

High isolation dual SPDT analog switch

Features

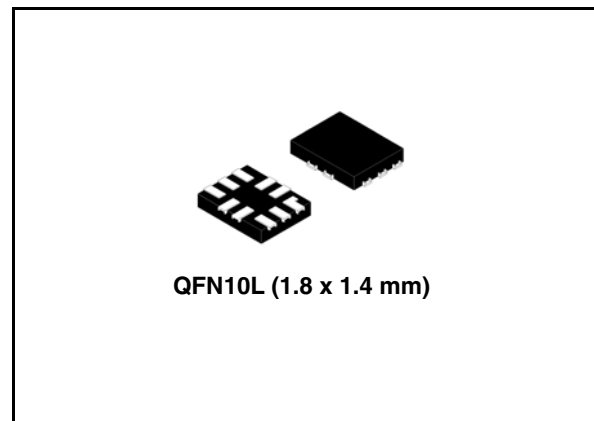
- Ultra high off-isolation:
-80 dB (typ) at 1 Mhz
- Ultra low power dissipation:
 $I_{CC} = 0.2 \mu\text{A}$ (max.) at $T_A = 85 \text{ }^\circ\text{C}$
- R_{PEAK} on $T_n = 1.30 \Omega$ max ($T_A = 25 \text{ }^\circ\text{C}$)
at $V_{CC} = 4.3 \text{ V}$
- R_{PEAK} on $S_n = 0.55 \Omega$ max ($T_A = 25 \text{ }^\circ\text{C}$)
at $V_{CC} = 4.3 \text{ V}$
- Wide operating voltage range:
 V_{CC} (opr) = 1.65 to 4.3 V single supply
- 4.3 V tolerant and 1.8 V compatible threshold
on digital control input at $V_{CC} = 1.65$ to 4.3 V
- Typical bandwidth (-3 dB) at 65 MHz on S_n
channel, 58 MHz on the T_n channel
- Latch-up performance exceeds 100 mA per
JESD 78, Class II
- ESD performance exceeds JESD22
2000-V Human body model (A114-A)

Description

The STG6684 is a high-speed CMOS low voltage dual analog SPDT (single pole dual throw) switch or 2:1 multiplexer/de-multiplexer switch fabricated in silicon gate C²MOS technology.

The STG6684 is designed to operate from 1.65 to 4.3 V, making this device ideal for portable applications.

The SELn inputs are provided to control the switch operation. The switch S_n is ON (connected to common ports D_n) when the SELn input is held low and OFF (high impedance state exists between the two ports) when SELn is held high.



The switch T_n is “on” (connected to common port D_n) when the SELn input is held high and “off” (high impedance state exists between the two ports) when SELn is held low.

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	Packaging
STG6684QTR	QFN10L (1.8 x 1.4 mm)	Tape and reel

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1 Pin settings

Figure 1. Pin connection (top through view)

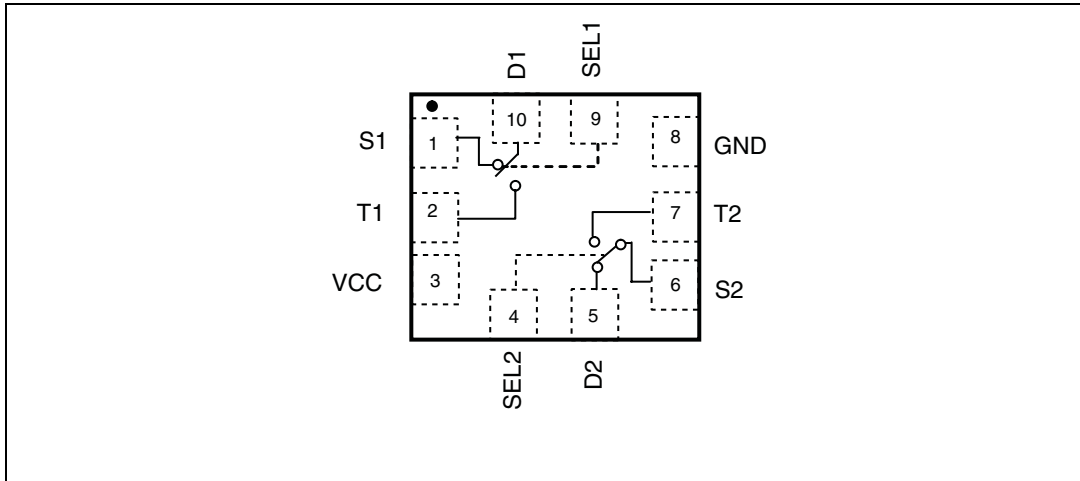


Table 2. Pin description

Pin number	Symbol	Name and function
1	S1	Independent channel
2	T1	Independent channel
3	V _{CC}	Positive supply voltage
4	SEL2	Selection control
5	D2	Common channel
6	S2	Independent channel
7	T2	Independent channel
8	GND	Ground (0 V)
9	SEL1	Selection control
10	D1	Common channel

