

## Low voltage low on-resistance SPDT switch with break-before-make feature



SOT323-6L

### Features

- High speed:
  - $t_{PD} = 0.3 \text{ ns}$  (max) at  $V_{CC} = 4.5 \text{ V}$
  - $t_{PD} = 0.8 \text{ ns}$  (max) at  $V_{CC} = 3.0 \text{ V}$
  - $t_{PD} = 1.2 \text{ ns}$  (max) at  $V_{CC} = 2.3 \text{ V}$
- Ultra low power dissipation:
  - $I_{CC} = 1 \mu\text{A}$  (max) at  $T_A = 85 \text{ }^\circ\text{C}$
- Low on-resistance; at  $V_{IN} = 0 \text{ V}$ :
  - $R_{ON} = 7 \Omega$  (max  $T_A = 85 \text{ }^\circ\text{C}$ ) at  $V_{CC} = 4.5 \text{ V}$
  - $R_{ON} = 9 \Omega$  (max  $T_A = 85 \text{ }^\circ\text{C}$ ) at  $V_{CC} = 3.0 \text{ V}$
- Wide operating voltage range:
  - $V_{CC} \text{ (OPR)} = 1.65 \text{ V to } 5.5 \text{ V}$  single supply
- TTL threshold ON control input at  $V_{CC} = 2.7 \text{ to } 3.6 \text{ V}$
- Pin and function compatible with 74 series 3157
- Latch-up performance exceeds 150 mA (JESD 17)

### Description

The **STG3157** is a high-speed CMOS analog SPDT (single-pole double-throw) switch or 2:1 multiplexer/demultiplexer bus switch manufactured using silicon gate CMOS technology. It is designed to operate from a 1.65 V to 5.5 V supply, making the device ideal for portable applications.

The **STG3157** features very low on-resistance ( $< 9 \Omega$ ) at  $V_{CC} = 3.0 \text{ V}$ . The IN input is provided to control the SPDT switch, and is compatible with standard CMOS output. Switch S1 is ON (connected to common port D) when the IN input is held high, and OFF (a high impedance state exists between the two ports) when IN is held low.

Switch S2 is ON (connected to common port D) when the IN input is held low and OFF (a high impedance state exists between the two ports) when IN is held high.

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

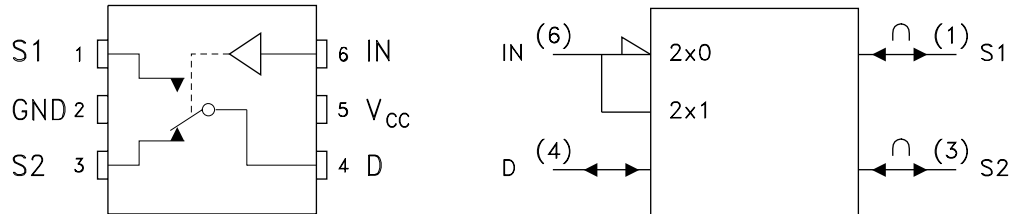
#### Maturity status link

[STG3157](#)

#### Device summary

<b>Order code</b>	STG3157CTR
<b>Package</b>	SOT323-6L
<b>Packing</b>	Tape and reel

# 1 Pin configuration

**Figure 1. Pin connections and IEC logic symbols**

**Table 1. Truth table**

IN	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
1, 3	S1, S2	Independent channels
4	D	Common channels
6	IN	Control
5	VCC	Positive supply voltage
2	GND	Ground (0 V)



## 2 Maximum ratings

Stressing the device above the ratings 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 +7.0	V
$V_I$	DC input voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{IC}$	DC control input voltage	-0.5 to $V_{CC} + 0.5$	V
$V_O$	DC output voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{IKC}$	DC input diode current on control pin ( $V_{IN} < 0$ V)	$\pm 50$	mA
$I_{IK}$	DC input diode current ( $V_{IN} < 0$ V)	$\pm 50$	mA
$I_{OK}$	DC output diode current	$\pm 20$	mA
$I_O$	DC output current	+128	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or ground current	$\pm 100$	mA
$T_{stg}$	Storage temperature	-65 to 150	°C
$T_L$	Lead temperature (10 s)	300	°C

