National Semiconductor

LM2940C 1A Low Dropout Regulator

General Description

The LM2940C positive voltage regulator features the ability to source 1A of output current with an input-output differential of typically 0.5V and a maximum of 1V over the entire temperature range. Familiar regulator features such as internal current limit and thermal overload protection are also provided. Furthermore, a quiescent current reduction circuit has been added which reduces the ground current when the differential between the input voltage and the output voltage exceeds approximately 3V. The quiescent current with 1A of output current and an input-output differential of 5V is therefore only 30 mA. Higher quiescent currents only exist when the regulator is in the dropout mode ($V_{IN} - V_{OUT} \leq 3V$).

The low dropout voltage coupled with the high output current capability make the LM2940C useful in applications where the input voltage is maintained at a level within one or two volts of the output voltage to reduce power dissipation and increase overall system efficiency.

The LM2940C is particularly suited for applications where battery life and reverse installation of batteries is a concern.

For automotive temperature range (−40°C to +125°C) applications, refer to the LM2940 datasheet.

Features

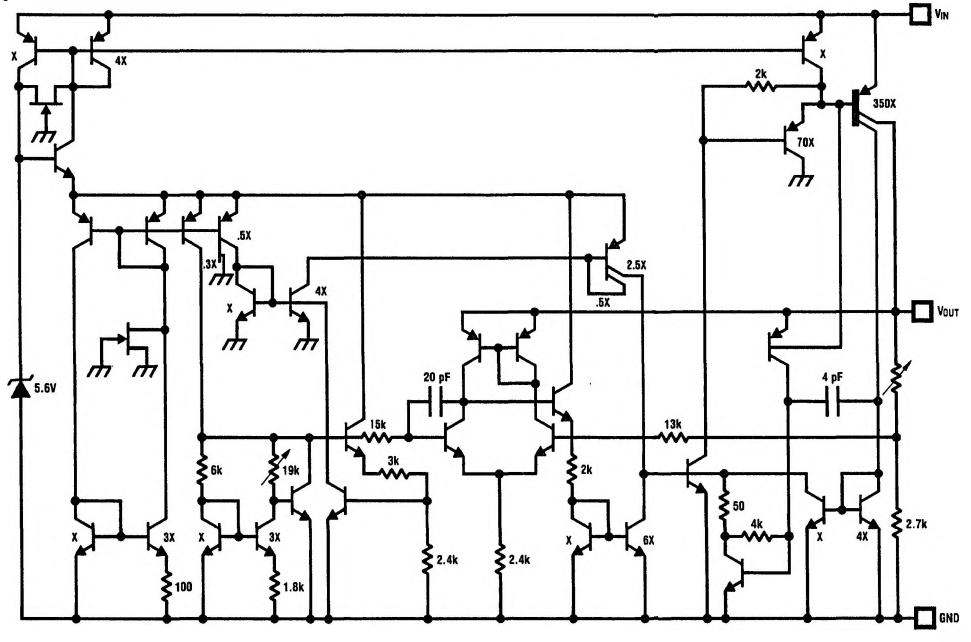
- Dropout voltage typically 0.5V @ I_O = 1A
- Output current in excess of 1A
- Output voltage trimmed before assembly
- Reverse battery protection
- Internal short circuit current limit
- Mirror image insertion protection
- 100% electrical burn-in in thermal limit

Output Voltages

LM2940CT-5.0	5V
LM2940CT-12	12V
LM2940CT-15	15V

For output voltages of 5V, 8V, and 10V, refer to the LM2940 datasheet.

Equivalent Schematic



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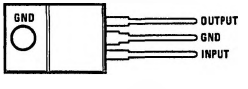
TO-220 3-Lead Plastic Package



Front View

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Order Number LM2940CT-5.0, LM2940CT-12, and LM2940CT-15
See NS Package T03B

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage	
Survival Voltage (≤ 1 ms)	45V
Operational Voltage	26V
Internal Power Dissipation (Note 1)	Internally limited
Operating Temp. Range (T_A)	0°C to +125°C
Maximum Junction Temperature	150°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	260°C
ESD Susceptability (Note 5)	2000V

Electrical Characteristics

$V_{IN} = V_O + 5V$, $I_O = 1A$, $C_{OUT} = 22\ \mu F$, $T_j = 25°C$, unless otherwise specified.

