

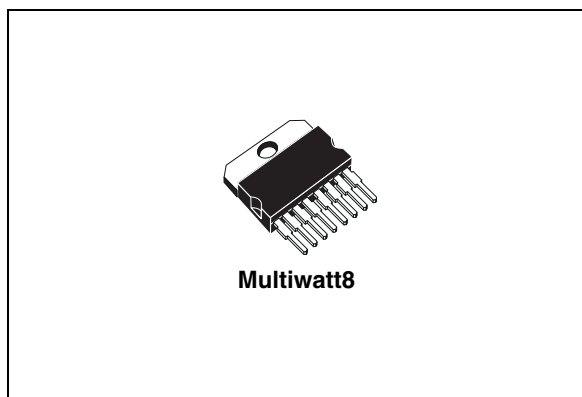
## Car alternator voltage regulator

### Features

- For air and liquid cooled applications
- DF output (inverted field monitor)
- Thermal protection
- Field driver, lamp driver, relay driver, and DF (field monitor) short circuit protected
- Load response control
- Single phase autostart

### Description

The L9466 is a monolithic multifunction generator Voltage regulator intended for use in automotive charging applications.



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

**Table 1. Device summary**

| Order code | Package    | Packing |
|------------|------------|---------|
| L9466N     | Multiwatt8 | Tube    |

# Contents

1      **Block diagram** ..... 3

2      **Pin description** ..... 4

3      **Electrical specifications** ..... 5

        3.1    Absolute maximum ratings ..... 5

        3.2    Thermal data ..... 5

        3.3    Electrical characteristics ..... 5

4      **Package information** ..... 9

5      **Revision history** ..... 10

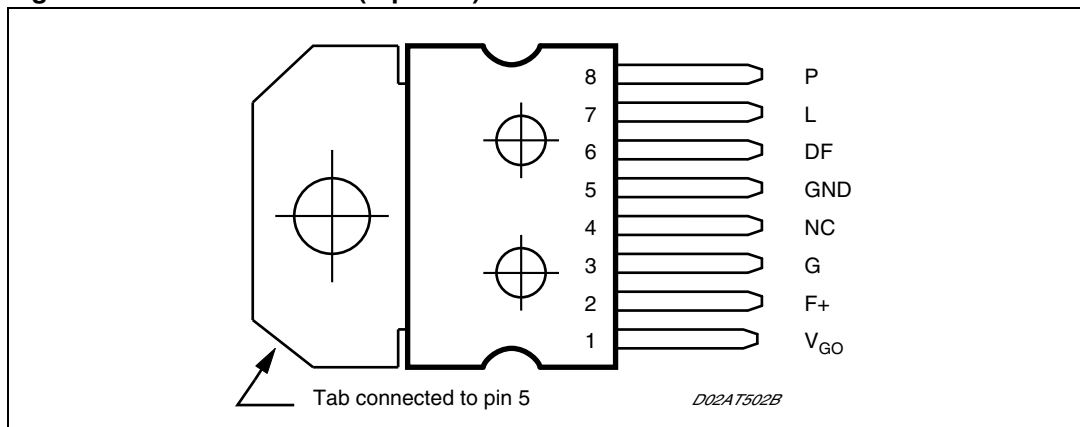


## 2 Pin description

**Table 2. Pin description**

| N° | Pin             | Description                                               |
|----|-----------------|-----------------------------------------------------------|
| 1  | V <sub>GO</sub> | Generator Output – Voltage Sense and Power Supply to ASVR |
| 2  | F+              | Field Driver - High Side Drive Output                     |
| 3  | G               | Ground for ASVR (Must be connected for Ground for ASVR)   |
| 4  | NC              | Not connected                                             |
| 5  | Gnd             | Internally connected to the Tab or Slug in MW-8.          |
| 6  | DF              | Inverted Field Monitor Output                             |
| 7  | L               | Lamp - Low Side Driver; Relay - High Side Driver          |
| 8  | P               | Phase Sense Input                                         |

**Figure 2. Pin connection (top view)**



## 3 Electrical specifications

### 3.1 Absolute maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol    | Parameter                 | Value                           | Unit |
|-----------|---------------------------|---------------------------------|------|
| $I_{OC}$  | Output current capability | Internally limited              |      |
| $P_{tot}$ | Power dissipation         | 6                               | W    |
|           | Short circuit protected   | All terminal, to VGO and ground |      |

