

## Low voltage 0.3Ω max dual SPDT switch with break-before-make feature and 15KV ESD protection

### Features

- Wide operating voltage range:  
 $V_{CC} \text{ (Opr)} = 1.65 \text{ V to } 4.8 \text{ V}$
- Low power dissipation:  
 $I_{CC} = 0.2 \mu\text{A (max) at } T_A = 85^\circ\text{C}$
- Low ON resistance  $V_{IN} = 0\text{V}$ :
  - $R_{ON} = 0.4 \Omega \text{ (max } T_A = 25^\circ\text{C) at } V_{CC} = 2.25 \text{ V}$
  - $R_{ON} = 0.35 \Omega \text{ (max } T_A = 25^\circ\text{C) at } V_{CC} = 3.0 \text{ V}$
  - $R_{ON} = 0.30 \Omega \text{ (max } T_A = 25^\circ\text{C) at } V_{CC} = 4.3 \text{ V}$
- Separate supply voltage for switch and control pin
- Separate control pin for each switch
- Latch-up performance exceeds 100 mA per JESD 78, class II
- ESD performance tested on common channels (D1 and D2 pins)
  - 9 kV IEC-61000-4-2 ESD, contact discharge
  - 15 kV IEC-61000-4-2 ESD, air gap discharge
- ESD performance tested on all other pins
  - 8 kV IEC-61000-4-2 ESD, contact discharge
  - 500 V machine model (JESD22 A115-A)
  - 1500 V charged-device model (JESD22 C101)
  - 8 kV IEC-61000-4-2 ESD, air gap discharge



### Description

The STG4259 is a high-speed CMOS low voltage dual analog SPDT (single pole dual throw) switch or 2:1 multiplexer/ demultiplexer switch fabricated in silicon gate C<sup>2</sup>MOS technology. It is designed to operate from 1.65 V to 4.8 V, making this device ideal for portable applications. It offers low ON resistance (0.30 Ω) at  $V_{CC} = 4.3 \text{ V}$ . The SEL inputs are provided to control the switches.

The switch S1 is ON (connected to common port D) when the SEL input is held high and OFF (high impedance state exists between the two ports) when SEL is held low; the switch S2 is ON (it is connected to common port D) when the SEL input is held low and OFF (high impedance state exist between the two ports) when SEL is held high.

Additional key features are fast switching speed, break-before-make delay time and ultra low power consumption. All inputs and outputs are equipped with protection circuits against static discharge, giving them ESD immunity and transient excess voltage.

**Table 1. Device summary**

Order code	Package	Packing
STG4259BJR	Flip-Chip11	Tape and Reel

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# 1 Logic diagram and pin-out information

