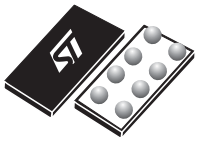
STG4160

Low voltage 0.5 Ω single SPDT switch with break-before-make feature and 15 kV contact ESD protection

Datasheet - production data



Flip Chip 8

Features

- Wide operating voltage range:
  V_{CC} (opr.) = 1.65 to 4.8 V
- Low power dissipation:
  I_{CC} = 0.2 µA (max.) at T_A = 85 °C
- Low on-resistance:
  - R_{ON} = 0.75 Ω (T_A = 25 °C) at V_{CC} = 2.25 V
  - R_{ON} = 0.50 Ω (T_A = 25 °C) at V_{CC} = 3.0 V
  - R_{ON} = 0.40 Ω (T_A = 25 °C) at V_{CC} = 4.3 V
- Separate supply voltage for switch and control pins
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- ESD performance tested on common pin (D pin):
  - 15 kV IEC 61000-4-2 ESD, contact discharge
  - 8 kV HBM JESD22 A114-B Class II
- ESD performance tested on S1 and S2 pin:
  8 kV IEC 61000-4-2 ESD, contact discharge
- ESD performance test on all other pins:
  - 4 kV HBM (JESD22 A114-B Class II)
  - 400 V machine model (JESD22 A115-A)
  - 1500 V charged-device model (JESD22 C101)

Applications

- Mobile phones

Description

The STG4160 device is a high-speed CMOS low voltage single analog SPDT (single pole dual throw) switch or 2:1 multiplexer/demultiplexer switch fabricated in silicon gate C^2MOS technology. It is designed to operate from 1.65 to 4.8 V, making this device ideal for portable applications. It offers low on-resistance (0.40 Ω typ.) at V_{CC} = 4.3 V. The SEL inputs are provided to control the switches.

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

Additional key features are fast switching speed, break-before-make delay time and ultra 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

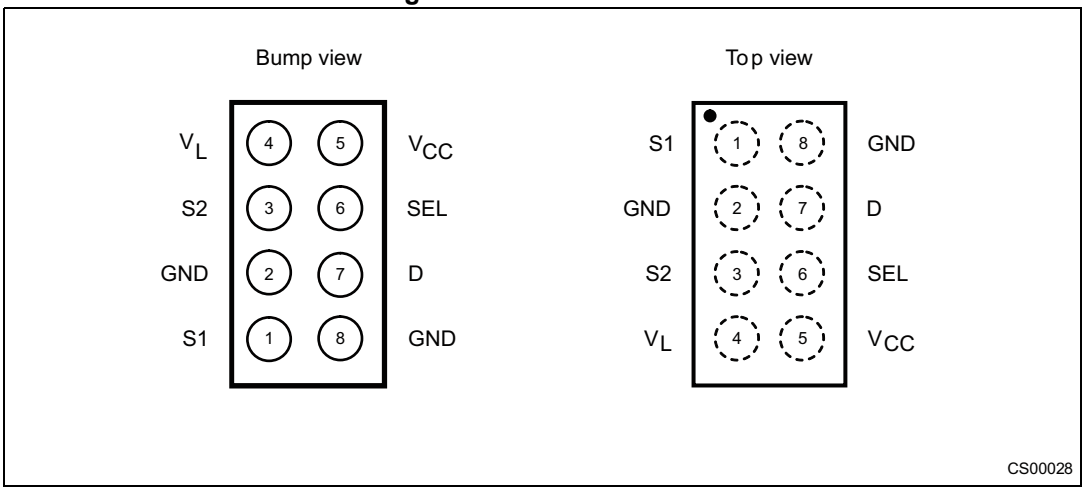
Order code	Package	Packing
STG4160BJR	Flip Chip 8	Tape and reel

Contents

1 Pin settings

1.1 Pin connections

Figure 1. Pin connections



1.2 Pin description

Table 2. Pin assignment

Pin number	Symbol	Name and function
1	S1	Independent channel
2	GND	Ground (0 V)
3	S2	Independent channel
4	V_L	Logic supply voltage
5	V_{CC}	Positive supply voltage
6	SEL	Control
7	D	Common channel
8	GND	Ground (0 V)