### 3.2 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   |
| $R_{th\ j-case}$ | Thermal resistance junction to case | 1.5         | °C/W |

### 3.3 Electrical characteristics

**Table 5. Electrical characteristics**

( $T_{case} = -35^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  continuous unless otherwise specified)

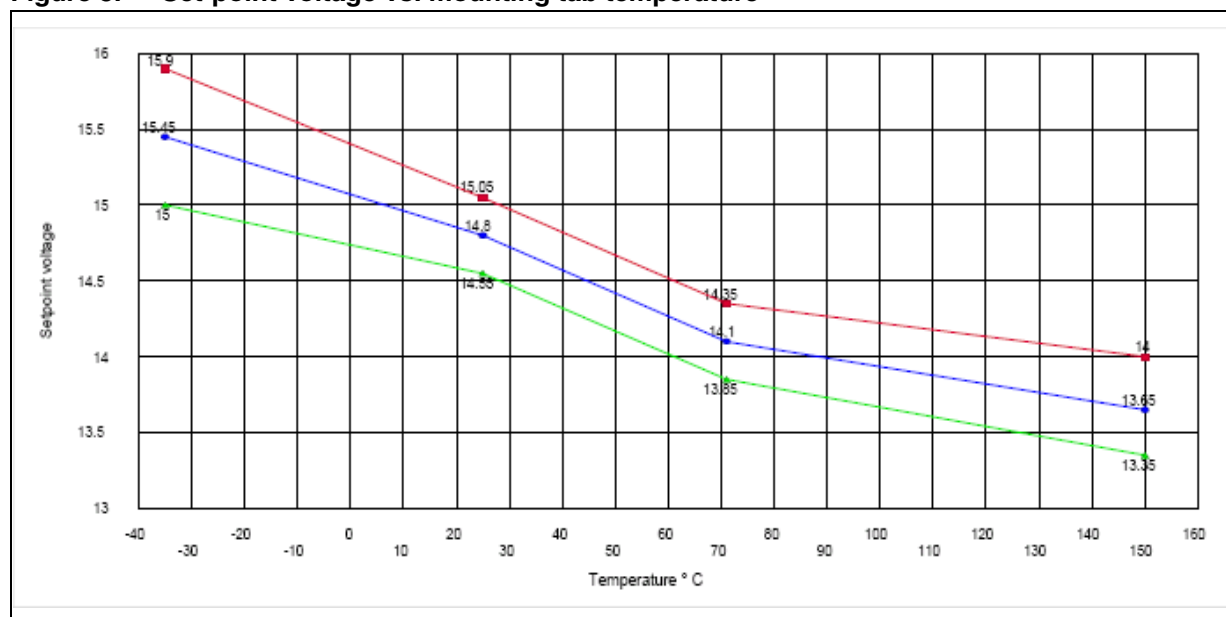
| Symbol     | Parameter                    | Test condition                                                                                                                                           | Min.                                    | Typ. | Max.         | Unit          |
|------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|--------------|---------------|
| $V_{OS}$   | Operating supply voltage     | $T_{case} = +25^{\circ}\text{C}$ to $+150^{\circ}\text{C}$                                                                                               | 8                                       |      | $V_{ov}$     | V             |
| $V_{OS}$   | Operating supply voltage     | $T_{case} = -40^{\circ}\text{C}$ to $+25^{\circ}\text{C}$                                                                                                | 10                                      |      | $V_{ov}$     | V             |
| $I_{SB}$   | Stand-by current             | $V_{GO} = 12.6\text{V}$ ; $T_{case} = 25^{\circ}\text{C}$ ; 10k $\Omega$ ; F+, G & Tab (Slug) Grounded; L, DF, & P unconnected; Regulator not activated. |                                         |      | 300          | $\mu\text{A}$ |
| $V_{SP}$   | Regulator set-point          |                                                                                                                                                          | Curve shown in <a href="#">Figure 3</a> |      |              |               |
| $V_{NB}$   | Generator output, no battery | No battery, $I_{OUT} = 2\text{A}$ to 50% Max. Load                                                                                                       | $V_{SP} - 2$                            |      | $V_{SP} + 2$ | V             |
| $T_C$      | Thermal compensation         | Voltage @ $V_{GO}$                                                                                                                                       | Curve shown in <a href="#">Figure 3</a> |      |              |               |
| $V_{LR}$   | Load regulation              | 6500 grpm, 10% to 95% load                                                                                                                               |                                         |      | 300          | mV            |
| $V_{SR}$   | Speed regulation             | 15A load, 2000 to 20,000 grpm                                                                                                                            |                                         |      | 100          | mV            |
| $V_{F-ON}$ | Output saturation voltage    | $I_F = 6\text{A}$ , $V_{GO} = 14.0\text{V}$ , $T_{case} = 25^{\circ}\text{C}$                                                                            |                                         |      | 750          | mV            |

