

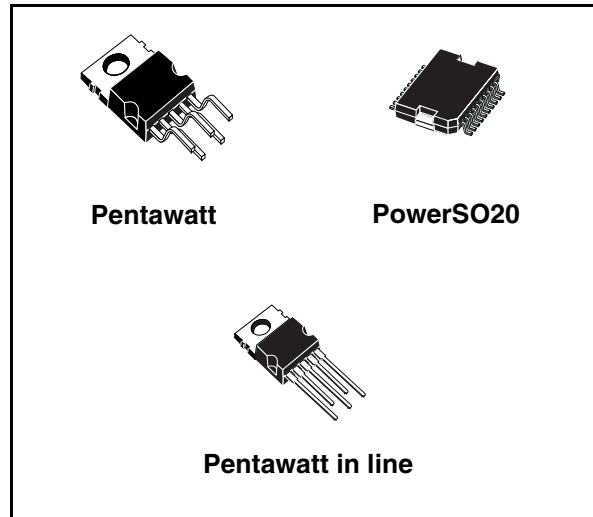
## Very Low Drop Voltage Regulator

### Features

- Operating DC supply voltage range 6V to 28V
- Transient supply voltage up to 40V
- Extremely low quiescent current
- High precision output voltage
- Output current capability up to 500mA
- Very low dropout voltage less than 0.6V
- Reset circuit sensing the output voltage
- Programmable reset pulse delay with external capacitor
- Thermal shutdown and short circuit protections

### Description

The L4925 is a monolithic integrated 5V voltage regulator with a very low dropout output and additional functions such as power-on reset and programmable reset delay time.



It is designed for supplying microcomputer controlled systems especially in automotive applications.

### Order codes

| Part number  | Package           | Packing     |
|--------------|-------------------|-------------|
| L4925        | Pentawatt         | Tube        |
| L4925L       | Pentawatt in Line | Tube        |
| L4925PD      | PowerSO20         | Tube        |
| L4925PD013TR | PowerSO20         | Tape & Reel |

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### 1.1 Block diagram

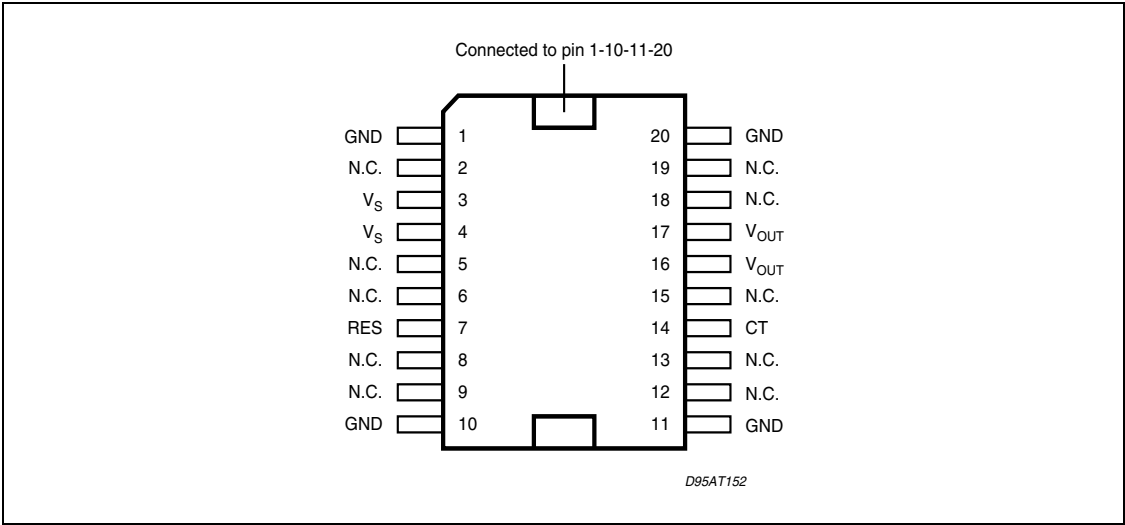
### 1.2.1 Pentawatt pin connections

tab connected to pin 3

5 V<sub>OUT</sub>  
 4 CT  
 3 GND  
 2 RESET  
 1 V<sub>s</sub>

1.2.2 PowerSO20 pin connections

Figure 3. PowerSo20 pin connections (top view)



