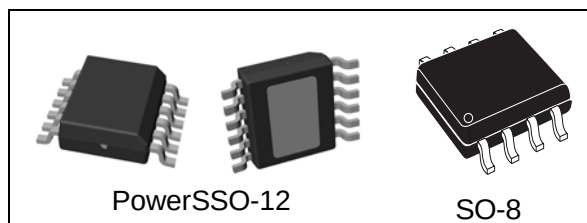


## OMNIFET III

## fully protected low-side driver

Datasheet - production data



### Description

The VNL5030J-E and VNL5030S5-E are monolithic devices made using STMicroelectronics® VIPower® technology, intended for driving resistive or inductive loads with one side connected to the battery. Built-in thermal shutdown protects the chip from overtemperature and short-circuit. Output current limitation protects the devices in an overload condition. In case of long duration overload, the device limits the dissipated power to a safe level up to thermal shutdown intervention. Thermal shutdown, with automatic restart, allows the device to recover normal operation as soon as a fault condition disappears. Fast demagnetization of inductive loads is achieved at turn-off.

### Features

| Type        | V <sub>clamp</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|--------------------|---------------------|----------------|
| VNL5030J-E  | 41 V               | 30 mΩ               | 25 A           |
| VNL5030S5-E |                    |                     |                |

- Automotive qualified
- Drain current: 25 A
- ESD protection
- Overvoltage clamp
- Thermal shutdown
- Current and power limitation
- Very low standby current
- Very low electromagnetic susceptibility
- Compliant with European directive 2002/95/EC
- Open drain status output

Table 1. Devices summary

| Package     | Order codes |               |
|-------------|-------------|---------------|
|             | Tube        | Tape and reel |
| PowerSSO-12 | VNL5030J-E  | VNL5030JTR-E  |
| SO-8        | VNL5030S5-E | VNL5030S5TR-E |

# Contents

|          |                                               |           |
|----------|-----------------------------------------------|-----------|
| <b>1</b> | <b>Block diagrams and pins configurations</b> | <b>5</b>  |
| <b>2</b> | <b>Electrical specifications</b>              | <b>7</b>  |
| 2.1      | Absolute maximum ratings                      | 7         |
| 2.2      | Thermal data                                  | 7         |
| 2.3      | Electrical characteristics                    | 8         |
| 2.4      | Electrical characteristics curves             | 11        |
| <b>3</b> | <b>Application information</b>                | <b>14</b> |
| 3.1      | MCU I/O protection                            | 14        |
| <b>4</b> | <b>Package and PC board thermal data</b>      | <b>16</b> |
| 4.1      | PowerSSO-12 thermal data                      | 16        |
| 4.2      | SO-8 thermal data                             | 19        |
| <b>5</b> | <b>Package and packing information</b>        | <b>22</b> |
| 5.1      | ECOPACK®                                      | 22        |
| 5.2      | PowerSSO-12 mechanical data                   | 22        |
| 5.3      | SO-8 mechanical data                          | 23        |
| 5.4      | PowerSSO-12 packing information               | 25        |
| 5.5      | SO-8 packing information                      | 26        |
| <b>6</b> | <b>Revision history</b>                       | <b>27</b> |

## List of tables

|           |                                                          |    |
|-----------|----------------------------------------------------------|----|
| Table 1.  | Devices summary . . . . .                                | 1  |
| Table 2.  | Pin function . . . . .                                   | 5  |
| Table 3.  | Suggested connections for unused and N.C. pins . . . . . | 6  |
| Table 4.  | Absolute maximum ratings . . . . .                       | 7  |
| Table 5.  | Thermal data. . . . .                                    | 7  |
| Table 6.  | PowerMOS section . . . . .                               | 8  |
| Table 7.  | Source drain diode . . . . .                             | 8  |
| Table 8.  | Status pin . . . . .                                     | 8  |
| Table 9.  | Logic input . . . . .                                    | 8  |
| Table 10. | Open-load detection . . . . .                            | 9  |
| Table 11. | Supply section . . . . .                                 | 9  |
| Table 12. | Switching characteristics . . . . .                      | 9  |
| Table 13. | Protection and diagnostics . . . . .                     | 10 |
| Table 14. | Truth table. . . . .                                     | 13 |
| Table 15. | PowerSSO-12 thermal parameters. . . . .                  | 18 |
| Table 16. | SO-8 thermal parameters . . . . .                        | 21 |
| Table 17. | PowerSSO-12 mechanical data . . . . .                    | 23 |
| Table 18. | SO-8 mechanical data . . . . .                           | 24 |
| Table 19. | Document revision history . . . . .                      | 27 |

## List of figures

|            |                                                                                             |    |
|------------|---------------------------------------------------------------------------------------------|----|
| Figure 1.  | Block diagram . . . . .                                                                     | 5  |
| Figure 2.  | Current and voltage conventions . . . . .                                                   | 6  |
| Figure 3.  | Configuration diagrams (top view) . . . . .                                                 | 6  |
| Figure 4.  | Source diode forward characteristics . . . . .                                              | 11 |
| Figure 5.  | Static drain source on-resistance vs. drain current ( $V_{IN} = 3.5\text{ V}$ ) . . . . .   | 11 |
| Figure 6.  | Static drain source on-resistance vs. input voltage . . . . .                               | 11 |
| Figure 7.  | Static drain source on-resistance vs. drain current ( $V_{IN} = 5\text{ V}$ ) . . . . .     | 11 |
| Figure 8.  | Transfer characteristics . . . . .                                                          | 12 |
| Figure 9.  | Transfer characteristics (inside view for $V_{IN} = 2\text{ V}$ to $3\text{ V}$ ) . . . . . | 12 |
| Figure 10. | Output characteristics ( $T_{case} = 25^{\circ}\text{C}$ ) . . . . .                        | 12 |
| Figure 11. | On-resistance vs. temperature . . . . .                                                     | 12 |
| Figure 12. | Input threshold vs. temperature . . . . .                                                   | 12 |
| Figure 13. | Switching characteristics . . . . .                                                         | 13 |
| Figure 14. | Application schematic . . . . .                                                             | 14 |
| Figure 15. | Maximum demagnetization energy ( $V_{CC} = 13.5\text{ V}$ ) . . . . .                       | 15 |
| Figure 16. | PowerSSO-12 PC board . . . . .                                                              | 16 |
| Figure 17. | PowerSSO-12 Rthj-amb vs PCB copper area in open box free air condition . . . . .            | 16 |
| Figure 18. | PowerSSO-12 thermal impedance junction ambient single pulse . . . . .                       | 17 |
| Figure 19. | Thermal fitting model of a LSD in PowerSSO-12 . . . . .                                     | 17 |
| Figure 20. | SO-8 PC board . . . . .                                                                     | 19 |
| Figure 21. | SO-8 Rthj-amb vs PCB copper area in open box free air condition . . . . .                   | 19 |
| Figure 22. | SO-8 thermal impedance junction ambient single pulse . . . . .                              | 20 |
| Figure 23. | Thermal fitting model of a LSD in SO-8 . . . . .                                            | 20 |
| Figure 24. | PowerSSO-12 package dimensions . . . . .                                                    | 22 |
| Figure 25. | SO-8 package dimensions . . . . .                                                           | 23 |
| Figure 26. | PowerSSO-12 tube shipment (no suffix) . . . . .                                             | 25 |
| Figure 27. | PowerSSO-12 tape and reel shipment (suffix "TR") . . . . .                                  | 25 |
| Figure 28. | SO-8 tube shipment (no suffix) . . . . .                                                    | 26 |
| Figure 29. | SO-8 tape and reel shipment (suffix "TR") . . . . .                                         | 26 |

# 1 Block diagrams and pins configurations

Figure 1. Block diagram

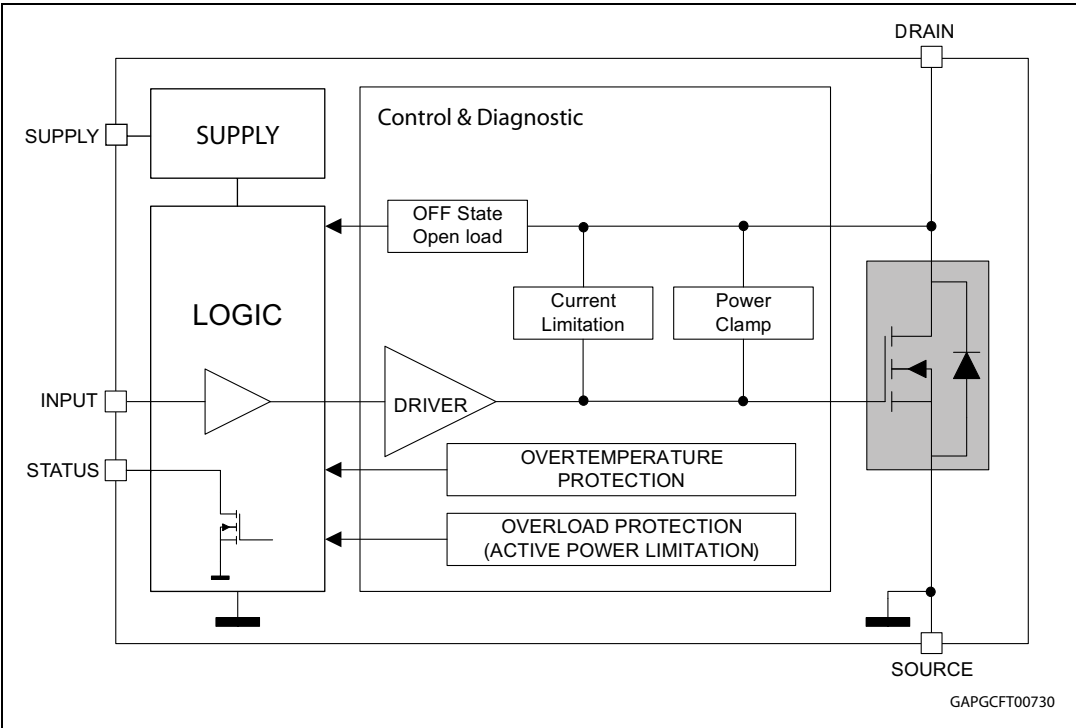


Table 2. Pin function

| Name   | Function                                                                                        |
|--------|-------------------------------------------------------------------------------------------------|
| INPUT  | Voltage controlled input pin with hysteresis, CMOS compatible; it controls output switch state. |
| DRAIN  | PowerMOS drain.                                                                                 |
| SOURCE | PowerMOS source and ground reference for the control section.                                   |
| SUPPLY | Supply voltage connected to the signal part (5 V).                                              |
| STATUS | Open drain digital diagnostic pin.                                                              |
| TAB    | Exposed pad. PowerMOS drain.                                                                    |

