

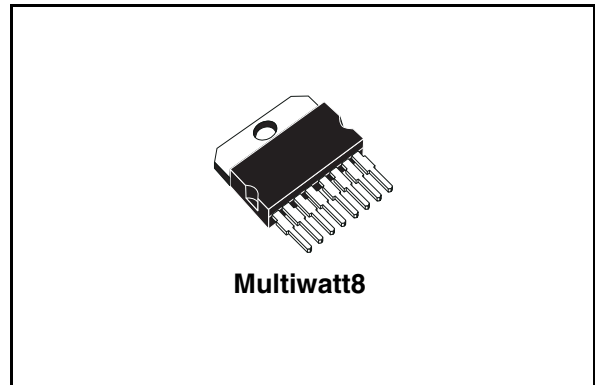
All silicon voltage regulator

Features

- High side field driver
- Thermal protection
- Field driver short circuit protection
- RVC interface
- Overvoltage protection
- Complex diagnostics
- Load Response Control
 - LRC rate 2.5s (standard version)
 - LRC rate 5.0s (optional version)

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 via RVC protocol.

Table 1. Device summary

Order code	Temp range, °C	Package	Packing
L9914	T _j = -35 to +150	Multiwatt8	Tube

Contents

- 1 Schematic diagram and pin description 3**
 - 1.1 Schematic diagram 3
 - 1.2 Pin description 3

- 2 Electrical specifications 4**
 - 2.1 Absolute maximum ratings 4
 - 2.2 Thermal data 4
 - 2.3 Electrical characteristics 4
 - 2.3.1 Fault 6
 - 2.3.2 Regulation feature 6

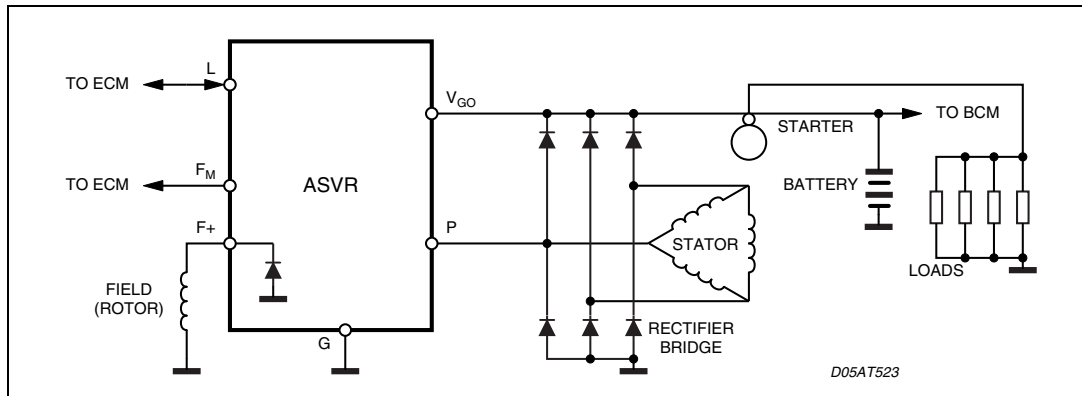
- 3 Package information 7**

- 4 Revision history 8**

1 Schematic diagram and pin description

1.1 Schematic diagram

Figure 1. Schematic diagram



1.2 Pin description

Figure 2. Pin connection (top view)

