National Semiconductor

MICROCIRCUIT DATA SHEET

MNLM101A-X REV 0A0

Original Creation Date: 06/21/95
Last Update Date: 03/17/97
Last Major Revision Date: 02/18/97

OPERATION AMPLIFIER

General Description

The LM101A is a general purpose operational amplifier which features improved performance over industry standards such as the LM709. Advanced processing techniques make possible an order of magnitude reduction in input currents, and a redesign of the biasing circuitry reduces the temperature drift of input current. Improved specifications include:

- Offset voltage 3 mV maximum over temperature
- Input current 100 nA maximum over temperture
- Offset current 20 nA maximum over temperature
- Offsets guaranteed over entire common mode and supply voltage ranges
- Slew rate of 10V/uS as a summing amplifier

This amplifier offers many features which make its application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, and freedom from oscillations and compensation with a single 30 pF capacitor. It has advantages over internally compensated amplifiers in that the frequency compensation can be tailored to the particular application. For example, in low frequency circuits it can be overcompensated for increased stability margin. Or the compensation can be optimized to give more than a factor of ten improvement in high frequency performance for most applications.

In addition, the device provides better accuracy and lower noise in high impedance circuitry. The low input currents also make it particularly well suited for long interval integrators or timers, sample and hold circuits, and low frequency waveform generators. Further, replacing circuits where matched transistor pairs buffer the inputs of conventional IC op amps, it can give lower offset voltage and a drift at a lower cost.

Industry Part Number

LM101A

Prime Die

LM101F

NS Part Numbers

LM101AH/883
LM101AJ-14/883
LM101AJ/883
LM101AW/883

Processing

MIL-STD-883, Method 5004

Quality Conformance Inspection

MIL-STD-883, Method 5005

Subgrp	Description	Temp (^{O}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)

Supply Voltage	±22V
Differential Input Voltage	±30V
Input Voltage (Note 3)	±15V
Ouput Short Circuit Duration (Note 4)	Continuous
Operating Ambient Temperature Range	-55 C to +125 C
Maximum Junction Temperature	150 C
Power Dissipation at TA = 25C (Note 2)	
H-Package (Still Air)	500 mW
H-Package (500LF/Min Air Flow)	1200 mW
J-Package	1000 mW
J-14-Package	TBD
W-Package	TBD
Thermal Resistance	
ThetaJA	
H-Pkg (Still Air)	165 C/W
H-Pkg (500LF/Min Air flow)	67 C/W
J-Pkg (Still Air)	110 C/W
J-Pkg (500LF/Min Air flow)	TBD
J-14-Pkg (Still Air)	TBD
J-14-Pkg (500LF/Min Air flow)	TBD
W-Pkg (Still Air)	233 C/W
W-Pkg (500LF/Min Air flow)	155 C/W
ThetaJC	
H-Pkg	25 C/W
J-Pkg	TBD
J-14-Pkg	TBD
W-Pkg	26 C/W
Storage Temperature Range	-65 C to +150 C
Lead Temperature (Soldering, 10 seconds)	300 C
ESD Tolerance (Note 5)	2000V

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: The maximum power dissipation must be derated at elevated temperatures and is dictated by Tjmax (maximum junction temperature), ThetaJA (package junction to ambient thermal resistance), and TA (ambient temperature). The maximum allowable power dissipation at any temperature is Pdmax = (Tjmax - TA)/ThetaJA or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 4: Continuous short circuit is allowed for case temperatures to 125 C and ambient temperatures to 75 C for LM101A.

Note 5: Human body model, 100 pF discharged through 1.5K Ohms.