2 Logic diagram

Figure 2. Logic block diagram

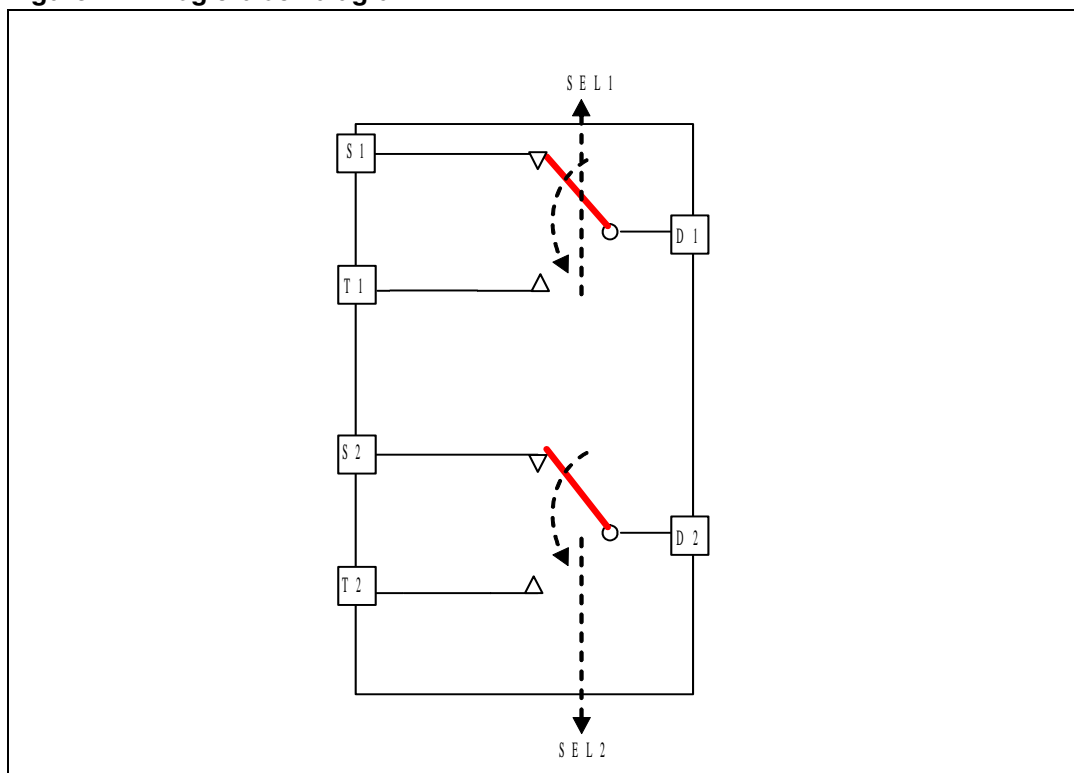


Table 3. Truth table

SELn	Switch Sn	Switch Tn
L	Sn is connected to Dn	OFF ⁽¹⁾
H	OFF ⁽¹⁾	Tn is connected to Dn

1. High impedance

3 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_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 ($V_{SEL} < 0$ 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⁾	1120	mW
T_{STG}	Storage temperature	-65 to 150	°C
T_L	Lead temperature (10 sec)	300	°C

1. Derate above 70 °C by 18.5 mW/°C

3.1 Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		1.65 to 4.3	V
V_I	Input voltage		0 to V_{CC}	V
V_{IC}	Control input voltage		0 to 4.3	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	$V_{CC} = 1.65\text{ V}$ to 2.7 V	0 to 20	ns/V
		$V_{CC} = 3.0\text{ V}$ to 4.3 V	0 to 10	

4 Electrical characteristics

Table 6. DC specifications

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
V _{IH}	High level input voltage	1.65 – 1.95		0.65 V _{CC}			0.65 V _{CC}		V
		2.3 – 2.5		1.2			1.2		
		2.7 – 3.0		1.3			1.3		
		3.3 – 3.6		1.4			1.4		
		4.3		1.5			1.5		
V _{IL}	Low level input voltage	1.65 – 1.95				0.25		0.25	V
		2.3 – 2.5				0.25		0.25	
		2.7 – 3.0				0.25		0.25	
		3.3 – 3.6				0.30		0.30	
		4.3				0.40		0.40	
R _{PEAK, Tn}	Switch T _n ON resistance	4.3	V _S = 0 V to V _{CC} I _S = 100 mA		1.10	1.3		1.5	Ω
		3.6			1.15	1.4		1.6	
		3.0			1.25	1.5		1.8	
		2.7			1.35	1.6		1.9	
		1.8			2.20	2.9		3.5	
R _{PEAK, Sn}	Switch S _n ON resistance	4.3	V _S = 0 V to V _{CC} I _S = 100 mA		0.45	0.55		0.62	Ω
		3.6			0.48	0.58		0.65	
		3.0			0.51	0.62		0.70	
		2.7			0.54	0.70		0.80	
		1.8			0.84	1.10		1.30	
ΔR _{ON, Tn}	ON resistance match between T _n channels ⁽¹⁾	4.3	V _S at R _{PEAK} I _S = 100 mA		10				mΩ
		3.6			14				
		3.0			14				
		2.7			15				
		1.8			30				
ΔR _{ON, Sn}	ON resistance match between S _n channels ⁽¹⁾	4.3	V _S at R _{PEAK} I _S = 100 mA		7				mΩ
		3.6			7				
		3.0			8				
		2.7			9				
		1.8			12				

Table 6. DC specifications

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
R _{FLAT, Tn}	ON resistance flatness for Tn channels ⁽²⁾	4.3	V _S = 0 to V _{CC} I _S = 100 mA		0.45	0.50		0.55	Ω
		3.6			0.45	0.50		0.55	
		3.0			0.50	0.55		0.60	
		2.7			0.55	0.60		0.70	
		1.8			1.10	1.70		2.00	
R _{FLAT, Sn}	ON resistance flatness for Sn channels ⁽²⁾	4.3	V _S = 0 to V _{CC} I _S = 100 mA		0.15	0.20		0.20	Ω
		3.6			0.15	0.20		0.20	
		3.0			0.15	0.20		0.20	
		2.7			0.15	0.20		0.20	
		1.8			0.35	0.55		0.66	
I _{OFF}	OFF state leakage current (Tn), (Sn), (Dn)	4.3	V _S = 0.3 or 4 V			±0.1		±1	μA
I _{SEL}	SEL leakage current	0 –4.3	V _{SEL} = 0 to 4.3 V			±0.05		±1	μA
I _{CC}	Quiescent supply current	1.65 –4.3	V _{SEL} = V _{CC} or GND			±0.05		±0.2	μA
I _{CCLV}	Quiescent supply current low voltage driving	4.3	V _{SEL} = 1.65 V		±37	±50		±100	μA
			V _{SEL} = 1.80 V		±33	±40		±50	
			V _{SEL} = 2.60 V		±12	±20		±30	

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 ($C_L = 35 \text{ pF}$, $R_L = 50 \text{ } \Omega$, $t_r = t_f \leq 5 \text{ ns}$)

Symbol	Parameter	V_{CC} (V)	Test condition	Value					Unit
				$T_A = 25 \text{ } ^\circ\text{C}$			$-40 \text{ to } 85 \text{ } ^\circ\text{C}$		
				Min	Typ	Max	Min	Max	
t_{PLH} , t_{PHL}	Propagation delay	1.65 – 1.95			0.45				ns
		2.3 – 2.7			0.45				
		3.0 – 3.3			0.30				
		3.6 – 4.3			0.30				
t_{ON}	Turn-ON time	1.65 – 1.95	$V_S = 0.8 \text{ V}$		120				ns
		2.3 – 2.7	$V_S = 1.5 \text{ V}$		65	85		90	
		3.0 – 3.3			42	55		65	
		3.6 – 4.3			40	55		65	
t_{OFF}	Turn-OFF time	1.65 – 1.95	$V_S = 0.8 \text{ V}$		45				ns
		2.3 – 2.7	$V_S = 1.5 \text{ V}$		18	30		40	
		3.0 – 3.3			16	30		40	
		3.6 – 4.3			15	30		40	
t_D	Break-before-make time delay	1.65 – 1.95	$C_L = 35 \text{ pF}$ $R_L = 50 \text{ } \Omega$ $V_S = 1.5 \text{ V}$	2	18				ns
		2.3 – 2.7		2	10				
		3.0 – 3.3		2	8				
		3.6 – 4.3		2	6				
Q	Charge injection	1.65 – 1.95	$C_L = 100 \text{ pF}$ $R_L = 1 \text{ M}\Omega$ $V_{GEN} = 0 \text{ V}$ $R_{GEN} = 0 \text{ } \Omega$		43				pC
		2.3 – 2.7			51				
		3.0 – 3.3			51				
		3.6 – 4.3			49				