**Table 4. Recommended operating conditions**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage <sup>(1)</sup>	1.65 to 5.5	V
$V_I$	Input voltage	0 to $V_{CC}$	V
$V_{IC}$	Control input voltage	0 to 5.5	V
$V_O$	Output voltage	0 to $V_{CC}$	V
$T_{op}$	Operating temperature	-55 to 125	°C
dt/dv	Input rise and fall time control input	$V_{CC} = 1.65$ V to 2.7 V	0 to 20
		$V_{CC} = 3.0$ to 4.5 V	0 to 10

1. Truth table guaranteed: 1.2 V to 6.0 V

### 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		0.75V <sub>C</sub>			0.75V <sub>CC</sub>			0.75V <sub>CC</sub>	V
		2.3-2.5		0.7V <sub>CC</sub>			0.7V <sub>CC</sub>			0.7V <sub>CC</sub>	
		2.7-3.6		2			2			2	
V <sub>IL</sub>	Low level input voltage	1.65-1.95				0.25V <sub>CC</sub>		0.25V <sub>CC</sub>		0.25V <sub>CC</sub>	V
		2.3-2.5				0.3V <sub>CC</sub>		0.3V <sub>CC</sub>		0.3V <sub>CC</sub>	
		2.7-3.6				0.8		0.8		0.8	
R <sub>ON</sub>	Switch on-resistance	4.5	V <sub>S</sub> = 0 V I <sub>S</sub> = 30 mA		4.4	7		7		9	Ω
			V <sub>S</sub> = 2.4 V I <sub>S</sub> = 30 mA		4.9	12		12		14.5	
			V <sub>S</sub> = 4.5 V I <sub>S</sub> = 30 mA		6.1	15		15		18	
		3.0	V <sub>S</sub> = 0 V I <sub>S</sub> = 100 mA		5.2	9		9		11	
			V <sub>S</sub> = 3 V I <sub>S</sub> = 24 mA		7.8	20		20		24	
		2.3	V <sub>S</sub> = 0 V I <sub>S</sub> = 8 mA		6.5	12		12		14.5	
			V <sub>S</sub> = 2.3 V I <sub>S</sub> = 8 mA		9.6	30		30		36	
		1.65	V <sub>S</sub> = 0 V I <sub>S</sub> = 4 mA		9.0	20		20		24	
			V <sub>S</sub> = 1.65 V I <sub>S</sub> = 4 mA		14	50		50		60	

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.
$\Delta R_{ON}$	On-resistance match between channels	4.5	V <sub>S</sub> = 3.15 V I <sub>S</sub> = 30 mA		0.10						Ω
		3.0	V <sub>S</sub> = 2.1 V I <sub>S</sub> = 24 mA		0.10						
		2.3	V <sub>S</sub> = 1.6 V I <sub>S</sub> = 8 mA		0.20						
		1.65	V <sub>S</sub> = 1.15 V I <sub>S</sub> = 4 mA		0.35						
R <sub>FLAT</sub>	On-resistance flatness	5.0	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 30 mA		3						Ω
		3.3	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 24 mA		6						
		2.5	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 8 mA		14						
		1.8	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 4 mA		80						
I <sub>OFF</sub>	OFF state leakage current	1.65 - 195	V <sub>S</sub> = 0 to V <sub>CC</sub>		±0.05	±0.1		± 1		± 10	μA
I <sub>IN</sub>	Input leakage current	0 - 5.5	V <sub>IN</sub> = 0 to 5.5 V		±0.05	±0.1		± 1		± 10	μA
I <sub>CC</sub>	Quiescent supply current	1.65 - 4.3	V <sub>IN</sub> = V <sub>CC</sub> or GND			1		1		10	μA

### 3.2 AC Electrical characteristics

 $C_L = 50 \text{ pF}$ ,  $R_L = 500 \text{ } \Omega$ 
**Table 6. AC specification**

