ALL SILICON VOLTAGE REGULATOR

1 Features

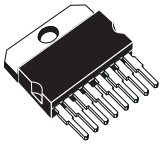
- High side field driver
- Thermal protection
- Field driver short circuit protection
- RVC interface
- Overvoltage protection
- Complex diagnostics
- Load Response Control

2 Description

The L9474 is a monolithic multifunction generator Voltage regulator intended for use in automotive applications.

This device regulates the output of an automotive generator by controlling the field winding current by means of a variable frequency PWM high side driver.

Figure 1. Package



Multiwatt8

Table 1. Order Codes

Part Number	Package
L9474	Multiwatt8

The setpoint voltage reference is selected by the ENGINE CONTROL UNIT via RVC protocol.

Figure 2. Schematic Diagram

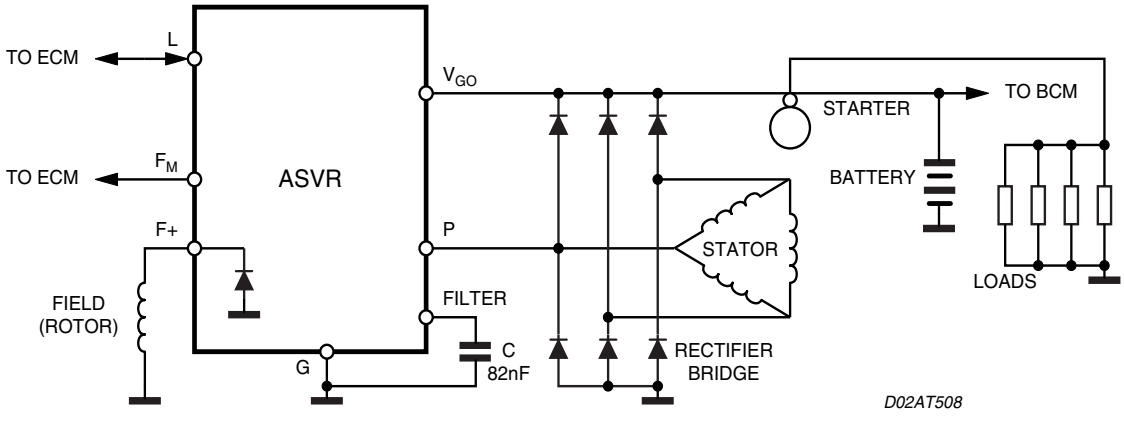


Table 2. Pin Description

N°	Pin	Function
1	P	Phase sense input
2	L	Warning terminal output and ECM PWM input
3	F_M	Field monitor output
4	RESERVED	Reserved
5	GND	
6	FILTER	Regulation loop filter
7	F+	Field high side driver output
8	V_{GO}	Generator output sense and voltage supply to L9474

Table 3. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_S	Transient Supply Voltage (load dump)	40	V
I_O	Output Current Capability	Internally limited	A
P_{tot}	Power Dissipation (@T_j = 150°C, I_{Field} = 6A)	6	W
V_{REV}	Reverse Voltage (see fig.1)	-2.5 to -6	V

Figure 3. Pin Connection (Top view)

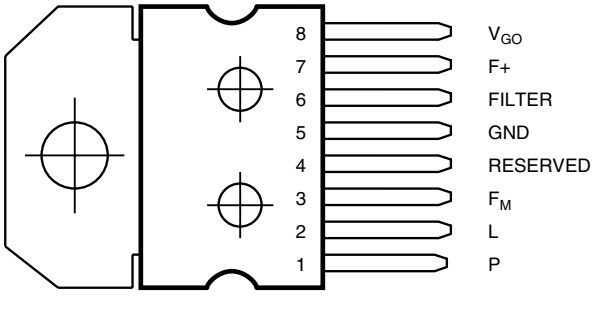


Table 4. Thermal Data

Symbol	Parameter	Value	Unit
T_j	Junction temperature	-40 to 150	°C
T_{stg}	Storage Temperature	-50 to 150	°C
T_{sd}	Thermal Shut Down	175 ±15	°C
$R_{th\ j\text{-}case}$	Thermal Resistance Junction to Case	1.5	°C/W