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

Symbol	Parameter	V_{CC} (V)	Test condition	Value					Unit
				$T_A = 25 \text{ } ^\circ\text{C}$			$-40 \text{ to } 85 \text{ } ^\circ\text{C}$		
				Min	Typ	Max	Min	Max	
OIRR _{Tn}	Off isolation for switch T1,T2	1.65 – 4.3	$V_S=1 \text{ V}_{RMS}$, $f=1 \text{ MHz}$, $R_L = 50 \text{ } \Omega$		-80				dB
			$V_S=1 \text{ V}_{RMS}$, $f = 10 \text{ MHz}$, $R_L = 50 \text{ } \Omega$		-60				
OIRR _{Sn}	Off isolation for switch S1, S2	1.65 – 4.3	$V_S = 1 \text{ V}_{RMS}$, $f = 100 \text{ kHz}$ $R_L = 50 \text{ } \Omega$		-66				dB
			$V_S=1 \text{ V}_{RMS}$, $f = 1 \text{ MHz}$ $R_L = 50 \text{ } \Omega$		-45				
Xtalk _{Sn}	Crosstalk between S1 and S2	1.65 – 4.3	$V_S=1 \text{ V}_{RMS}$, $f = 1 \text{ MHz}$ Signal = 0 dBm		-90				dB
			$V_S=1 \text{ V}_{RMS}$, $f = 10 \text{ MHz}$ Signal = 0 dBm		-69				
Xtalk _{Tn}	Crosstalk between T1 and T2	1.65 – 4.3	$V_S=1 \text{ V}_{RMS}$, $f = 1 \text{ MHz}$ Signal = 0 dBm		-85				dB
			$V_S=1 \text{ V}_{RMS}$, $f = 10 \text{ MHz}$ Signal = 0 dBm		-74				
THD _{Sn}	Total harmonic distortion	2.3 – 4.3	$f = 20 \text{ Hz to } 20 \text{ kHz}$ $R_L = 600 \text{ } \Omega$ $C_L = 50 \text{ pF}$ $V_{IN} = 2 \text{ V}_{P-P}$ $V_{DC} = V_{CC}/2$		0.01				%
BW _{Tn}	-3dB bandwidth for switch T1, T2	1.65 – 4.3	$R_L = 50 \text{ } \Omega$ Signal = 0 dBm		58				MHz
BW _{Sn}	-3dB bandwidth for switch S1,S2	1.65 – 4.3	$R_L = 50 \text{ } \Omega$ Signal = 0 dBm		65				MHz

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
C _{SEL}	Control pin input capacitance		V _{CC} = 0 V		9				pF
C _{ON,Tn}	Tn port capacitance when the switch is enabled	3.3	f = 1 MHz		113				
C _{ON,Sn}	Sn port capacitance when the switch is enabled	3.3	f = 1 MHz		88				
C _{OFF,Tn}	Tn port capacitance when the switch is disabled	3.3	f = 1 MHz		85				
C _{OFF,Sn}	Sn port capacitance when the switch is disabled	3.3	f = 1 MHz		40				

