

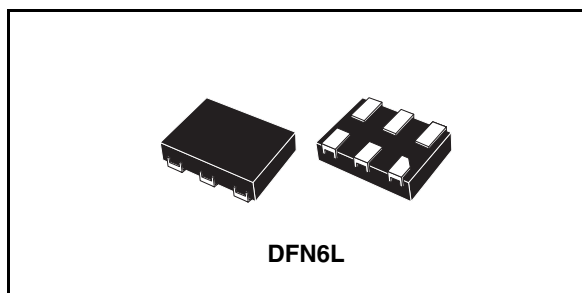


## STG3159

### Low voltage 1Ω max single SPDT switch with break-before-make feature

#### Features

- High speed:
  - $t_{PD} = 1.5\text{ns}$  (Typ.) at  $V_{CC} = 3.0\text{V}$
  - $t_{PD} = 1.5\text{ns}$  (Typ.) at  $V_{CC} = 2.3\text{V}$
- Ultra low power dissipation:
  - $I_{CC} = 0.2\mu\text{A}$  (Max.) at  $T_A = 85^\circ\text{C}$
- Low "ON" resistance:
  - $R_{ON} = 1.0\Omega$  ( $T_A = 25^\circ\text{C}$ ) at  $V_{CC} = 4.3\text{V}$
  - $R_{ON} = 1.1\Omega$  ( $T_A = 25^\circ\text{C}$ ) at  $V_{CC} = 3.0\text{V}$
  - $R_{ON} = 1.7\Omega$  ( $T_A = 25^\circ\text{C}$ ) at  $V_{CC} = 1.8\text{V}$
- Wide operating voltage range:
  - $V_{CC}$  (OPR) = 1.65V to 4.5V single supply
- 4.5V Tolerant and 1.8V compatible threshold on digital control input at  $V_{CC} = 2.3\text{V}$  to 3.0V
- Latch-up performance exceeds 100mA per JESD 78, Class II
- ESD Performance tested per JESD22
  - 2000V Human-body model (A114-B, Class II)
  - 200V Machine model (A115-A)
  - 1000V Charged-device model (C101)



#### Description

The STG3159 is a high-speed CMOS low voltage single analog S.P.D.T. (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 1.65V to 4.3V, making this device ideal for portable applications.

The device offers very low ON-Resistance (1Ω) at  $V_{CC} = 4.3\text{V}$ . The SEL inputs are provided to control the switch. The switch S1 is ON (they are connected to common Ports Dn) 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 exists 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.

#### Order codes

Part number	Package	Packaging
STG3159DTR	DFN6L (1.2mm x 1mm)	Tape and Reel

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# 1 Pin connections and functions

Figure 1. Pin connections (top through view)

