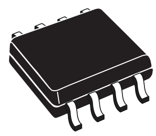
ST890

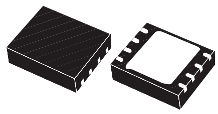
1.2 A current limited high side power switch with thermal shutdown

Features

- 2.7 V to 5.5 V input range
- Programmable current limit up to 1.2 A
- Low quiescent current
- Thermal shutdown
- Active low $\overline{\text{FAULT}}$ indicator output
- 90 mΩ (typ.) ON resistance
- SO-8 and DFN8L (3 x 3 mm) packages



SO-8



DFN8L
(3 x 3 mm)

Applications

- PCMCIA slots
- Access bus slots
- Portable equipment

Description

The ST890 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 SO-8 and DFN8L (3 x 3 mm) packages.

Table 1. Device summary

Order code	Package	Packaging
ST890BDR	SO-8	2500 parts per reel
ST890CDR	SO-8	2500 parts per reel
ST890DTR	DFN8L (3 x 3 mm)	3000 parts per reel

Contents

1 Device summary

Figure 1. SO-8 pin connection (top view)

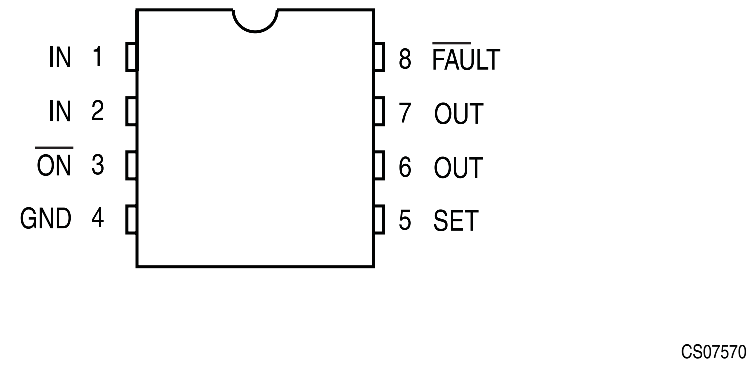


Table 2. SO-8 pin description

Pin N.	Symbol	Name and function
1, 2	IN	Input P-channel MOSFET source. Bypass IN with a 1 µF 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. $R_{SET} = 1.24x1110/ I_{LIM}$, where I_{LIM} is the desired current limit in Amperes
6,7	OUT	Switch output. P-channel MOSFET drain. Bypass OUT with a 0.1 µF 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°C

Figure 2. DFN8L (3 x 3 mm) pin connection (top view)

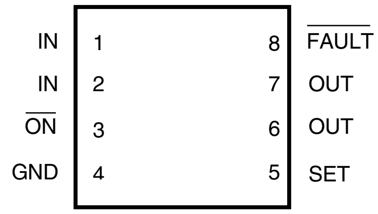


Table 3. DFN8L (3 x 3 mm) pin description

Pin N.	Symbol	Name and function
1, 2	IN	Input P-channel MOSFET source. Bypass IN with a 1 µF 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 µF capacitor to ground. $R_{SET} = 1.24x1110/I_{LIM}$, where I_{LIM} is the desired current limit in Amperes
8	$\overline{\text{FAULT}}$	Fault indicator output. This open drain output goes low when in current limit or when the die temperature exceeds 135 °C

