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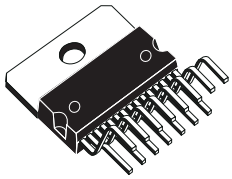
# L5957

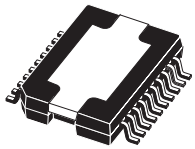
## Multifunction voltage regulator for car radio

## Features

- Four outputs:
  - 8.5 V @ 500 mA
  - 5 V @ 300 mA Permanent
  - 5 V @ 800 mA
  - 3.3 V @ 800 mA
- 2 A high side driver
- Reset function
- Ignition comparator
- Load dump protection
- Thermal shutdown
- Overcurrent limitation
- All pins ESD protected



**Multiwatt15 (Vertical)**



**PowerSO20 (Slug up)**

## Description

The L5957 contains a triple voltage regulator and a power switch.

The IC includes a monitoring circuit for detection.

The IC features a very low quiescent current in standby.

**Table 1. Device summary**

| Order code | Package | Packing |
|---|---|---|
| L5957PD | PowerSO20 (slug up) | Tube |
| L5957PDTR | PowerSO20 (slug up) | Tape and reel |
| L5957 | Multiwatt15 (Vertical) | Tube |

# Contents

# List of tables

# List of figures

# 1 Block and pins connection diagrams

**Figure 1. Block diagram**

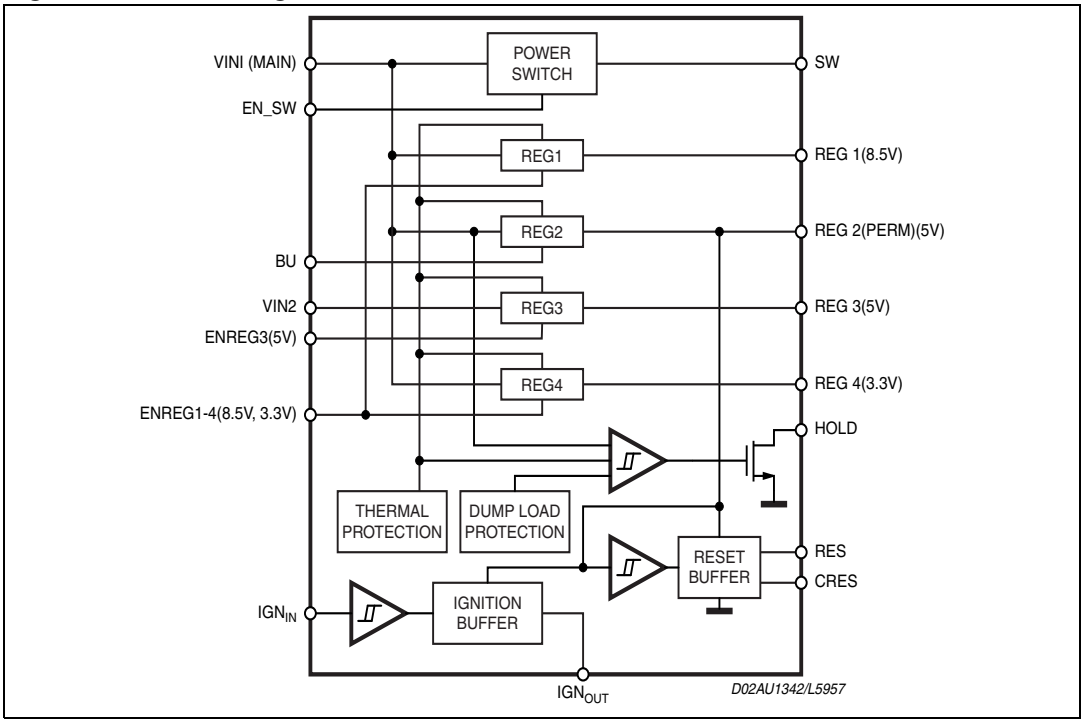
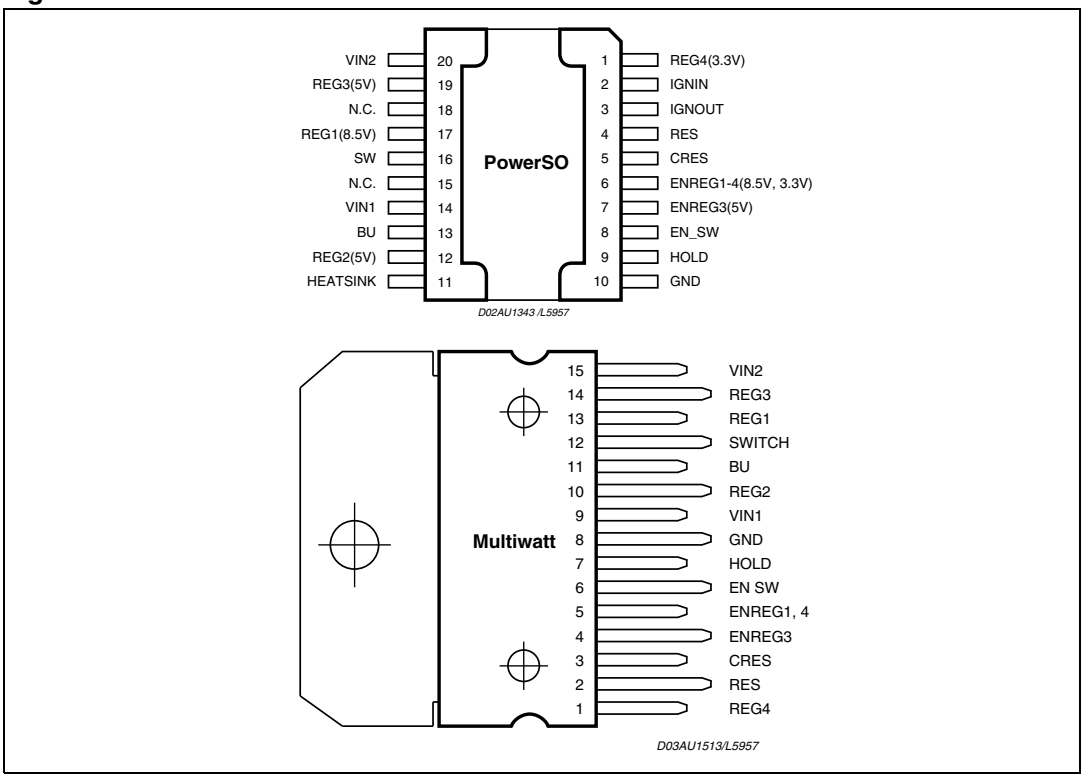