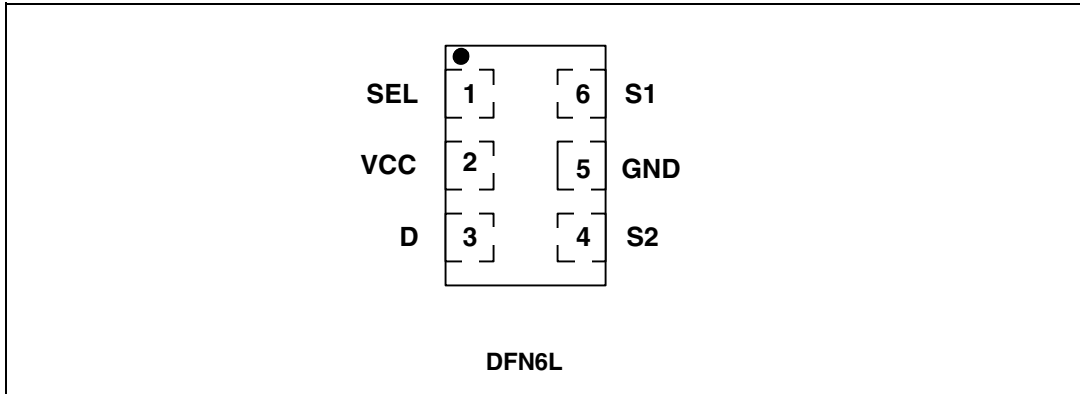


Table 1. Truth table

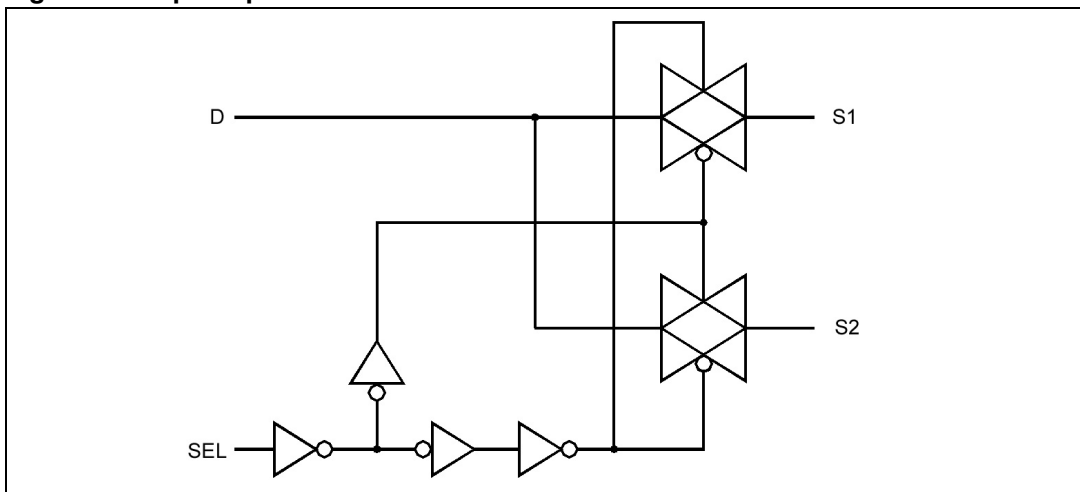
Sel	Switch S1	Switch S2
H	ON	OFF <sup>(1)</sup>
L	OFF <sup>(1)</sup>	ON

1. High impedance

Table 2. Pin descriptions

Pin N°	Symbol	Name and function
6, 4	S1, S2	Independent channels
3	D	Common channels
1	SEL	Control
2	V <sub>CC</sub>	Positive supply voltage
5	GND	Ground (0V)

Figure 2. Input equivalent circuit



## 2 Electrical ratings

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 3. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	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 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 ( $V_{SEL} < 0V$ )	-50	mA
$I_{IK}$	DC Input diode current ( $V_{SEL} < 0V$ )	$\pm 50$	mA
$I_{OK}$	DC Output diode current	$\pm 20$	mA
$I_O$	DC Output current	$\pm 200$	mA
$I_{OP}$	DC Output current peak (pulse at 1ms, 10% duty cycle)	$\pm 400$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or ground current	$\pm 100$	mA
$P_D$	Power dissipation at $T_A = 70^\circ C$ <sup>(1)</sup>	1120	mW
$T_{stg}$	Storage temperature	-65 to 150	$^\circ C$
$T_L$	Lead temperature (10 sec)	300	$^\circ C$

1. Derate above 70°C by 18.5mW/C

**Table 4. Recommended operating conditions**

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply voltage <sup>(1)</sup>	1.65 to 4.5	V	
$V_I$	Input voltage	0 to $V_{CC}$	V	
$V_{IC}$	Control input voltage	0 to 4.5	V	
$V_O$	Output voltage	0 to $V_{CC}$	V	
$T_{op}$	Operating temperature	-55 to 125	$^\circ C$	
dt/dv	Input rise and fall time control input	$V_{CC} = 1.65V$ to $2.7V$	0 to 20	ns/V