Figure 2. Current and voltage conventions

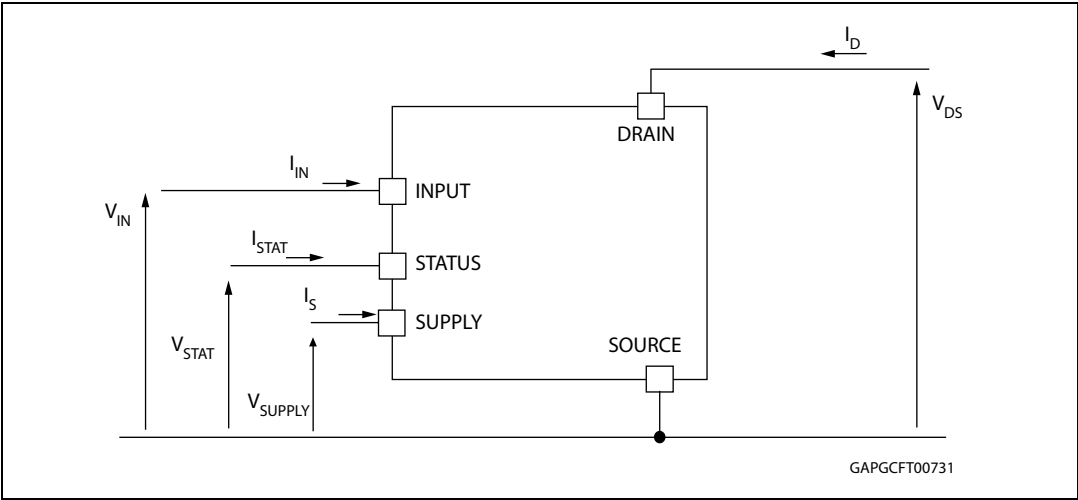


Figure 3. Configuration diagrams (top view)

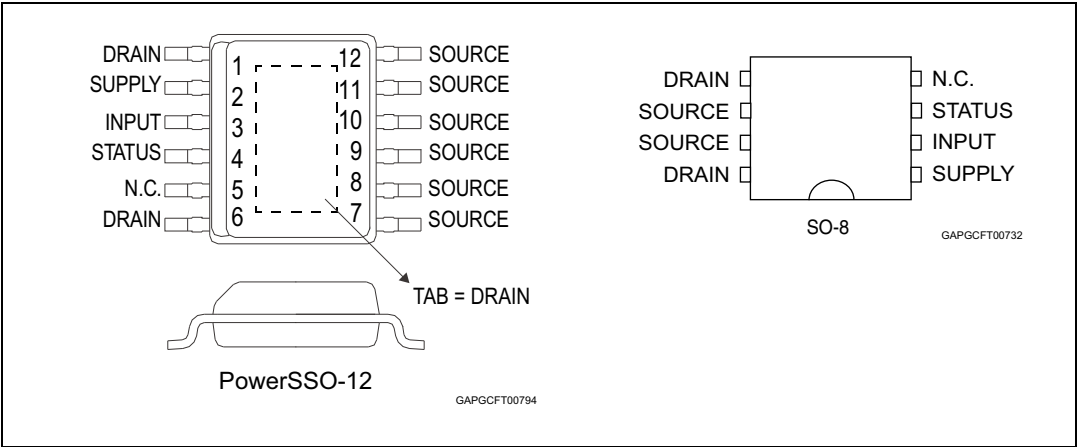


Table 3. Suggested connections for unused and N.C. pins

| Connection / pin | Status           | N.C. | Input                  |
|------------------|------------------|------|------------------------|
| Floating         | X <sup>(1)</sup> | X    | X                      |
| To ground        | Not allowed      | X    | Through 10 kΩ resistor |

1. X: do not care.

## 2 Electrical specifications

### 2.1 Absolute maximum ratings

Stressing the device above the rating listed in [Table 4](#) may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Table 4. Absolute maximum ratings**

| Symbol     | Parameter                                                                                               | Value              |      | Unit |
|------------|---------------------------------------------------------------------------------------------------------|--------------------|------|------|
|            |                                                                                                         | PowerSSO-12        | SO-8 |      |
| $V_{DS}$   | Drain-source voltage ( $V_{IN} = 0$ V)                                                                  | Internally clamped |      | V    |
| $I_D$      | DC drain current                                                                                        | Internally limited |      | A    |
| $-I_D$     | Reverse DC drain current                                                                                | 30                 |      | A    |
| $I_S$      | DC supply current                                                                                       | -1 to 10           |      | mA   |
| $I_{IN}$   | DC input current                                                                                        | -1 to 10           |      | mA   |
| $I_{STAT}$ | DC status current                                                                                       | -1 to 10           |      | mA   |
| $V_{ESD1}$ | Electrostatic discharge<br>( $R = 1.5$ k $\Omega$ ; $C = 100$ pF)<br>– DRAIN<br>– SUPPLY, INPUT, STATUS | 5000<br>4000       |      | V    |
| $V_{ESD2}$ | Electrostatic discharge on output pin only<br>( $R = 330$ $\Omega$ , $C = 150$ pF)                      | 2000               |      | V    |
| $T_j$      | Junction operating temperature                                                                          | -40 to 150         |      | °C   |
| $T_{stg}$  | Storage temperature                                                                                     | -55 to 150         |      | °C   |
| $E_{AS}$   | Single pulse avalanche energy<br>( $L = 1.16$ mH, $T_j = 150$ °C, $R_L = 0$ , $I_{OUT} = I_{limL}$ )    | 184                |      | mJ   |

### 2.2 Thermal data

**Table 5. Thermal data**

| Symbol        | Parameter                           | Maximum value |      | Unit |
|---------------|-------------------------------------|---------------|------|------|
|               |                                     | PowerSSO-12   | SO-8 |      |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 61            | 101  | °C/W |

## 2.3 Electrical characteristics

Values specified in this section are for  $V_{\text{SUPPLY}} = V_{\text{IN}} = 4.5 \text{ V to } 5.5 \text{ V}$ ,  $-40^\circ\text{C} < T_j < 150^\circ\text{C}$ , unless otherwise stated.

**Table 6. PowerMOS section**

| Symbol              | Parameter                            | Test conditions                                                                                          | Min. | Typ. | Max. | Unit             |
|---------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------|------|------|------|------------------|
| $V_{\text{SUPPLY}}$ | Operating supply voltage             |                                                                                                          | 3.5  | 5    | 5.5  | V                |
| $R_{\text{ON}}$     | ON-state resistance                  | $I_D = 2.8 \text{ A}$ ; $T_j = 25^\circ\text{C}$ ;<br>$V_{\text{SUPPLY}} = V_{\text{IN}} = 5 \text{ V}$  |      |      | 30   | $\text{m}\Omega$ |
|                     |                                      | $I_D = 2.8 \text{ A}$ ; $T_j = 150^\circ\text{C}$ ;<br>$V_{\text{SUPPLY}} = V_{\text{IN}} = 5 \text{ V}$ |      |      | 60   |                  |
| $V_{\text{CLAMP}}$  | Drain-source clamp voltage           | $V_{\text{IN}} = 0 \text{ V}$ ; $I_D = 2.8 \text{ A}$                                                    | 41   | 46   | 52   | V                |
| $V_{\text{CLTH}}$   | Drain-source clamp threshold voltage | $V_{\text{IN}} = 0 \text{ V}$ ; $I_D = 2 \text{ mA}$                                                     | 36   |      |      | V                |
| $I_{\text{DSS}}$    | OFF-state output current             | $V_{\text{IN}} = 0 \text{ V}$ ; $V_{\text{DS}} = 13 \text{ V}$ ;<br>$T_j = 25^\circ\text{C}$             | 0    |      | 3    | $\mu\text{A}$    |
|                     |                                      | $V_{\text{IN}} = 0 \text{ V}$ ; $V_{\text{DS}} = 13 \text{ V}$ ;<br>$T_j = 125^\circ\text{C}$            | 0    |      | 5    |                  |

**Table 7. Source drain diode**

| Symbol          | Parameter          | Test conditions                                       | Min. | Typ. | Max. | Unit |
|-----------------|--------------------|-------------------------------------------------------|------|------|------|------|
| $V_{\text{SD}}$ | Forward on voltage | $I_D = 2.8 \text{ A}$ ; $V_{\text{IN}} = 0 \text{ V}$ | —    | 0.8  | —    | V    |

**Table 8. Status pin**

| Symbol             | Parameter                    | Test conditions                                   | Min. | Typ. | Max. | Unit          |
|--------------------|------------------------------|---------------------------------------------------|------|------|------|---------------|
| $V_{\text{STAT}}$  | Status low output voltage    | $I_{\text{STAT}} = 1 \text{ mA}$                  |      |      | 0.5  | V             |
| $I_{\text{LSTAT}}$ | Status leakage current       | Normal operation; $V_{\text{STAT}} = 5 \text{ V}$ |      |      | 10   | $\mu\text{A}$ |
| $C_{\text{STAT}}$  | Status pin input capacitance | Normal operation; $V_{\text{STAT}} = 5 \text{ V}$ |      |      | 100  | pF            |
| $V_{\text{STCL}}$  | Status clamp voltage         | $I_{\text{STAT}} = 1 \text{ mA}$                  | 5.5  |      | 7    | V             |
|                    |                              | $I_{\text{STAT}} = -1 \text{ mA}$                 |      | -0.7 |      |               |

