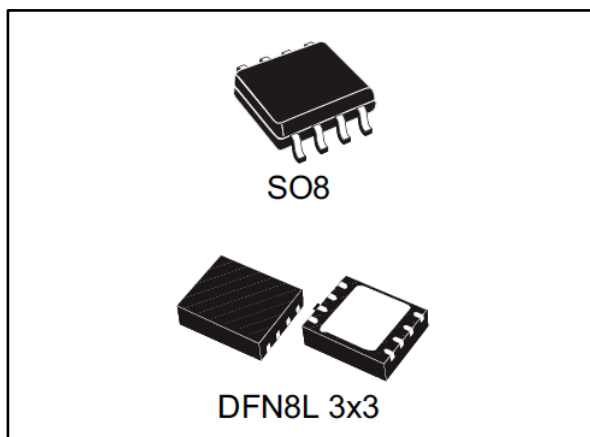


## 1.2 A current limited high-side power switch with thermal shutdown

Datasheet - production data



### Applications

- PCMCIA slots
- Access bus slots
- Portable equipment

### Description

The ST890 device is a low voltage, P-channel MOSFET power switch intended for high-side load switching applications.

The switch operates with inputs from 2.7 V to 5.5 V, making it ideal for both 3 V and 5 V systems.

The internal current limiting circuitry protects the input supply against overload. The thermal overload protection limits power dissipation and junction temperatures.

The maximum current limit is 1.2 A. The current limit through the switch is programmed with a resistor from SET to ground. The devices are available in SO8 and DFN8L 3x3 packages.

### Features

- 2.7 to 5.5 V input range
- Programmable current limit up to 1.2 A
- Low quiescent current
- Thermal shutdown
- Active-low FAULT indicator output
- 90 m $\Omega$  (typ.) ON resistance
- SO8 and DFN8L 3x3 packages

## Contents

|          |                                                                |           |
|----------|----------------------------------------------------------------|-----------|
| <b>1</b> | <b>Device summary.....</b>                                     | <b>3</b>  |
| <b>2</b> | <b>Pinout information.....</b>                                 | <b>4</b>  |
| <b>3</b> | <b>Absolute maximum ratings and operating conditions .....</b> | <b>5</b>  |
| <b>4</b> | <b>Electrical information .....</b>                            | <b>6</b>  |
| 4.1      | Characteristics and timings .....                              | 6         |
| 4.2      | Application circuit .....                                      | 7         |
| 4.3      | Functional description .....                                   | 7         |
| 4.3.1    | Output current limit .....                                     | 7         |
| 4.3.2    | Output short-circuit protection .....                          | 7         |
| 4.3.3    | Programming $I_{LIM}$ .....                                    | 8         |
| 4.3.4    | <b>FAULT</b> pin.....                                          | 8         |
| 4.3.5    | Thermal protection.....                                        | 8         |
| 4.4      | Typical performance characteristics.....                       | 9         |
| <b>5</b> | <b>Package information .....</b>                               | <b>10</b> |
| 5.1      | SO8 package information.....                                   | 11        |
| 5.2      | SO8 tape and reel information .....                            | 12        |
| 5.3      | DFN8L 3x3 package information.....                             | 13        |
| 5.4      | DFN8L 3x3 tape and reel information .....                      | 15        |
| <b>6</b> | <b>Ordering information.....</b>                               | <b>17</b> |
| <b>7</b> | <b>Revision history .....</b>                                  | <b>18</b> |