Figure 1. Functional diagram

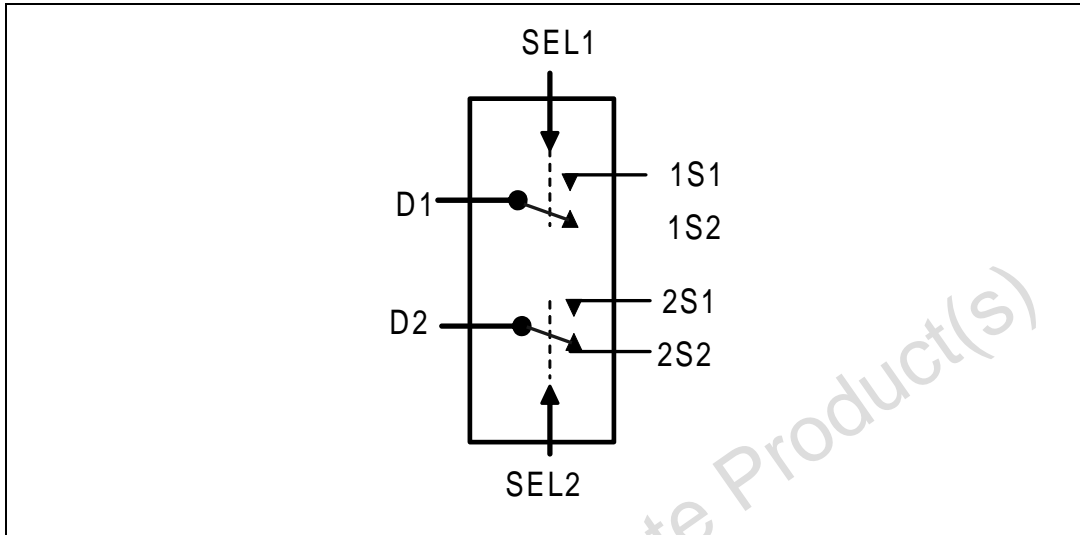


Figure 2. Input equivalent circuit

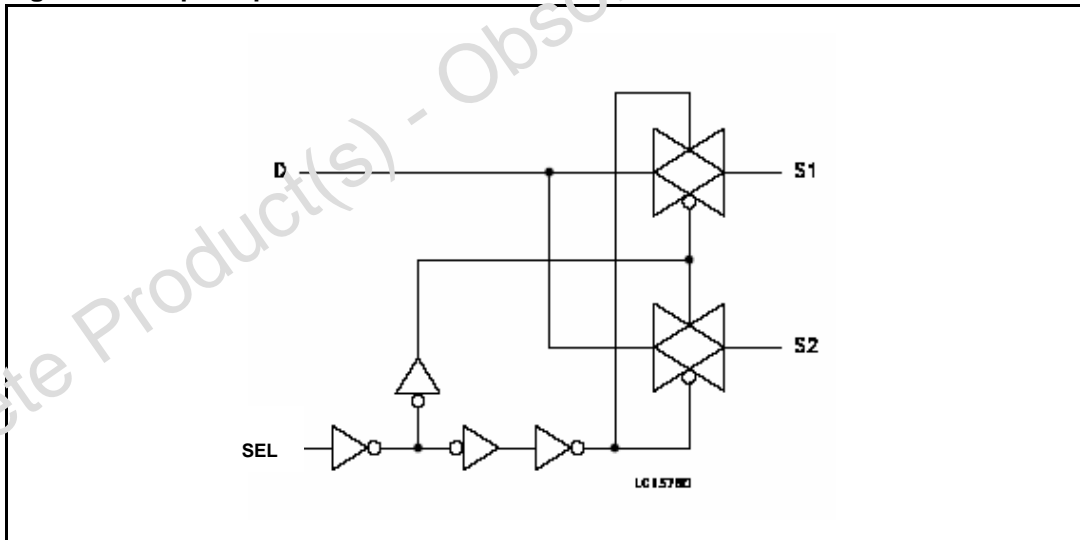
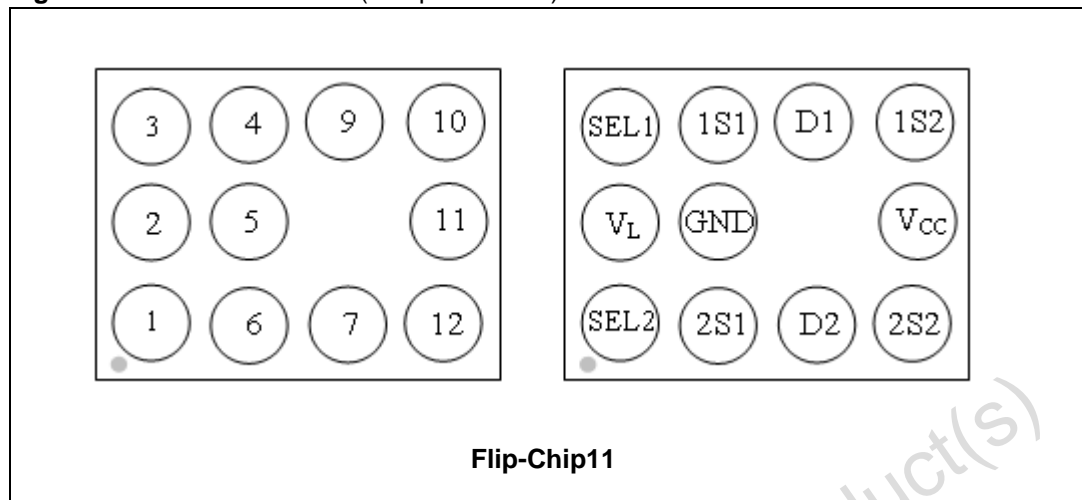


Table 2. Truth table

SELn	Switch nS1	Switch nS2
H	ON	OFF <sup>(1)</sup>
L	OFF <sup>(1)</sup>	ON

1. High impedance

**Figure 3. Pin connection (bump side view)**



**Table 3. Pin description**

Flip-Chip11	Symbol	Name and function
4, 10, 6, 12	1S1, 1S2, 2S1, 2S2	Independent channels
9, 7	D1, D2	Common channels
3, 1	SEL1, SEL2	Control
11	V <sub>CC</sub>	Positive supply voltage
2	V <sub>L</sub>	Logic supply voltage
5	GND	Ground (0V)

## 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 4. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	-0.5 to 5.5	V
$V_L$	Logic supply voltage	-0.5 to 5.5	V
$V_I$	DC input voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{IC}$	DC control input voltage	-0.5 to $V_L + 0.5$	V
$V_O$	DC output voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{IKC}$	DC input diode current on control pin ( $V_{SEL} < 0V$ )	- 50	mA
$I_{IK}$	DC input diode current ( $V_{SEL} < 0V$ )	± 50	mA
$I_{OK}$	DC output diode current	± 20	mA
$I_O$	DC output current	± 300	mA
$I_{OP}$	DC output current peak (pulse at 1ms, 10% duty cycle)	± 500	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or ground current	± 100	mA
$P_D$	Power dissipation at $T_A = 70^\circ C$ <sup>(1)</sup>	500	mW
$T_{stg}$	Storage temperature	-50 to 105	°C
$T_L$	Lead temperature (10 sec)	260	°C

1. Derate above 70°C by 18.5mW/C

**Table 5. Recommended operating conditions**

Symbol	Parameter		Value	Unit
$V_{CC}$	Supply voltage <sup>(1)</sup>		1.65 to 4.8	V
$V_L$	Logic supply voltage		1.65 to $V_{CC}$	V
$V_I$	Input voltage		0 to $V_{CC}$	V
$V_{IC}$	Control input voltage		0 to $V_L$	V
$V_O$	Output voltage		0 to $V_{CC}$	V
$T_{op}$	Operating temperature		-40 to 85	°C
dt/dv	Input rise and fall time control input	$V_L = 1.65 \text{ V to } 2.7 \text{ V}$	0 to 20	ns/V
		$V_L = 3.0 \text{ to } 4.8 \text{ V}$	0 to 10	

1. Truth table guaranteed: 1.65 V to 4.8 V

### 3 Electrical characteristics

Table 6. DC specifications

Symbol	Parameter	Test conditions			Value					Unit
		V <sub>CC</sub> (V)	V <sub>L</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		
					Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High level input voltage	1.65 - 4.3	1.65 - 1.95		1.25			1.25		V
			2.3 - 2.7		1.75			1.75		
			3.0 - 3.6		2.35			2.35		
			4.3		2.8			2.8		
V <sub>IL</sub>	Low level input voltage	1.65 - 4.3	1.65 - 1.95				0.6	0.6	V	
			2.3 - 2.7				0.8	0.8		
			3.0 - 3.6				1.05	1.05		
			4.3				1.5	1.5		
R <sub>ON</sub>	ON resistance	1.8	1.65 - 4.3	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 100 mA		0.49	0.65		0.85	Ω
		2.25				0.30	0.40		0.50	
		3				0.25	0.35		0.45	
		3.7				0.22	0.32		0.42	
		4.3				0.21	0.30		0.40	
ΔR <sub>ON</sub>	ON resistance match between channels (1)	1.8	1.65 - 4.8	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 100 mA		5				mΩ
		2.25				3				
		3				3				
		3.7				3				
		4.3				3				
R <sub>FLAT</sub>	ON resistance flatness (2)	1.8	1.65 - 4.8	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 100 mA		300	400		450	mΩ
		2.5				130	170		230	
		3				90	120		170	
		3.7				90	120		170	
		4.3				90	120		170	
I <sub>OFF</sub>	Sn OFF state leakage current	1.65 - 4.8	1.65 - 4.8	V <sub>S</sub> = 0 to V <sub>CC</sub> V <sub>D</sub> = 0 to V <sub>CC</sub>	-20		20	-300	300	nA
I <sub>ON</sub>	Sn ON state leakage current	1.65 - 4.8	1.65 - 4.8	V <sub>S</sub> = 0 to V <sub>CC</sub> V <sub>D</sub> = open	-20		20	-100	100	nA