**Table 9. Logic input**

| Symbol               | Parameter                | Test conditions                 | Min. | Typ. | Max. | Unit          |
|----------------------|--------------------------|---------------------------------|------|------|------|---------------|
| $V_{\text{IL}}$      | Low-level input voltage  |                                 |      |      | 0.9  | V             |
| $I_{\text{IL}}$      | Low-level input current  | $V_{\text{IN}} = 0.9 \text{ V}$ | 1    |      |      | $\mu\text{A}$ |
| $V_{\text{IH}}$      | High-level input voltage |                                 | 2.1  |      |      | V             |
| $I_{\text{IH}}$      | High-level input current | $V_{\text{IN}} = 2.1 \text{ V}$ |      |      | 10   | $\mu\text{A}$ |
| $V_{\text{I(hyst)}}$ | Input hysteresis voltage |                                 | 0.13 |      |      | V             |



Table 9. Logic input (continued)

| Symbol    | Parameter           | Test conditions          | Min. | Typ. | Max. | Unit |
|-----------|---------------------|--------------------------|------|------|------|------|
| $V_{ICL}$ | Input clamp voltage | $I_{IN} = 1 \text{ mA}$  | 5.5  |      | 7    | V    |
|           |                     | $I_{IN} = -1 \text{ mA}$ |      | -0.7 |      |      |

Table 10. Open-load detection

| Symbol         | Parameter                                                                      | Test conditions         | Min. | Typ. | Max. | Unit          |
|----------------|--------------------------------------------------------------------------------|-------------------------|------|------|------|---------------|
| $V_{OI}$       | Open-load OFF-state voltage detection threshold                                | $V_{IN} = 0 \text{ V}$  | 0.6  | 1.2  | 1.7  | V             |
| $t_{d(oloff)}$ | Delay between INPUT falling edge and STATUS falling edge in openload condition | $I_{OUT} = 0 \text{ A}$ | 45   | 425  | 1100 | $\mu\text{s}$ |

Table 11. Supply section

| Symbol    | Parameter            | Test conditions                                                               | Min. | Typ. | Max. | Unit          |
|-----------|----------------------|-------------------------------------------------------------------------------|------|------|------|---------------|
| $I_S$     | Supply current       | OFF-state; $T_j = 25^\circ\text{C}$ ;<br>$V_{IN} = V_{DRAIN} = 0 \text{ V}$ ; |      | 10   | 25   | $\mu\text{A}$ |
|           |                      | ON-state; $V_{IN} = 5 \text{ V}$ ; $V_{DS} = 0 \text{ V}$                     |      | 25   | 65   |               |
| $V_{SCL}$ | Supply clamp voltage | $I_{SCL} = 1 \text{ mA}$                                                      | 5.5  |      | 7    | V             |
|           |                      | $I_{SCL} = -1 \text{ mA}$                                                     |      | -0.7 |      |               |

Table 12. Switching characteristics<sup>(1)</sup>

| Symbol       | Parameter                           | Test conditions                                       | PowerSSO-12 |       |      | SO-8 |       |      | Unit          |
|--------------|-------------------------------------|-------------------------------------------------------|-------------|-------|------|------|-------|------|---------------|
|              |                                     |                                                       | Min.        | Typ.  | Max. | Min. | Typ.  | Max. |               |
| $t_{d(ON)}$  | Turn-on delay time                  | $R_L = 4.5 \Omega$ ;<br>$V_{CC} = 13 \text{ V}^{(2)}$ | —           | 7.6   | —    | —    | 7.6   | —    | $\mu\text{s}$ |
| $t_{d(OFF)}$ | Turn-off delay time                 | $R_L = 4.5 \Omega$ ;<br>$V_{CC} = 13 \text{ V}^{(2)}$ | —           | 18.8  | —    | —    | 18.8  | —    | $\mu\text{s}$ |
| $t_r$        | Rise time                           | $R_L = 4.5 \Omega$ ;<br>$V_{CC} = 13 \text{ V}^{(2)}$ | —           | 8     | —    | —    | 8     | —    | $\mu\text{s}$ |
| $t_f$        | Fall time                           | $R_L = 4.5 \Omega$ ;<br>$V_{CC} = 13 \text{ V}^{(2)}$ | —           | 9     | —    | —    | 9     | —    | $\mu\text{s}$ |
| $W_{ON}$     | Switching energy losses at turn-on  | $R_L = 4.5 \Omega$ ;<br>$V_{CC} = 13 \text{ V}^{(2)}$ | —           | 0.068 | —    | —    | 0.068 | —    | mJ            |
| $W_{OFF}$    | Switching energy losses at turn-off | $R_L = 4.5 \Omega$ ;<br>$V_{CC} = 13 \text{ V}^{(2)}$ | —           | 0.077 | —    | —    | 0.077 | —    | mJ            |
| $Q_g$        | Total gate charge                   | $V_{SUPPLY} = V_{IN} = 5 \text{ V}$                   | —           | 6     | —    | —    | 6     | —    | nC            |

1. See [Figure 14: Application schematic](#).

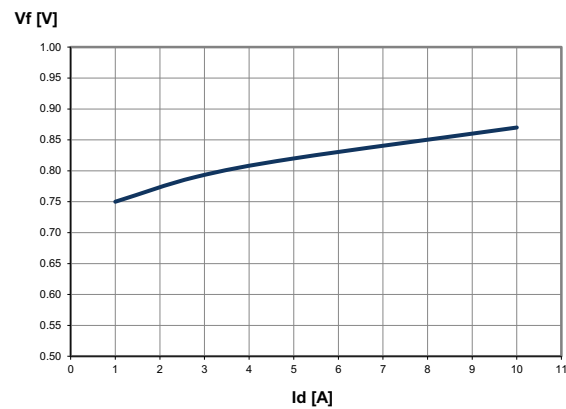
2. See [Figure 13: Switching characteristics](#).

Table 13. Protection and diagnostics

| Symbol     | Parameter                                    | Test conditions                                                                    | Min.         | Typ.         | Max. | Unit               |
|------------|----------------------------------------------|------------------------------------------------------------------------------------|--------------|--------------|------|--------------------|
| $I_{limH}$ | DC short-circuit current                     | $V_{DS} = 13\text{ V};$<br>$V_{SUPPLY} = V_{IN} = 5\text{ V}$                      | 25           | 35           | 49   | A                  |
| $I_{limL}$ | Short-circuit current during thermal cycling | $V_{DS} = 13\text{ V}; T_R < T_J < T_{TSD};$<br>$V_{SUPPLY} = V_{IN} = 5\text{ V}$ |              | 15           |      | A                  |
| $t_{dimL}$ | Step response current limit                  | $V_{DS} = 13\text{ V}; V_{input} = 5\text{ V}$                                     |              | 44           |      | $\mu\text{s}$      |
| $T_{TSD}$  | Shutdown temperature                         |                                                                                    | 150          | 175          | 200  | $^{\circ}\text{C}$ |
| $T_R$      | Reset temperature                            |                                                                                    | $T_{RS} + 1$ | $T_{RS} + 5$ |      | $^{\circ}\text{C}$ |
| $T_{RS}$   | Thermal reset of STATUS                      |                                                                                    | 135          |              |      | $^{\circ}\text{C}$ |
| $T_{HYST}$ | Thermal hysteresis ( $T_{TSD} - T_R$ )       |                                                                                    |              | 7            |      | $^{\circ}\text{C}$ |

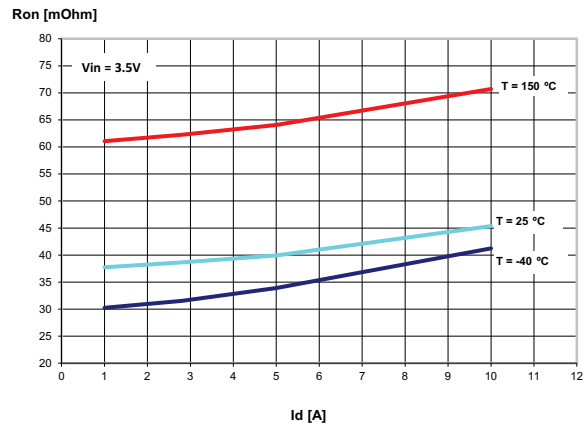
2.4 Electrical characteristics curves

Figure 4. Source diode forward characteristics



GAPG2207131617CFT

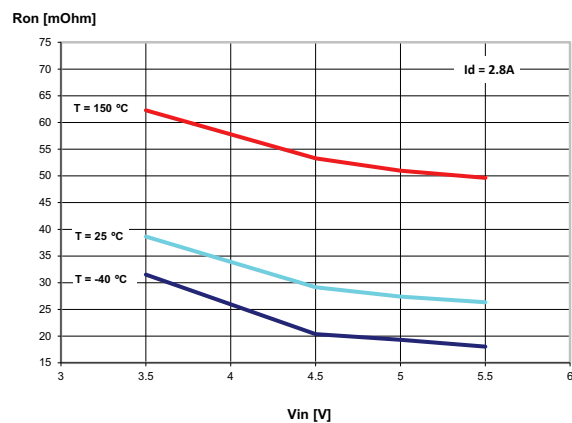
Figure 5. Static drain source on-resistance vs. drain current ( $V_{IN} = 3.5\text{ V}$ )



Note: Input and supply pins connected together

GAPG2207131621CFT

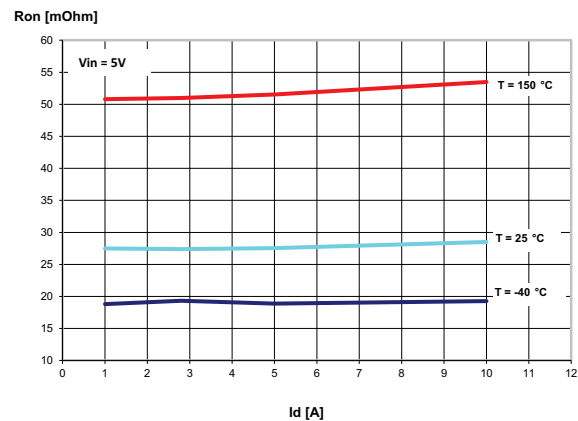
Figure 6. Static drain source on-resistance vs. input voltage