**Figure 2. Pins connection**



# 2 Electrical specifications

## 2.1 Absolute maximum ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{SDC}$ | DC operating supply voltage | 30 | V |
| $V_{STR}$ | Transient supply voltage | 50 | V |
| $I_O$ | Output current | internally limited | |
| $T_{op}$ | Operating temperature range | -40 to 85 | °C |
| $T_{stg}$ | Storage temperature | -55 to 150 | °C |
| $T_j$ | Junction temperature | -55 to 150 | °C |
| $P_d$ | Power dissipation $T_{case}$ = 85 °C | 43 | W |

## 2.2 Thermal data

**Table 3. Thermal data**

| Symbol | Parameter | PowerSO | Multiwatt | Unit |
|---|---|---|---|---|
| $R_{th\ j\text{-}case}$ | Thermal resistance junction-to-case Max. | 1.5 | 1.8 | °C/W |

## 2.3 Electrical characteristics

$V_S$ = 14.4 V; $T_{amb}$ = 25 °C; unless otherwise specified.

**Table 4. Electrical characteristics**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Input supplies** | | | | | | |
| $V_{in1}$ | Input supply voltage 1 | Operating | 9 | - | 18 | V |
| $V_{in2}$ | Input supply voltage 2 | Operating | 6 | - | 18 | V |
| $I_q$ | Total quiescent current | Standby (-20 °C to 85 °C) $IGN_{IN}$ = 5 V | - | - | 70 | µA |
| | | REGx = 5 V, REGsw = 5 V, $IGN_{IN}$ = 5 V | - | 5 | - | mA |
| | | Standby (-20 °C to 85 °C) $IGN_{IN}$ = 5 V, $V_{CC}$ = 18 V | - | 100 | - | µA |
| Load Dump $V_{in1}$ | Battery over voltage | $V_{in1}$ | 18 | 20 | 22 | V |
| Load Dump $V_{in2}$ | | $V_{in2}$ | 18 | 20 | 22 | V |

**Table 4. Electrical characteristics (continued)**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Regulator 1** | | | | | | |
| $V_{o\ (REG\ 1)}$ | Output voltage 8.5 V | - | 8 | 8.5 | 9 | V |
| ΔV | Line regulation | $V_{in1}$ = 10 to 18 V; I = 500 mA | - | - | 50 | mV |
| | | $V_{in1}$ = 9.3 to 18 V; I = 10 mA | - | - | 50 | mV |
| ΔVi | Load regulation | $I_{reg1}$ = 1 to 500 mA | - | - | 100 | mV |
| $I_q$ | Quiescent current | $I_{reg1}$ = 10 mA | - | - | 5 | mA |
| PSRR | Supply voltage ripple rejection | f = 1 kHz; $V_{in1}$ = 1.5 Vpp; $I_o$ = 500 mA | 50 | - | - | dB |
| $V_{drop}$ | Drop out voltage | $I_{reg1}$ = 500 mA (1) | - | - | 0.6 | V |
| $I_m$ | Current limit | $R_{short}$ = 0.5 Ω | 0.6 | - | 1.2 | A |
| **Regulator 2** | | | | | | |
| $V_{o\ (ST\ BY)}$ | Output voltage 5 V | - | 4.7 | 5 | 5.3 | V |
| ΔV | Line regulation | $V_{in1}$ = 7 to 18 V; I = 300 mA | - | - | 50 | mV |
| | | $V_{in1}$ = 6 to 18 V; I = 10 mA | - | - | 50 | mV |
| ΔVi | Load regulation | $I_{reg2}$ = 1 to 300 mA | - | - | 100 | mV |
| $I_q$ | Quiescent Current | $I_{reg2}$ = 10 mA | - | - | 3 | mA |
| PSRR | Supply voltage ripple rejection | f = 1 kHz; $V_{in1}$ = 1.5 Vpp; $I_o$ = 300 mA | 50 | - | - | dB |
| $V_{drop}$ | Drop out voltage | $I_{reg2}$ = 300 mA (1) | - | - | 1.5 | V |
| | | $I_{reg2}$ = 100 mA (1) | - | - | 0.6 | V |
| $I_m$ | Current limit | $R_{short}$ = 0.5 Ω | 400 | - | 800 | mA |
| **Regulator 3** | | | | | | |
| $V_{o\ (REG\ 3)}$ | Output voltage 5V | - | 4.75 | 5 | 5.25 | V |
| ΔV | Line regulation | $V_{in2}$ = 7 to 18 V; I = 800 mA | - | - | 50 | mV |
| | | $V_{in2}$ = 6 to 18 V; I = 10 mA | - | - | 50 | mV |
| ΔVi | Load regulation | $I_{reg3}$ = 1 to 800 mA | - | - | 100 | mV |
| $I_q$ | Quiescent current | $I_{reg3}$ = 10 mA | - | - | 5 | mA |
| PSRR | Supply voltage ripple rejection | f = 1 kHz; $V_{in1}$ = 1.5 Vpp; $I_o$ = 800 mA | 50 | - | - | dB |
| $V_{drop}$ | Drop out voltage | $I_{reg3}$ = 800 mA (1) | - | - | 1.5 | V |
| $I_m$ | Current limit | $R_{short}$ = 0.5 Ω | 1 | - | 2 | A |
| **Regulator 4** | | | | | | |
| $V_{o\ (REG\ 4)}$ | Output voltage 3.3V | - | 3.10 | 3.3 | 3.50 | V |
| ΔV | Line regulation | $V_{in2}$ = 6 to 18 V; I = 800 mA | - | - | 50 | mV |
| ΔV | Line regulation | $V_{in2}$ = 6 to 18 V; I = 10 mA | - | - | 50 | mV |