**Table 5. Electrical characteristics (continued)**  
 ( $T_{\text{case}} = -35^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  continuous unless otherwise specified)

| Symbol             | Parameter                          | Test condition                                                                                           | Min. | Typ.      | Max. | Unit          |
|--------------------|------------------------------------|----------------------------------------------------------------------------------------------------------|------|-----------|------|---------------|
| $V_{\text{F-ON}}$  | Output saturation voltage          | $I_{\text{F}} = 5\text{A}$ , $V_{\text{GO}} = 13.5\text{V}$ ,<br>$T_{\text{case}} = 125^{\circ}\text{C}$ |      |           | 850  | mV            |
| $I_{\text{F-LIM}}$ | Field limit current <sup>(1)</sup> | Current F+ Terminal to Gnd.<br>@ $T_{\text{case}} \leq 25^{\circ}\text{C}$                               | 9.0  |           |      | A             |
| $I_{\text{F-LIM}}$ | Field limit current <sup>(1)</sup> | Current F+ Terminal to Gnd.<br>@ $T_{\text{case}} = +150^{\circ}\text{C}$                                | 6.0  |           |      | A             |
| $I_{\text{G-MIN}}$ | Min. generator current load        | Current measured @ generator output                                                                      | 0.5  |           |      | A             |
| $V_{\text{D-F}}$   | Field discharge diode              | $I_{\text{F}} = 6\text{A}$ , $T_{\text{case}} = 25^{\circ}\text{C}$                                      |      |           | 1.85 | V             |
| $I_{\text{D-R}}$   | Diode reverse current              | $V_{\text{R}} = 20\text{V}$                                                                              |      |           | 1    | mA            |
| $F_{\text{OSC}}$   | Oscillation frequency              | During LRC operation                                                                                     | 340  | 400       | 460  | Hz            |
| $V_{\text{DF}}$    | DF saturation voltage              | $I_{\text{DF}} \leq 10\text{mA}$                                                                         |      |           | 0.8  | V             |
| $I_{\text{DF-LK}}$ | DF output leakage current          | $V_{\text{DF}} < 25\text{V}$                                                                             |      |           | 10   | $\mu\text{A}$ |
| $F_{\text{TURBO}}$ | Internal clock frequency           | $V_{\text{DF}} = 32 - 35\text{V}$ ; at $2.2\text{k}\Omega$                                               |      | 4X        |      | Hz            |
| $F_{\text{TURBO}}$ | IRD, SS, LRC Rate                  | $V_{\text{DF}} = 32 - 35\text{V}$ ; at $2.2\text{k}\Omega$                                               |      | $\div 16$ |      |               |

1. The Field Drive capability shall not decrease as a function of temperature between  $25^{\circ}\text{C}$  and  $150^{\circ}\text{C}$ , at a rate faster than  $-0.024\text{A}/^{\circ}\text{C}$  (for example, Field Drive shall be capable of  $\geq 7.2\text{A}$  at  $100^{\circ}\text{C}$ ).

**Figure 3. Set-point voltage vs. mounting tab temperature**



**Table 6. Diagnostic ( $T_{case} = -35^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  unless otherwise specified)**

