National Semiconductor

MICROCIRCUIT DATA SHEET

MNLM2991-X REV 0D1

Original Creation Date: 09/06/95
Last Update Date: 12/15/98
Last Major Revision Date: 09/06/95

NEGATIVE LOW DROPOUT ADJUSTABLE REGULATOR

General Description

The LM2991 is a low dropout adjustable negative regulator with a output voltage range between -2V to -25V. The LM2991 provides up to 1A of load current and features a $\overline{ON}$/Off pin for remote shutdown capability.

The LM2991 uses new circuit design techniques to provide a low dropout voltage, low quiescent current and low temperature coefficient precision reference. The dropout voltage at 1A load current is typically 0.6V and a guaranteed worst-case maximum of 1V over the entire operating temperature range. The quiescent current is typically 1mA with a 1A load current and an input-output voltage differential greater than 3V. A unique circuit design of the internal bias supply limits the quiescent current to only 9mA (typical) when the regulator is in the dropout mode (Vout - Vin $\leq$ 3V).

The LM2991 is short-circuit proof, and thermal shutdown includes hysteresis to enhance the reliability of the device when inadvertently overloaded for extended periods.

Industry Part Number

LM2991

NS Part Numbers

LM2991J-QML*
LM2991J-QMLV**
LM2991WG-QML***

Prime Die

LM2991

Controlling Document

See Features Page

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

Features

- Output voltage adjustable from -2V to -25V
- Output current in excess of 1A
- Dropout voltage typically 0.6V at 1A load
- Low quiescent current
- Internal short circuit current limit
- Internal thermal shutdown with hysteresis
- TTL, CMOS compatible ON/OFF switch
- Functional complement to the LM2941 series
- SMD : 5962-9650501QEA*, VEA**, QXA***

Applications

- Post switcher regulator
- Local, on-card, regulation
- Battery operated equipment

(Absolute Maximum Ratings)

(Note 1)

Input Voltage		-26V to +0.3V
Power Dissipation (Note 2, 3)		Internally Limited
Operating Temperature Range (Tj)		-55 C to +125 C
Maximum Junction Temperature (Tjmax)		150 C
Storage Temperature Range		-65 C to +150 C
Thermal Resistance (Note 3)		
ThetaJA		
CERAMIC DIP	(Still Air @ 0.5 C/W)	75 C/W
	(500LF/Min Air flow @ 0.5 C/W)	35 C/W
CERAMIC SOIC	(Still Air @ 0.5 C/W)	119 C/W
	(500LF/Min Air flow @ 0.5 C/W)	73 C/W
ThetaJC		
CERAMIC DIP		5 C/W
CERAMIC SOIC		3 C/W
Package Weight (Typical)		TBD
Lead Temperature (Soldering, 10 seconds)		260 C
ESD Susceptibility (Note 4)		1.5kV

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 specification 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. If this dissipation is exceeded, the die temperature will rise above 125 C and the LM2991 will go into thermal shutdown.

Note 3: The package material for these devices allows much improved heat transfer over our standard ceramic packages. In order to take full advantage of this improved heat transfer, heat sinking must be provided between the package base (directly beneath the die), and either metal traces on, or thermal vias through, the printed circuit board. Without this additional heat sinking, device power dissipation must be calculated using junction-to-ambient, rather than junction-to-case, thermal resistance. It must not be assumed that the device leads will provide substantial heat transfer out of the package, since the thermal resistance of the leadframe material is very poor, relative to the material of the package base. The stated junction-to-case thermal resistance is for the package material only, and does not account for the additional thermal resistance between the package base and the printed circuit board. The user must determine the value of the additional thermal resistance and must combine this with the stated value for the package, to calculate the total allowed power dissipation for the device.

Note 4: Human body model, 100pF discharge through a 1.5K Ohms resistor.

Recommended Operating Conditions

(Note 1)

Maximum Input Voltage (Operational)

-26V

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.