**Table 4. Electrical characteristics (continued)**

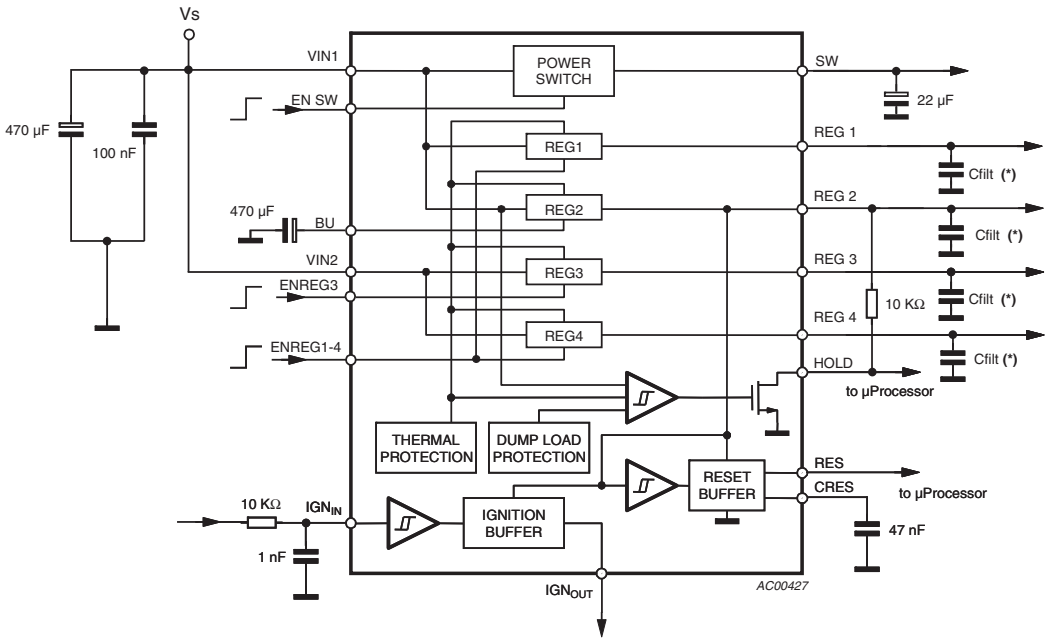
| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $\Delta Vi$ | Load regulation | $I_{reg4}$ = 1 to 800 mA | - | - | 100 | mV |
| $I_q$ | Quiescent current | $I_{reg4}$ = 10 mA | - | - | 5 | mA |
| PSRR | Supply voltage ripple rejection | f = 1 kHz; $V_{in1}$ = 1.5 Vpp; $I_o$ = 800 mA | 48 | - | - | dB |
| $V_{drop}$ | Drop out voltage | $I_{reg4}$ = 800 mA (1) | - | - | 2.65 | V |
| $I_m$ | Current limit | $R_{short}$ = 0.5 Ω | 0.9 | - | 2 | A |
| **Power switch** | | | | | | |
| $V_{dropSW}$ | Drop voltage power switch | $I_{dcSW}$ = 1.8 A max. | - | - | 0.5 | V |
| $I_{pSW1}$ | Peak current power switch | Peak time < 10 ms | 2 | - | 3.5 | A |
| $I_{pSW2}$ | | Peak time > 40 ms | 1 | - | 2 | A |
| $SW_{DEL}$ | Delay Protection | - | 15 | - | 45 | ms |
| **Reset buffer (with push-pull buffer)** | | | | | | |
| RES | RES falling | Vreg2 = 5 V | 4.6 | 4.7 | 4.8 | V |
| RES | RES rising | Vreg2 = 5 V | 4.65 | 4.8 | 4.95 | V |
| $V_{HYS(RES)}$ | Hysteresis of reset buffer | - | 50 | - | 200 | mV |
| $IH_{source\ (RES)}$ | High level source current | Reset = 0 V | 1000 | 1300 | 1600 | µA |
| $IL_{sink\ (RES)}$ | Low level sink current | Reset = 5 V | 14 | 16 | 18 | mA |
| $RES_{delay}$ | Cres = 47nF | - | 10 | - | 60 | ms |
| $\Delta TRES$ | Reset rise and fall time | R = 10 kΩ C = 15 pF | - | - | 50 | µs |
| $I_{Charge}$ | Charge current | $C_{RES}$ = 0 V | 3 | 5 | 10 | µA |
| $I_{Discharge}$ | Discharge current | $C_{RES}$ = 5 V | 1 | - | 3 | mA |
| $V_{TH(F)}$ | Falling voltage threshold | - | 1 | 1.2 | 1.4 | V |
| $V_{TH(R)}$ | Rising voltage threshold | - | 2.5 | 2.8 | 3.5 | V |
| $V_{ol}$ | Low level | $I_{SINK(RES)}$ = 1 mA | | 0.3 | 0.5 | V |
| $V_{oh}$ | High level | - | 4.5 | Vreg2 | 5.5 | V |
| **Hold signal** | | | | | | |
| $V_{lowl}$ | Hold output low for $V_{in1}$ low | Low detection | - | - | 9 | V |
| $V_{lowh}$ | Hold output high for $V_{in1}$ normal | Normal high detection | 10 | - | 18 | V |
| $V_{lowl}$ | Hold output low for $V_{in1}$ high | low detection | 22 | - | - | V |
| $V_{HOLD\ R}$ | Low $V_{IN1}$ threshold | $V_{IN1}$ Low TH. | 9 | 9.5 | 10 | V |
| $V_{HYS\ (HOLD\_L)}$ | Hysteresis low TH. | - | 50 | 150 | 200 | mV |
| $V_{HOLD\ F}$ | High $V_{IN1}$ threshold | $V_{IN1}$ High TH. | 18 | 20 | 22 | V |
| $V_{HYS\ (HOLD\_M)}$ | Hysteresis high TH. | - | 50 | 150 | 250 | mV |

