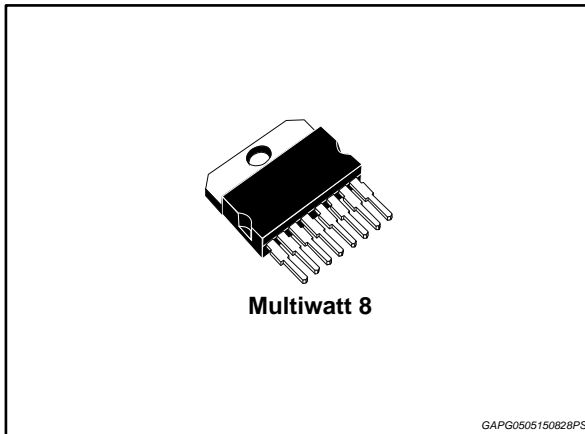


## All silicon voltage regulator

Datasheet - production data



- 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.

### Features

- High side field driver
- Thermal protection
- Field driver short circuit protection
- RVC interface

**Table 1: Device summary**

Order code	Package	Packing
L9474N	Multiwatt 8	Tube

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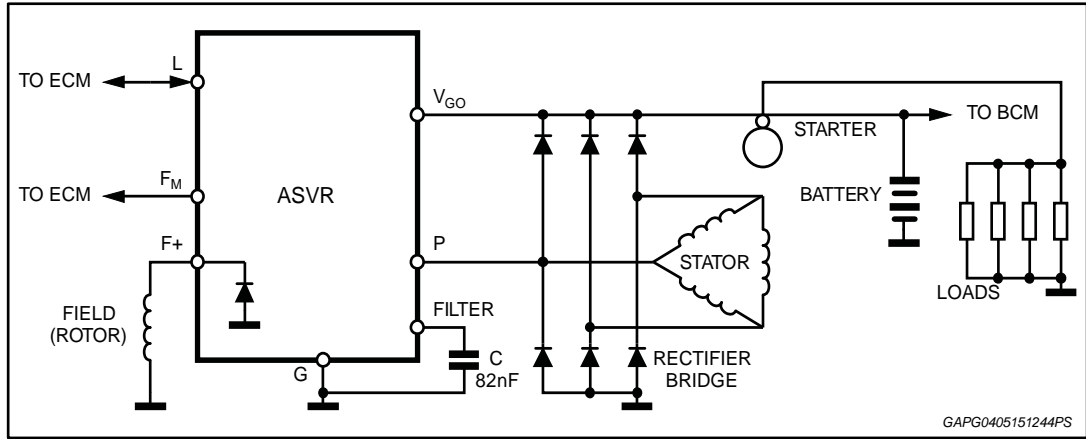
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# 1 Schematic diagram and pin description

## 1.1 Schematic diagram

Figure 1: Schematic diagram



## 1.2 Pin description

Figure 2: Pin connection diagram (top view)