1.3 Thermal data

Table 1. Thermal data

| Symbol          | Parameter                                   | Pentawatt | PSO20    | Unit |
|-----------------|---------------------------------------------|-----------|----------|------|
| $R_{th(j-amb)}$ | Thermal Resistance Junction to ambient      | 20 to 60  | 15 to 60 | °C/W |
| $R_{th(j-amb)}$ | Thermal Resistance Junction to ambient max. | 3.5       | 3.5      | °C/W |

## 2 Electrical specifications

### 2.1 Absolute maximum ratings

**Table 2. Absolute maximum ratings**

| Symbol     | Parameter                             | Value              | Unit |
|------------|---------------------------------------|--------------------|------|
| $V_{SDC}$  | DC Operating Supply Voltage           | 28                 | V    |
| $V_{STR}$  | Transient Supply Voltage ( $t < 1s$ ) | 40                 | V    |
| $I_O$      | Output Current                        | internally limited |      |
| $V_O$      | Output Voltage                        | 20                 | V    |
| $V_{RES}$  | Output Voltage                        | 20                 | V    |
| $I_{RES}$  | Output Current                        | 5                  | mA   |
| $T_{stg}$  | Storage Temperature                   | -55 to 150         | °C   |
| $T_J$      | Operating Junction Temperature        | -40 to 150         | °C   |
| $T_{J-SD}$ | Thermal Shutdown-Junction Temperature | 165                | °C   |

*Note:* The circuit is ESD protected according to MIL-STD-883C. According to ISO/DIS 7637 the transients must be clamped with external circuitry (see Application Circuit).

### 2.2 Electrical characteristics

**Table 3. Electrical characteristics**  
( $V_S = 14V$ ;  $T_J = -40$  to  $125^\circ C$  unless otherwise specified)

| Symbol    | Parameter                                                    | Test Condition                                   | Min. | Typ. | Max. | Unit    |
|-----------|--------------------------------------------------------------|--------------------------------------------------|------|------|------|---------|
| $V_O$     | Output Voltage                                               | $V_I = 6$ to $28V$ ; $I_O = 1$ to $500mA$        | 4.90 | 5    | 5.10 | V       |
| $V_O$     | Output Voltage                                               | $V_I = 35V$ ; $T < 1s$ ;<br>$I_O = 1$ to $500mA$ |      |      | 5.50 | V       |
| $V_{DP}$  | Dropout Voltage                                              | $I_O = 100mA$                                    |      | 0.2  | 0.3  | V       |
|           |                                                              | $I_O = 500mA$                                    |      | 0.3  | 0.6  | V       |
| $V_{IO}$  | Input to Output Voltage Difference in Undervoltage Condition | $V_I = 4V$ ; $I_O = 100mA$                       |      |      | 0.5  | V       |
| $V_{OL}$  | Line Regulation                                              | $V_I = 6$ to $28V$ ; $I_O = 1$ to $1mA$          |      |      | 10   | mV      |
| $V_{OLO}$ | Load Regulation                                              | $I_O = 1$ to $500mA$                             |      |      | 50   | mV      |
| $I_{LIM}$ | Current Limit                                                | $V_O = 4.5V$ ;                                   | 550  | 1000 | 1500 | mA      |
|           |                                                              | $V_O = 0$ ; Foldback characteristic              |      | 250  |      | mA      |
| $I_{QSE}$ | Quiescent Current                                            | $I_O = 0.3mA$                                    |      | 190  | 360  | $\mu A$ |

**Table 3. Electrical characteristics** (continued)  
 ( $V_S = 14V$ ;  $T_j = -40$  to  $125^\circ C$  unless otherwise specified)

| Symbol         | Parameter                             | Test Condition                                   | Min. | Typ. | Max. | Unit    |
|----------------|---------------------------------------|--------------------------------------------------|------|------|------|---------|
| $I_Q$          | Quiescent Current                     | $I_O = 500mA$                                    |      |      | 20   | mA      |
| <b>RESET</b>   |                                       |                                                  |      |      |      |         |
| $V_{RT}$       | Reset Threshold Voltage               |                                                  | 4.2  |      | 4.8  | V       |
| $V_{RTH}$      | Reset Threshold                       |                                                  | 50   | 100  | 200  | mV      |
| $t_{RD}$       | Reset Pulse Delay                     | $C_T = 100nF$ ; $t_R \geq 100\mu s$              | 60   | 100  | 140  | ms      |
| $t_{RR}$       | Reset Reaction Time                   | $C_T = 100nF$ ;                                  |      | 5    | 30   | $\mu s$ |
| $V_{RL}$       | Reset Output LOW Voltage              | $R_{RES} = 10K\Omega$ to $V_O$ ; $V_S = \geq 3V$ |      |      | 0.4  | V       |
| $I_{RH}$       | Reset Output HIGH Leakage Current     | $V_{RES} = 5V$                                   |      |      | 1    | $\mu A$ |
| $V_{CTth}$     | Delay Comparator Threshold            |                                                  |      | 2    |      | V       |
| $V_{CTth\ hy}$ | Delay Comparator Threshold Hysteresis |                                                  |      | 200  |      | mV      |

