

MNLM611AM-X REV 1AL

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OPERATIONAL AMPLIFIER AND ADJUSTABLE REFERENCE
General Description

The LM611 consist of a single-supply op-amp and a programmable voltage reference in one space saving 8-pin package. The op-amp out-performs most single-supply op-amps by providing higher speed and bandwidth along with low supply current. This device was specifically designed to lower cost and board space requirements in transducer, test, measurement and data acquisition systems.

Combining a stable voltage reference with a wide output swing op-amp makes the LM611 ideal for single supply transducers, signal conditioning and bridge driving where large common-mode-signals are common. The voltage reference consists of a reliable band-gap design that maintains low dynamic output impedance (1 ohm typical), excellent initial tolerance (0.6%), and the ability to be programmed from 1.2V to 6.3V via two external resistors. The voltage reference is very stable even when driving large capacitive loads, as are commonly encountered in CMOS data acquisition systems.

As a member of National's Super-Block™ family, the LM611 is a space-saving monolithic alternative to a multichip solution, offering a high level of integration without sacrificing performance.

Industry Part Number

LM611

NS Part Numbers

LM611AMJ/883

Prime Die

LM611

Processing

MIL-STD-883, Method 5004

Quality Conformance Inspection

MIL-STD-883, Method 5005

Subgrp	Description	Temp (°C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55

(Absolute Maximum Ratings)

(Note 1)

Voltage on Any Pins Except VR (referred to V-pin)	36V (Max) -0.3V (Min)
Current through Any Input Pin	± 20mA
Differential Input Voltage Military and Industrial	± 36V
Storage Temperature Range	-65C ≤ TA ≤ +150
Maximum Junction Temperature	150 C
Thermal Resistance (Note 3)	
N Package	100 C/W
M Package	150 C/W
ESD Tolerance (Note 4)	± 1 kV

- Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- Note 2: More accurately, it is excessive current flow, with resulting excess heating, that limits the voltages on all pins. When any pin is pulled a diode drop below V_{CC} , a parasitic NPN transistor turns ON. No latch-up will occur as long as the current through that pin remains below the Maximum Rating. Operation is defined and unpredictable when any parasitic diode or transistor is conducting.
- Note 3: Junction temperature may be calculated using $T_J = T_A + P_D \theta_{JA}$. The given thermal resistance is worst-case for packages in sockets in still air. For packages soldered to copper-clad board with dissipation from one op amp or reference output transistor, normal θ_{JA} is 90 C/W for the N package and 135 C/W for the M Package.
- Note 4: Human body model, 100 pF discharged through a 1.5K Ohms resistor.

Electrical Characteristics

DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: $V_- = Gnd = 0V$, $V_+ = 5V$, $V_{cm} = V_{out} = V_+/2$, $I_r = 100\mu A$ Feedback Pin Shorted to Gnd

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
I _{cc}	Total Supply Current	R _{load} = Infinity, $4V \leq V_+ \leq 36V$				300	μA	1
						320	μA	2, 3
V _s	Supply Voltage Range				2.8	36	V	1
					3.0	36	V	2, 3

DC PARAMETERS: Operational Amplifier

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: $V_- = Gnd = 0V$, $V_+ = 5V$, $V_{cm} = V_{out} = V_+/2$, $I_r = 100\mu A$ Feedback Pin Shorted to Gnd

V _{io1}	Offset Voltage Over V ₊ Range	$4V \leq V_+ \leq 36V$			-3.5	3.5	mV	1
						-6.0	6.0	mV
V _{io2}	Offset Voltage Over V _{cm} Range	V _{cm} =0V through V _{cm} =(V ₊ -1.4V) Room, (V ₊ -1.8V) Hot and Cold.			-3.5	3.5	mV	1
						-6.0	6.0	mV
I _{ib}	Input bias Current				-25	25	nA	1
						-30	30	nA
I _{io}	Input Offset Current				-4	4	nA	1
						-5	5	nA
CMRR	Common-Mode Rejection Ratio	V ₊ =30V, $0V \leq V_{cm} \leq 1.4V$ (Room) and $\leq 1.8V$ (Over Temp) CMRR = $20\log(\Delta V_{cm}/\Delta V_{io})$			80		dB	1
						75		dB
PSRR	Power Supply Rejection Ratio	$4V \leq V_+ \leq 30V$, $V_{cm} = V_+/2$ PSRR= $20\log(\Delta V_+/\Delta V_{io})$			80		dB	1
						75		dB
I _{out}	Output Source Current	V _{out} =V ₊ -2.5V, V _{in} = 0V, V _{-in} = -0.3V				-20	mA	1
						-13	mA	2, 3
I _{sink}	Output Sink Current	V _{out} =1.6V, V _{in} = 0V, V _{-in} = 0.3V			14		mA	1
						8	mA	2, 3
I _{short}	Short Circuit Current	V _{out} =0V, V _{in} = 3V, V _{-in} = 2V, Source				50	mA	1
						60	mA	2, 3
		V _{out} =5V, V _{in} = 2V, V _{-in} = 3V, Sink				60	mA	1
						80	mA	2, 3