		$V_{CC} = 3.0$ to $4.5V$	0 to 10	

1. Truth table guaranteed: 1.2V to 4.5V

### 3 Electrical characteristics

#### 3.1 DC electrical characteristics

Table 5. DC specifications

Symbol	Parameter	Test conditions		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IH</sub>	High level input voltage	1.65-1.95		0.65V <sub>CC</sub>			0.65V <sub>CC</sub>		0.65V <sub>CC</sub>		V
		2.3-2.5		1.2			1.2		1.2		
		2.7-3.0		1.3			1.3		1.3		
		3.3-3.6		1.4			1.4		1.4		
		4.3		1.6			1.6		1.6		
V <sub>IL</sub>	Low level input voltage	1.65-1.95				0.40		0.40		0.40	V
		2.3-2.5				0.60		0.60		0.60	
		2.7-3.0				0.60		0.60		0.60	
		3.3-3.6				0.60		0.60		0.60	
		4.3				0.80		0.80		0.80	
R <sub>PEAK</sub>	Switch ON peak resistance	1.8	V <sub>S</sub> = 0V to V <sub>CC</sub> I <sub>S</sub> = 100mA		2.2	3.0		3.5			Ω
		2.7			1.3	1.6		1.8			
		3.0			1.2	1.5		1.7			
		4.3			1.1	1.2		1.4			
R <sub>ON</sub>	Switch On resistance	1.8	V <sub>S</sub> = 0.9V I <sub>S</sub> = 100mA		1.7	2.3		2.7			Ω
		2.7	V <sub>S</sub> = 1.3V I <sub>S</sub> = 100mA		1.2	1.5		1.7			
		3.0	V <sub>S</sub> = 1.5V I <sub>S</sub> = 100mA		1.1	1.2		1.6			
		4.3	V <sub>S</sub> = 2.5V I <sub>S</sub> = 100mA		1.0	1.1		1.3			
ΔR <sub>ON</sub>	ON resistance match between channels <sup>(1)</sup>	1.8	V <sub>S</sub> @ R <sub>ON</sub> Max I <sub>S</sub> = 100mA		0.06						Ω
		2.7			0.05						
		3.0			0.05						
		4.3			0.05						
R <sub>FLAT</sub>	ON resistance flatness <sup>(2)</sup>	1.8	V <sub>S</sub> = 0V to V <sub>CC</sub> I <sub>S</sub> = 100mA		1.0	1.5		1.5			Ω
		2.7			0.45	0.60		0.70			
		3.0			0.40	0.50		0.60			
		4.3			0.37	0.50		0.60			

