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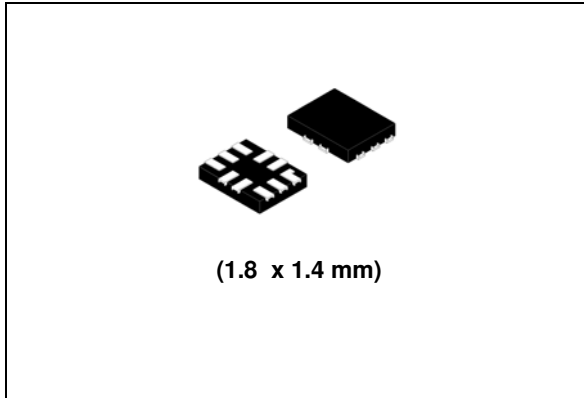
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## Low voltage 0.5 $\Omega$ max dual single-pole double-throw analog switch with break-before-make

Datasheet - production data



### Description

The AS21P2TLR is a high-speed CMOS single-pole double-throw (SPDT) analog switch or dual 2:1 multiplexer/demultiplexer bus switch fabricated using silicon gate C<sup>2</sup>MOS technology. Designed to operate from 1.65 to 4.3 V, this device is ideal for portable applications.

It offers very low ON resistance ( $R_{ON} < 0.5 \Omega$ ) at  $V_{CC} = 3.6$  V. The  $n_{IN}$  inputs are provided to control the independent channel switches  $nS1$  and  $nS2$ . The switches  $nS1$  are ON (connected to common ports  $Dn$ ) when the  $n_{IN}$  input is held high and OFF (state of high impedance exists between the two ports) when  $n_{IN}$  is held low. The switches  $nS2$  are ON (connected to common ports  $Dn$ ) when the  $n_{IN}$  input is held low and OFF (state of high impedance exists between the two ports) when  $n_{IN}$  is held high. Additional key features are fast switching speed, break-before-make delay time and ultralow power consumption. All inputs and outputs are equipped with protection circuits against static discharge, giving them ESD and excess transient voltage immunity.

### Features

- Ultra low power dissipation:  $I_{CC} = 0.2 \mu A$  (max.) at  $T_A = 85 \text{ }^\circ C$
- Low ON resistance  $V_{IN} = 0$  V:
  - $R_{ON} = 0.50 \Omega$  (max.  $T_A = 25 \text{ }^\circ C$ ) at  $V_{CC} = 4.3$  V
  - $R_{ON} = 0.50 \Omega$  (max.  $T_A = 25 \text{ }^\circ C$ ) at  $V_{CC} = 3.6$  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  $V_{CC} = 2.3$  to 4.3 V
- Latch-up performance exceeds 300 mA (JESD 17)
- ESD performance: HMB > 2 kV (MIL STD 883 method 3015)

Table 1. Device summary

Order code	Package	Packing
AS21P2TLRQ	QFN10L (1.8 x 1.4 mm)	Tape and reel

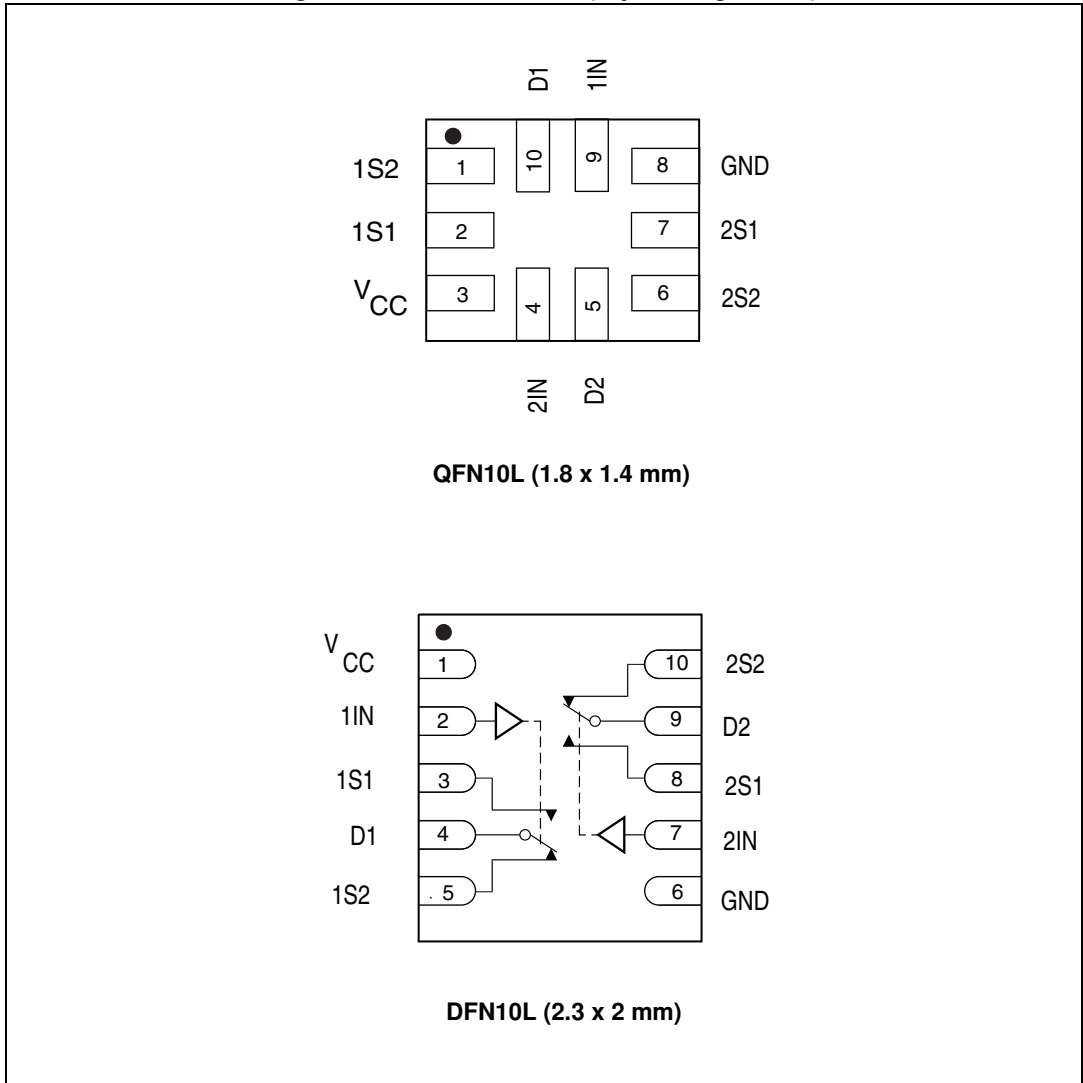
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# 1 Pin settings