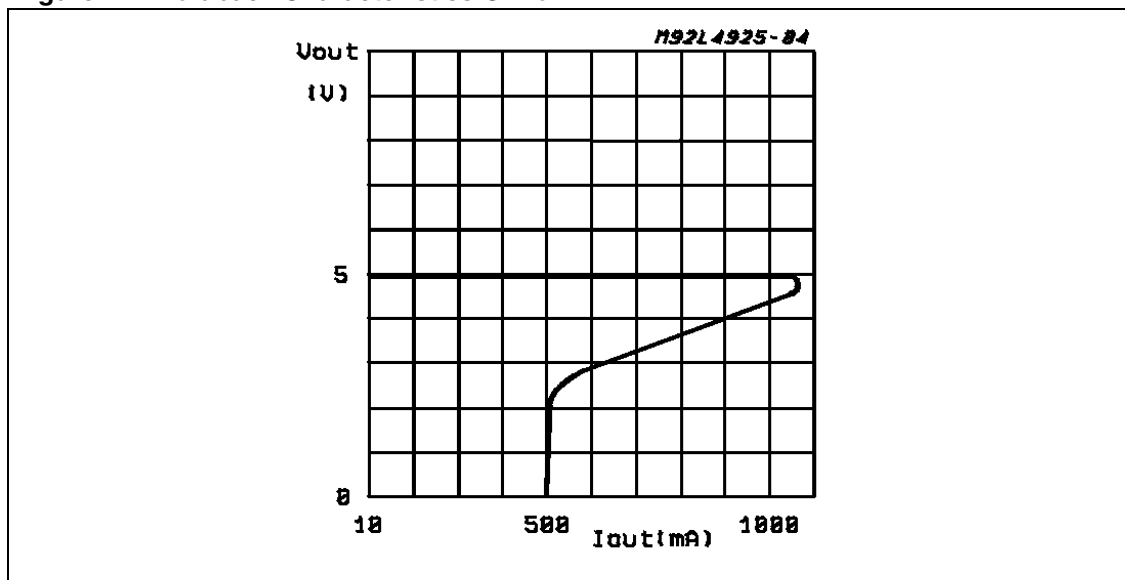
### 3 Functional description

The L4925 is a monolithic integrated voltage regulator, based on the STM modular voltage regulator approach. Several outstanding features and auxiliary functions are implemented to meet the requirements of supplying microprocessor systems in automotive applications. Nevertheless, it is suitable also in other applications where the present functions are required. The modular approach of this device allows to get easily also other features and functions when required.

#### 3.1 Voltage regulator

The voltage regulator uses an Isolated Collector Vertical PNP transistor as a regulating element. With this structure very low dropout voltage at currents up to 500mA is obtained.

**Figure 4. Foldback Characteristics Of  $V_o$**



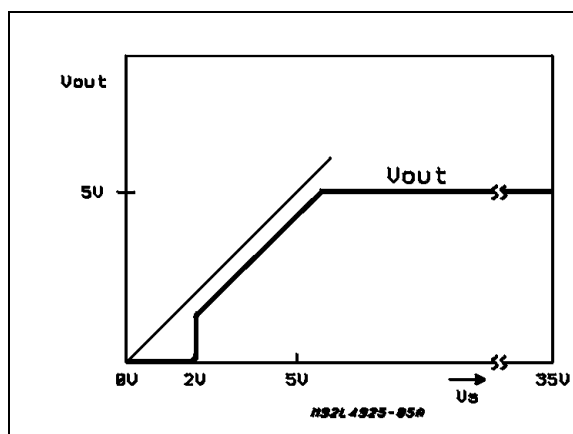
The dropout operation of the standby regulator is maintained down to 3V input supply voltage. The output voltage is regulated up to the transient input supply voltage of 35V. With this feature no functional interruption due to overvoltage pulses is generated.

The typical curve showing the standby output voltage as a function of the input supply voltage is shown in [Figure 5](#).