Figure 3. Schematic diagram

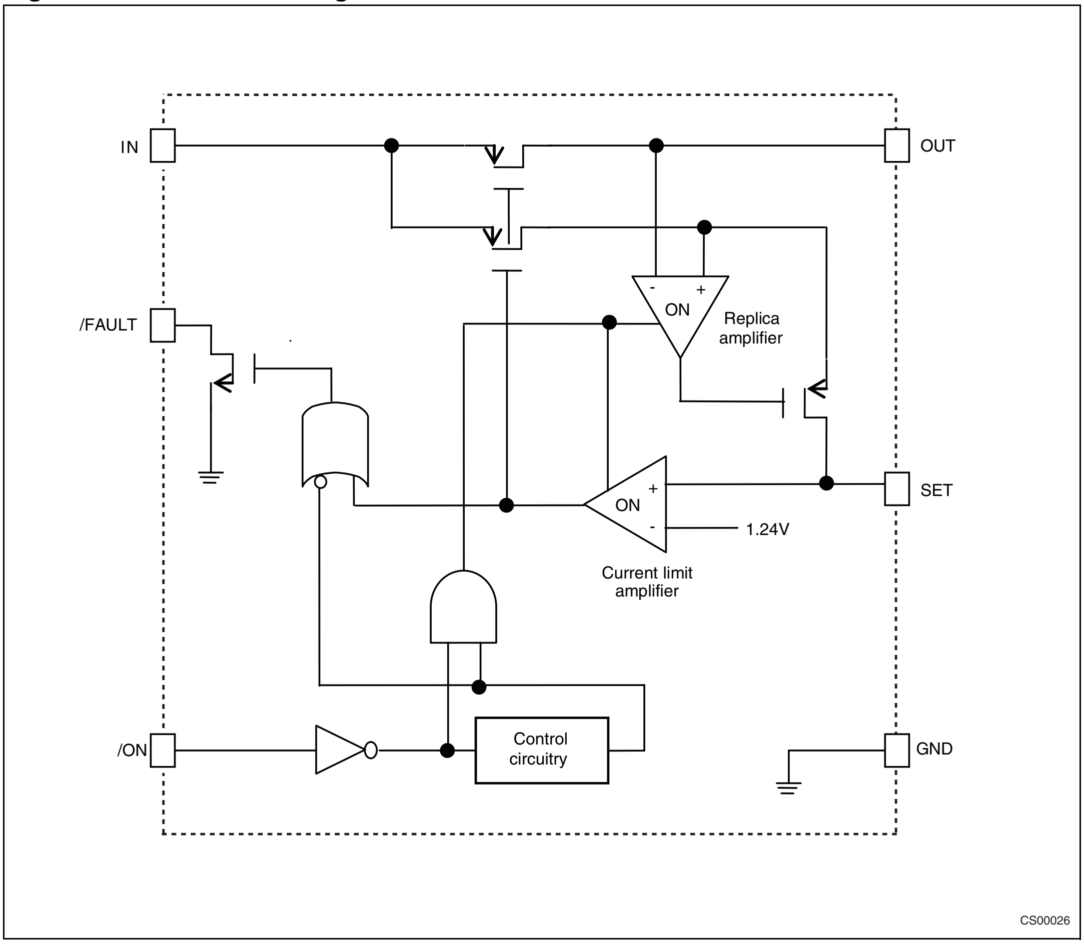


Table 4. Truth table for $\overline{ON}$/OFF switch

$\overline{ON}$/OFF	OUT
L	ON
H	OFF

Table 5. Truth table for $\overline{FAULT}$

FAULT	FLAG
H	Normal operation
L	Fault condition

2 Maximum rating

Stressing the device above the rating listed in the “Absolute maximum ratings” table 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. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 6. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_I	Supply voltage	-0.5 to +6	V
V_{ON}	Input voltage at ON pin	-0.5 to +6	V
V_{FAULT_N}	Input voltage at FAULT_N pin	-0.5 to +6	V
V_{SET}	Voltage at SET pin	-0.5 to (V_{IN} +0.5)	V
I_{DS}	Maximum continuous switching current	1.5	A
T_{stg}	Storage temperature	-65 to +150	°C
T_{op}	Operating ambient temperature range	-40 to +85	°C

Table 7. Thermal data

Symbol	Parameter	SO-8	DFN8L	Unit
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	160(1)	37.6(2)	°C/W

1. This value depends from thermal design of PCB on which the device is mounted.
2. This value depends from the 4-layer PCB, JEDEC standard test board.

Table 8. Electrical characteristics

Symbol	Parameter	Test condition(1)	Value			Unit
			T_A = 25°C			
			Min	Typ	Max	
V_I	Operating voltage	I_D = 1 mA	2.7		5.5	V
I_{CC}	ON quiescent supply current	V_I = 5 V, $\overline{ON}$ = GND IO = 0		13	25	µA
$I_{(CCOFF)}$	OFF quiescent supply current	$\overline{ON}$ = IN $V_I = V_{OUT}$ = 5.5 V			1	µA
		$\overline{ON}$ = IN V_I = 5.5 V V_O = 0			5	

Table 8. Electrical characteristics (continued)

Symbol	Parameter	Test condition(1)	Value $T_A = 25°C$ Min	Typ	Max	Unit
V_{ULO}	Undervoltage lockout	Rising edge	2.0	2.4	2.6	V
V_{HYST}	Undervoltage lockout hysteresis			100		mV
R_{ON}	ON resistance	$V_I = 4.5$ V		75	120	mΩ
		$V_I = 3$ V		90	130	mΩ
V_{SET}	Reference voltage to turn the switch OFF	$I_O = 100$ mA V_{SET} rise until $V_I - V_O >$ 0.8V	1.178	1.24	1.302	V
I_{MAX}	Maximum programmable output over current limit			1.2		A
I_{SC}	Short circuit current limit	VI = 5V, OUT connected to GND, device enabled into short circuit		1.2 I_{LIM}	1.5 I_{LIM}	A
I_{LIM}/I_{SET}	I_{LIM} to I_{SET} current ratio	$I_O = 500$ mA $V_O > 1.6$ V	970	1110	1300	
V_{IL}	ON input low level voltage	$V_I = 2.7$ to 5.5 V			0.8	V
V_{IH}	ON input high level voltage	$V_I = 2.7$ to 3.6 V	2.0			V
		$V_I = 2.7$ to 5.5 V	2.4			V
I_I	ON input leakage current	$V_I = 5.5$ V			1	µA
I_{SET} bias	I_{SET} bias current	$V_{SET} = 1.24$ V $I_O = 0_A$ $V_I = V_O$		0.5	3	µA
V_{OL}	$\overline{\text{FAULT}}$ output low voltage	$I_{SINK} = 1$ mA $V_{SET} = 1.4$ V		0.15		V
I_{OH}	$\overline{\text{FAULT}}$ output high voltage	$V_{FAULT} = 5.5$ V $V_{SET} = 1$ V			1	µA
T_{PROT}	Thermal protection			130		°C
T_{HYST}	Thermal hysteresis			15		°C