| Symbol         | Parameter                                          | Conditions                                                                                              | Min.         | Typ.           | Max.         | Units |
|----------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------|----------------|--------------|-------|
| $V_{OV}$       | Over-voltage                                       |                                                                                                         | $V_{SP} + 1$ | $V_{SP} + 1.3$ | $V_{SP} + 2$ | V     |
| $V_{UV}$       | Under-voltage                                      | $F_P > F_{P-LRC}$                                                                                       | 0.95         |                | 1.8          | V     |
| $V_{L-SAT}$    | Lamp ON saturation voltage                         | $I_L = 0.5\text{A}$ (sunked by ASVR)                                                                    | $>V_{L-ACT}$ | 1.33           | 1.45         | V     |
| $V_{L-SAT-BO}$ | Lamp ON voltage <sup>(1)</sup>                     | $I_L < 0.5\text{A}$ , $V_{GO} = \text{Open}$ ; $T_{case} = -35^{\circ}\text{C}$ to $85^{\circ}\text{C}$ |              | 3.8            | 5            | V     |
| $V_{L-RLY}$    | Lamp OFF (relay drive) saturation voltage (vs. B+) | $I_L = 750\text{mA}$ (Sourced by ASVR)<br><sup>(2)</sup> $T_{case} < 125^{\circ}\text{C}$               |              |                | 1.85         | V     |
| $T_{DELAY}$    | Fault indication delay time                        | Delay before Lamp ON                                                                                    | 0.9          | 1.1            | 1.3          | s     |

1. This condition can happen when the connection between the battery and  $V_{GO}$  or the output terminal of the generator is broken. The 1.1 second delay is not required, and current is sunked by ASVR.
2. When no fault is detected the Lamp terminal is pulled up by ASVR.

**Table 7. Fault indication table**

| Conditions                                                                                | $T_{Delay}$ |
|-------------------------------------------------------------------------------------------|-------------|
| Initial KEY-ON Bulb and Wiring Check (Lamp ON for 1 sec. $\pm 15\%$ after initial KEY-ON) | No          |
| $V_{GO} > V_{OV}$                                                                         | Yes         |
| $V_P < V_{P-F}$ AND $V_{GO} < V_{SP}$                                                     | Yes         |
| $F_P < F_{P-TR}$ @ $V_{P-TR}$                                                             | Yes         |
| No Connection Between Battery and $V_{GO}$                                                | No          |
| At Start: Lamp ON until $F_P > F_{P-IR}$ AND $V_P > V_{P-F}$ i.e. until $V_P$ reaches 8V. | No          |

**Table 8. Regulation features**

| Symbol     | Parameter                                   | Conditions                                                                | Min. | Typ. | Max. | Unit |
|------------|---------------------------------------------|---------------------------------------------------------------------------|------|------|------|------|
| $V_{L-PD}$ | L terminal regulator activate threshold     | $V_{GO} = 12.6\text{V}$                                                   | 0.8  | 1    | 1.15 | V    |
| $I_{L-PD}$ | L terminal pull down current                | $V_L = V_{L-ACT}$<br>$V_{GO} = 12.6\text{V}$                              | 0.09 |      | 0.78 | mA   |
| $V_{P-IR}$ | Initiate regulation phase voltage threshold | Regulator Activated                                                       | 1.1  | 1.3  | 1.5  | V    |
| $I_P$      | Phase terminal current sink                 | $V_P > 1.5\text{V}$ and $< 12.6\text{V}$<br>$V_{GO} = 12.6\text{V}$       | 0.25 |      | 3.5  | mA   |
| $F_{P-IR}$ | Initiate regulation phase frequency         |                                                                           | 123  | 145  | 167  | Hz   |
| $F_{P-TR}$ | Terminate regulation phase frequency        |                                                                           | 59   | 72   | 86   | Hz   |
| IRD        | Initiate regulation delay                   | Regulator activated, $V_{P-IR}$ and $F_{P-IR}$ Conditions Met First Time. | 1.7  | 2    | 2.3  | s    |

