LM2990QML Negative Low Dropout Regulator

Check for Samples: LM2990QML

FEATURES

- 5% Output Accuracy over Entire Operating Range
- 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
- Functional Complement to the LM2940 Series

APPLICATIONS

- Post Switcher Regulator
- Local, On-Card, Regulation
- Battery Operated Equipment

DESCRIPTION

The LM2990 is a three-terminal, low dropout, 1 ampere negative voltage regulator available with a fixed output voltage of −5V.

The LM2990 uses new circuit design techniques to provide low dropout and low quiescent current. The dropout voltage at 1A load current is typically 0.6V and a ensured worst-case maximum of 1V over the entire operating temperature range. The quiescent current is typically 1 mA with 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 9 mA (typical) when the regulator is in the dropout mode ($V_{OUT} − V_{IN} \leq 3V$). Output voltage accuracy is ensured to ±5% over load, and temperature extremes.

The LM2990 short-circuit proof, and thermal shutdown includes hysteresis to enhance the reliability of the device when overloaded for an extended period of time.

Top View

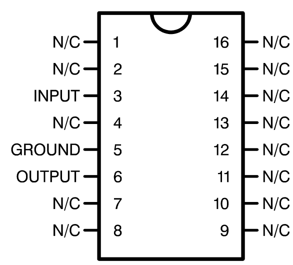
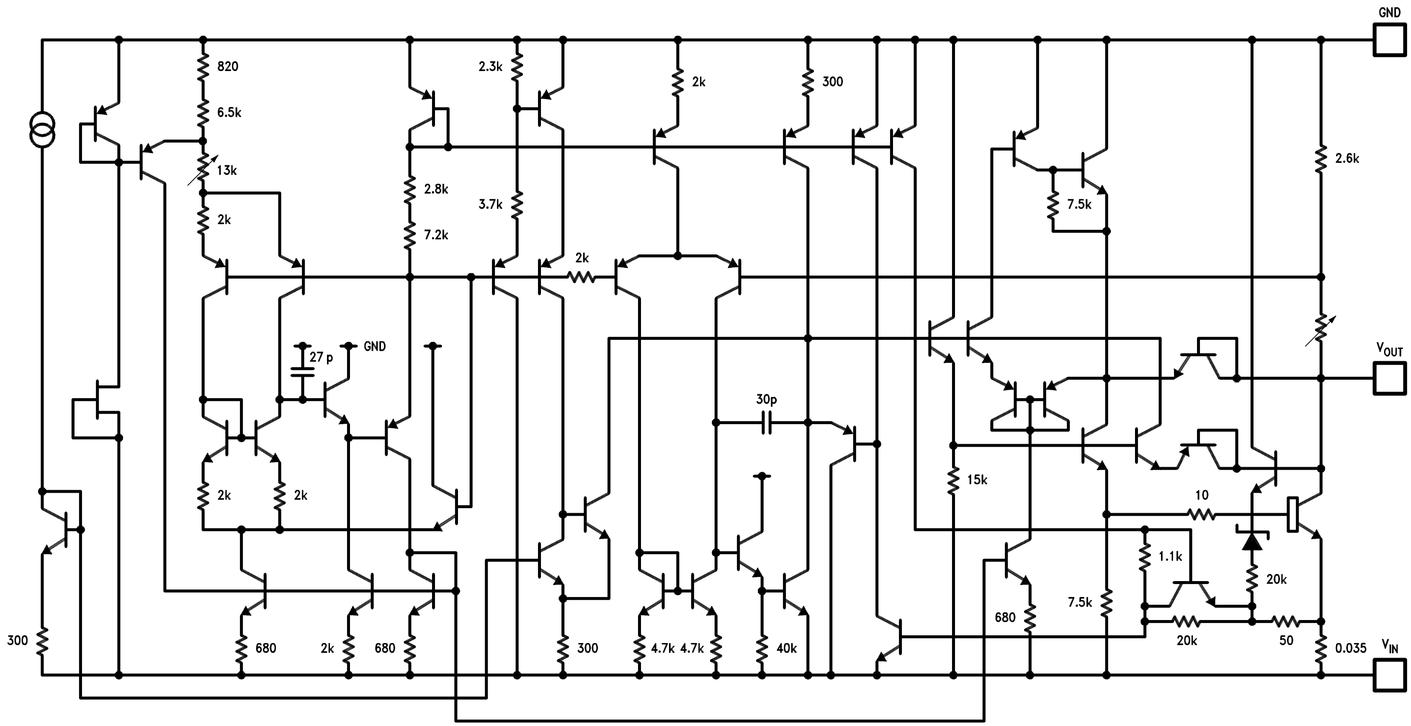