Note: Input and supply pins connected together

GAPG2207131659CFT

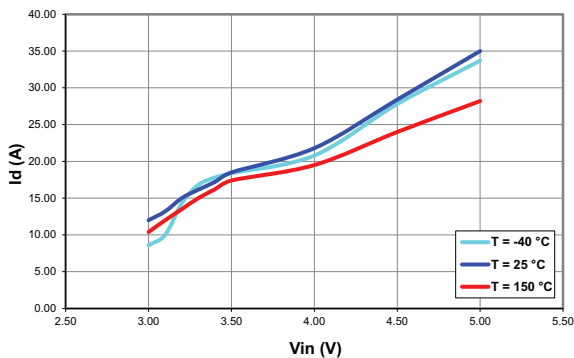
Figure 7. Static drain source on-resistance vs. drain current ( $V_{IN} = 5\text{ V}$ )



Note: Input and supply pins connected together

GAPG2207131702CFT

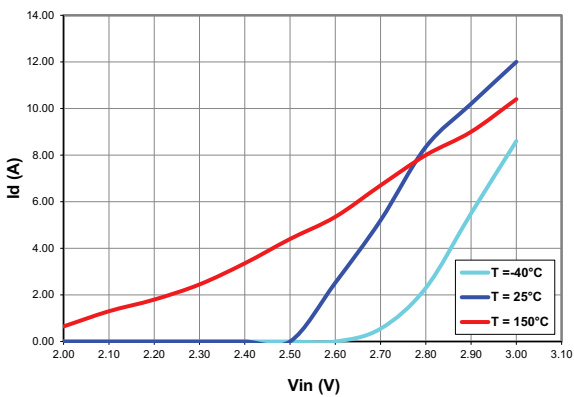
Figure 8. Transfer characteristics



Note: Input and supply pins connected together

GAPG2307130857CFT

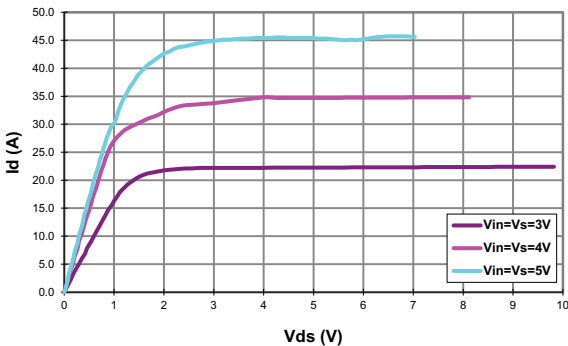
Figure 9. Transfer characteristics (inside view for  $V_{IN} = 2\text{ V to }3\text{ V}$ )



Note: Input and supply pins connected together

GAPG2307130859CFT

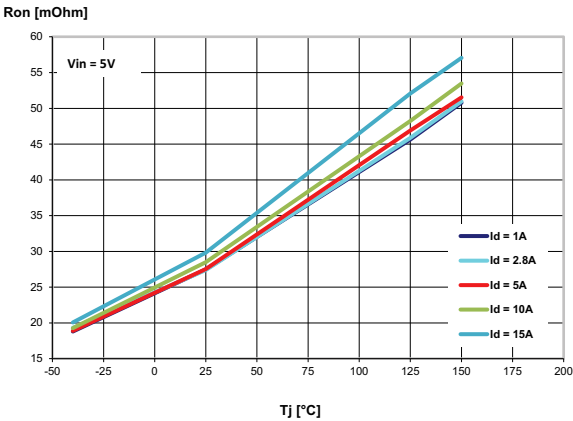
Figure 10. Output characteristics ( $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ )



Note: Input and supply pins connected together

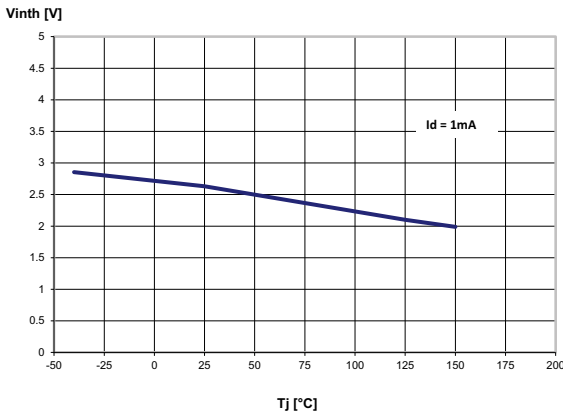
GAPG2307130907CFT

Figure 11. On-resistance vs. temperature



GAPG2307130912CFT

Figure 12. Input threshold vs. temperature



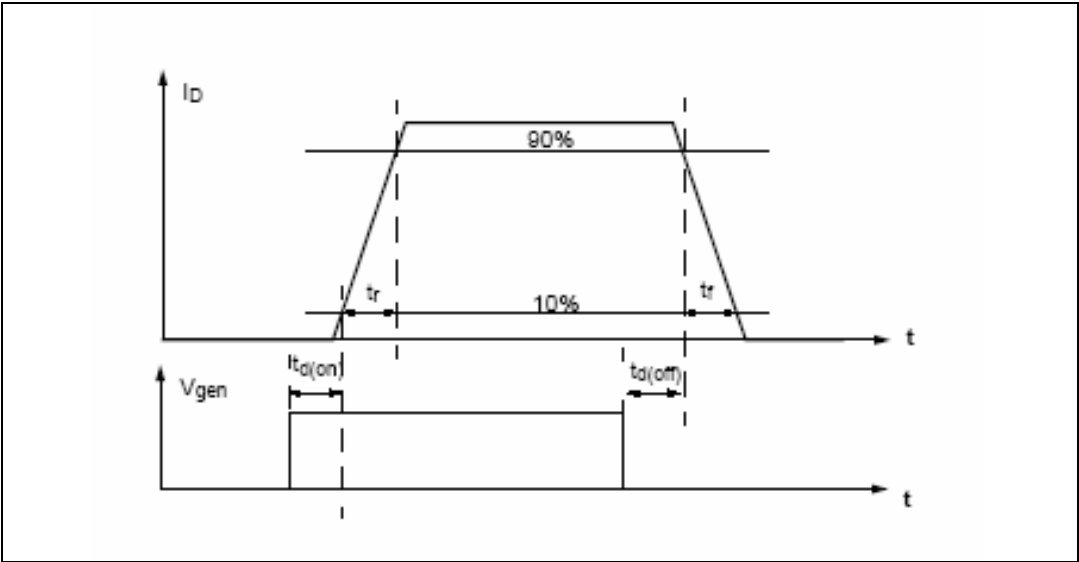
Note: Input and supply pins connected together

GAPG2307130915CFT

Table 14. Truth table

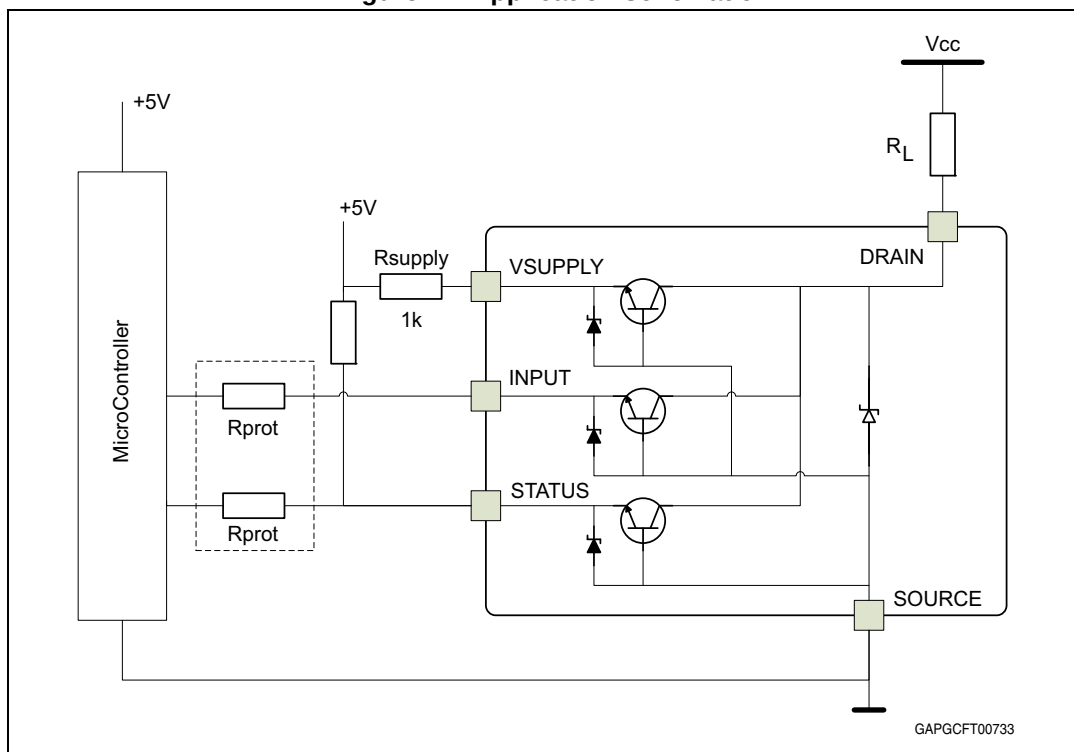
| Conditions                       | INPUT | DRAIN | STATUS |
|----------------------------------|-------|-------|--------|
| Normal operation                 | L     | H     | H      |
|                                  | H     | L     | H      |
| Current limitation               | L     | H     | H      |
|                                  | H     | X     | H      |
| Overtemperature                  | L     | H     | H      |
|                                  | H     | H     | L      |
| Undervoltage                     | L     | H     | X      |
|                                  | H     | H     | X      |
| Output voltage < V <sub>OL</sub> | L     | L     | L      |
|                                  | H     | L     | H      |

