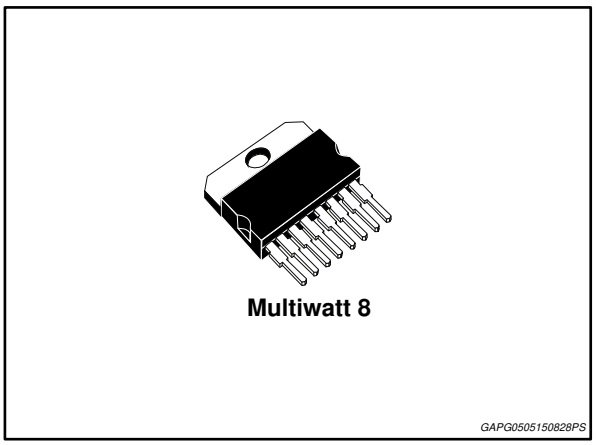
L9474N

All silicon voltage regulator

Datasheet - production data



Features

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

Description

The L9474N 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.

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

Table 1: Device summary

Order code	Package	Packing
L9474N	Multiwatt 8	Tube

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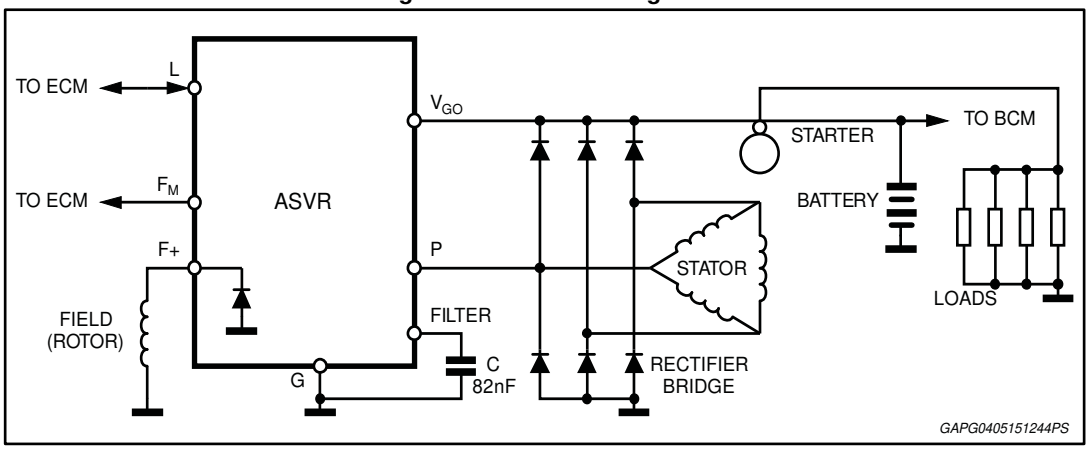
1 Schematic diagram and pin description

1.1 Schematic diagram

Figure 1: Schematic diagram



1.2 Pin description

Figure 2: Pin connection diagram (top view)

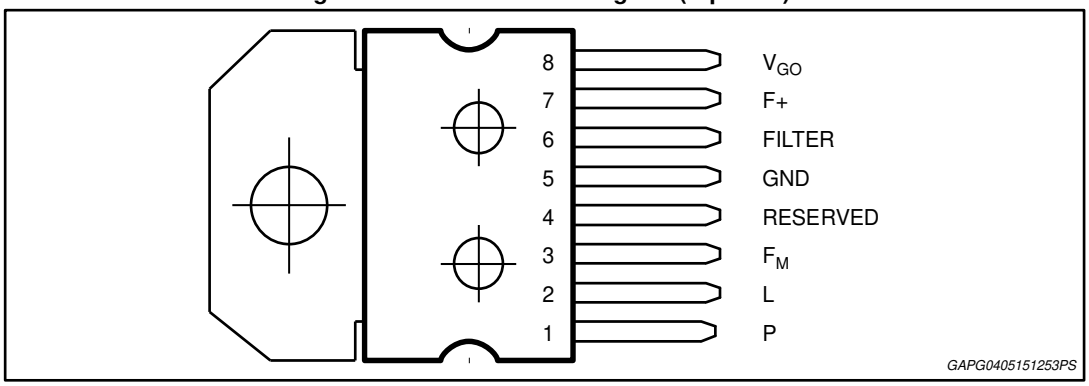


Table 2: Pin description

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	Ground
6	FILTER	Regulation loop filter
7	F+	Field high side driver output
8	V_{GO}	Generator output sense and voltage supply to L9474N

2 Electrical specification

2.1 Absolute maximum ratings

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}= 6 A)	6	W
V_{REV}	Reverse voltage (see fig.1)	-2.5 to -6	V

2.2 Thermal data

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

2.3 Electrical characteristic

T_j -35 °C to +150 °C unless otherwise specified.

