

## High isolation dual SPDT analog switch

### Features

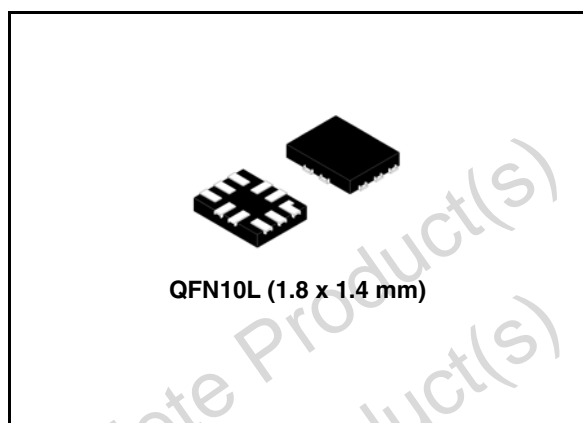
- Ultra high off-isolation:  
-80 dB (typ) at 1 Mhz
- Ultra low power dissipation:  
 $I_{CC} = 0.2 \mu\text{A}$  (max.) at  $T_A = 85 \text{ }^\circ\text{C}$
- $R_{PEAK}$  on  $T_n = 1.30 \Omega$  max ( $T_A = 25 \text{ }^\circ\text{C}$ )  
at  $V_{CC} = 4.3 \text{ V}$
- $R_{PEAK}$  on  $S_n = 0.55 \Omega$  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  
JEDEC 78, Class II
- ESD performance exceeds JEDEC22  
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 C<sup>2</sup>MOS 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)

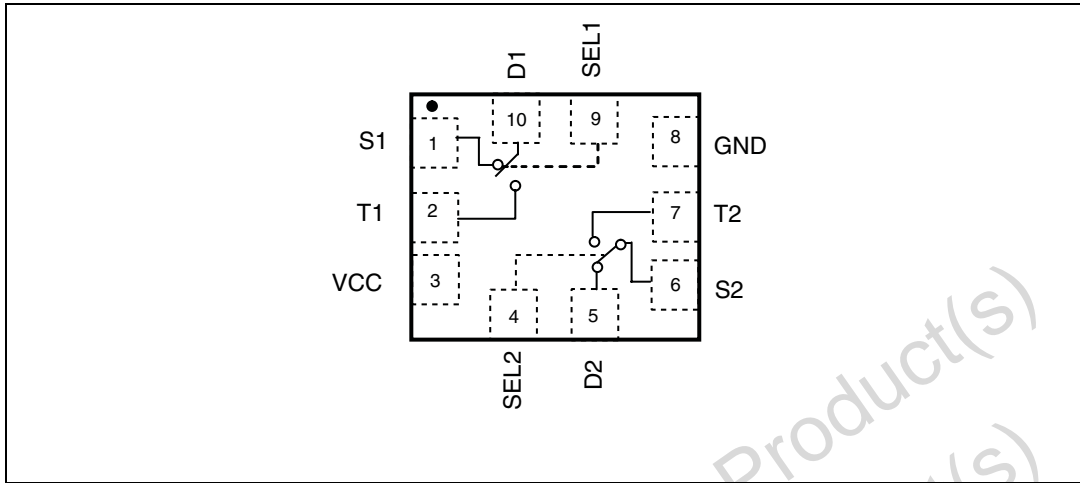


Table 2. Pin description

Pin number	Symbol	Name and function
1	S1	Independent channel
2	T1	Independent channel
3	V <sub>CC</sub>	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