Electrical Characteristics

DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: Vin = -10V, Vo = -3V, Io = 1A, Co = 47uF, R1 = 2.7K, Tj = 25 C

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vref	Reference Voltage	5mA ≤ Io ≤ 1A			-1.234	-1.186	V	1
		5mA ≤ Io ≤ 1A, Vo - 1V ≥ Vin ≥ -26V			-1.27	-1.15	V	2, 3
Vout	Output Voltage Range					-3	V	1
		Vin = -26V			-24		V	1
					+25		V	2, 3
VRLN	Line Regulation	Io = 5mA, Vo - 1V ≥ Vin ≥ -26V			-26	+26	mV	1, 2, 3
VRLD	Load Regulation	50mA ≤ Io ≤ 1A			-12	+12	mV	1
		50mA ≤ Io ≤ 1A			-15	+15	mV	2, 3
V DO	Dropout Voltage	Io = 0.1A, Delta Vo ≤ 100mV				0.2	V	1
		Io = 0.1A, Delta Vo ≤ 100mV				0.3	V	2, 3
		Io = 1A, Delta Vo ≤ 100mV				0.8	V	1
		Io = 1A, Delta Vo ≤ 100mV				1	V	2, 3
I q	Quiescent Current	Io ≤ 1A				5	mA	1, 2, 3
	Dropout Quiescent Current	Vin = Vo, Io ≤ 1A				50	mA	1, 2, 3
R R	Ripple Rejection	Vripple = 1Vrms, Fripple = 1KHz, Io = 5mA			50		dB	1
V O N	Output Noise	10Hz - 100KHz, Io = 5mA				450	uV	1
						500	uV	2, 3
	$\overline{ON}$/OFF Input Voltage	(Vout:ON)				0.8	V	1, 2, 3
	$\overline{ON}$/OFF Input Voltage	(Vout:OFF)			2.4		V	1, 2, 3
	$\overline{ON}$/OFF Input Current	$V_{\overline{ON}}$/OFF = 0.8V (Vout:ON)				10	uA	1
	$\overline{ON}$/OFF Input Current	$V_{\overline{ON}}$/OFF = 0.8V (Vout:ON)				25	uA	2, 3
	$\overline{ON}$/OFF Input Current	$V_{\overline{ON}}$/OFF = 2.4V (Vout:OFF)				100	uA	1
	$\overline{ON}$/OFF Input Current	$V_{\overline{ON}}$/OFF = 2.4V (Vout:OFF)				150	uA	2, 3
I l	Output Leakage Current	Vin = -26V, $V_{\overline{ON}}$/OFF = 2.4V, Vout = 0V				250	uA	1
		Vin = -26V, $V_{\overline{ON}}$/OFF = 2.4V, Vout = 0V				300	uA	2, 3

Electrical Characteristics

DC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: Vin = -10V, Vo = -3V, Io = 1A, Co = 47uF, R1 = 2.7K, Tj = 25 C

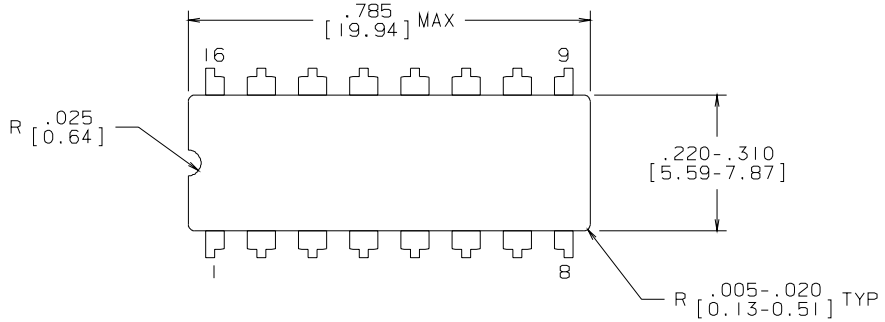
SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
I Limit	Current Limit	Vout = 0V			1.5	2.5	A	1
					1.0	4.0	A	2, 3