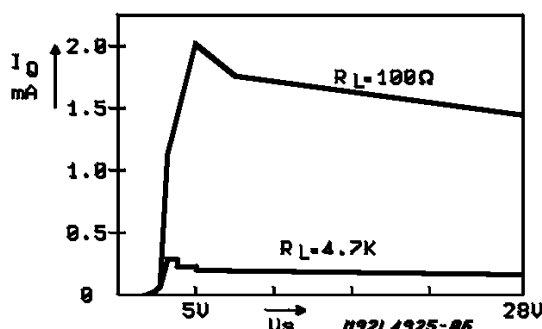
The current consumption of the device (quiescent current) is less than 250μA. To reduce the quiescent current peak in the undervoltage region and to improve the transient response in this region, the dropout voltage is controlled.

The quiescent current as a function of the supply input voltage is shown in [Figure 6](#).

**Figure 5. Output voltage vs. input voltage**



**Figure 6. Quiescent current vs. supply voltage**



## 3.2 Reset circuit

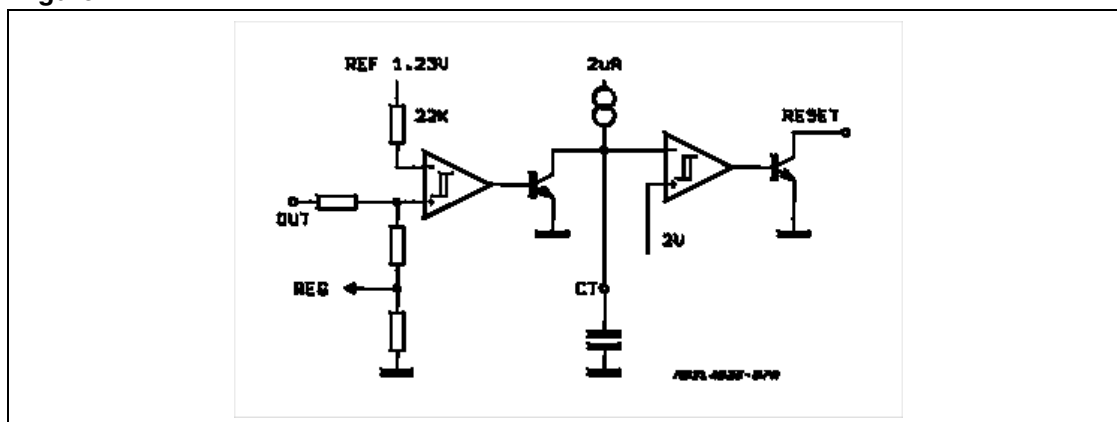
The block circuit diagram of the reset circuit is shown in [Figure 7](#). The reset circuit supervises the output voltage. The reset threshold of 4.5V is defined with the internal reference voltage and standby output divider. The reset pulse delay time  $t_{RD}$  is defined with the charge time of an external capacitor  $C_T$ :

$$t_{RD} = \frac{C_T \cdot 2V}{2\mu A}$$

The reaction time of the reset circuit originates from the discharge time limitation of the reset capacitor  $C_T$  and it is proportional to the value of  $C_T$ . The reaction time of the reset circuit increases the noise immunity. Standby output voltage drops below the reset threshold only a bit longer than the reaction time results in a shorter reset delay time.

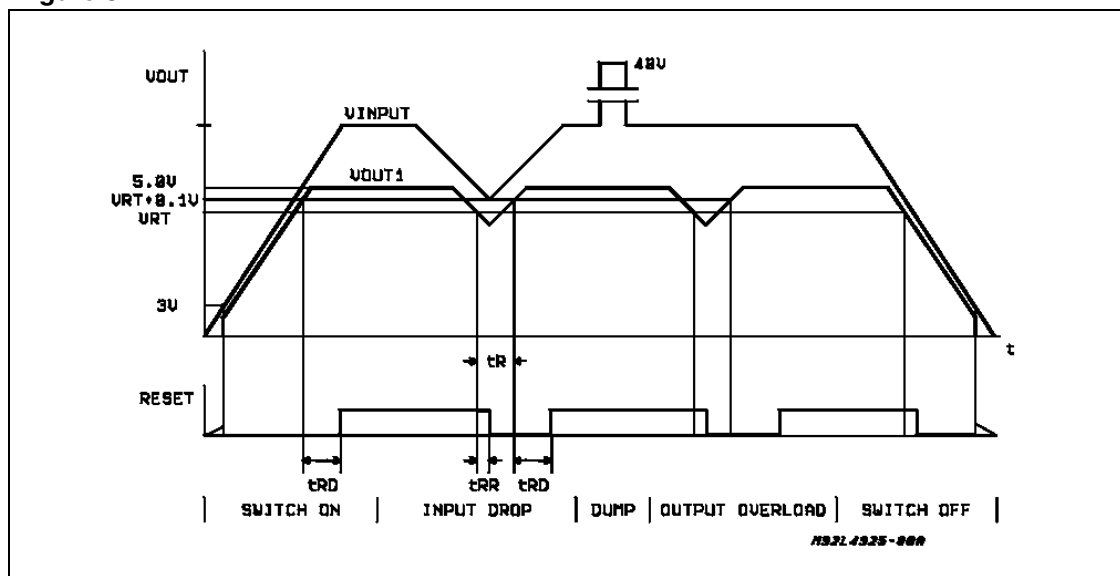
The nominal reset delay time will be generated for standby output voltage drops longer than approximately 50ms. The typical reset output waveforms are shown in [Figure 8](#).