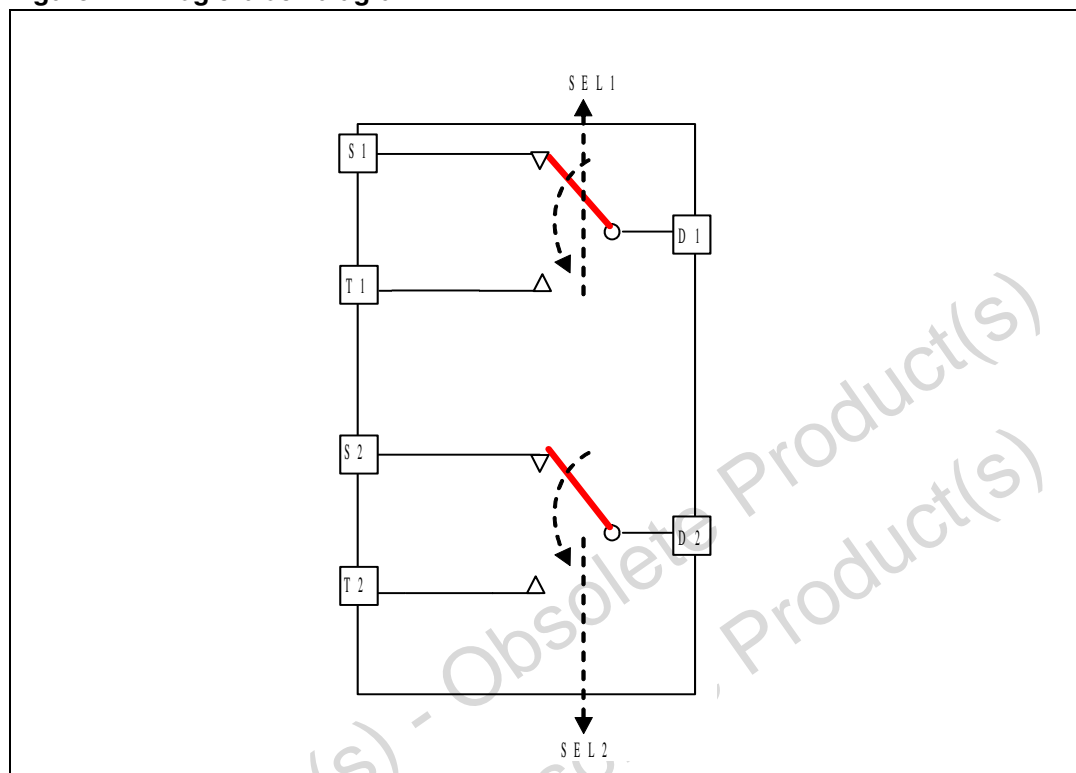


Table 3. Truth table

SELn	Switch Sn	Switch Tn
L	Sn is connected to Dn	OFF <sup>(1)</sup>
H	OFF <sup>(1)</sup>	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)	$\pm 50$	mA
$I_{OK}$	DC output diode current	$\pm 20$	mA
$I_O$	DC output current	$\pm 300$	mA
$I_{OP}$	DC output current peak (pulse at 1 ms, 10% duty cycle)	$\pm 500$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or ground current	$\pm 100$	mA
$P_D$	Power dissipation at $T_A=70$ °C <sup>(1)</sup>	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	$V_{CC} = 1.65\text{ V to }2.7\text{ V}$	0 to 20	ns/V
		$V_{CC} = 3.0\text{ V to }4.3\text{ V}$	0 to 10	

## 4 Electrical characteristics

Table 6. DC specifications

Symbol	Parameter	V <sub>CC</sub> (V)	Test condition	Value					Unit
				T <sub>A</sub> = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High level input voltage	1.65 – 1.95		0.65 V <sub>CC</sub>			0.65 V <sub>CC</sub>		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 <sub>IL</sub>	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 <sub>PEAK, Tn</sub>	Switch T <sub>n</sub> ON resistance	4.3	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 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 <sub>PEAK, Sn</sub>	Switch S <sub>n</sub> ON resistance	4.3	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 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 <sub>ON, Tn</sub>	ON resistance match between T <sub>n</sub> channels <sup>(1)</sup>	4.3	V <sub>S</sub> at R <sub>PEAK</sub> I <sub>S</sub> = 100 mA		10				mΩ
		3.6			14				
		3.0			14				
		2.7			15				
		1.8			30				
ΔR <sub>ON, Sn</sub>	ON resistance match between S <sub>n</sub> channels <sup>(1)</sup>	4.3	V <sub>S</sub> at R <sub>PEAK</sub> I <sub>S</sub> = 100 mA		7				mΩ
		3.6			7				
		3.0			8				
		2.7			9				
		1.8			12				

Table 6. DC specifications

Symbol	Parameter	V <sub>CC</sub> (V)	Test condition	Value					Unit	
				T <sub>A</sub> = 25 °C			-40 to 85 °C			
				Min	Typ	Max	Min	Max		
R <sub>FLAT, Tn</sub>	ON resistance flatness for Tn channels <sup>(2)</sup>	4.3	V <sub>S</sub> = 0 to V <sub>CC</sub> I <sub>S</sub> = 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 <sub>FLAT, Sn</sub>	ON resistance flatness for Sn channels <sup>(2)</sup>	4.3	V <sub>S</sub> = 0 to V <sub>CC</sub> I <sub>S</sub> = 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 <sub>OFF</sub>	OFF state leakage current (Tn), (Sn), (Dn)	4.3	V <sub>S</sub> = 0.3 or 4 V				±0.1		±1	μA
I <sub>SEL</sub>	SEL leakage current	0 – 4.3	V <sub>SEL</sub> = 0 to 4.3 V				±0.05		±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	μA
I <sub>CCLV</sub>	Quiescent supply current low voltage driving	4.3	V <sub>SEL</sub> = 1.65 V		±37	±50		±100	μA	
			V <sub>SEL</sub> = 1.80 V		±33	±40		±50		
			V <sub>SEL</sub> = 2.60 V		±12	±20		±30		

1. ΔR<sub>ON</sub> = R<sub>ON(max)</sub> - R<sub>ON(min)</sub>.

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 <sub>Tn</sub>	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 <sub>Sn</sub>	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 <sub>Sn</sub>	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 <sub>Tn</sub>	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 <sub>Sn</sub>	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 <sub>Tn</sub>	-3dB bandwidth for switch T1, T2	1.65 – 4.3	$R_L = 50 \text{ } \Omega$ , Signal = 0 dBm		58				MHz
BW <sub>Sn</sub>	-3dB bandwidth for switch S1,S2	1.65 – 4.3	$R_L = 50 \text{ } \Omega$ , Signal = 0 dBm		65				MHz