Table 5. Electrical Characteristcs (T_j -35°C to +150°C unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{OS}	Operating Supply Voltage		8		16[1]	V
I_{SB}	Stand-by Current [2]	V_{GO} = 12.6V, T_{case} -35 to +80°C			400	µA
		V_{GO} = 12.6 V, 80 <T_{case}< +150 °C			1	mA
V_{SF}	Regulator Set-Point in Fault	PWM signal loss		13.8		V
V_{NB}	Generator output, no battery	No battery, I_{OUT} =2A to 50% max load	V_S-2		V_S+2	V
T_C	Thermal compensation	Driven by ECM	RVC or FLAT			V
V_{LR}	Load Regulation	6500 grpm, 10% to 95% load			300	mV
V_{SR}	Speed Regulation	15A load, 2,000 to 10,000 grpm			100	mV
V_{FON}	Output Saturation Voltage	I_F = 9A, T_{case} < = 25°C			750	mV
V_{FON}	Output Saturation Voltage	I_F = 6A, T_{case} > 25°C			850	mV
I_{FLIM}	Field limit current	F shorted to gnd, T_{case} < = 25°C	9			A
		F shorted to gnd, T_{case} = 150 °C	6			A
V_F	Field Discharge Rectifier	I_F =6A, T_{case} = 25 °C			1.85	V
I_R	Diode Reverse Current	V_R = 16 V			1	mA
f_{OSC}	Oscillation frequency	During LRC operation	340	400	460	Hz
MFDC	Minimum Field Duty-Cycle	V(V_{GO}) < V_{OV} [3]		6.25		%
R_{FM}	Impedance @ F_M pin	Impedance between FM and F+	0.8		2.5	KΩ

Notes:
1. 16 Volts is the maximum operating voltage.
2. Stand-by current measured with L, FM open; F connected to gnd; P open or tied to gnd.
3. When the voltage sensed at VGO terminal is above VOV the Minimum Field Duty-Cycle will be 0 %.