**Table 6. DC specifications (continued)**

$I_D$	D ON state leakage current	1.65 - 4.8	1.65 - 4.8	$V_S = \text{open}$ $V_D = 0 \text{ to } V_{CC}$	-20	20	-100	100	nA
$I_{CC}$	Quiescent supply current	1.65-4.8	1.65 - 4.8	$V_{SEL} = V_{CC}$ or GND	-0.05	0.05	-0.2	0.2	$\mu\text{A}$
$I_{SEL}$	SEL leakage current	1.65-4.8	1.65 - 4.8	$V_{SEL} = 4.3\text{V}$ or GND	-0.1	0.1	-1	1	$\mu\text{A}$

- $\Delta R_{ON} = R_{ON(\text{Max})} - R_{ON(\text{Min})}$
- Flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal ranges.

**Table 7. AC electrical characteristics ( $C_L = 35 \text{ pF}$ ,  $R_L = 50 \text{ }\Omega$ ,  $t_r = t_f \leq 5 \text{ ns}$ )**

Symbol	Parameter	Test conditions			Value					Unit
		$V_{CC}$ (V)	$V_L$ (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		
					Min	Typ	Max	Min	Max	
$t_{PLH}$ , $t_{PHL}$	Propagation delay	1.65 - 1.95	1.65 - 4.8			0.13				ns
		2.3 - 2.7				0.15				
		3.0 - 3.3				0.16				
		3.6 - 4.3				0.16				
$t_{ON}$	Turn-ON time	1.65 - 1.95	1.65 - 4.8	$V_S = V_{CC}$ $R_L = 50 \text{ }\Omega$ $C_L = 30 \text{ pF}$		95	123		95	ns
		2.3 - 2.7				48	62		70	
		3 - 3.6				33	43		55	
		4.3				29	38		40	
$t_{OFF}$	Turn-OFF time	1.65 - 1.95	1.65 - 4.8	$V_S = V_{CC}$ $R_L = 50 \text{ }\Omega$ $C_L = 30 \text{ pF}$		12	15		70	ns
		2.3 - 2.7				12	16		55	
		3 - 3.6				13	17		40	
		4.3				13	17		35	
$t_D$	Break-before-make time delay	1.65 - 1.95	1.65 - 4.8	$C_L = 35 \text{ pF}$ $R_L = 50 \text{ }\Omega$ $V_S = V_{CC}/2$	10	66				ns
		2.3 - 2.7			10	28				
		3 - 3.6			10	18				
		4.3			10	12				
Q	Charge injection	1.65-1.95	1.65-4.8	$C_L = 1\text{nF}$ $V_{GEN} = 0\text{V}$		86				pC
		2.3-2.7				95				
		3.0-3.3				98				
		3.6-4.3				103				



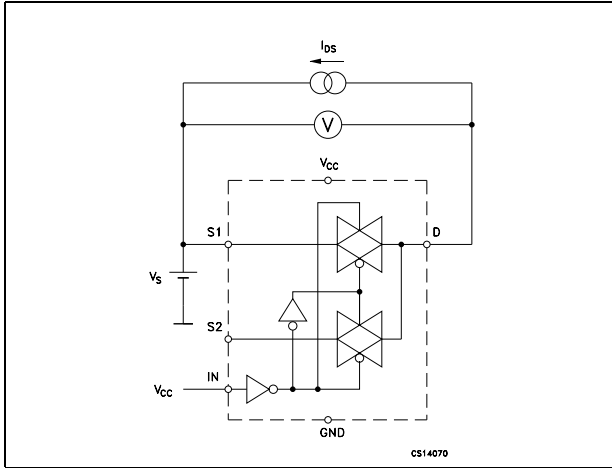
**Table 8. Analog switch characteristics** ( $C_L = 5\text{pF}$ ,  $R_L = 50\Omega$ ,  $T_A = 25^\circ\text{C}$ )

Symbol	Parameter	Test conditions			Value					Unit	
		$V_{CC}$ (V)	$V_L$ (V)		$T_A = 25^\circ\text{C}$			-40 to $85^\circ\text{C}$			
					Min	Typ	Max	Min	Max		
$O_{IRR}$	OFF isolation (1)	1.65 - 4.3	4.3	$V_S = 1V_{RMS}$ $f = 100\text{kHz}$		-71					dB
Xtalk	Crosstalk	1.6 - 4.3	4.3	$V_S = 1V_{RMS}$ $f = 100\text{kHz}$		-93					dB
$T_{HD}$	Total harmonic distortion	2.3 - 4.3	4.3	$R_L = 600\Omega$ $C_L = 50\text{pF}$ $V_S = V_{CC} V_{PP}$ $f = 600\text{Hz to } 20\text{kHz}$		0.01					%
BW	-3dB bandwidth (switch ON)	1.65 - 4.3	4.3	$R_L = 50\Omega$		10					MHz
$C_{SEL}$	Control pin input capacitance	1.8 - 4.3	1.8 - 4.3	$V_L = V_{CC}$		30					pF
$C_{Sn}$	Sn port capacitance	1.8 - 4.3	1.8 - 4.3	$V_L = V_{CC}$		95					pF
$C_D$	D port capacitance when switch is enabled	1.8 - 4.3	1.8 - 4.3	$V_L = V_{CC}$		230					pF