Electrical Characteristics

DC PARAMETERS: Voltage Reference

(The following conditions apply to all the following parameters, unless otherwise specified.)
 DC: $V^- = \text{Gnd} = 0\text{V}$, $V^+ = 5\text{V}$, $V_{\text{cm}} = V_{\text{out}} = V^+/2$, $I_{\text{r}} = 100\mu\text{A}$ Feedback Pin Shorted to Gnd

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vr	Voltage Reference		1		1.2365	1.2515	V	1
Delta Vr/Delta Ir	Vr Change with Current	Vr(100uA) - Vr(17uA)			-1	1	mV	1
					-1.1	1.1	mV	2, 3
		Vr(10mA) - Vr(100uA)	2		-5	5	mV	1
			2		-5.5	5.5	mV	2, 3
R	Resistance	Delta Vr(10mA to 100uA)/9.9mA	3			0.51	Ohms	1
			3			0.56	Ohms	2, 3
		Delta Vr(100uA to 17uA)/83uA	3			12	Ohms	1
			3			13	Ohms	2, 3
Delta Vr/Delta Vro	Vr Change with High Vro	Vr(Vro=Vr)-Vr(Vro=5.0V) (3.76V between Anode and FEEDBACK)				7	mV	1
						10	mV	2, 3
Delta Vr/Delta V+	Vr Change with V+ Change	Vr(V+=5V)-Vr(V+=36V)			-1.2	1.2	mV	1
					-1.3	1.3	mV	2, 3
		Vr(V+=5V)-Vr(V+=3V)			-1	1	mV	1
					-1.5	1.5	mV	2, 3
Del Vr/Del Vanode	Vr Change with Vanode Change	V+= V+max, Delta Vr=Vr(at Vanode=V-=Gnd) -Vr(at Vanode=V+ -1.0V)				1.5	mV	1
						3.0	mV	2, 3
Ib(If)	FEEDBACK Bias Current	Ifb; Vanode <= Vfb <= 3.76V				35	nA	1
						40	nA	2, 3

DC PARAMETERS: Operational Amplifiers

(The following conditions apply to all the following parameters, unless otherwise specified.)
 DC: $V^- = \text{Gnd} = 0\text{V}$, $V^+ = 5\text{V}$, $V_{\text{cm}} = V_{\text{out}} = V^+/2$, $I_{\text{r}} = 100\mu\text{A}$ Feedback Pin Shorted to Gnd

Av	Open Loop Voltage Gain	Rl=10KOhms, V+=30V, 5V <= Vout <= 25V			100		V/mV	4
					40		V/mV	5, 6
Vol	Output Voltage Swing High	Rl = 10K Ohms, V+ = 36V			V+-1.7		V	4
					v+-1.9		V	5, 6
Vo2	Output Voltage Swing Low	Rl = 10K Ohms to V+, V+ = 36V				V-+0.9	V	4
						V-+1.0	V	5, 6

Electrical Characteristics

AC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
 AC: $V^- = \text{Gnd} = 0\text{V}$, $V^+ = 5\text{V}$, $V_{\text{cm}} = V_{\text{out}} = V^+ / 2$, $I_{\text{r}} = 100\mu\text{A}$ Feedback Pin Shorted to Gnd

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Sr	Slew Rate	$V^+ = 30\text{V}$	4		0.55		V/ μs	7
			4		0.45		V/ μs	8A, 8B

Note 1: V_{ro} is the reference output voltage, which may be set for 1.2V to 5.0V. V_{r} is the V_{ro} -to Feedback voltage (nominally 1.244V).

Note 2: Low contact resistance is required for accurate measurement.

Note 3: Guaranteed by V_{r} change with current.

Note 4: Slew rate is measured with the op amp in a voltage follower configuration. For rising slew rate, the input voltage is driven from 5V to 25V, and the output voltage transition is sampled at 10V and 20V. For falling slew rate, the input voltage is driven from 25V to 5V, and the output voltage transition is sampled at 20V and 10V.

Revision History

Rev	ECN #	Rel Date	Originator	Changes
0BL	M0001697	08/25/99	Barbara Lopez	Changed: MNL611AM-X Rev. 0AL to MNL611AM-X Rev. 0BL.
1AL	M0003388	08/25/99	Rose Malone	Update MDS: MNL611AM-X, Rev. 0BL to MNL611AM-X, Rev. 1AL. Changed conditions for: Delta Vr/Delta Vro From Vr(Vro=Vr)-Vr(Vro=6.3V), (5.06V between Anode and FEEDBACK) To Vr(Vro=Vr)-Vr(Vro=5.0V), (3.76V between Anode and FEEDBACK), Ib(If) From Ifb; Vanode <= Vfb <= 5.06V To Ifb; Vanode <= Vfb <= 3.76V, and Note 1.