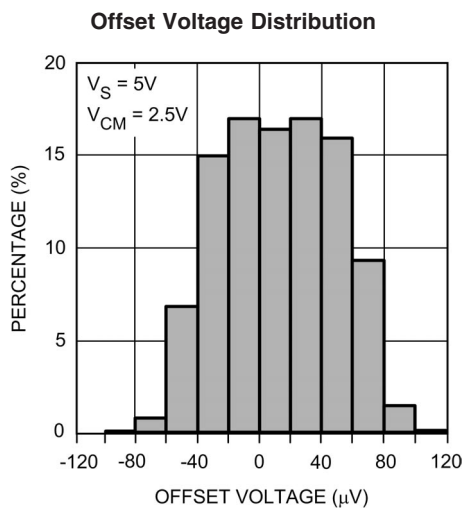
Unless otherwise noted, typical values at  $V_S = 5\text{V}$ .

- Input offset voltage  $\pm 150 \mu\text{V}$  (max)
- Input bias current 100 fA
- Input voltage noise  $5.8 \text{ nV}/\sqrt{\text{Hz}}$
- 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, 600 $\Omega$
- Operating temperature range  $-40^\circ\text{C}$  to  $125^\circ\text{C}$
- Rail-to-rail output swing
- Space saving TSOT23 package

### Applications

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

### Typical Performance



LMP™ is a trademark of National Semiconductor Corporation.

**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/Output Pins	$V^+ +0.3V, V^- -0.3V$
Storage Temperature Range	$-65^\circ\text{C}$ to $150^\circ\text{C}$
Junction Temperature (Note 3)	$+150^\circ\text{C}$

## Soldering Information

Infrared or Convection (20 sec)	$235^\circ\text{C}$
Wave Soldering Lead Temp. (10 sec)	$260^\circ\text{C}$

**Operating Ratings** (Note 1)

Temperature Range (Note 3)	$-40^\circ\text{C}$ to $125^\circ\text{C}$
Supply Voltage ( $V_S = V^+ - V^-$ )	1.8V to 5.5V
$0^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$	1.8V to 5.5V
$-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$	2V to 5.5V
Package Thermal Resistance ( $\theta_{JA}$ (Note 3))	170°C/W
6-Pin TSOT23	

**2.5V Electrical Characteristics**

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

## 2.5V Electrical Characteristics (Continued)

Unless otherwise specified, all limits are guaranteed for  $T_A = 25^\circ\text{C}$ ,  $V^+ = 2.5\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V^+/2$ ,  $V_{\text{EN}} = V^+$ . **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/ $\mu\text{s}$
		$A_V = +1$ , Falling (90% to 10%)		10.5		
GBW	Gain Bandwidth Product			14		MHz
$e_n$	Input-Referred Voltage Noise	$f = 400\text{ Hz}$		7		nV/ $\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$		6.2		
$i_n$	Input-Referred Current Noise	$f = 1\text{ kHz}$		0.01		pA/ $\sqrt{\text{Hz}}$
$t_{\text{on}}$	Turn-on Time			140		ns
$t_{\text{off}}$	Turn-off Time			1000		ns
$V_{\text{EN}}$	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		
$I_{\text{EN}}$	Shutdown Pin Input Current	$V_{\text{EN}} > 2.1\text{V}$ (Note 7)		1.5	3.0	$\mu\text{A}$
		$V_{\text{EN}} < 0.4\text{V}$ (Note 7)		0.003	0.1	
THD	Total Harmonic Distortion	$f = 1\text{ kHz}$ , $A_V = 1$ , $R_L = 600\Omega$		0.01		%