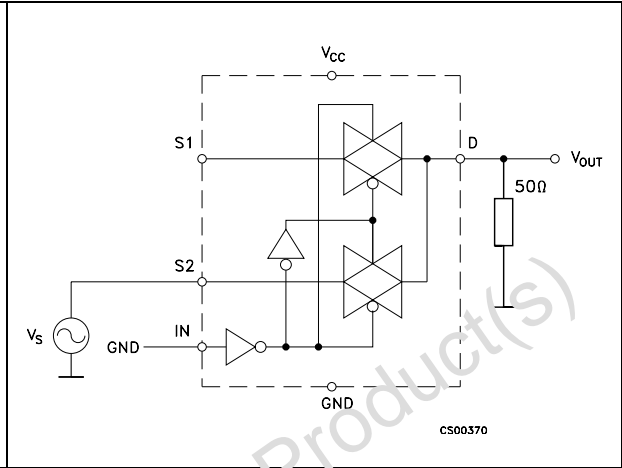
1. OFF-isolation =  $20 \cdot \log_{10}(V_D/V_S)$ ,  $V_D$  = output,  $V_S$  = input to off switch

# 4 Test circuits

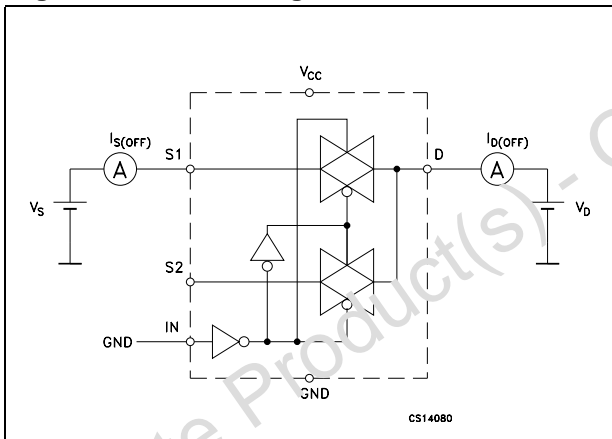
**Figure 4. ON resistance**



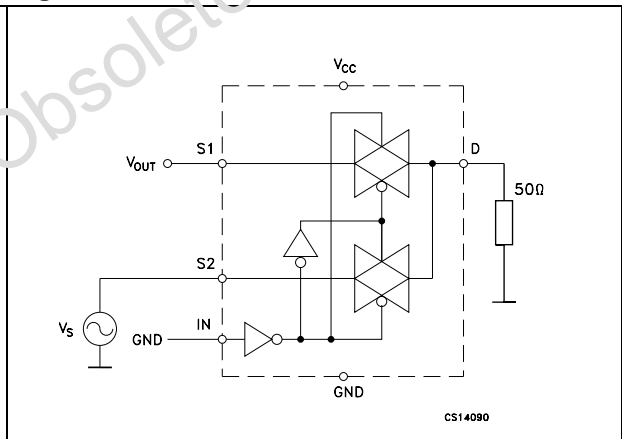
**Figure 5. Bandwidth**



**Figure 6. OFF leakage**



**Figure 7. Channel-to-channel crosstalk**



**Figure 3. OFF isolation**

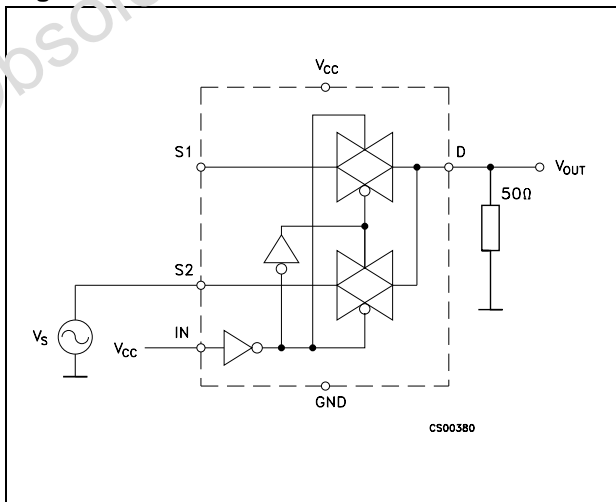
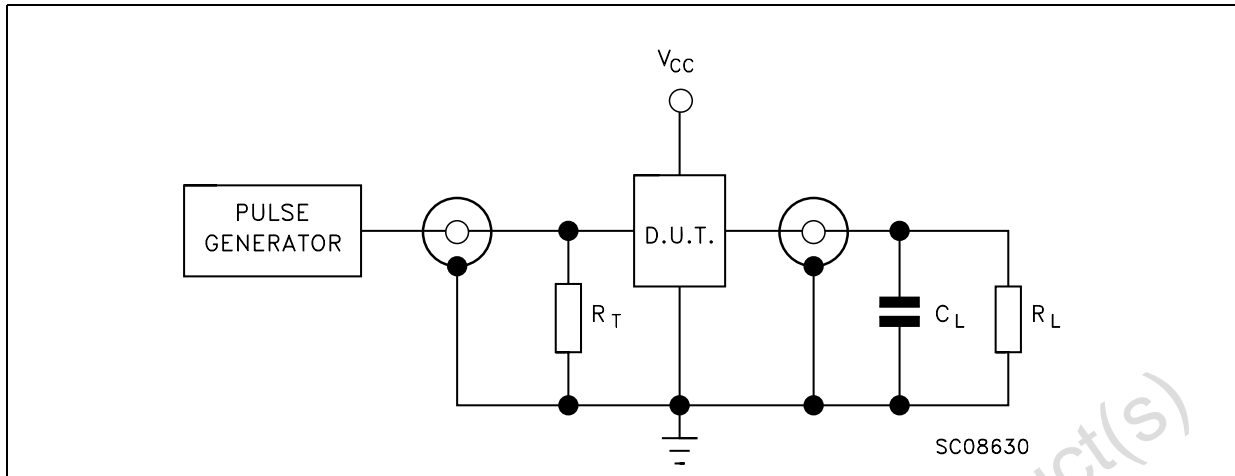
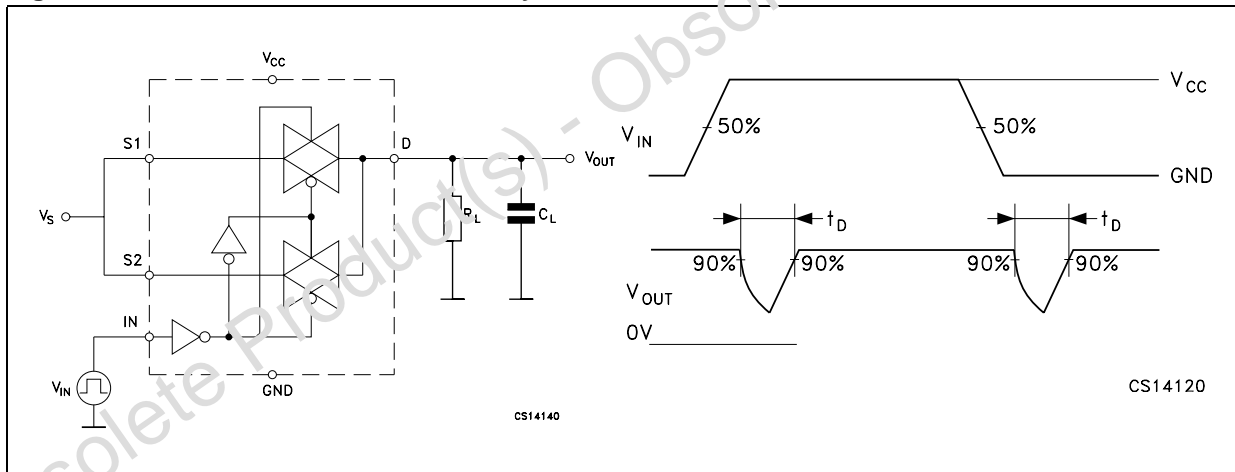