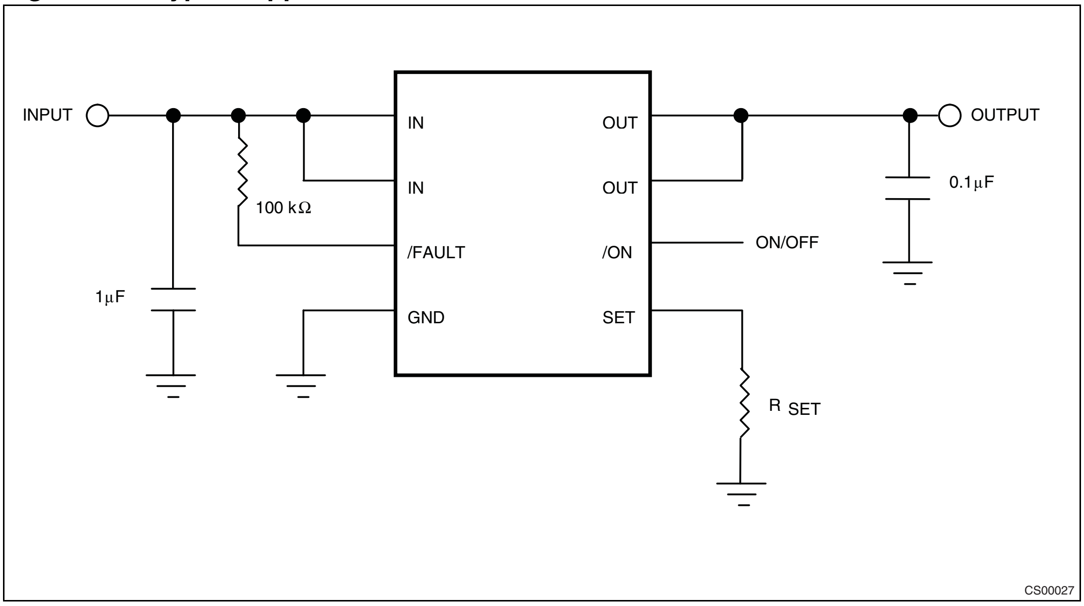
1. $V_{IN} = 3$ V, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise specified. Typical values are at $T_A = 25°C$

Table 9. Timing characteristics

Symbol	Parameter	Test condition(1)	Value			Unit
			T_A = 25°C			
			Min	Typ	Max	
t_{RESP}	Slow current loop response time	20% current overdrive, V_{CC} = 5 V		5		µs
	Fast current loop response time			2		µs
t_{ON}	Turn ON time	V_I = 5 V IO = 500 mA		25	50	µs
		V_I = 3 V IO = 500 mA		50		µs
t_{OFF}	Turn OFF time	V_I = 5 V	1	2	10	µs

1. V_{IN} = 3 V, T_A = T_{MIN} to T_{MAX}, unless otherwise specified. Typical values are at T_A = 25 °C

Figure 4. Typical application circuit



2.1 Functional description

2.1.1 Output current limit

I_{LIM} is the output current that ST890 limits under the condition V_O (output voltage) > 1.6 V.

When I_{LIM} is reached, the Fault pin is asserted.

2.1.2 Output short circuit protection

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

I_{sc} is the output short circuit current limit level (typ 1.2 x I_{LIM}). When the output is short circuit such as V_O < 1.6 V, the ST890 limits the output current to no more than the I_{sc} level.

When the output is short circuit, the Fault pin is asserted.

2.1.3 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 following relationships:

Equation 1

$$I_{SET} = V_{SET} / R_{SET}$$

Equation 2

$$I_{LIM} / I_{SET} = 1110$$

therefore:

Equation 3

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

2.1.4 Fault pin

The Fault pin (pin 8) is an open drain active low output. This pin should be connected to an external pull-up resistor.

The 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

2.1.5 Thermal protection

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

2.2 Typical performance characteristics

Unless otherwise specified Tj = 25 °C.

