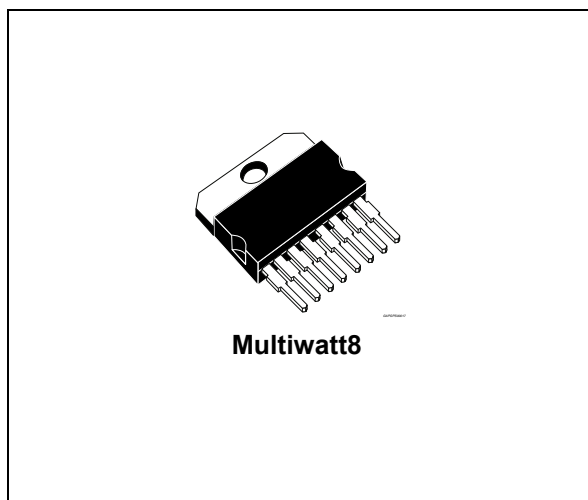


## All silicon automotive voltage regulator

Datasheet - production data



### Features

- AEC-Q100 qualified
- High side field driver



- Thermal protection
- Field driver short circuit protection
- RVC interface
- Overvoltage protection
- Complex diagnostics
- Load response control
  - LRC rate 2.5 s (L9914A)

### Description

The L9914 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 (ECU) via RVC protocol.

**Table 1. Device summary**

Order code	Temp range, °C	Package	Packing
L9914A	$T_j = -40$ to $+150$	Multiwatt8	Tube

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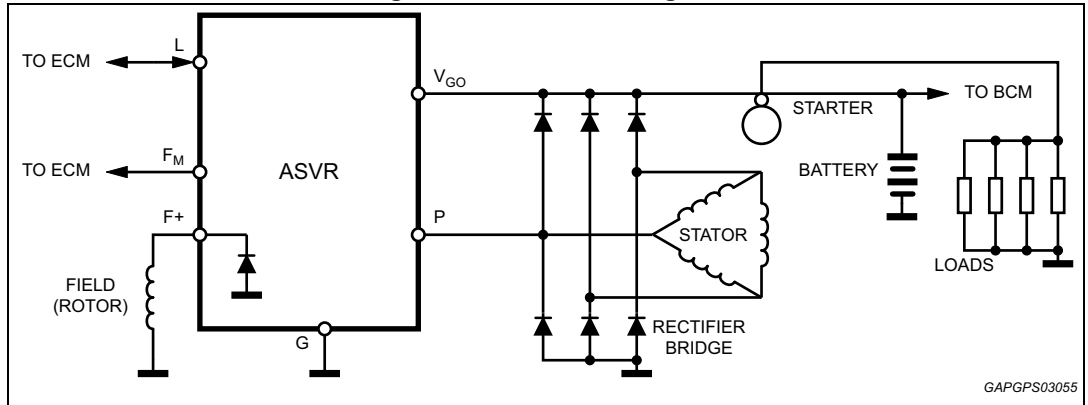
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# 1 Schematic diagram and pin description