Figure 4. Reverse B+ Test Circuit

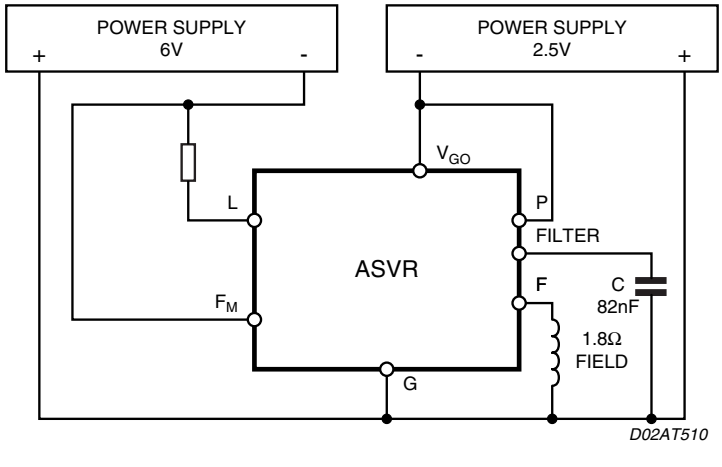


Figure 5. Setpoint Voltage vs. L terminal signal

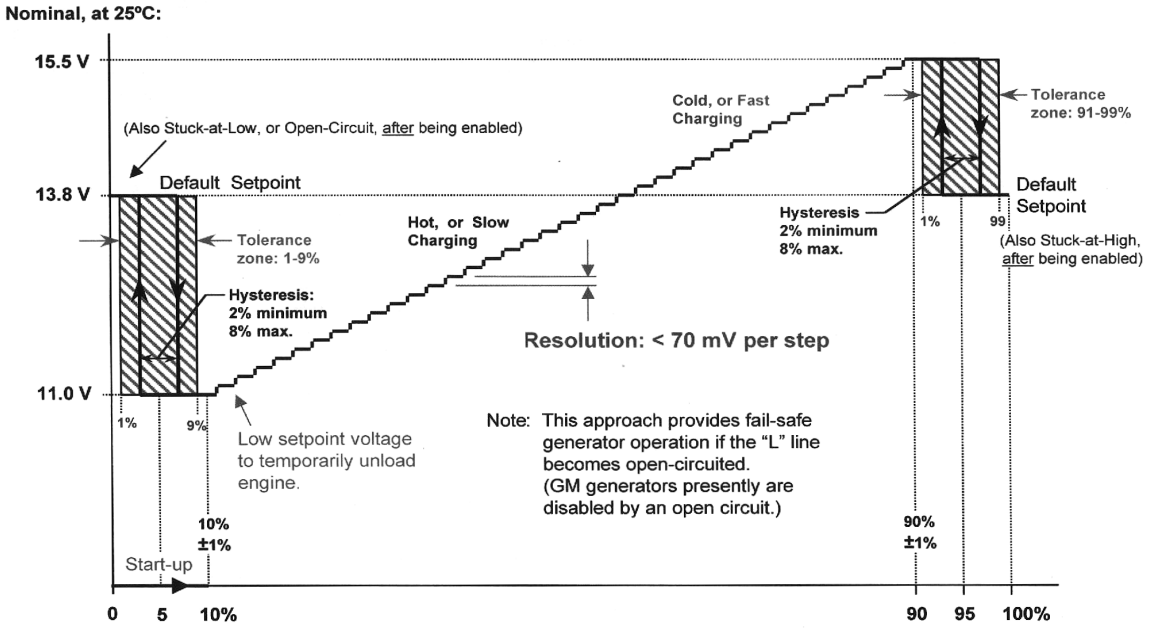


Table 6. Diagnostic (T_j -35°C to +150°C unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{OV}	Overvoltage[4]		16.5		22	V
V_{LSAT}	L Saturation Voltage	I_L = 50 mA			1.35	V
T_{DELAY}	Fault Indication Delay Time		0.935	1.1	1.265	s

Note:
4. When the Vgo voltage overcomes this value the MFDC is cancelled

Table 7. FAULT

The following table lists the conditions that cause the fault driver to function (L terminal now switching be-tween 0V and VLSAT. To prevent L flicker, specific faults are required to be present for TDELAY seconds be-fore the fault driver is activated. This delay is indicated in the table.

Conditions	Delay
1. Key-on (RVC PWM signal acknowledgement)	No
2. Phase Voltage < VP2 **AND** V_{GO} < setpoint	Yes

Table 8. Regulation Features

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{LON}	Lamp term turn on [5] threshold	fL = 128Hz +/-5%	0.65	0.9	1.15	V
I_{LON}		VL = 0.65V	0.3		1.5	mA
V_{P1}	Initiation of regulation detection phase voltage threshold [6]	I_P = 1mA (sinking current)		0.35		V
V_{P2}	Fault detection phase voltage threshold [7]		7	8	9	V
I_P	Sinking current @ P terminal	V_P = 1.5V	0.5	1	1.8	mA
f_{IFR}	Initiation of field regulation frequency			72		Hz
FSDF	Field Strobe Duty Factor	@ "power up" with $f_{PHASE} < f_{IFR}$		12.5		%
LRC	Load Response Control rate [8]		2.125	2.5	2.875	s
f_{LRC}	LRC transition frequency	LRC disabled above this value	263	310	357	Hz
Δgnd	Difference between ECM & Alternator ground		-0.2		0.2	V

Notes:

5. A 128Hz PWM signal applied to L input, higher than this threshold, will turn on the device.
6. This threshold on the phase signal is used to detect the phase frequency, fIFR, for the Initiation of field regulation.
7. This threshold on the phase signal is used to sense the presence of the phase for fault detection purposes. Furthermore, to prevent the loss of phase signal, a 31.25% duty cycle is applied to field output when phase drops below Vp2 and Vgo is above setpoint.
8. This is the time duration the L9474 takes to rump up from 0 % to 100% duty cycle in response to an increased load on the generator. The LRC ratio is set 1:4 and the Vreg comparator status is latched at foundamental frequency rate.