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.
t <sub>LH</sub> , t <sub>HL</sub>	Propagation delay	1.65-1.95	V <sub>I</sub> = Open								ns
		2.3-2.7				1.2		1.2		1.8	
		3.0-3.3				0.8		0.8		1.2	
		4.5-5.5				0.3		0.3		0.5	
t <sub>PZH</sub> , t <sub>PZL</sub>	Output enable time (D to Sn)	1.65-1.95		7		15	7	20	7	27	ns
		2.3-2.7		3.5		11	3.5	14	3.5	17	
		3.0-3.3		2.5		7	2.5	7.6	2.5	9	
		4.5-5.5		1.7		5.2	1.7	5.7	1.7	7	
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Output disable time (D to Sn)	1.65-1.95		3		10	3	13	3	16	ns
		2.3-2.7		2		7	2	7.5	2	9	
		3.0-3.3		1.5		5	1.5	5.3	1.5	6.5	
		4.5-5.5		1.7		3.5	1.7	3.8	1.7	5	
t <sub>D</sub>	Break-before-make time delay	1.65-5.5		0.5			0.5		0.5		ns
Q	Charge injection	5			23						pC
		3.3			19						

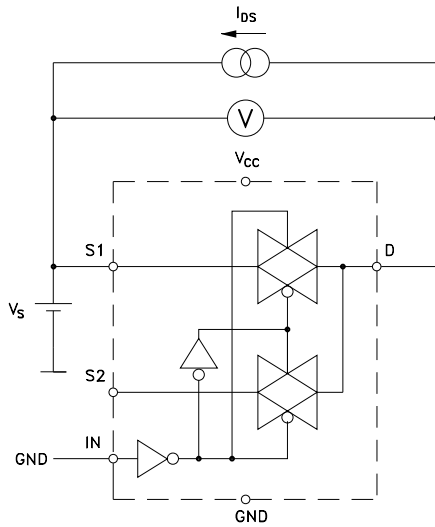
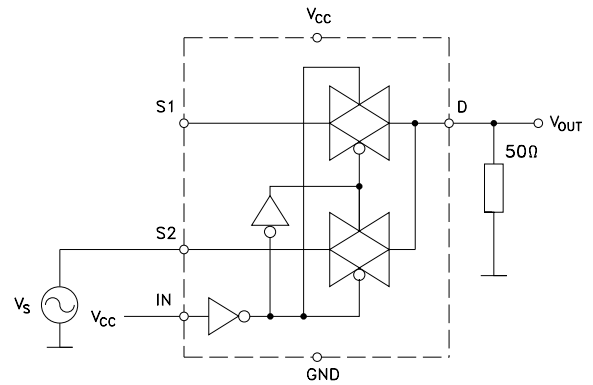
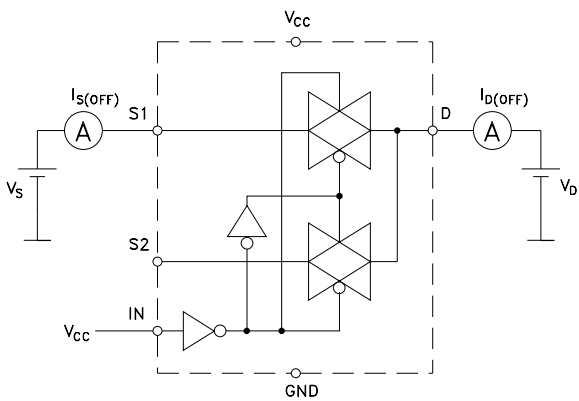
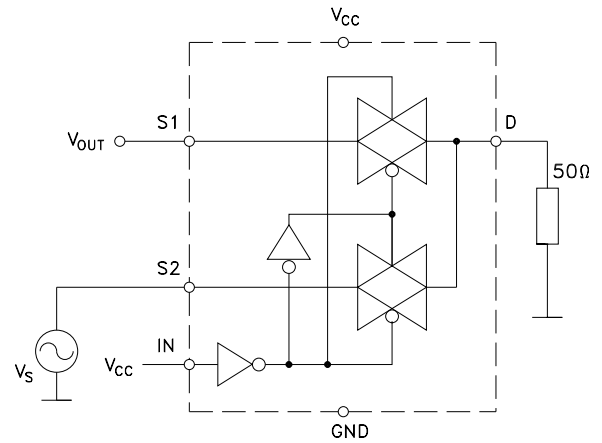
### 3.3 Analog switch characteristics