1 Device summary

Figure 1: Schematic diagram

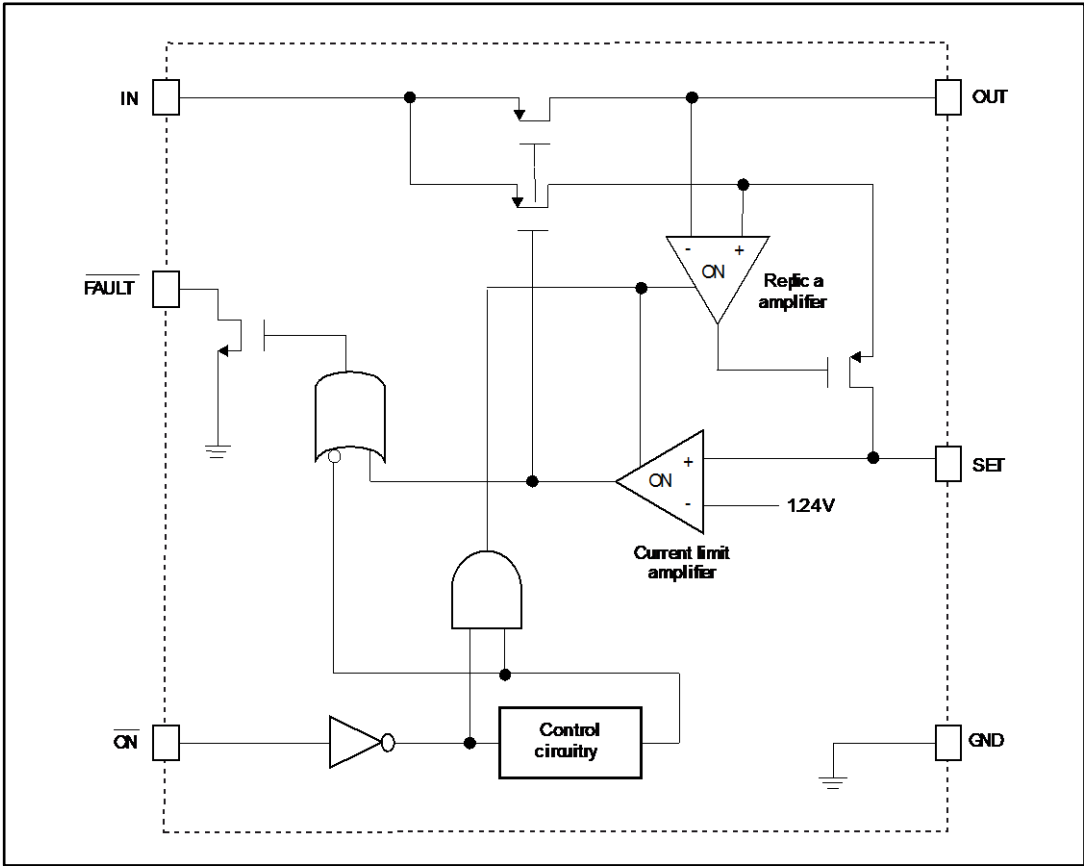


Table 1: Truth table for  $\overline{\text{ON}}$  /OFF switch

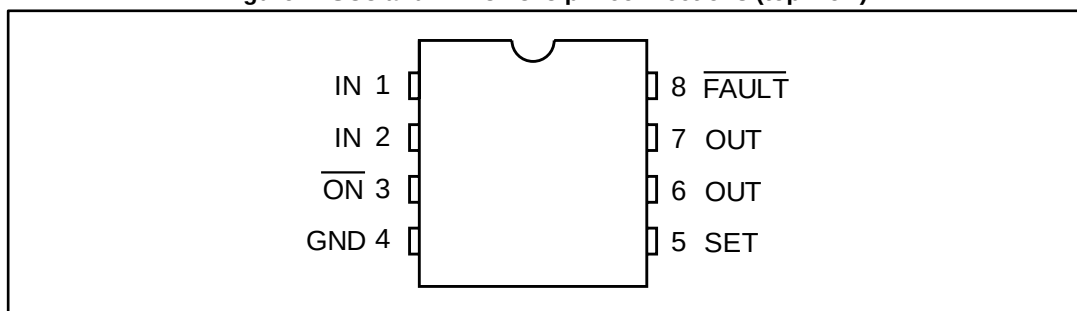
| $\overline{\text{ON}}$ /OFF | OUT |
|-----------------------------|-----|
| L                           | ON  |
| H                           | OFF |

Table 2: Truth table for  $\overline{\text{FAULT}}$

| $\overline{\text{FAULT}}$ | FLAG             |
|---------------------------|------------------|
| H                         | Normal operation |
| L                         | Fault condition  |

## 2 Pinout information

Figure 2: SO8 and DFN8L 3x3 pin connections (top view)



1. The exposed pad of the DFN8L 3x3 is not internally connected. It can be connected to the PCB groundplane for best thermal performance.

Table 3: SO8 and DFN8L 3x3 pin description

| Pin no. | Symbol                    | Name and function                                                                                                                          |
|---------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 2    | IN                        | Input P-channel MOSFET source. Bypass IN with a 1 $\mu\text{F}$ capacitor to ground.                                                       |
| 3       | $\overline{\text{ON}}$    | Active-low switch ON input. A logic low turns the switch ON.                                                                               |
| 4       | GND                       | Ground                                                                                                                                     |
| 5       | SET                       | Set current limit input. A resistor from SET to GND sets the current limit for the switch.                                                 |
| 6, 7    | OUT                       | Switch output. P-channel MOSFET drain. Bypass OUT with a 0.1 $\mu\text{F}$ capacitor to ground.                                            |
| 8       | $\overline{\text{FAULT}}$ | Fault indicator output. This open drain output goes low when in current limit or when the die temperature exceeds 135 $^{\circ}\text{C}$ . |

### 3 Absolute maximum ratings and operating conditions

Stressing the device above the ratings listed in [Table 4: "Absolute maximum ratings"](#) 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 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 |
|----------------|--------------------------------------|----------------------------|------|
| $V_I$          | Voltage at IN pin                    | -0.5 to 6                  | V    |
| $V_{ON}$       | Input voltage at ON pin              | -0.5 to 6                  |      |
| $V_{FAULT\_N}$ | Input voltage at FAULT_N pin         | -0.5 to 6                  |      |
| $V_{SET}$      | Voltage at SET pin                   | -0.5 to ( $V_{IN} + 0.5$ ) |      |
| $I_{DS}$       | Maximum continuous switching current | 1.5                        | A    |
| $T_{stg}$      | Storage temperature                  | -65 to 150                 | °C   |

**Table 5: Thermal data**

| Symbol        | Parameter                           | SO8                | DFN8L               | Unit |
|---------------|-------------------------------------|--------------------|---------------------|------|
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 160 <sup>(1)</sup> | 37.6 <sup>(2)</sup> | °C/W |

**Notes:**

<sup>(1)</sup>This value depends on the thermal design of the PCB on which the device is mounted.

<sup>(2)</sup>This value depends on the four-layer PCB, JEDEC standard test board. For best thermal performance, the exposed pad PCB area should be connected by a via to the PCB groundplane.

**Table 6: Operating conditions**

| Symbol     | Parameter                            | ST890CDR   | ST890BDR  | ST890DTR | Unit |
|------------|--------------------------------------|------------|-----------|----------|------|
| $V_I$      | Voltage at IN pin                    | 2.7 to 5.5 |           |          | V    |
| $T_{oper}$ | Operating free-air temperature range | 0 to 70    | -40 to 85 |          | °C   |