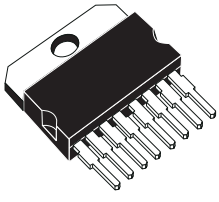
3 Package Information

Figure 6. Multiwatt8 Mechanical Data & Package Dimensions

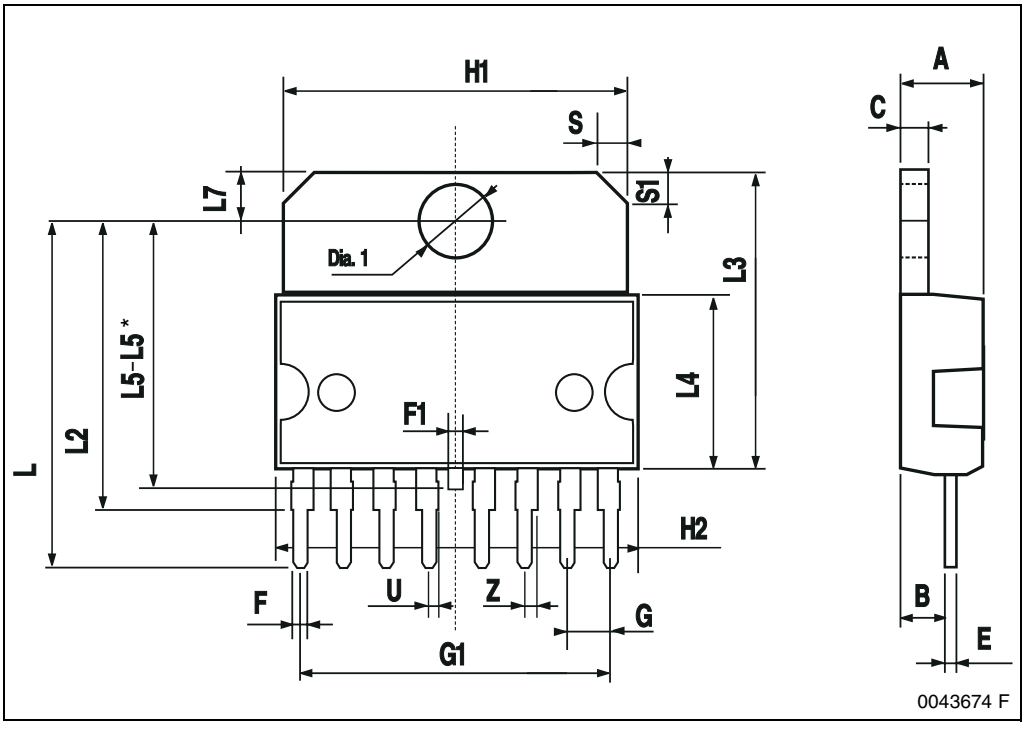
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			5			0.197
B			2.65			0.104
C			1.6			0.063
E	0.49		0.55	0.019		0.022
F	0.78		0.85	0.030		0.033
F1	0.68		0.75	0.027		0.029
G	2.40	2.54	2.68	0.094	0.10	0.105
G1	17.64	17.78	17.92	0.69	0.70	0.71
H1	19.6			0.772		
H2			20.2			0.795
L	20.35		20.65	0.80		0.81
L2	17.05	17.20	17.35	0.67	0.68	0.68
L3	17.25	17.5	17.75	0.679	0.689	0.699
L4	10.3	10.7	10.9	0.406	0.421	0.429
L5	15.45		15.75	0.61		0.62
L5*	15.05		15.35	0.59		0.60
L7	2.65		2.9	0.104		0.114
S	1.9		2.6	0.075		0.102
S1	1.9		2.6	0.075		0.102
U	0.40		0.55	0.015		0.022
Z	0.70		0.85	0.028		0.034
Dia1	3.65		3.85	0.144		0.152

L5 = with wedged frame std.
L5* = with wedged frame anchor holes.

OUTLINE AND MECHANICAL DATA



Multiwatt8 (Floating)



4 Revision History

Table 9. Revision History

Date	Revision	Description of Changes
March 2005	1	First Issue