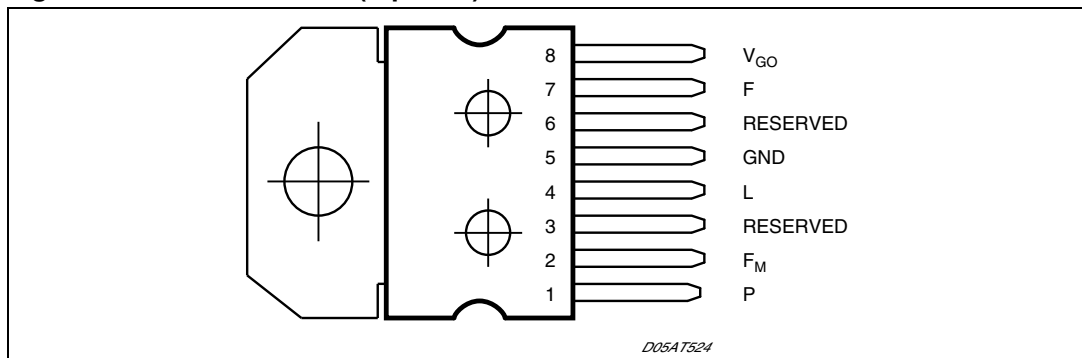


Table 2. Pin description

N°	Pin	Function
1	P	Phase sense input
2	F _M	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 _{GO}	Generator output sense and voltage supply to L9474

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 Figure 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	$^\circ\text{C}$
T_{stg}	Storage temperature	-50 to 150	$^\circ\text{C}$
T_{sd}	Thermal shut down	175 ± 15	$^\circ\text{C}$
$R_{th\ j-case}$	Thermal resistance junction to case	1.5	$^\circ\text{C/W}$

2.3 Electrical characteristics

Table 5. Electrical characteristics
(T_j -35 $^\circ\text{C}$ to +150 $^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{OS}	Operating supply voltage		8		16 ⁽¹⁾	V
I_{SB}	Standby Current ⁽²⁾	$V_{GO} = 12.6\text{V}$, $T_{case} -35$ to $+80^\circ\text{C}$			400	μA
		$V_{GO} = 12.6\text{V}$, $80 < T_{case} < +150^\circ\text{C}$			1	mA
V_{SF}	Regulator set-point in fault	PWM signal loss		13.8		V
V_{NB}	Generator output, no battery	No battery, $I_{OUT} = 2\text{A}$ 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	$I_F = 9\text{A}$, $T_{case} \leq 25^\circ\text{C}$			750	mV
V_{FON}	Output saturation voltage	$I_F = 6\text{A}$, $T_{case} > 25^\circ\text{C}$			850	mV

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{FLIM}	Field limit current	F shorted to Gnd, $T_{case} \leq 25^\circ\text{C}$	9			A
		F shorted to Gnd, $T_{case} = 150^\circ\text{C}$	6			A
V_F	Field discharge rectifier	$I_F = 6\text{A}$, $T_{case} = 25^\circ\text{C}$			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
MFDC	Minimum field duty-cycle	$V(V_{GO}) < V_{OV}^{(3)}$		6.25		%
R_{FM}	Impedance @ F_M pin	Impedance between FM and F+	5		15	K Ω

- 16 Volts is the maximum operating voltage.
- Standby current measured with L, FM open; F connected to gnd; P open or tied to gnd.
- 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