Figure 1. 16-Lead CDIP Package
See Package Number NFE0016A

Equivalent Schematic



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings[(1)]

Input Voltage			−26V to +0.3V
Power Dissipation[(2)]			Internally Limited
Junction Temperature (T_{Jmax})			150°C
Storage Temperature			−65°C ≤ T_A ≤ +150°C
Thermal Resistance	$θ_{JA}$	CDip (Still Air at 0.5°C/W)	75°C/W
		CDip (500LF/Min Air flow at 0.5°C/W)	35°C/W
	$θ_{JC}$	CDip[(3)]	5°C/W
Package Weight	CDip		TBD
Lead Temperature (Soldering, 10 sec.)			260°C
ESD Susceptibility[(4)]			2KV

(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 ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
(2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), $θ_{JA}$ (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/θ_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.
(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 $θ_{JA}$, rather than $θ_{JC}$, 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 $θ_{JC}$ 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.
(4) Human body model, 1.5 kΩ in series with 100 pF.

Recommended Operating Conditions[(1)]

Temperature Range (T_J)	−55°C ≤ T_J ≤ +125°C
Maximum Input Voltage (Operational)	−26V

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Quality Conformance Inspection

Table 1. Mil-Std-883, Method 5005 - Group A

Subgroup	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
12	Settling time at	+25
13	Settling time at	+125
14	Settling time at	-55

LM2990-5.0 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified. $V_{IN} = -5V + V_{O\ Nom}$, $I_O = 1A$, $C_O = 47\mu F$ (1)

Parameter		Test Conditions	Notes	Min	Max	Unit	Sub-groups
V_O	Output Voltage	$5mA \le I_O \le 1A$		-5.10	-4.90	V	1
				-5.25	-4.75	V	2, 3
V_{RLine}	Line Regulation	$I_O = 5mA$, $V_{O\ Nom} -1V > V_{IN} > -26V$			40	mV	1, 2, 3
V_{RLoad}	Load Regulation	$50mA \le I_O \le 1A$			70	mV	1
					100	mV	2, 3
V_{DO}	Dropout Voltage	$I_O = 0.1A$, $\Delta V_O \le 100mV$			0.3	V	1, 2, 3
		$I_O = 1A$, $\Delta V_O \le 100mV$			1.0	V	1, 2, 3
I_Q	Quiescent Current	$I_O \le 1A$			5.0	mA	1
					10	mA	2, 3
		$I_O = 1A$, $V_{IN} = V_{O\ Nom}$			50	mA	1, 2, 3
I_{OS}	Short Circuit Current	$R_L = 1\Omega$		1.5		A	1
			See (2)	1.3		A	2, 3
I_{Max}	Maximum Output Current		See (2)	1.5		A	1
RR	Ripple Rejection	$V_{Ripple} = 1V_{RMS}$, $F_{Ripple} = 1KHz$, $I_O = 5mA$		50		dB	1
V_{On}	Output Noise Voltage	10Hz-100Khz, $I_O = 5mA$			750	µV	1, 2, 3

(1) $V_{O\ Nom}$ is the nominal (typical) regulator output voltage, −5V.
(2) The −5V version, tested with a lower input voltage, does not reach the foldback current limit and therefore conducts a higher short circuit current level. If the LM2990 output is pulled above ground, the maximum allowed current sunk back into the LM2990 is 1.5A.

