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



SOT323-6L

Features

- High speed:
  - t_{PD} = 0.3 ns (max) at V_{CC} = 4.5 V
  - t_{PD} = 0.8 ns (max) at V_{CC} = 3.0 V
  - t_{PD} = 1.2 ns (max) at V_{CC} = 2.3 V
- Ultra low power dissipation:
  - I_{CC} = 1 µA (max) at T_A = 85 °C
- Low on-resistance; at V_{IN} = 0 V:
  - R_{ON} = 7 Ω (max T_A = 85 °C) at V_{CC} = 4.5 V
  - R_{ON} = 9 Ω (max T_A = 85 °C) at V_{CC} = 3.0 V
- Wide operating voltage range:
  - V_{CC} (OPR) = 1.65 V to 5.5 V single supply
- TTL threshold ON control input at V_{CC} = 2.7 to 3.6 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 Ω) at V_{CC} = 3.0 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	
Order code	STG3157CTR
Package	SOT323-6L
Packing	Tape and reel

1 Pin configuration

Figure 1. Pin connections and IEC logic symbols

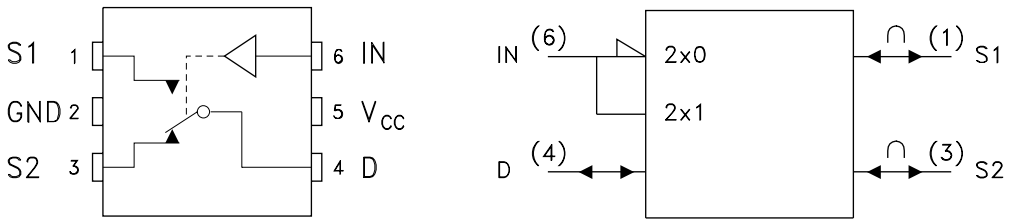


Table 1. Truth table

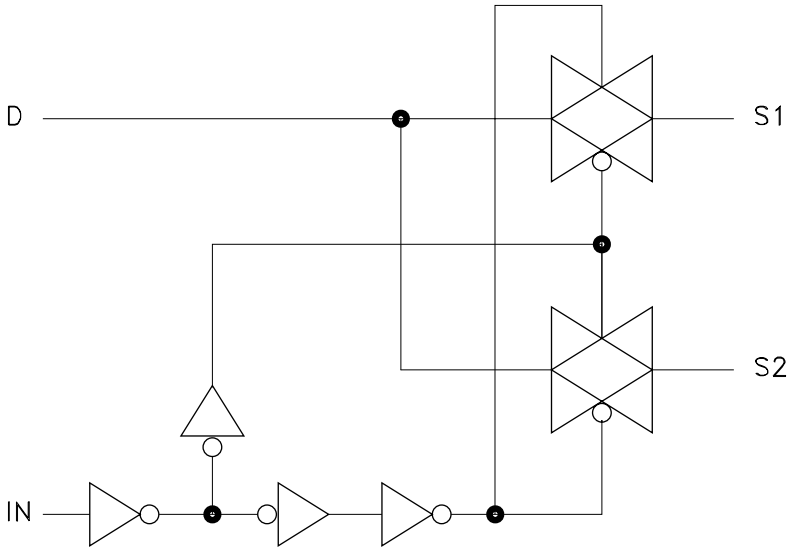
IN	Switch S1	Switch S2
H	ON	OFF (1)
L	OFF (1)	ON

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)