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

# 5 Test circuit

Figure 3. ON resistance

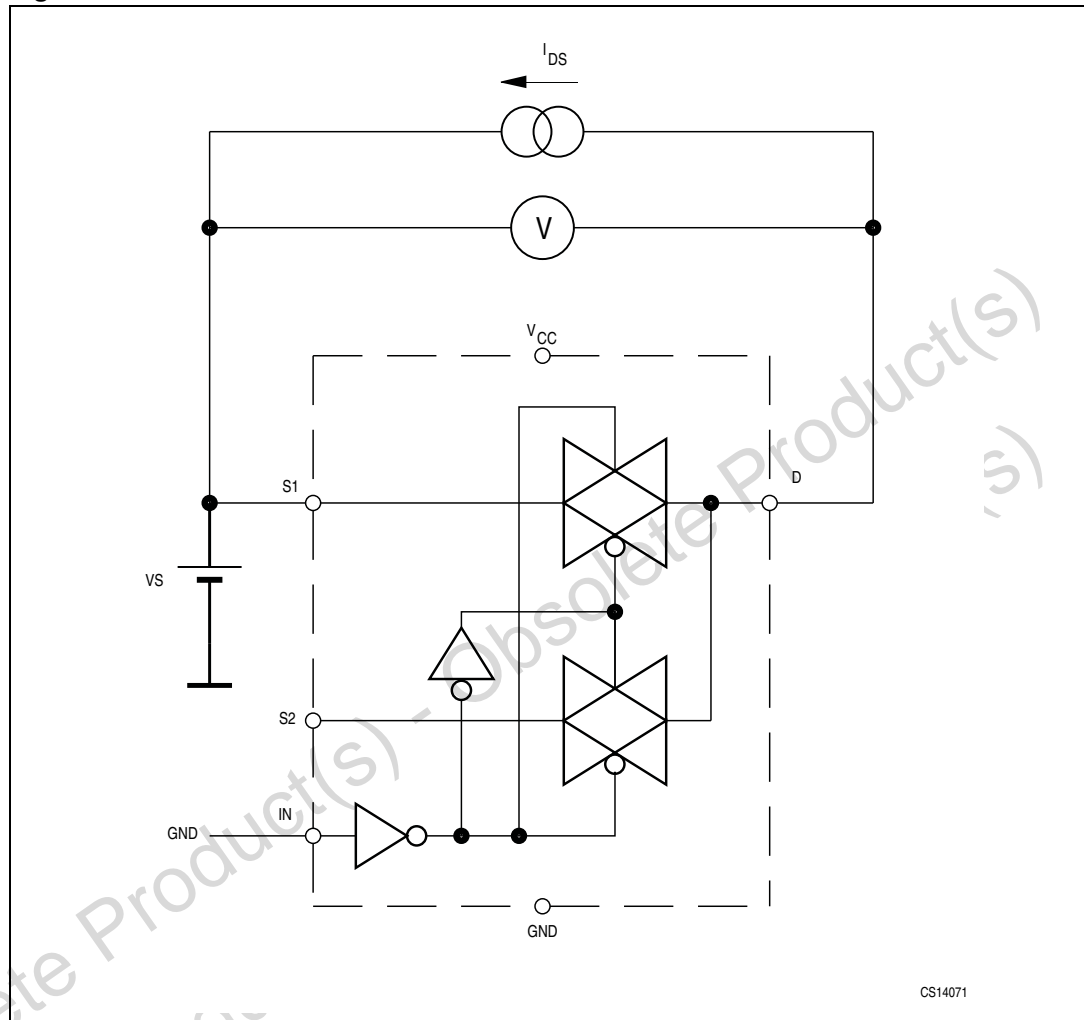


Figure 4. OFF leakage

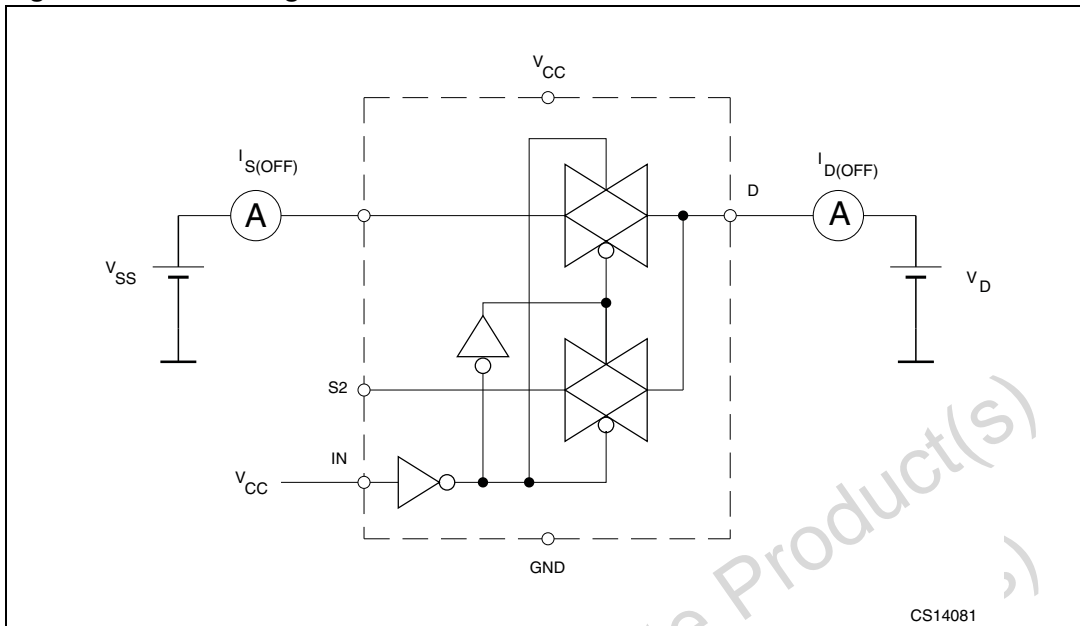


Figure 5. OFF isolation