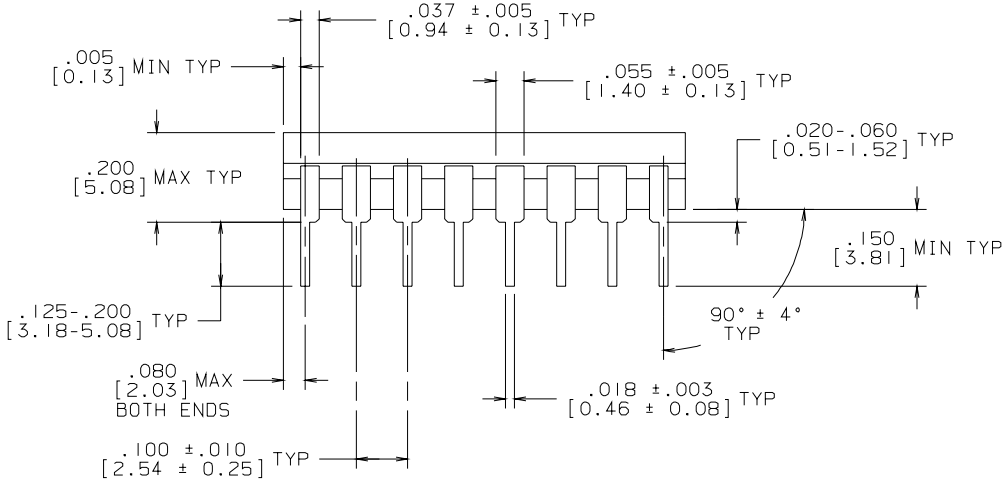
Graphics and Diagrams

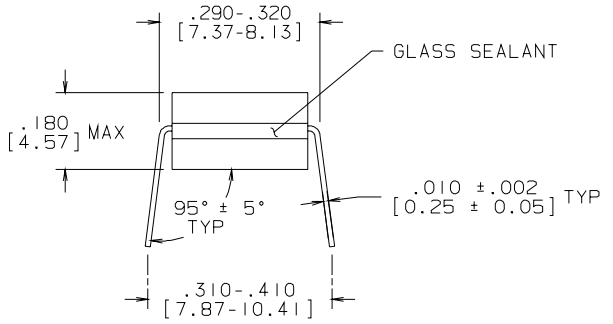
GRAPHICS#	DESCRIPTION
06323HRB3	CERDIP (J), 16 LEAD (B/I CKT)
06349HRA2	CERPACK (W), 16 LEAD (B/I CKT)
J16ARL	CERDIP (J), 16 LEAD (P/P DWG)
P000384A	CERAMIC SOIC (WG), 16 LEAD (PINOUT)
P000388A	CERDIP (J), 16 LEAD (PINOUT)
WG16ARC	CERAMIC SOIC (WG), 16 LEAD (P/P DWG)

See attached graphics following this page.

REVISIONS				
LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
L	REVISE PER CURRENT STD; REDRAW	09996	09/15/93	TL/







MIL/AERO CONFIGURATION CONTROL

MIL-M-38510 CONFIGURATION CONTROL

CONTROLLING DIMENSION: INCH

APPROVALS	DATE
DRAWN T. LEQUANG	09/15/93
DFTG. CHK.	
ENGR. CHK.	
APPROVAL	

NATIONAL SEMICONDUCTOR CORPORATION
2900 Semiconductor Drive, Santa Clara, CA 95052-8090

CERDIP (J), 16 LEAD

PROJECTION

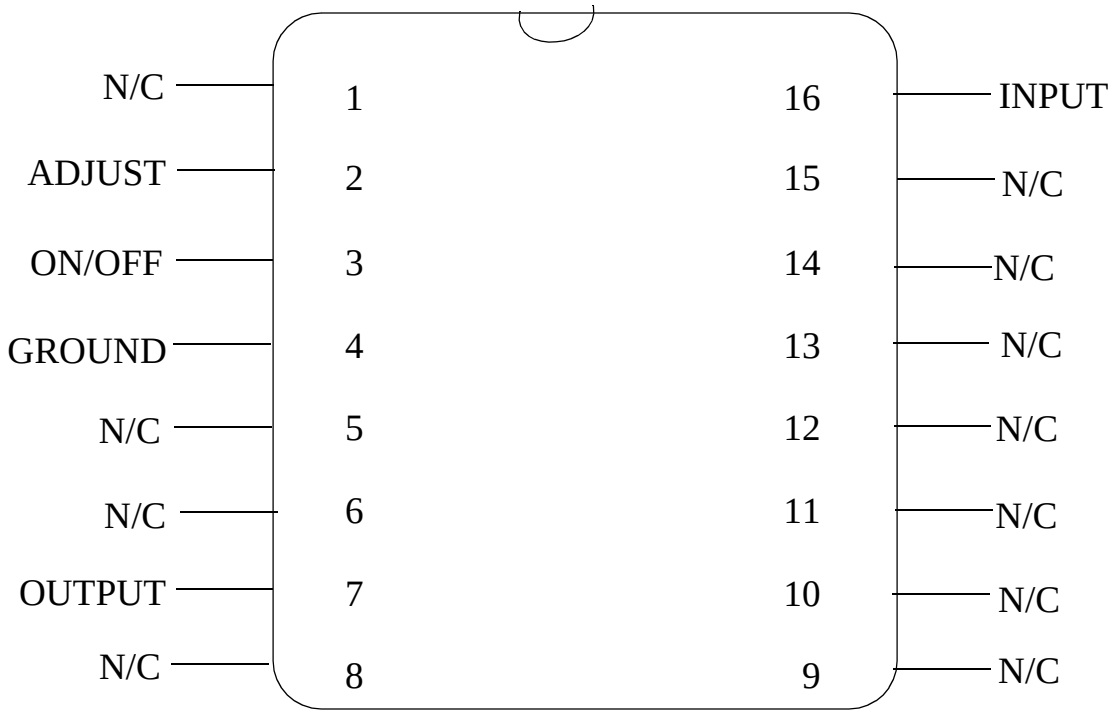
INCH [MM]