Table 5. DC specifications (continued)

Symbol	Parameter	Test conditions		Value						Unit	
		Vcc (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
I <sub>OFF</sub>	OFF state leakage current (SN), (D)	4.3	V <sub>S</sub> = 0.3 or 4V			±20		±100			nA
I <sub>IN</sub>	Input leakage current	0 – 4.3	V <sub>SEL</sub> = 0 to 4.3V			±0.1		±1			μA
I <sub>CC</sub>	Quiescent supply current	1.65 – 4.3	V <sub>SEL</sub> = V <sub>CC</sub> or GND			±0.05		±0.2		±1	μA
I <sub>CCLV</sub>	Quiescent supply current low voltage driving	4.3	V <sub>SEL</sub> = 1.65V		±17	±35		±70			μA
		4.3	V <sub>SEL</sub> = 1.80V		±15	±30		±60			
		4.3	V <sub>SEL</sub> = 2.60V		±5	±10		±20			

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.

### 3.2 AC electrical characteristics

**Table 6. AC Electrical characteristics** ( $C_L = 35\text{pF}$ ,  $R_L = 50\Omega$ ,  $t_r = t_f \leq 5\text{ns}$ )

Symbol	Parameter	Test conditions		Value						Unit	
		Vcc (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation delay	1.65-1.95	V <sub>S</sub> = OPEN		0.15						ns
		2.3-2.7			0.14						
		3.0-3.3			0.13						
		3.6-4.3			0.13						
t <sub>ON</sub>	Turn-ON time	1.65-1.95	V <sub>S</sub> = 0.8V		36						ns
		2.3-2.7	V <sub>S</sub> = 1.5V		22	32		42			
		3.0-3.3			16	26		36			
		3.6-4.3			13	23		33			
t <sub>OFF</sub>	Turn-OFF time	1.65-1.95	V <sub>S</sub> = 0.8		29						ns
		2.3-2.7	V <sub>S</sub> = 1.5V		17	27		37			
		3.0-3.3			12	23		33			
		3.6-4.3			11	21		31			
t <sub>D</sub>	Break before make time delay	1.65-1.95	C <sub>L</sub> = 35pF R <sub>L</sub> = 50Ω V <sub>S</sub> = 1.5V		15						ns
		2.3-2.7			10						
		3.0-3.3			8						
		3.6-4.3			6						
Q	Charge injection	1.65	C <sub>L</sub> = 100pF V <sub>GEN</sub> = 0V R <sub>GEN</sub> = 0Ω		16						pC
		2.3			22						
		3			26						
		4.3			33						

### 3.3 Analog switch characteristics

**Table 7. Analog switch characteristics** ( $C_L = 5\text{pF}$ ,  $R_L = 50\Omega$ ,  $T_A = 25^\circ\text{C}$ )

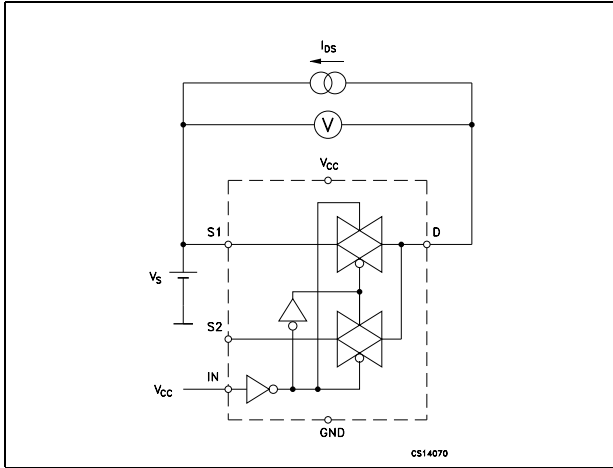
Symbol	Parameter	Test conditions		Value						Unit		
		Vcc (V)		$T_A = 25^\circ\text{C}$			$-40 \text{ to } 85^\circ\text{C}$		$-55 \text{ to } 125^\circ\text{C}$			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
OIRR	Off Isolation (1)	1.65-4.3	$V_S = 1V_{RMS}$ $f = 100\text{kHz}$		-80							dB
Xtalk	Crosstalk	1.6-4.3	$V_S = 1V_{RMS}$ $f = 100\text{kHz}$		-80							dB
THD	Total harmonic distortion	2.3-4.3	$R_L = 600\Omega$ $V_S = 2V_{PP}$ $f = 20\text{Hz to } 20\text{kHz}$		0.03							%
BW	-3dB bandwidth	1.65-4.3	$R_L = 50\Omega$		150							MHz
$C_{IN}$	Control pin input capacitance				6							pF
$C_{ON}$	Sn port capacitance when switch is enabled	3.3	$f = 1\text{MHz}$		52							
$C_{OFF}$	Sn port capacitance when switch is disabled	3.3	$f = 1\text{MHz}$		25							
$C_D$	D Port Capacitance when Switch is Enabled	3.3	$f = 1\text{MHz}$		50							