## 1.1 Schematic diagram

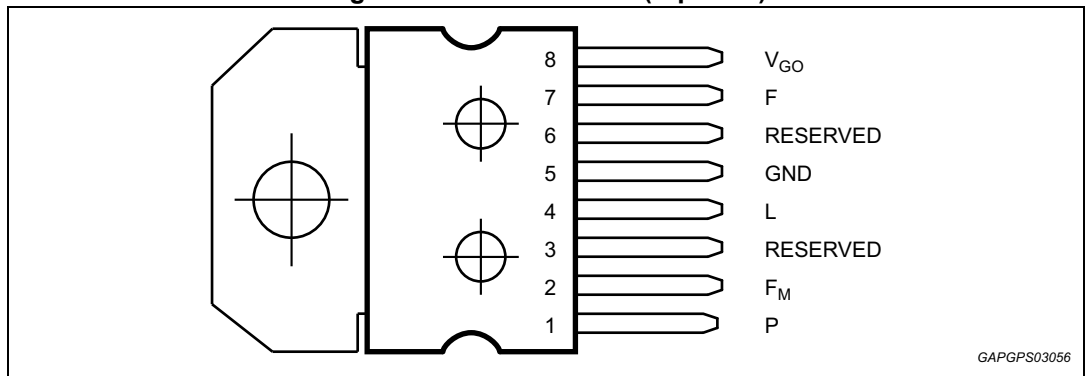
Figure 1. Schematic diagram



GAPGPS03055

## 1.2 Pin description

Figure 2. Pin connection (top view)



GAPGPS03056

Table 2. Pin description

N°	Pin	Function
1	P	Phase sense input
2	F <sub>M</sub>	Field monitor output
3	RESERVED	Reserved
4	L	Warning terminal output and ECM PWM input
5	GND	Ground
6	RESERVED	Reserved
7	F	Field high side driver output
8	V <sub>Go</sub>	Generator output sense and voltage supply to L9914

## 2 Electrical specifications

### 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 (@ $T_j = 150^\circ\text{C}$ , $I_{Field} = 6\text{ A}$ )	6	W
$V_{REV}$	Reverse voltage (see <a href="#">Figure 1.</a> )	-2.5 to -6	V

### 2.2 Absolute maximum ratings and operative range by pin

Table 4. Absolute maximum ratings and operative range by pin

Pin #	Name	Absolute maximum rating		Operative range		Unit
		Min.	Max.	Min.	Max.	
1	P	-5	VGO+3V	-1.5	20	V
2	FM	-1.5	50	-1.5	18	V
3	RESERVED	-0.3	7	must be connect to GND		V
4	L	-0.3	50	-0.3	18	V
5	GND	-	-	-	-	-
6	RESERVED	-0.3	7	must be connect to GND		V
7	F	-1.5	VGO	-1.5	VGO	V
8	VGO	-2.5	50	8	18	V

### 2.3 Thermal data

Table 5. Thermal data

Symbol	Parameter	Value	Unit
$T_j$	Junction temperature	-40 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-50 to 150	$^\circ\text{C}$
$T_{sd}$	Thermal shut down	$175 \pm 15$	$^\circ\text{C}$
$R_{th\ j-case}$	Thermal resistance junction to case	1.5	$^\circ\text{C/W}$

## 2.4 Electrical characteristics

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

**Table 6. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{OS}$	Operating supply voltage	-	8	-	16 <sup>(1)</sup>	V
$I_{SB}$	Standby current <sup>(2)</sup>	$V_{GO} = 12.6$ V, $T_{case} -35$ to $+80$ °C	-	-	400	$\mu$ A
		$V_{GO} = 12.6$ 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, $I_{OUT} = 2$ A to 50 % max load	$V_S^{(3)}-2$	-	$V_S+2$	V
$T_C$	Thermal compensation	Driven by ECM	RVC or FLAT			V
$V_{LR}$	Load regulation - L9914A	6500 grpm, 10 % to 95 % load	-	-	300	mV
$V_{SR}$	Speed regulation	15 A load, 2,000 to 10,000 grpm	-	-	100	mV
$V_{FON}$	Output saturation voltage	$I_F = 9$ A, $T_{case} \leq 25$ °C	-	-	750	mV
$V_{FON}$	Output saturation voltage	$I_F = 6$ A, $T_{case} > 25$ °C	-	-	850	mV
$I_{FLIM}$	Field limit current	F shorted to GND, $T_{case} \leq 25$ °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
MFDC	Minimum field duty-cycle	$V(V_{GO}) < V_{OV}$ <sup>(4)</sup>	-	6.25	-	%
$R_{FM}$	Impedance @ $F_M$ pin	Impedance between FM and F+	5	-	15	K $\Omega$