5 Test circuit

Figure 3. ON resistance

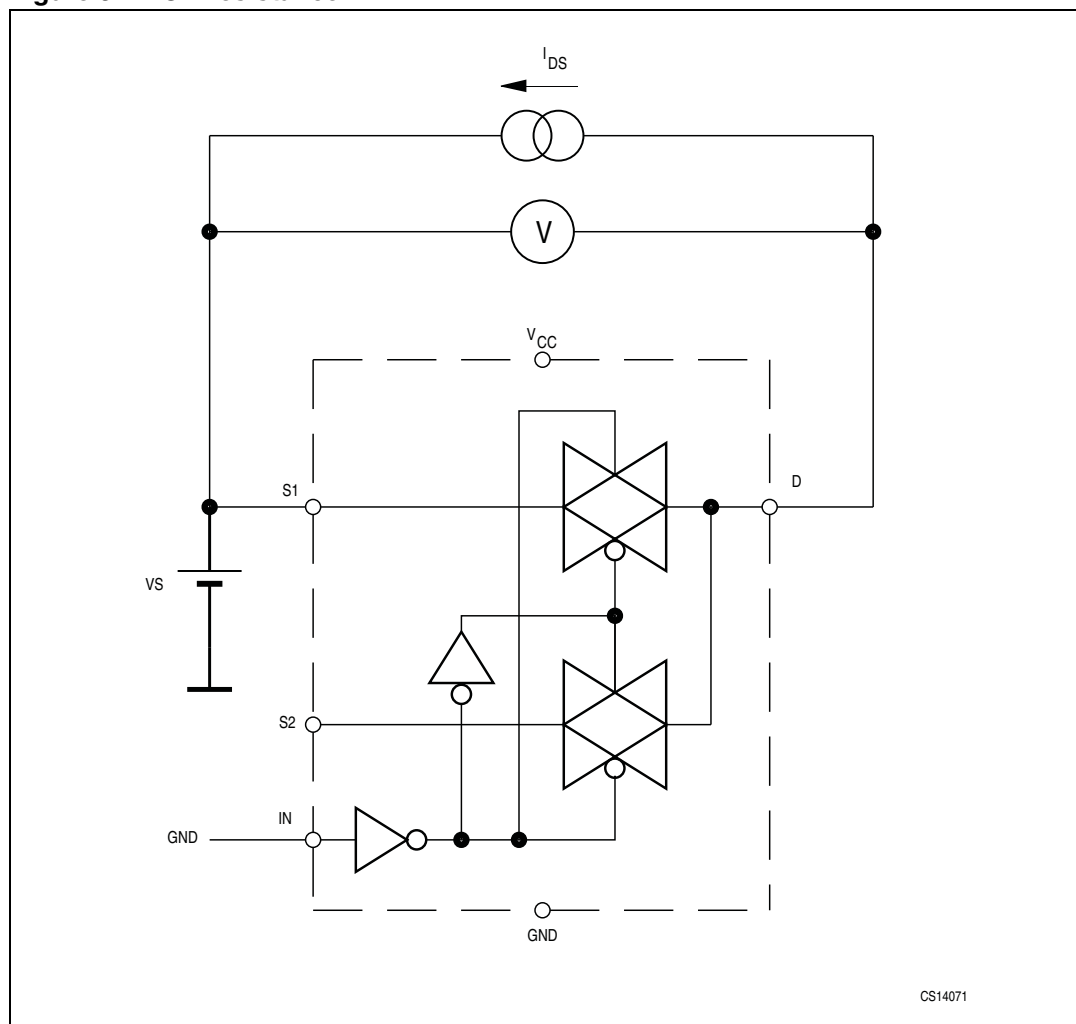
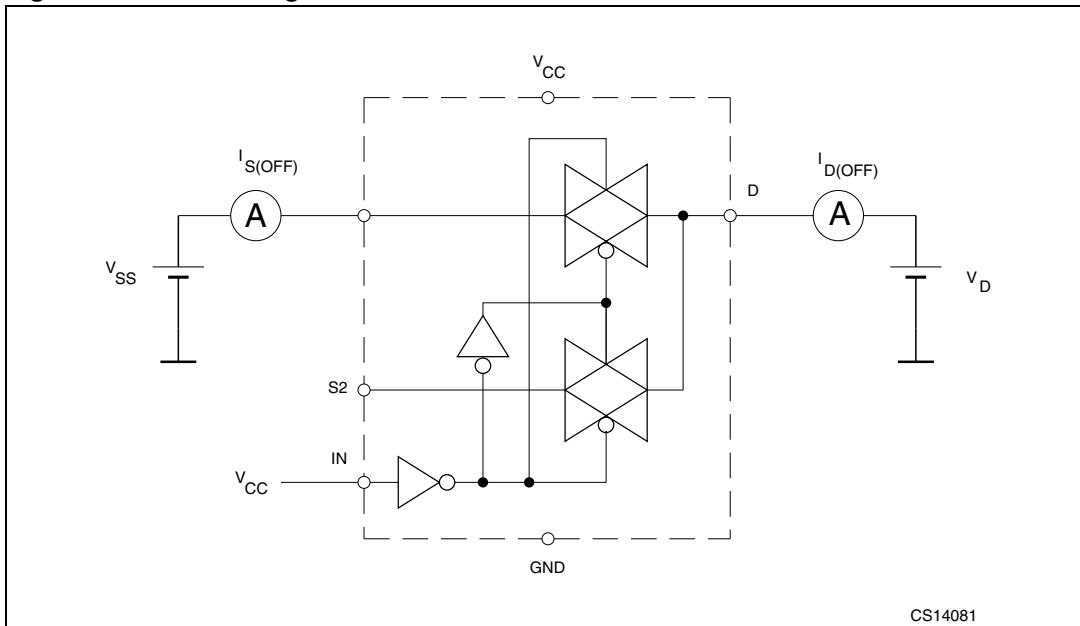
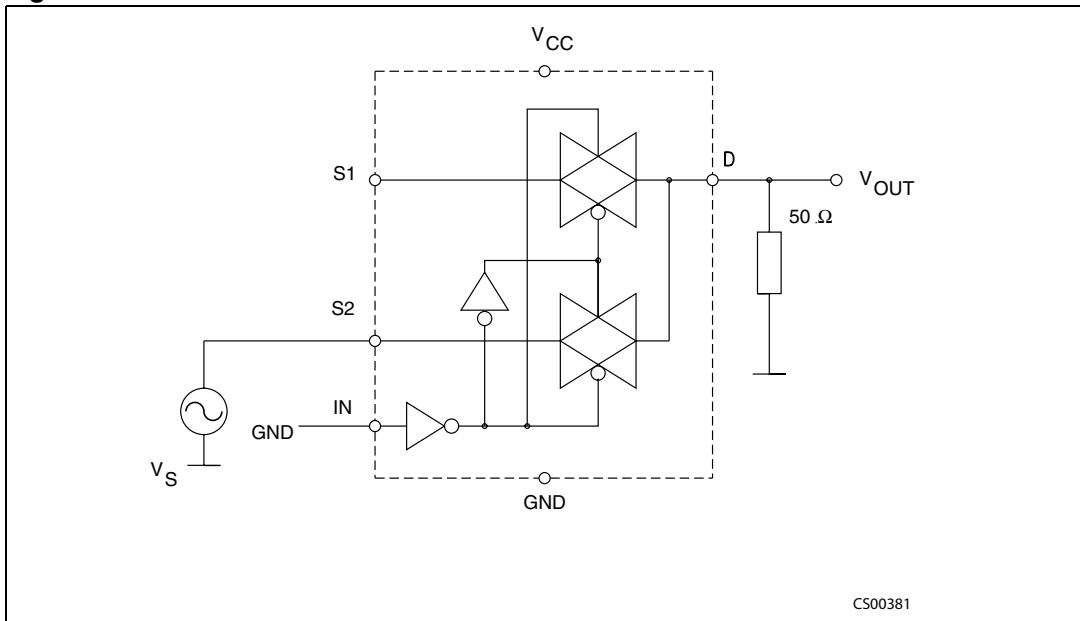