## 4 Electrical information

### 4.1 Characteristics and timings

Table 7: Electrical characteristics

| Symbol                             | Parameter                                          | Test condition <sup>(1)</sup>                                                                | T <sub>A</sub> = 25 °C |                         |                         | Unit |
|------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------|-------------------------|-------------------------|------|
|                                    |                                                    |                                                                                              | Min.                   | Typ.                    | Max.                    |      |
| V <sub>I</sub>                     | Operating voltage                                  | I <sub>D</sub> = 1 mA                                                                        | 2.7                    |                         | 5.5                     | V    |
| I <sub>CC</sub>                    | ON quiescent supply current                        | V <sub>I</sub> = 5 V, $\overline{\text{ON}}$ = GND, I <sub>O</sub> = 0                       |                        | 13                      | 25                      | μA   |
| I <sub>CCOFF</sub>                 | OFF quiescent supply current                       | $\overline{\text{ON}}$ = IN, V <sub>I</sub> = V <sub>OUT</sub> = 5.5 V                       |                        |                         | 1                       |      |
|                                    |                                                    | $\overline{\text{ON}}$ = IN, V <sub>I</sub> = 5.5 V, V <sub>O</sub> = 0                      |                        |                         | 5                       |      |
| V <sub>ULO</sub>                   | Undervoltage lockout                               | Rising edge                                                                                  | 2                      | 2.4                     | 2.6                     | V    |
| V <sub>HYST</sub>                  | Undervoltage lockout hysteresis                    |                                                                                              |                        | 100                     |                         | mV   |
| R <sub>ON</sub>                    | ON resistance                                      | V <sub>I</sub> = 4.5 V                                                                       |                        | 75                      | 120                     | mΩ   |
|                                    |                                                    | V <sub>I</sub> = 3 V                                                                         |                        | 90                      | 130                     |      |
| V <sub>SET</sub>                   | Reference voltage to turn the switch OFF           | I <sub>O</sub> = 100 mA, V <sub>SET</sub> rise until V <sub>I</sub> - V <sub>O</sub> > 0.8 V | 1.178                  | 1.24                    | 1.302                   | V    |
| I <sub>MAX</sub>                   | Maximum programmable output over current limit     |                                                                                              |                        | 1.2                     |                         | A    |
| I <sub>SC</sub>                    | Short-circuit current limit                        | V <sub>I</sub> = 5 V, OUT connected to GND, device enabled into short-circuit                |                        | 1.2<br>I <sub>LIM</sub> | 1.5<br>I <sub>LIM</sub> |      |
| I <sub>LIM</sub> /I <sub>SET</sub> | I <sub>LIM</sub> to I <sub>SET</sub> current ratio | I <sub>O</sub> = 500 mA, V <sub>O</sub> > 1.6 V                                              | 970                    | 1110                    | 1300                    |      |
| V <sub>IL</sub>                    | ON input low level voltage                         | V <sub>I</sub> = 2.7 to 5.5 V                                                                |                        |                         | 0.8                     | V    |
| V <sub>IH</sub>                    | ON input high level voltage                        | V <sub>I</sub> = 2.7 to 3.6 V                                                                | 2                      |                         |                         |      |
|                                    |                                                    | V <sub>I</sub> = 2.7 to 5.5 V                                                                | 2.4                    |                         |                         |      |
| I <sub>I</sub>                     | ON input leakage current                           | V <sub>I</sub> = 5.5 V                                                                       |                        |                         | 1                       | μA   |
| I <sub>SET bias</sub>              | I <sub>SET</sub> bias current                      | V <sub>SET</sub> = 1.24 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>O</sub>               |                        | 0.5                     | 3                       |      |
| V <sub>OL</sub>                    | $\overline{\text{FAULT}}$ output low voltage       | I <sub>SINK</sub> = 1 mA, V <sub>SET</sub> = 1.4 V                                           |                        | 0.15                    |                         | V    |
| I <sub>OH</sub>                    | $\overline{\text{FAULT}}$ output leakage current   | V <sub>FAULT</sub> = 5.5 V, V <sub>SET</sub> = 1 V                                           |                        |                         | 1                       | μA   |
| T <sub>PROT</sub>                  | Thermal protection                                 |                                                                                              |                        | 130                     |                         | °C   |
| T <sub>HYST</sub>                  | Thermal hysteresis                                 |                                                                                              |                        | 15                      |                         |      |

**Notes:**

<sup>(1)</sup>V<sub>IN</sub> = 3 V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified. Typical values are at T<sub>A</sub> = 25 °C

Table 8: Timing characteristics

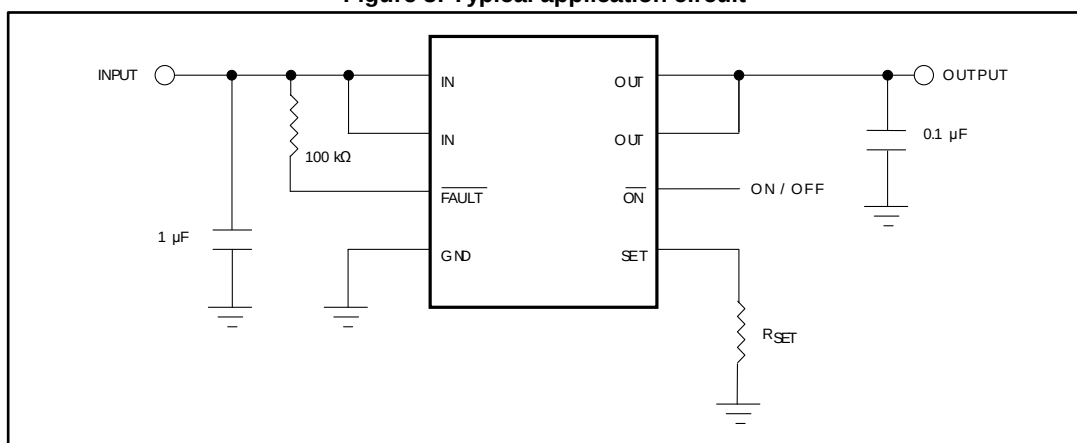
| Symbol            | Parameter                       | Test condition <sup>(1)</sup>                    | T <sub>A</sub> = 25 °C |      |      | Unit |
|-------------------|---------------------------------|--------------------------------------------------|------------------------|------|------|------|
|                   |                                 |                                                  | Min.                   | Typ. | Max. |      |
| t <sub>RESP</sub> | Slow current loop response time | 20 % current overdrive,<br>V <sub>CC</sub> = 5 V |                        | 5    |      | μs   |
|                   | Fast current loop response time |                                                  |                        | 2    |      |      |
| t <sub>ON</sub>   | Turn ON time                    | V <sub>I</sub> = 5 V, I <sub>O</sub> = 500 mA    |                        | 25   | 50   |      |
|                   |                                 | V <sub>I</sub> = 3 V, I <sub>O</sub> = 500 mA    |                        | 50   |      |      |
| t <sub>OFF</sub>  | Turn OFF time                   | V <sub>I</sub> = 5 V                             | 1                      | 2    | 10   |      |

**Notes:**

<sup>(1)</sup>V<sub>IN</sub> = 3 V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified. Typical values are at T<sub>A</sub> = 25 °C

## 4.2 Application circuit

Figure 3: Typical application circuit



## 4.3 Functional description

### 4.3.1 Output current limit

I<sub>LIM</sub> is the output current that the ST890 device limits under the condition V<sub>O</sub> (output voltage) > 1.6 V.

When I<sub>LIM</sub> is reached, the  $\overline{\text{FAULT}}$  pin is asserted.

### 4.3.2 Output short-circuit protection

The ST890 device provides short-circuit protection by limiting the output current during a short circuit event.

I<sub>SC</sub> is the output short-circuit current limit level (typ. 1.2 x I<sub>LIM</sub>). When a short circuit event occurs on the output, such as V<sub>O</sub> < 1.6 V, the ST890 device limits the output current to no more than the I<sub>SC</sub> level.

When a short circuit event occurs on the output, the  $\overline{\text{FAULT}}$  pin is asserted.

