

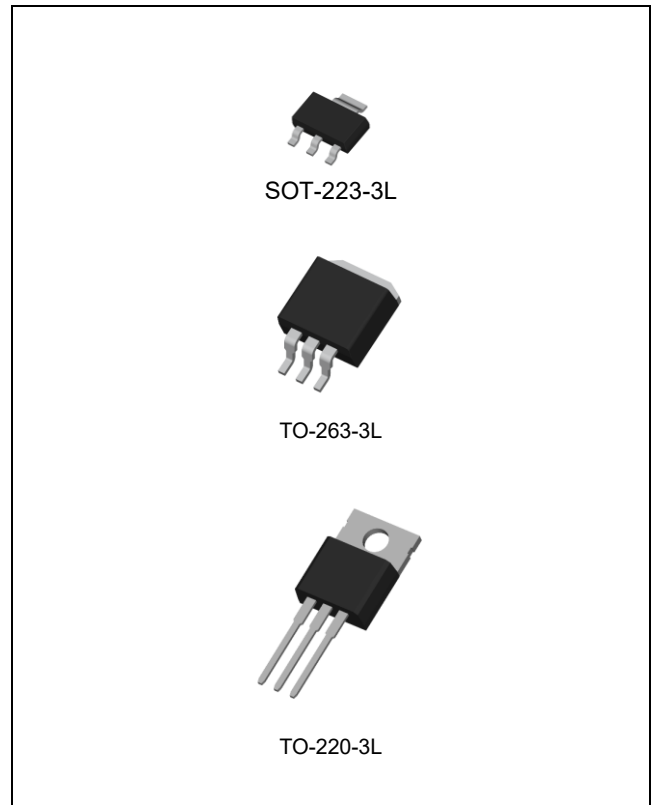
FEATURES

- Operational VIN up to +26V
- +60V/-20V Voltage Transients
- Output Current in Excess 1.0A
- Dropout Voltage typically 0.4V @ I_{OUT} = 1.0A
- Reverse Battery Protection
- Internal Short Circuit Current Limit
- Available with 3.3V and 5.0V Output Voltage

DESCRIPTION

The LM2940H fixed positive voltage regulator features the ability to source 1.0A of output current with a dropout voltage of typically 0.4V and a maximum of 0.7V over the entire temperature range.

Designed also for vehicular applications, the LM2940H and all regulated circuitry are protected from reverse battery installations or 2-battery jumps. During line transients, such as load dump when the input voltage can momentarily exceed the specified maximum operating voltage, the regulator will automatically shut down to protect both the internal circuits and load. Short circuit and thermal overload protection are also provided.



ORDERING INFORMATION

Device	Package
LM2940HS-x.x	SOT-223-3L
LM2940HR-X.X	TO-263-3L
LM2940HT-x.x	TO-220-3L

xx: Output Voltage

ABSOLUTE MAXIMUM RATINGS (Note 1)

CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Input Voltage <small>(Note 2)</small>	V _{IN}	-20	60	V
Maximum Junction Temperature	T _J	-	150	°C
Storage Temperature	T _{STG}	-65	150	°C

Note 1. Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Note 2. Maximum positive supply voltage of 60V must be limited duration (< 100ms) and duty cycle (≤ 1%). The maximum continuous supply voltage is 26V.

RECOMMENDED OPERATING RATINGS (Note 3)

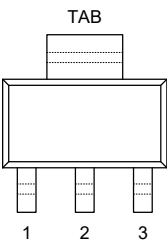
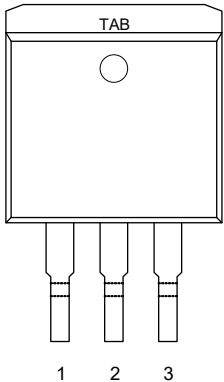
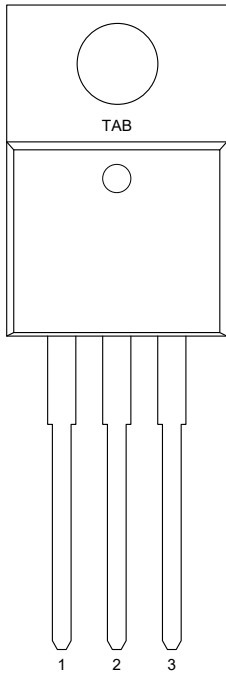
CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Maximum Operating Input Voltage (Continuous)	V_{IN}	-	26	V
Operating Ambient Temperature Range	T_A	-40	85	°C
Operating Junction Temperature Range	T_J	-40	125	°C

Note 3. The device is not guaranteed to function outside its operating ratings.