Electrical Characteristics

DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: Vcc = ±20V, Vcm = 0

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vio	Input Offset Voltage	Vcm = -15V, Rs = 50 Ohms			-2	2	mV	1
					-3	3	mV	2, 3
		Vcm = 15V, Rs = 50 Ohms			-2	2	mV	1
					-3	3	mV	2, 3
		Rs = 50 Ohms			-2	2	mV	1
					-3	3	mV	2, 3
		Vcc = ±5V, Rs = 50 Ohms			-2	2	mV	1
		Vcc = ±5V, Rs = 50 Ohms			-3	3	mV	2, 3
Iio	Input Offset Current	Vcm = -15V			-10	10	nA	1
					-20	20	nA	2, 3
		Vcm = 15V			-10	10	nA	1
					-20	20	nA	2, 3
					-10	10	nA	1
					-20	20	nA	2, 3
		Vcc = ±5V			-10	10	nA	1
		Vcc = ±5V			-20	20	nA	2, 3
Iib+	Input Bias Current	Vcm = -15V			1	75	nA	1
					1	100	nA	2, 3
		Vcm = 15V			1	75	nA	1
					1	100	nA	2, 3
					1	75	nA	1
					1	100	nA	2, 3
		Vcc = ±5V			1	75	nA	1
		Vcc = ±5V			1	100	nA	2, 3

Electrical Characteristics

DC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: Vcc = ±20V, Vcm = 0

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Iib-	Input Bias Current	Vcm = -15V			1	75	nA	1
					1	100	nA	2, 3
		Vcm = 15V			1	75	nA	1
					1	100	nA	2, 3
					1	75	nA	1
					1	100	nA	2, 3
		Vcc = ±5V			1	75	nA	1
		Vcc = ±5V			1	100	nA	2, 3
PSRR+	Power Supply Rejection Ratio	+Vcc=+20V and +5V, -Vcc=-20V, Rs=50 Ohms			80		dB	1, 2, 3
PSRR-	Power Supply Rejection Ratio	+Vcc=+20V, -Vcc=-20V and -5V, Rs=50 Ohms			80		dB	1, 2, 3
CMRR	Common Mode Rejection Ratio	-15V <=Vcm <=15V, Rs = 50 Ohms			80		dB	1, 2, 3
Icc	Supply Current					3	mA	1
						2.5	mA	2
						3.5	mA	3
VioAdj+	Input Offset Voltage Adjust				4		mV	1, 2, 3
VioAdj-	Input Offset Voltage Adjust					-4	mV	1, 2, 3
Ios+	Short Circuit Current				-45	-7	mA	1, 2, 3
Ios-	Short Circuit Current				7	45	mA	1, 2, 3
Vin	Input Voltage Range	Vcc = ±20V	1		-15	15	V	1, 2, 3
Avs+	Large Signal Gain	Vcc = ±15V, Rs = 0, Rl=2K Ohms, Vo=10V			50		V/mV	4
		Vcc = ±15V, Rs = 0, Rl=2K Ohms, Vo=10V			25		V/mV	5, 6
Avs-	Large Signal Gain	Vcc = ±15V, Rs = 0, Rl=2K Ohms, Vo=-10V			50		V/mV	4
		Vcc = ±15V, Rs = 0, Rl=2K Ohms, Vo=-10V			25		V/mV	5, 6
Rin	Input Resistance		2		1.5		MOhms	4
			2		0.5		MOhms	5, 6

Electrical Characteristics

DC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: Vcc = ±20V, Vcm = 0

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vop+	Output Voltage Swing	Rl = 10K Ohms			16		V	4, 5, 6
		Rl = 2K Ohms			15		V	4, 5, 6
		Rl = 10K Ohms, Vcc = ±15V			12		V	4, 5, 6
		Rl = 2K Ohms, Vcc = ±15V			10		V	4, 5, 6
Vop-	Output Voltage Swing	Rl = 10K Ohms				-16	V	4, 5, 6
		Rl = 2K Ohms				-15	V	4, 5, 6
		Rl = 10K Ohms, Vcc = ±15V				-12	V	4, 5, 6
		Rl = 2K Ohms, Vcc = ±15V				-10	V	4, 5, 6

AC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: Vcc = ±20V, Rl = 2K Ohms, Av = 1

Sr+	Slew Rate	Vin = -5V to 5V				0.2	V/uS	7
Sr-	Slew Rate	Vin = 5V to -5V				0.2	V/uS	7
Gbw	Gain Bandwidth	Vin = 50mVrms, f = 20KHz				0.25	MHz	7

Note 1: Parameter guaranteed by the input conditions of several DC parameters.
Note 2: Parameter guaranteed, not tested.