2 Logic diagram

Figure 2. Functional diagram

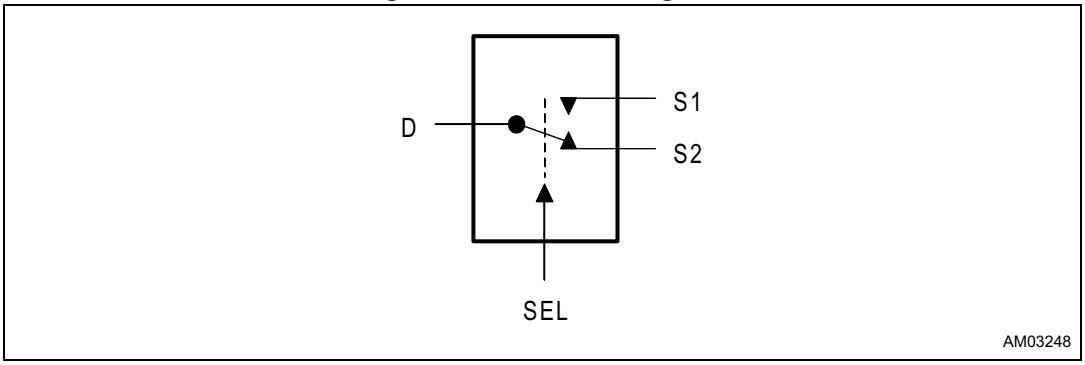


Figure 3. Circuit equivalent logic

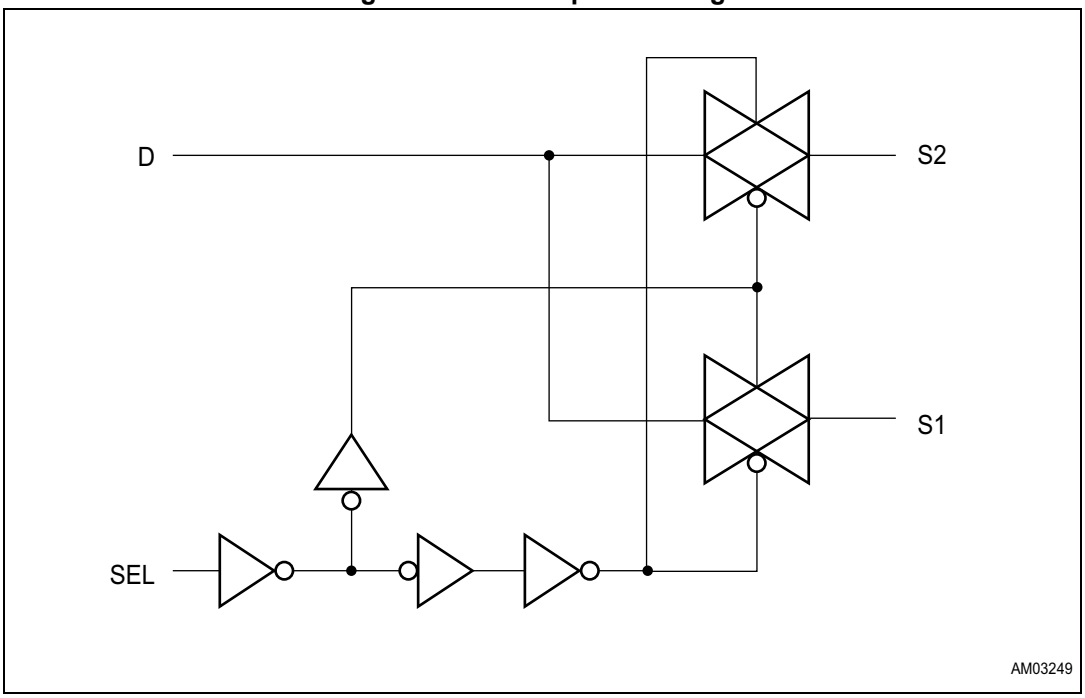


Table 3. Truth table

SEL	Switch S1	Switch S2
H	ON	OFF(1)
L	OFF(1)	ON

1. High impedance.

3 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 *Table 5* 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 + 5.5	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} < 0 V)	- 50	mA
I_{IK}	DC input diode current (V_{SEL} < 0 V)	± 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 1 ms, 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 °C(1)	500	mW
T_{stg}	Storage temperature	-65 to 150	°C
T_L	Lead temperature (10 sec.)	260	°C

1. Derate above 70 °C by 18.5 mW/C.

Table 5. Recommended operating conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		1.65 to 4.8	V
V_L	Logic supply voltage(1)		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 to 2.7 V	0 to 20	ns/V
		V_L= 3.0 to 4.8 V	0 to 10	

1. V_L pin should not be left floating.

4 Electrical characteristics

Table 6. DC specifications

Symbol	Parameter	V_{CC} (V)	V_L (V)	Test conditions	Value					Unit
					T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
V_{IH}	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		2.34			2.34		
			4.3		2.80			2.80		
V_{IL}	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_{ON}	On-resistance	1.8	1.65 – 4.3	V_S = 0 V to V_{CC} I_S = 100 mA		1.5	2.5		3.7	Ω
		2.25				0.75	1.0		1.3	
		3				0.50	0.65		0.8	
		3.7				0.45	0.55		0.7	
		4.3				0.40	0.5		0.65	
ΔR_{ON}	On-resistance match between channels(1)	1.8	1.65 – 4.3	V_S = 0 V to V_{CC} I_S = 100 mA		40				mΩ
		2.25				20				
		3				10				
		3.7				10				
		4.3				10				
R_{FLAT}	On-resistance flatness(2)	1.8	1.65 – 4.3	V_S = 0 V to V_{CC} I_S = 100 mA		1.0	1.7		2.0	mΩ
		2.25				300	430		550	
		3				150	190		270	
		3.7				140	180		230	
		4.3				140	180		220	
I_{OFF}	Sn OFF state leakage current	4.3	4.3	V_S = 0.3 to 4.0 V_D = 0.3 to 4.0	-30		30	-300	300	nA
I_{ON}	Sn ON state leakage current	4.3	4.3	V_S = 0.3 to 4.0 V_D = open	-30		30	-300	300	nA
I_D	D ON state leakage current	4.3	4.3	V_S = open V_D = 0 to 4.0	-30		30	-300	300	nA

Table 6. DC specifications (continued)

Symbol	Parameter	V_{CC} (V)	V_L (V)	Test conditions	Value					Unit
					T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
I_{CC}	Quiescent supply current	1.65 – 4.3	1.65 – 4.3	V_{SEL} = V_{CC} or GND	-0.05		0.05	-0.2	0.2	µA
I_{SEL}	SEL leakage current	1.65 – 4.3	1.65 – 4.3	V_{SEL}= 4.3V or GND	-0.2		0.2	-2	2	µA

1. $\Delta R_{ON} = R_{ON(Max)} - R_{ON(Min)}$.
2. 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 pF, R_L = 50 Ω, t_r = t_f ≤ 5 ns)

Symbol	Parameter	Test conditions			Value					Unit
		V_{CC} (V)	V_L (V)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
t_{PLH}, t_{PHL}	Propagation delay	1.65 – 1.95	1.65 – 4.3			0.18				ns
		2.3 – 2.7				0.14				
		3.0 – 3.3				0.12				
		3.6 – 4.3				0.12				
t_{ON}	Turn-on time	1.65 – 1.95	1.65 – 4.3	V_S = V_{CC} R_L = 50 Ω C_L = 30 pF		70	123		160	ns
		2.3 – 2.7				48	62		80	
		3 – 3.6				33	43		56	
		4.3				29	38		49	
t_{OFF}	Turn-off time	1.65 – 1.95	1.65 – 4.3	V_S = V_{CC} R_L = 50 Ω C_L = 30 pF		36	45		60	ns
		2.3 – 2.7				35	47		62	
		3 – 3.6				30	40		51	
		4.3				29	38		50	
t_D	Break-before-make time delay	1.65 – 1.95	1.65 – 4.3	C_L = 35 pF R_L = 50 Ω V_S = V_{CC}/2	10	42				ns
		2.3 – 2.7			10	22				
		3 – 3.6			5	15				
		4.3			5	12				
Q	Charge injection	1.65 – 1.95	1.65 – 4.3	C_L = 1 nF V_{GEN} = 0 V		75				pC
		2.3 – 2.7				98				
		3.0 – 3.3				133				
		3.6 – 4.3				162				