Definition of Terms

Dropout Voltage: The input-output voltage differential at which the circuit ceases to regulate against further reduction in input voltage. Measured when the output voltage has dropped 100 mV from the nominal value obtained at (V_O + 5V) input, dropout voltage is dependent upon load current and junction temperature.

Input Voltage: The DC voltage applied to the input terminals with respect to ground.

Input-Output Differential: The voltage difference between the unregulated input voltage and the regulated output voltage for which the regulator will operate.

Line Regulation: The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

Load Regulation: The change in output voltage for a change in load current at constant chip temperature.

Long Term Stability: Output voltage stability under accellerated life-test conditions after 1000 hours with maximum rated voltage and junction temperature.

Output Noise Voltage: The RMS AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

Quiescent Current: That part of the positive input current that does not contribute to the positive load current. The regulator ground lead current.

Ripple Rejection: The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

Temperature Stability of V_O: The percentage change in output voltage for a thermal variation from room temperature to either temperature extreme.

Typical Performance Characteristics

Dropout Voltage

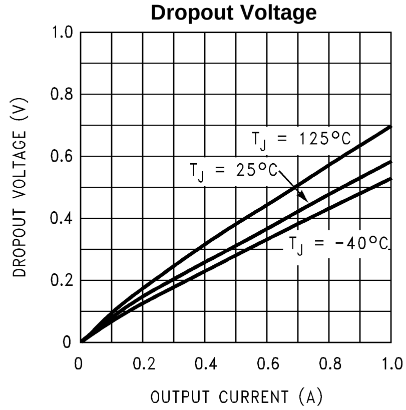


Figure 2.

Normalized Output Voltage

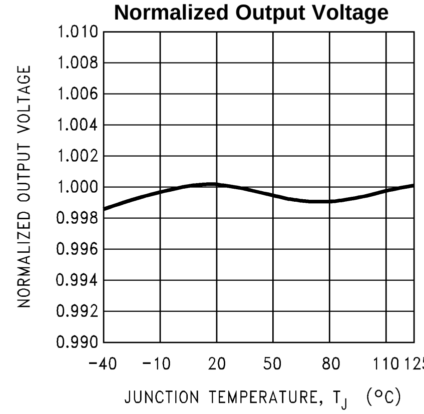


Figure 3.

LM2990-5.0
Quiescent Current

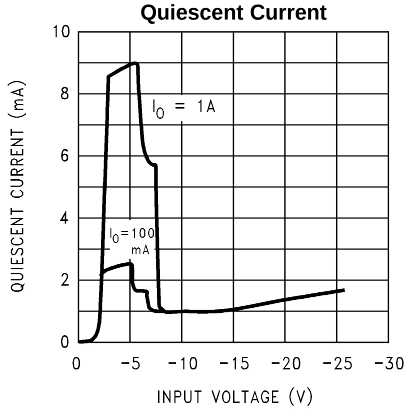


Figure 4.

LM2990-5.0
Low Voltage Behavior

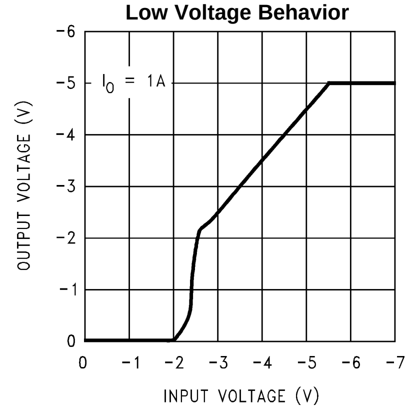


Figure 5.

LM2990-5.0
Line Transient Response

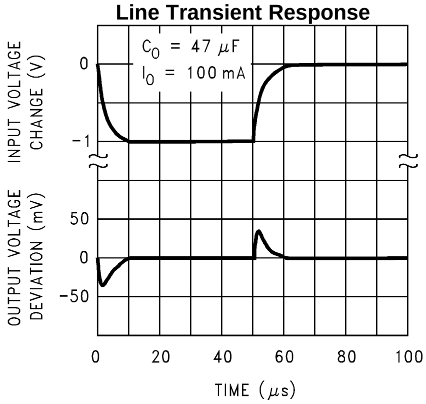


Figure 6.