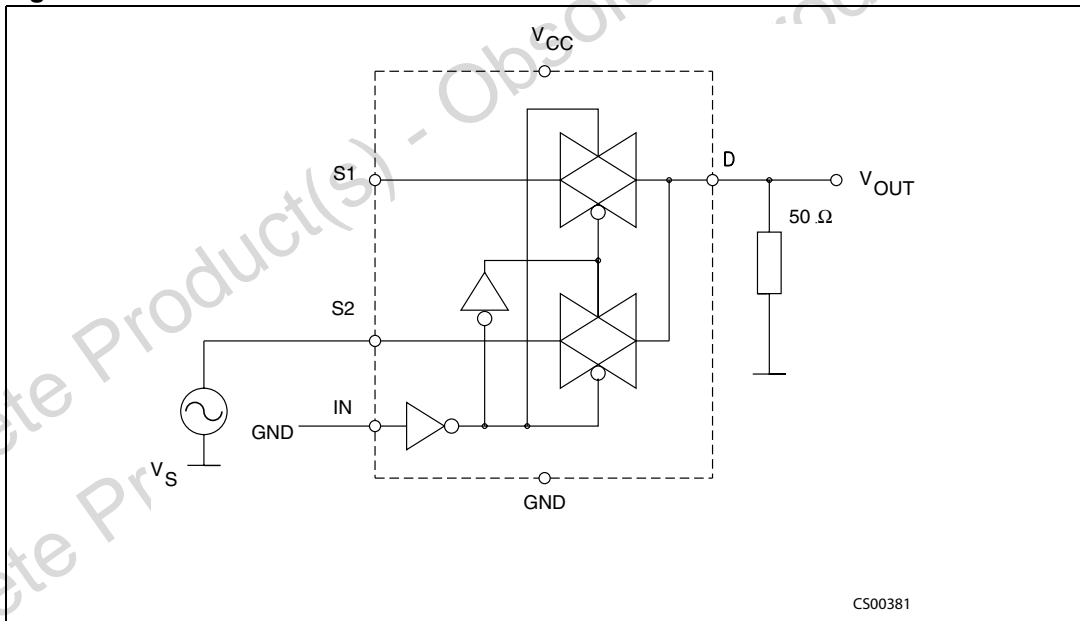


Figure 6. Bandwidth

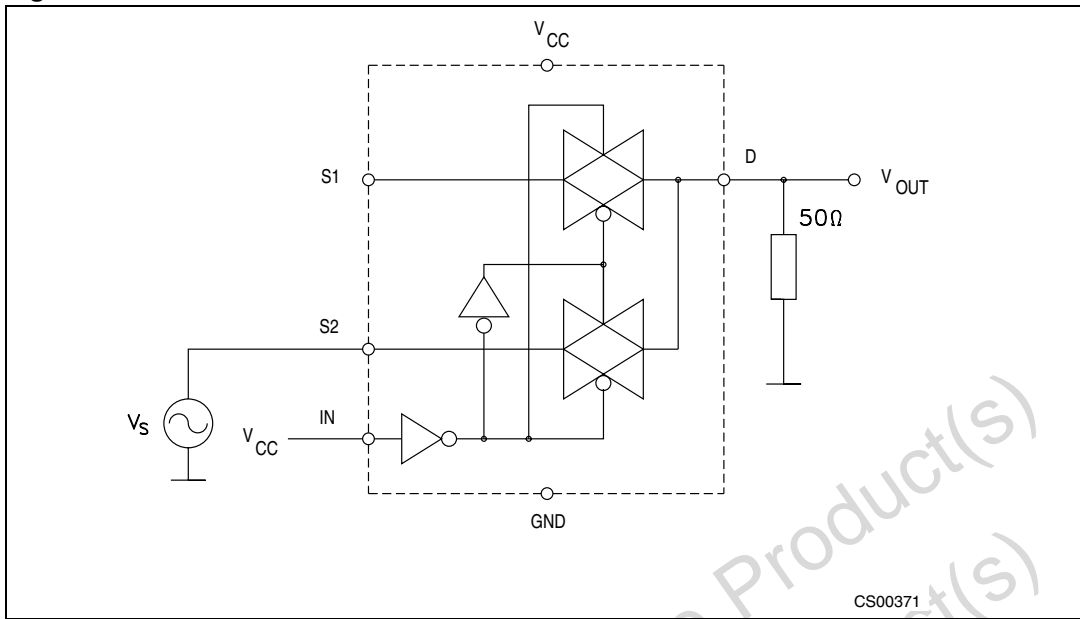


Figure 7. Switch-to-switch crosstalk

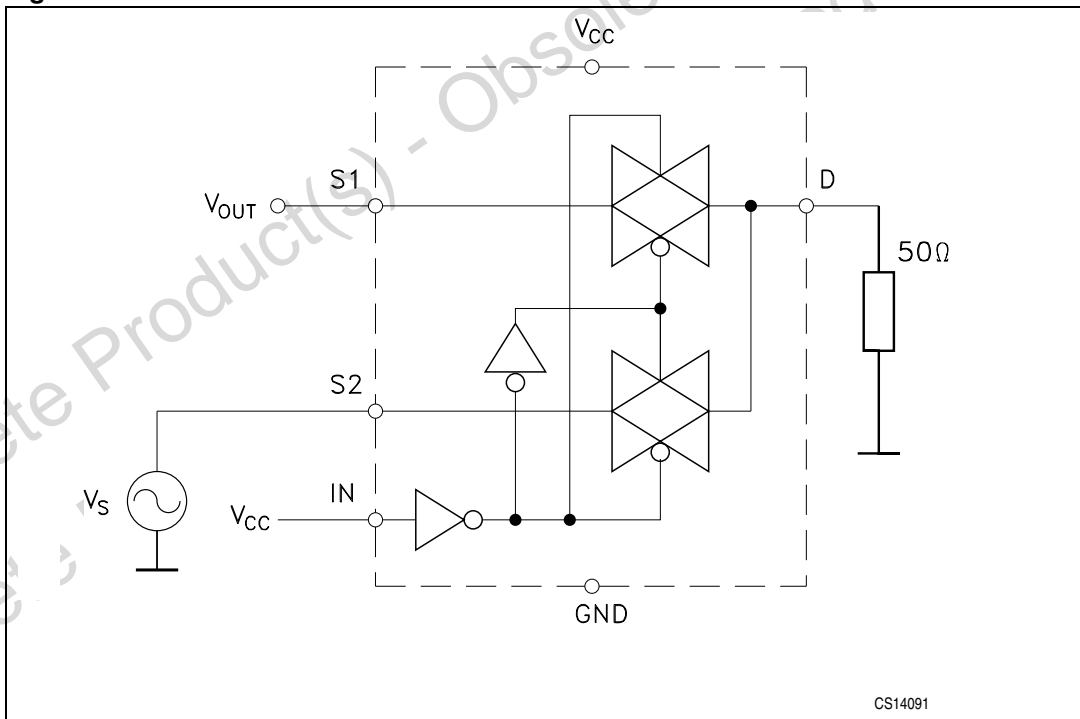
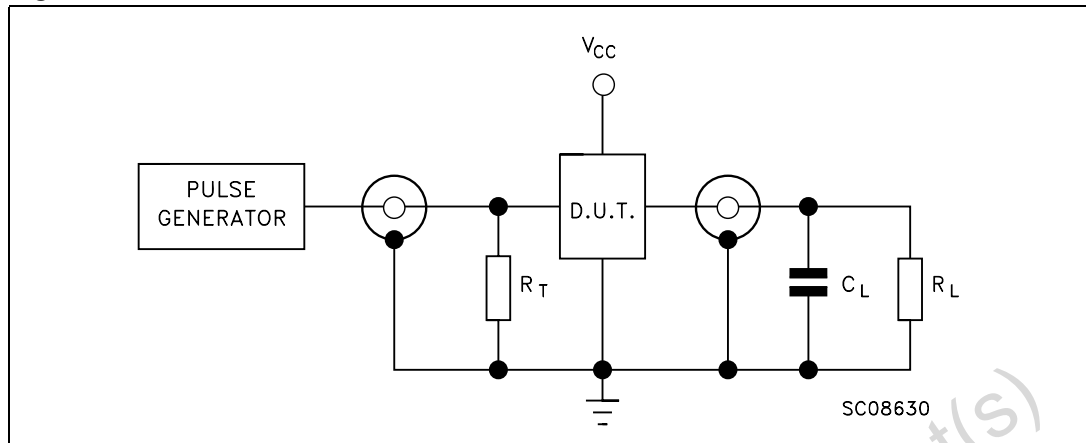