 $C_L = 5 \text{ pF}$ ,  $R_L = 50 \text{ } \Omega$ , T<sub>A</sub> = 25 °C

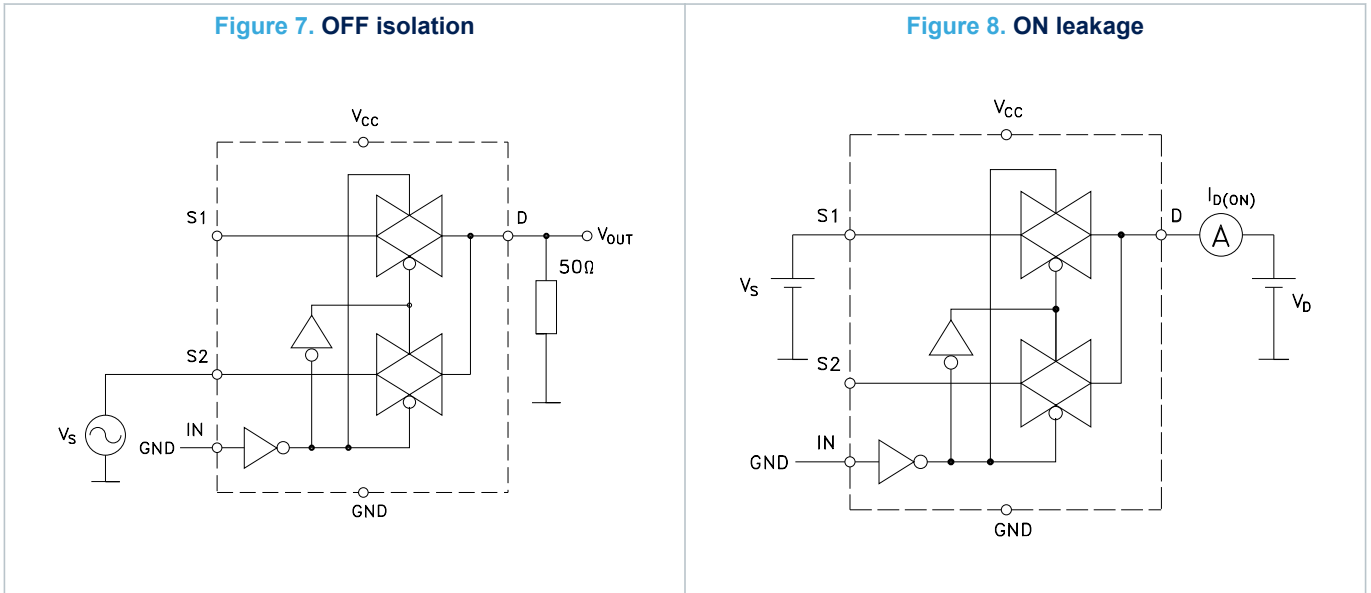
**Table 7. Analog switch characteristics**

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.
OIRR	Off isolation	1.65-5.5	R <sub>L</sub> = 50 Ω f = 10 MHz		-57						dB
Xtalk	Crosstalk	1.65-5.5	R <sub>L</sub> = 50 Ω f = 10 MHz		-54						dB
BW	- 3 dB bandwidth	1.65-5.5	R <sub>L</sub> = 50 Ω		250						MHz
C <sub>IN</sub>	Control pin input capacitance				5						pF
CS <sub>n</sub>	Sn port capacitance	5.0	f = 1 MHz		13						
C <sub>D</sub>	D port capacitance when switch is enabled	5.0	f = 1 MHz		21						