**Table 4. Electrical characteristics (continued)**

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Ignition buffer (push-pull with schmitt trigger)** | | | | | | |
| $IGN_{IN}$ | $IGN_{out\ falling}$ | - | 1.03 | 1.17 | 1.28 | V |
| $IGN_{IN}$ | $IGN_{out\ rising}$ | - | 1.18 | 1.27 | 1.33 | V |
| $V_{hys(IGNout)}$ | Hysteresis of ignition buffer | - | 30 | 50 | 100 | mV |
| $IH_{source(IGNout)}$ | High level source current | $I_{GNout}$ = 0 V | 1000 | 1500 | 2000 | µA |
| $IL_{sink(IGNout)}$ | Low level sink current | $I_{GNout}$ = 5 V | 10 | 15 | 20 | mA |
| $V_{ol}$ | Low level | $IL_{sink\ (IGNout)}$ = 1 mA | - | 0.3 | 0.5 | V |
| $V_{oh}$ | High level | - | 4.5 | Vreg2 | 5.5 | V |
| $IGN_{RISE}$ | Rising time | C = 15 pF | - | - | 10 | µs |
| $IGN_{FALL}$ | Fall time | C = 15 pF | - | - | 10 | µs |
| $I_{CLAMP}$ | Input clamp current | $V_{CC} < V_{IGN} < 50$ V | - | - | 2 | mA |
| $IGN_{IN}$ | Input voltage | Operative | 0 | - | 50 | V |
| **Enable input (regulators 1,3,4 and power switch)** | | | | | | |
| $V_{TH}$ | Voltage threshold | - | 1.3 | - | 2.3 | V |
| $EN_{IN}$ | Input voltage | Operative | 0 | - | 5 | V |

1. Drop condition means that the supply voltage drop down to 100 mV from the regulated output and the regulator is sourcing its maximal load current.

**Figure 3. Typical application circuit**




**(*)** Recommended output filtering capacitors for all the regulators: C range = 5 µF to 100 µF, ESR range = 0.5 Ω to 10 Ω (T= -40 °C to +85 °C)