SCALE	SIZE	DRAWING NUMBER	REV
N/A	B	MKT-J16A	L

DO NOT SCALE DRAWING | SHEET 1 OF 1

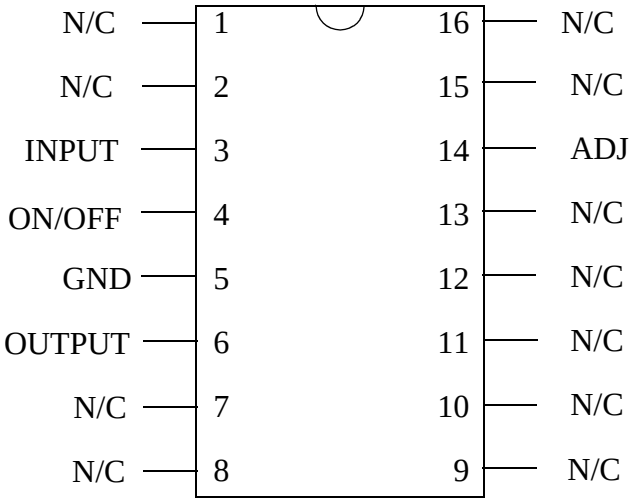
NOTES: UNLESS OTHERWISE SPECIFIED

1. LEAD FINISH TO BE 200 MICROINCHES / 5.08 MICROMETERS MINIMUM SOLDER MEASURED AT THE CREST OF THE MAJOR FLATS.
2. JEDEC REGISTRATION MO-036, VARIATION AD, DATED 04/1981.



LM2991WG
16 - LEAD CERAMIC SOIC
CONNECTION DIAGRAM
TOP VIEW
P000384A

National Semiconductor™
MIL/AEROSPACE OPERATIONS
2900 SEMICONDUCTOR DRIVE
SANTA CLARA, CA 95050