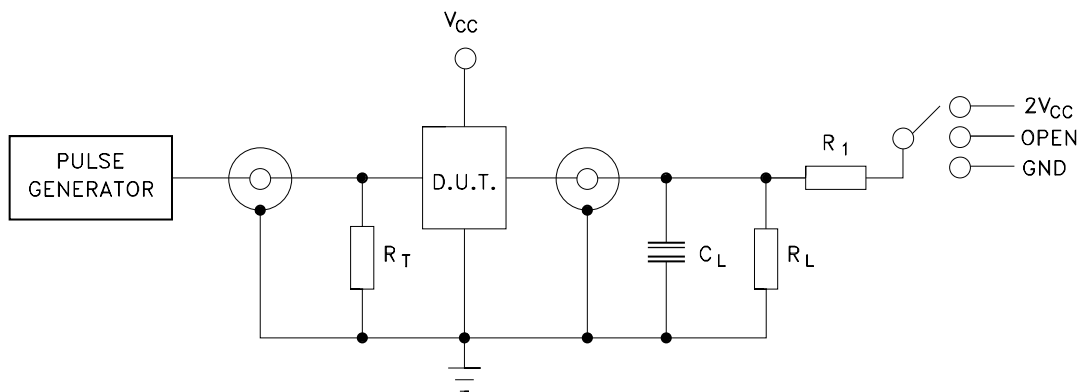
## 4 Test circuits

**Figure 3. On-resistance**

**Figure 4. Bandwidth**

**Figure 5. OFF leakage**

**Figure 6. Channel-to-channel crosstalk**






**Figure 9. Test circuit**



**Table 8. Test circuit**

Test	Switch
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$	$V_{CC}$
$t_{PZH}$ , $t_{PHZ}$	GND

*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  $50 \Omega$ )