Figure 9. Test circuit

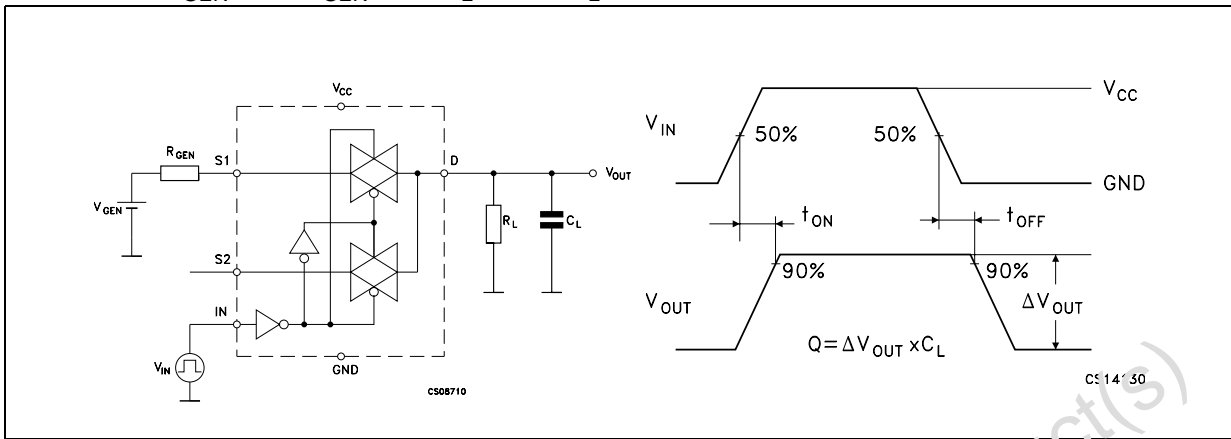


- Note:
- 1  $C_L = 5/35\text{pF}$  or equivalent: (includes jig capacitance)
  - 2  $R_L = 50\Omega$  or equivalent
  - 3  $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

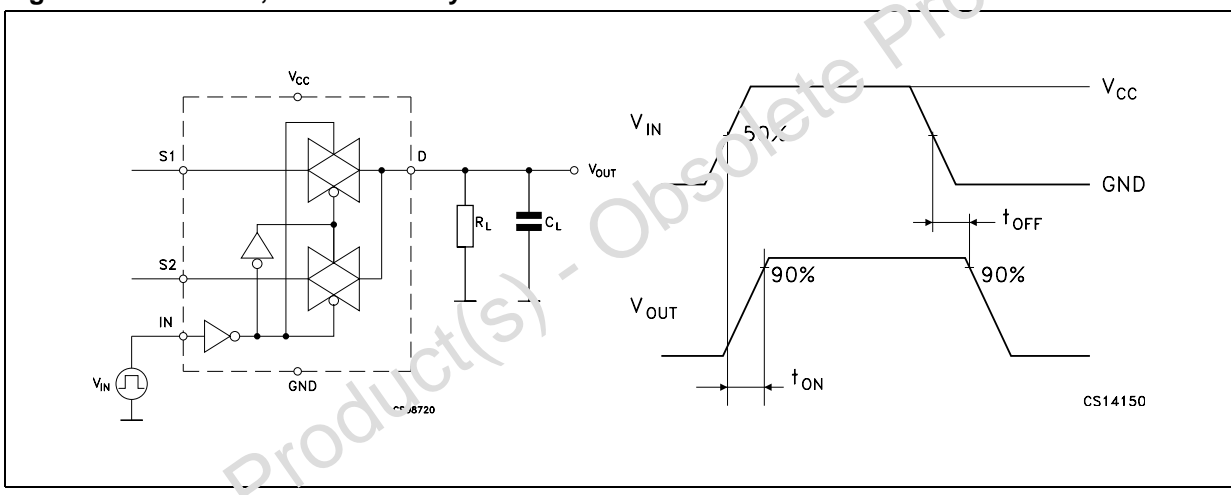
Figure 10. Break-before-make time delay



**Figure 11. Switching time and charge injection**  
( $V_{GEN} = 0V$ ,  $R_{GEN} = 0\Omega$ ,  $R_L = 1M\Omega$ ,  $C_L = 100pF$ )