Table 5: Electrical characteristic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_{OS}	Operating supply voltage	-	8	-	16 (1)	V
I_{SB}	Standby Current (2)	V_{GO}= 12.6 V, 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	13.6	13.8	14.0	V
V_{NB}	Generator output, no battery	No battery, I_{OUT}= 2 A 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= 9 A, T_{case}≤ 25 °C	-	-	750	mV
		I_F= 6 A, 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= 6 A, 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

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
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 V is the maximum operating voltage.

(2) Standby current measured with L, FM open; F connected to GND; P open or tied to GND.

(3) When the voltage sensed at V_{GO} terminal is above V_{OV} the Minimum Field Duty-Cycle will be 0%.

Figure 3: Reverse B+ test circuit

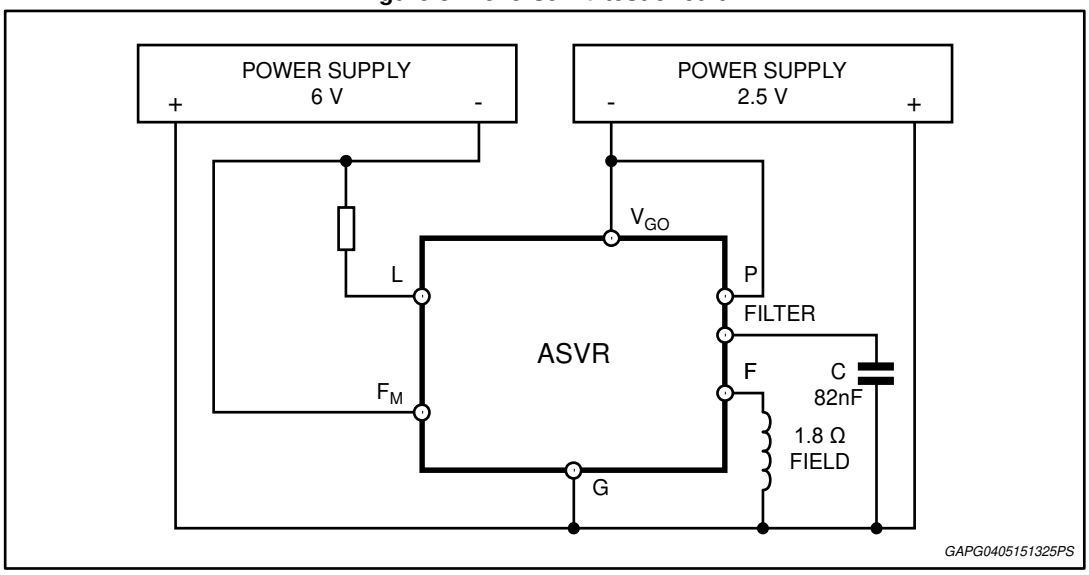
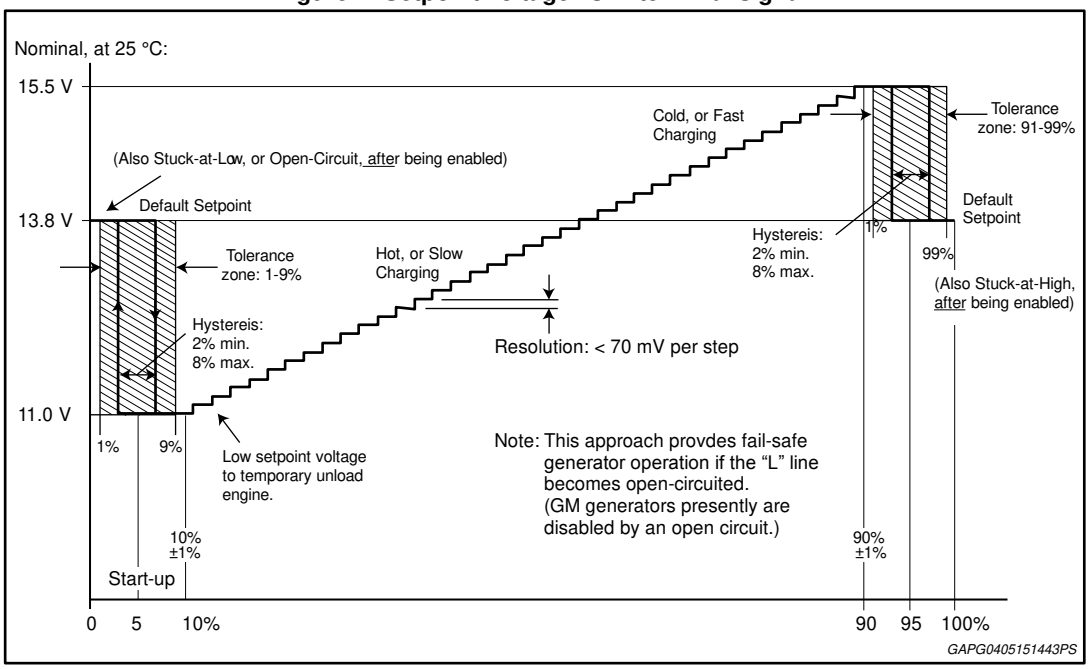