Figure 13. Switching characteristics



### 3 Application information

Figure 14. Application schematic



#### 3.1 MCU I/O protection

ST suggests to insert a resistor ( $R_{prot}$ ) in line to prevent the microcontroller I/O pins from latching up<sup>(a)</sup>. The value of these resistors is a compromise between the leakage current of microcontroller and the current required by the LSD I/Os (input levels compatibility) with the latch-up limit of microcontroller I/Os:

##### Equation 1

$$\frac{0.7}{I_{latchup}} \leq R_{prot} \leq \frac{(V_{OH\mu C} - V_{IH})}{I_{IH\ max}}$$

Let:

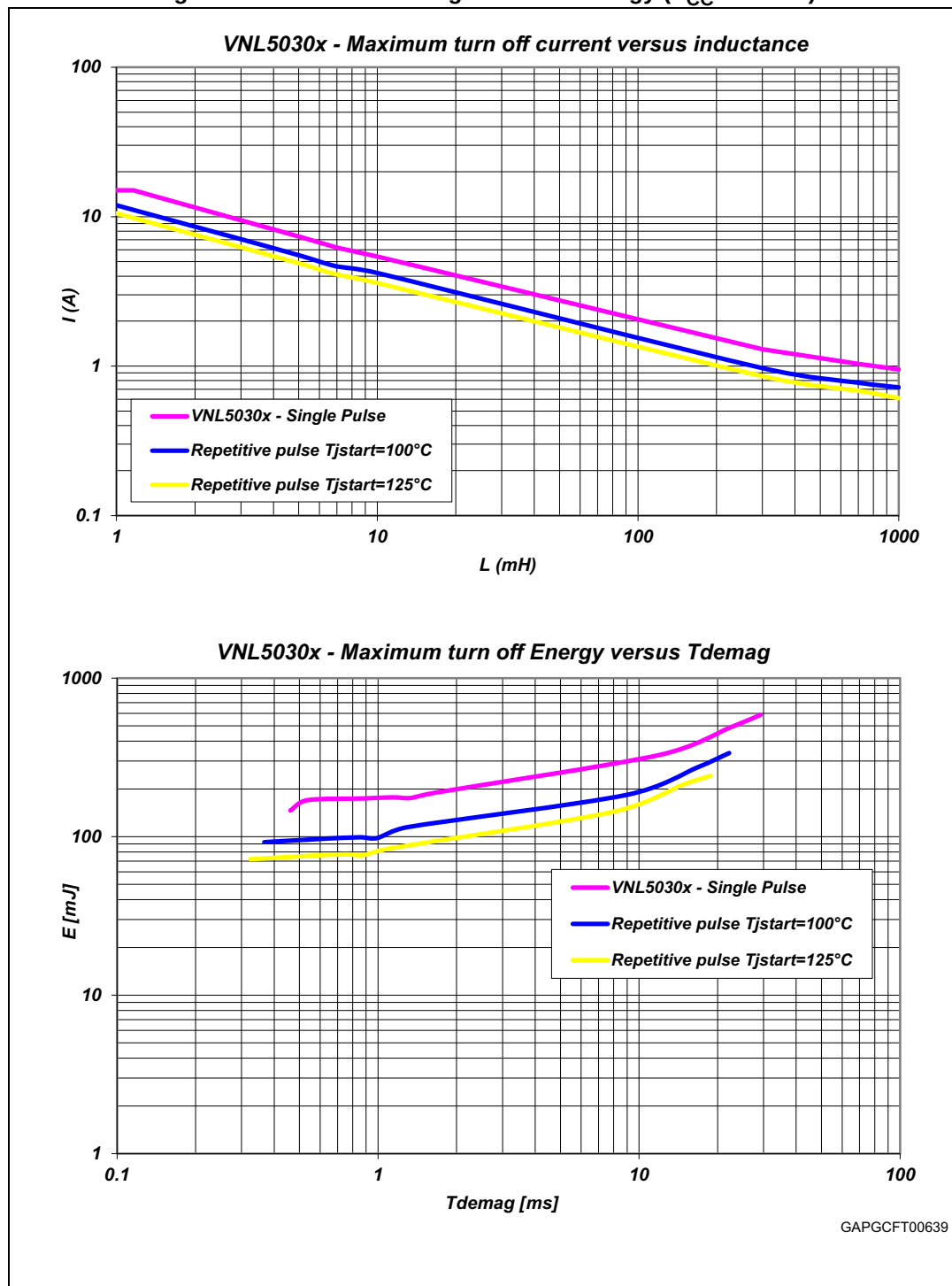
- $I_{latchup} \geq 20\text{ mA}$
- $V_{OH\mu C} \geq 4.5\text{ V}$
- $35\ \Omega \leq R_{prot} \leq 100\text{ K}\Omega$

a. In case of negative transient on the drain pin.

Then, the recommended value is  $R_{\text{prot}} = 1 \text{ K}\Omega$

Figure 15 shows the turn-off current drawn during the demagnetization.

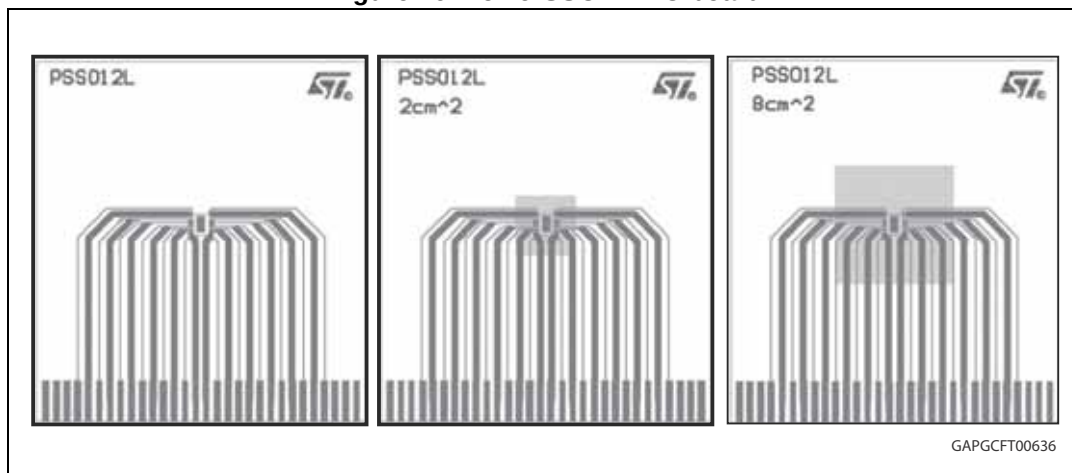
Figure 15. Maximum demagnetization energy ( $V_{\text{CC}} = 13.5 \text{ V}$ )



## 4 Package and PC board thermal data

### 4.1 PowerSSO-12 thermal data

Figure 16. PowerSSO-12 PC board



1. Layout condition of R<sub>th</sub> and Z<sub>th</sub> measurements (board finish thickness 1.6 mm +/- 10%; board double layer; board dimension 77x86; board material FR4; Cu thickness 0.070mm (front and back side); thermal vias separation 1.2 mm; thermal via diameter 0.3 mm +/- 0.08 mm; Cu thickness on vias 0.025 mm; footprint dimension 4.1 mm x 6.5 mm).

Figure 17. PowerSSO-12 R<sub>thj-amb</sub> vs PCB copper area in open box free air condition

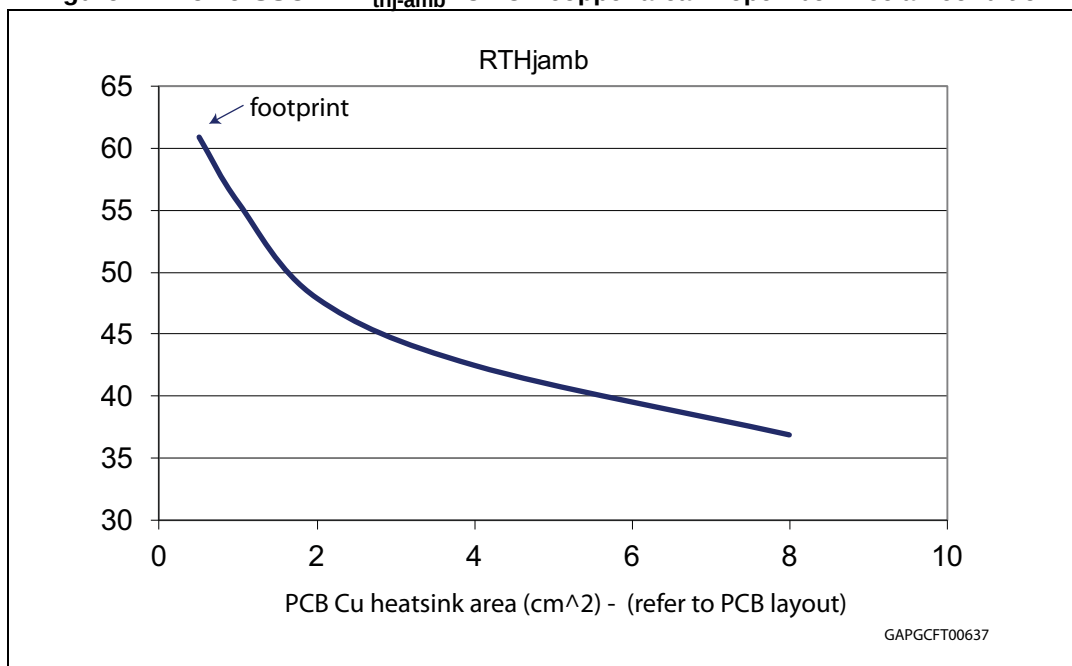
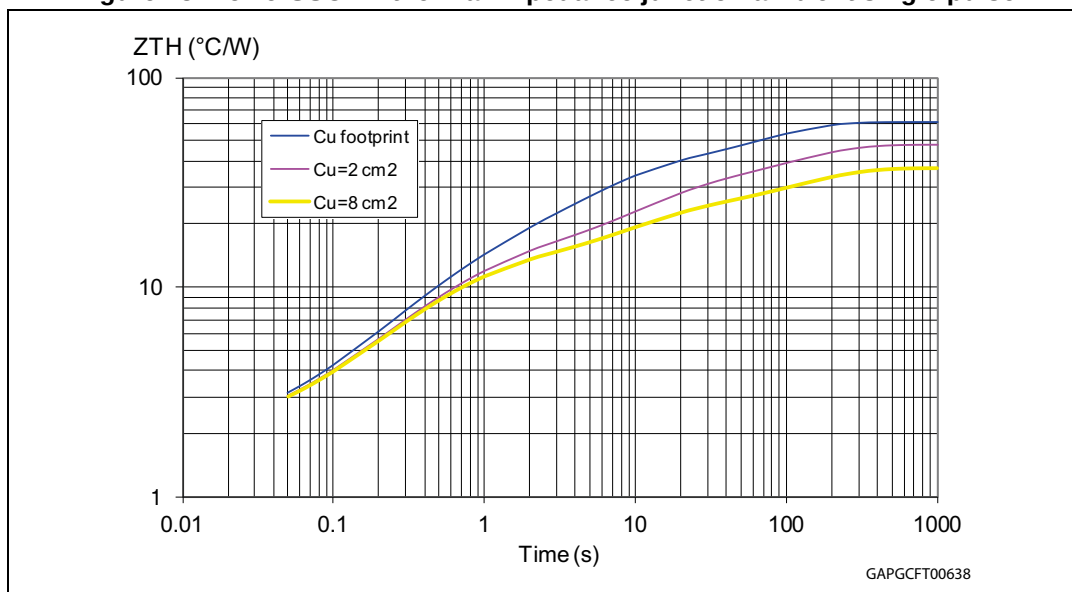