### 4.3.3 Programming $I_{LIM}$

The ST890's  $I_{LIM}$  can be programmed through the external resistor,  $R_{SET}$ , connected at the SET pin (pin 5).

$I_{LIM}$  is determined by the equations below.

#### Equation 1

$$I_{SET} = \frac{V_{SET}}{R_{SET}}$$

#### Equation 2

$$\frac{I_{LIM}}{I_{SET}} = 1110$$

Therefore:

#### Equation 3

$$R_{SET} = 1.24 \times \frac{1110}{I_{LIM}}$$

### 4.3.4 $\overline{\text{FAULT}}$ pin

The  $\overline{\text{FAULT}}$  pin (pin 8) is an open drain active-low output. This pin should be connected to an external pull-up resistor.

The  $\overline{\text{FAULT}}$  pin is asserted low when:

- $I_{OUT}$  reaches the programmed  $I_{LIM}$  value
- A short-circuit event occurs
- The device goes into thermal protection

### 4.3.5 Thermal protection

The thermal protection of the ST890 is triggered to turn off the switch when the junction temperature exceeds 130 °C (typ.).



## 4.4 Typical performance characteristics

Unless otherwise specified  $T_j = 25\text{ }^{\circ}\text{C}$ .

Figure 4: ON resistance vs. supply voltage (A)

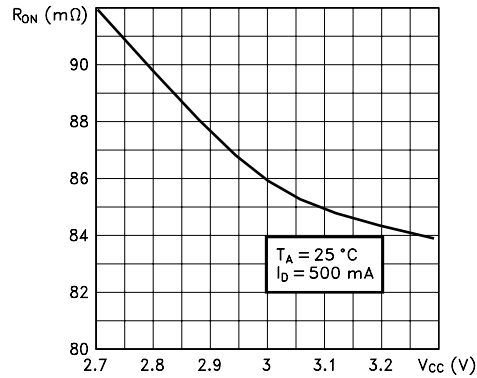


Figure 5: ON resistance vs. supply voltage (B)

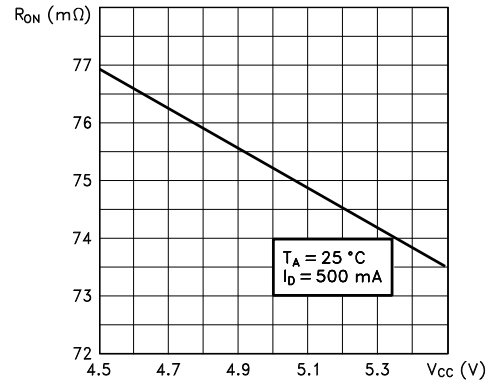


Figure 6: ON resistance vs. temperature (A)

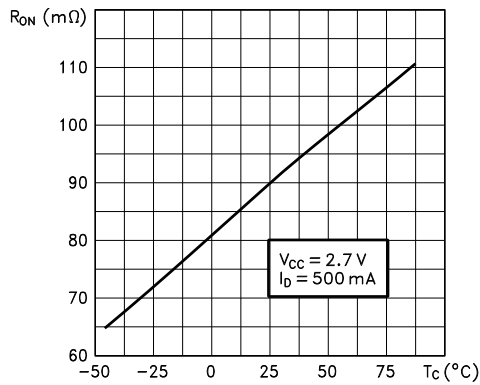


Figure 7: ON resistance vs. temperature (B)

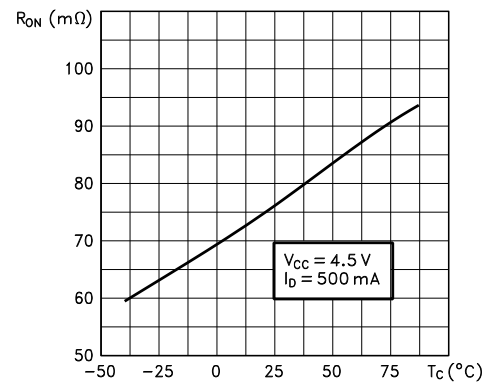


Figure 8: Switching waveforms (A)

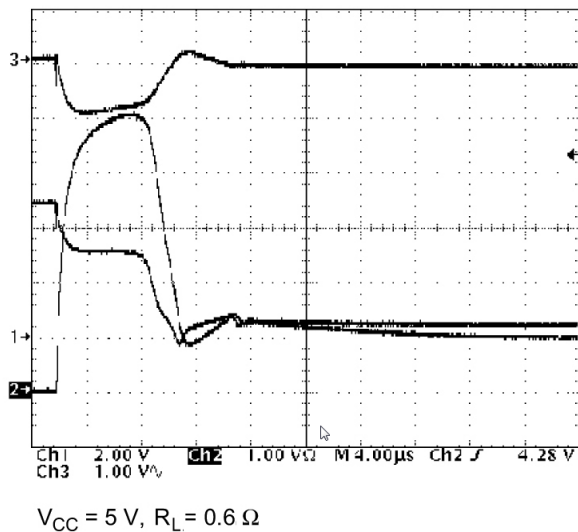
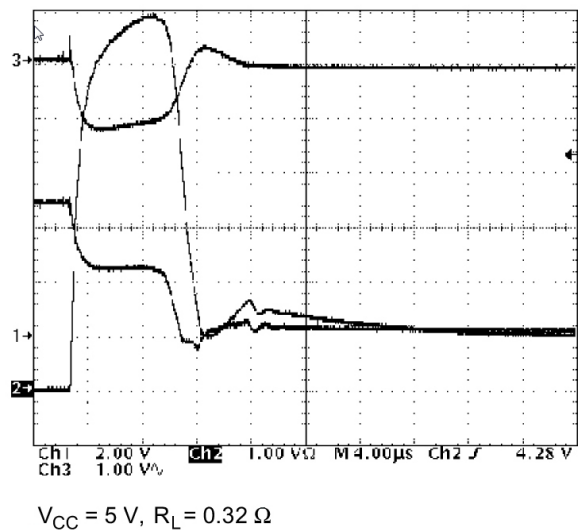


Figure 9: Switching waveforms (B)