## 1.1 Pin connection

Figure 1. Pin connection (top through view)



## 1.2 Pin description

**Table 2. Pin description**

Pin number	Symbol	Name and function
1	1S2	Independent channel
2	1S1	Independent channel
3	V <sub>CC</sub>	Positive voltage supply
4	2IN	Control
5	D2	Common channel
6	2S2	Independent channel
7	2S1	Independent channel
8	GND	Ground (0 V)
9	1IN	Control
10	D1	Common channel

*Note:* Exposed pad must be soldered to a floating plane. Do NOT connect to power or ground.

## 2 Input equivalent circuit and truth table

Figure 2. Input equivalent circuit

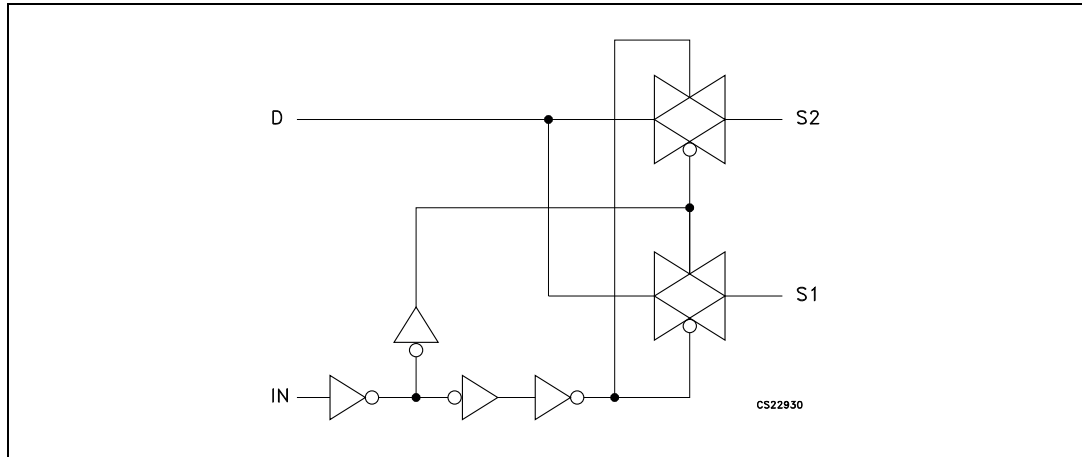


Table 3. Truth table

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

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 ( $V_{IN} < 0$ V)	-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	$\pm 300$	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	1120	mW
$T_{STG}$	Storage temperature	-65 to 150	°C
$T_L$	Lead temperature (10 sec)	300	°C

**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	$V_{CC} = 1.65$ to $2.7$ V	0 to 20
		$V_{CC} = 3.0$ to $4.3$ V	0 to 10
			ns/V

## 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		
		3.0 – 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	
		3.0 – 3.6				0.30		0.30	
		4.3				0.40		0.40	
R <sub>ON</sub>	Switch ON resistance	4.3	V <sub>S</sub> = 0 V to V <sub>CC</sub> I <sub>S</sub> = 100 mA		0.45	0.50		0.60	Ω
		3.6			0.45	0.50		0.60	
		3.0			0.50	0.55		0.60	
		2.3			0.60	0.70		0.80	
		1.8			0.80	0.9		1.0	
ΔR <sub>ON</sub>	ON resistance match between channels <sup>(1),(2)</sup>	2.7	V <sub>S</sub> = 1.5 V I <sub>S</sub> = 100 mA		0.1			Ω	
R <sub>FLAT</sub>	ON resistance flatness <sup>(3)</sup>	4.3	V <sub>S</sub> = 1.5 V 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	
		2.3			0.20	0.25		0.25	
		1.65			0.35	0.45		0.45	
I <sub>OFF</sub>	OFF state leakage current (nSn), (Dn)	4.3	V <sub>S</sub> = 0.3 or 4 V			±20		±100	nA
I <sub>IN</sub>	Input leakage current	0 – 4.3	V <sub>IN</sub> = 0 to 4.3 V			±0.05		±1	μA
I <sub>CC</sub>	Quiescent supply current <sup>(1)</sup>	1.65 – 4.3	V <sub>IN</sub> = V <sub>CC</sub> or GND			±0.05		±0.2	μA



Table 6. DC specifications (continued)

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	
I <sub>CCLV</sub>	Quiescent supply current low voltage driving	4.3	V <sub>1IN</sub> , V <sub>2IN</sub> = 1.65 V		±37	±50		±100	μA
			V <sub>1IN</sub> , V <sub>2IN</sub> = 1.80 V		±33	±40		±50	
			V <sub>1IN</sub> , V <sub>2IN</sub> = 2.60 V		±12	±20		±30	

1. Guaranteed by design.
2. ΔR<sub>ON</sub> = R<sub>ON(max)</sub> - R<sub>ON(min)</sub>.
3. 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<sub>L</sub> = 35 pF, R<sub>L</sub> = 50 Ω, t<sub>r</sub> = t<sub>f</sub> ≤ 6 ns)