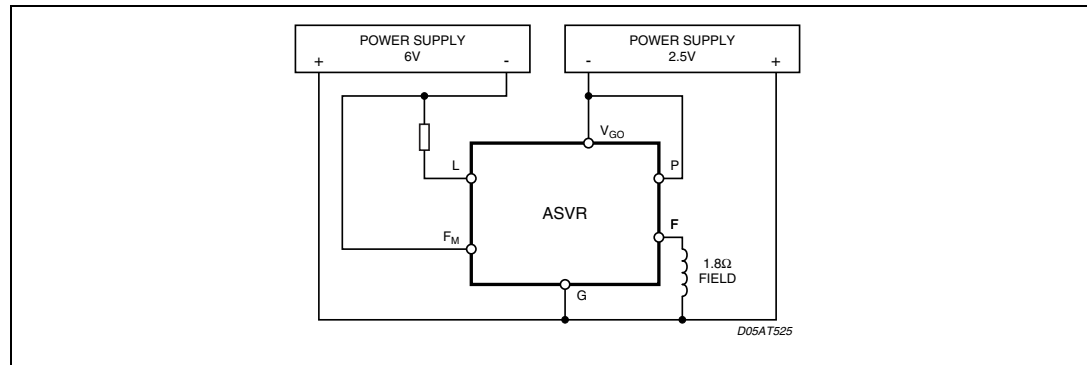


Figure 4. Setpoint voltage vs. L terminal signal

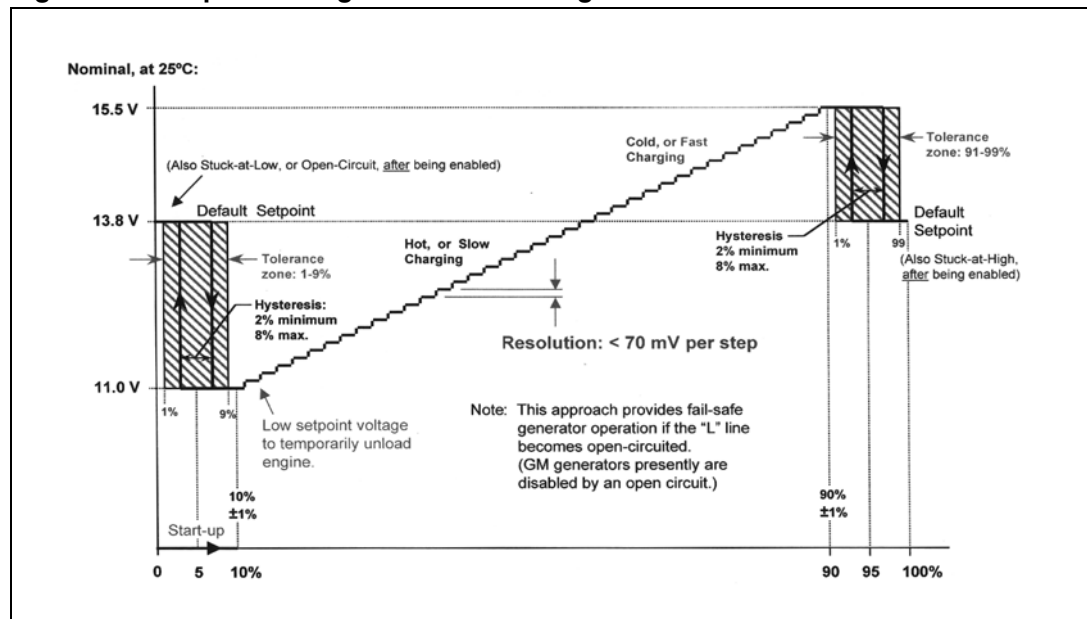


Table 6. Diagnostic (Tj -35°C to +150°C unless otherwise specified)

Symbol	Parameter	Test Conditions	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

1. When the Vgo voltage overcomes this value the MFDC is cancelled.

2.3.1 Fault

The following table lists the conditions that cause the fault driver to function (L terminal now switching between 0V 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 7. Fault

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

2.3.2 Regulation feature

Table 8. Regulation feature

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{LON}	Lamp term turn on ⁽¹⁾ threshold	f _L = 128Hz ±5%	0.65	0.9	1.15	V
I _{LON}		V _L = 0.65V	0.3		1.5	mA
V _{P1}	Initiation of regulation detection phase voltage threshold ⁽²⁾	I _P = 1mA (sinking current)		0.4		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}		18.75		%
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
V _{OV}	Overvoltage		16.5		22	V
V _{LSAT}	L saturation voltage	I _L = 20 mA			1.35	V
T _{DELAY}	Fault indication delay time		0.935	1.1	1.265	s