**Figure 7.**





**Figure 8.**



## 4 Application information

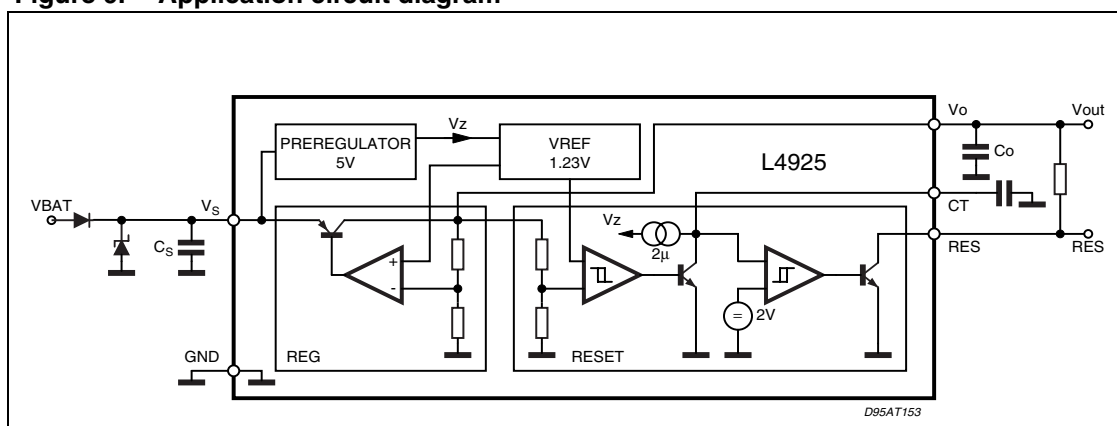
### 4.1 Supply voltage transients

High supply voltage transients can cause a reset output signal disturbance.

For supply voltage greater than 8V the circuit shows a high immunity of the reset output against supply transients of more than 100V/ms. For supply voltage lower than 8V, supply transients of more than 0.4V/ms. can cause a reset signal disturbance.

### 4.2 Application circuit

Figure 9. Application circuit diagram



For stability:  $C_S \geq 1\mu\text{F}$ ;  $C_O \geq 10\mu\text{F}$ ;  $\text{ESR} \leq 2.5\Omega$  at 10 KHz