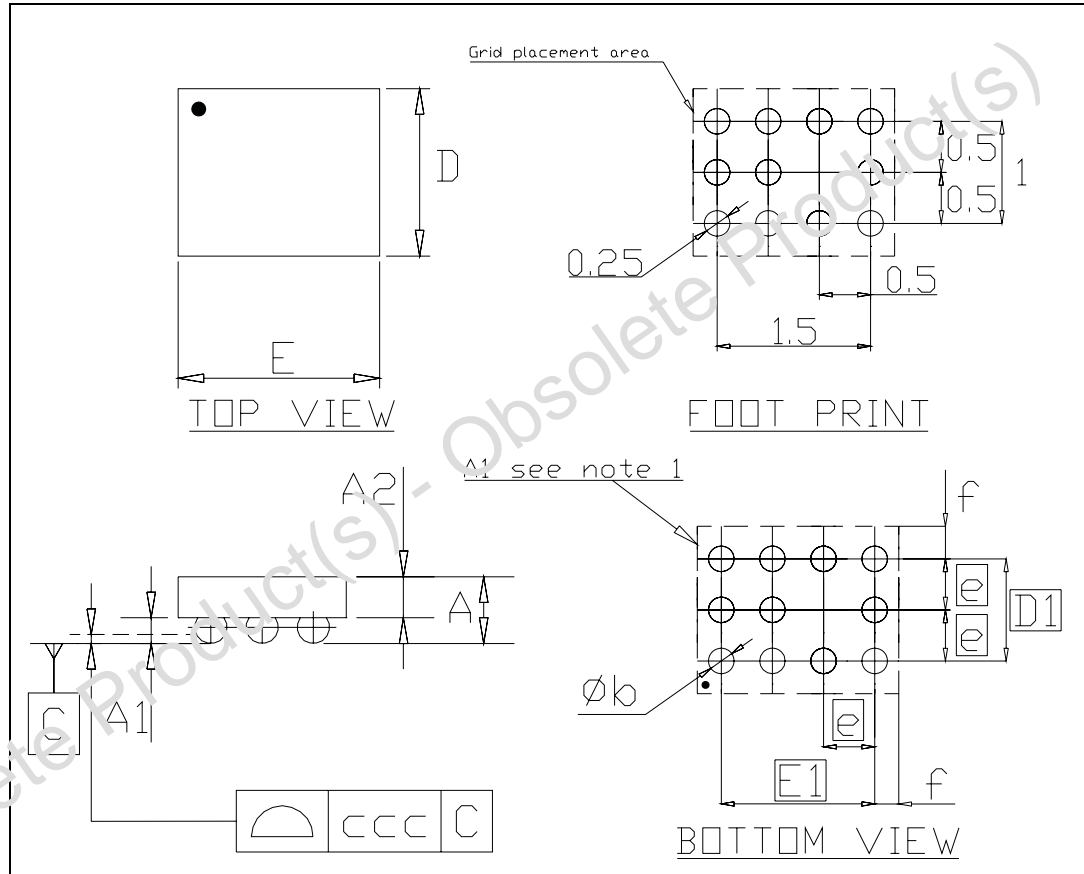
**Figure 12. Turn ON, turn OFF delay time**



## 5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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](http://www.st.com).

Figure 13. Flip-Chip11 package outline



1. Drawing not to scale.

**Table 9. Flip-Chip11 mechanical data**

Dim.	Data book (mm)			Drawing (mm)		
	Min	Typ	Max	Min	Typ	Max
A	0.585	0.65	0.715	0.60	0.65	0.70
A1	0.21	0.25	0.29	0.22	0.25	0.28
A2		0.4		0.38	0.4	0.42
b	0.265	0.315	0.365	0.290	0.315	0.340
D	1.518	1.568	1.618	1.553	1.568	1.583
D1		1		0.99	1	1.01
E	2.018	2.068	2.118	2.083	2.068	2.118
E1		1.5		1.49	1.5	1.51
e	0.45	0.5	0.55	0.46	0.5	0.54
f		0.284		0.272	0.284	0.292
ccc		0.08			0.08	

The terminal A1 on the bumps side is identified by a distinguishing feature (for instance by a circular "clear area" - typically 0.1 mm diameter) and/or a missing bump. The terminal A1 on the backside of the product is identified by a distinguishing feature (for instance by a circular "dot" - typically 0.5 mm diameter).