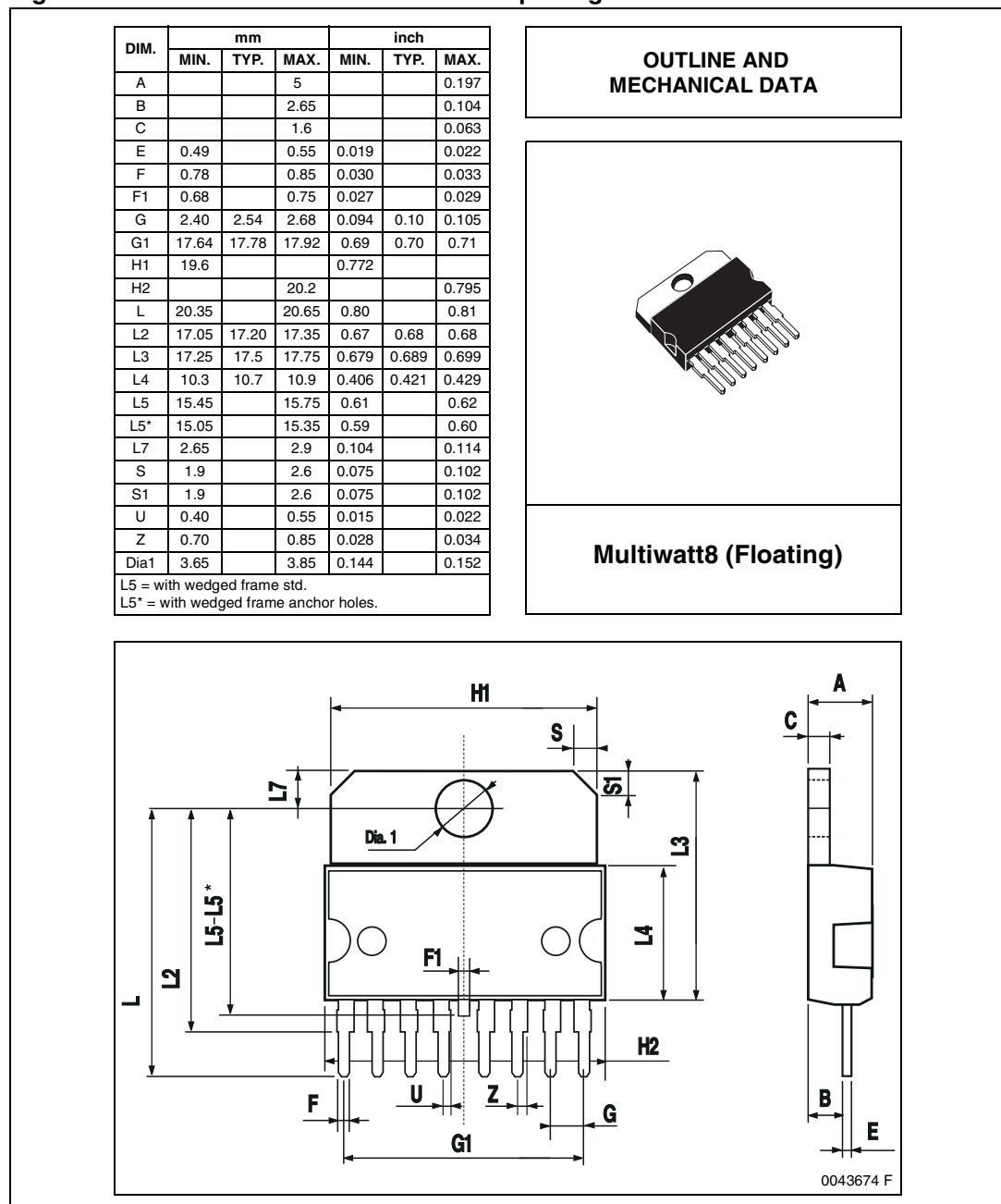
1. A 128Hz PWM signal applied to L input, higher than this threshold, will turn on the device.
2. This threshold on the phase signal is used to detect the phase frequency, f_{IFR}, for the Initiation of field regulation.
3. This threshold on the phase signal is used to sense the presence of the phase 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 Vp2 and Vgo 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 (also) offers these devices in ECOPACK[®] packages. ECOPACK[®] packages are lead-free. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label.

ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 5. Multiwatt8 mechanical data and package dimensions



4 Revision history

Table 9. Document revision history

Date	Revision	Changes
22-May-2006	1	Initial release.
20-Nov-2008	2	Document status promoted from preliminary data to datasheet.
19-Sep-2013	3	Updated disclaimer.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com