Figure 5. ON resistance vs. supply voltage

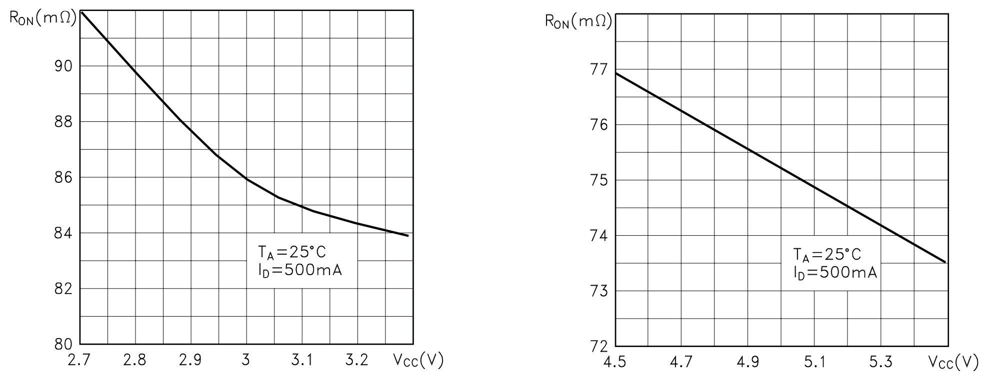


Figure 6. ON resistance vs. temperature

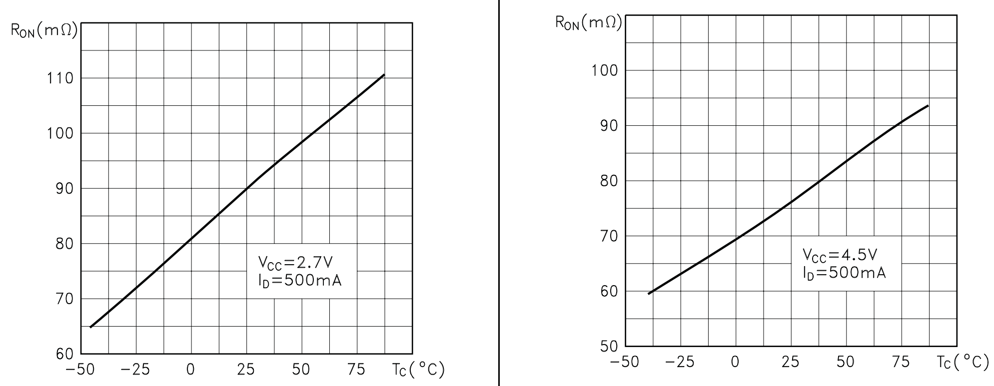
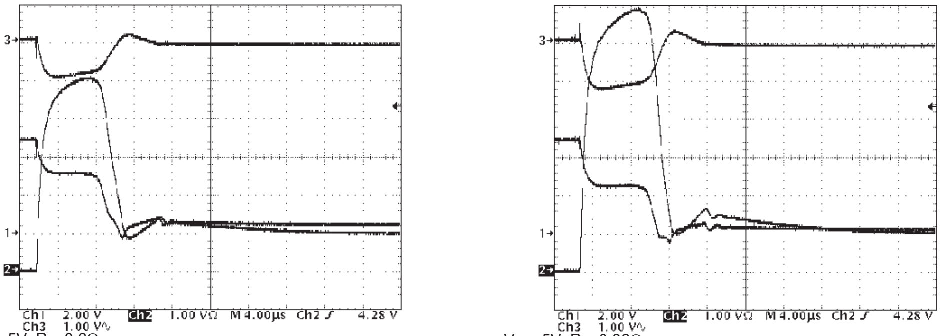