## 5 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](http://www.st.com). ECOPACK® is an ST trademark.

## 5.1 SO8 package information

Figure 10: SO8 package outline

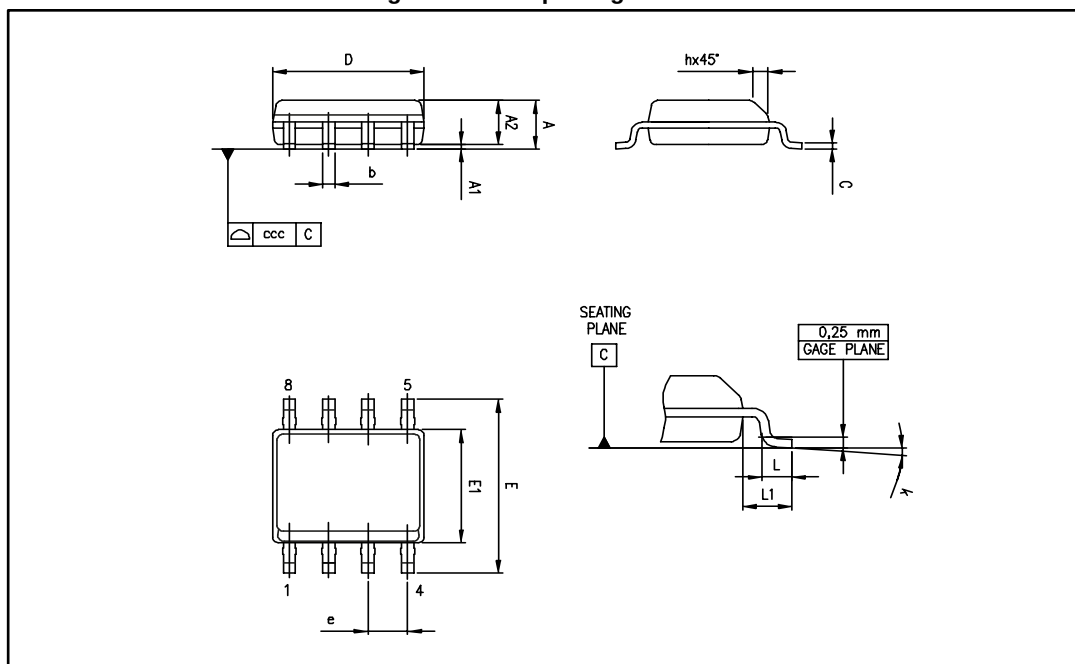
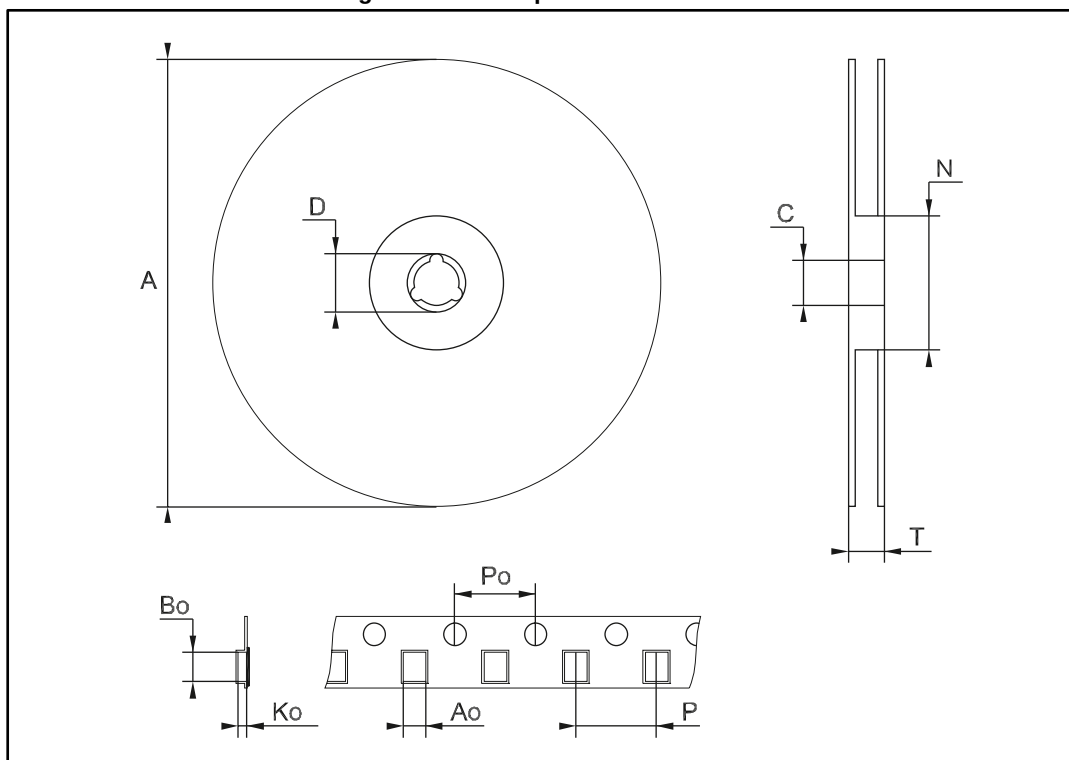


Table 9: SO8 mechanical data

| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.  | Max   |
| A    |             |      | 1.75 |        |       | 0.069 |
| A1   | 0.10        |      | 0.25 | 0.004  |       | 0.010 |
| A2   | 1.25        |      |      | 0.049  |       |       |
| b    | 0.28        |      | 0.48 | 0.011  |       | 0.019 |
| c    | 0.17        |      | 0.23 | 0.007  |       | 0.010 |
| D    | 4.80        | 4.90 | 5.00 | 0.189  | 0.193 | 0.197 |
| E    | 5.80        | 6.00 | 6.20 | 0.228  | 0.236 | 0.244 |
| E1   | 3.80        | 3.90 | 4.00 | 0.150  | 0.154 | 0.157 |
| e    |             | 1.27 |      |        | 0.050 |       |
| h    | 0.25        |      | 0.50 | 0.010  |       | 0.020 |
| L    | 0.40        |      | 1.27 | 0.016  |       | 0.050 |
| L1   |             | 1.04 |      |        | 0.040 |       |
| k    | 0°          |      | 8°   | 0°     |       | 8°    |
| ccc  |             |      | 0.10 |        |       | 0.004 |