**Figure 14. Foot print recommendations**

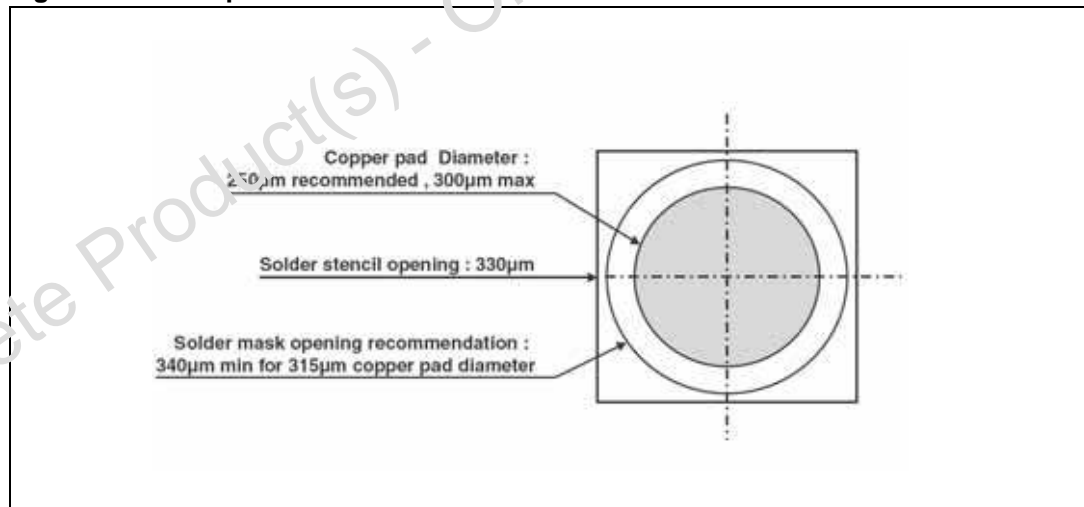


Figure 15. Marking

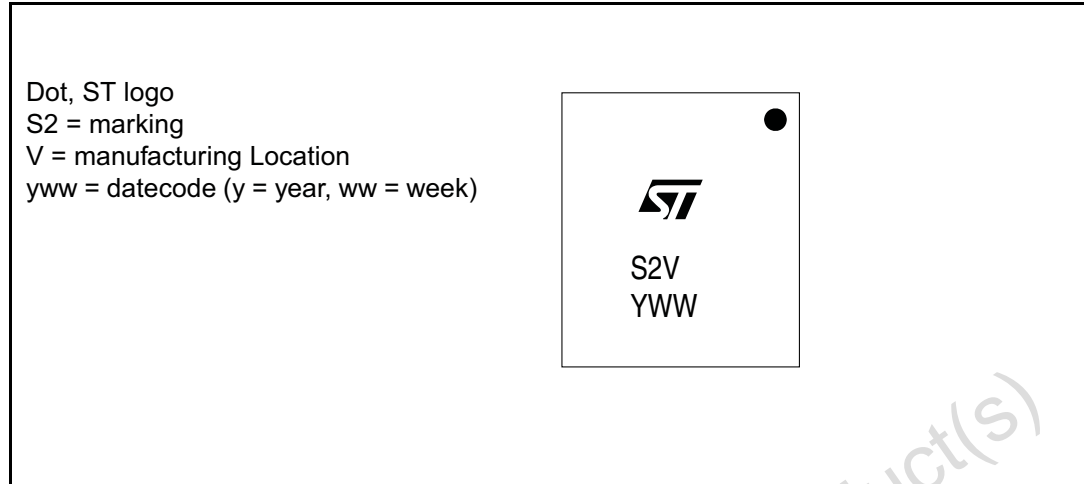


Figure 16. Flip-Chip11 tape specification

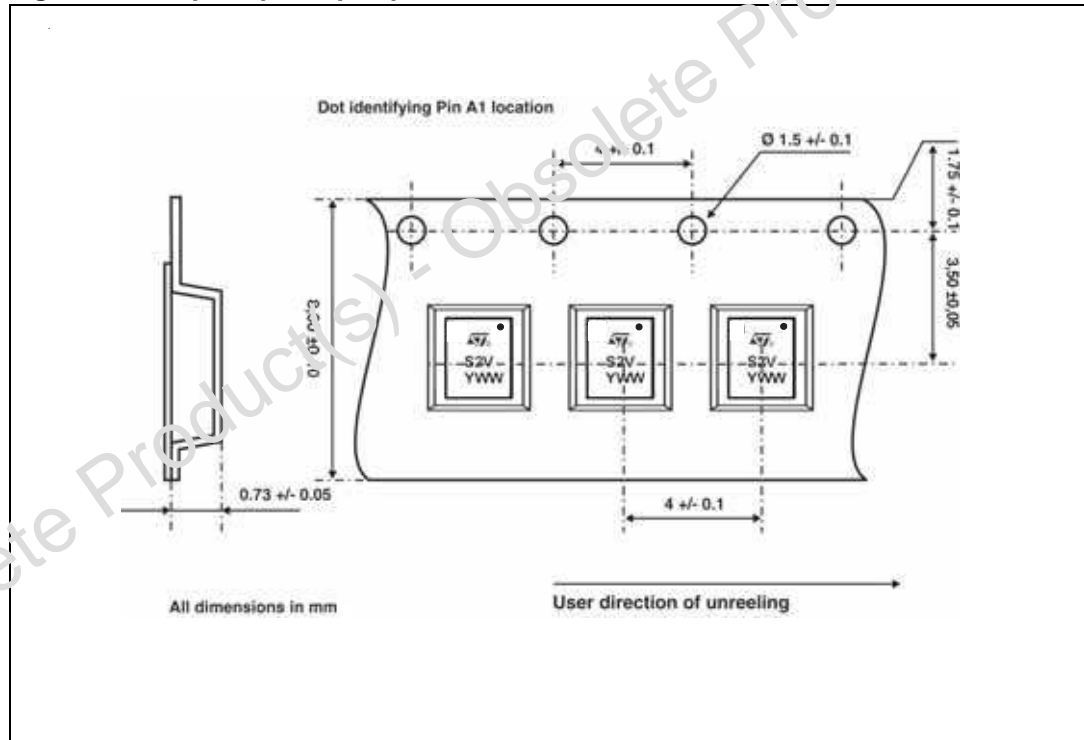


Figure 17. Flip-Chip11 reel information

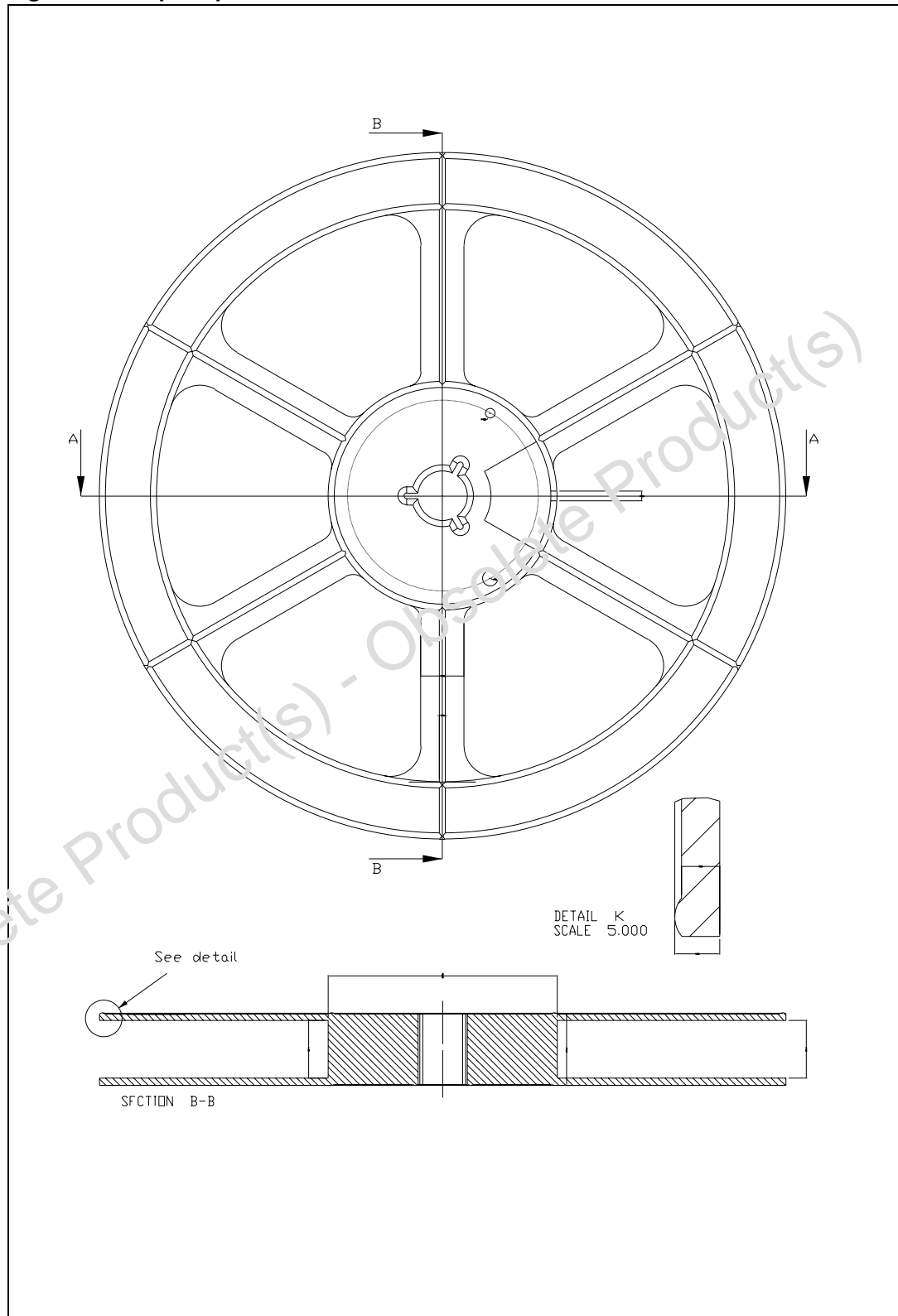
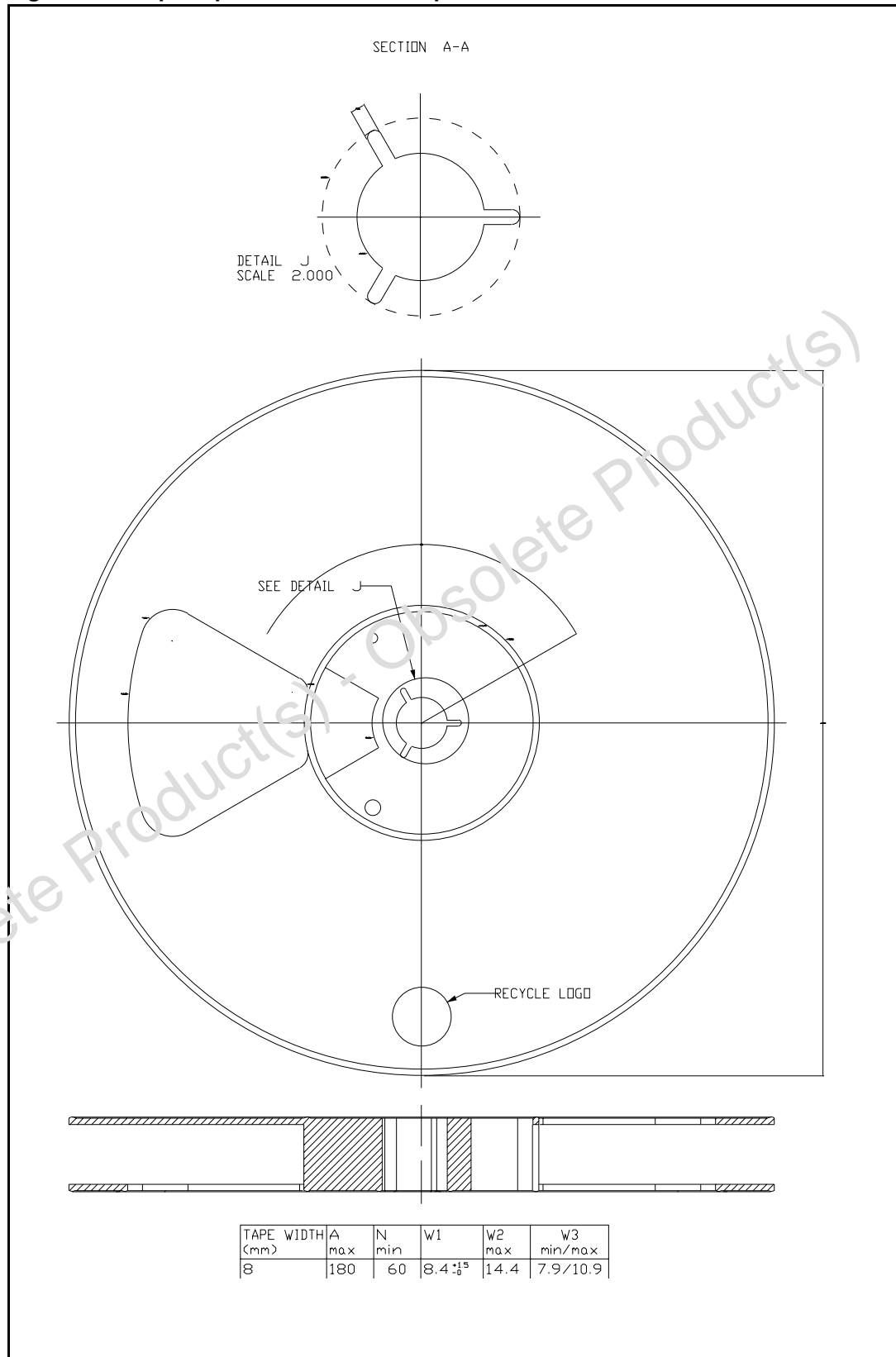




Figure 18. Flip-Chip11 reel for carrier tape information



## 6 Revision history

Table 10. Document revision history

Date	Revision	Changes
03-Oct-2006	1	First release
16-Oct-2006	2	Schematic <i>Figure 1 on page 3</i> updated
07-Aug-2007	3	Air discharge ESD rating updated
28-Aug-2007	4	Changed <i>Figure 16 on page 15</i>

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