**Figure 4. Maximum ESR for stability valid for all the regulators outputs**

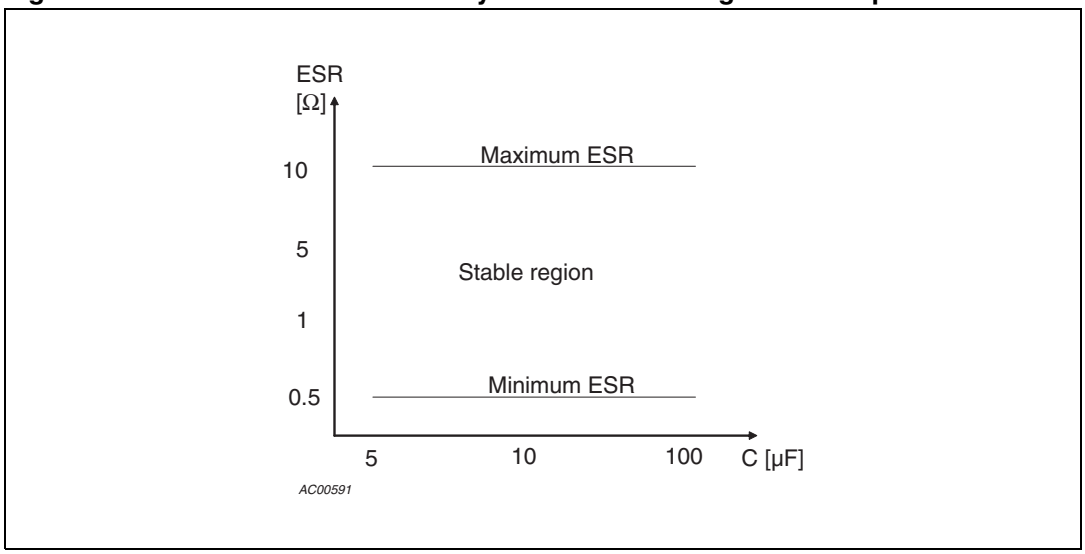



**Figure 5. Timing diagram of regulators and power switch**

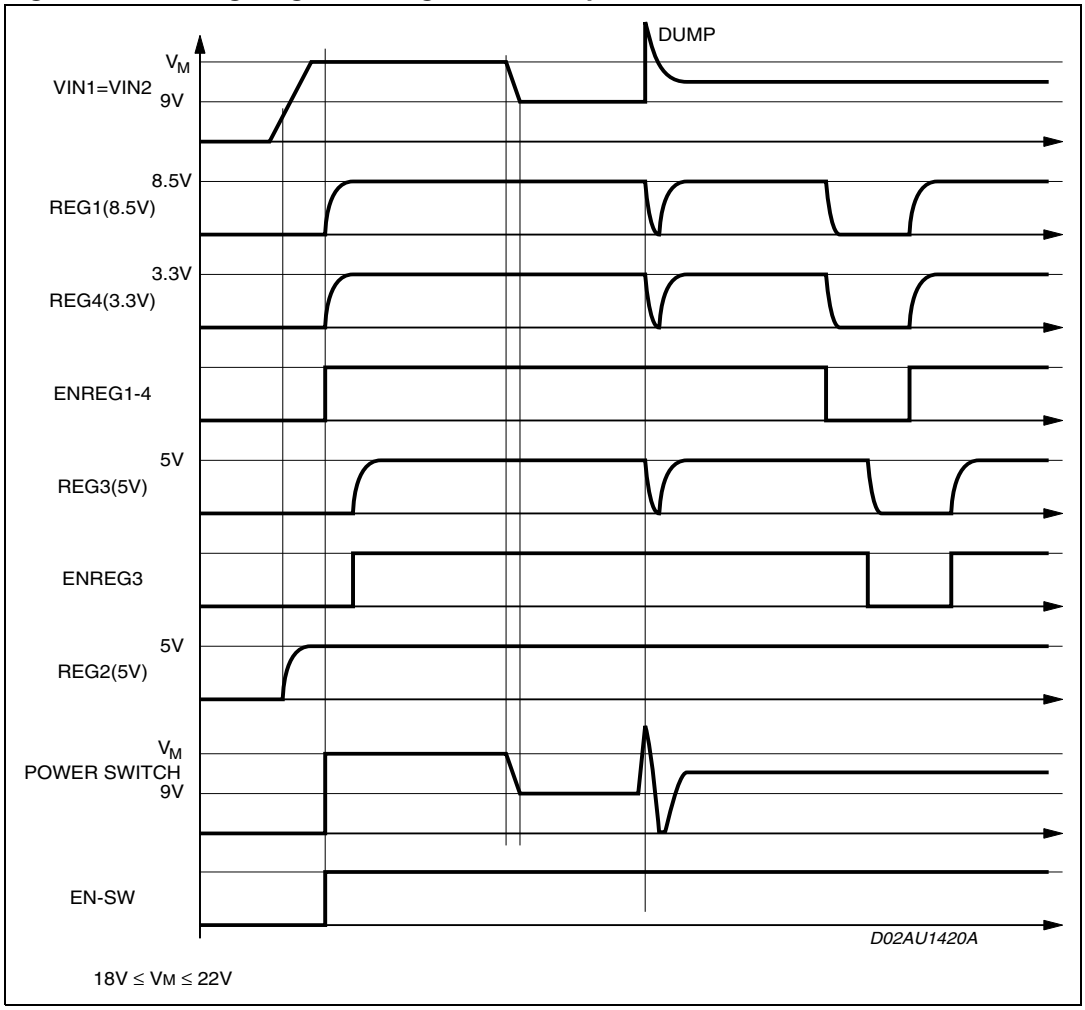


**Figure 6. Backup and reset diagram**

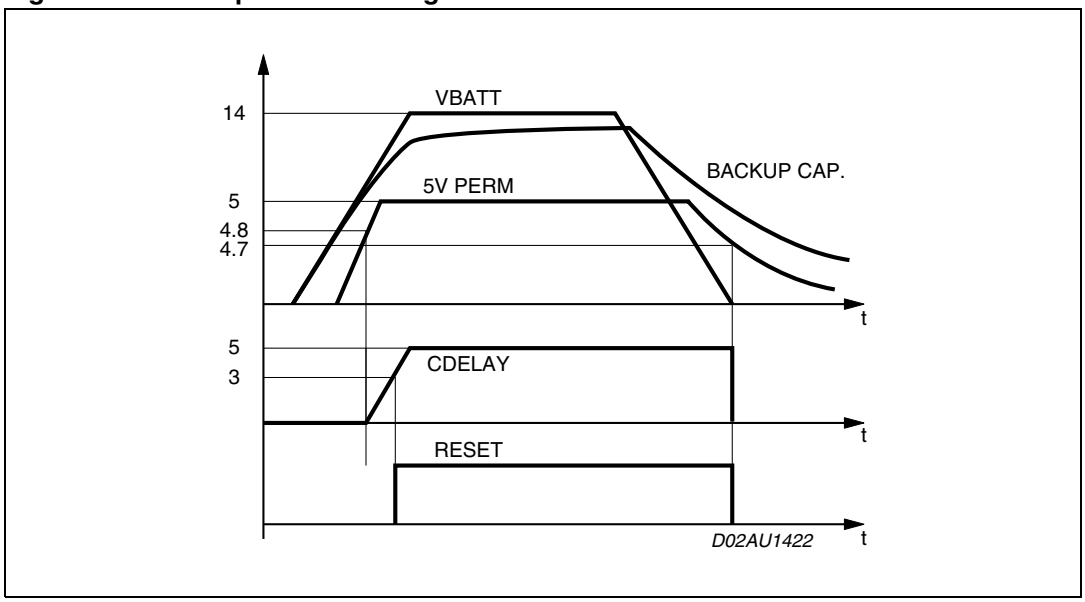



**Figure 7. Hold and thermal protection**

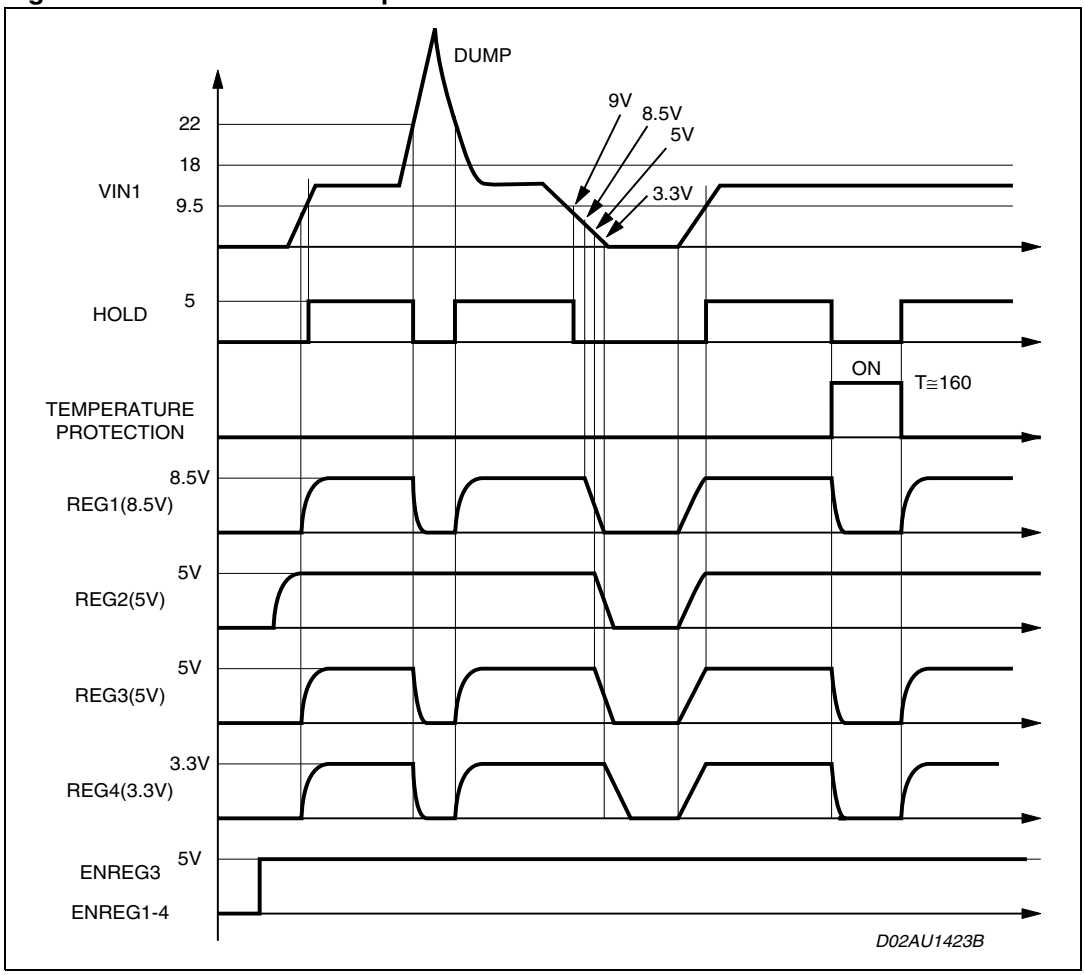


**Figure 8. Ignition buffer diagram**

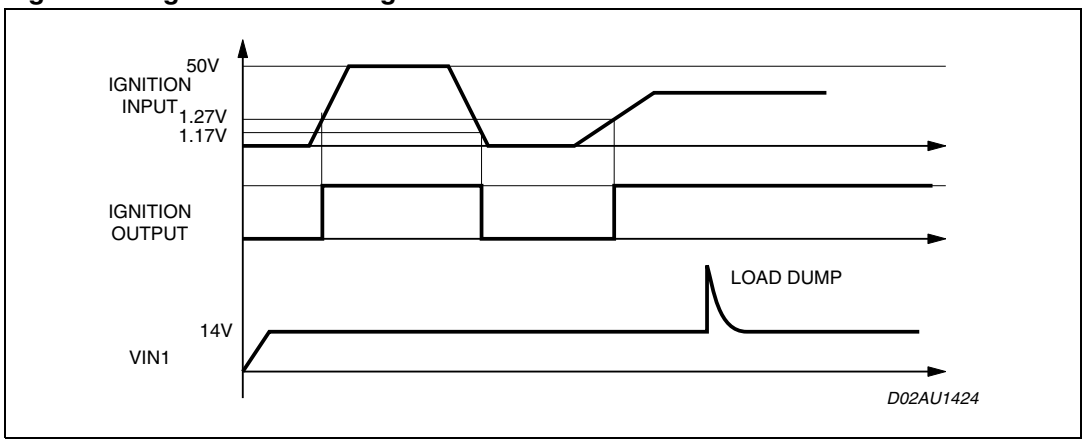



**Figure 9. Protection of the power switch**

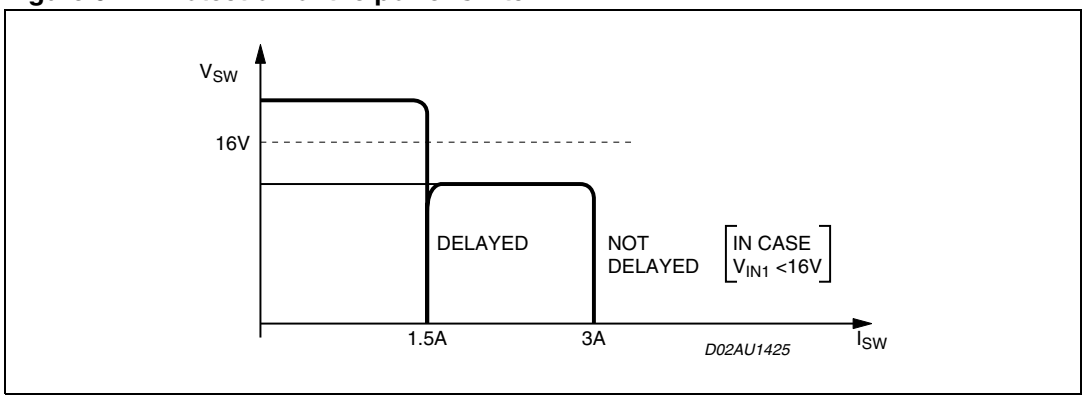
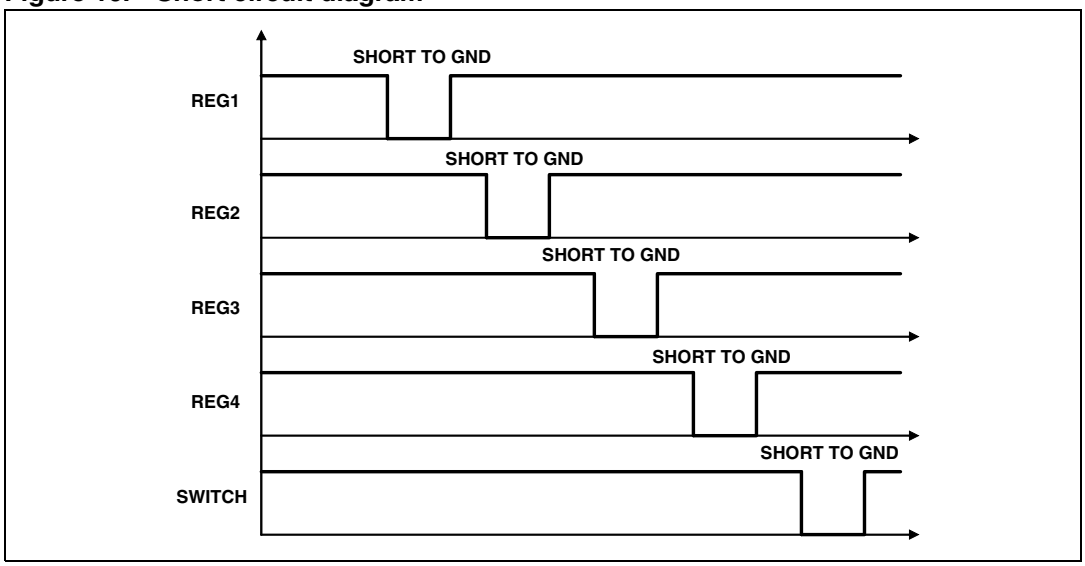