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	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation delay	1.65 – 1.95			0.45				ns
		2.3 – 2.7			0.40				
		3.0 – 3.3			0.30				
		3.6 – 4.3			0.30				
t <sub>ON</sub>	Turn-ON time	1.65 – 1.95	V <sub>S</sub> = 0.8 V		120				ns
		2.3 – 2.7	V <sub>S</sub> = 1.5 V		65	85		90	
		3.0 – 3.3			42	55		65	
		3.6 – 4.3			40	55		65	
t <sub>OFF</sub>	Turn-OFF time	1.65 – 1.95	V <sub>S</sub> = 0.8 V		45				ns
		2.3 – 2.7	V <sub>S</sub> = 1.5 V		18	30		40	
		3.0 – 3.3			16	30		40	
		3.6 – 4.3			15	30		40	
t <sub>D</sub>	Break-before make time delay	1.65 – 1.95	C <sub>L</sub> = 35 pF R <sub>L</sub> = 50 Ω V <sub>S</sub> = 1.5 V		2	80			ns
		2.3 – 2.7			2	60			
		3.0 – 3.3			2	55			
		3.6 – 4.3			2	50			

Table 7. AC electrical characteristics ( $C_L = 35 \text{ pF}$ ,  $R_L = 50 \text{ } \Omega$ ,  $t_r = t_f \leq 6 \text{ ns}$ ) (continued)

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	
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	Off isolation <sup>(1)</sup>	1.65 – 4.3	$V_S = 1 \text{ V}_{RMS}$ $f = 100 \text{ kHz}$		-66				dB
Xtalk	Crosstalk	1.65 – 4.3	$V_S = 1 \text{ V}_{RMS}$ $f = 100 \text{ kHz}$		-72				dB
THD	Total harmonic distortion	2.3 – 4.3	$R_L = 600 \text{ } \Omega$ $V_{IN} = 2V_{PP}$ $f = 20 \text{ Hz to } 20 \text{ kHz}$		0.02				%
BW	-3 dB bandwidth	1.65 – 4.3	$R_L = 50 \text{ } \Omega$		55				MHz
$C_{IN}$	Control pin input capacitance				5				pF
$C_{Sn}$	Sn port capacitance	3.3	$f = 1 \text{ MHz}$		40				
$C_D$	D port capacitance when switch is enabled	3.3	$f = 1 \text{ MHz}$		114				