## 5V Electrical Characteristics

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

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
$V_{\text{OS}}$	Input Offset Voltage			$\pm 10$	$\pm 150$ <b><math>\pm 550</math></b>	$\mu\text{V}$
TC $V_{\text{OS}}$	Input Offset Average Drift	(Note 6)		$\pm 1$	$\pm 4$	$\mu\text{V}/^\circ\text{C}$
$I_{\text{B}}$	Input Bias Current	(Notes 7, 8) $V_{\text{CM}} = 2\text{V}$		0.1	1 <b>100</b>	pA
$I_{\text{OS}}$	Input Offset Current	(Note 8)		11	150	fA
CMRR	Common Mode Rejection Ratio	$0\text{V} \leq V_{\text{CM}} \leq 3.7\text{V}$	85 <b>82</b>	100		dB
PSRR	Power Supply Rejection Ratio	$2\text{V} \leq V^+ \leq 5.5\text{V}$ , $V^- = 0\text{V}$ , $V_{\text{CM}} = 0$	85 <b>80</b>	100		dB
		$1.8\text{V} \leq V^+ \leq 5.5\text{V}$ , $V^- = 0\text{V}$ , $V_{\text{CM}} = 0$	85	98		
CMVR	Input Common-Mode Voltage Range	CMRR $\geq 80\text{ dB}$ <b>CMRR <math>\geq 78\text{ dB}</math></b>	-0.3 <b>-0.3</b>		4 <b>4</b>	V
$A_{\text{VOL}}$	Large Signal Voltage Gain	$V_{\text{O}} = 0.3\text{ to }4.7\text{V}$ , $R_L = 2\text{ k}\Omega\text{ to }V^+/2$	88 <b>82</b>	107		dB
		$V_{\text{O}} = 0.3\text{ to }4.7\text{V}$ , $R_L = 10\text{ k}\Omega\text{ to }V^+/2$	92 <b>88</b>	110		
$V_{\text{O}}$	Output Swing High	$R_L = 2\text{ k}\Omega\text{ to }V^+/2$	70 <b>77</b>	35		mV from $V^+$
		$R_L = 10\text{ k}\Omega\text{ to }V^+/2$	60 <b>66</b>	25		
	Output Swing Low	$R_L = 2\text{ k}\Omega\text{ to }V^+/2$		50	70 <b>73</b>	mV
		$R_L = 10\text{ k}\Omega\text{ to }V^+/2$		20	60 <b>62</b>	
$I_{\text{O}}$	Output Short Circuit Current	Sourcing to $V^-$ $V_{\text{IN}} = 200\text{ mV}$ (Note 9)	46 <b>38</b>	60		mA
		Sinking to $V^+$ $V_{\text{IN}} = -200\text{ mV}$ (Note 9)	10.5 <b>6.5</b>	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	$\mu$ A
SR	Slew Rate	$A_V = +1$ , Rising (10% to 90%)	6.0	9.5		V/ $\mu$ s
		$A_V = +1$ , 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/ $\sqrt{\text{Hz}}$
		$f = 1$ kHz		5.8		
$i_n$	Input-Referred Current Noise	$f = 1$ kHz		0.01		pA/ $\sqrt{\text{Hz}}$
$t_{on}$	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	$V_{EN} > 4.6$ V (Note 7)		5.6	10	$\mu$ A
		$V_{EN} < 0.4$ V (Note 7)		0.005	0.2	
THD	Total Harmonic Distortion	$f = 1$ kHz, $A_V = 1$ , $R_L = 600\Omega$		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 k $\Omega$  in series with 100 pF. Machine Model: 0 $\Omega$  in series with 200 pF.

**Note 3:** The maximum power dissipation is a function of  $T_{J(\text{MAX})}$ ,  $\theta_{JA}$ . The maximum allowable power dissipation at any ambient temperature is  $P_D = (T_{J(\text{MAX})} - T_A)/\theta_{JA}$ . 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.

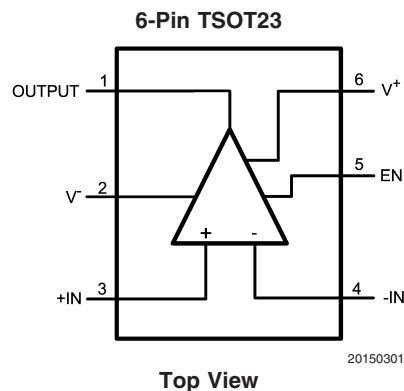
**Note 6:** Offset voltage average drift is determined by dividing the change in  $V_{OS}$  at the temperature extremes by the total temperature change.

**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.

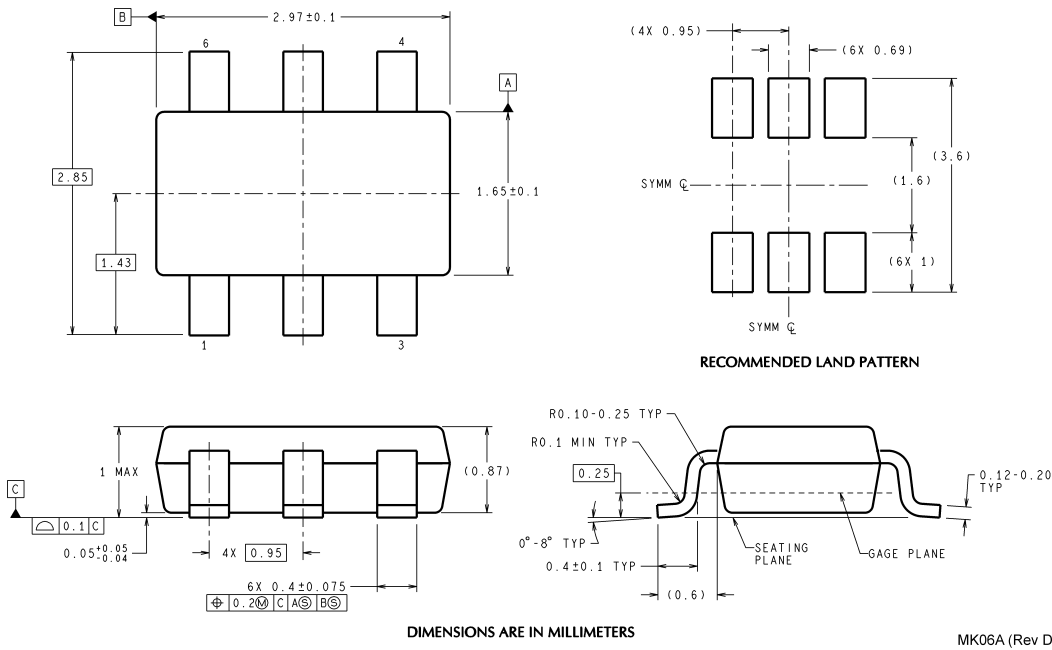
## Connection Diagram



## 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**

MK06A (Rev D)

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