LM2990-5.0
Load Transient Response

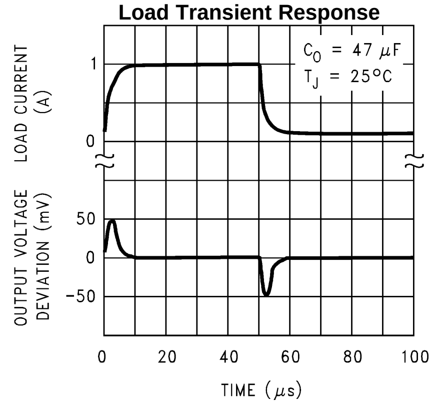


Figure 7.

Typical Performance Characteristics (continued)

LM2990-5.0
Ripple Rejection

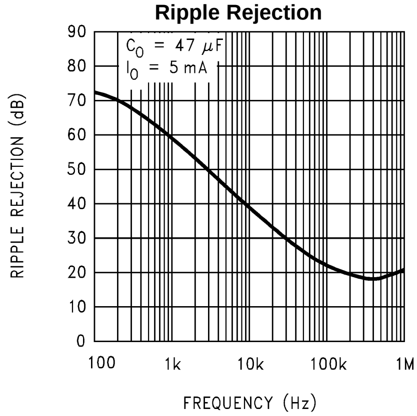


Figure 8.

LM2990-5.0
Output Impedance

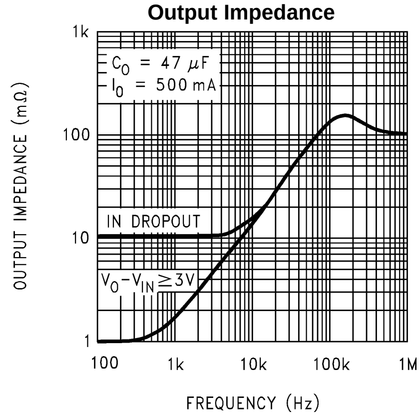


Figure 9.

Maximum Output Current

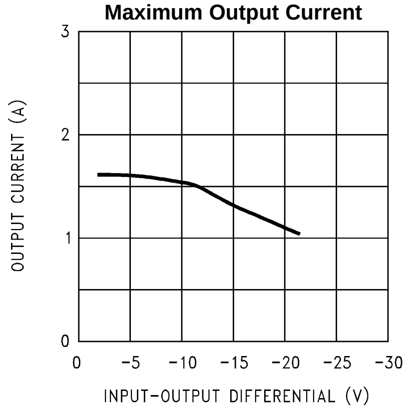


Figure 10.

Maximum Output Current

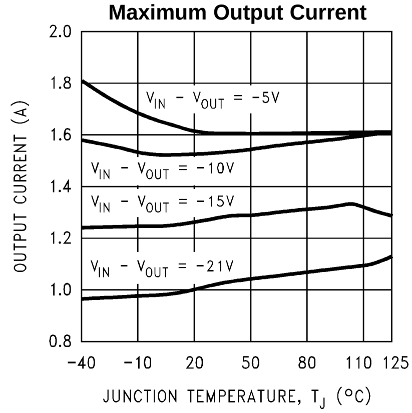
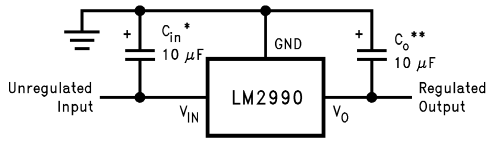


Figure 11.

TYPICAL APPLICATIONS



*Required if the regulator is located further than 6 inches from the power supply filter capacitors. A 1 μF solid tantalum or a 10 μF aluminum electrolytic capacitor is recommended.
**Required for stability. Must be at least a 10 μF aluminum electrolytic or a 1 μF solid tantalum to maintain stability. May be increased without bound to maintain regulation during transients. Locate the capacitor as close as possible to the regulator. The equivalent series resistance (ESR) is critical, and should be less than 10Ω over the same operating temperature range as the regulator.