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

# 5 Test circuit

Figure 3. ON resistance

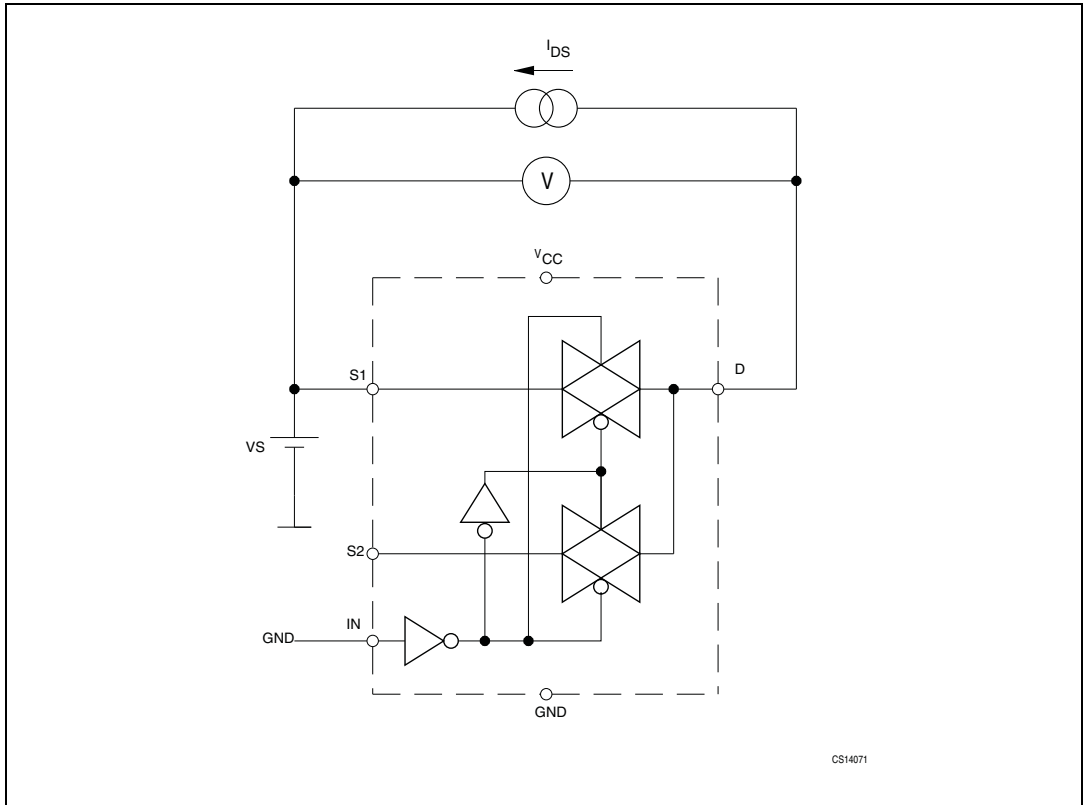


Figure 4. OFF leakage

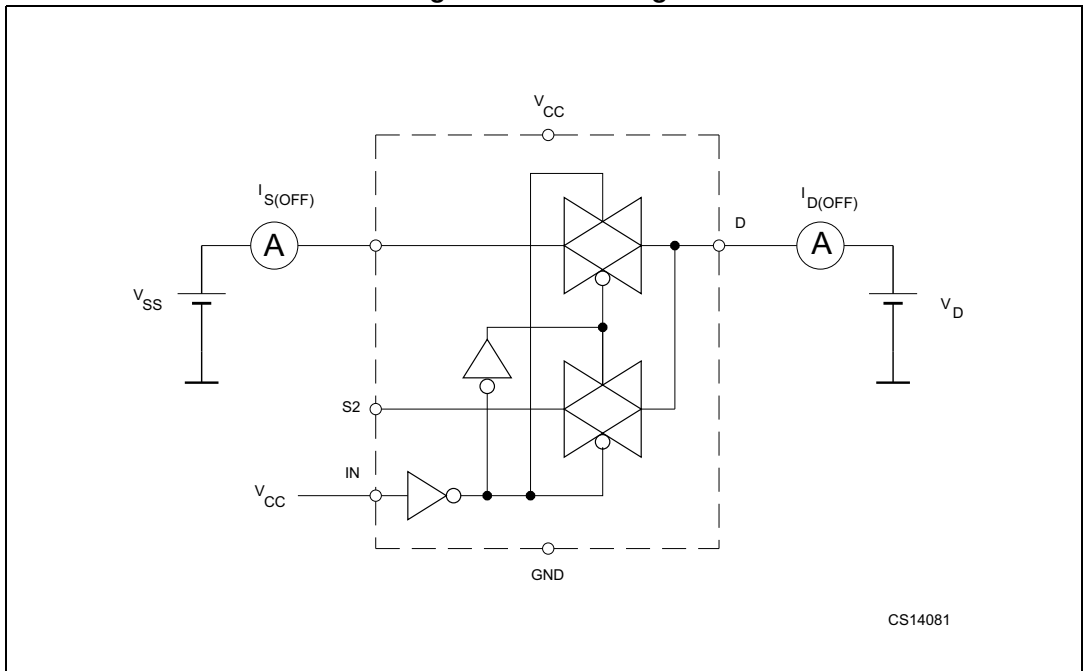


Figure 5. OFF isolation

