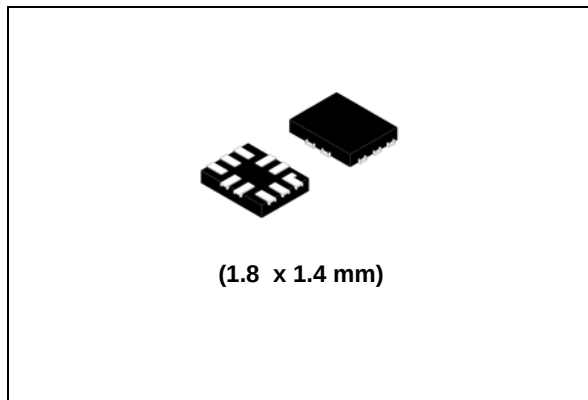


## Low voltage 0.5 $\Omega$ max dual single-pole double-throw analog switch with break-before-make

Datasheet - production data



### Features

- Ultra low power dissipation:  $I_{CC} = 0.2 \mu A$  (max.) at  $T_A = 85^\circ C$
- Low ON resistance  $V_{IN} = 0 V$ :
  - $R_{ON} = 0.50 \Omega$  (max.  $T_A = 25^\circ C$ ) at  $V_{CC} = 4.3 V$
  - $R_{ON} = 0.50 \Omega$  (max.  $T_A = 25^\circ C$ ) 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)

### 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  $IN$  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.

Table 1. Device summary

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

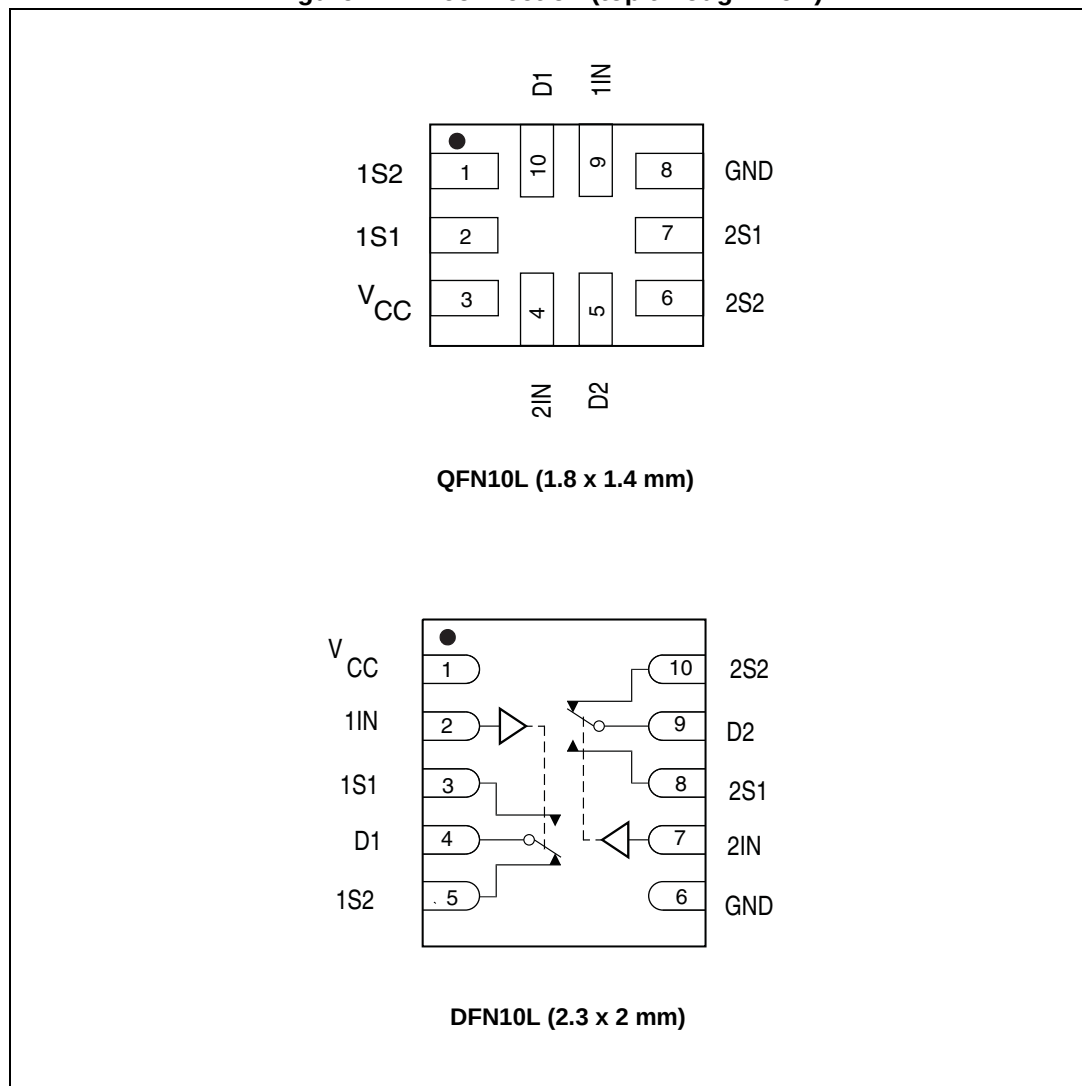
## Contents

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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