Figure 7. Switching waveforms



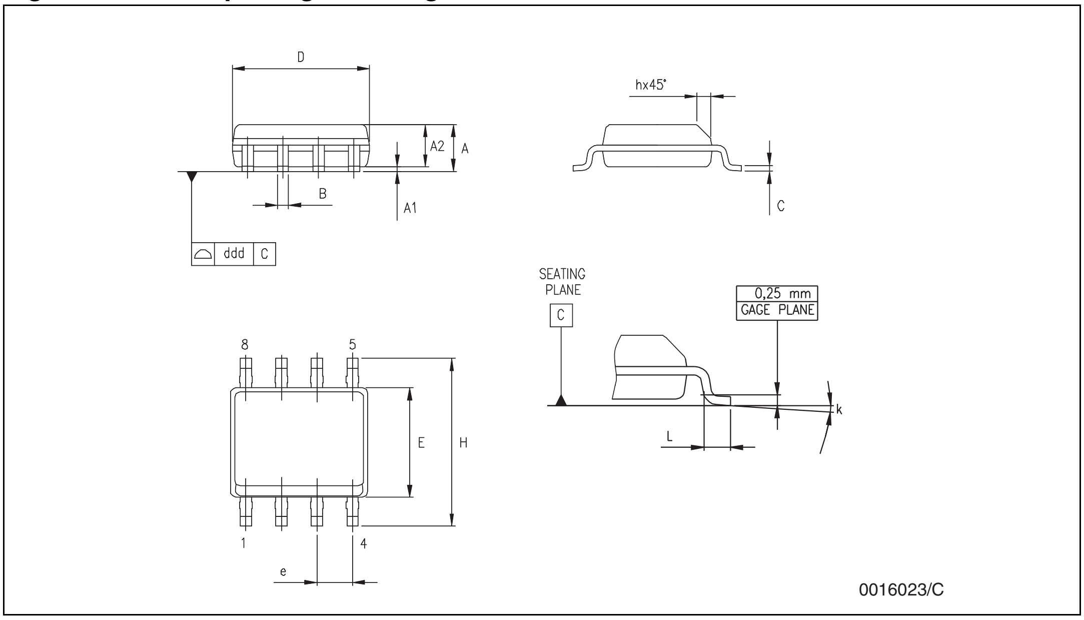
V_{CC}=5V, R_L=0.6Ω

V_{CC}=5V, R_L=0.32Ω

3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 8. SO-8 package drawing

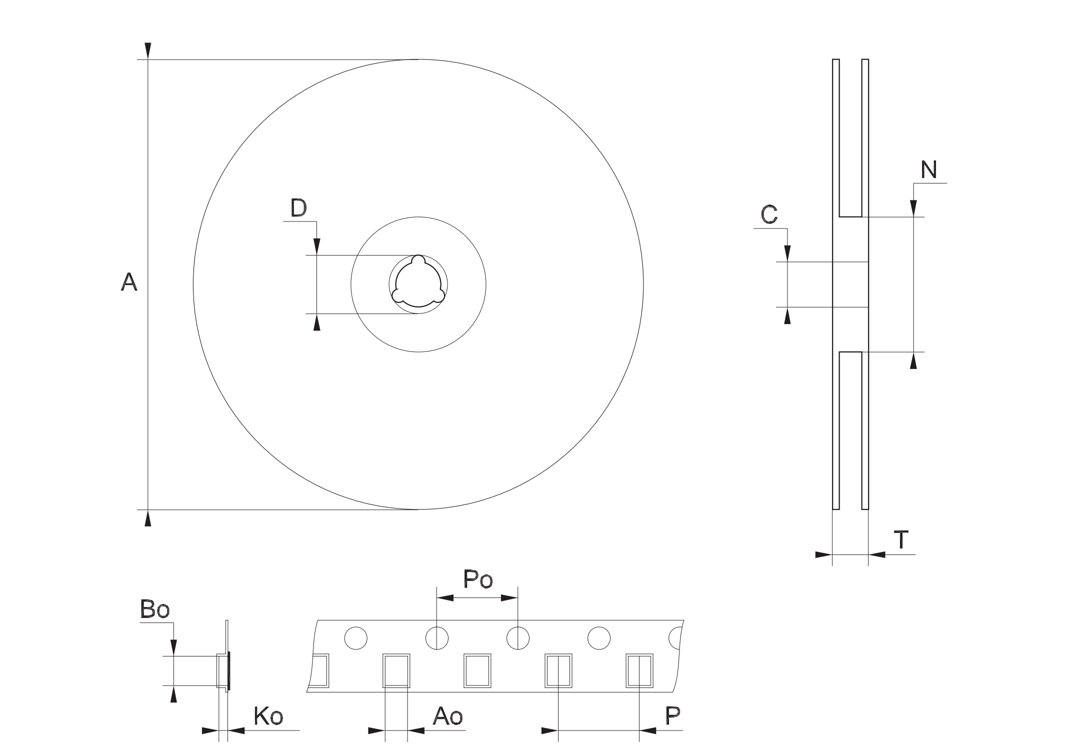


1. Drawing not to scale.

Table 10. SO-8 package mechanical data

Symbol	millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8°(max)					
ddd			0.1			0.04