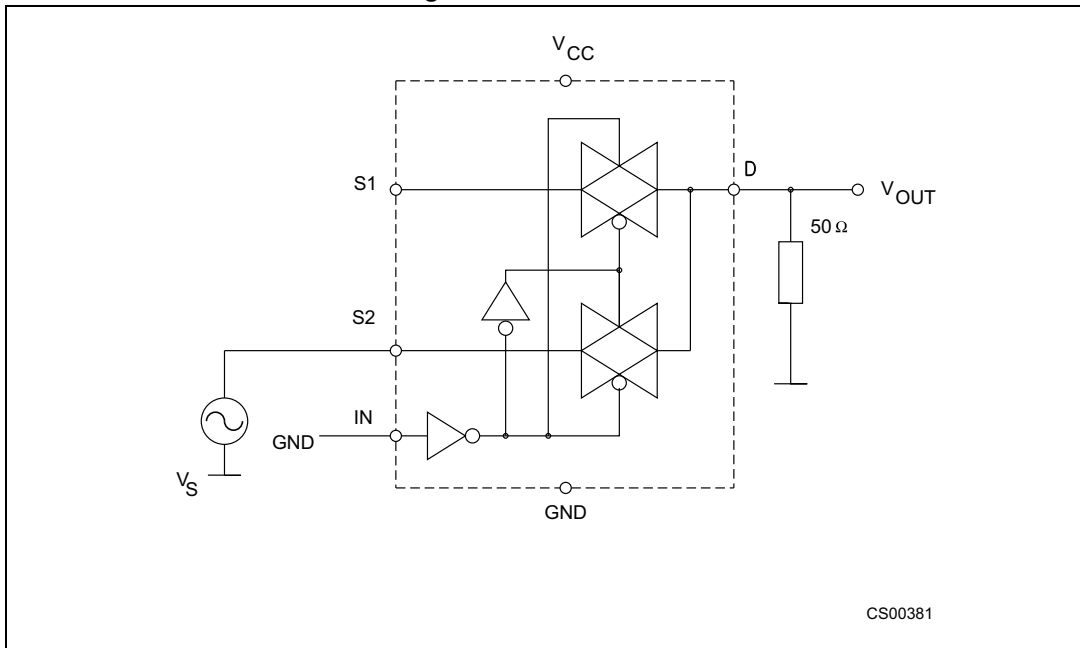


Figure 6. Bandwidth

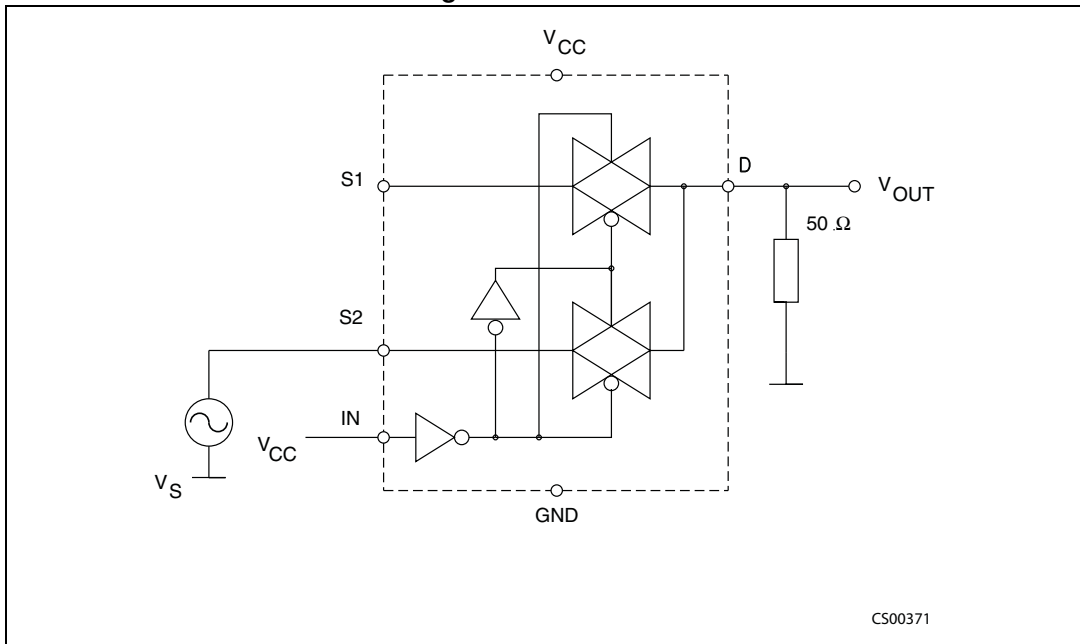


Figure 7. Channel-to-channel crosstalk

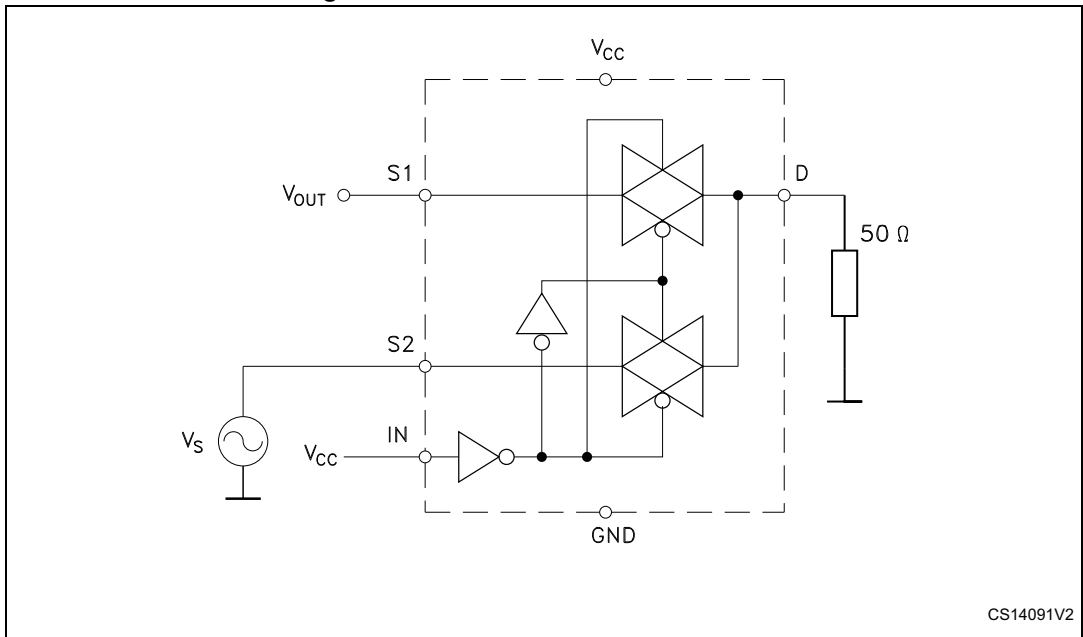
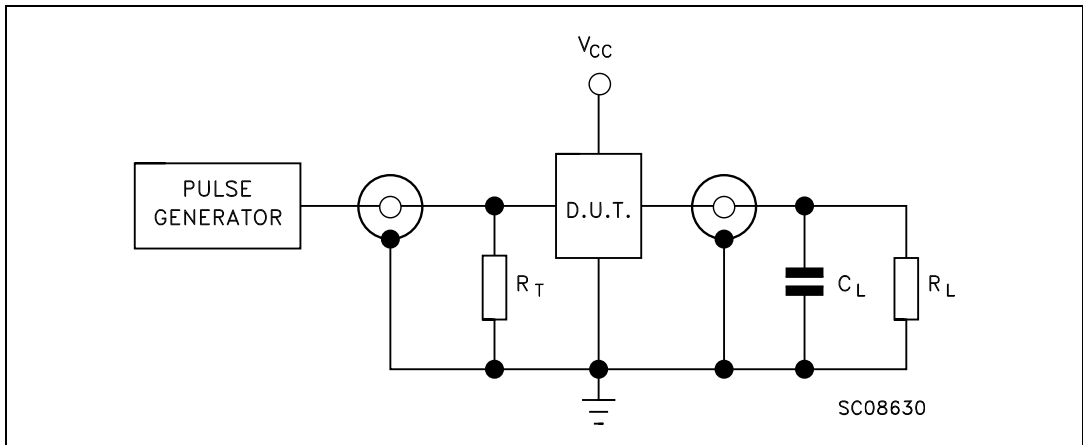