1. OFF Isolation =  $20\text{Log}_{10} (V_D/V_S)$ ,  $V_D$  = output.  $V_S$  = input to OFF switch.

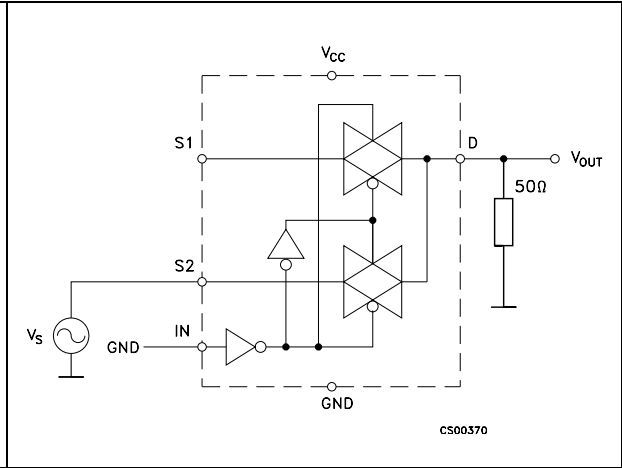


# 4 Test circuits

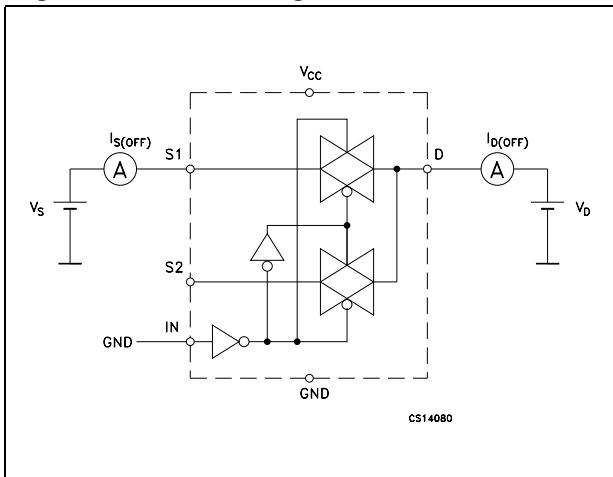
**Figure 3. ON-Resistance**



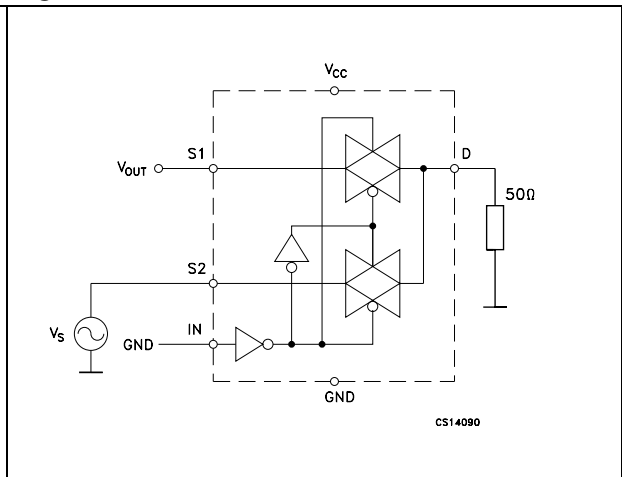
**Figure 4. Bandwidth**



**Figure 5. OFF Leakage**



**Figure 6. Channel to channel crosstalk**



**Figure 7. OFF Isolation**

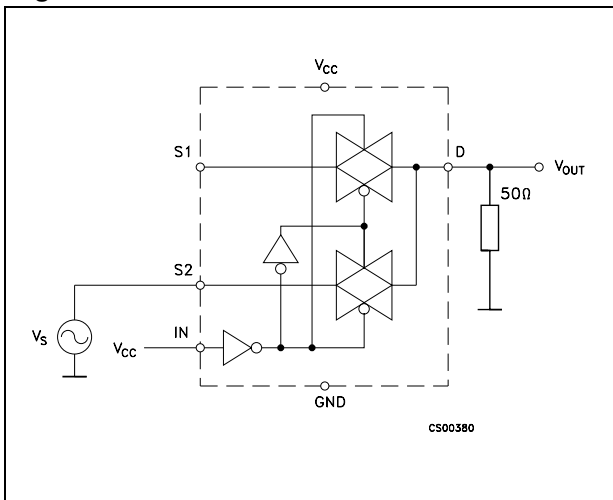
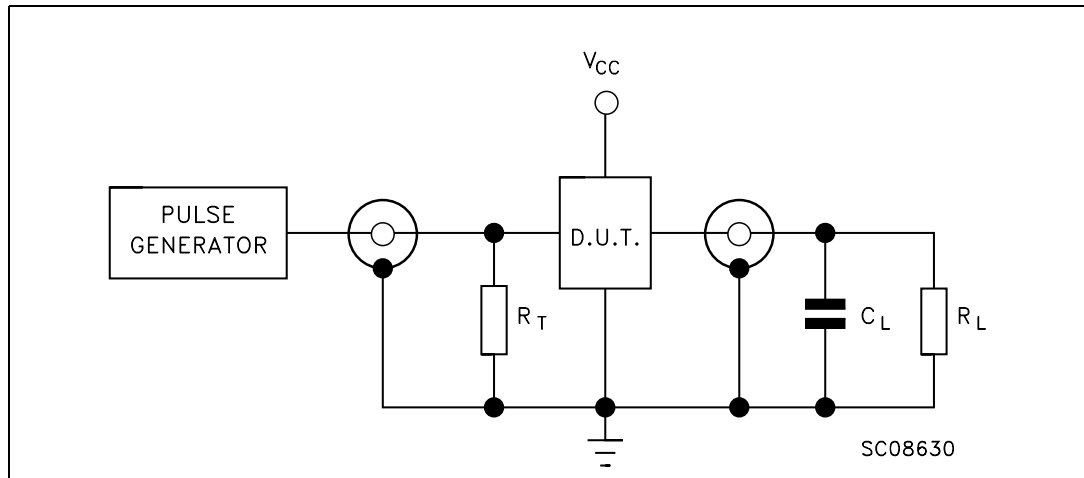