**Table 8. Regulation features** (continued)

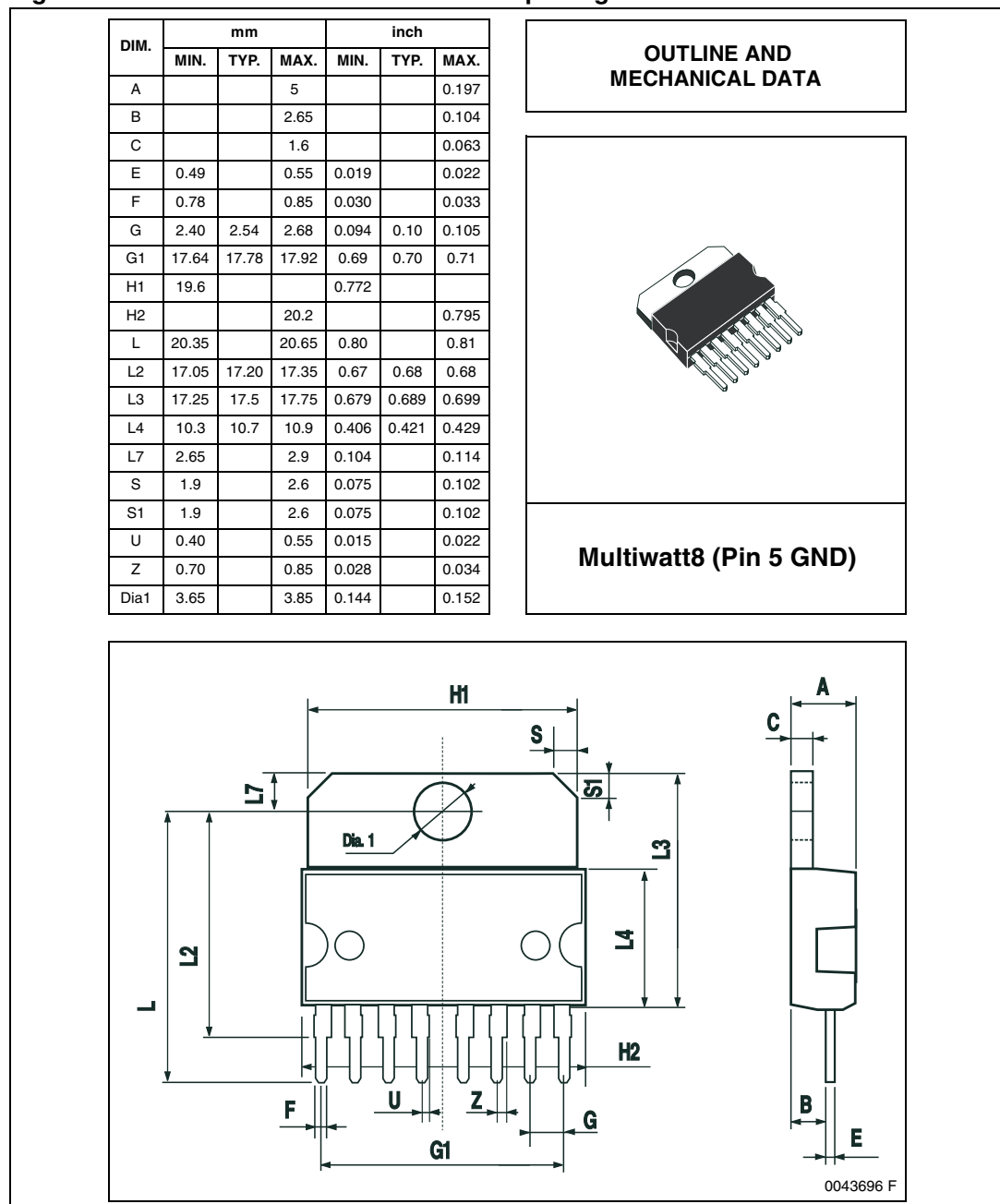
| Symbol             | Parameter                  | Conditions                                                                        | Min. | Typ.  | Max. | Unit |
|--------------------|----------------------------|-----------------------------------------------------------------------------------|------|-------|------|------|
| FSDC               | Field strobe duty cycle    | Regulator activated AND<br>(regulation terminated OR<br>regulation NOT initiated) | 16   | 18.75 | 22   | %    |
| LRC                | Load response control rate | Field drive duty cycle increase                                                   | 8.5  | 10    | 11.5 | %/s  |
| F <sub>P-LRC</sub> | LRC transition frequency   | LRC enabled if $F_P < F_{P-LRC}$                                                  | 255  | 300   | 345  | Hz   |
| SS                 | Soft-start                 | LRC enabled until $V_{SP}$ reached<br>regardless other conditions                 | 34   | 40    | 46   | %/s  |

## 4 Package information

In order to meet environmental requirements, ST (also) offers these devices in ECOPACK<sup>®</sup> packages. ECOPACK<sup>®</sup> 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](http://www.st.com).

**Figure 4. Multiwatt8 mechanical data and package dimensions**



## 5 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                                                                                           |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------|
| 17-May-1994 | 1        | Initial release.                                                                                                  |
| 21-Oct-2008 | 2        | Revalidation document.<br>Document reformatted.<br>Updated <a href="#">Section 2: Pin description on page 4</a> . |
| 19-Sep-2013 | 3        | Updated Disclaimer.                                                                                               |

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