Recommended for application:  $C_S = C_O = 10\mu\text{F}$  to  $100\mu\text{F}$

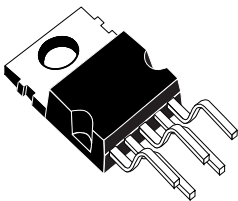
# 5 Package Informations

Figure 10. Pentawatt Mechanical Data & Package Dimensions

| DIM. | mm         |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 4.80  |       |       | 0.188 |
| C    |            |       | 1.37  |       |       | 0.054 |
| D    | 2.40       |       | 2.80  | 0.094 |       | 0.11  |
| D1   | 1.20       |       | 1.35  | 0.047 |       | 0.053 |
| E    | 0.35       |       | 0.55  | 0.014 |       | 0.022 |
| E1   | 0.76       |       | 1.19  | 0.030 |       | 0.047 |
| F    | 0.80       |       | 1.05  | 0.031 |       | 0.041 |
| F1   | 1.00       |       | 1.40  | 0.039 |       | 0.055 |
| G    | 3.20       | 3.40  | 3.60  | 0.126 | 0.134 | 0.142 |
| G1   | 6.60       | 6.80  | 7.00  | 0.260 | 0.267 | 0.275 |
| H2   |            |       | 10.40 |       |       | 0.41  |
| H3   | 10.05      |       | 10.40 | 0.395 |       | 0.409 |
| L    | 17.55      | 17.85 | 18.15 | 0.691 | 0.703 | 0.715 |
| L1   | 15.55      | 15.75 | 15.95 | 0.612 | 0.620 | 0.628 |
| L2   | 21.2       | 21.4  | 21.6  | 0.831 | 0.843 | 0.850 |
| L3   | 22.3       | 22.5  | 22.7  | 0.878 | 0.886 | 0.894 |
| L4   |            |       | 1.29  |       |       | 0.051 |
| L5   | 2.60       |       | 3.00  | 0.102 |       | 0.118 |
| L6   | 15.10      |       | 15.80 | 0.594 |       | 0.622 |
| L7   | 6.00       |       | 6.60  | 0.236 |       | 0.260 |
| L9   | 2.10       |       | 2.70  | 0.083 |       | 0.106 |
| L10  | 4.30       |       | 4.80  | 0.170 |       | 0.189 |
| M    | 4.23       | 4.5   | 4.75  | 0.167 | 0.178 | 0.187 |
| M1   | 3.75       | 4.0   | 4.25  | 0.148 | 0.157 | 0.187 |
| V4   | 40° (Typ.) |       |       |       |       |       |
| V5   | 90° (Typ.) |       |       |       |       |       |
| DIA  | 3.65       |       | 3.85  | 0.143 |       | 0.151 |