Figure 8. Test circuit



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

Figure 9. Break-before-make time delay

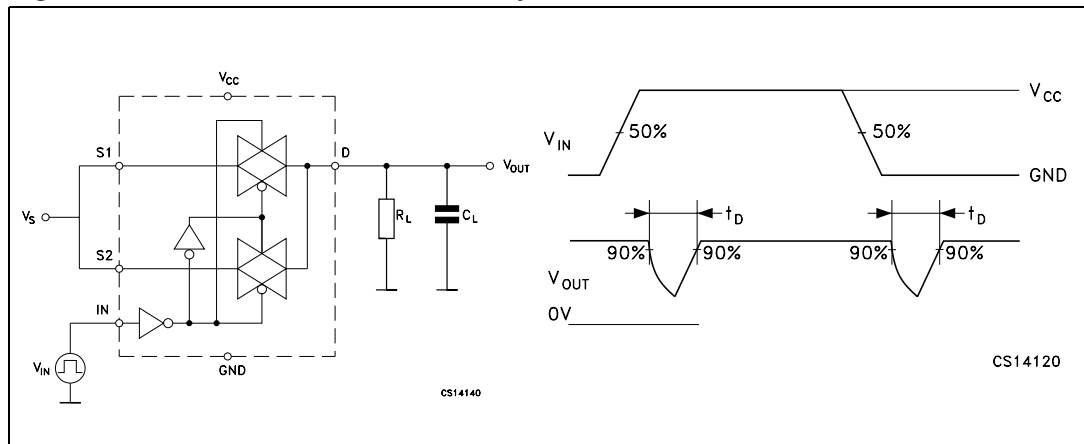


Figure 10. Switching time and charge injection  
 $(V_{GEN} = 0V, R_{GEN} = 0\Omega, R_L = 1M\Omega, C_L = 100\text{pF})$

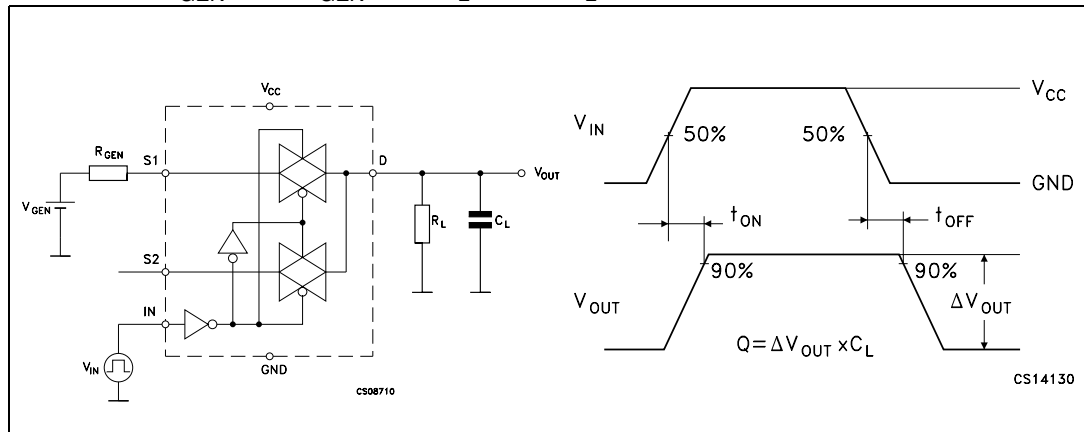
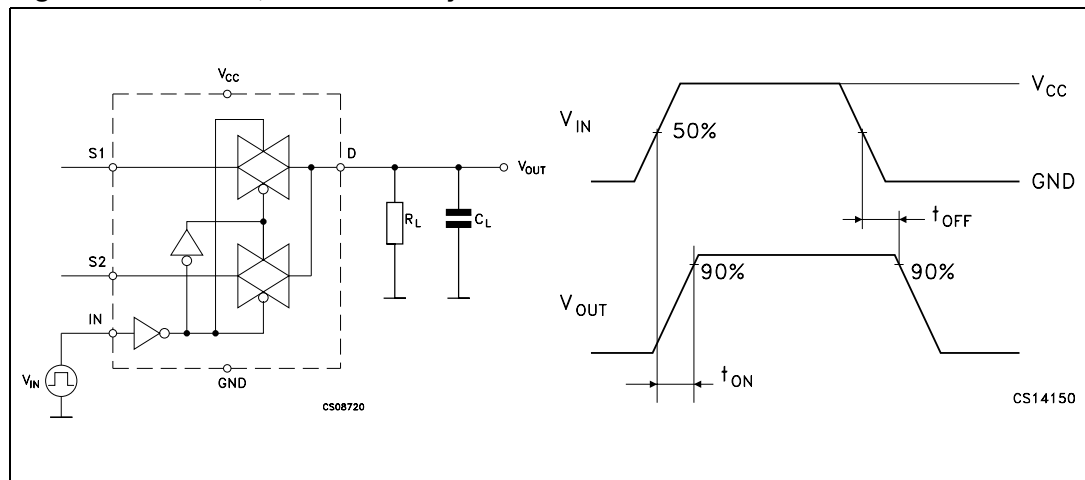