Figure 18. PowerSSO-12 thermal impedance junction ambient single pulse

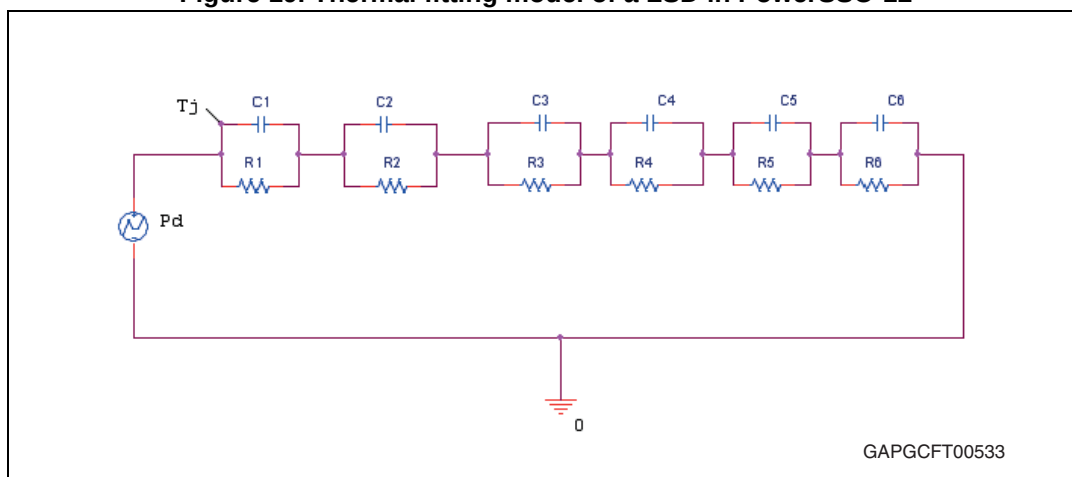


Equation 2: pulse calculation formula

$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where  $\delta = t_p/T$ 

Figure 19. Thermal fitting model of a LSD in PowerSSO-12



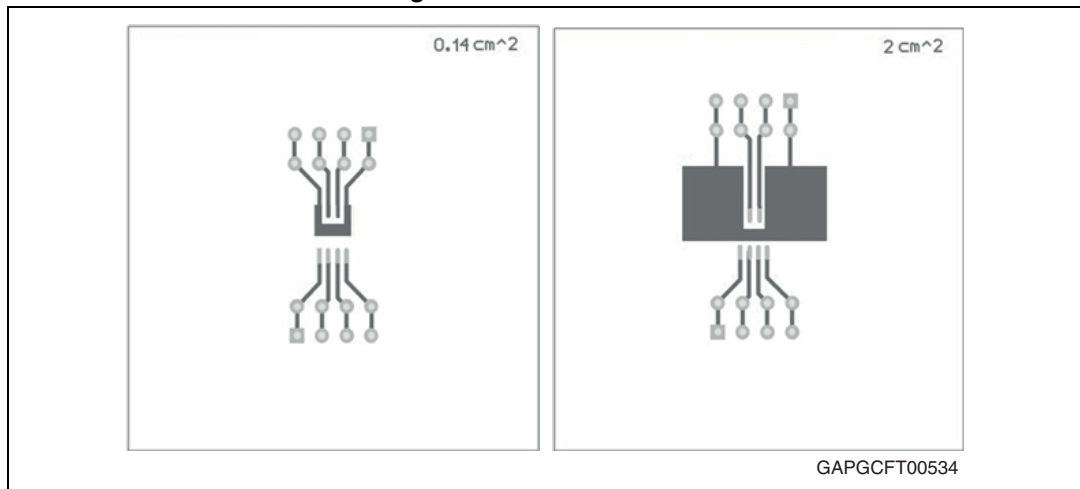
1. The fitting model is a simplified thermal tool and is valid for transient evolutions where the embedded protections (power limitation or thermal cycling during thermal shutdown) are not triggered.

Table 15. PowerSSO-12 thermal parameters

| Areal/island (cm <sup>2</sup> ) | Footprint | 2   | 8   |
|---------------------------------|-----------|-----|-----|
| R1 (°C/W)                       | 0.7       |     |     |
| R2 (°C/W)                       | 1.2       |     |     |
| R3 (°C/W)                       | 3         |     |     |
| R4 (°C/W)                       | 8         | 8   | 7   |
| R5 (°C/W)                       | 22        | 15  | 10  |
| R6 (°C/W)                       | 26        | 20  | 15  |
| C1 (W.s/°C)                     | 0.001     |     |     |
| C2 (W.s/°C)                     | 0.005     |     |     |
| C3 (W.s/°C)                     | 0.08      |     |     |
| C4 (W.s/°C)                     | 0.1       | 0.1 | 0.1 |
| C5 (W.s/°C)                     | 0.27      | 0.8 | 1   |
| C6 (W.s/°C)                     | 3         | 6   | 9   |