ORDERING INFORMATION

VOUT	Package	Order No.	Supplied As	Status
3.3V	SOT-223-3L	LM2940HS-3.3	Tape & Reel	Active
	TO-263-3L	LM2940HR-3.3	Tape & Reel	Active
	TO-220-3L	LM2940HT-3.3	Tube	Contact us
5.0V	SOT-223-3L	LM2940HS-5.0	Tape & Reel	Contact us
	TO-263-3L	LM2940HR-5.0	Tape & Reel	Active
	TO-220-3L	LM2940HT-5.0	Tube	Contact us

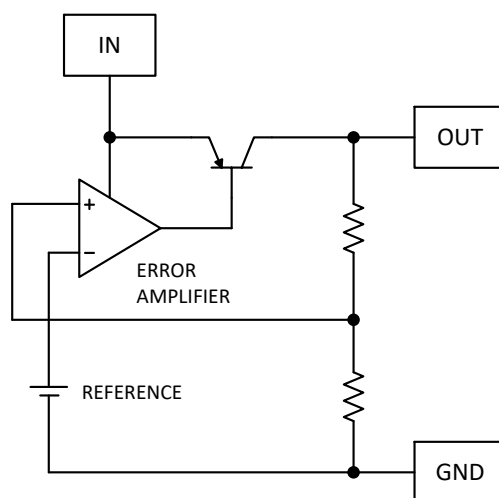
PIN CONFIGURATION

		
SOT-223	TO-263-3L	TO-220

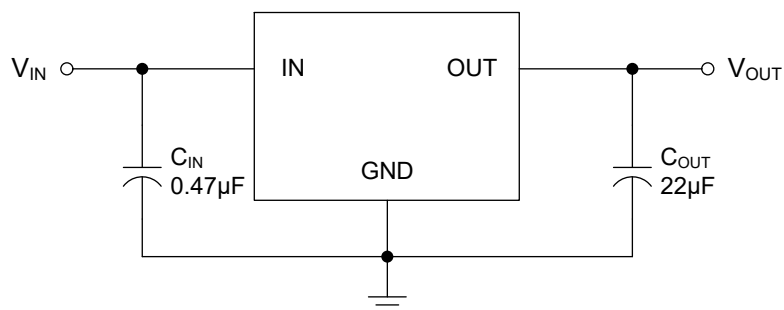
PIN DESCRIPTION

Pin No.			Pin Name	Pin Function
SOT-223	TO-263	TO-220		
1	1	1	IN	Input Voltage
2	2	2	GND	Ground
3	3	3	OUT	Output Voltage
TAB	TAB	TAB	TAB	Connect to GND

BLOCK DIAGRAM



TYPICAL APPLICATION CIRCUITS



- * C_{IN} required if regulator is located far from power supply filter.
- ** C_{OUT} must be at least $22\mu\text{F}$ to maintain stability. May be increased without bound to maintain regulation during transients. Located as close as possible to the regulator. This capacitor must be rated over the same operating temperature range as the regulator.
- *** For the details, refer to the Application Information.

ELECTRICAL CHARACTERISTICS

The following specifications apply for $T_J = 25^\circ\text{C}$; $V_{IN} = V_{OUT} + 5.0\text{V}$; $I_{OUT} = 1.0\text{A}$; $C_{OUT} = 22\mu\text{F}$, unless otherwise specified. **Boldface** type specifications apply over the full operating temperature range.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage ^(Note 4)	V_{OUT}	$5.0\text{mA} \leq I_{OUT} \leq 1.0\text{A}$,	-2.0	-	2.0	%
		$(V_{OUT} + 1.0\text{V}) \leq V_{IN} \leq 26\text{V}$	-3.0	-	3.0	
Line Regulation	LNR	$I_{OUT} = 5.0\text{mA}$, $(V_{OUT} + 1.0\text{V}) \leq V_{IN} \leq 26\text{V}$	-	0.06	0.5	%
Load Regulation ^(Note 4)	LDR	$V_{IN} = V_{OUT} + 5.0\text{V}$, $5.0\text{mA} \leq I_{OUT} \leq 1.0\text{A}$	-	0.2	1.0	%
			1.8	-	-	
Quiescent Current	I_Q	$I_{OUT} = 5.0\text{mA}$	-	0.3	0.4	mA
			0.5	-	-	
		$I_{OUT} = 1.0\text{A}$	-	11	16	mA
			20	-	-	
Dropout Voltage	V_{DO}	$I_{OUT} = 100\text{mA}$	-	110	150	mV
			230	-	-	
		$I_{OUT} = 1.0\text{A}$	-	400	550	mV
			700	-	-	
Short Circuit Current	I_{SC}	$V_{IN} = V_{OUT(NOM)} + 1.0\text{V}$, $V_{OUT} = 0\text{V}$	-	1.5	2.4	A
Output Noise Voltage	e_n	$f = 10\text{Hz to } 100\text{kHz}$	-	150	-	μVrms
Ripple Rejection	PSRR	$f = 120\text{Hz}$ (1.0Vrms), $I_{OUT} = 100\text{mA}$	60	72	-	dB
Long Term Stability	$\Delta V_{OUT}/\Delta t$	$t = 1000\text{ hr}$	-	0.4	-	%
Reverse Polarity Transient Input Voltage		$R_{OUT} = 100\Omega$, $t \leq 1\text{ms}$	-35	-	-	V