Output Voltage (V_O)		5V			12V			15V			Units
Parameter	Conditions	Typ	Tested Limit (Note 2)	Design Limit (Note 3)	Typ	Tested Limit (Note 2)	Design Limit (Note 3)	Typ	Tested Limit (Note 2)	Design Limit (Note 3)	
Output Voltage	5 mA ≤ I_O ≤ 1A	5.00	4.85 5.15	4.75 5.25	12.00	11.64 12.36	11.40 12.60	15.00	14.55 15.45	14.25 15.75	V_{MIN} V_{MAX}
		6.25V ≤ V_{IN} ≤ 26V			13.6V ≤ V_{IN} ≤ 26V			16.75V ≤ V_{IN} ≤ 26V			
Line Regulation	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5$ mA	20	50		20	120		20	150		mV_{MAX}
Load Regulation	50 mA ≤ I_O ≤ 1A	35	50		55	120		70	150		mV_{MAX}
Output Impedance	100 mADC and 20 mArms f_O = 120 Hz	35			80			100			mΩ
Quiescent Current	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5$ mA	10	15		10	15		10	15		mA_{MAX}
	$V_{IN} = V_O + 5V$, $I_O = 1A$	30	45	60	30	45	60	30	45	60	mA_{MAX}
Output Noise Voltage	10 Hz–100 kHz I_O = 5 mA	150			360			450			μVrms
Ripple Rejection	f_O = 120 Hz, 1 Vrms, I_O = 100 mA	72	60		66	54		64	52		dBmin
Long Term Stability		20			48			60			mV/1000 Hr
Dropout Voltage	I_O = 1A	0.5	0.8	1.0	0.5	0.8	1.0	0.5	0.8	1.0	V_{MAX}
	I_O = 100 mA	110	150	200	110	150	200	110	150	200	mV_{MAX}
Short Circuit Current	$V_{IN\ MAX}$ = 26V (Note 4)	1.9	1.6		1.9	1.6		1.9	1.6		A_{MIN}
Maximum Line Transient	$R_L = 100\Omega$, T ≤ 1 ms	55	45		55	45		55	45		V_{MIN}
		V_O < 6V			V_O < 13V			V_O < 16V			
Reverse Polarity DC Input Voltage	$R_L = 100\Omega$, $V_O \ge -0.6V$	−30	−15		−30	−15		−30	−15		V_{MIN}
Reverse Polarity, Transient Input Voltage	T ≤ 1 ms, $R_L = 100\Omega$	−55	−45	−45	−55	−45	−45	−55	−45	−45	V_{MIN}

Note 1: Thermal resistance without a heat sink for junction-to-case temperature is 3°C/W. Thermal resistance case-to-ambient is 50°C/W.

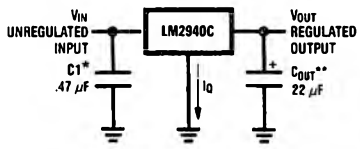
Note 2: Tested Limits are guaranteed and 100% production tested.

Note 3: Design Limits are guaranteed (but not 100% production tested) over the operating temperature and supply voltage range. These limits are not used to calculate outgoing quality levels.

Note 4: Output current will decrease with increasing temperature, but will not go below 1A at the maximum specified temperature.

Note 5: Human body model, 100 pF discharged through a 1.5 kΩ resistor.

Typical Application



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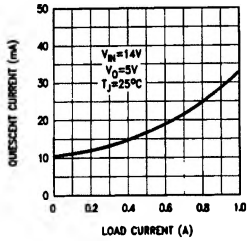
*Required if regulator is located far from power supply filter.

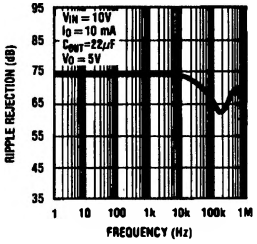
**C_{OUT} must be at least 22 μF to maintain stability. May be increased without bound to maintain regulation during transients. Locate as close as possible to the regulator. This capacitor must be rated over the same operating temperature range as the regulator. The equivalent series resistance (ESR) of this capacitor is critical; see curve.

