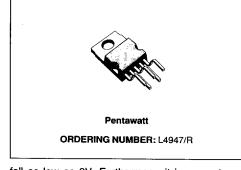


# 5V-0.5A VERY LOW DROP REGULATOR WITH RESET

- PRECISE OUTPUT VOLTAGE (5V ± 4%) OVER FULL TEMPERATURE RANGE (-40 / 125 °C)
- VERY LOW VOLTAGE DROP (0.75Vmax)
   OVER FULL T RANGE
- OUTPUT CURRENT UP TO 500mA
- RESET FUNCTION
- POWER-ON RESET DELAY PULSE DEFINED BY THE EXTERNAL CAPACITOR
- +80V LOAD DUMP PROTECTION
- -80V LOAD DUMP PROTECTION
- REVERSE VOLTAGE PROTECTION
- SHORT CIRCUIT PROTECTION AND THER-MAL SHUT-DOWN (with hysteresis)
- LOW START UP CURRENT

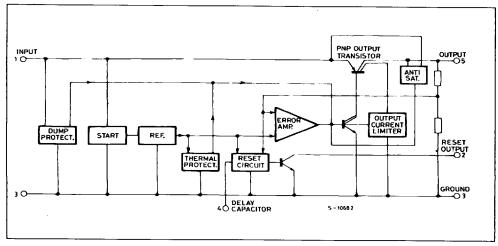


fall as low as 6V. Furthermore, it incorporates a complete range of protection circuits against the dangerous overvoltages always present on the battery rail of the car. The reset function makes the device particularly suited to supply microprocessor based systems: a signal is available (after an externally programmable delay) to reset the microprocessor at power-on phase; at power-off, this signal becomes low inhibiting the microprocessor.

#### DESCRIPTION

The L4947/R is a monolithic integrated circuit in Pentawatt package specially designed to provide a stabilized supply voltage for automotive and industrial electronic systems. Thanks to its very low voltage drop, in automotive applications the L4947/R can work correctly even during the cranking phase, when the battery voltage could

# **BLOCK DIAGRAM**



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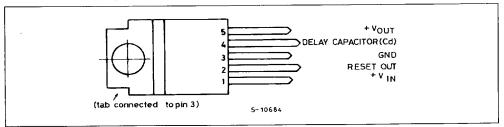
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### **ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
Vi	DC Input Voltage DC Reverse Input Voltage Transient Input Overvoltages: Load Dump: 5 ms $\leq$ trise $\leq$ 10 ms $_{17}$ Fall Time Constant = 100 ms Rsource $\geq$ 0.5 $_{27}$ Field Decay: 5 ms $\leq$ trial $\leq$ 10 ms, Rsource $\geq$ 10 $_{27}$ trible Time Constant = 33 ms Low Energy Spike: trise = 1 $_{27}$ trigle = 500 $_{27}$ trigle = 10 $_{27}$ trigle = 500 $_{27}$ trigle = 10 $_{27}$ trigle = 500 $_{27}$ trigle = 10 $_{27}$ trigle = 500 $_{27}$ tr	35 -18 80 -80 ±100	V
VR	Reset Output Voltage	35	V
T <sub>J</sub> , T <sub>stg</sub>	Junction and Storage Temperature Range	- 55 to 150	_°C

Note: The circuit is ESD protected according to MIL-STD-883C.

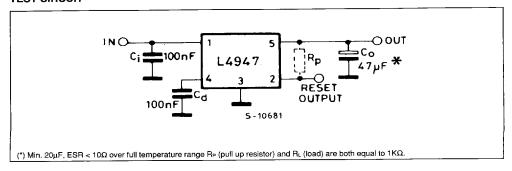
## PIN CONNECTION (Top view)