Figure 8. Test circuit



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  $50 \Omega$ )

Figure 9. Break-before-make time delay

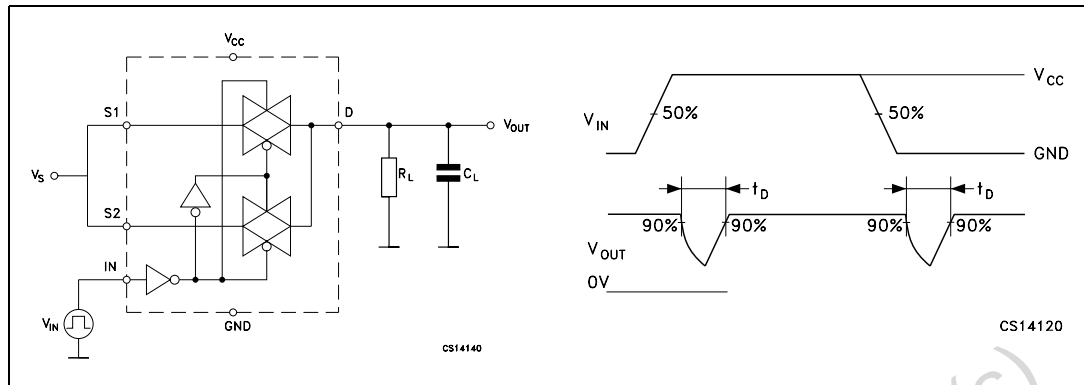


Figure 10. Switching time and charge injection ( $V_{GEN} = 0$ ,  $R_{GEN} = 0 \Omega$ ,  $R_L = 1 M\Omega$ ,  $C_L = 100 pF$ )

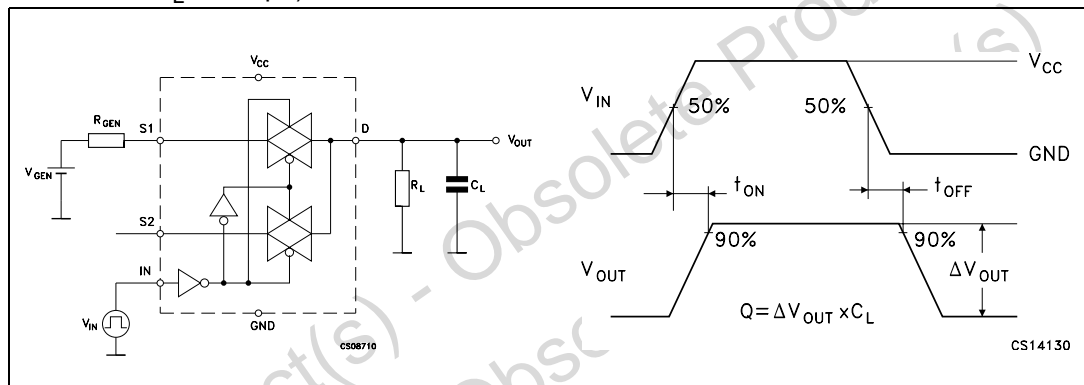
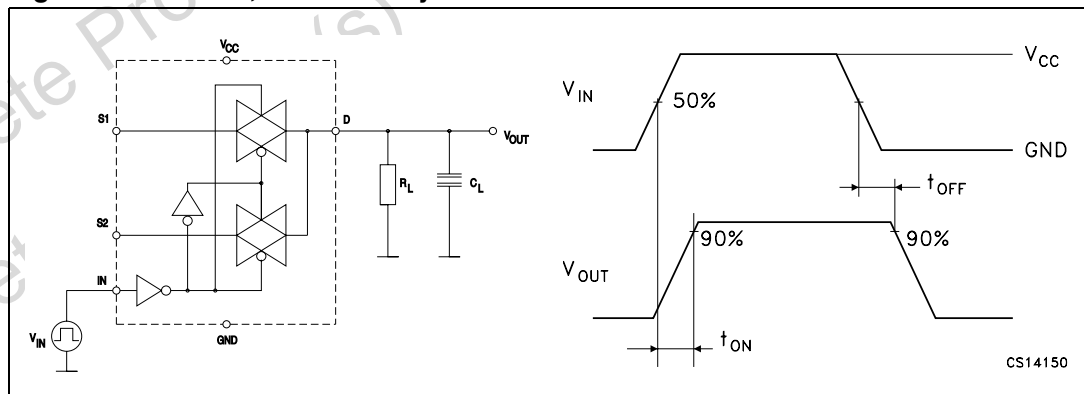