Table 7. AC electrical characteristics (C_L = 35 pF, R_L = 50 Ω, $t_r = t_f \leq$ 5 ns) (continued)

Symbol	Parameter	Test conditions			Value					Unit
		V_{CC} (V)	V_L (V)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
OIRR	OFF-isolation(1)	1.65 – 4.3	4.3	V_S = 1 V_{RMS} f = 100 kHz		77				dB
				V_S = 1 V_{RMS} f = 1 MHz		67				
				V_S = 1 V_{RMS} f = 5 MHz		50				
Xtalk	Crosstalk	1.65 – 4.3	4.3	V_S = 1 V_{RMS} f = 100 kHz		80				dB
				V_S = 1 V_{RMS} f = 1 MHz		67				
				V_S = 1 V_{RMS} f = 5 MHz		50				
THD	Total harmonic distortion	2.3 – 4.3	4.3	R_L = 600 Ω C_L = 50 pF $V_S = V_{CC}$ f = 600 Hz to 20 kHz		0.01				%
BW	-3 dB Bandwidth (switch ON)	1.65 – 4.3	4.3	R_L = 50 Ω		50				MHz

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

Table 8. Capacitive characteristics

Symbol	Parameter	Test conditions			Value					Unit
		V_{CC} (V)	V_L (V)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
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	$V_L = V_{CC}$		94				pF
C_D	D port capacitance when the switch is enabled	1.8 – 4.3	1.8 – 4.3	$V_L = V_{CC}$		227				pF