**Figure 10. Short circuit diagram**



# 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*.

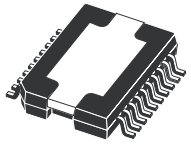
ECOPACK® is an ST trademark.

**Figure 11. PowerSO20 (slug up) mechanical data and package dimensions**

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 3.25 | | 3.5 | 0.128 | | 0.138 |
| A2 | 3 | 3.15 | 3.3 | 0.118 | 0.124 | 0.130 |
| A4 | 0.8 | | 1 | 0.031 | | 0.039 |
| A5 | 0.15 | 0.2 | 0.25 | 0.006 | 0.008 | 0.010 |
| a1 | 0.030 | | -0.040 | 0.0012 | | -0.0016 |
| b | 0.4 | | 0.53 | 0.016 | | 0.021 |
| c | 0.23 | | 0.32 | 0.009 | | 0.012 |
| D (1) | 15.8 | | 16 | 0.622 | | 0.630 |
| D1 | 9.4 | | 9.8 | 0.370 | | 0.385 |
| D2 | | 1 | | | 0.039 | |
| E | 13.9 | | 14.5 | 0.547 | | 0.570 |
| E1 (1) | 10.9 | | 11.1 | 0.429 | | 0.437 |
| E2 | | | 2.9 | | | 0.114 |
| E3 | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | 1.12 | 1.27 | 1.42 | 0.044 | 0.050 | 0.056 |
| e3 | | 11.43 | | | 0.450 | |
| G | 0 | | 0.1 | 0 | | 0.004 |
| H | 15.5 | | 15.9 | 0.61 | | 0.625 |
| h | | | 1.1 | | | 0.043 |
| L | 0.8 | | 1.1 | 0.031 | | 0.043 |
| N | 10¡ (max) | | | | | |
| R | | 0.6 | | | 0.024 | |
| S | 0¡ (min.) 8¡ (max.) | | | | | |
| V | 5¡ (min.) 7¡ (max.) | | | | | |

(1) ÒDÓ and E1Ó do not include mold flash or protusions.
- Mold flash or protusions shall not exceed 0.15mm (0.006Ó)
- Critical dimensions: ÒEÓ, Òa1Ó, Òe3Ó and ÒGÓ.