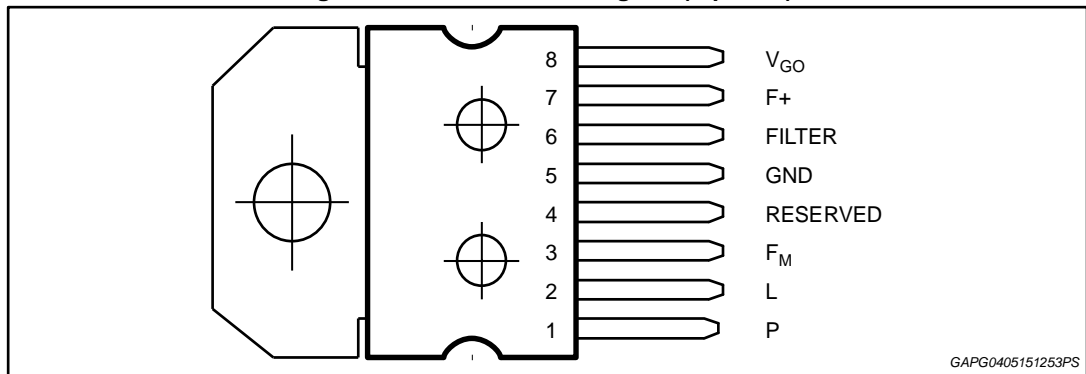


Table 2: Pin description

N°	Pin	Function
1	P	Phase sense input
2	L	Warning terminal output and ECM PWM input
3	F <sub>M</sub>	Field monitor output
4	RESERVE D	Reserved
5	GND	Ground
6	FILTER	Regulation loop filter
7	F+	Field high side driver output
8	V <sub>GO</sub>	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 (@ $T_j = 150\text{ °C}$ , $I_{Field} = 6\text{ A}$ )	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	$175 \pm 15$	°C
$R_{th-j-case}$	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 <sup>(1)</sup>	V
$I_{SB}$	Standby Current <sup>(2)</sup>	$V_{GO} = 12.6\text{ V}$ , $T_{case} = -35\text{ to }+80\text{ °C}$	-	-	400	μA
		$V_{GO} = 12.6\text{ V}$ , $80 < T_{case} < +150\text{ °C}$	-	-	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, $I_{OUT} = 2\text{ A}$ 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	$I_F = 9\text{ A}$ , $T_{case} \leq 25\text{ °C}$	-	-	750	mV
		$I_F = 6\text{ A}$ , $T_{case} > 25\text{ °C}$	-	-	850	mV
$I_{FLIM}$	Field limit current	F shorted to GND, $T_{case} \leq 25\text{ °C}$	9	-	-	A
		F shorted to GND, $T_{case} = 150\text{ °C}$	6	-	-	A
$V_F$	Field discharge rectifier	$I_F = 6\text{ A}$ , $T_{case} = 25\text{ °C}$	-	-	1.85	V
$I_R$	Diode reverse current	$V_R = 16\text{ V}$	-	-	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 @ $F_{Mpin}$	Impedance between FM and F+	0.8	-	2.5	k $\Omega$

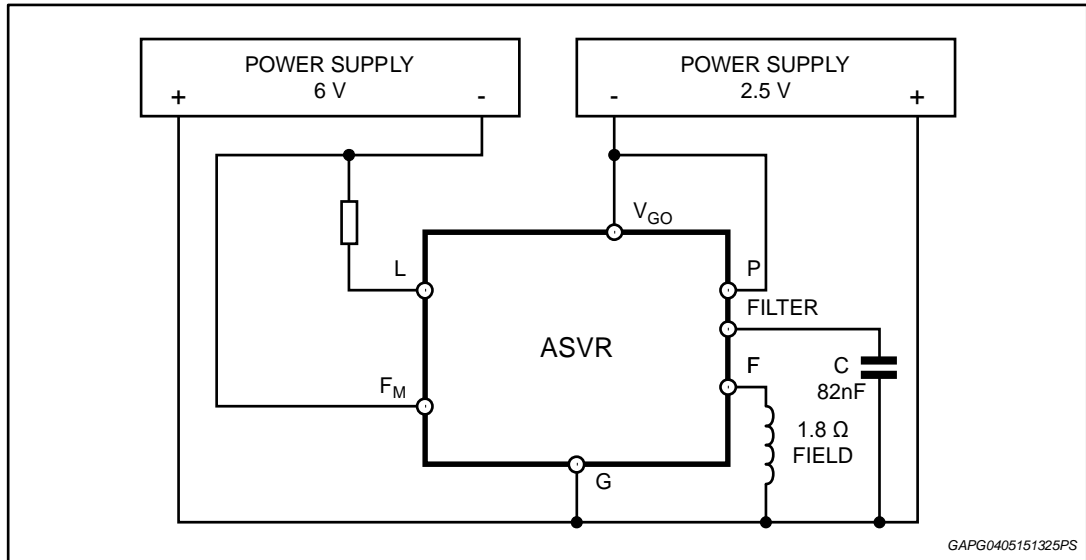
**Notes:**

<sup>(1)</sup>16 V is the maximum operating voltage.