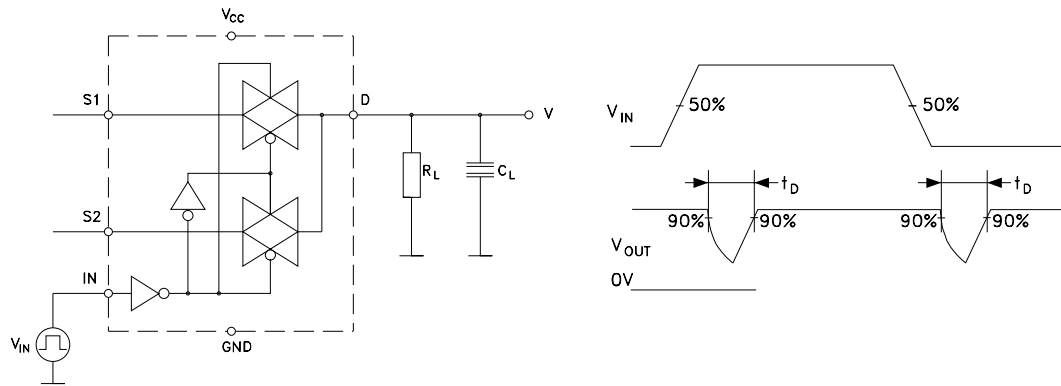
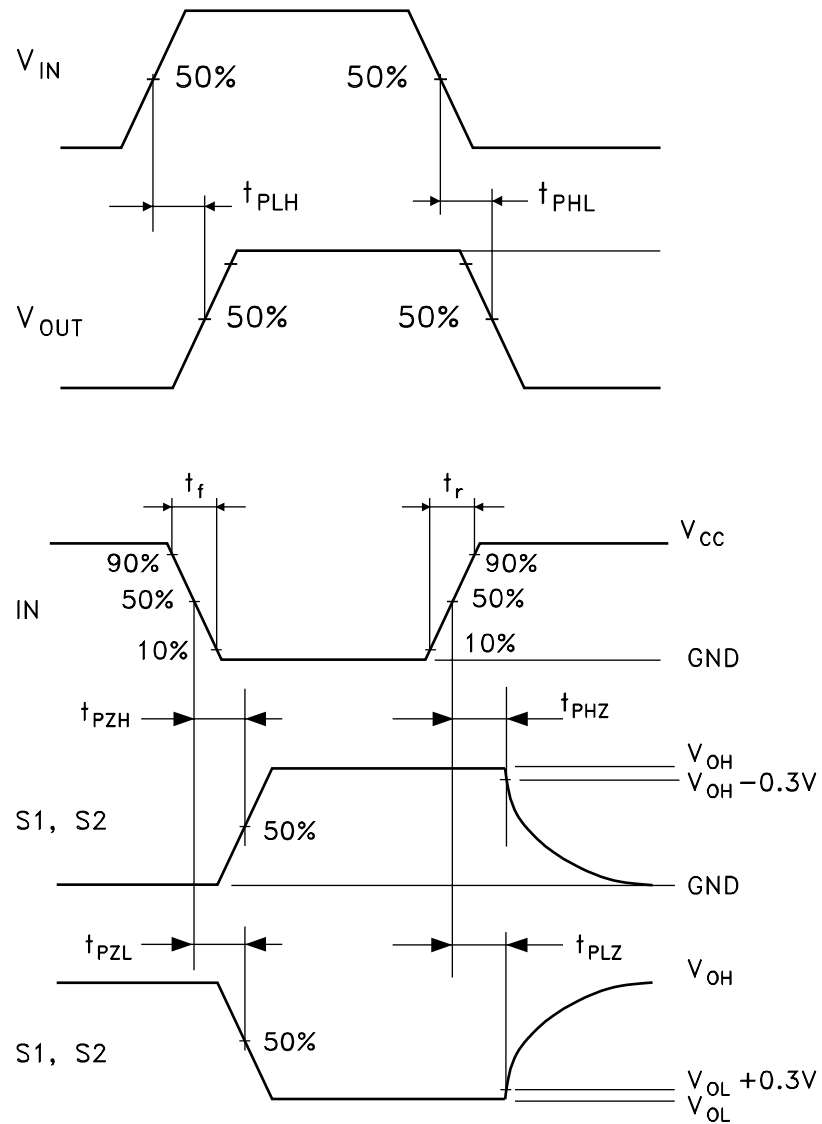
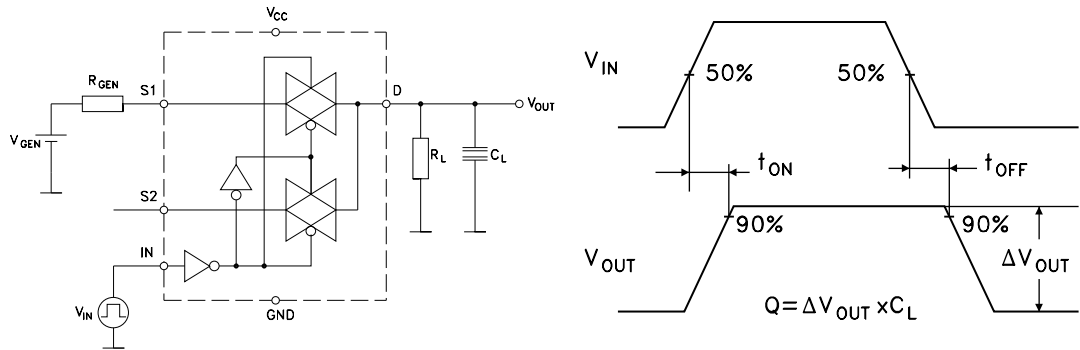
**Figure 10. Break-before-make time delay**

**Figure 11. Switching time and charge injection**


Figure 12. Charge injection ( $V_{GEN} = 0\text{ V}$ ,  $R_{GEN} = 0\ \Omega$ ,  $R_L = 1\text{ M}\Omega$ ,  $C_L = 100\text{ pF}$ )