Figure 8. Test circuit



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

Figure 9. Break-before-make time delay

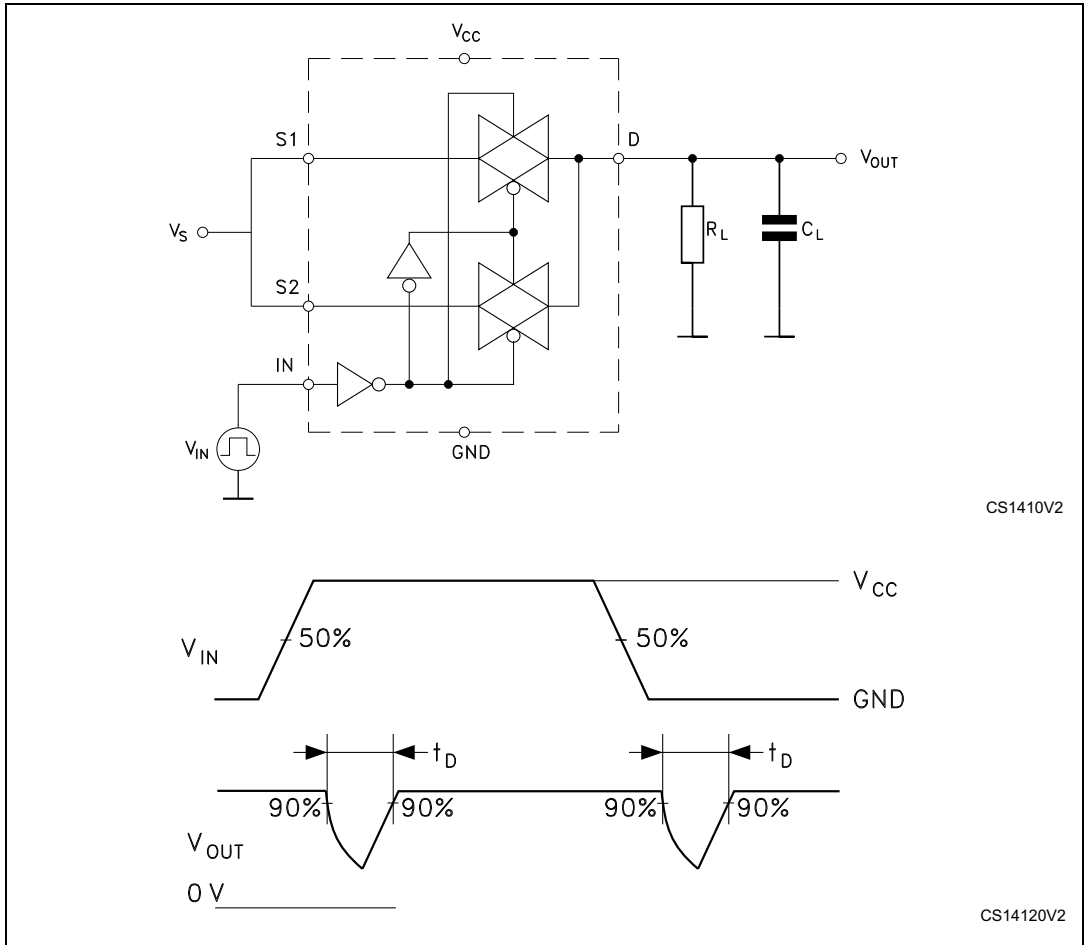


Figure 10. Charge injection ( $V_{GEN} = 0\text{ V}$ ,  $R_{GEN} = 0\ \Omega$ ,  $R_L = 1\text{ M}\Omega$ ,  $C_L = 100\text{ pF}$ )

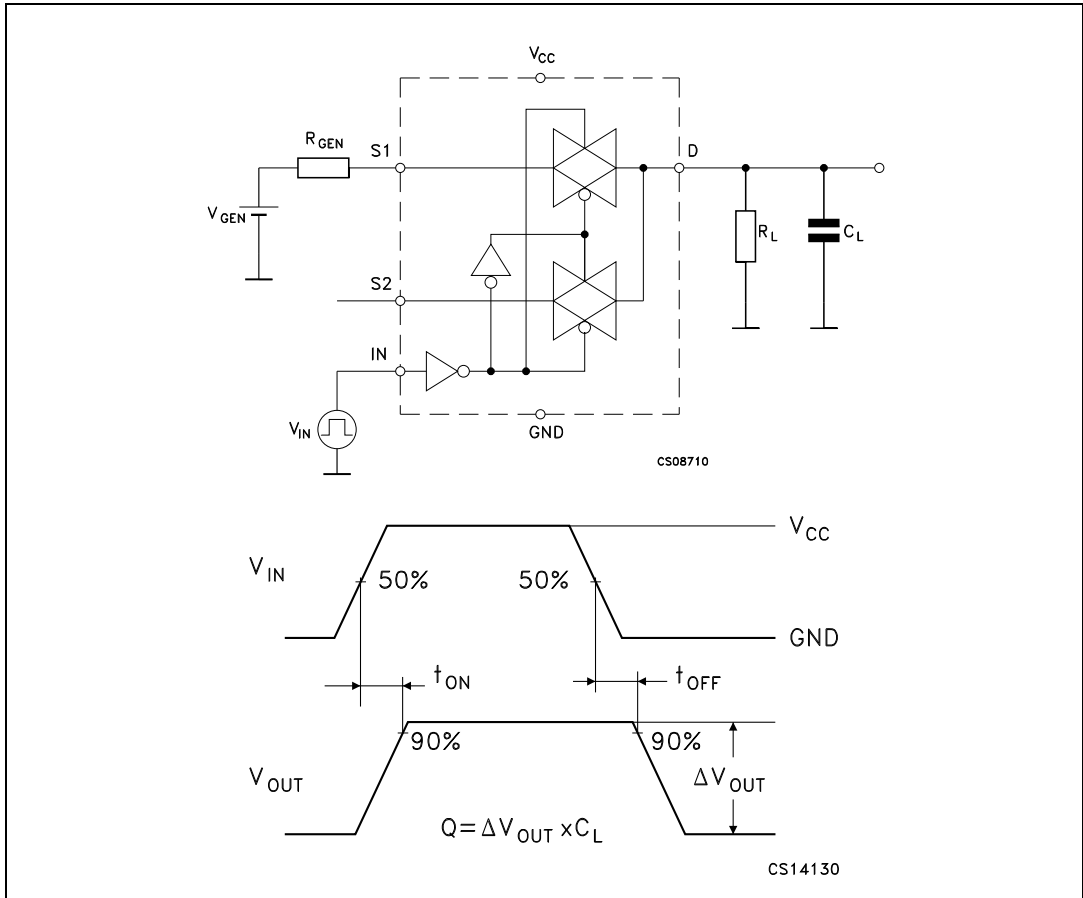
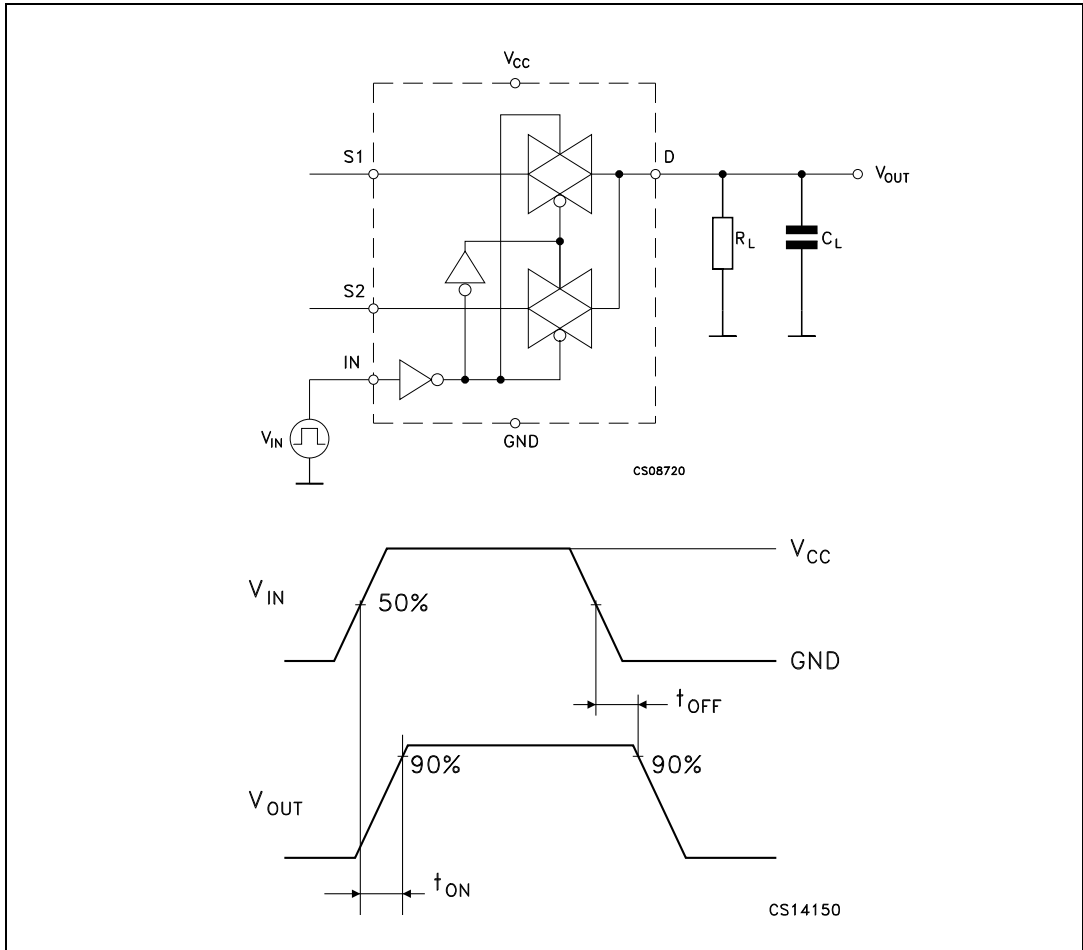