Figure 11. Turn on, turn off delay time





# 6 Application diagram

Figure 12. Application diagram

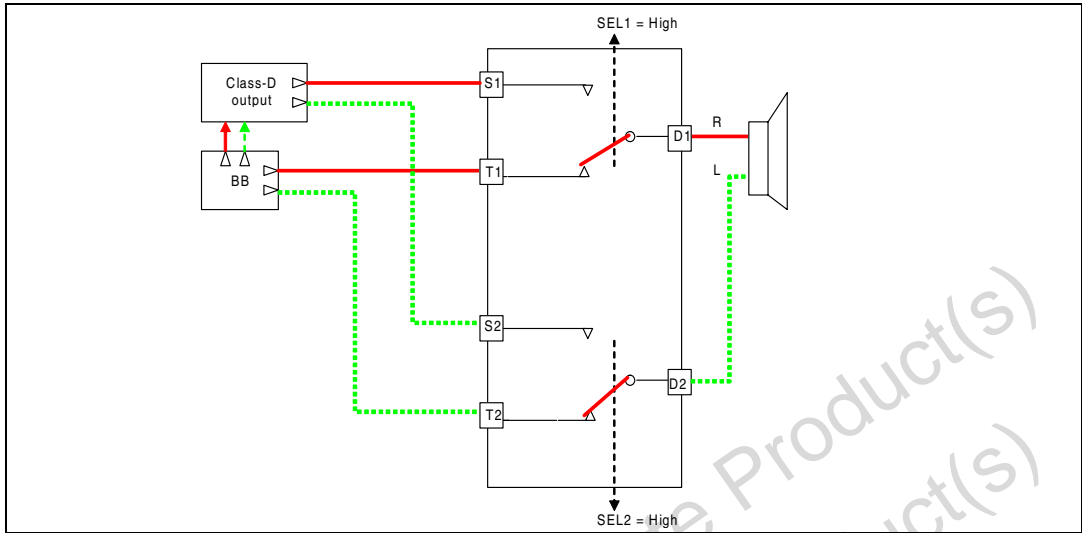
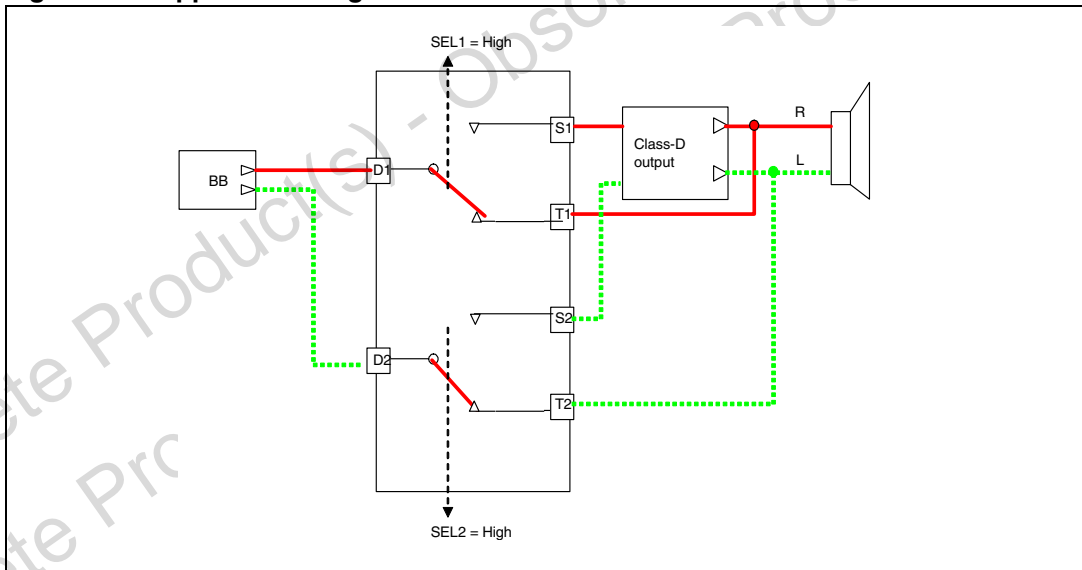