Figure 2. Input equivalent circuit



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 VCC+ 0.5	V
V_{IC}	DC control input voltage	-0.5 to VCC+ 0.5	V
V_O	DC output voltage	-0.5 to VCC+ 0.5	V
I_{IKC}	DC input diode current on control pin (V_{IN} < 0 V)	±50	mA
I_{IK}	DC input diode current (V_{IN} < 0 V)	±50	mA
I_{OK}	DC output diode current	±20	mA
I_O	DC output current	+128	mA
I_{CC} or I_{GND}	DC V_{CC} or ground current	±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 (1)		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	ns/V
		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_{CC} (V)		T_A = 25 °C			-40 to 85 °C		-55 to125 °C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High level input voltage	1.65-1.95		0.75V_{CC}			0.75V_{CC}		0.75V_{CC}		V
		2.3-2.5		0.7V_{CC}			0.7V_{CC}		0.7V_{CC}		
		2.7-3.6		2			2		2		
V_{IL}	Low level input voltage	1.65-1.95				0.25V_{CC}		0.25V_{CC}		0.25V_{CC}	V
		2.3-2.5				0.3V_{CC}		0.3V_{CC}		0.3V_{CC}	
		2.7-3.6				0.8		0.8		0.8	
R_{ON}	Switch on-resistance	4.5	V_S = 0 V I_S = 30 mA		4.4	7		7		9	Ω
			V_S = 2.4 V I_S = 30 mA		4.9	12		12		14.5	
			V_S = 4.5 V I_S = 30 mA		6.1	15		15		18	
		3.0	V_S = 0 V I_S = 100 mA		5.2	9		9		11	
			V_S = 3 V I_S = 24 mA		7.8	20		20		24	
		2.3	V_S = 0 V I_S = 8 mA		6.5	12		12		14.5	
			V_S = 2.3 V I_S = 8 mA		9.6	30		30		36	
		1.65	V_S = 0 V I_S = 4 mA		9.0	20		20		24	
			V_S =1.65 V I_S = 4 mA		14	50		50		60	
ΔR_{ON}	On-resistance match between channels	4.5	V_S = 3.15 V I_S = 30 mA		0.10						Ω
		3.0	V_S = 2.1 V I_S = 24 mA		0.10						
		2.3	V_S = 1.6 V I_S = 8 mA		0.20						
		1.65	V_S= 1.15 V I_S = 4 mA		0.35						

Symbol	Parameter	Test conditions		Value							Unit
		V_{CC} (V)		T_A = 25 °C			-40 to 85 °C		-55 to125 °C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
R_{FLAT}	On-resistance flatness	5.0	V_S = 0 V to V_{CC} I_S = 30 mA		3						Ω
		3.3	V_S = 0 V to V_{CC} I_S = 24 mA		6						
		2.5	V_S = 0 V to V_{CC} I_S = 8 mA		14						
		1.8	V_S = 0 V to V_{CC} I_S = 4 mA		80						
I_{OFF}	OFF state leakage current	1.65 -195	V_S = 0 to V_{CC}		±0.05	±0.1		± 1		± 10	µA
I_{IN}	Input leakage current	0 - 5.5	V_{IN} = 0 to 5.5 V		±0.05	±0.1		± 1		± 10	µA
I_{CC}	Quiescent supply current	1.65 - 4.3	V_{IN} = V_{CC} or GND			1		1		10	µA

3.2 AC Electrical characteristics

C_L = 50 pF, R_L = 500 Ω

Table 6. AC specification

Symbol	Parameter	Test conditions		Value							Unit
		V_{CC}(V)		T_A = 25 °C			-40 to 85 °C		-55 to 125 °C		
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{LH}, t_{HL}	Propagation delay	1.65-1.95	V_I = 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_{PZH}, t_{PZL}	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_{PLZ}, t_{PHZ}	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_D	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 pF, R_L = 50 Ω, T_A = 25 °C

Table 7. Analog switch characteristics

Symbol	Parameter	Test conditions		Value							Unit
		V_{CC} (V)		T_A = 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_L = 50 Ω f = 10 MHz		-57						dB
Xtalk	Crosstalk	1.65-5.5	R_L = 50 Ω f = 10 MHz		-54						dB
BW	- 3 dB bandwidth	1.65-5.5	R_L = 50 Ω		250						MHz
C_{IN}	Control pin input capacitance				5						pF
CS_n	Sn port capacitance	5.0	f = 1 MHz		13						
C_D	D port capacitance when switch is enabled	5.0	f = 1 MHz		21						