- 16 V is the maximum operating voltage.
- Standby current measured with L, FM open; F connected to GND; P open or tied to GND.
- $V_S = V_{set}$  point (with or without protocol).
- 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**

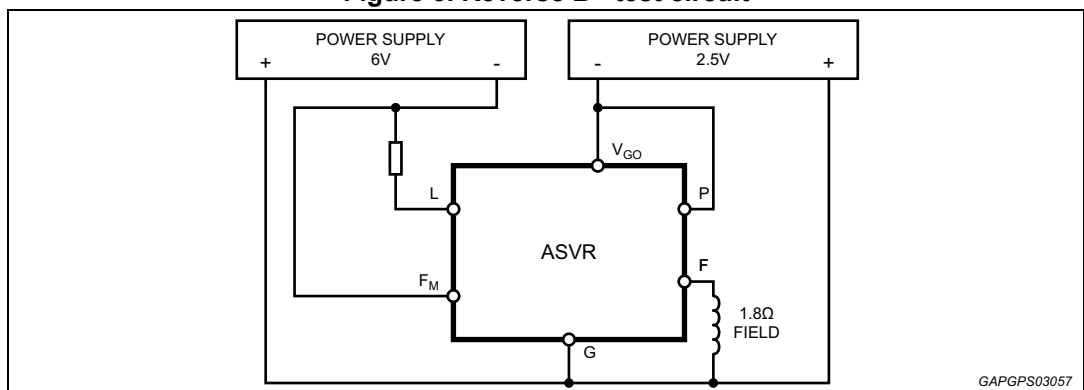
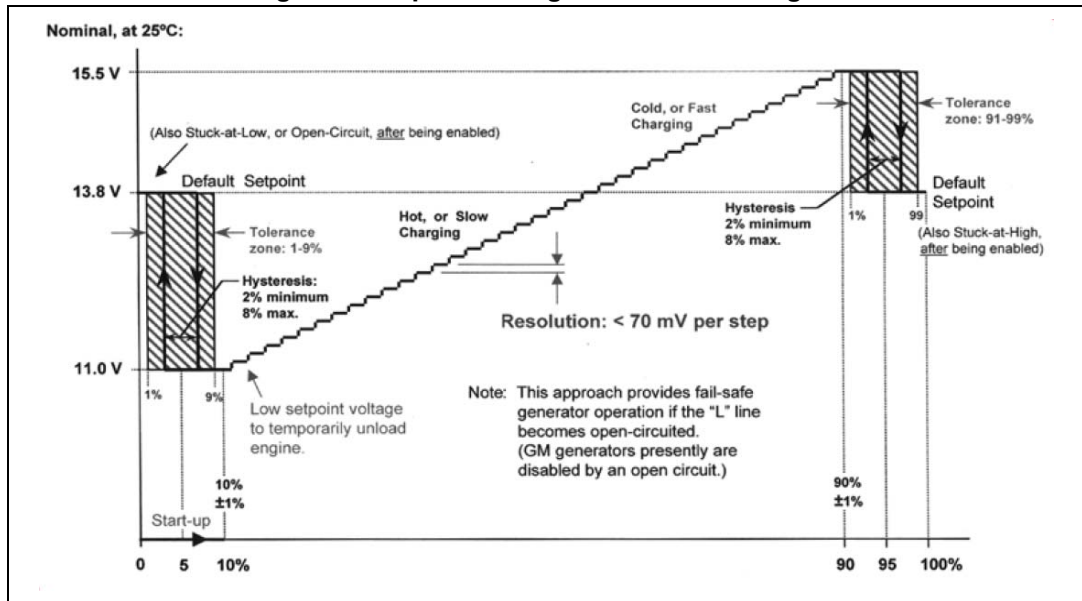


Figure 4. Setpoint voltage vs. L terminal signal



## 2.5 Diagnostic

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

Table 7. Diagnostic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{OV}$	Overvoltage <sup>(1)</sup>	-	16.5	-	22	V
$T_{DELAY}$	Fault indication delay time	-	0.935	1.1	1.265	s

1. When the  $V_{GO}$  voltage overcomes this value the MFDC is cancelled.

### 2.5.1 Fault

The following table lists the conditions that cause the fault driver to function (L terminal now switching between 0 V and  $V_{LSAT}$ ). To prevent L flicker, specific faults are required to be present for  $T_{DELAY}$  seconds before the fault driver is activated. This delay is indicated in the following table.