5 Test circuits

Figure 4. On-resistance

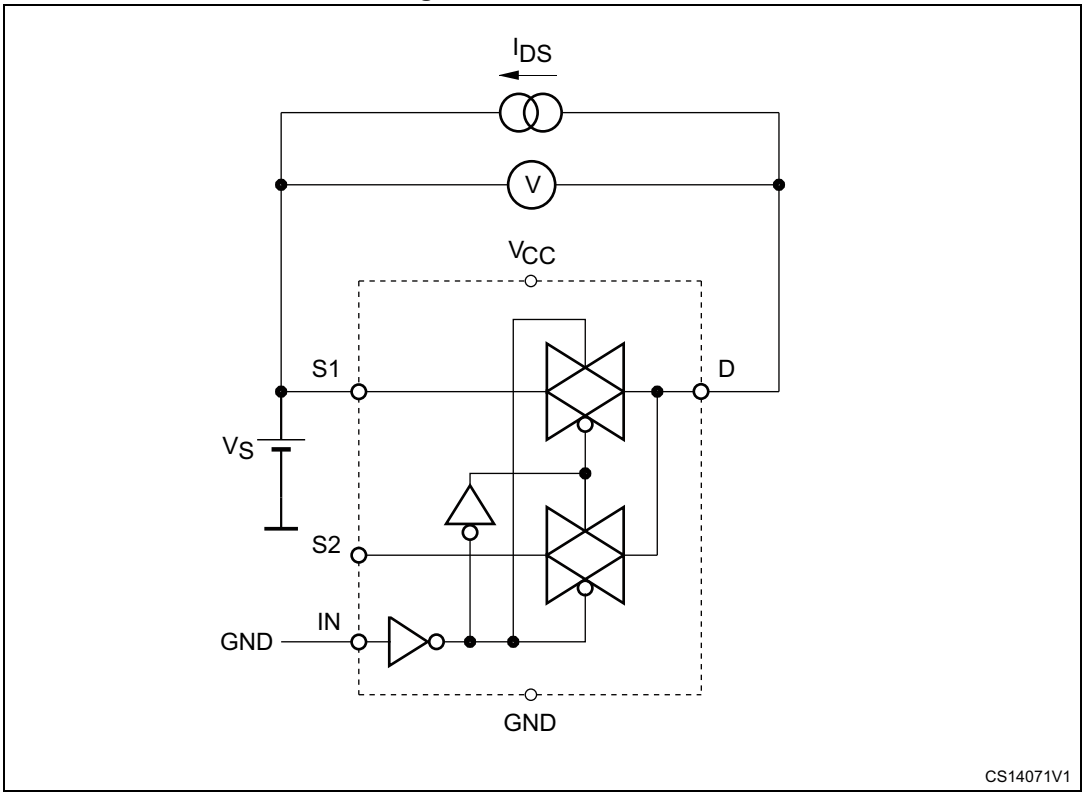


Figure 5. Bandwidth

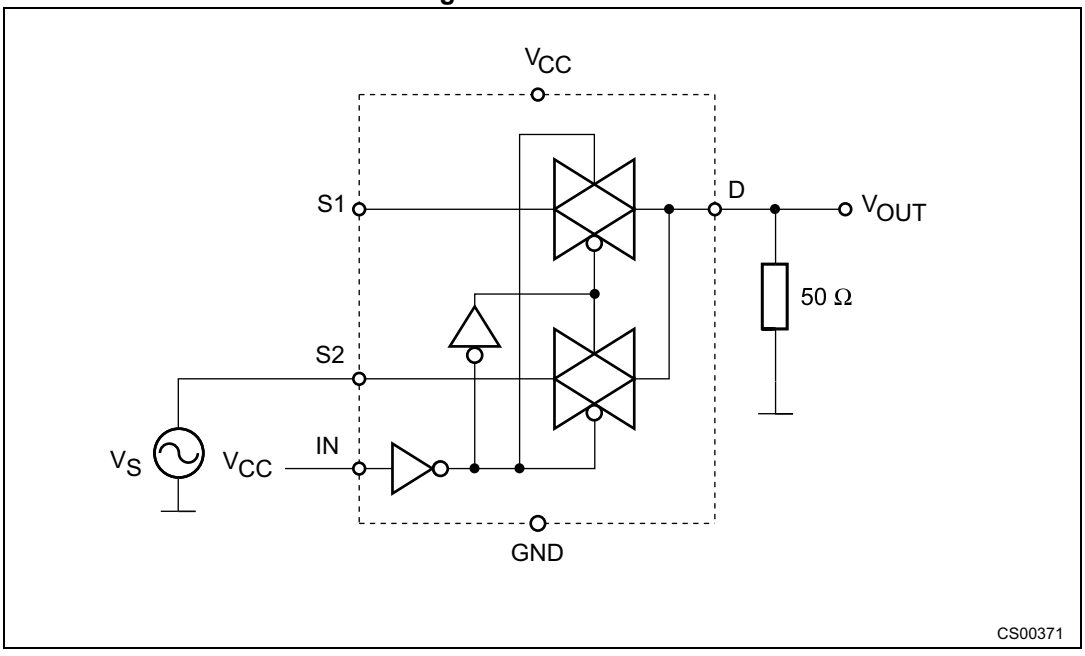


Figure 6. OFF-leakage

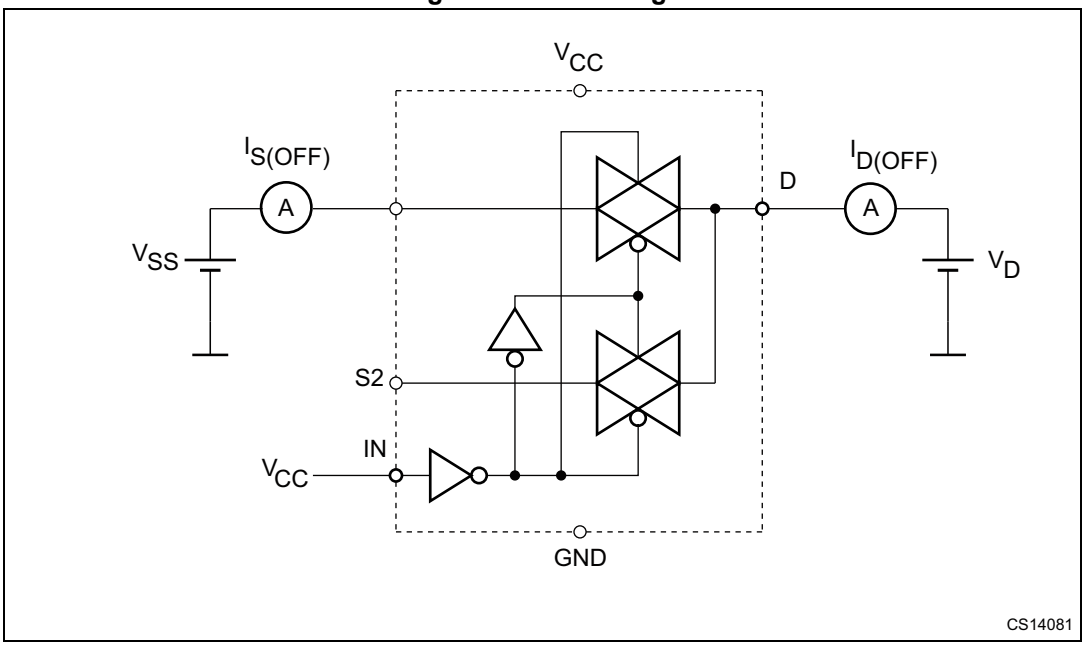


Figure 7. Channel-to-channel crosstalk

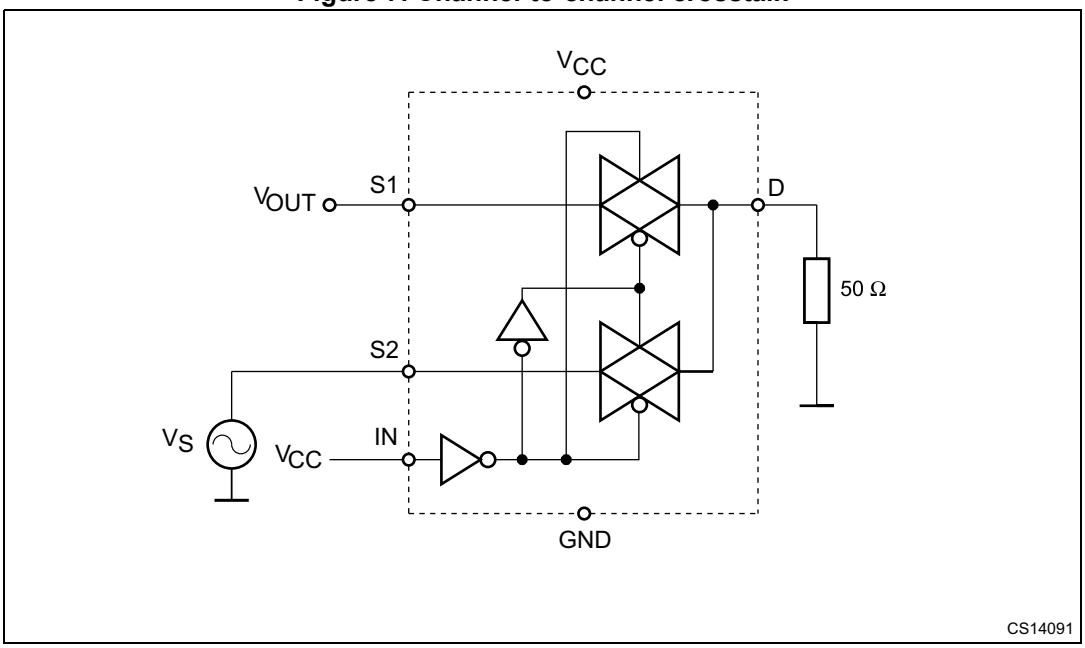


Figure 8. OFF-isolation

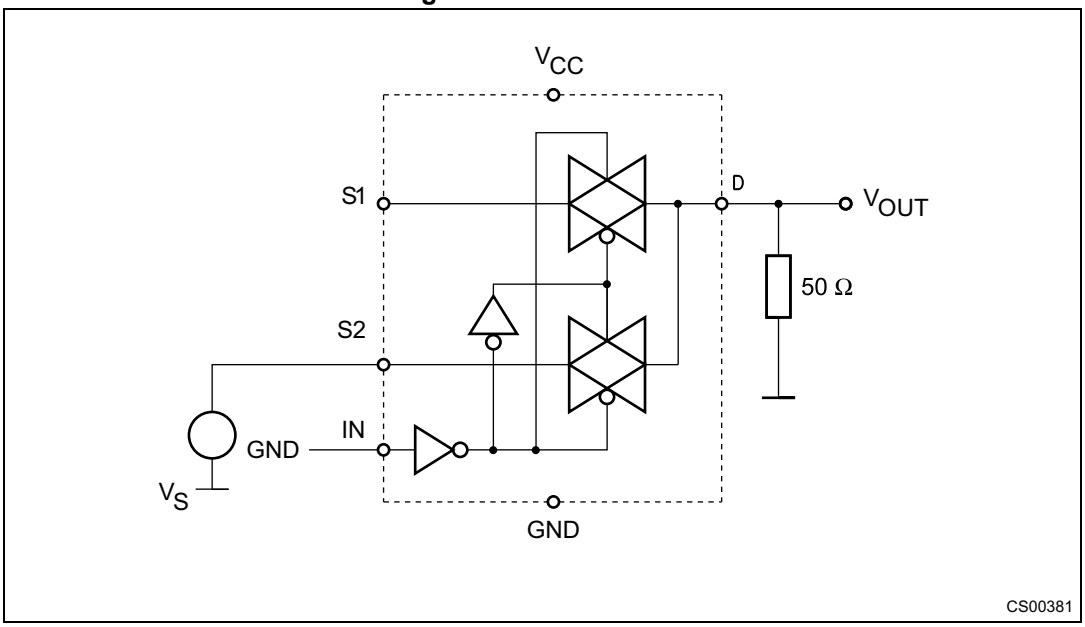