4 Test circuits

Figure 3. On-resistance

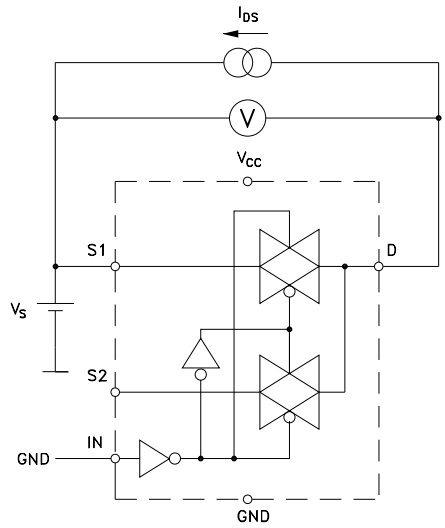


Figure 4. Bandwidth

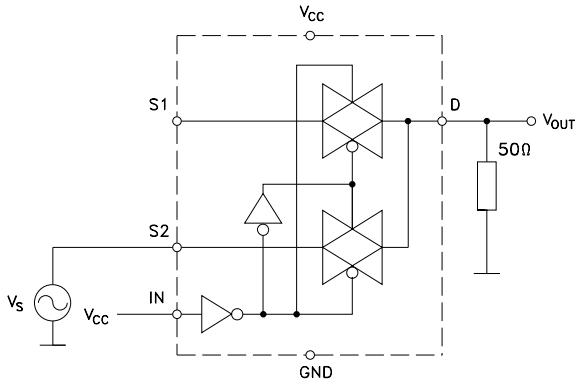


Figure 5. OFF leakage

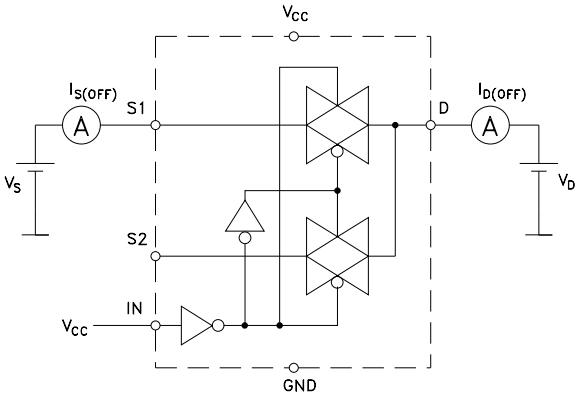


Figure 6. Channel-to-channel crosstalk

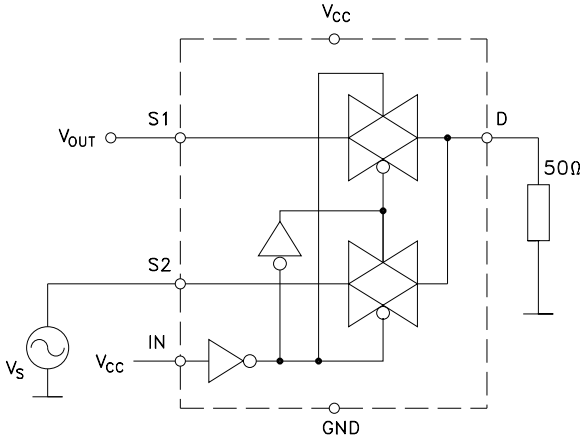


Figure 7. **OFF isolation**

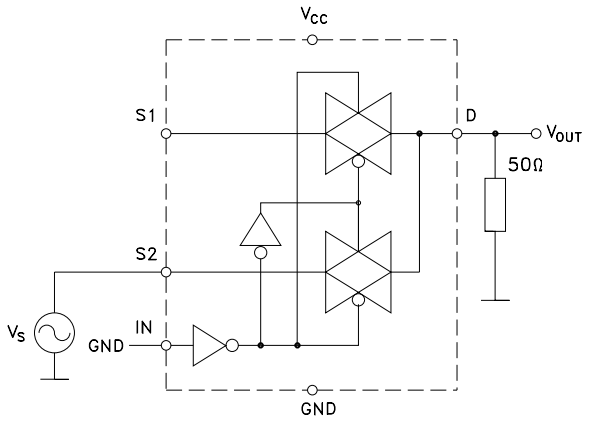