Figure 11. Turn ON, turn OFF delay time



## 5 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](http://www.st.com)

**Table 8. DFN6 (1.2mm x 1mm) Mechanical data**

Dim.	mm.			inch		
	Typ.	Min.	Max.	Typ.	Min.	Max.
A	0.50	0.45	0.55	0.019	0.017	0.021
A1	0.02	0	0.05	0.001	0	0.002
A3	0.127			0.005		
b	0.20	0.15	0.25	0.007	0.006	0.010
D	1.20	1.10	1.30	0.047	0.043	0.051
E	1	0.90	1.10	0.039	0.035	0.043
e	0.40			0.015		
L	0.35	0.30	0.40	0.013	0.011	0.015
L1	0.45	0.40	0.50	0.017	0.015	0.019

**Figure 12. Package dimensions**

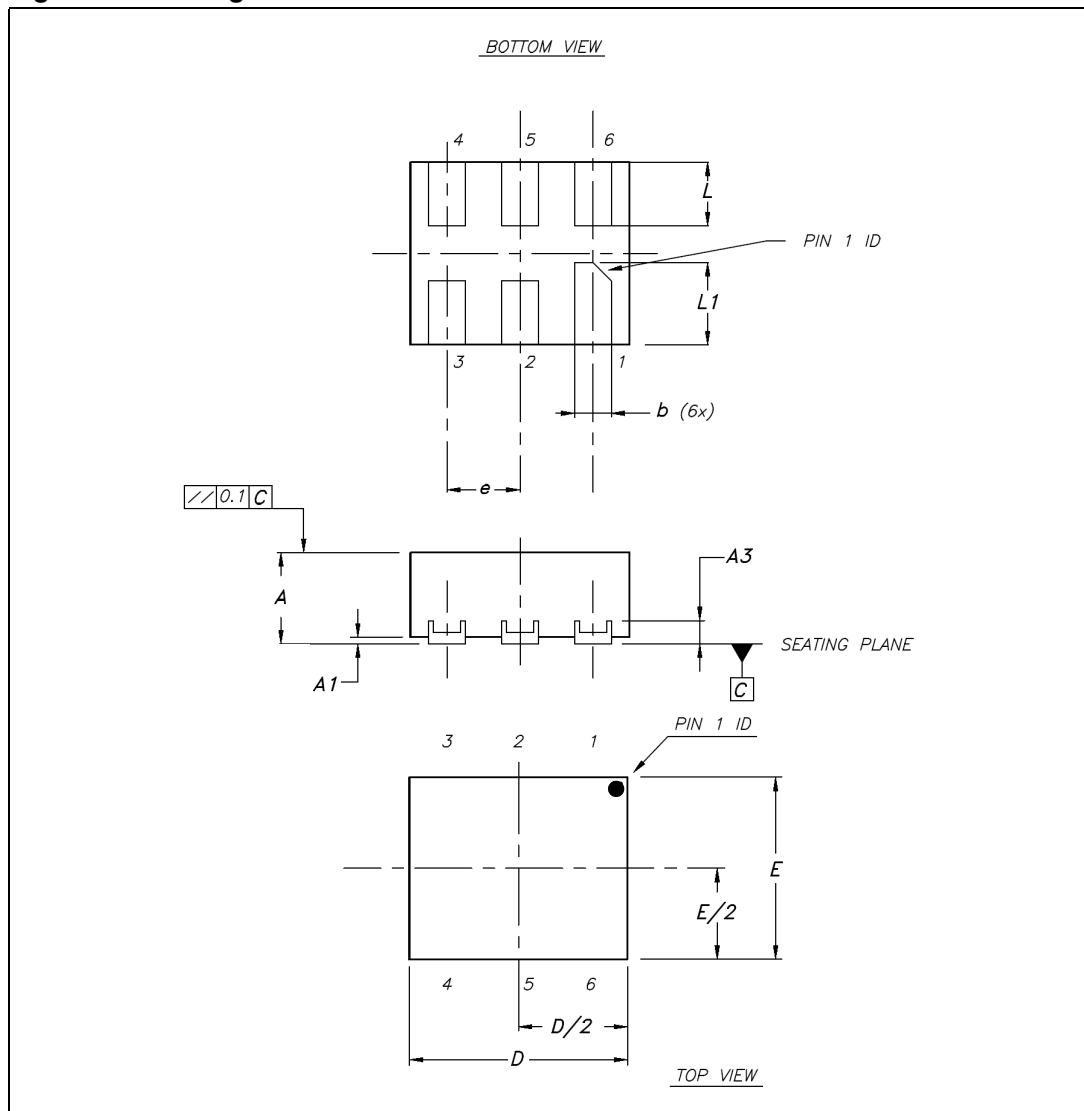
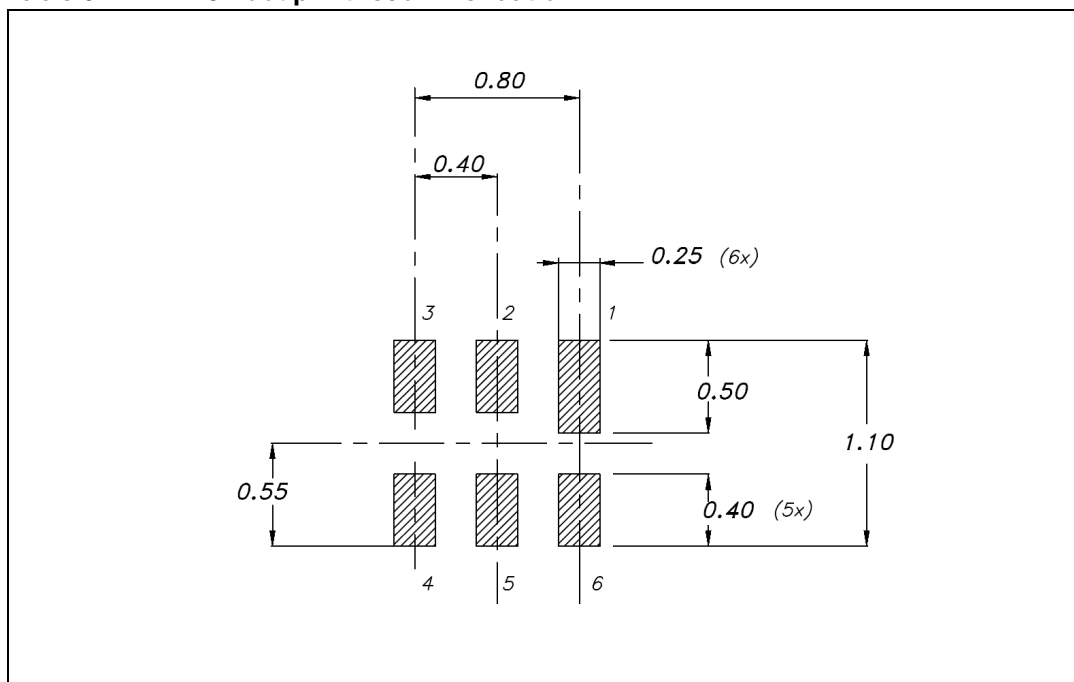