LM2991J

16 - LEAD DIP

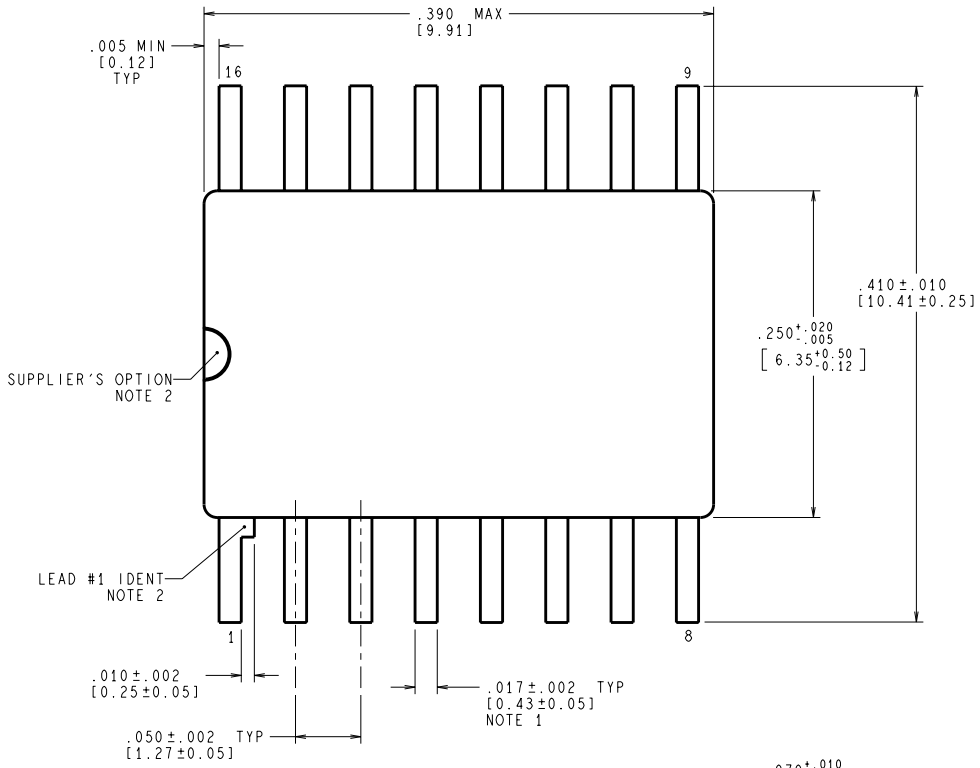
CONNECTION DIAGRAM

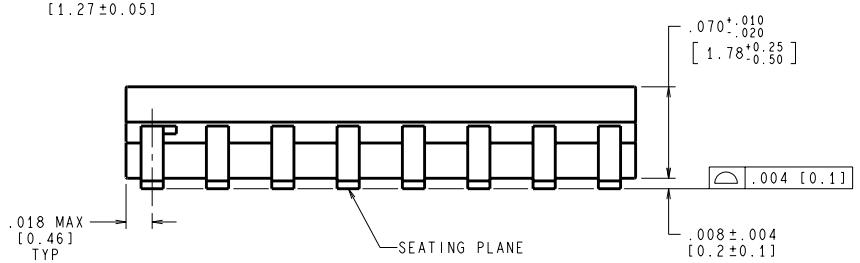
TOP VIEW

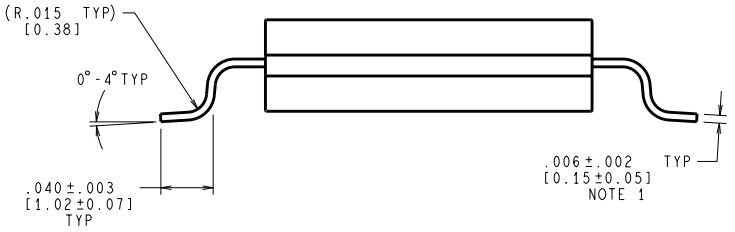
P000388A

National Semiconductor™
MIL/AEROSPACE OPERATIONS
2900 SEMICONDUCTOR DRIVE
SANTA CLARA, CA 95050

REVISIONS				
LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
A	RELEASE TO DOCUMENT CONTROL	11376	02/29/1996	MS/KH
B	LD PITCH TOL WAS ±.005; CHANGE LD RADIUS TO REF DIM; REMOVE THE OTHER R.006±.002; DIM .040±.003 WAS .037±.003	11443	04/19/1996	MS/KH
C	R .015[0.38] WAS R .006[0.15]	11840	10/08/1997	TL/







NOTES: UNLESS OTHERWISE SPECIFIED

1. LEAD FINISH: SOLDER DIPPED WITH Sn60 OR Sn63 SOLDER CONFORMING TO MIL-PRF-38535 TO A MINIMUM THICKNESS OF 200 MICROINCHES/ 5.08 MICROMETERS. SOLDER MAY BE APPLIED OVER LEAD BASIS METAL OR Sn PLATE. MAXIMUM LIMIT MAY BE INCREASED BY .003 IN/ 0.08mm AFTER LEAD FINISH APPLIED.
2. LEAD 1 IDENTIFICATION SHALL BE:
   a) A NOTCH OR OTHER MARK WITHIN THIS AREA
   b) A TAB ON LEAD 1, EITHER SIDE
3. NO JEDEC REGISTRATION AS OF FEBRUARY 1996.

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535
CONFIGURATION CONTROL

APPROVALS	DATE
DRAWN: MARTA SUCHY	02/29/96
DFTG. CHK.	
ENGR. CHK.	

National Semiconductor
2900 Semiconductor dr, Santa Clara, CA 95052-8090

CERPACK, 16 LEAD, GULL WING

PROJECTION — INCH [MM]

SCALE	SIZE	DRAWING NUMBER	REV
N/A	C	(SC)MKT-WG16A	C

DO NOT SCALE DRAWING — SHEET 1 of 1

Revision History

Rev	ECN #	Rel Date	Originator	Changes
0B0	M0001490	05/19/98	Barbara Lopez	Changed: MNLM2991-X Rev. 0A0 to MNLM2991-X Rev. 0B0. Added power dissipation note for Aluminum Nitride package.
0C1	M0002862	12/15/98	Barbara Lopez	Updated MDS: MNLM2991-X Rev. 0B0 to MNLM2991-X Rev. 0C1. Added WG package to MDS. Updated B/I CKT and Pinout for J package. Added WG package graphics. Added Package Weight to Absolute section.
0D1	M0003138	12/15/98	Rose Malone	Update MDS: MNLM2991-X, Rev. 0C1 to MNLM2991-X, Rev. 0D1.