Table 8. Fault

Conditions	Delay
1. Key-on (RVC PWM signal acknowledgement)	No
2. Phase voltage < $V_{P2}$ and $V_{GO}$ < setpoint	Yes



## 2.5.2 Regulation feature

**Table 9. Regulation feature characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{LON}$	Lamp term turn on <sup>(1)</sup> threshold	$f_L = 128 \text{ Hz} \pm 5 \%$	0.65	0.9	1.15	V
$I_{LON}$		$V_L = 0.65 \text{ V}$	0.3	-	1.5	mA
$V_{P1}$	Initiation of regulation detection phase voltage threshold <sup>(2)</sup>	$I_P = 1 \text{ mA}$ (sinking current)	-	0.4	-	V
$V_{P2}$	Fault detection phase voltage threshold <sup>(3)</sup>	-	7	8	9	V
$I_P$	Sinking current @ P terminal	$V_P = 1.5 \text{ V}$	0.5	1	1.8	mA
$f_{IFR}$	Initiation of field regulation frequency	for L9914A	61	72	83	Hz
FSDF	Field strobe duty factor	@ "power up" with $f_{PHASE} < f_{IFR}$ for L9914A	-	13.5	-	%
LRC	Load response control rate <sup>(4)</sup>	for L9914A	2.125 4.25	2.5 5.0	2.875 5.75	s
$f_{LRC}$	LRC transition frequency	LRC disabled above this value for L9914A	263	310	357	Hz
$\Delta_{gnd}$	Difference between ECM & alternator ground	-	-0.2	-	0.2	V
$V_{OV}$	Overvoltage	-	16.5	-	22	V
$V_{LSAT}$	L saturation voltage	$I_L = 10 \text{ mA}$	-	-	1.55	V
$T_{DELAY}$	Fault indication delay time	-	0.935	1.1	1.265	s

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 L9914 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 Vreg 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