## 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 SOT323-6L package information

Figure 13. SOT323-6L package drawing outline

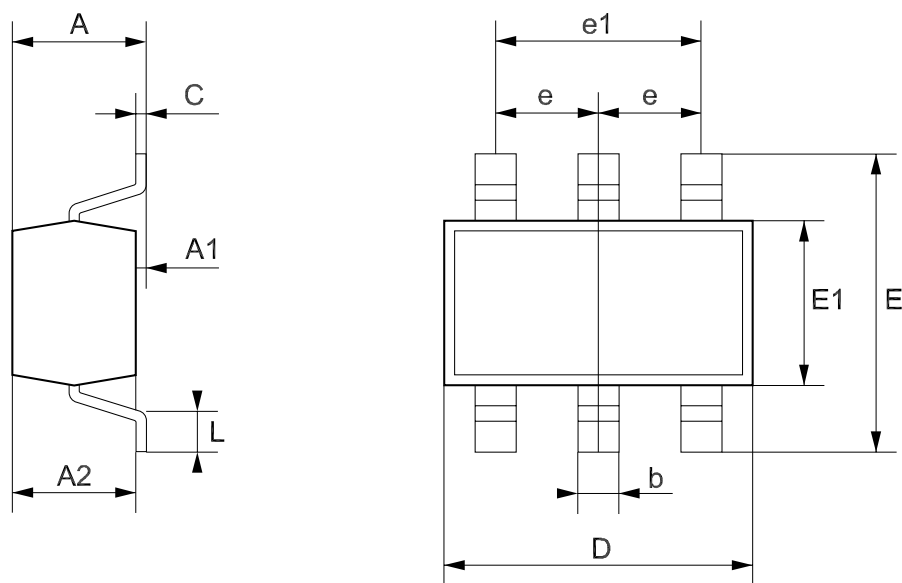


Table 9. SOT323-6L mechanical data

Dim.	mm.			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.80		1.10	31.5		43.3
A1	0.00		0.10	0.0		3.9
A2	0.80		1.00	31.5		39.4
b	0.15		0.30	5.9		11.8
C	0.10		0.18	3.9		7.1
D	1.80		2.20	70.9		86.6
E	1.80		2.40	70.9		94.5
E1	1.15		1.35	45.3		53.1
e		0.65			25.6	
e1		1.3			51.2	
L	0.10		0.30	3.9		11.8

Figure 14. SOT323-6L footprint recommendation

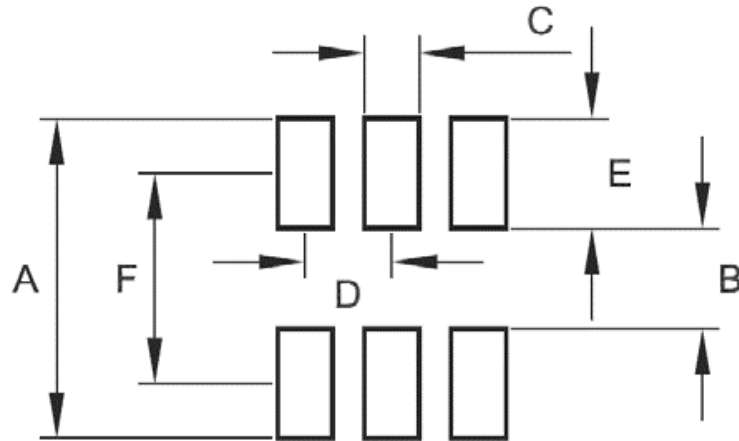
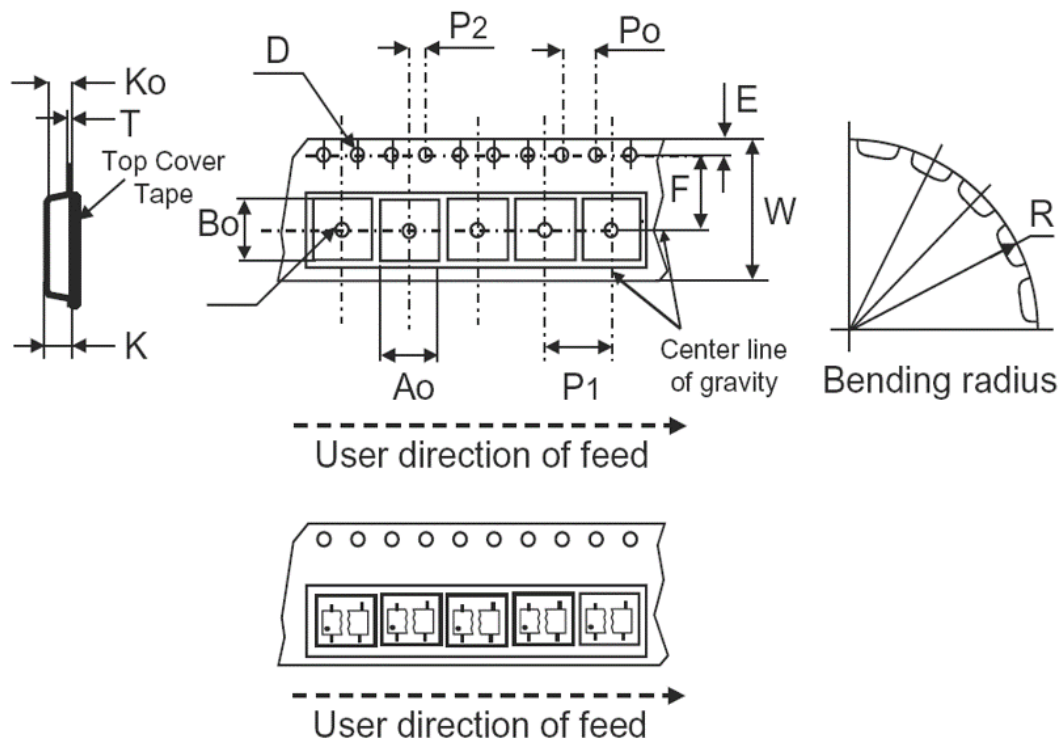