Figure 8. **ON leakage**

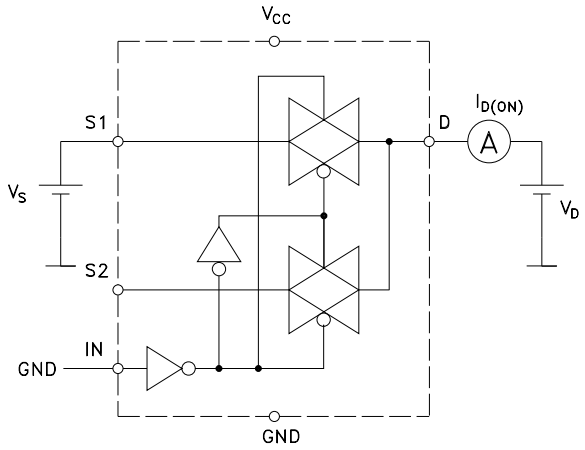


Figure 9. **Test circuit**

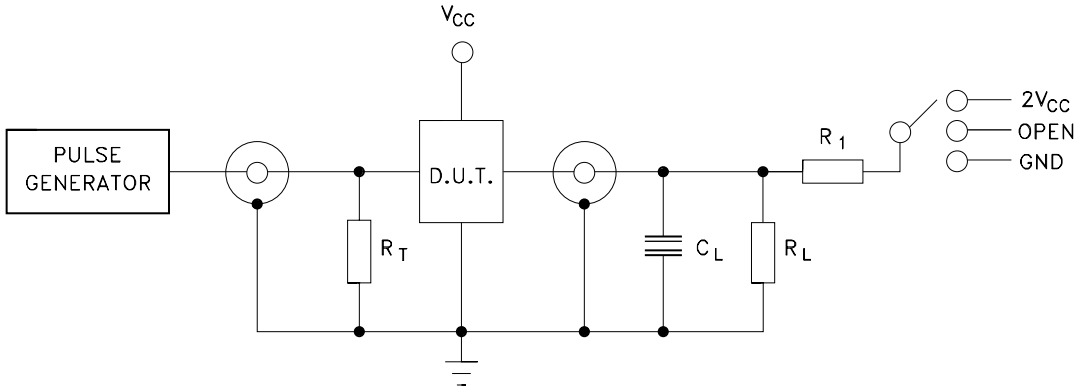


Table 8. **Test circuit**

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

Note: *C_L = 5/35 pF or equivalent: (includes jig capacitance)*
R_L = 50 Ω or equivalent
R_T = Z_{OUT}ofpulse generator (typically 50 Ω)