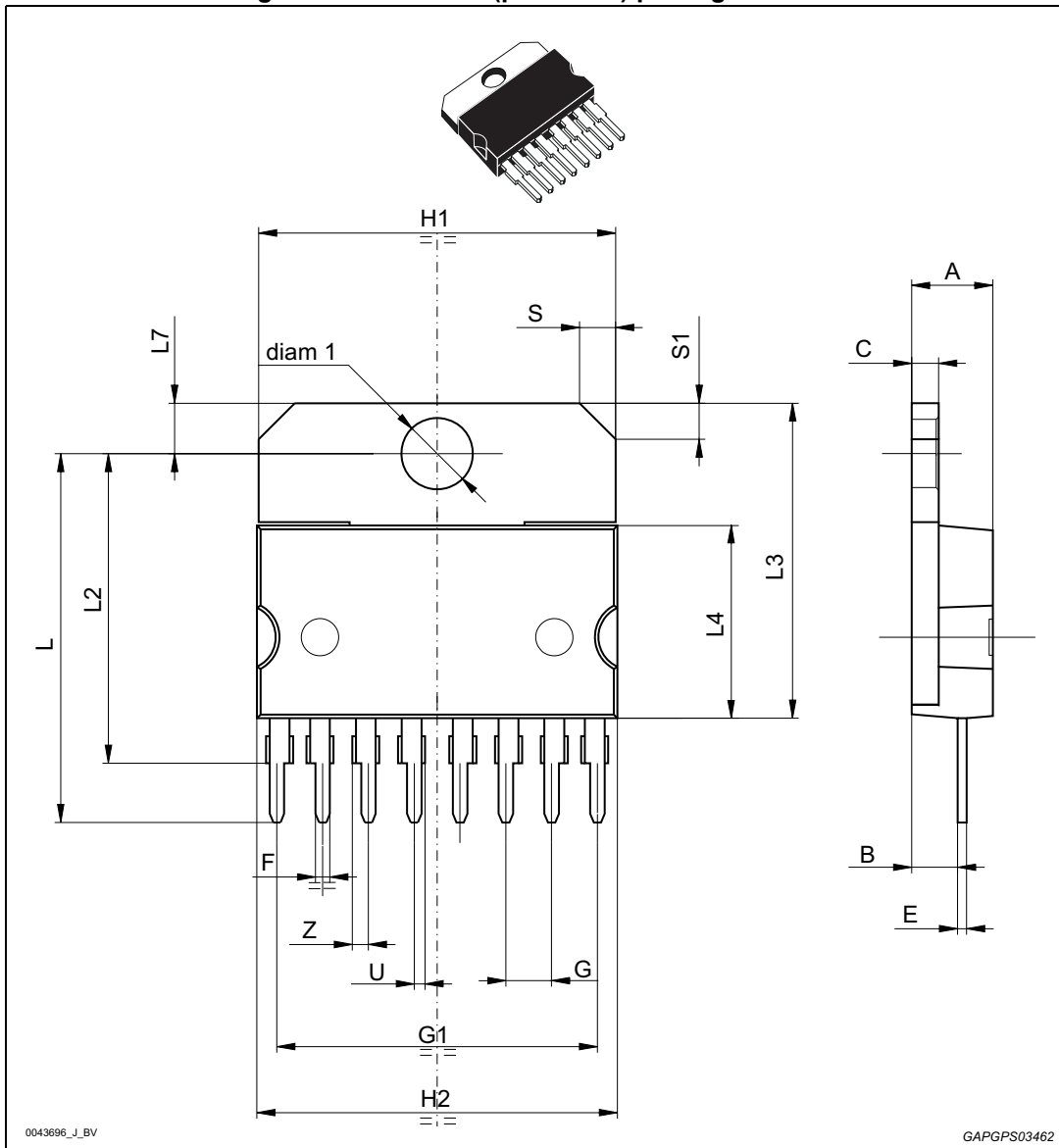


Table 10. Multiwatt 8 (pin 5GND) package mechanical drawing

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

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

## 4 Revision history

**Table 11. Document revision history**

Date	Revision	Changes
22-May-2006	1	Initial release.
20-Nov-2008	2	Document status promoted from preliminary data to production.
19-Sep-2013	3	Updated disclaimer.
09-Apr-2014	4	Updated: <ul style="list-style-type: none"> <li>– <i>Features</i>;</li> <li>– <i>Description</i>;</li> <li>– <i>Table 1: Device summary</i>;</li> <li>– <i>Table 6: Electrical characteristics</i>;</li> <li>– <i>Table 9: Regulation feature characteristics</i>.</li> </ul>
04-Sep-2014	5	Added <i>Table 4: Absolute maximum ratings and operative range by pin</i> .
16-Apr-2018	6	Added in cover page “automotive” in the title and a new feature “AEC-Q100 qualified”. Updated in <i>Table 9: Regulation feature characteristics</i> the “Field strobe duty factor” parameter. Reformatted <i>Section 3: Package information</i> , no content change.
17-Mar-2021	7	Updated: <ul style="list-style-type: none"> <li>– <i>Features</i>;</li> <li>– <i>Table 1: Device summary</i>;</li> <li>– <i>Table 6: Electrical characteristics</i>;</li> <li>– <i>Table 9: Regulation feature characteristics</i>.</li> </ul>

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