## 5.2 SO8 tape and reel information

Figure 11: SO8 tape and reel outline



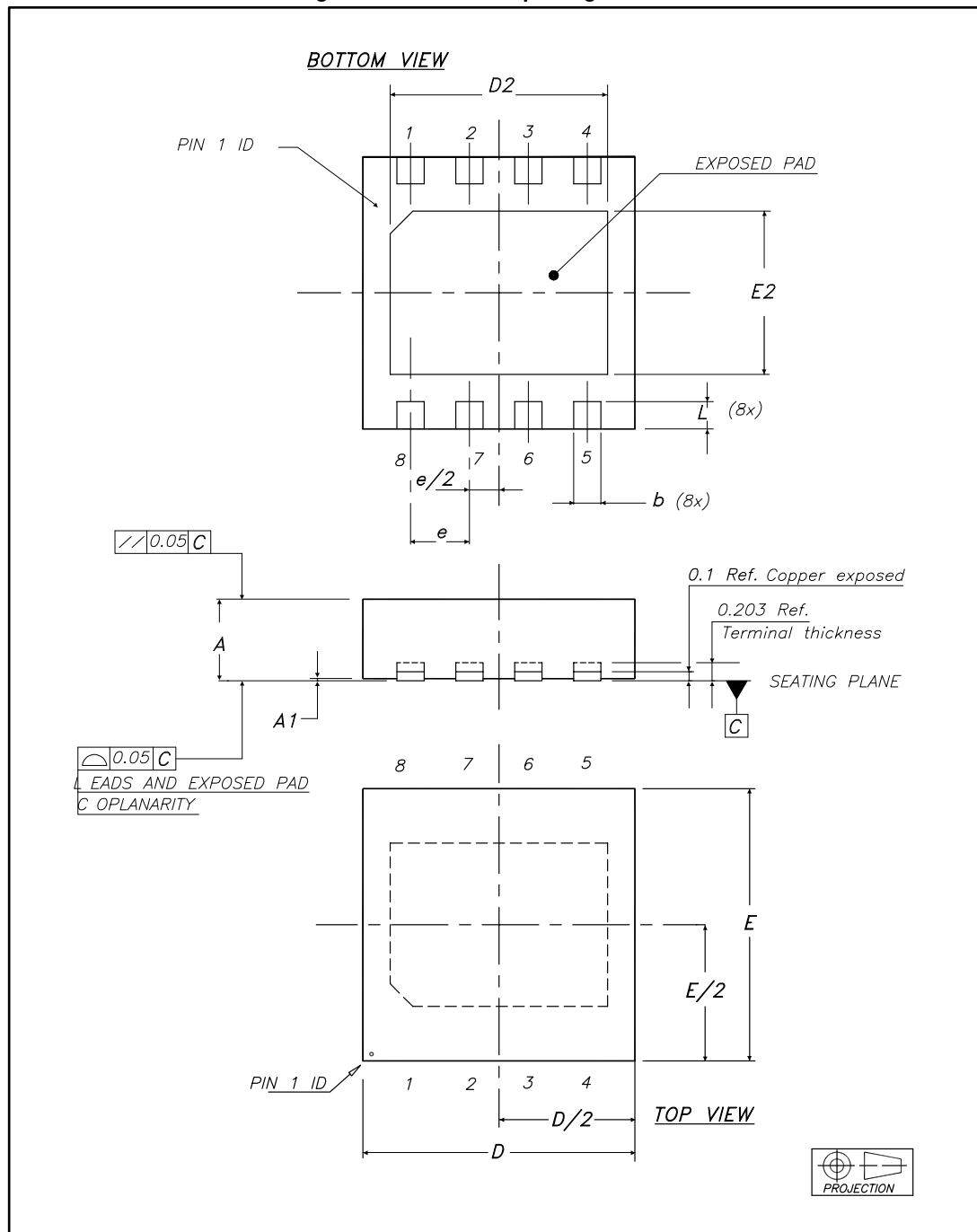
1. Drawing not to scale

Table 10: SO8 tape and reel mechanical data

| Symbol | Dimensions |      |      |        |      |        |
|--------|------------|------|------|--------|------|--------|
|        | mm         |      |      | Inches |      |        |
|        | Min.       | Typ. | Max. | Min.   | Typ. | Max.   |
| A      |            | —    | 330  |        | —    | 12.992 |
| C      | 12.8       |      | 13.2 | 0.504  |      | 0.519  |
| D      | 20.2       |      |      | 0.795  |      |        |
| N      | 60         |      |      | 2.362  |      |        |
| T      |            |      | 22.4 |        |      | 0.882  |
| Ao     | 8.1        |      | 8.5  | 0.319  |      | 0.335  |
| Bo     | 5.5        |      | 5.9  | 0.216  |      | 0.232  |
| Ko     | 2.1        |      | 2.3  | 0.082  |      | 0.090  |
| Po     | 3.9        |      | 4.1  | 0.153  |      | 0.161  |
| P      | 7.9        |      | 8.1  | 0.311  |      | 0.319  |