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

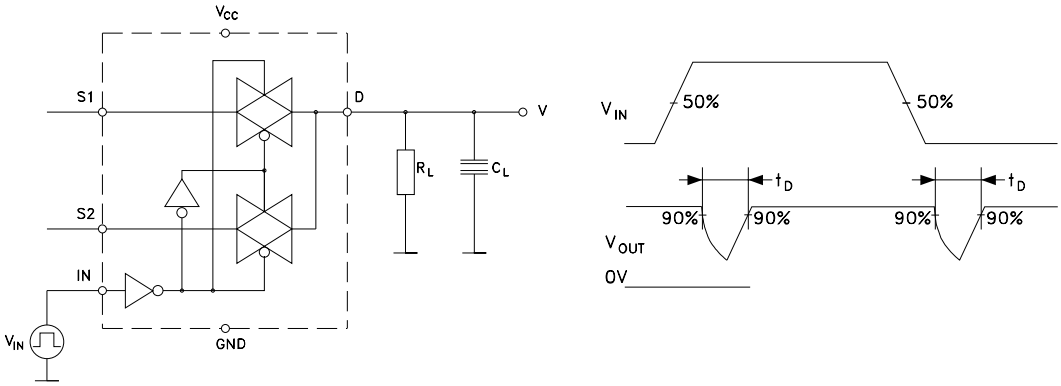


Figure 11. **Switching time and charge injection**

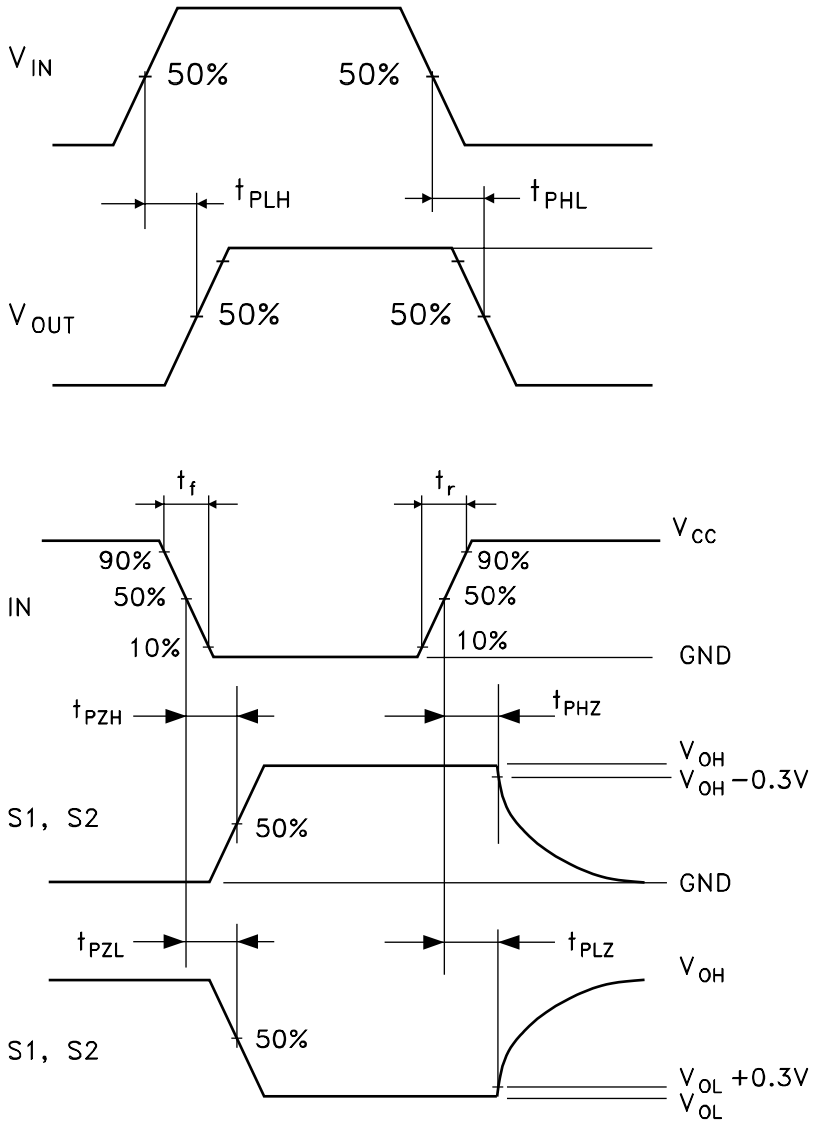
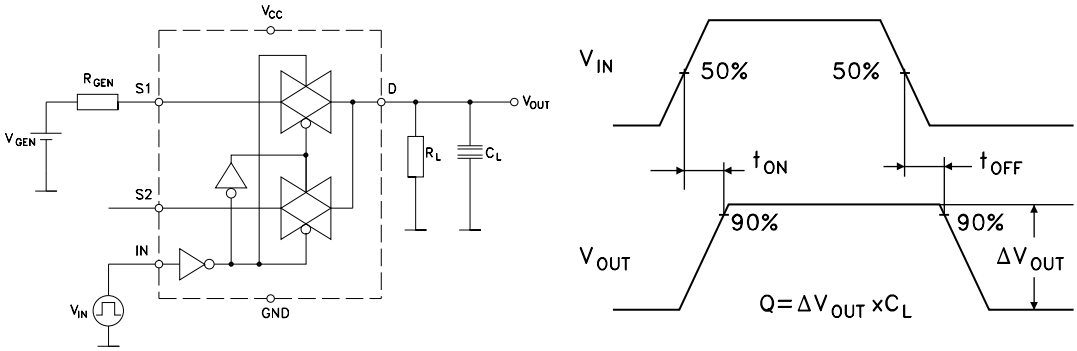


Figure 12. **Charge injection (V_{GEN} = 0 V, R_{GEN} = 0 Ω, R_L = 1 MΩ, C_L = 100 pF)**



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. ECOPACK is an ST trademark.