## OUTLINE AND MECHANICAL DATA

Weight: 2.00gr



## Pentawatt V

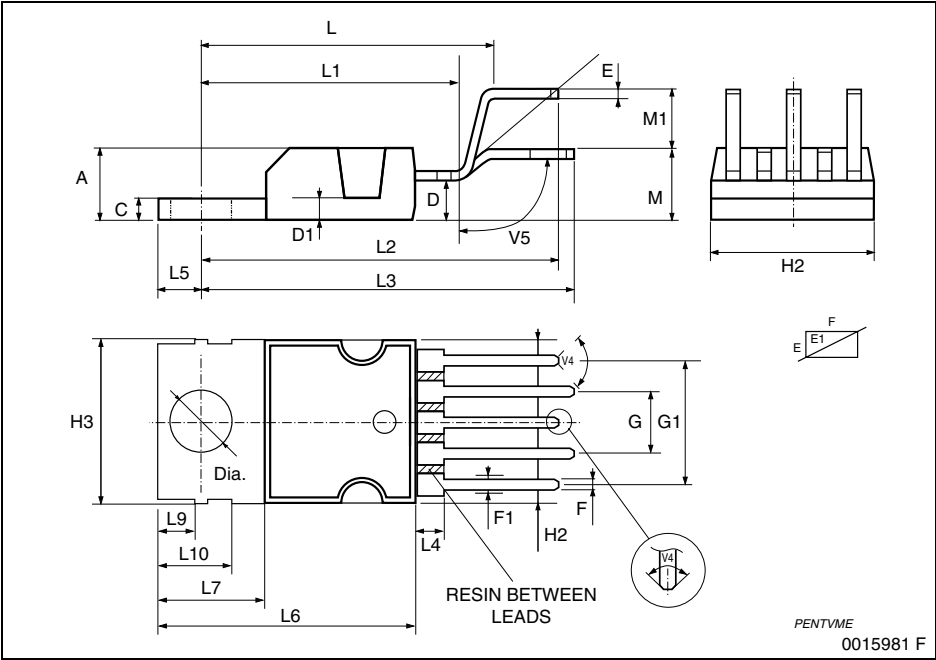


Figure 11. Pentawatt in Line Mechanical Data & Package Dimensions

| DIM. | mm    |       |       | inch   |        |        |
|------|-------|-------|-------|--------|--------|--------|
|      | MIN.  | TYP.  | MAX.  | MIN.   | TYP.   | MAX.   |
| A    |       |       | 4.80  |        |        | 0.188  |
| C    |       |       | 1.37  |        |        | 0.054  |
| D    | 2.40  |       | 2.80  | 0.094  |        | 0.11   |
| D1   | 1.20  |       | 1.35  | 0.047  |        | 0.053  |
| E    | 0.35  |       | 0.55  | 0.014  |        | 0.022  |
| E1   | 0.76  |       | 1.19  | 0.030  |        | 0.047  |
| F    | 0.80  |       | 1.05  | 0.031  |        | 0.041  |
| F1   | 1.00  |       | 1.40  | 0.039  |        | 0.055  |
| G    | 3.20  | 3.40  | 3.60  | 0.126  | 0.134  | 0.142  |
| G1   | 6.60  | 6.80  | 7.00  | 0.260  | 0.267  | 0.275  |
| H2   |       |       | 10.40 |        |        | 0.41   |
| H3   | 10.05 |       | 10.40 | 0.395  |        | 0.409  |
| L2   | 23.05 | 23.40 | 23.80 | 0.9075 | 0.9213 | 0.9370 |
| L3   | 25.30 | 25.65 | 26.10 | 0.9961 | 1.0098 | 1.0276 |
| L4   | 0.90  |       | 2.90  | 0.0354 |        | 0.1142 |
| L5   | 2.60  |       | 3.00  | 0.102  |        | 0.118  |
| L6   | 15.10 |       | 15.80 | 0.594  |        | 0.622  |
| L7   | 6.00  |       | 6.60  | 0.236  |        | 0.260  |
| L9   | 2.10  |       | 2.70  | 0.083  |        | 0.106  |
| L10  | 4.30  |       | 4.80  | 0.170  |        | 0.189  |
| DIA  | 3.65  |       | 3.85  | 0.143  |        | 0.151  |

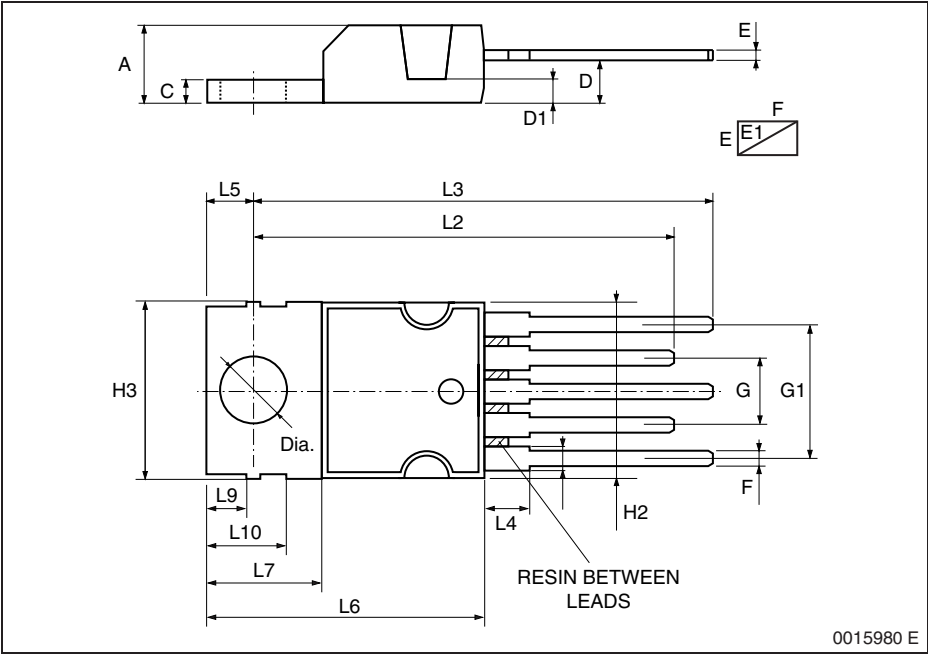
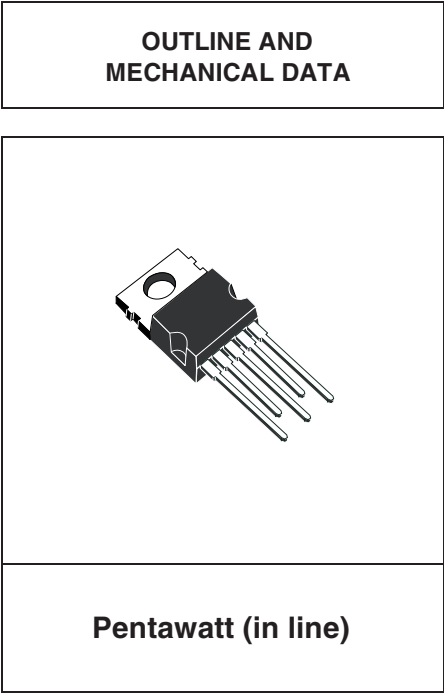