### 5.3 DFN8L 3x3 package information

Figure 12: DFN8L 3x3 package outline

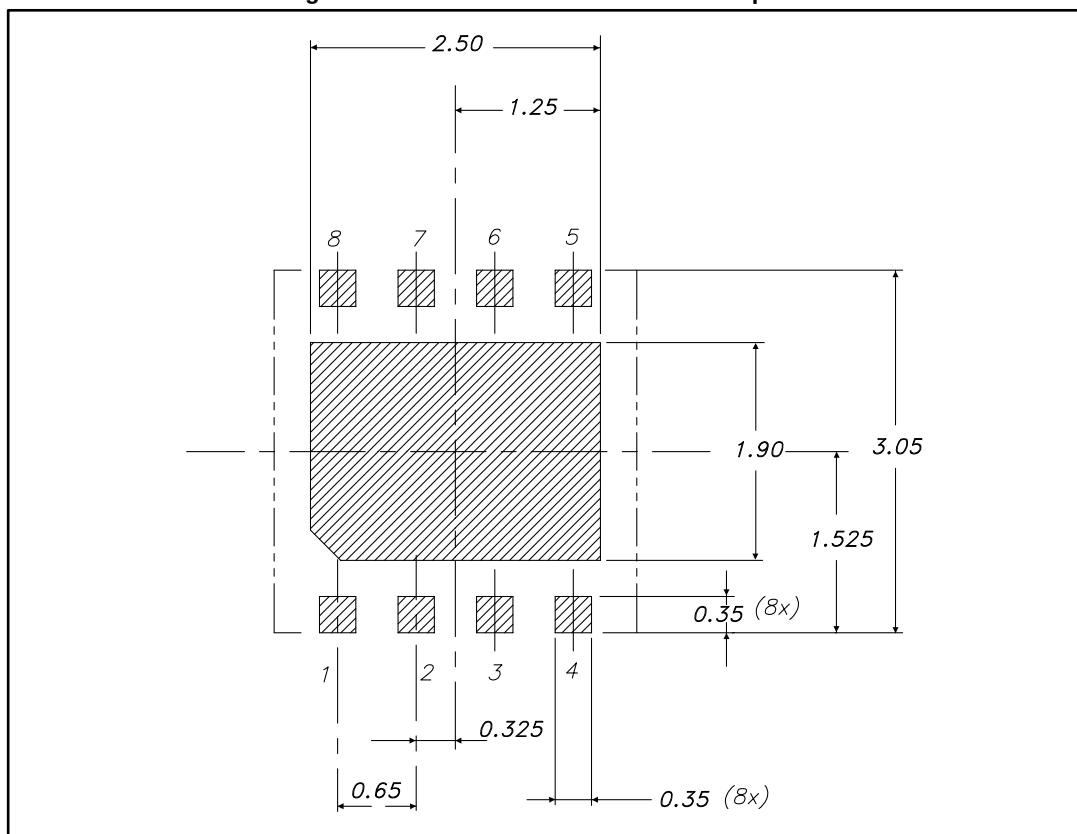


1. Drawing is not to scale
2. Dimensions in millimeters

Table 11: DFN8L 3x3 mechanical data

| Ref. | Dimensions  |       |      |        |       |       |
|------|-------------|-------|------|--------|-------|-------|
|      | Millimeters |       |      | Inches |       |       |
|      | Min.        | Typ.  | Max. | Min.   | Typ.  | Max   |
| A    | 0.80        | 0.85  | 0.90 | 0.031  | 0.033 | 0.035 |
| A1   | 0           | 0.02  | 0.05 | 0      | 0.001 | 0.002 |
| b    | 0.25        | 0.030 | 0.35 | 0.010  | 0.001 | 0.014 |
| D    | 2.95        | 3     | 3.05 | 0.116  | 0.118 | 0.120 |
| D2   | 2.30        | 2.40  | 2.50 | 0.091  | 0.094 | 0.098 |
| E    | 2.95        | 3     | 3.05 | 0.116  | 0.118 | 0.120 |
| E2   | 1.70        | 1.80  | 1.90 | 0.067  | 0.071 | 0.075 |
| e    |             | 0.65  |      |        | 0.026 |       |
| L    | 0.25        | 0.30  | 0.35 | 0.010  | 0.012 | 0.014 |

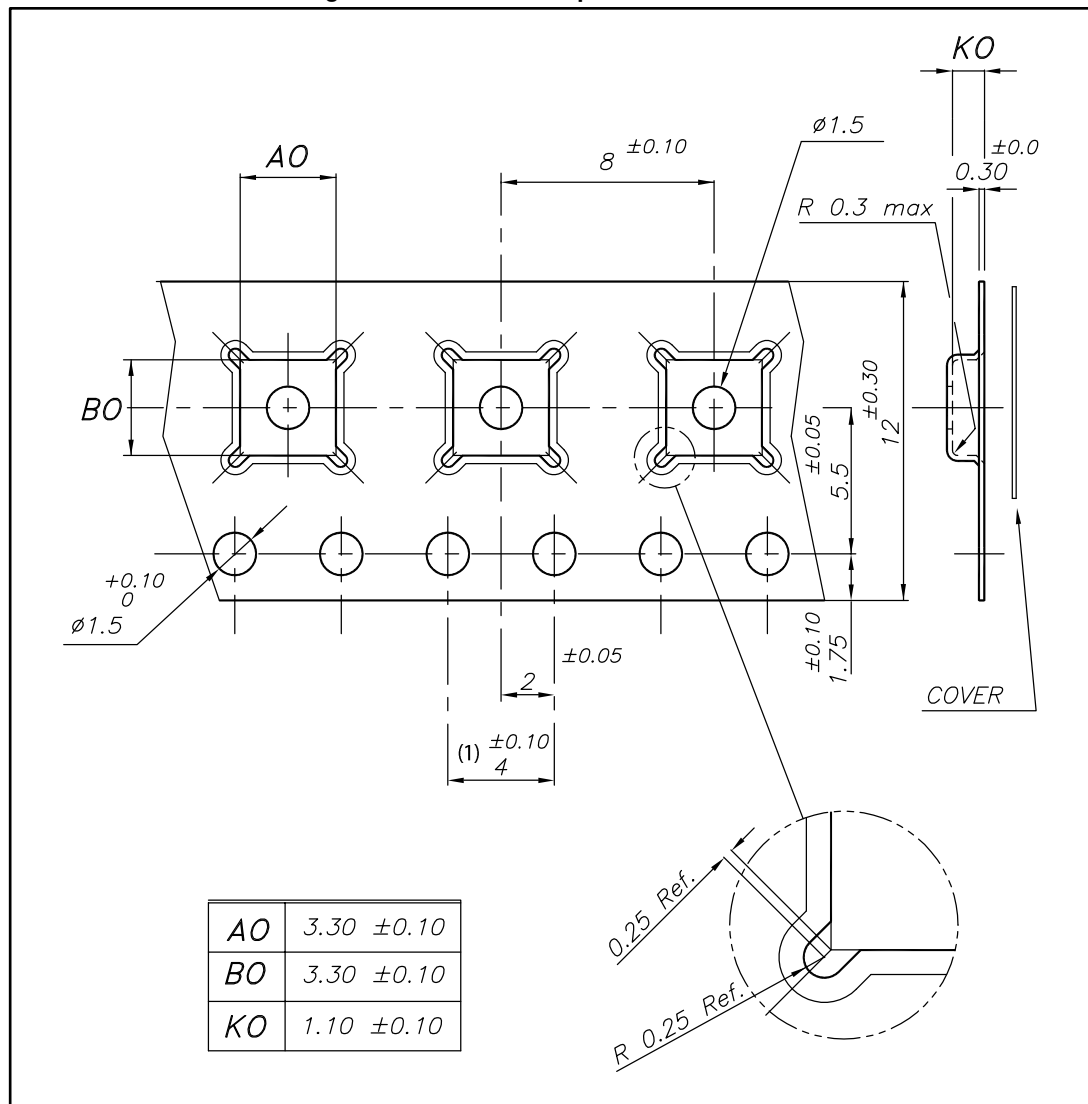
Figure 13: DFN8L 3x3 recommended footprint