Figure 13. Application diagram



## 7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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).

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

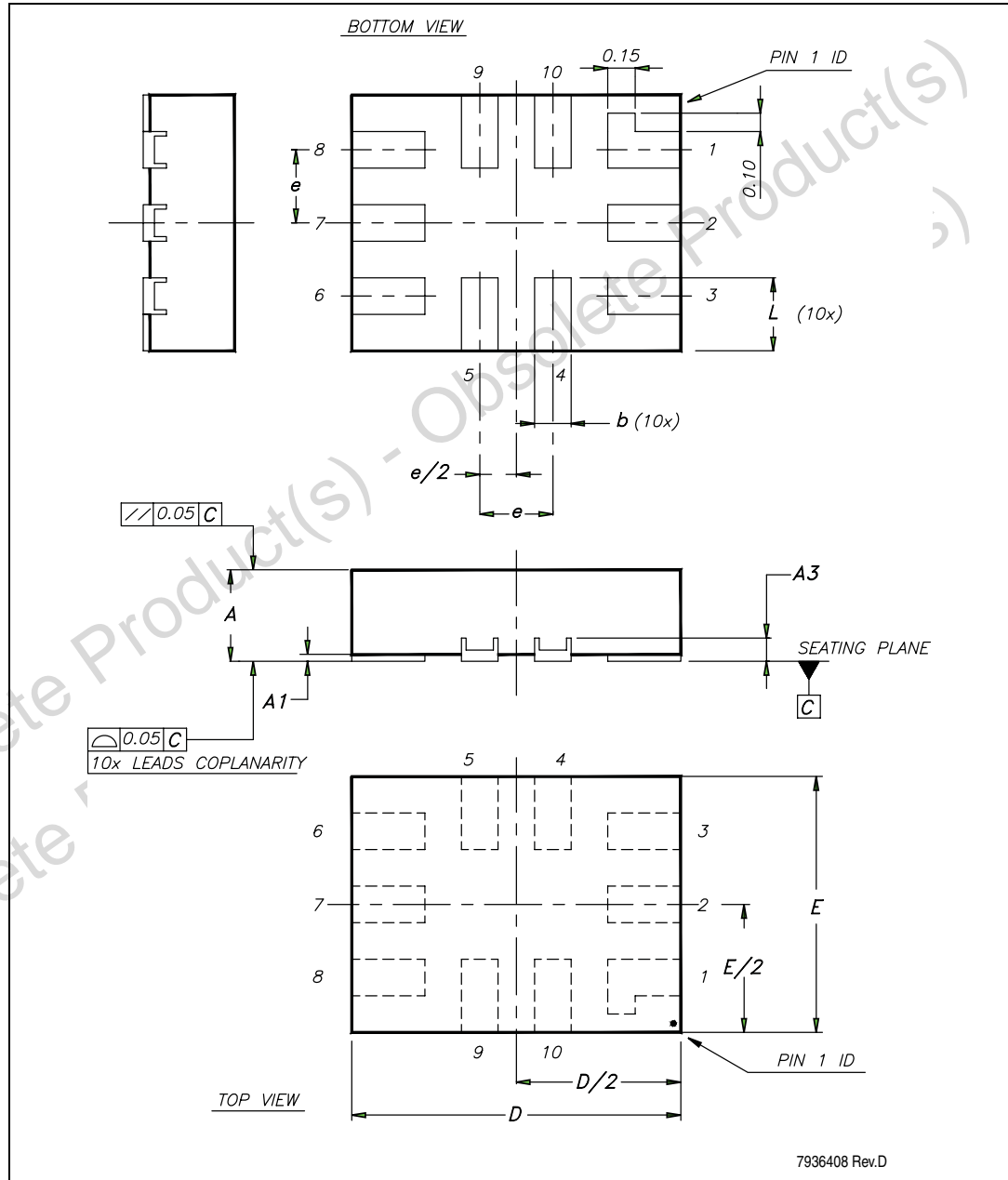


Table 2. QFN10L(1.8 x 1.4 mm) mechanical data

Symbol	Millimeters		
	Min	Typ	Max
A	0.45	0.50	0.55
A1	0	0.02	0.05
A3		0.127	
b	0.15	0.20	0.25
D	1.75	1.80	1.85
E	1.35	1.40	1.45
e		0.40	
L	0.35	0.40	0.45