Figure 4: Setpoint voltage vs. L terminal signal



2.4 Diagnostic

T_j -35 °C to +150 °C unless otherwise specified.

Table 6: Diagnostic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_{OV}	Overvoltage (1)	-	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

Notes:

(1)When the V_{GO}voltage overcomes this value the MFDC is deleted.

2.5 Fault

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

Table 7: Fault driver to function list condition

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

2.6 Regulation features

Table 8: Regulation features

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{LON}	Lamp term turn on threshold (1)	f_L= 128 Hz ±5%	0.65	0.9	1.15	V
I_{LON}	Lamp term turn on current	V_L= 0.65 V	0.3	-	1.5	mA
V_{P1}	Initiation of regulation detection phase voltage threshold (2)	I_P= 1 mA (sinking current)	-	0.35	-	V
V_{P2}	Fault detection phase voltage threshold (3)	-	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 (4)	-	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:

(1)A 128 Hz PWM signal applied to L input, higher than this threshold, will turn on the device.

(2)This threshold on the phase signal is used to detect the phase frequency, f_{IFR}, for the Initiation of field regulation.

(3)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 V_{p2} and V_{GO} is above setpoint.

(4)This is the time duration the L9474N 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 V_{reg} comparator status is latched at fundamental frequency rate.

3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: ***www.st.com***. ECOPACK® is an ST trademark.