1. Drawing not to scale
2. Dimensions in millimeters

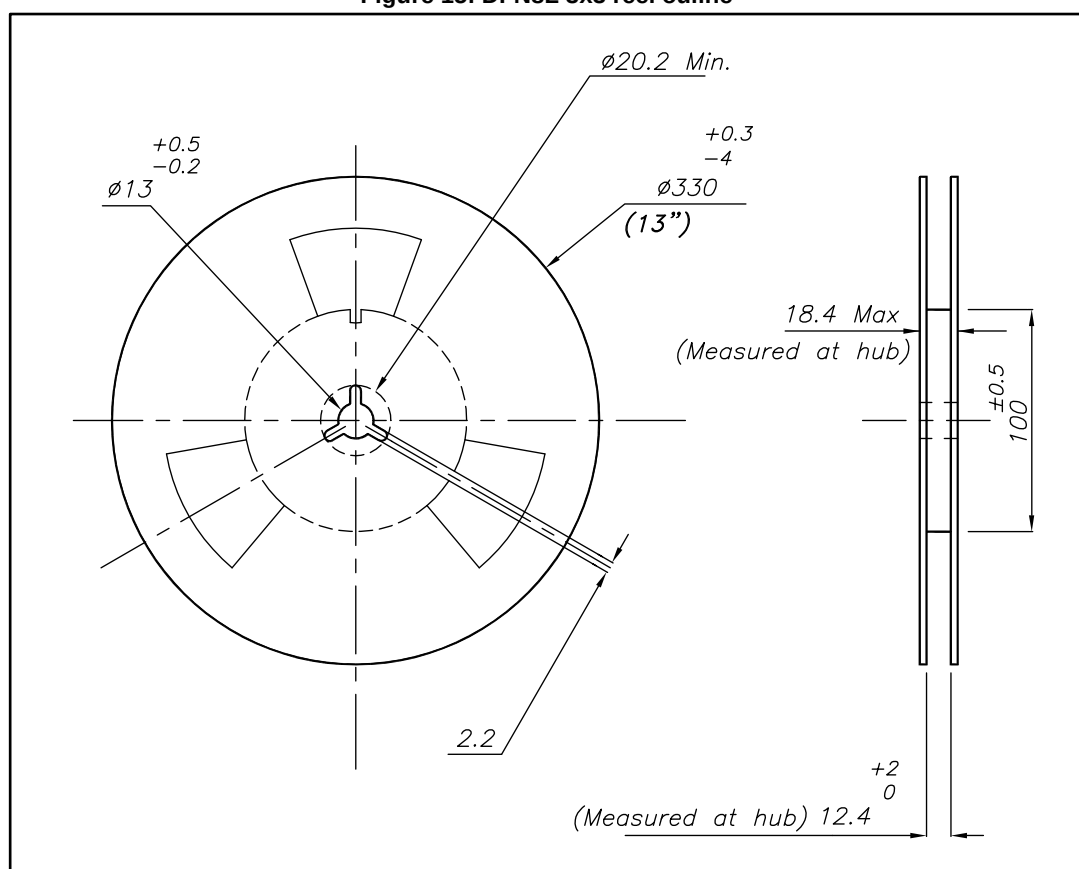
## 5.4 DFN8L 3x3 tape and reel information

Figure 14: DFN8L 3x3 tape and reel outline



1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.20$

Figure 15: DFN8L 3x3 reel outline





## 6 Ordering information

Table 12: Order codes

| Order code | Temperature range | Package   | Packaging     | Marking |
|------------|-------------------|-----------|---------------|---------|
| ST890CDR   | 0 to 70 °C        | SO8       | Tape and reel | ST890C  |
| ST890BDR   | -40 to 85 °C      |           |               | ST890B  |
| ST890DTR   |                   | DFN8L 3x3 |               | UD91    |

## 7 Revision history

**Table 13: Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22-Jul-2005 | 4        | Added 3 rows on Table 2 on page 3                                                                                                                                                                                                                                                                                                                                                                                                             |
| 10-Aug-2007 | 5        | Removed ST890CD and ST890BD from Table 1 on page 1<br>Updated short circuit current limit value in Table 8 on page 7                                                                                                                                                                                                                                                                                                                          |
| 1-Dec-2007  | 6        | Added Section : Contents.<br>Added ST890D and related DFN8L package information.<br>Added Figure 2: DFN8L (3 x 3 mm) pin connection (top view) on page 4.<br>Figure 3: Schematic diagram on page 5: redrawn, no content change.<br>Modified title in Table 5: Truth table for FAULT on page 5.<br>Updated Table 8: Electrical characteristics on page 7.<br>Figure 4: Typical application circuit on page 8: redrawn, no content change.      |
| 13-Oct-2008 | 7        | Updated: Table 2 on page 3, Table 3 on page 4.<br>Added: Section 2.1: Functional description on page 9 and Figure 12 on page 18.                                                                                                                                                                                                                                                                                                              |
| 04-Mar-2009 | 8        | Replaced ST890B, ST890C and ST890D with ST890.<br>Modified: Table 6: Absolute maximum ratings                                                                                                                                                                                                                                                                                                                                                 |
| 25-Jan-2013 | 9        | Updated Figure 1, Figure 3, Table 5, Section 2.1 (overlined " FAULT " and " ON " pin, minor corrections).<br>Updated Table 3 (added "Exposed pad").<br>Added cross-references to Section 2.<br>Updated note 2. below Table 7.<br>Updated Table 8 (parameter of I <sub>OH</sub> symbol corrected to " FAULT output leakage current").<br>Updated ECOPACK in Section 3.<br>Minor corrections throughout document.                               |
| 12-Dec-2016 | 10       | Updated datasheet layout<br><a href="#">Table 4: "Absolute maximum ratings"</a> : removed reference to the "SURE" program, updated name of parameter V <sub>I</sub> , and removed parameter T <sub>op</sub> .<br>Added <a href="#">Table 6: "Operating conditions"</a><br>Updated SO8 package information<br><a href="#">Table 11: "DFN8L 3x3 mechanical data"</a> : added inches dimensions<br>Added <a href="#">Table 12: "Order codes"</a> |

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