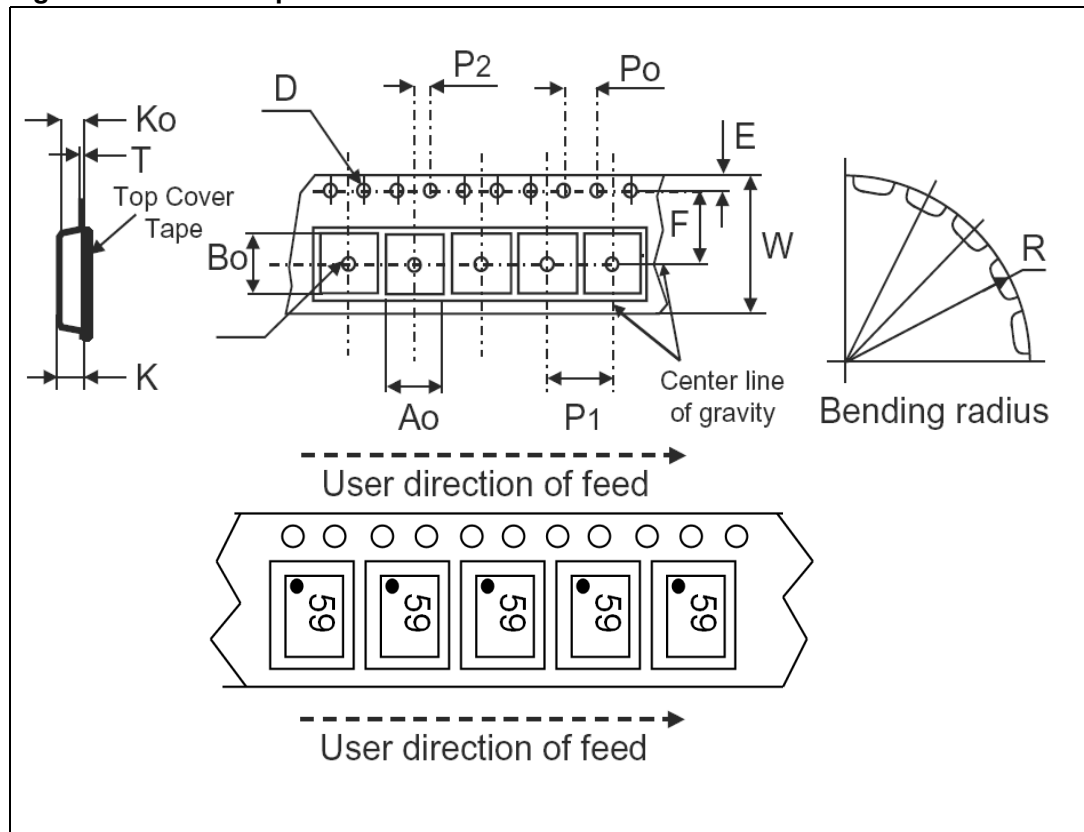
Table 9. DFN6 Foot print recommendation



**Table 10. DFN6L Tape information**

Dim	mm.	inch
D	1.50 +0.1/0	0.059 +0.004/0
E	1.75 ±0.1	0.069 ±0.004
Po	4.00 ±0.1	0.157 ±0.004
T max.	0.40	0.016
D1 min.	1	0.039
F	3.5 ±0.05	0.138 ±0.002
K max.	2.40	0.094
P2	2.00 ±0.05	0.079 ±0.002
R	25	0.984
W	8.00 ±0.30	0.315 ±0.012
P1	4.00	0.157
Ao, Bo, Ko	0.05 min to 0.50 max.	0.002 min to 0.020 max.

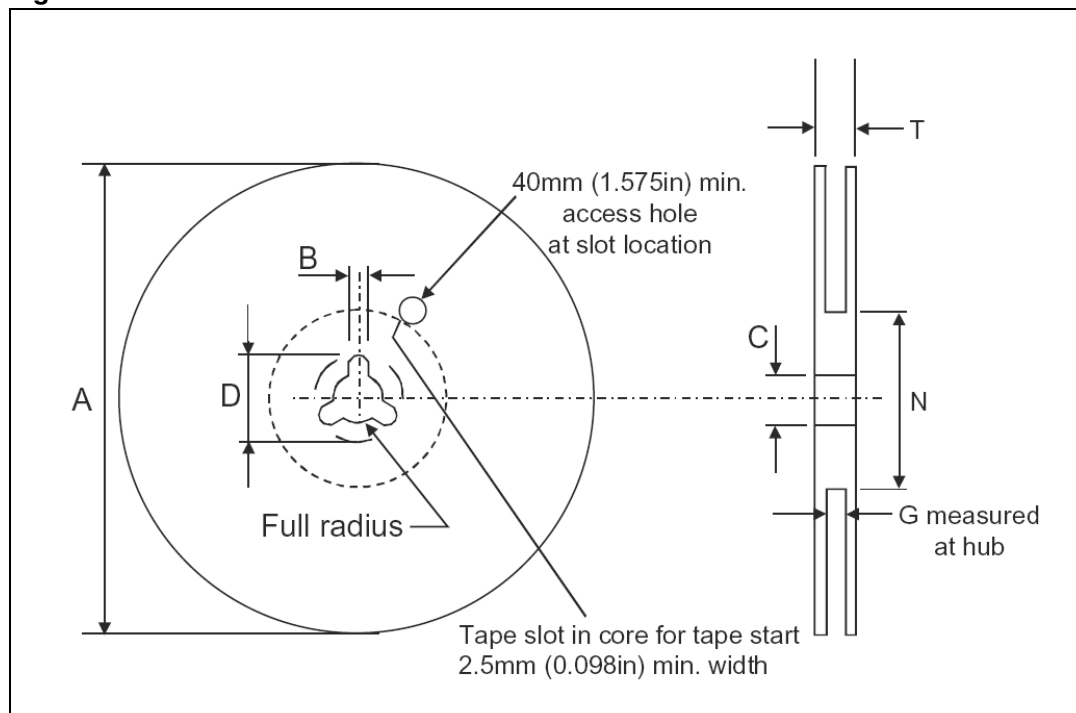
**Figure 13. DFN6L Tape information**



**Table 11. DFN6L Reel information**

Dim	mm.	inch
Tape size	8.0 ±0.30	0.315 ±0.012
A max.	180.0	7.086
B min.	1.5	0.059
C	13.0 ±0.20	0.512 ±0.008
D min.	20.2	0.795
N min.	60	2.362
G	8.4 +2/-0	0.319 +0.079/-0
T max.	14.4	0.567

**Figure 14. DFN6L Reel information**





## 6 Revision history

Table 12. Revision history

Date	Revision	Changes
06-Dec-2006	1	First release

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