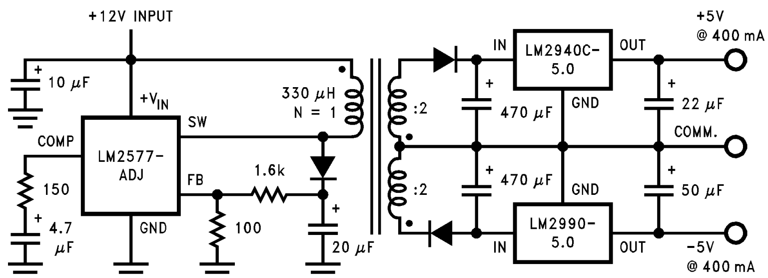


Figure 12. Post Regulator for an Isolated Switching Power Supply

The LM2940 is a positive 1A low dropout regulator; refer to its datasheet for further information.

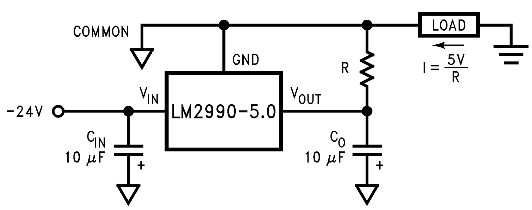


Figure 13. Fixed Current Sink

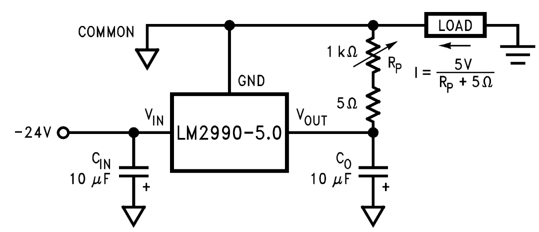


Figure 14. Adjustable Current Sink

Application Hints

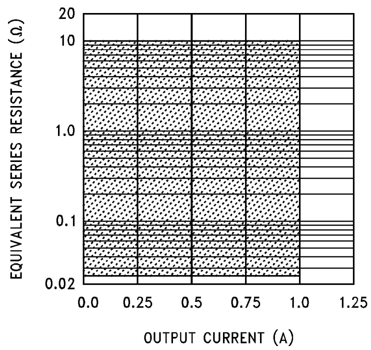
EXTERNAL CAPACITORS

The LM2990 regulator requires an output capacitor to maintain stability. The capacitor must be at least 10 μF aluminum electrolytic or 1 μF solid tantalum. The output capacitor's ESR must be less than 10Ω, or the zero added to the regulator frequency response by the ESR could reduce the phase margin, creating oscillations (refer to the graph on the right). An input capacitor, of at least 1 μF solid tantalum or 10 μF aluminum electrolytic, is also needed if the regulator is situated more than 6″ from the input power supply filter.

FORCING THE OUTPUT POSITIVE

Due to an internal clamp circuit, the LM2990 can withstand positive voltages on its output. If the voltage source pulling the output positive is DC, the current must be limited to 1.5A. A current over 1.5A fed back into the LM2990 could damage the device. The LM2990 output can also withstand fast positive voltage transients up to 26V, without any current limiting of the source. However, if the transients have a duration of over 1 mS, the output should be clamped with a Schottky diode to ground.

Figure 15. Output Capacitor ESR



REVISION HISTORY

Released	Revision	Section	Changes
12/08/2010	A	New Release, Corporate format	MDS data sheet converted into Corp. data sheet format. Data Sheet referencing Die NSID LM2990–5.0 MD8 and MW8 only. Package products are Code K no longer available. Archive the 3 MDS data sheets MNLM2990-5.0-X Rev 0B1, MNLM2990-12-X Rev 0B0, and MNLM2990-15-X Rev 0B0.