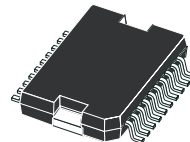
Figure 12. PowerSO20 Mechanical Data &amp; Package Dimensions

| DIM.   | mm        |       |      | inch  |       |       |
|--------|-----------|-------|------|-------|-------|-------|
|        | MIN.      | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A      |           |       | 3.6  |       |       | 0.142 |
| a1     | 0.1       |       | 0.3  | 0.004 |       | 0.012 |
| a2     |           |       | 3.3  |       |       | 0.130 |
| a3     | 0         |       | 0.1  | 0.000 |       | 0.004 |
| b      | 0.4       |       | 0.53 | 0.016 |       | 0.021 |
| c      | 0.23      |       | 0.32 | 0.009 |       | 0.013 |
| D (1)  | 15.8      |       | 16   | 0.622 |       | 0.630 |
| D1 (2) | 9.4       |       | 9.8  | 0.370 |       | 0.386 |
| E      | 13.9      |       | 14.5 | 0.547 |       | 0.570 |
| e      |           | 1.27  |      |       | 0.050 |       |
| e3     |           | 11.43 |      |       | 0.450 |       |
| E1 (1) | 10.9      |       | 11.1 | 0.429 |       | 0.437 |
| E2     |           |       | 2.9  |       |       | 0.114 |
| E3     | 5.8       |       | 6.2  | 0.228 |       | 0.244 |
| G      | 0         |       | 0.1  | 0.000 |       | 0.004 |
| H      | 15.5      |       | 15.9 | 0.610 |       | 0.626 |
| h      |           |       | 1.1  |       |       | 0.043 |
| L      | 0.8       |       | 1.1  | 0.031 |       | 0.043 |
| N      | 8'(typ.)  |       |      |       |       |       |
| S      | 8'(max. ) |       |      |       |       |       |
| T      |           | 10    |      |       | 0.394 |       |

- (1) "D and E1" do not include mold flash or protrusions.  
 - Mold flash or protrusions shall not exceed 0.15mm (0.006")  
 - Critical dimensions: "E", "G" and "a3".  
 (2) For subcontractors, the limit is the one quoted in jedec MO-166

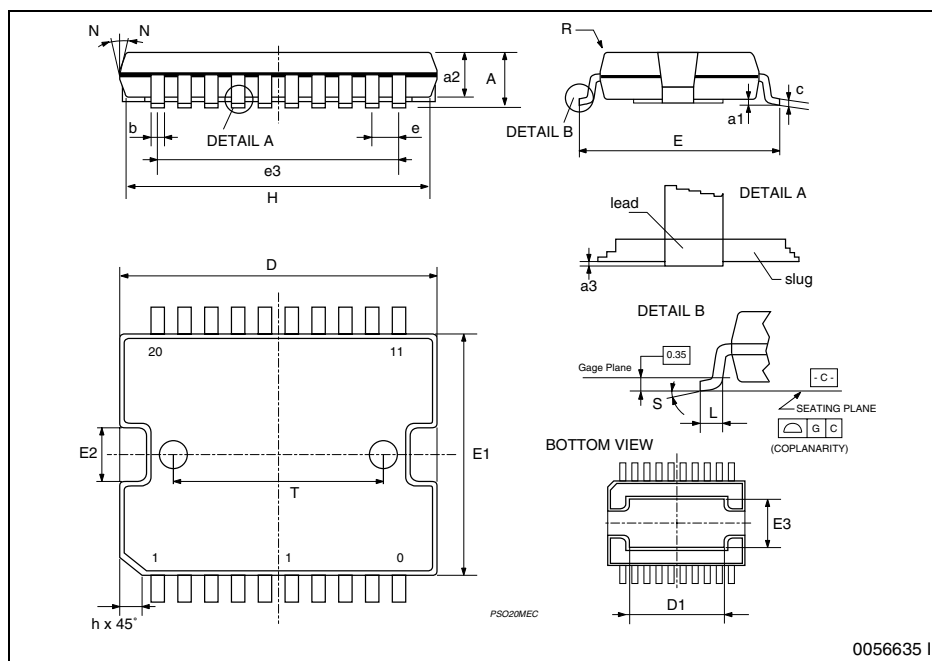
### OUTLINE AND MECHANICAL DATA

Weight: 1.9gr



JEDEC MO-166

**PowerSO-20**



## 6 Revision history

| Date         | Revision | Changes                                                                                                           |
|--------------|----------|-------------------------------------------------------------------------------------------------------------------|
| October 2003 | 4        | First issue in EDOCD DMS                                                                                          |
| 18-Nov-2005  | 5        | Added GND pins to fig. 4<br>Added order code and changed the formatting style in compliance with the new template |
| 03-Feb-2006  | 6        | Reset Threshold Voltage changed from 4.5V / 5.2V (min/max) to 4.2V / 4.8V on <a href="#">Table 3</a> .            |

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