Note 4. Parameters are measured at a constant junction temperature by low duty cycle pulse testing.

TYPICAL OPERATING CHARACTERISTICS

T.B.D.

APPLICATION INFORMATION

The LM2940H regulator is suitable for Automotive and Industrial applications where continuous connection to a battery supply is required.

INPUT CAPACITOR

The LM2940H requires a low source impedance to maintain regulator stability because critical portions of the internal bias circuitry are connected directly to IN pin. In general, a 0.47 μ F electrolytic capacitor, located within two inches of the regulator, is adequate for a majority of applications. Additionally, and at a minimum, a 0.1 μ F ceramic capacitor would be located between the LM2940H IN pin and GND pin, and as close as is physically possible to the regulator itself.

OUTPUT CAPACITOR

An output bypass capacitor is required for stability. This capacitance must be placed between the OUT pin and GND pin, as close as is physically possible, using traces that are not part of the load current path.

The output capacitor must meet the requirements for minimum capacitance across the entire operating ambient temperature range. There is no limit to the maximum output capacitance.

The minimum bypass capacitance for the output is 22 μ F. A 22 μ F, or larger output bypass capacitor is recommended for typical applications.

Solid tantalums capacitors are recommended as they generally maintain capacitance over a wide temperature range.

THERMAL PROTECTION

Device operational range is limited by the maximum junction temperature (T_J). The junction temperature is influenced by the ambient temperature (T_A), package selection, input voltage (V_{IN}), and the output load current. When operating with maximum load currents the input voltage and/or ambient temperature will be limited.

Even though the LM2940H is equipped with circuitry to protect itself from excessive thermal dissipation, it is not recommended that the LM2940H be operated at, or near, the maximum recommended die junction temperature (T_J) as this may impair long term device reliability.

The thermal protection circuitry monitors the temperature at the die level. When the die temperature exceeds typically 160°C the voltage regulator output will be switched off.

MAXIMUM OUTPUT CURRENT CAPABILITY

The LM2940H can deliver a continuous current of 1.0A over the full operating temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1A may be still undeliverable due to the restriction of the power dissipation of LM2940H. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA} \quad / \quad T_J = T_C + P_D \times \theta_{JC} \quad / \quad T_J = T_A + P_D \times \theta_{JA}$$

where T_J is the junction temperature, T_C is the case temperature, T_A is the ambient temperature, P_D is the total power dissipation of the device, θ_{CA} is the thermal resistance of case-to-ambient, θ_{JC} is the thermal resistance of junction-to-case, and θ_{JA} is the thermal resistance of junction to ambient. The total power dissipation of the device is given by:

$$P_D = P_{IN} - P_{OUT} = (V_{IN} \times I_{IN}) - (V_{OUT} \times I_{OUT})$$

$$= (V_{IN} \times (I_{OUT} + I_{GND})) - (V_{OUT} \times I_{OUT}) = (V_{IN} - V_{OUT}) \times I_{OUT} + (V_{IN} \times I_{GND})$$

where I_{GND} is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise (T_{Rmax}) depends on the maximum ambient temperature (T_{Amax}) of the application, and the maximum allowable junction temperature (T_{Jmax}):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance, θ_{JA} , can be calculated using the formula:

$$\theta_{CA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$$

The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of θ_{JA} calculated above is over its rating of a package, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable θ_{JA} falls near or below these limits, a heat sink or proper area of copper plane is required. The absolute maximum ratings of thermal resistances are as follow:

CHARACTERISTICS	SYMBOL	RATING	UNIT
Thermal Resistance Junction-To-Ambient / SOT-223-3L	$\theta_{JA-SOT-223-3L}$	137	°C/W
Thermal Resistance Junction-To-Ambient / SOT-263-3L	$\theta_{JA-SOT-263-3L}$	80	°C/W
Thermal Resistance Junction-To-Ambient / TO-220-3L	$\theta_{JA-TO-220-3L}$	70	°C/W

No heat sink / No air flow / No adjacent heat source / $T_A=25^\circ\text{C}$

REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.