Figure 9. SO-8 tape and reel specifications

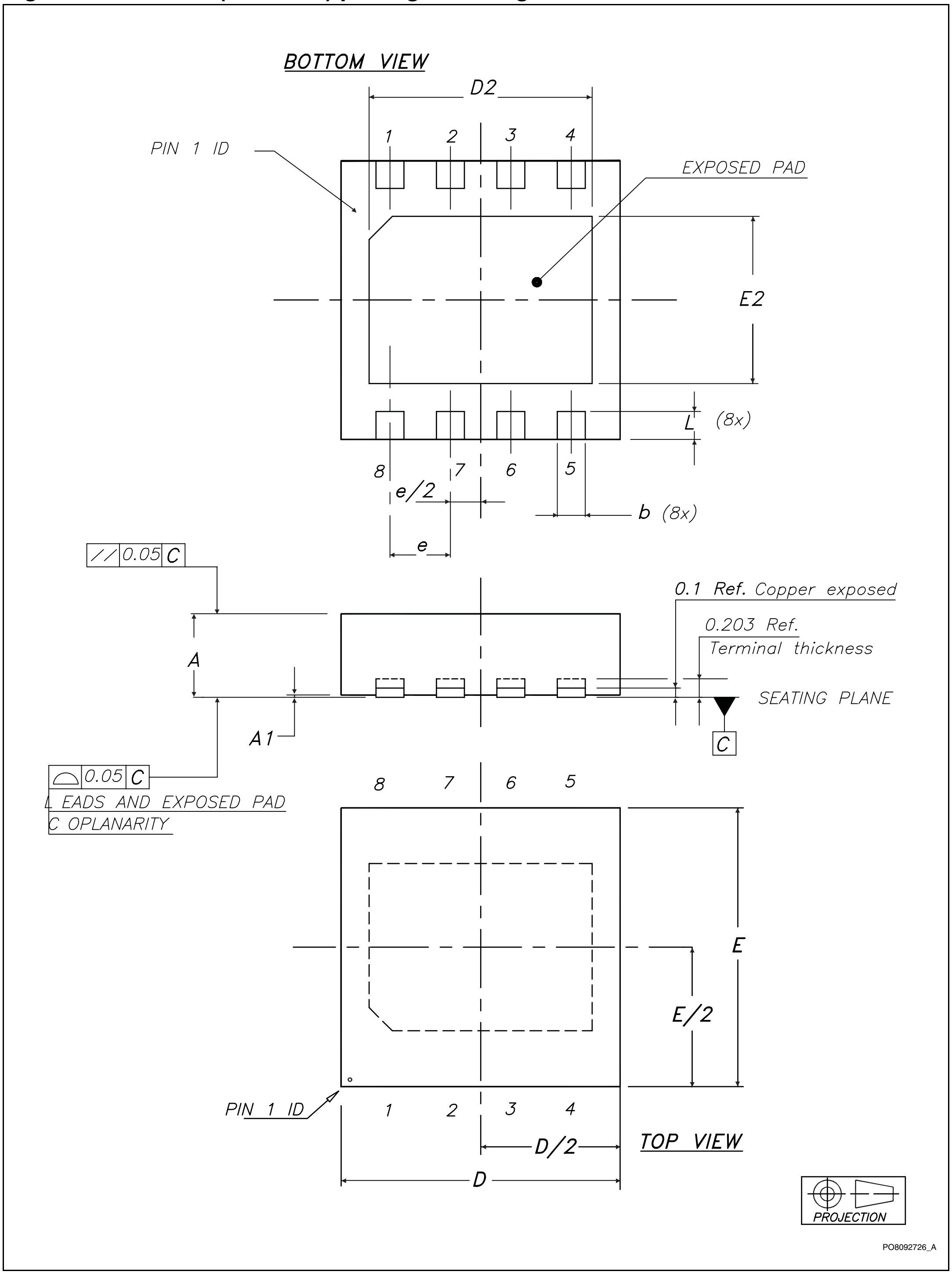


1. Drawing not to scale.

Table 11. SO-8 tape and reel mechanical data

Symbol	millimeters			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

Figure 10. DFN8L (3 x 3 mm) package drawing

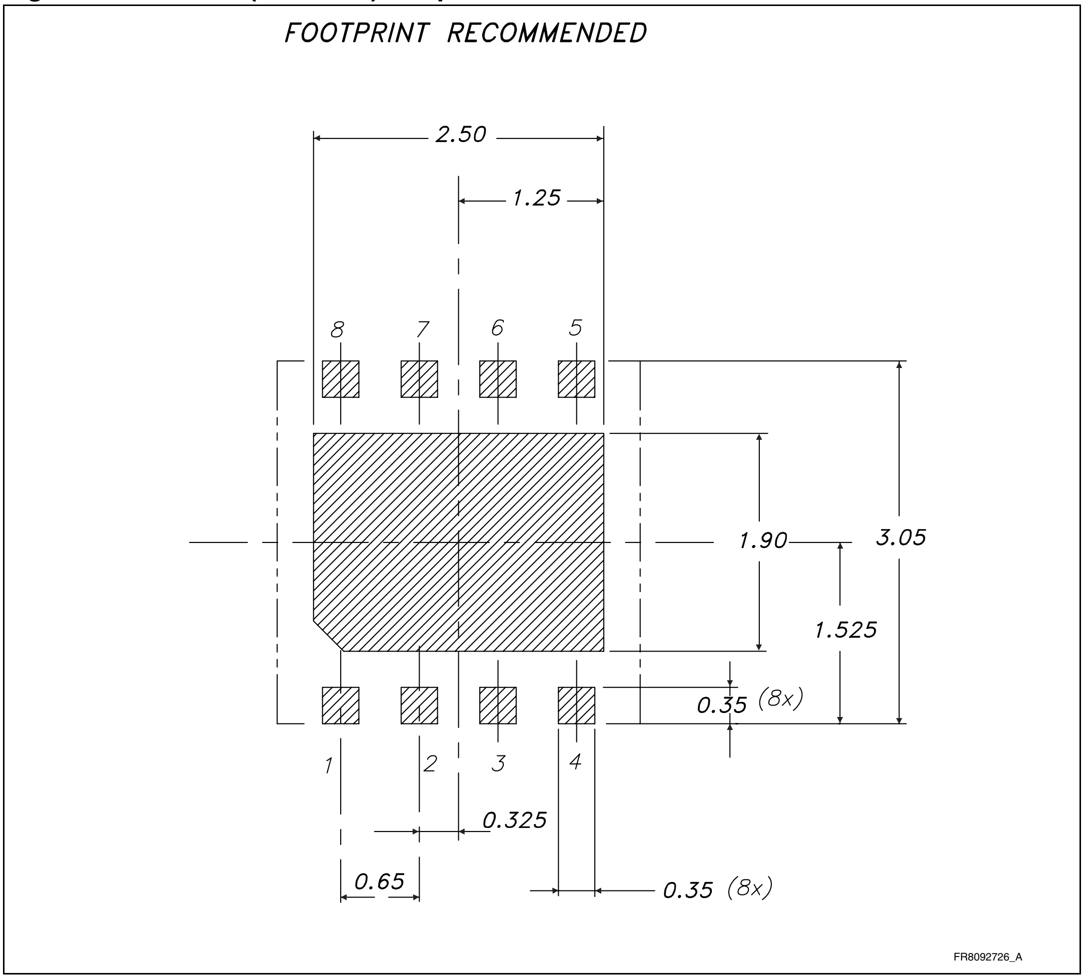