**OUTLINE AND MECHANICAL DATA**



**PowerSO20 (SLUG UP)**

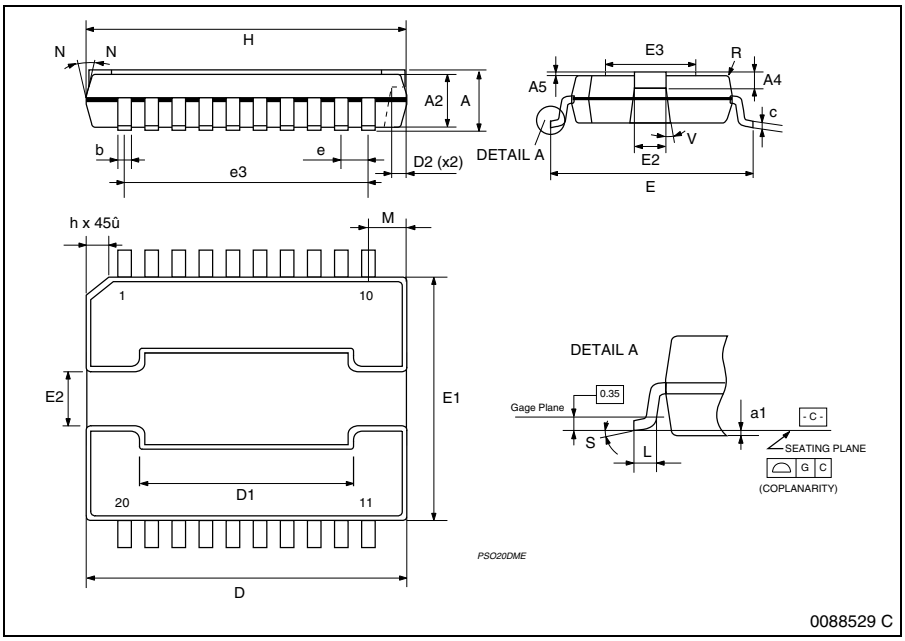
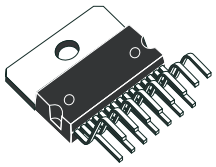


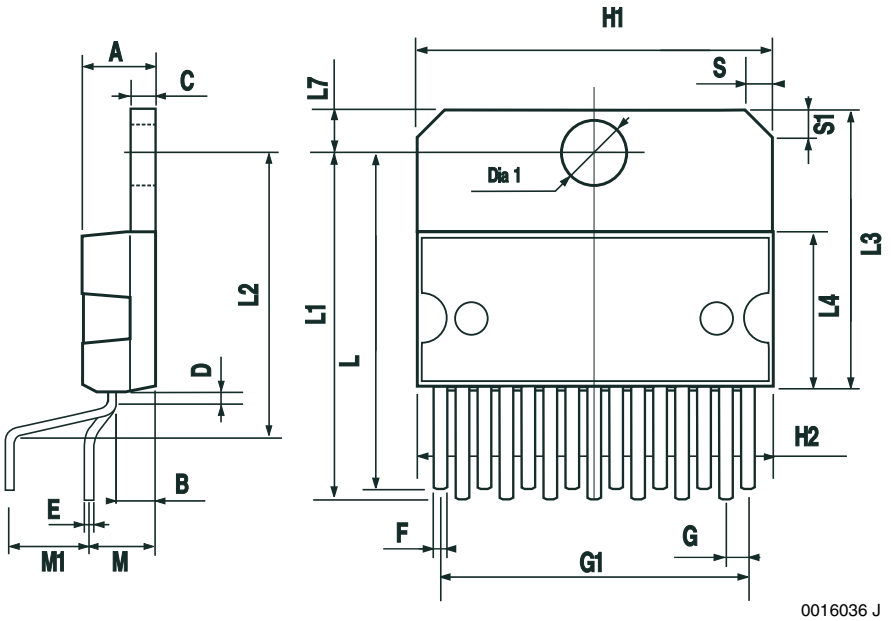
**Figure 12. Multiwatt15 (vertical) mechanical data and package dimensions**

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A5 | | | | | | 0.197 |
| B | | | 2.65 | | | 0.104 |
| C | | | 1.6 | | | 0.063 |
| D | | 1 | | | 0.039 | |
| E | 0.49 | | 0.55 | 0.019 | | 0.022 |
| F | 0.66 | | 0.75 | 0.026 | | 0.030 |
| G | 1.02 | 1.27 | 1.52 | 0.040 | 0.050 | 0.060 |
| G1 | 17.53 | 17.78 | 18.03 | 0.690 | 0.700 | 0.710 |
| H1 | 19.6 | | | 0.772 | | |
| H2 | | | 20.2 | | | 0.795 |
| L | 21.9 | 22.2 | 22.5 | 0.862 | 0.874 | 0.886 |
| L1 | 21.7 | 22.1 | 22.5 | 0.854 | 0.87 | 0.886 |
| L2 | 17.65 | | 18.1 | 0.695 | | 0.713 |
| L3 | 17.25 | 17.5 | 17.75 | 0.679 | 0.689 | 0.699 |
| L4 | 10.3 | 10.7 | 10.9 | 0.406 | 0.421 | 0.429 |
| L7 | 2.65 | | 2.9 | 0.104 | | 0.114 |
| M | 4.25 | 4.55 | 4.85 | 0.167 | 0.179 | 0.191 |
| M1 | 4.73 | 5.08 | 5.43 | 0.186 | 0.200 | 0.214 |
| S | 1.9 | | 2.6 | 0.075 | | 0.102 |
| S1 | 1.9 | | 2.6 | 0.075 | | 0.102 |
| Dia1 | 3.65 | | 3.85 | 0.144 | | 0.152 |

**OUTLINE AND MECHANICAL DATA**



**Multiwatt15 (vertical)**



# 4 Revision history

Table 5. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 11-Feb-2008 | 1 | Initial release. |
| 08-Jan-2010 | 2 | Updated *Section 1: Block and pins connection diagrams on page 5*.<br>Updated *Figure 3*, *5* and *6*. |
| 20-Sep-2013 | 3 | Updated disclaimer. |

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