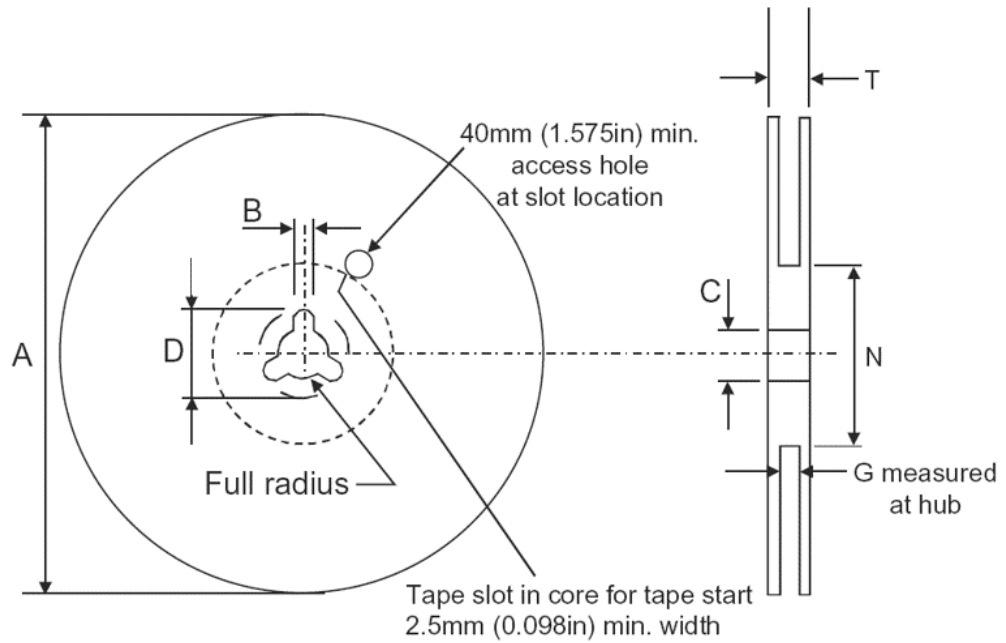
Table 10. SOT323-6L footprint recommendation

Dim.	mm.	inch
A	2.88	0.113
B	0.78	0.031
C	0.36	0.014
D	0.65	0.026
E	1.05	0.041
F	1.65	0.065

## 5.2 SOT323-6L packing information

**Figure 15. SOT323-6L tape information**

**Table 11. SOT323-6L 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 16. SOT323-6L reel information**

**Table 12. SOT323-6L 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

## Revision history

**Table 13. Document revision history**

Date	Revision	Changes
02-Sep-2002	1	Initial release.
19-Apr-2010	2	Document reformatted. In the Features list on the coverage, updated the "Latch-up performance exceeds" value from 300 mA to 150 mA. Minor text changes throughout the document. Replaced Order codes table on the coverage with Table 1: Device summary. Added ECOPACK® statement in Section 5: Package information.
29-Nov-2018	3	Updated $V_{CC}$ value on <a href="#">Table 4. Recommended operating conditions</a> .



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