### THERMAL DATA

١	Symbol	pol Parameter		Value	Unit
	R <sub>th i-case</sub>	Thermal Resistance Junction-case	/lax	3.5	°C/W

### **TEST CIRCUIT**



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**ELECTRICAL CHARACTERISTICS** (refer to the test circuit,  $V_i = 14.4V$ ,  $C_0 = 47\mu F$ , ESR <  $10\Omega$ ,  $R_p = 1K\Omega$ ,  $R_L = 1K\Omega$ ,  $-40^{\circ}C \le T_J \le 125^{\circ}C$ , unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Vo	Output Voltage	I <sub>o</sub> = 0mA to 500mA Over Full T Range T <sub>J</sub> = 25°C	4.80	5.00	5.20	٧
Vi	Operating Input Voltage	I <sub>0</sub> = 0mA to (*) 500mA	4.90	5.00	5.10	V V
ΔV <sub>o</sub>	Line Regulation	V <sub>i</sub> = 6V to 26V ; I <sub>o</sub> = 5mA		2	26 10	mV
$\Delta V_o$	Load Regulation	I <sub>o</sub> = 5mA to 500mA		15	60	mV
V <sub>i</sub> –V <sub>o</sub>	Dropout Voltage	I <sub>o</sub> = 500mA, T <sub>J</sub> = 25°C Over Full T Range		0.40	0.55 0.75	V
l <sub>q</sub>	Quiescent Current	I <sub>o</sub> = 0mA, T <sub>J</sub> = 25°C I <sub>o</sub> = 0mA Over Full T I <sub>o</sub> = 500mA Over Full T		5 6.5 110	10 13 180	mA mA mA
ΔV <sub>o</sub> T	Temperature Output Voltage Drift			-0.5		mV/°C
SVR	Supply Volt. Rej.	$I_0 = 350 mA$ ; $f = 120 Hz$ $C_0 = 100 \mu F$ ; $V_i = 12 V \pm 5 V_{pp}$	50	60		dB
I <sub>sc</sub>	Output Short Circuit Current		0.50	0.80	1.50	А
VR	Reset Output Saturation Voltage	$1.5V < V_o < V_{RT (off)},$ $I_R = 1.6mA$			0.40	٧
		$3.0V < V_0 < V_{RT (off)},$ $I_R = 8mA$			0.40	V
I <sub>R</sub>	Reset Output Leakage Current	$V_0$ in Regulation, $V_R = 5V$			50	μА
V <sub>RT peak</sub>	Power On-Off Reset out Peak Voltage	1KΩ Reset Pull-up to $V_0$ , $T_J = 25^{\circ}C$		0.50	0.80	٧
V <sub>RT</sub> (off)	Power OFF V₀ Threshold	$V_o$ @ Reset Out H to L Transition T <sub>J</sub> = 25°C	4.70 4.75	Vo-0.15		V
V <sub>RT (on)</sub>	Power ON V₀ Threshold	V₀ @ Reset Out L to H Transition		V <sub>RT (off)</sub> + 0.05	V <sub>o</sub> – 0.04	٧
$V_{Hyst}$	Power ON-Off Hysteresis	V <sub>RT (on)</sub> –V <sub>RT (off)</sub>		0.05		V
V <sub>d</sub>	Delay Comparator Threshold	V <sub>d</sub> @ Reset Out L to H Transition	3.65	4.00	4.35	٧
_		V <sub>d</sub> @ Reset Out H to L -Transition	3.20	3.55	3.90	٧
V <sub>dH</sub>	Delay Comparator Hysteresis			0.45		٧
la	Delay Capacitor Charging Current	$V_d = 3V$ , $T_J = 25^{\circ}C$		20		/μΑ
V <sub>disch</sub>	Delay Capacitor Discharge Voltage	Vo < V <sub>RT (off)</sub>		0.55	1.20	٧
Td	Power on Reset Delay Time	C <sub>d</sub> = 100nF, T <sub>J</sub> = 25°C	10	20	30	ms

(\*) For a DC voltage  $26 < V_i < 37V$  the device is not operating

#### **FUNCTIONAL DESCRIPTION**

The L4947/R is a very low drop 5V/0.5A voltage regulator provided with a reset function and therefore particularly suited to meet the requirements of supplying the microprocessor systems used in automotive and industrial applications.

The block diagram shows the basic structure of the device: the reference, the error amplifier, the driver, the power PNP, the protection and reset functions.

The power stage is a Lateral PNP transistor which allows a very low dropout voltage (typ. 400mV at  $T_J=25^{\circ}\text{C}$ , max. 750mV over the full temperature range @  $I_O=500\text{mA}$ ). The typical curve of the dropout voltage as a function of the junction temperature is shown in Fig. 1 : that is the worst case, where  $I_O=500\text{mA}$ .

The current consumption of the device (quiescent

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current) is maximum 13mA - over full T - when no load current is required.

The internal antisaturation circuit allows a drastic reduction in the current peak which takes place during the start up.

The reset function supervises the regulator output voltage inhibiting the microprocessor when the device is out of regulation and resetting it at the power-on after a settable delay. The reset is LOW when the output voltage value is lower than the reset threshold voltage. At the power-on phase the output voltage increases (see Fig. 2) and when it reaches the power-on Vo threshold VRT (On) - the reset output becomes HIGH after a delay time set by the external capacitor Cd. At the power-off the output voltage decreases: at the VRT(Off) threshold value (Vo-0.15V typ. value) the reset output instantaneously goes down (LOW status) inhibiting the microprocessor. The typical

Figure 1: Typical Dropout Voltage vs.  $T_j$  ( $I_0 = 500$ mA).

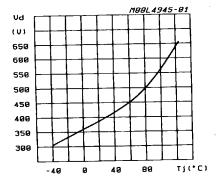


Figure 2: Reset Waveforms:

- (1) Without External Capacitor Cd.
- (2) With External Capacitor Cd.

power on-off hysteresis is 50mV.

The three gain stages (operational amplifier, driver and power PNP) require the external capacitor ( $C_{omin}=20\mu F$ ) to guarantee the global stability of the system.

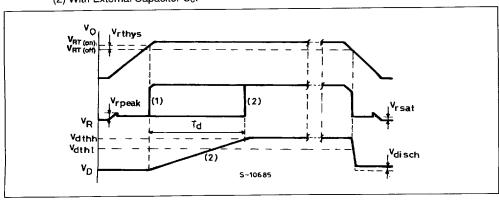
Load dump and field decay protections (± 80V), reverse voltage (– 18V) and short circuit protection, thermal shutdown are the main features that make the L4947/R specially suitable for applications in the automotive environment.

#### EXTERNAL COMPENSATION

Since the purpose of a voltage regulator is to supply and load variations, the open loop gain of the regulator must be very high at low frequencies. This may cause instability as a result of the various poles present in the loop. To avoid this instability dominant pole compensation is used to reduce phase shift due to other poles at the unity gain frequency. The lower the frequency of these others poles at the unity gain frequency. The lower the frequency of these other poles, the greater must be capacitor esed to create the dominant pole for the same DC gain.

Where the output transistor is a lateral PNP type there is a pole in the regulation loop at a frequencybtoo low to be compensated by a capacitor which can be integrated. An external compensation is therefore necessary so a very high value capacitor must be connected from the output to ground.

The paeassitic equivalent series resistance of the capacitor used adds a zero to the regulation loop. This zero may compromise the stability of the system since its effect tends to cancel the effect of the pole added. In regulators this ESR must be less than  $3\Omega$  and the minimum capacitor value is 47uF.



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