Typical Performance Characteristics

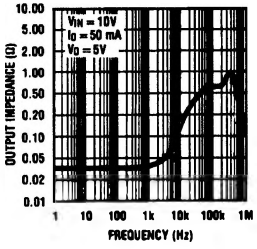
Quiescent Current



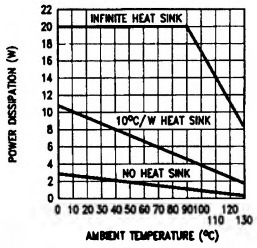
Ripple Rejection



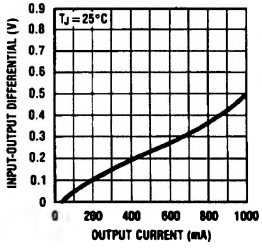
Output Impedance



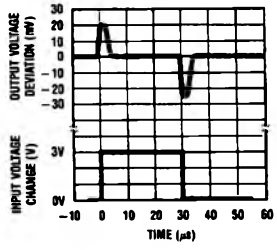
Maximum Power Dissipation (TO-220)



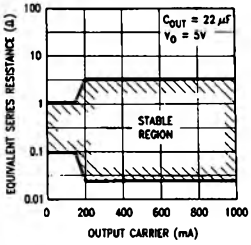
Dropout Voltage



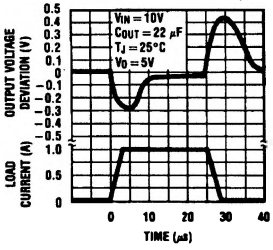
Line Transient Response



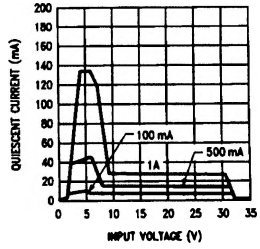
Output Capacitor ESR



Load Transient Response



Quiescent Current



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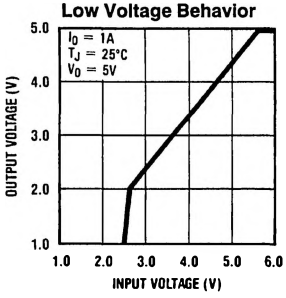
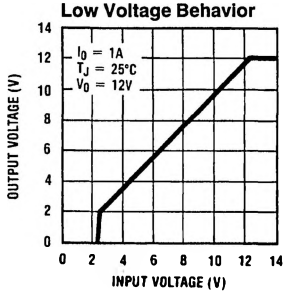
Typical Performance Characteristics (Continued)

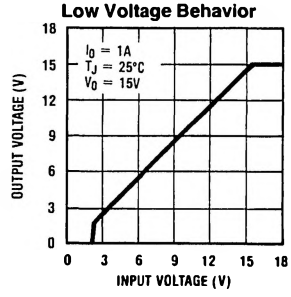
Low Voltage Behavior



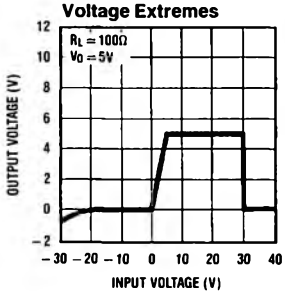
Low Voltage Behavior



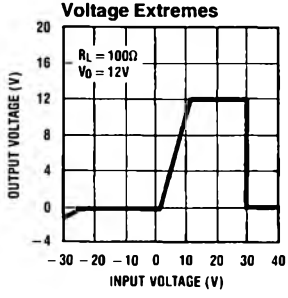
Low Voltage Behavior



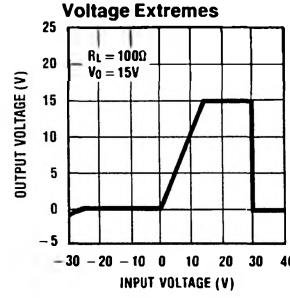
Output at Voltage Extremes



Output at Voltage Extremes



Output at Voltage Extremes



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