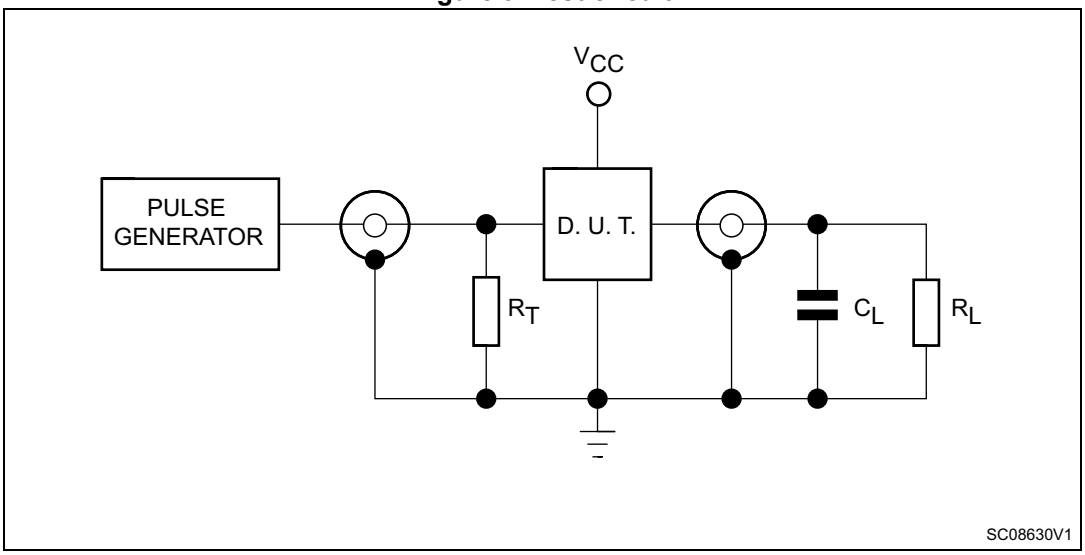


Figure 9. Test circuit



1. C_L = 5/35 pF or equivalent (includes jig capacitance).
2. R_L = 50 Ω or equivalent.
3. R_T = Z_{OUT} of pulse generator (typically 50 Ω).

Figure 10. Break-before-make time delay

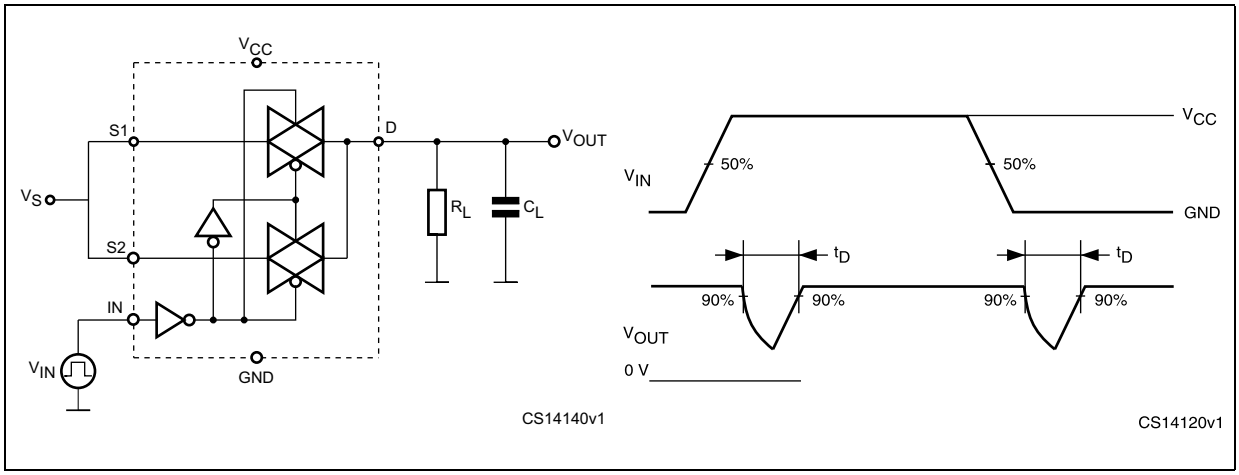


Figure 11. Switching time and charge injection (V_{GEN} = 0 V, R_{GEN} = 0 Ω, R_L = 1 MΩ, C_L = 100 pF)