Figure 15. QFN10L (1.8 x 1.4 mm) footprint recommendations

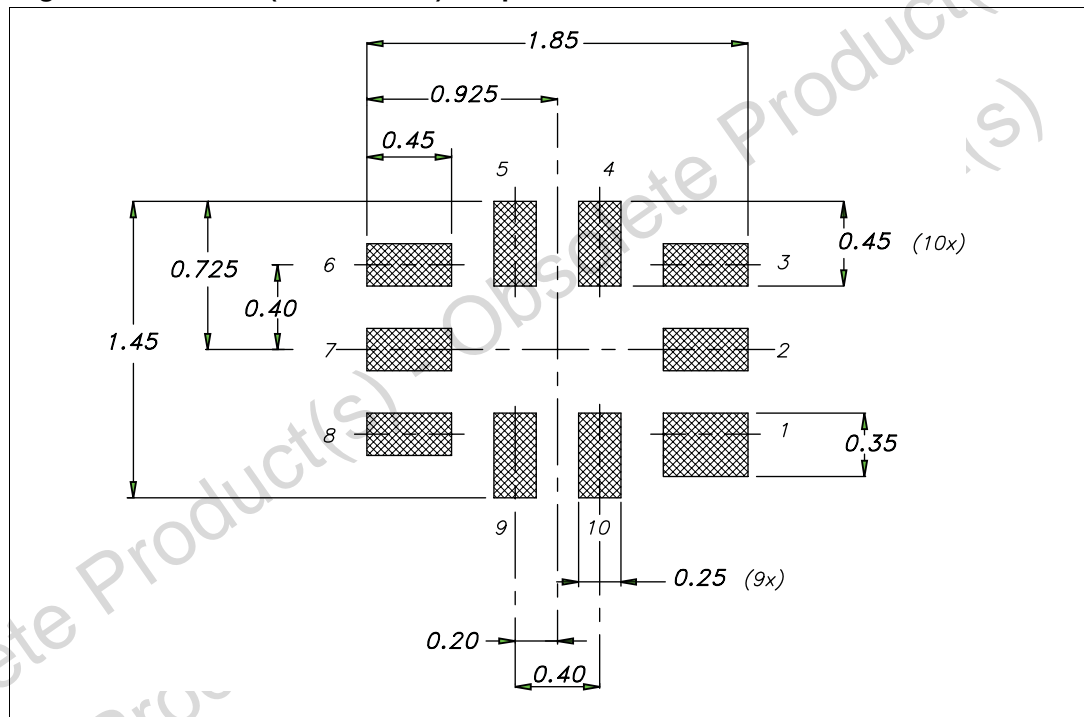
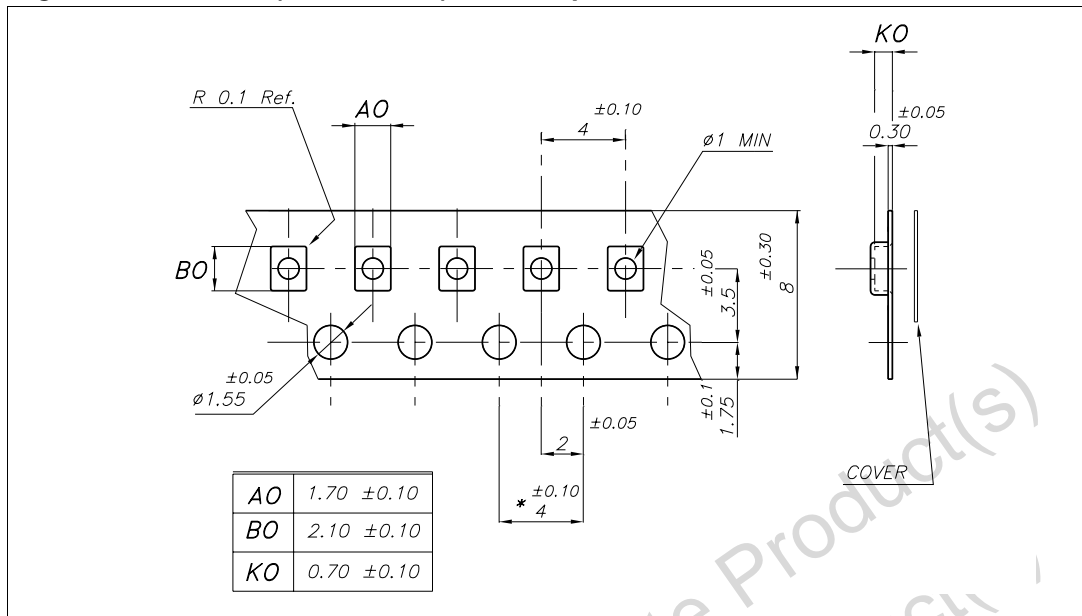
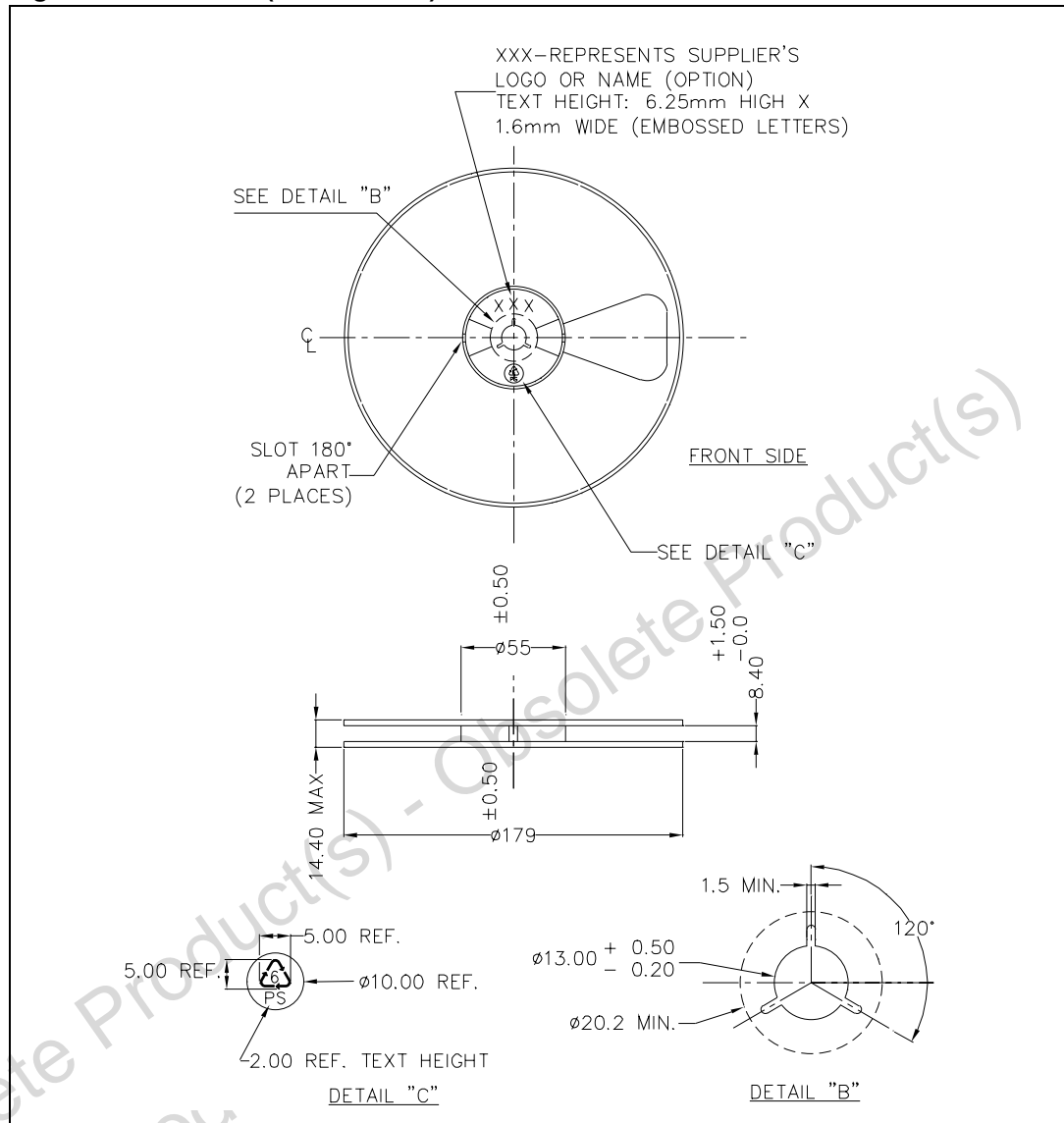


Figure 16. QFN10L (1.8 x 1.4 mm) carrier tape



Obsolete Product(s) - Obsolete Product(s)  
 Obsolete Product(s) - Obsolete Product(s)

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





## 8 Revision history

Table 9. Document revision history

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

Obsolete Product(s) - Obsolete Product(s)  
Obsolete Product(s) - Obsolete Product(s)

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