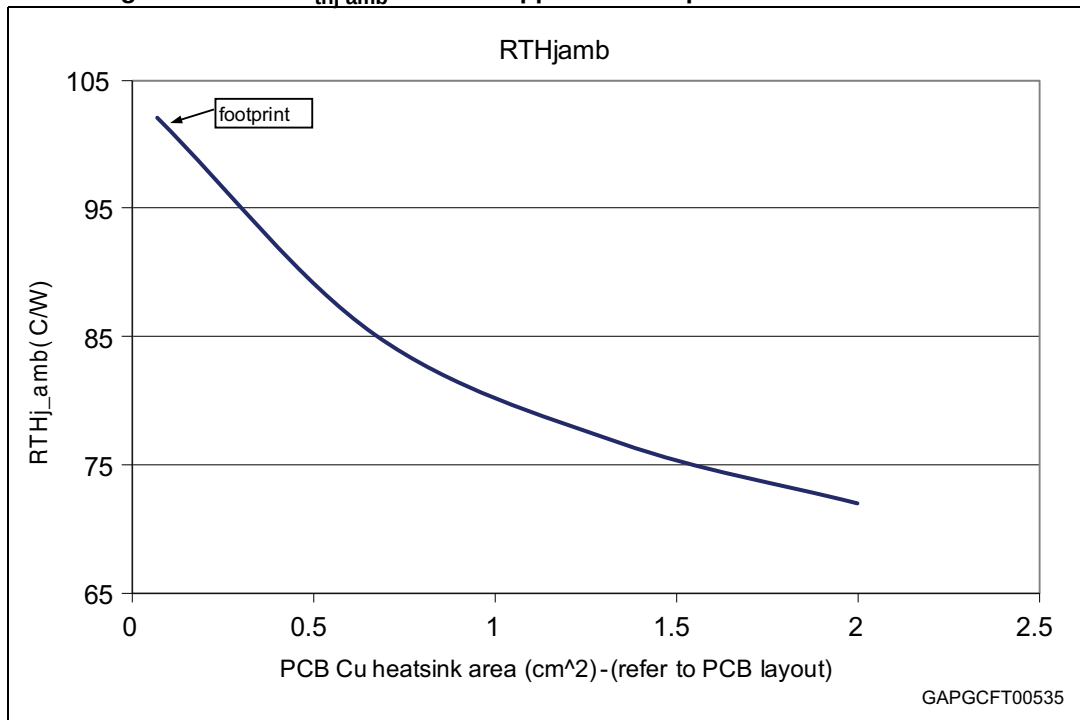
## 4.2 SO-8 thermal data

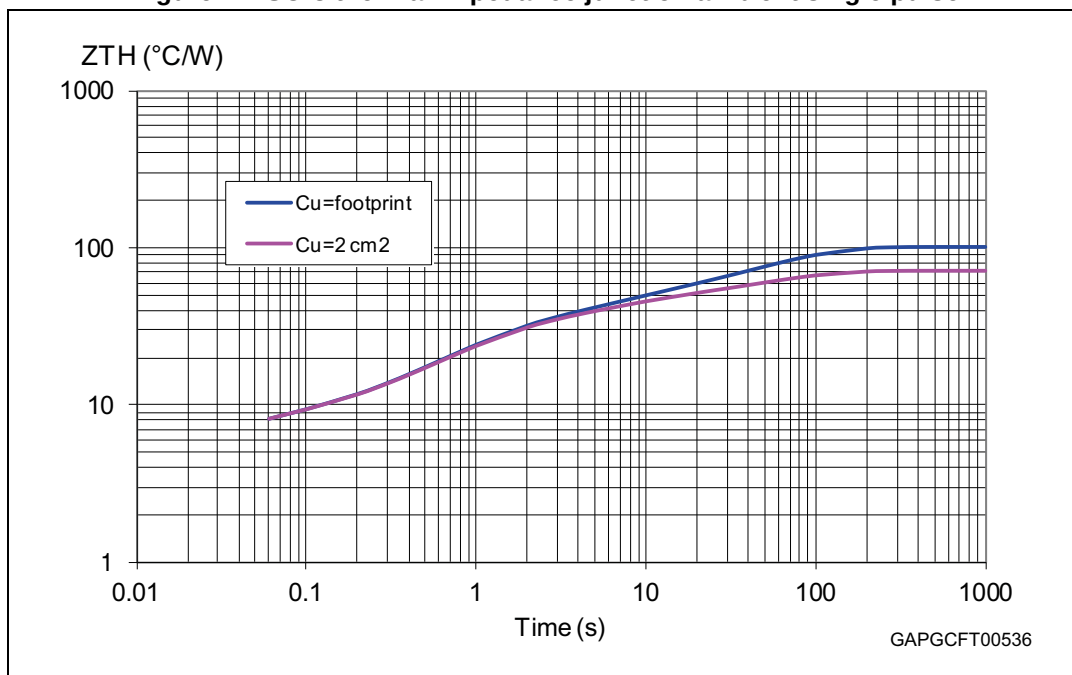
Figure 20. SO-8 PC board



1. Layout condition of  $R_{th}$  and  $Z_{th}$  measurements (PCB FR4 area = 58 mm x 58 mm, PCB thickness = 2 mm, Cu thickness = 35  $\mu\text{m}$  (front and back side), Copper areas: from minimum pad lay-out to 2  $\text{cm}^2$ ).

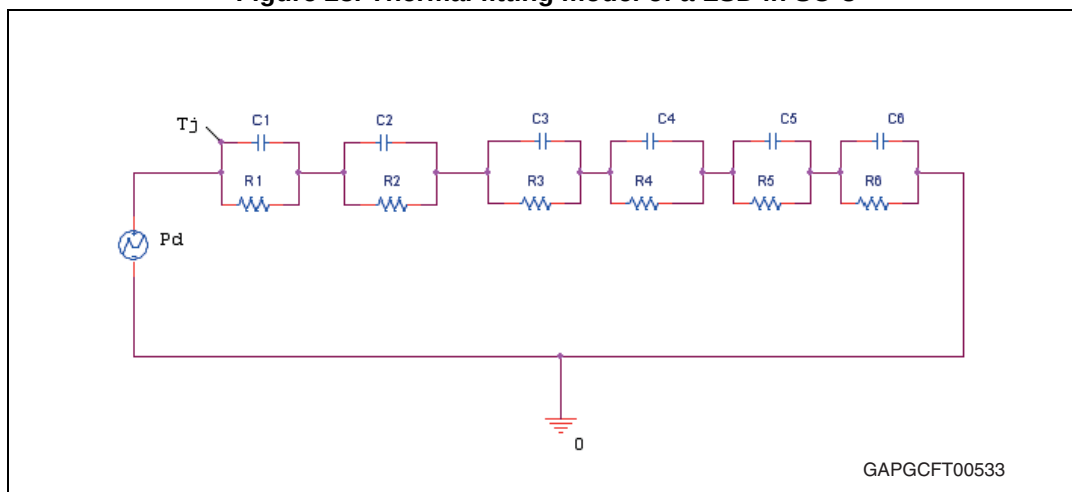
Figure 21. SO-8  $R_{thj-amb}$  vs PCB copper area in open box free air condition



**Figure 22. SO-8 thermal impedance junction ambient single pulse****Equation 3: pulse calculation formula**

$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where  $\delta = t_p/T$

**Figure 23. Thermal fitting model of a LSD in SO-8**

1. The fitting model is a simplified thermal tool and is valid for transient evolutions where the embedded protections (power limitation or thermal cycling during thermal shutdown) are not triggered.

Table 16. SO-8 thermal parameters

| Area/island (cm <sup>2</sup> ) | Footprint | 2  |
|--------------------------------|-----------|----|
| R1 (°C/W)                      | 0.3       |    |
| R2 (°C/W)                      | 2.2       |    |
| R3 (°C/W)                      | 3.5       |    |
| R4 (°C/W)                      | 21        |    |
| R5 (°C/W)                      | 16        |    |
| R6 (°C/W)                      | 58        | 28 |
| C1 (W.s/°C)                    | 0.0001    |    |
| C2 (W.s/°C)                    | 0.002     |    |
| C3 (W.s/°C)                    | 0.0075    |    |
| C4 (W.s/°C)                    | 0.045     |    |
| C5 (W.s/°C)                    | 0.35      |    |
| C6 (W.s/°C)                    | 1.05      | 2  |

## 5 Package and packing information

### 5.1 ECOPACK®

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.

### 5.2 PowerSSO-12 mechanical data

Figure 24. PowerSSO-12 package dimensions

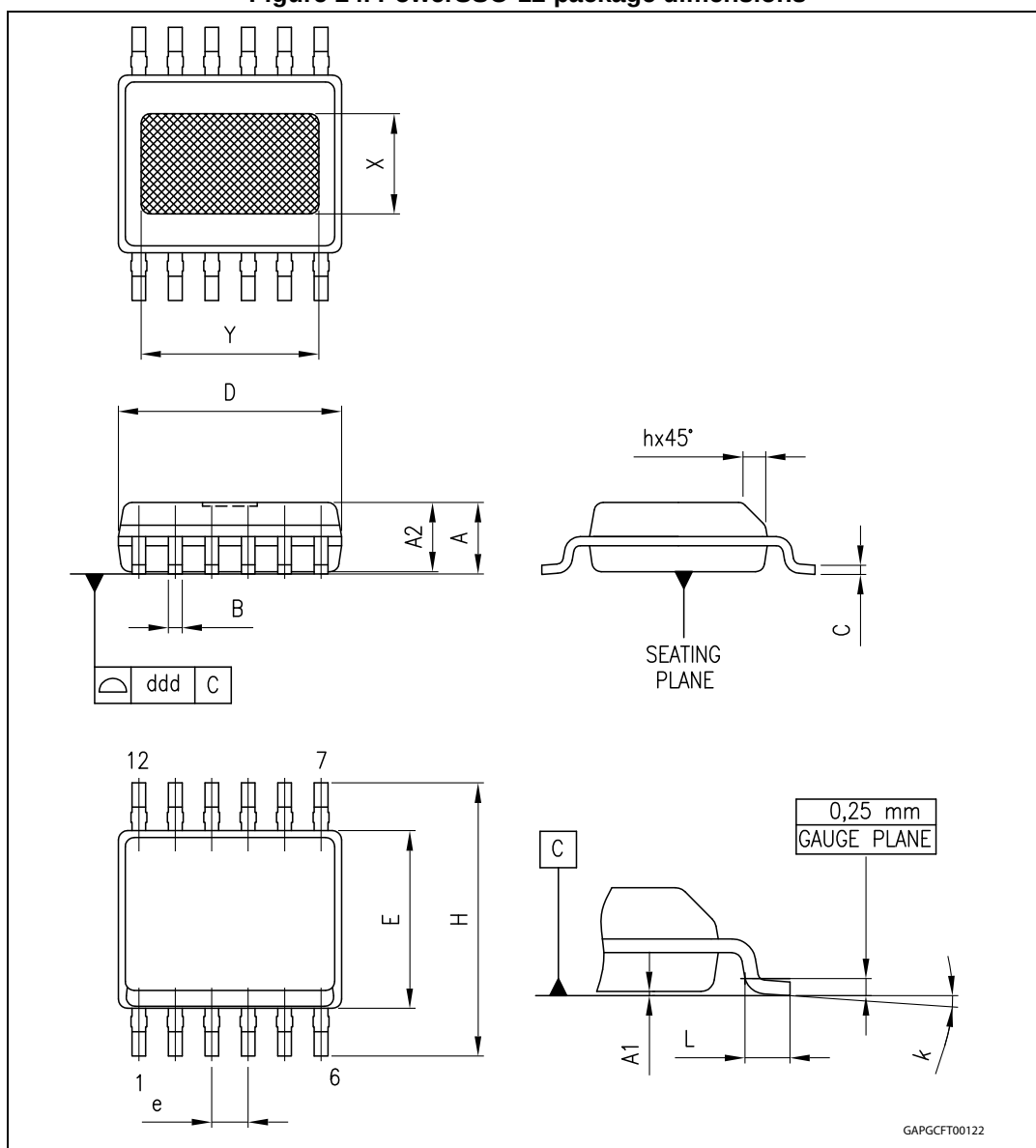


Table 17. PowerSSO-12 mechanical data

| DIM. | mm.  |      |      | inch |      |      |
|------|------|------|------|------|------|------|
|      | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A    | 1.25 |      | 1.62 | A    | 1.25 |      |
| A1   | 0    |      | 0.1  | A1   | 0    |      |
| A2   | 1.10 |      | 1.65 | A2   | 1.10 |      |
| B    | 0.23 |      | 0.41 | B    | 0.23 |      |
| C    | 0.19 |      | 0.25 | C    | 0.19 |      |
| D    | 4.8  |      | 5.0  | D    | 4.8  |      |
| E    | 3.8  |      | 4.0  | E    | 3.8  |      |
| e    |      | 0.8  |      | e    |      | 0.8  |
| H    | 5.8  |      | 6.2  | H    | 5.8  |      |
| h    | 0.25 |      | 0.5  | h    | 0.25 |      |
| L    | 0.4  |      | 1.27 | L    | 0.4  |      |
| k    | 0°   |      | 8°   | k    | 0°   |      |
| X    | 1.9  |      | 2.5  | X    | 1.9  |      |
| Y    | 3.6  |      | 4.2  | Y    | 3.6  |      |
| ddd  |      |      | 0.1  | ddd  |      |      |