Figure 4. OFF leakage



CS14081

Figure 5. OFF isolation



CS00381

Figure 6. Bandwidth

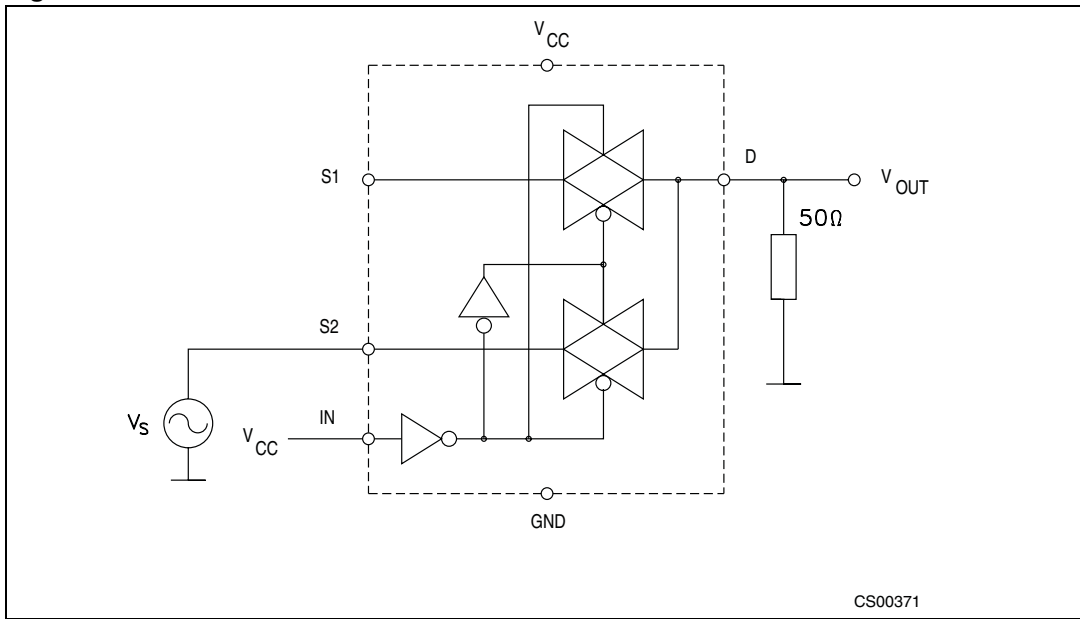


Figure 7. Switch-to-switch crosstalk

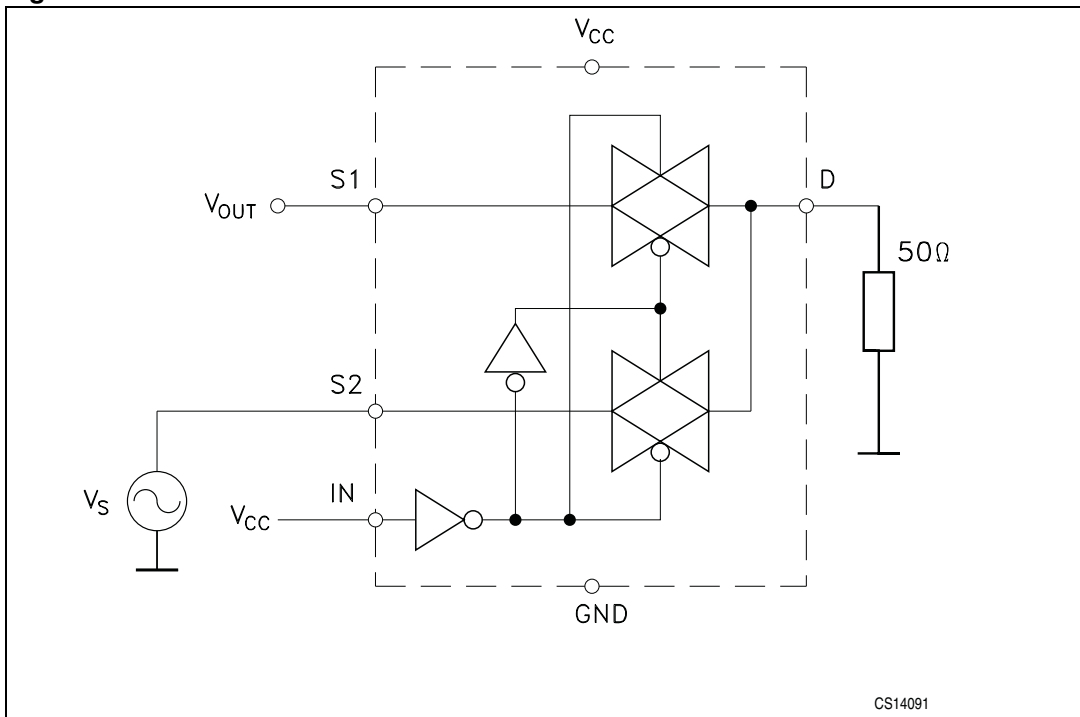
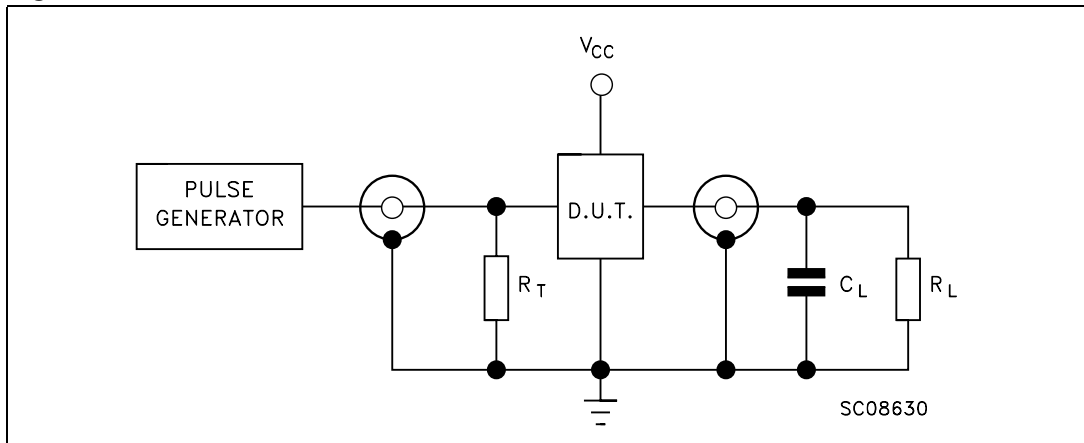


Figure 8. Test circuit



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

Figure 9. Break-before-make time delay

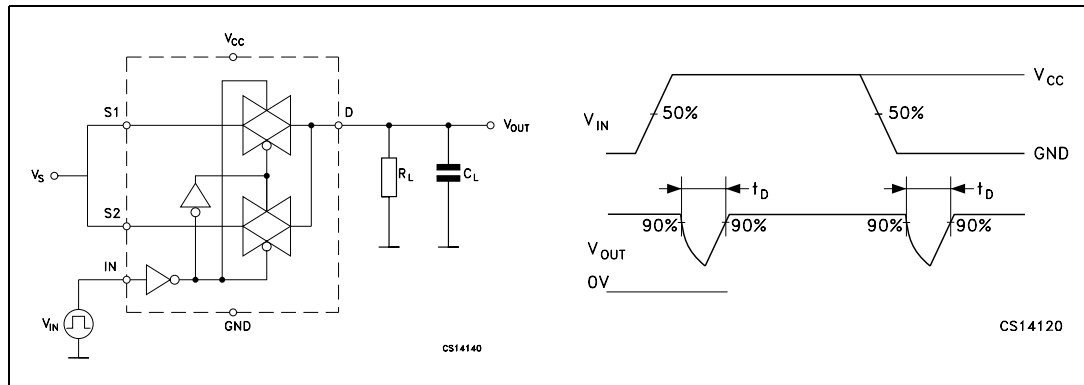


Figure 10. Switching time and charge injection ($V_{GEN} = 0$, $R_{GEN} = 0 \Omega$, $R_L = 1 M\Omega$, $C_L = 100 pF$)