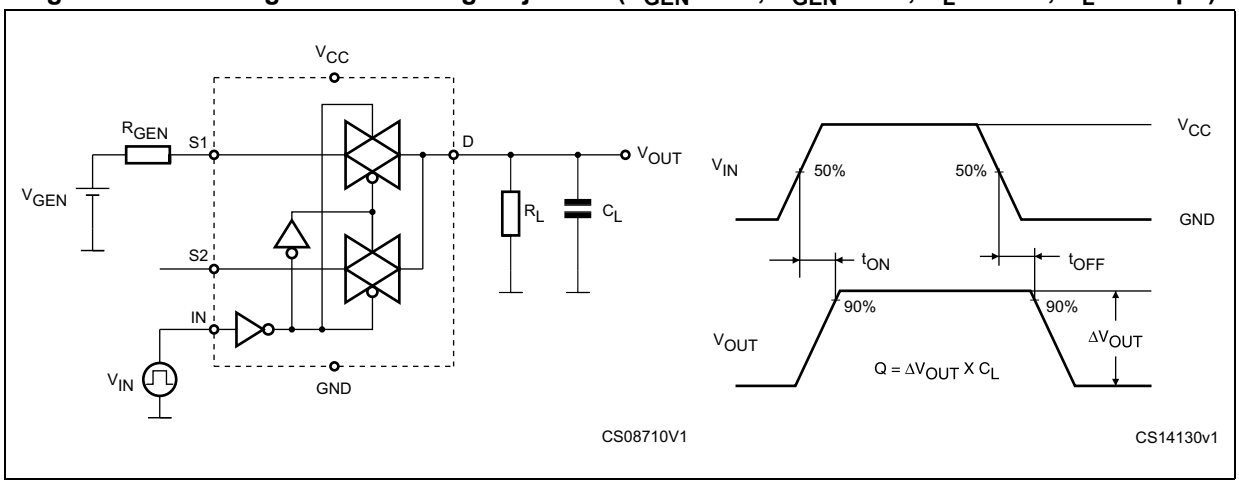
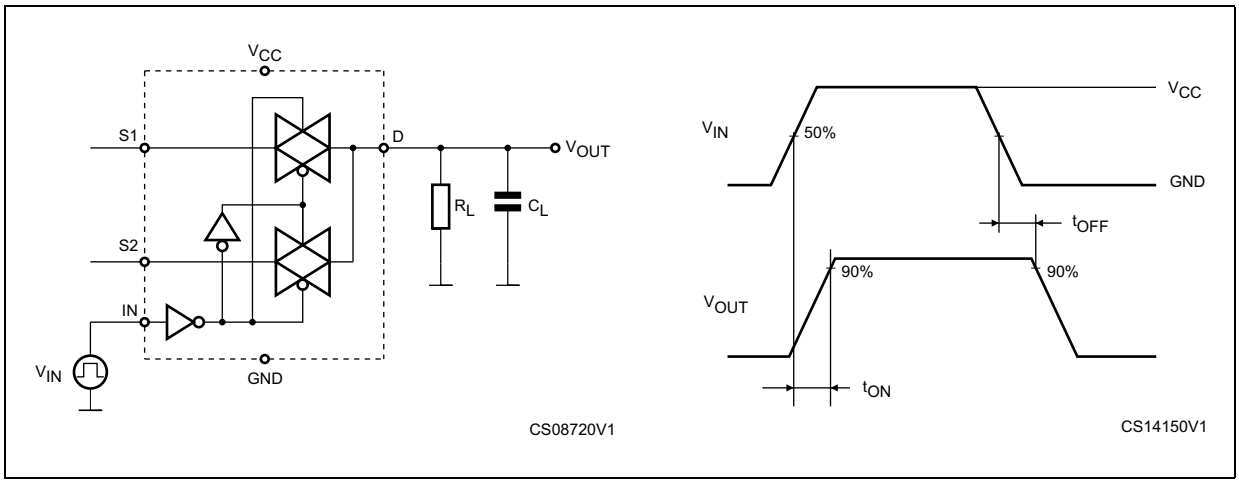


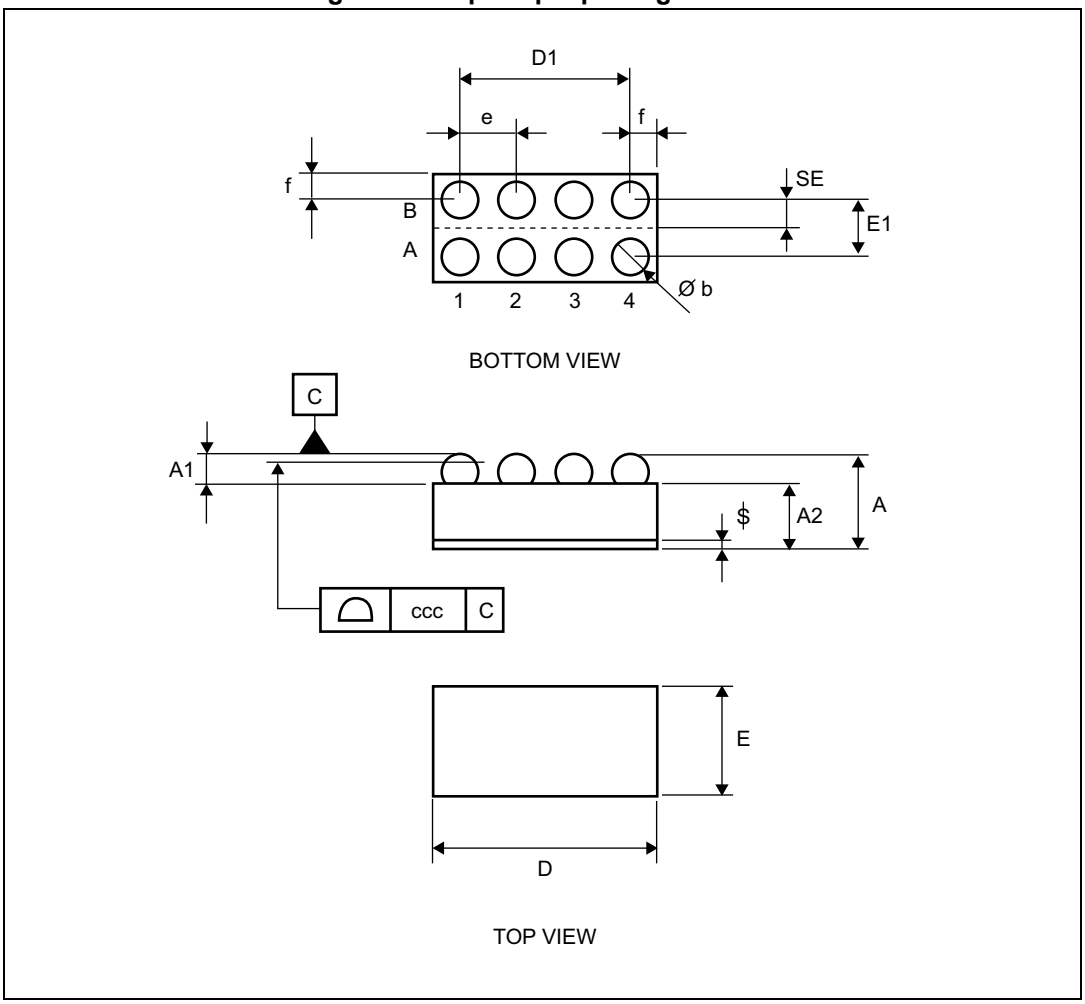
Figure 12. Turn-on, turn-off delay time



6 Package mechanical data

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*. ECOPACK is an ST trademark.