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

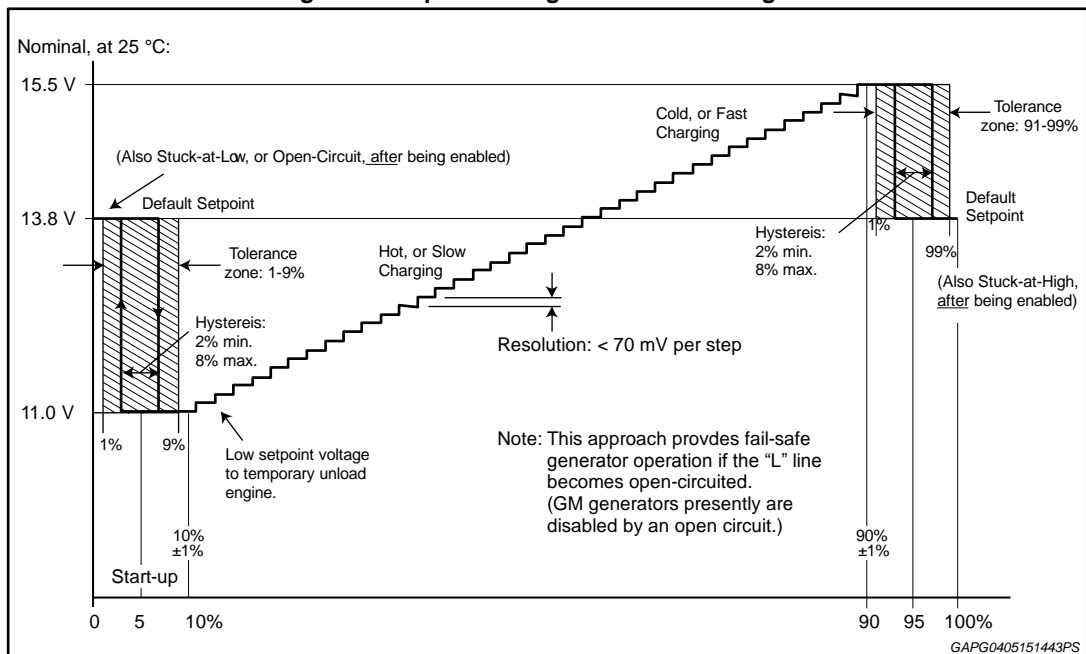
<sup>(3)</sup>When the voltage sensed at  $V_{GO}$  terminal is above  $V_{OV}$  the Minimum Field Duty-Cycle will be 0%.

**Figure 3: Reverse B+ test circuit**



GAPG0405151325PS

**Figure 4: Setpoint voltage vs. L terminal signal**



GAPG0405151443PS

## 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 <sub>OV</sub>	Overvoltage <sup>(1)</sup>	-	16.5	-	22	V
V <sub>LSAT</sub>	L saturation voltage	I <sub>L</sub> = 50 mA	-	-	1.35	V
T <sub>DELAY</sub>	Fault indication delay time		0.935	1.1	1.265	s

### Notes:

<sup>(1)</sup>When the V<sub>GO</sub>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 V<sub>LSAT</sub>. To prevent L flicker, specific faults are required to be present for T<sub>DELAY</sub> 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 <sub>GO</sub> < setpoint	Yes

## 2.6 Regulation features

Table 8: Regulation features

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V <sub>LOn</sub>	Lamp term turn on threshold <sup>(1)</sup>	f <sub>L</sub> = 128 Hz ±5%	0.65	0.9	1.15	V
I <sub>LOn</sub>	Lamp term turn on current	V <sub>L</sub> = 0.65 V	0.3	-	1.5	mA
V <sub>P1</sub>	Initiation of regulation detection phase voltage threshold <sup>(2)</sup>	I <sub>P</sub> = 1 mA (sinking current)	-	0.35	-	V
V <sub>P2</sub>	Fault detection phase voltage threshold <sup>(3)</sup>	-	7	8	9	V
I <sub>P</sub>	Sinking current @ P terminal	V <sub>P</sub> = 1.5V	0.5	1	1.8	mA
f <sub>IFR</sub>	Initiation of field regulation frequency	-	-	72	-	Hz
FSDF	Field Strobe Duty Factor	@ 'power up' with f <sub>PHASE</sub> < f <sub>IFR</sub>	-	12.5	-	%
LRC	Load response control rate <sup>(4)</sup>	-	2.125	2.5	2.875	s
f <sub>LRC</sub>	LRC transition frequency	LRC disabled above this value	263	310	357	Hz
Δgnd	Difference between ECM & alternator ground	-	-0.2	-	0.2	V

### Notes:

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



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

<sup>(3)</sup>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.