5.3 SO-8 mechanical data

Figure 25. SO-8 package dimensions

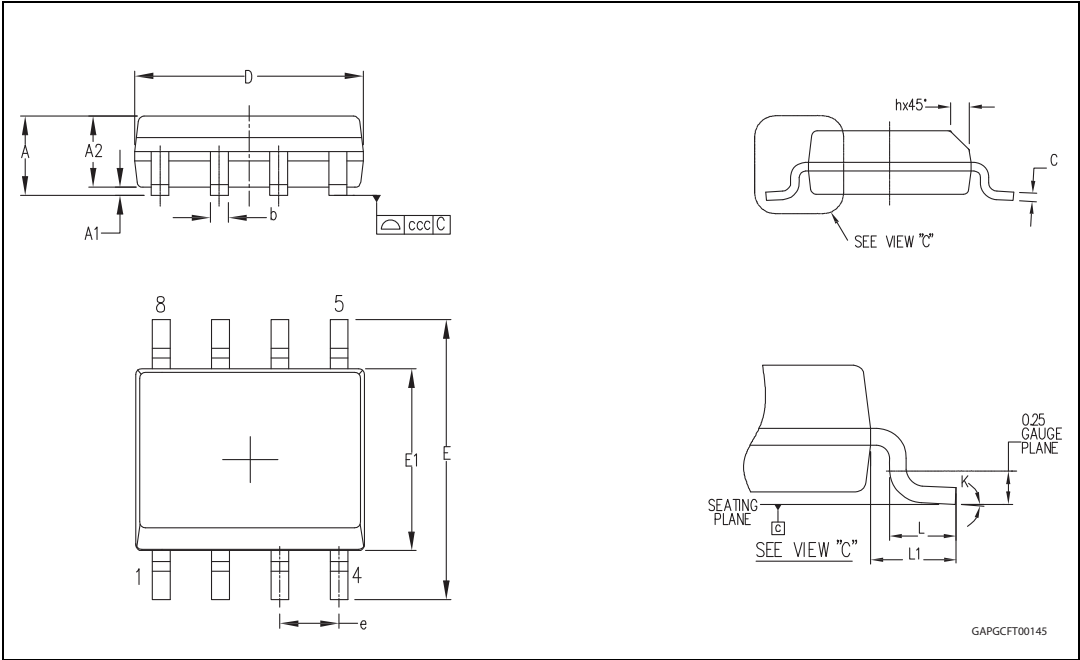


Table 18. SO-8 mechanical data

| Symbol            | Millimeters |      |      |
|-------------------|-------------|------|------|
|                   | Min.        | Typ. | Max. |
| A                 |             |      | 1.75 |
| A1                | 0.10        |      | 0.25 |
| A2                | 1.25        |      |      |
| b                 | 0.28        |      | 0.48 |
| c                 | 0.17        |      | 0.23 |
| D <sup>(1)</sup>  | 4.80        | 4.90 | 5.00 |
| E                 | 5.80        | 6.00 | 6.20 |
| E1 <sup>(2)</sup> | 3.80        | 3.90 | 4.00 |
| e                 |             | 1.27 |      |
| h                 | 0.25        |      | 0.50 |
| L                 | 0.40        |      | 1.27 |
| L1                |             | 1.04 |      |
| k                 | 0°          |      | 8°   |
| ccc               |             |      | 0.10 |

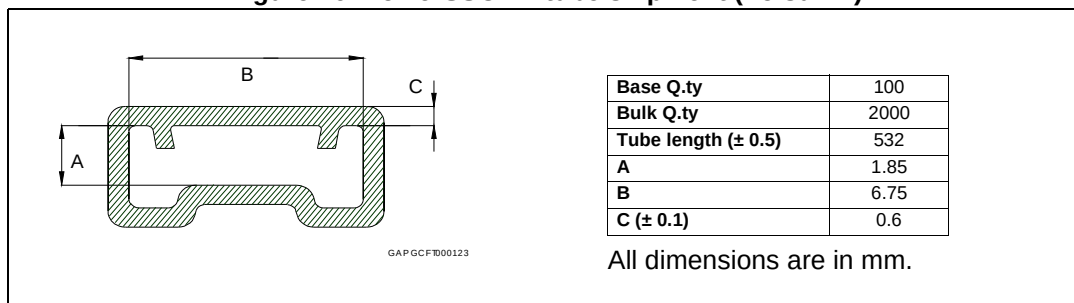
1. Dimensions D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm in total (both side).
2. Dimension "E1" does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25 mm per side.



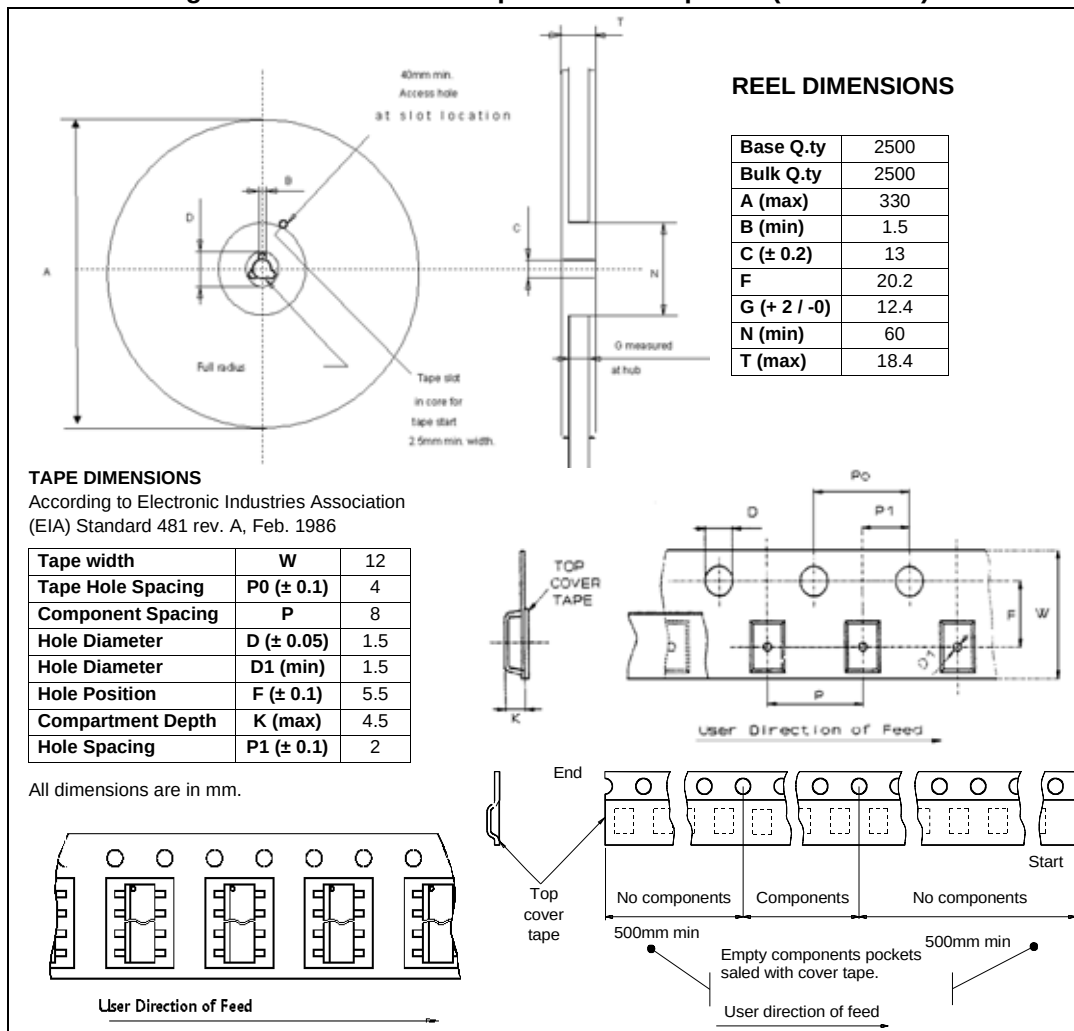
## 5.4 PowerSSO-12 packing information

The devices can be packed in tube or tape and reel shipments (see the [Table 1: Devices summary](#)).

**Figure 26. PowerSSO-12 tube shipment (no suffix)**



**Figure 27. PowerSSO-12 tape and reel shipment (suffix "TR")**





## 6 Revision history

**Table 19. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                            |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14-Feb-2012 | 1        | Initial release.                                                                                                                                                                                                                                                                                   |
| 14-Jun-2012 | 2        | Updated <a href="#">Table 2: Pin function</a><br>Updated <a href="#">Figure 3: Configuration diagrams (top view)</a><br><a href="#">Table 12: Switching characteristics</a> :<br>– Q <sub>G</sub> : added row                                                                                      |
| 14-Sep-2012 | 3        | <a href="#">Table 4: Absolute maximum ratings</a> :<br>– I <sub>D</sub> , I <sub>S</sub> , I <sub>STAT</sub> : updated values<br>Updated <a href="#">Table 5: Thermal data</a> and <a href="#">Table 12: Switching characteristics</a>                                                             |
| 15-May-2013 | 4        | Removed <a href="#">Table: Input section</a> .<br>Updated <a href="#">Figure 14: Application schematic</a><br>Updated <a href="#">Section 3.1: MCU I/O protection</a>                                                                                                                              |
| 18-Sep-2013 | 5        | Updated disclaimer.                                                                                                                                                                                                                                                                                |
| 21-Nov-2013 | 6        | Updated <a href="#">Features</a> list<br>Added <a href="#">Section 2.4: Electrical characteristics curves</a><br><a href="#">Table 11: Supply section</a> :<br>– I <sub>S</sub> : updated max value<br>Updated <a href="#">Figure 15: Maximum demagnetization energy (V<sub>CC</sub> = 13.5 V)</a> |

**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](http://www.st.com)