Figure 13. Flip Chip 8 package outline



1. Drawing is not to scale.

Table 9. Flip Chip 8 mechanical data

Symbol	Dimensions (mm)		
	Min.	Typ.	Max.
A	0.535	0.58	0.625
A1	0.18	0.205	0.23
A2	0.355	0.375	0.395
b	0.215	0.255	0.295
D	1.85	1.9	1.95
D1		1.5	
e	0.45	0.5	0.55
E	0.85	0.9	0.95
E1	0.45	0.5	0.55
SE		0.25	
f	0.19	0.2	0.21
ccc		0.08	

Figure 14. Flip Chip 8 footprint

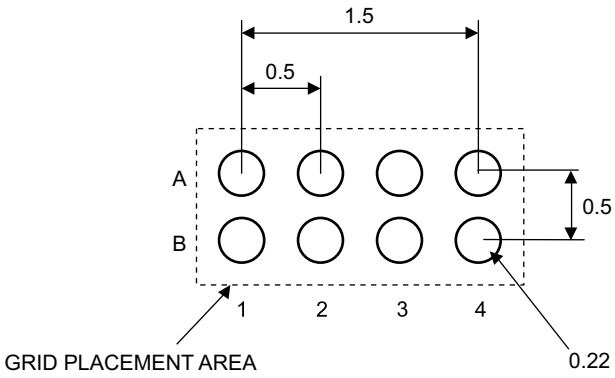


Figure 15. Flip Chip 8 tape and reel

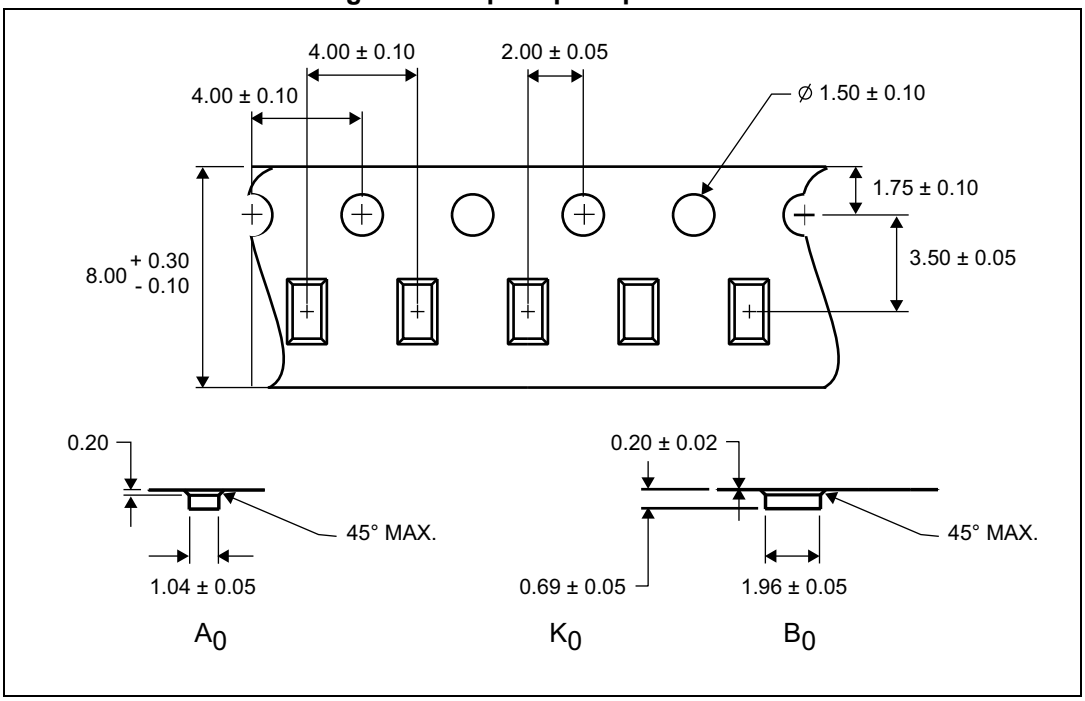


Figure 16. Tape orientation

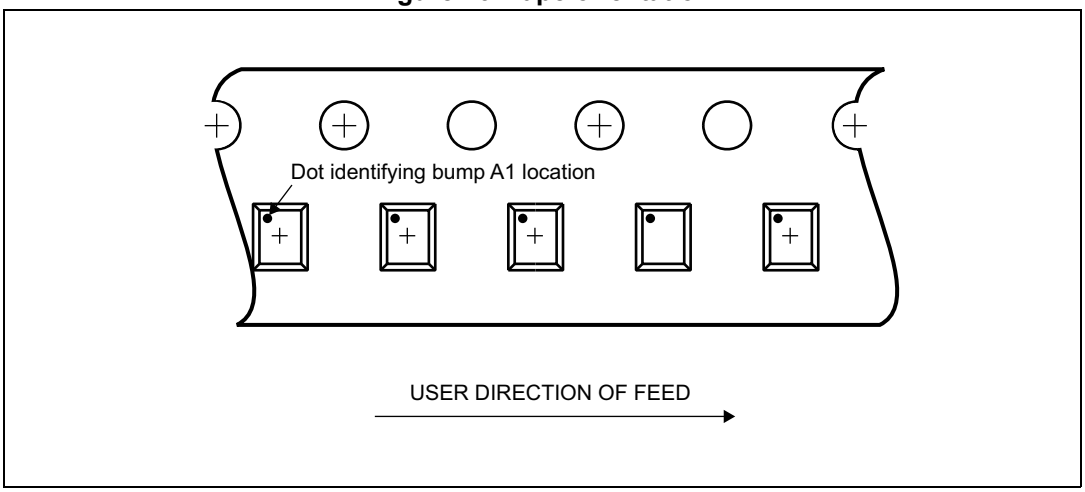
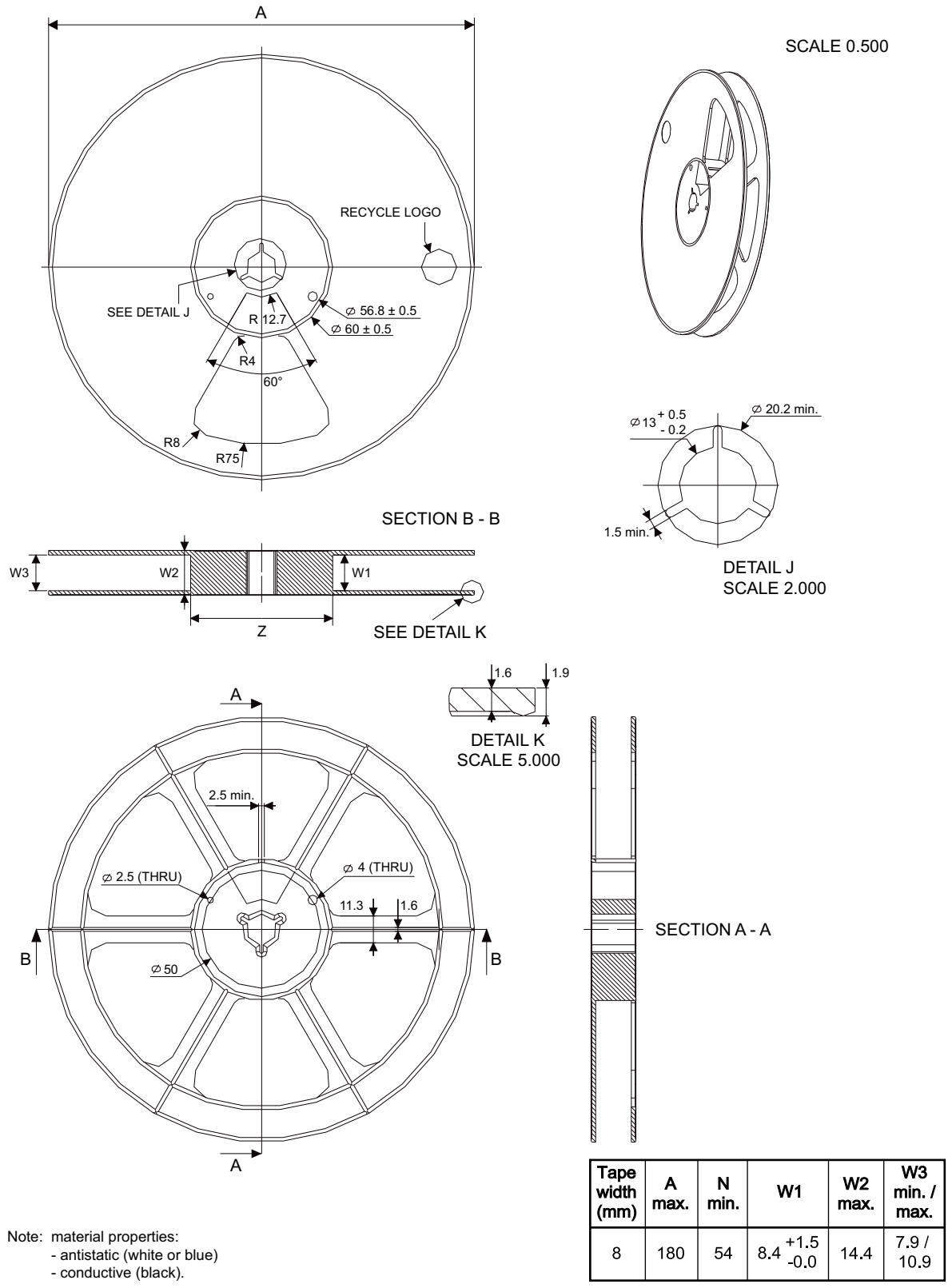


Figure 17. Reel information

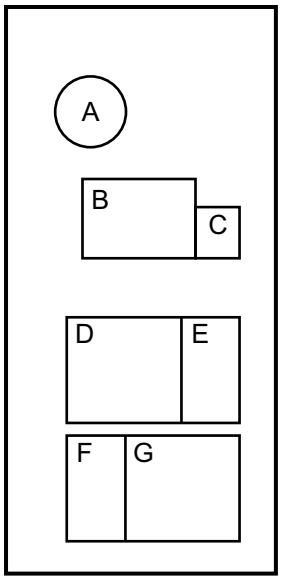


Tape width (mm)	A max.	N min.	W1	W2 max.	W3 min. / max.
8	180	54	8.4 +1.5 -0.0	14.4	7.9 / 10.9

Note: material properties:
- antistatic (white or blue)
- conductive (black).

7 Package marking information

Table 10. Device topside marking information

Marking composition: Flip Chip 8	
Package face: top	**Legend**
	■ Unmarkable surface ☐ Marking composition field A - 53312 - dot B - 53313 - standard ST logo (0000093) C - 53323 - ECO level D - 53314 - marking area E - 53318 - additional information (max. char. allowed = 1) F - 53319 - Assembly year (Y) G - 53322 - Assembly week (WW)

8 Revision history

Table 11. Document revision history

Date	Revision	Changes
11-Sep-2008	1	Initial release.
19-Feb-2009	2	Updated: I_{ON} values in *Table 6: DC specifications*.
15-May-2013	3	Slightly redrawn *Figure 3* to *Figure 15* and *Figure 17*. Updated *Figure 16* (added “Dot identifying bump A1 location”). Updated *Section 3: Maximum ratings* (added cross-references). Corrected units in *Table 8*. Updated *Section 6: Package mechanical data* (updated ECOPACK text). Added *Section 7: Package marking information*. Minor corrections throughout document.

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