5.1 SOT323-6L package information

Figure 13. SOT323-6L package drawing outline

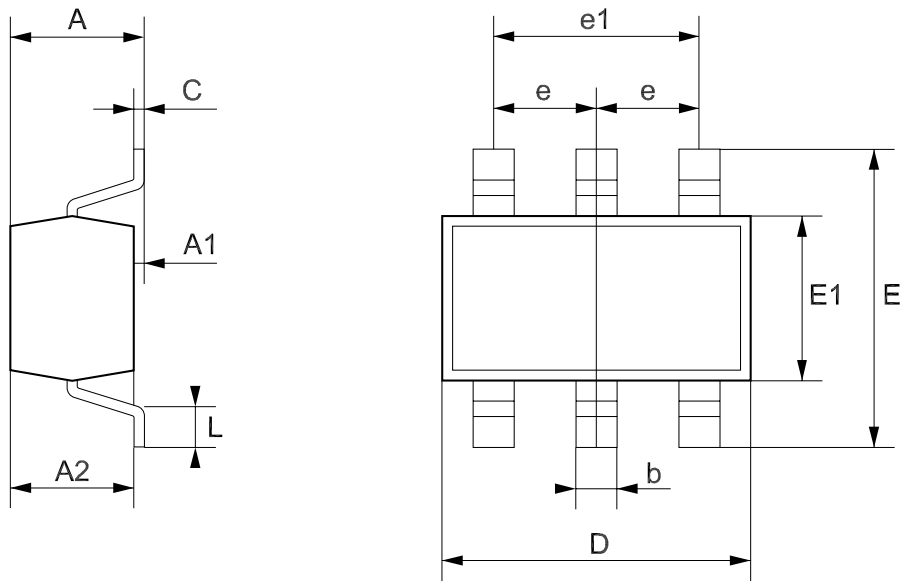


Table 9. SOT323-6L mechanical data

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**

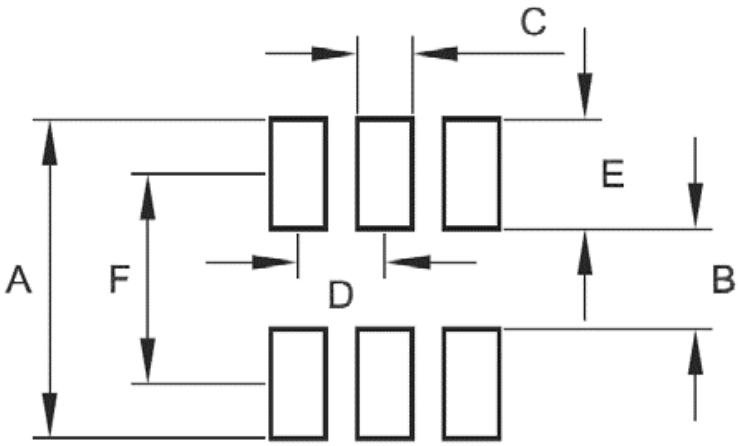


Table 10. **SOT323-6L footprint recommendation**

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**

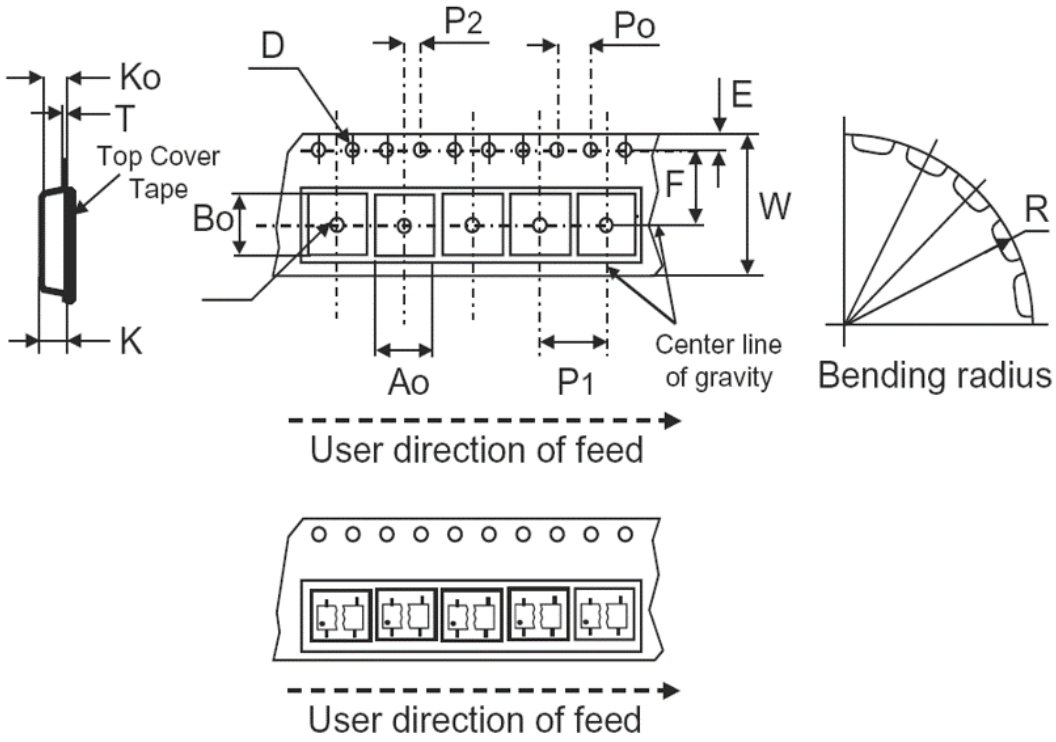


Table 11. **SOT323-6L tape information**

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**

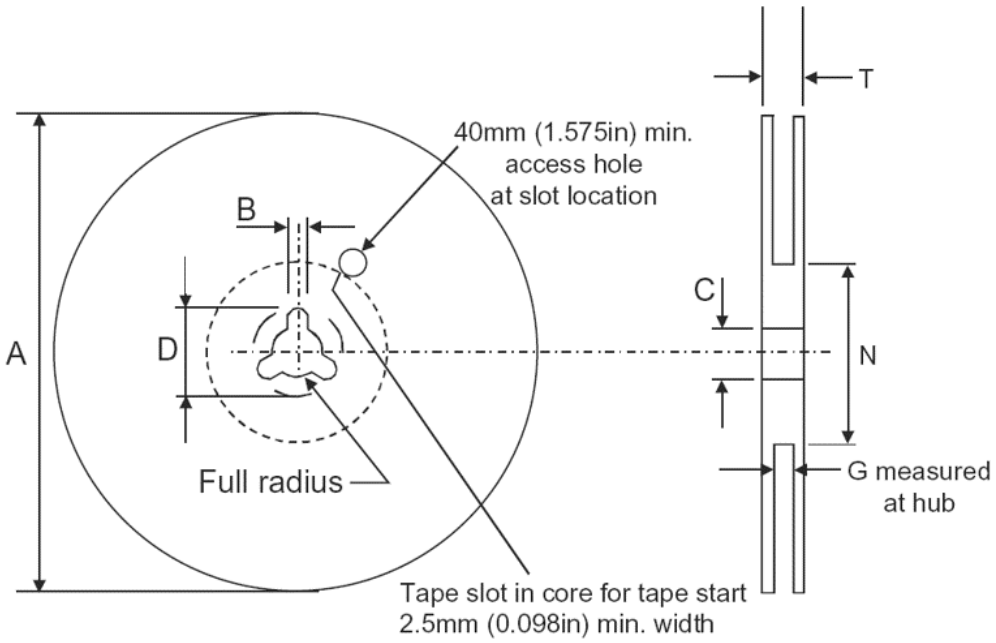


Table 12. **SOT323-6L reel information**

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

6 Ordering information

Table 13. **Order code**

Order code	Package	Packing	Marking
STG3157CTR	SOT323-6L	Tape and reel	VU

Revision history

Table 14. **Document revision history**

Date	Revision	Changes
02-Sep-2002	1	Initial release.
19-Apr-2010	2	Document reformatted. In the Features list on the coverpage, 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 coverpage with Table 1: Device summary. Added ECOPACK®statement in Section 5: Package information.
29-Nov-2018	3	Updated V_{CC} value on Table 4. Recommended operating conditions.
20-Jul-2021	4	Added new Section 6 Ordering information.

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