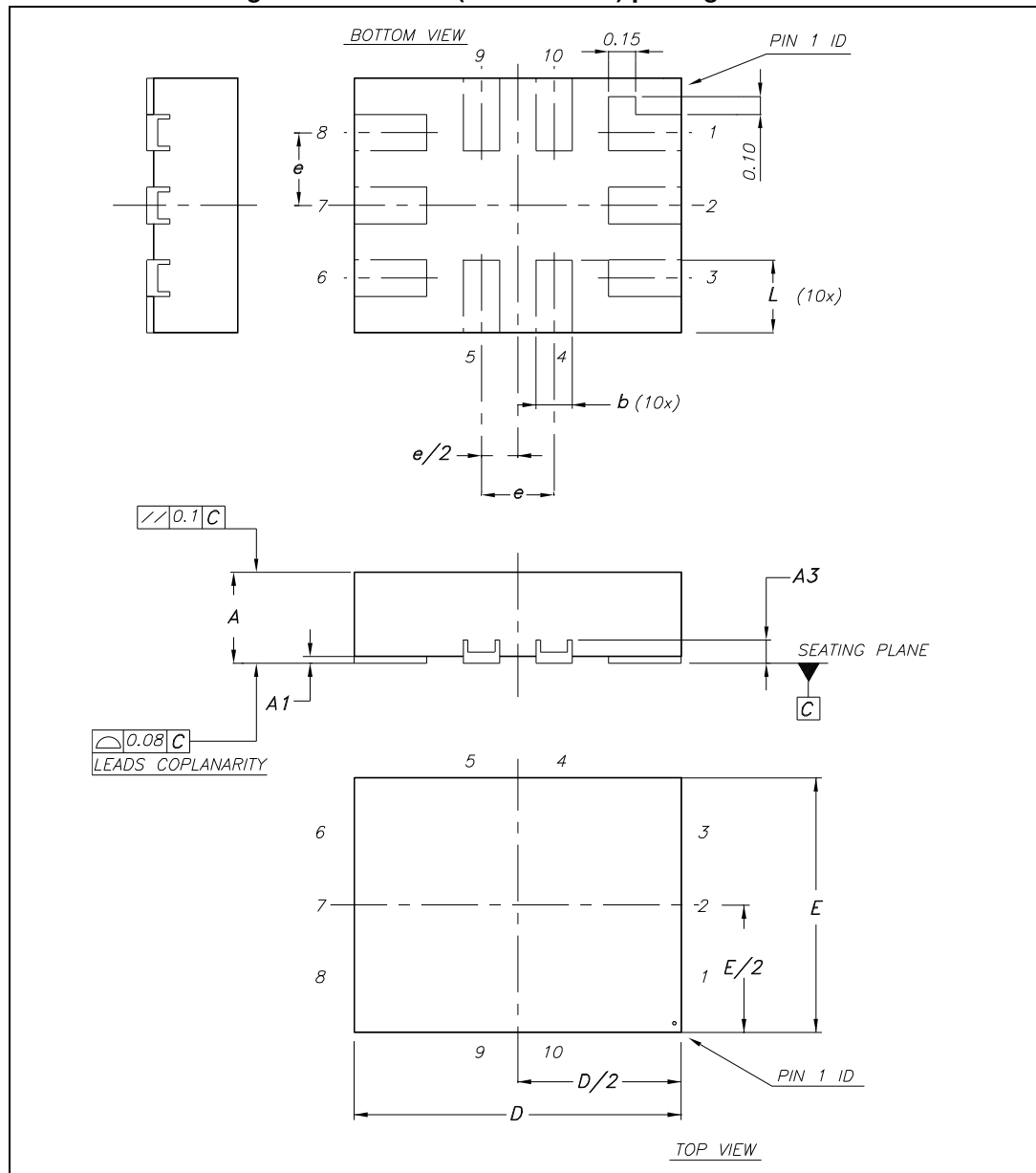
Figure 11. Turn-on, turn-off delay time



## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

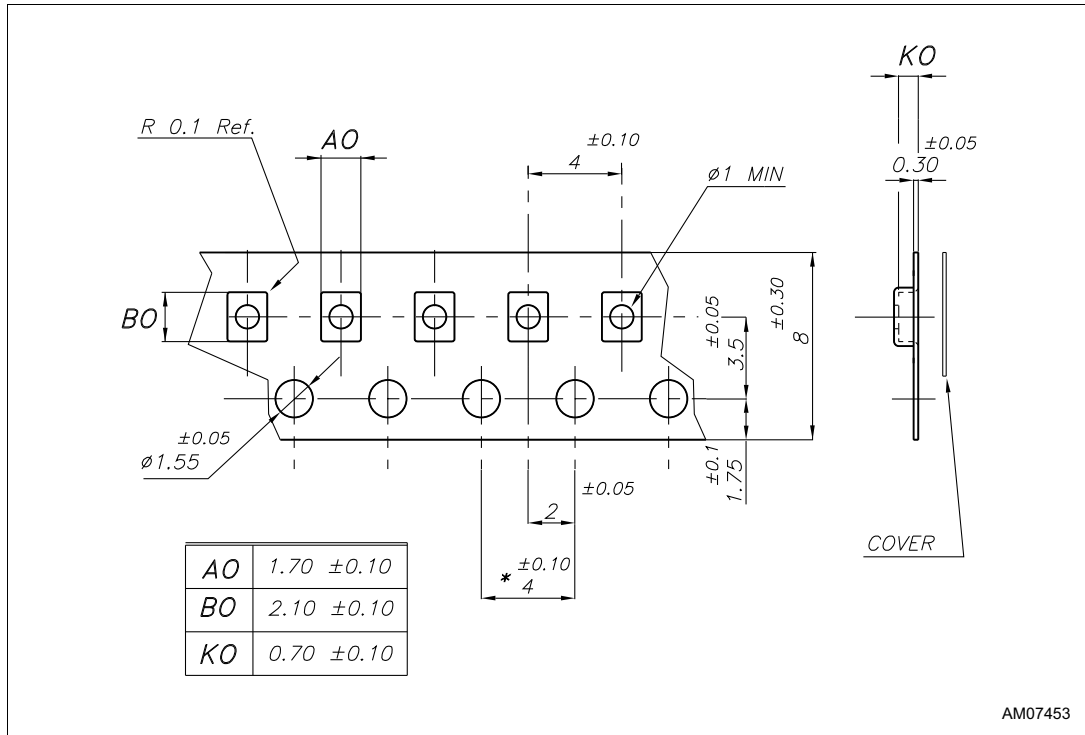
**Figure 12. QFN10L (1.8 x 1.4 mm) package outline**



1. Drawing not to scale.

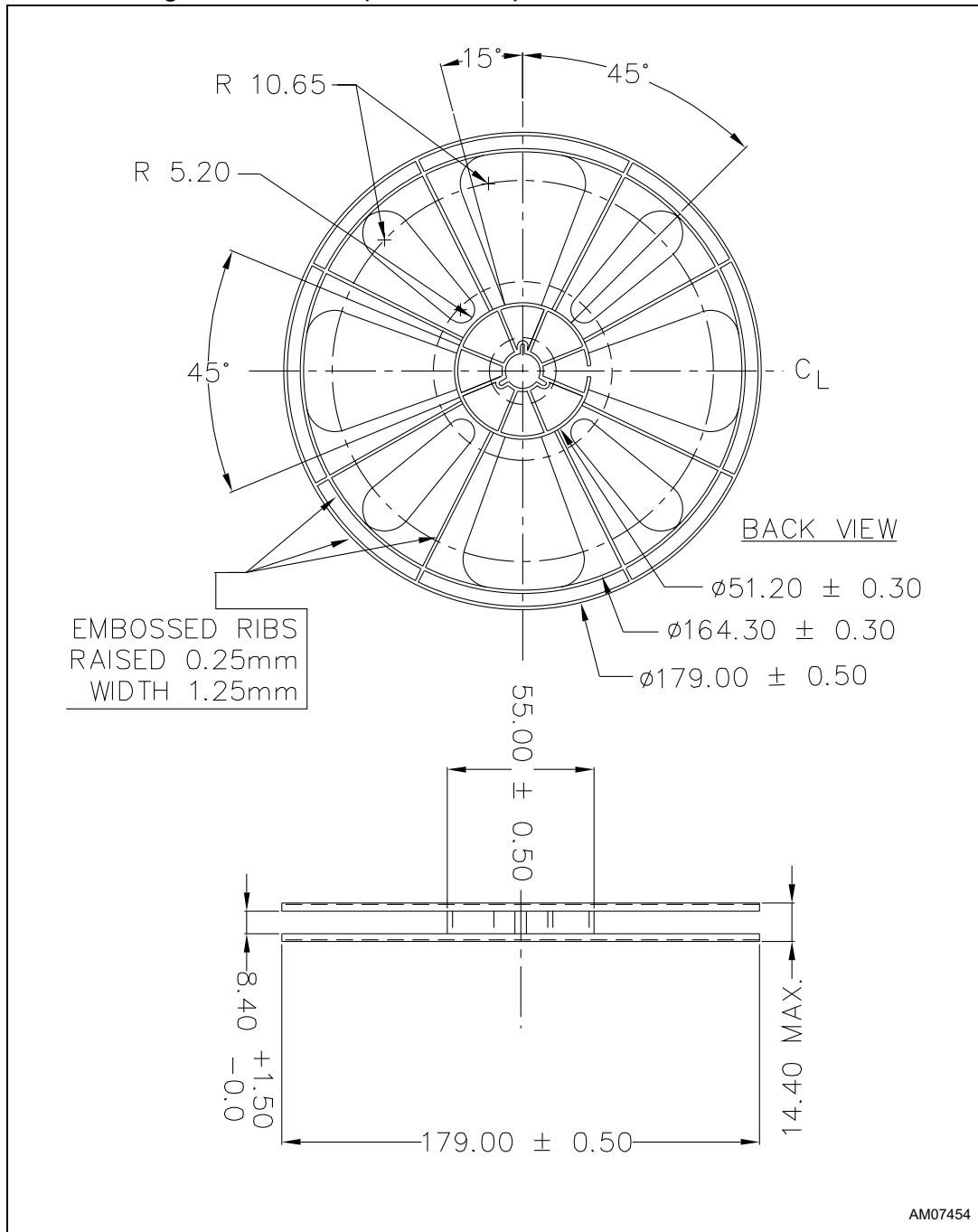


Figure 14. QFN10L (1.8 x 1.4 mm) carrier type



1. Drawing not to scale.

Figure 15. QFN10L (1.8 x 1.4 mm) reel information - back view



1. Drawing not to scale.



## 7 Revision history

Table 10. Document revision history

Date	Revision	Changes
07-Mar-2014	1	Initial release.



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