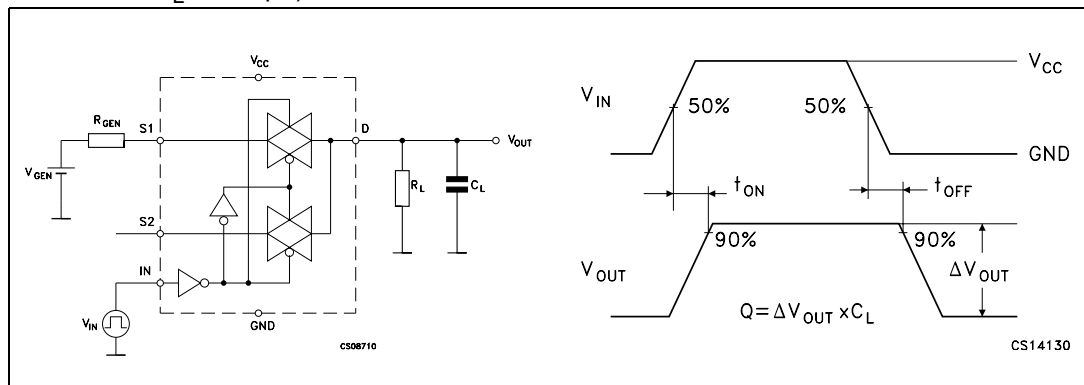
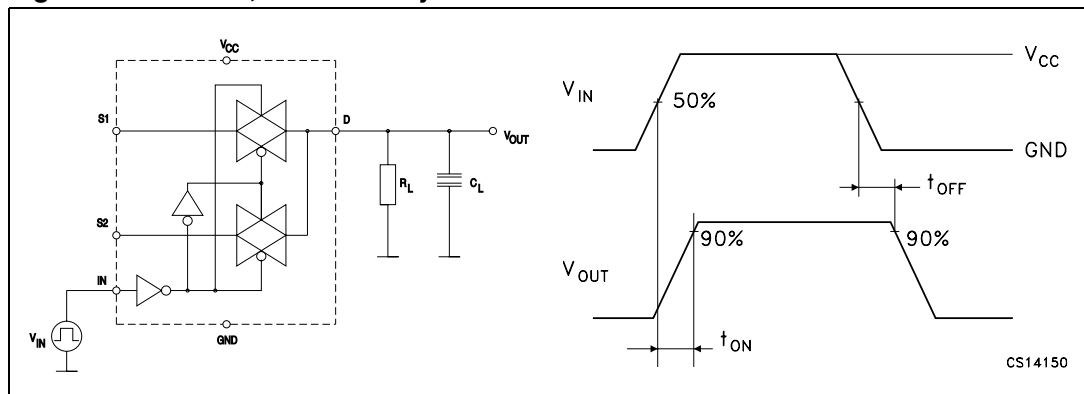


Figure 11. Turn on, turn off delay time



6 Application diagram

Figure 12. Application diagram

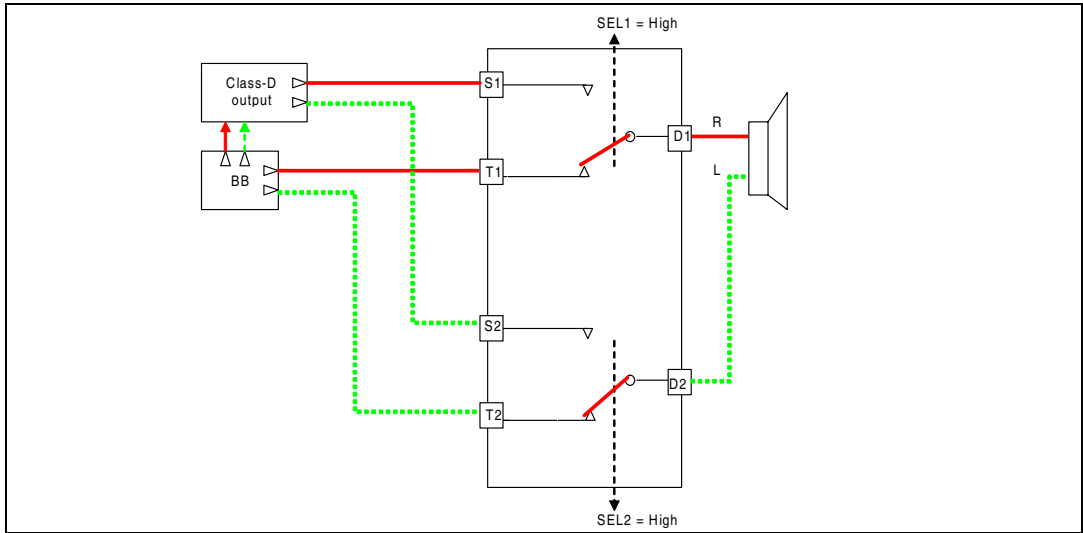
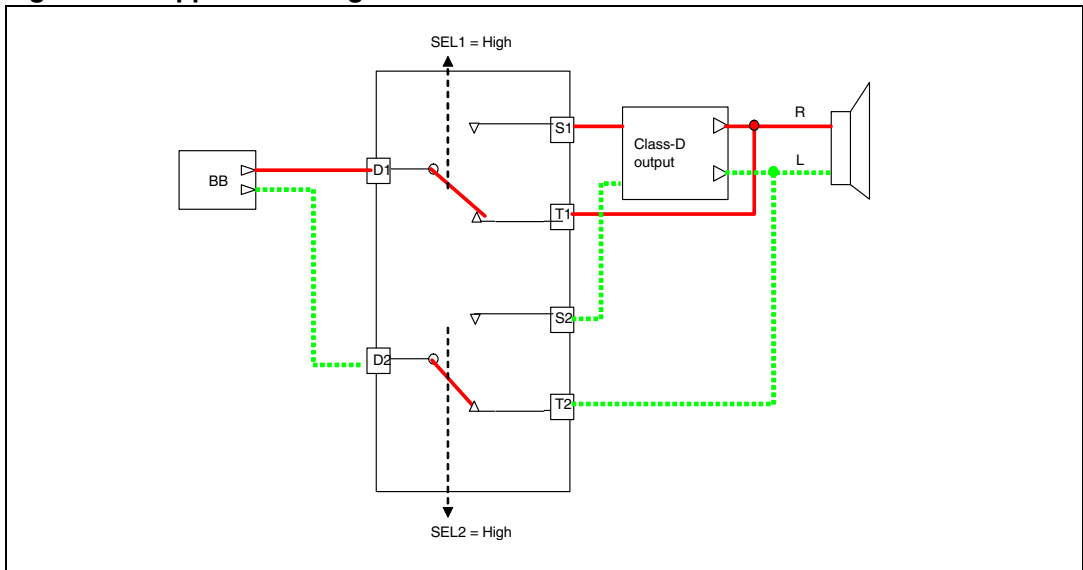


Figure 13. Application diagram



7 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.