1. Drawing is not to scale.
2. Dimensions in millimeters.

Table 12. DFN8L (3 x 3 mm) package mechanical data

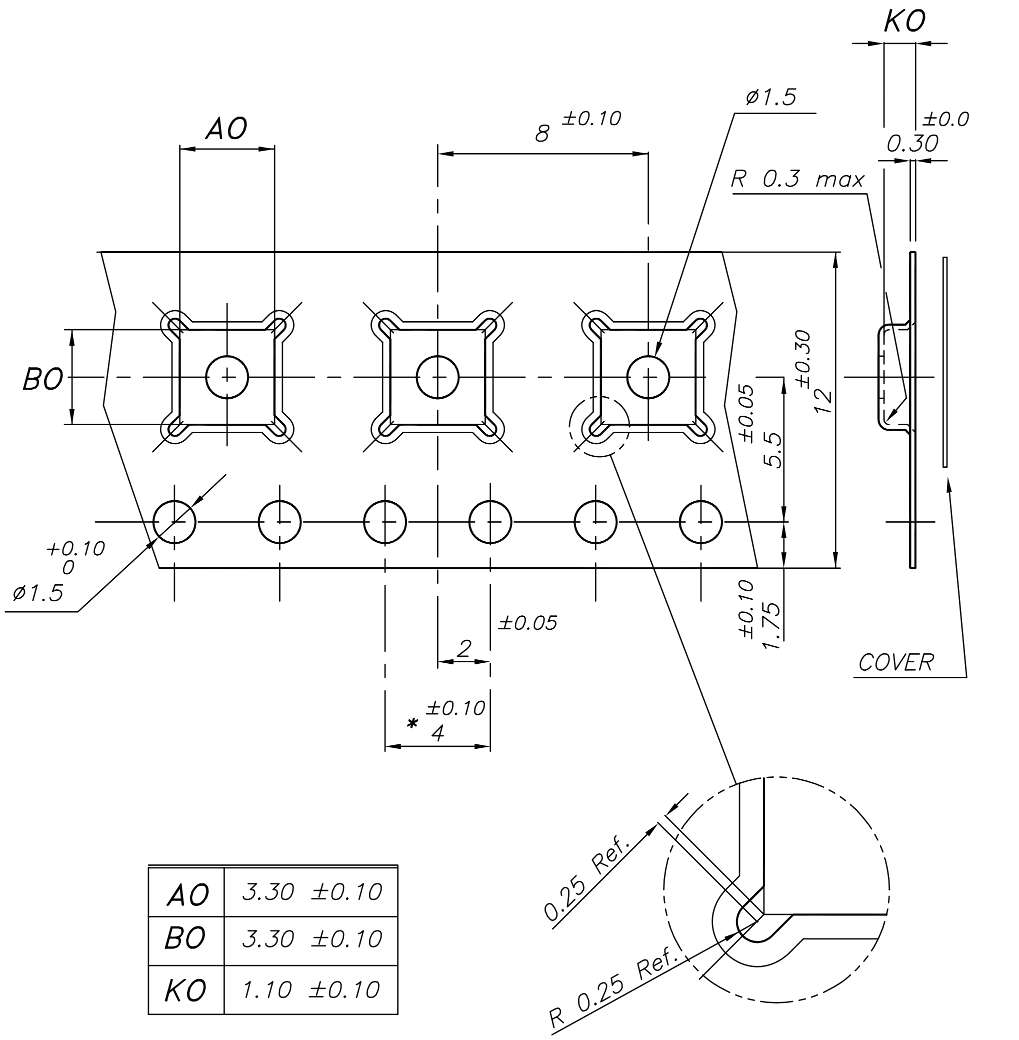
Symbol	millimeters		
	Min	Typ	Max
A	0.80	0.85	0.90
A1	0	0.02	0.05
b	0.25	0.030	0.35
D	2.95	3	3.05
D2	2.30	2.40	2.50
E	2.95	3	3.05
E2	1.70	1.80	1.90
e		0.65	
L	0.25	0.30	0.35