3.1 Multiwatt 8 (pin 5 GND) package information

Figure 5: Multiwatt 8 (pin 5GND) package outline

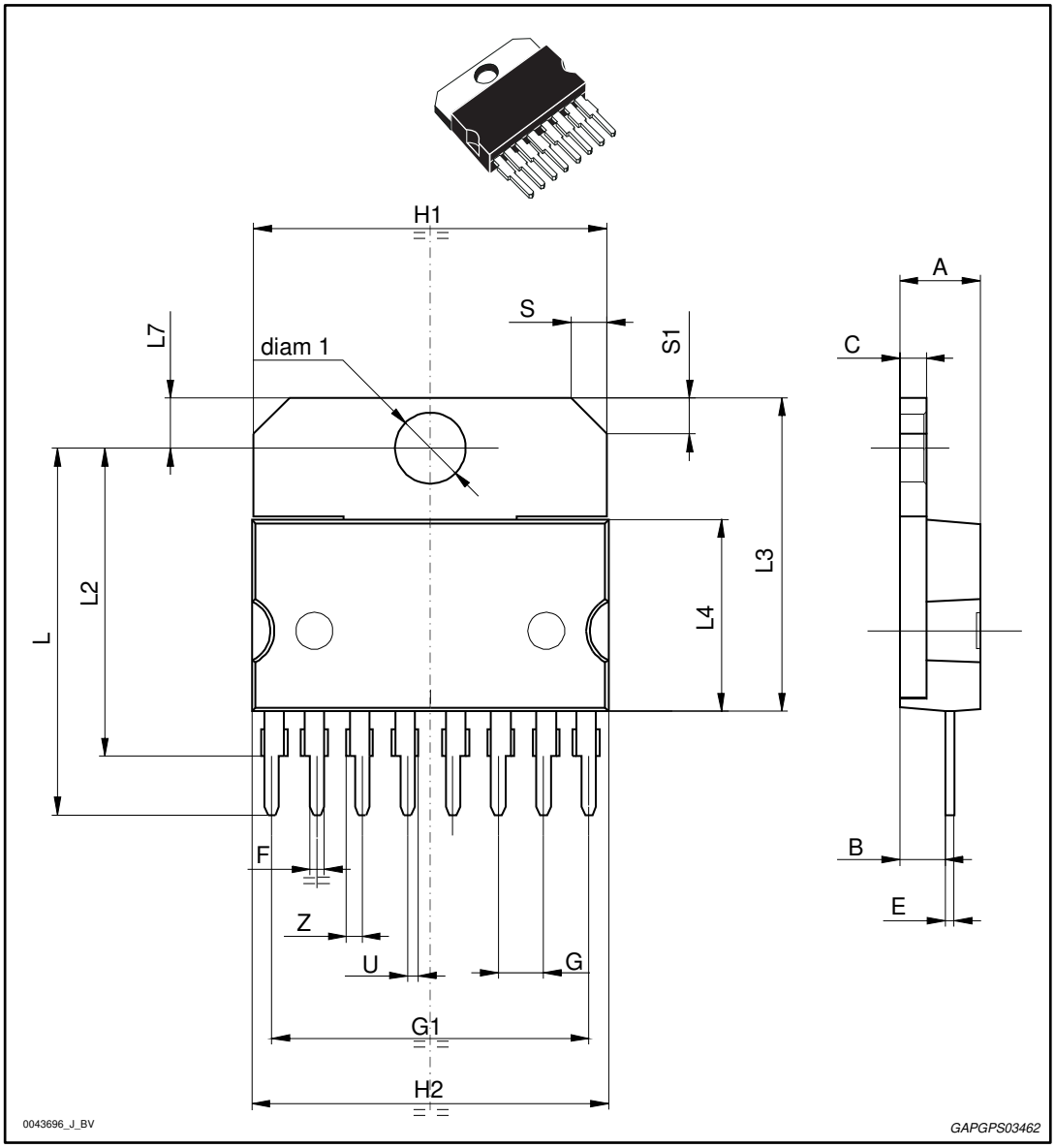


Table 9: Multiwatt 8 (pin 5GND) package mechanical drawing

Ref	Dimensions					
	Millimeters			Inches [1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	-	-	5	-	-	0.1969
B	-	-	2.65	-	-	0.1043
C	-	-	1.6	-	-	0.0630
E	0.49	-	0.55	0.0193	-	0.0217
F	0.78	-	0.85	0.0307	-	0.0335
G	2.40	2.54	2.68	0.0945	0.1000	0.1055
G1	17.64	17.78	17.92	0.6945	0.7000	0.7055
H1	19.6	-	-	0.7717	-	-
H2	-	-	20.2	-	-	0.7953
L	20.35		20.65	0.8012		0.8130
L2	17.05	17.20	17.35	0.6713	0.6772	0.6831
L3	17.25	17.5	17.75	0.6791	0.6890	0.6988
L4	10.3	10.7	10.9	0.4055	0.4213	0.4291
L7	2.65	-	2.9	0.1043	-	0.1142
S	1.9	-	2.6	0.0748	-	0.1024
S1	1.9	-	2.6	0.0748	-	0.1024
U	0.40	-	0.55	0.0157	-	0.0217
Z	0.70	-	0.85	0.0276	-	0.0335
diam1	3.65	-	3.85	0.1437	-	0.1516

Notes:

[1] Values in inches are converted from mm and rounded to 4 decimal digits.

4 Revision history

Table 10: Document revision history

Date	Revision	Changes
05-May-2015	1	Initial release.

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