Figure 14. QFN10L (1.8 x 1.4 mm) package outline

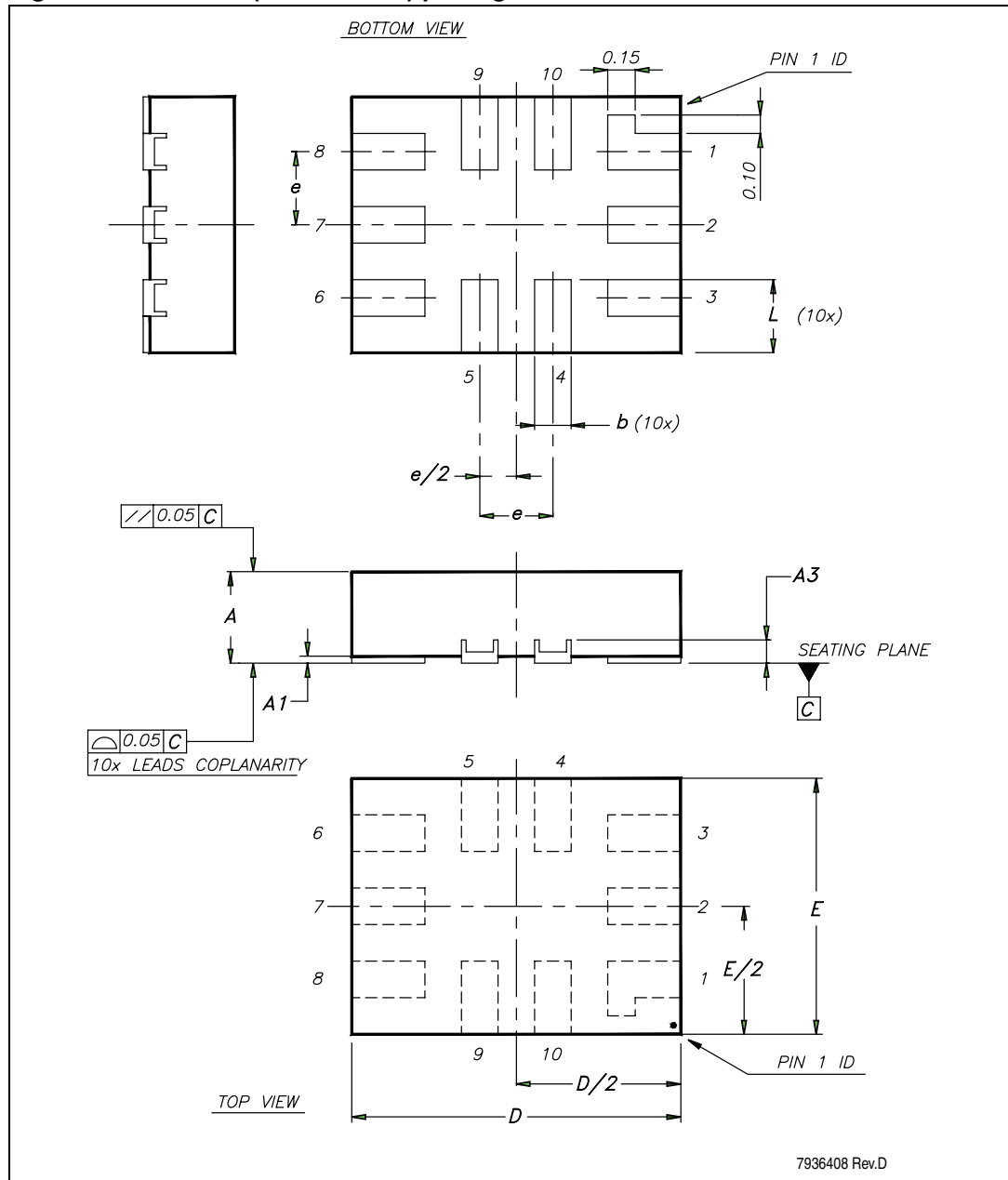


Figure 16. QFN10L (1.8 x 1.4 mm) carrier tape

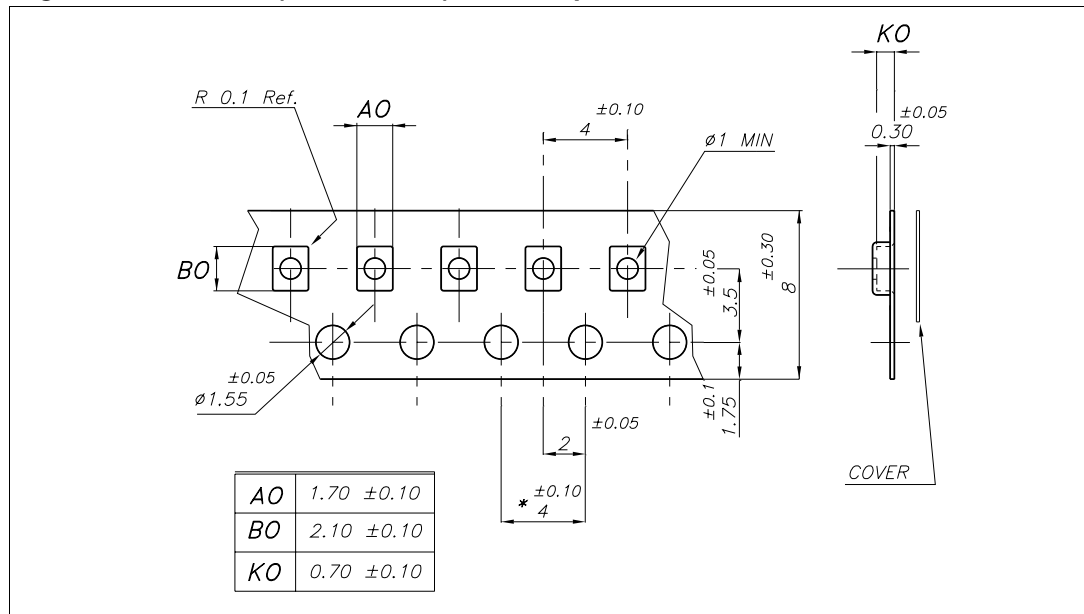


Figure 17. QFN10L (1.8 x 1.4 mm) reel information - front side

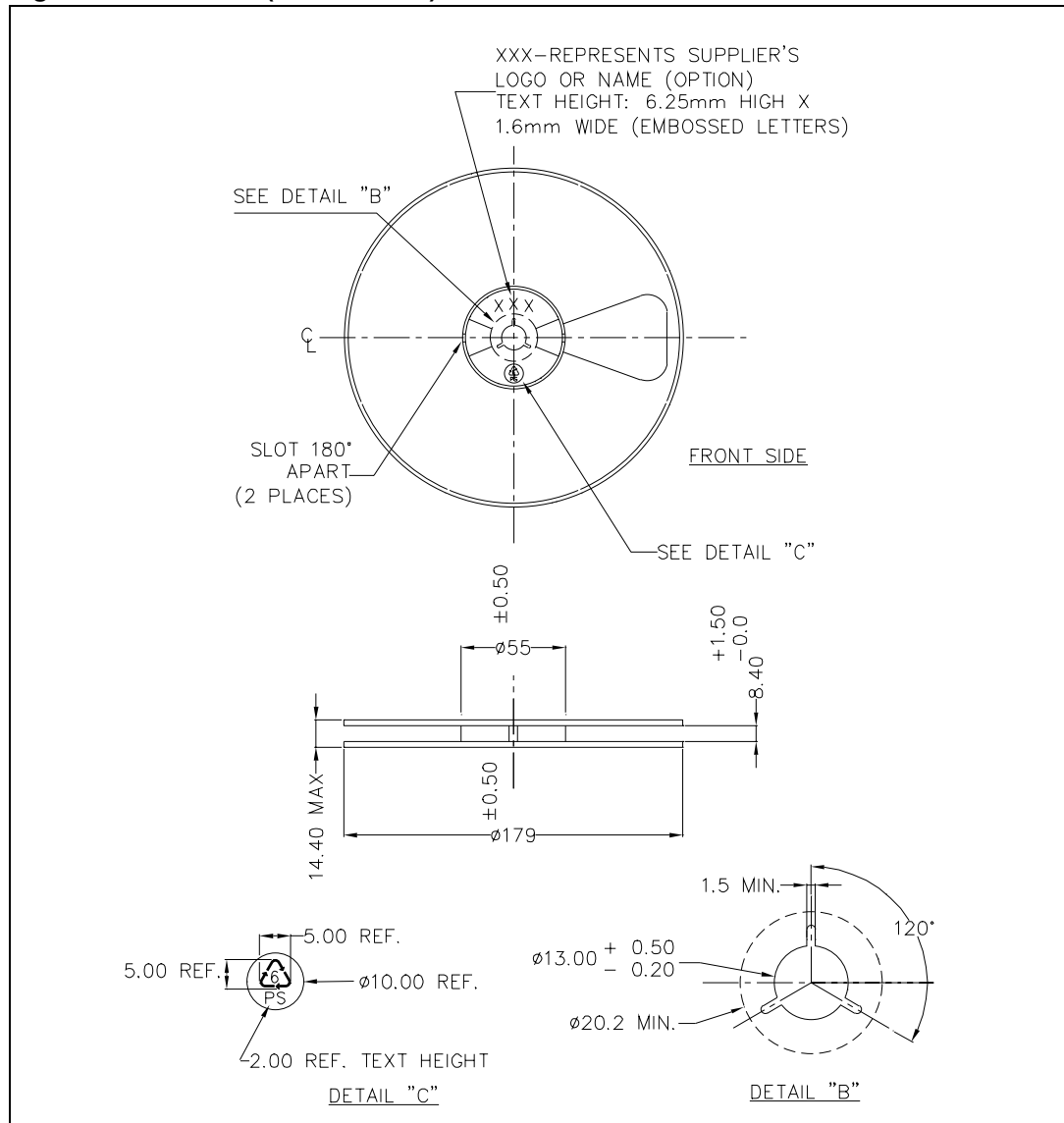