Figure 11. DFN8L (3 x 3 mm) footprint recommendations



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

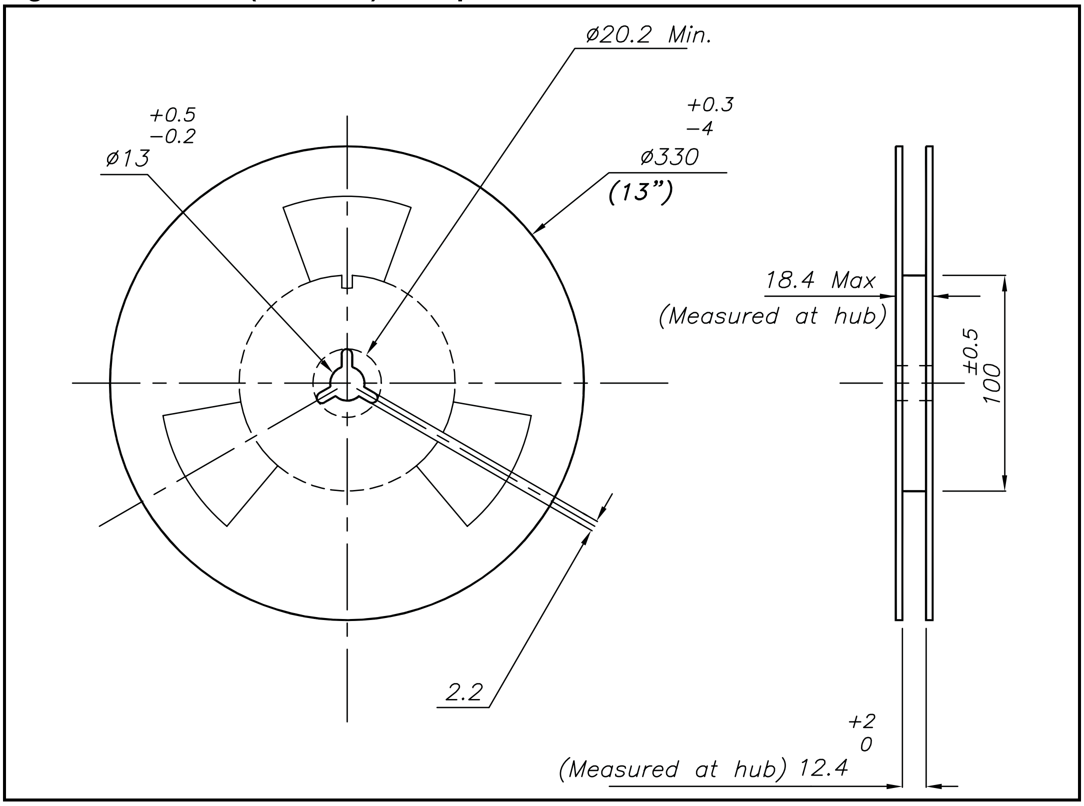
Figure 12. DFN8L (3 x 3 mm) tape and reel specifications



AO	3.30 ±0.10
BO	3.30 ±0.10
KO	1.10 ±0.10

– * 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.20

Figure 13. DFN8L (3 x 3 mm) reel specifications



4 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* Updated short circuit current limit value in *Table 8 on page 6*
1-Dec-2007	6	Added *Section : Contents*. Added ST890D and related DFN8L package information. Added *Figure 2: DFN8L (3 x 3 mm) pin connection (top view) on page 4*. *Figure 3: Schematic diagram on page 5*: redrawn, no content change. Modified title in *Table 5: Truth table for FAULT on page 5*. Updated *Table 8: Electrical characteristics on page 6*. *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*. Added: *Section 2.1: Functional description on page 9* and *Figure 12 on page 17*.
04-Mar-2009	8	Replaced ST890B, ST890C and ST890D with ST890. Modified: *Table 6: Absolute maximum ratings*

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