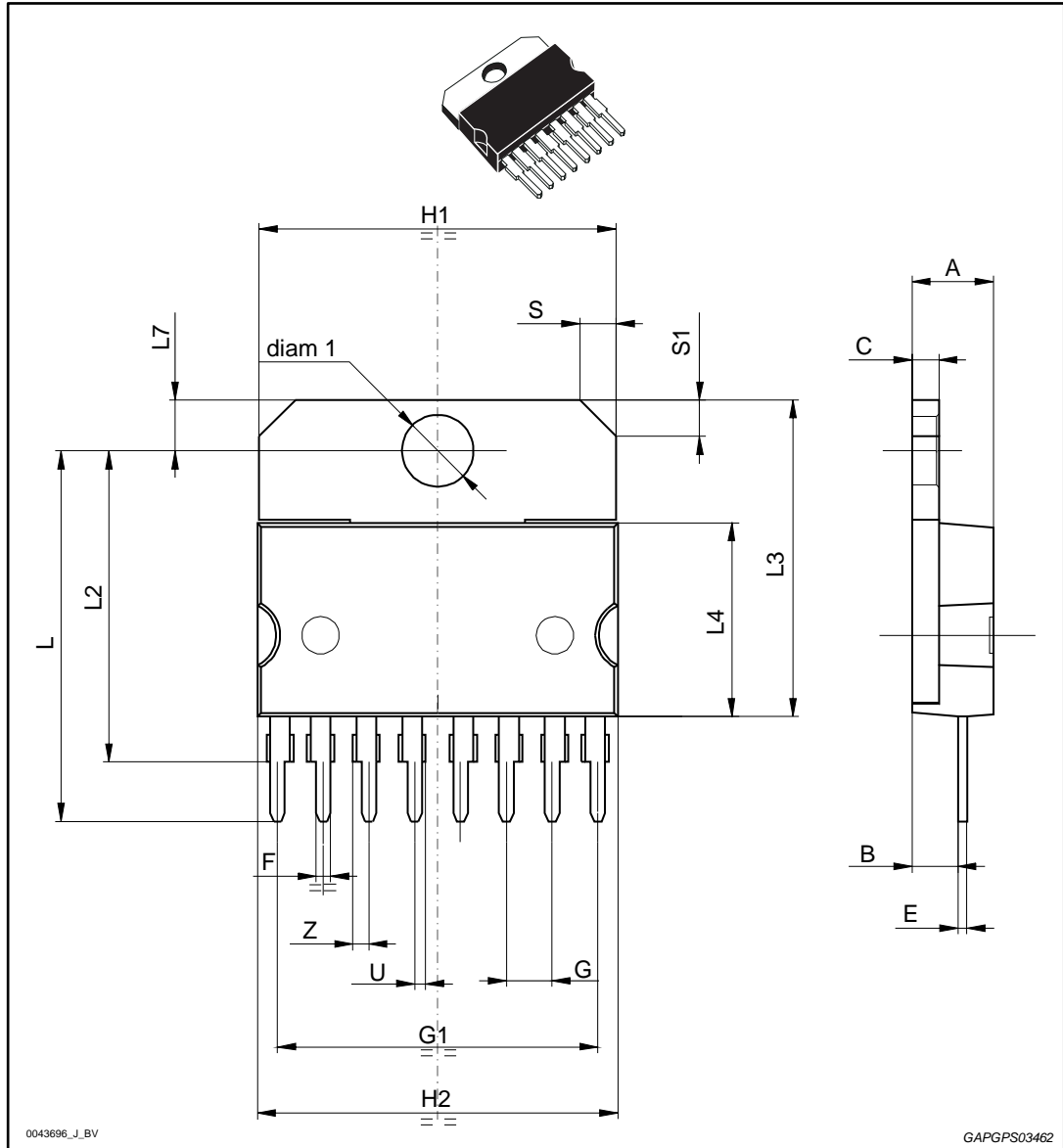
<sup>(4)</sup>This is the time duration the L9474N takes to ramp up from 0% to 100% duty cycle in response to an increased load on the generator. The LRC ratio is set 1:4 and the  $V_{reg}$  comparator status is latched at fundamental frequency rate.

### 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](http://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



0043696\_J\_BV

GAPGPS03462

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

Ref	Dimensions					
	Millimeters			Inches <sup>(1)</sup>		
	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:**

<sup>(1)</sup>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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