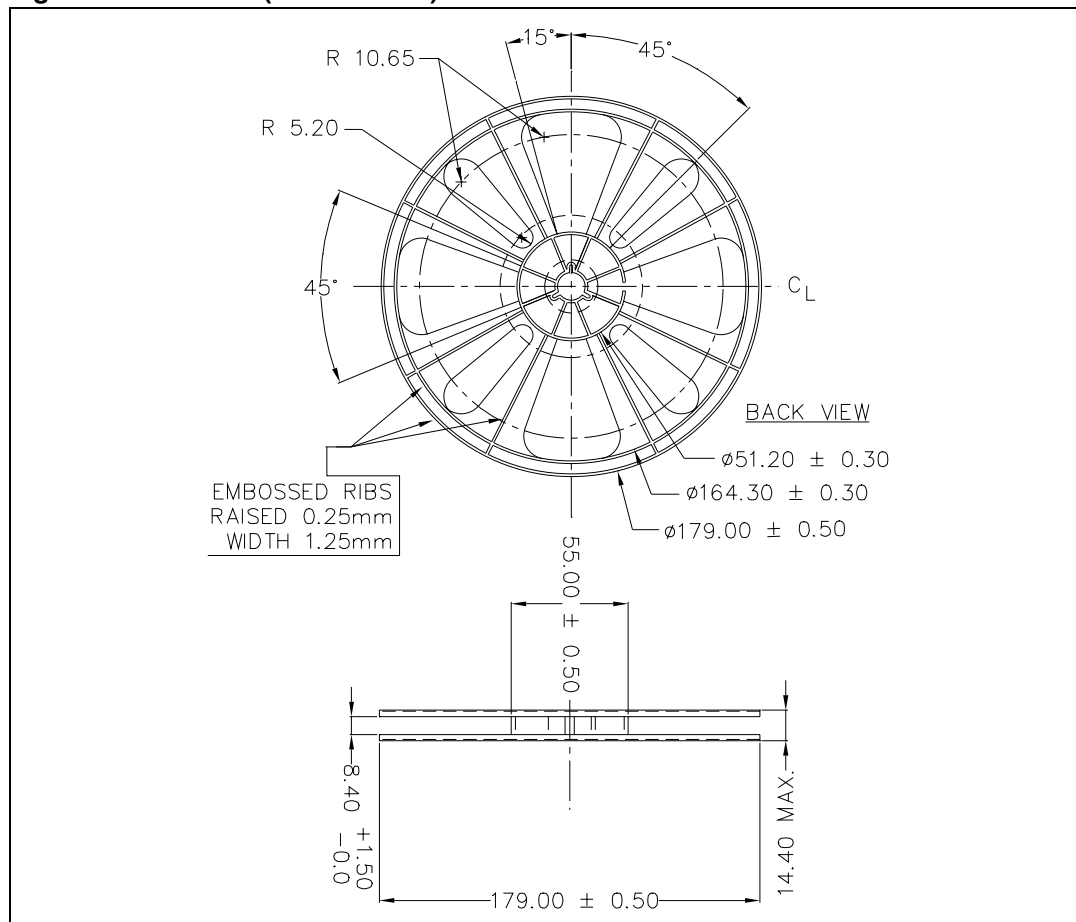


Figure 18. QFN10L(1.8 x 1.4 mm) reel information - back view



8 Revision history

Table 9. Document revision history

Date	Revision	Changes
9-Jan-2008	1	Initial release.

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