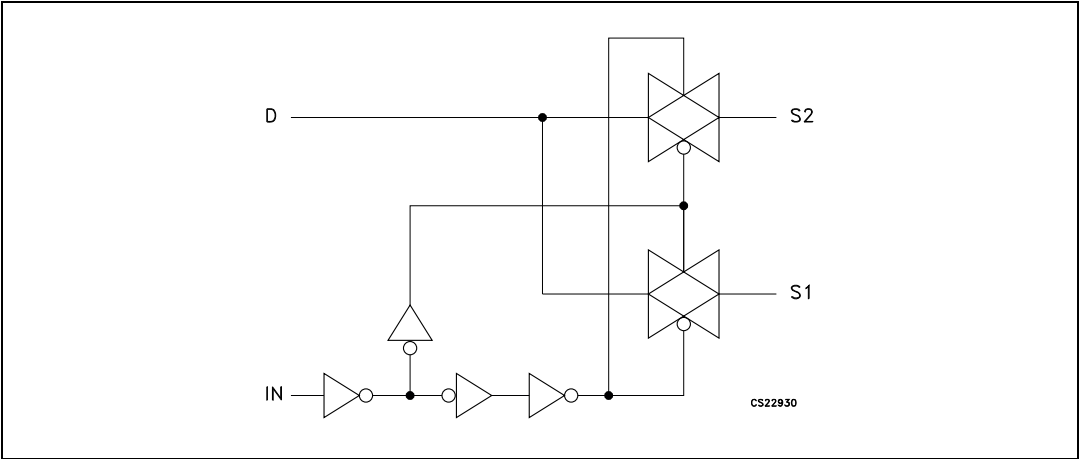


Table 3. Truth table

| 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       | ns/V |
|          |                                        | $V_{CC} = 3.0$ to $4.3$ 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                  |      |      |
|                   |                                                         | 3.0 – 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><br>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<br>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<br>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.  $\Delta R_{ON} = R_{ON(max)} - R_{ON(min)}$ .
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> ,<br>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<br>R <sub>L</sub> = 50 Ω<br>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 ( $C_L = 35 \text{ pF}$ ,  $R_L = 50 \Omega$ ,  $t_r = t_f \leq 6 \text{ ns}$ ) (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 |      |
| Q      | Charge injection | 1.65 – 1.95         | C <sub>L</sub> = 100 pF<br>R <sub>L</sub> = 1 MΩ<br>V <sub>GEN</sub> = 0 V<br>R <sub>GEN</sub> = 0 Ω |                        | 43  |     |              |     | pC   |
|        |                  | 2.3 – 2.7           |                                                                                                      |                        | 51  |     |              |     |      |
|        |                  | 3.0 – 3.3           |                                                                                                      |                        | 51  |     |              |     |      |
|        |                  | 3.6 – 4.3           |                                                                                                      |                        | 49  |     |              |     |      |

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

| 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 |      |
| OIRR            | Off isolation <sup>(1)</sup>              | 1.65 – 4.3          | V <sub>S</sub> = 1 V <sub>RMS</sub><br>f = 100 kHz                                  |                        | -66  |     |              |     | dB   |
| Xtalk           | Crosstalk                                 | 1.65 – 4.3          | V <sub>S</sub> = 1 V <sub>RMS</sub><br>f = 100 kHz                                  |                        | -72  |     |              |     | dB   |
| THD             | Total harmonic distortion                 | 2.3 – 4.3           | R <sub>L</sub> = 600 Ω<br>V <sub>IN</sub> = 2V <sub>PP</sub><br>f = 20 Hz to 20 kHz |                        | 0.02 |     |              |     | %    |
| BW              | -3 dB bandwidth                           | 1.65 – 4.3          | R <sub>L</sub> = 50 Ω                                                               |                        | 55   |     |              |     | MHz  |
| C <sub>IN</sub> | Control pin input capacitance             |                     |                                                                                     |                        | 5    |     |              |     | pF   |
| C <sub>Sn</sub> | Sn port capacitance                       | 3.3                 | f = 1 MHz                                                                           |                        | 40   |     |              |     |      |
| C <sub>D</sub>  | D port capacitance when switch is enabled | 3.3                 | f = 1 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

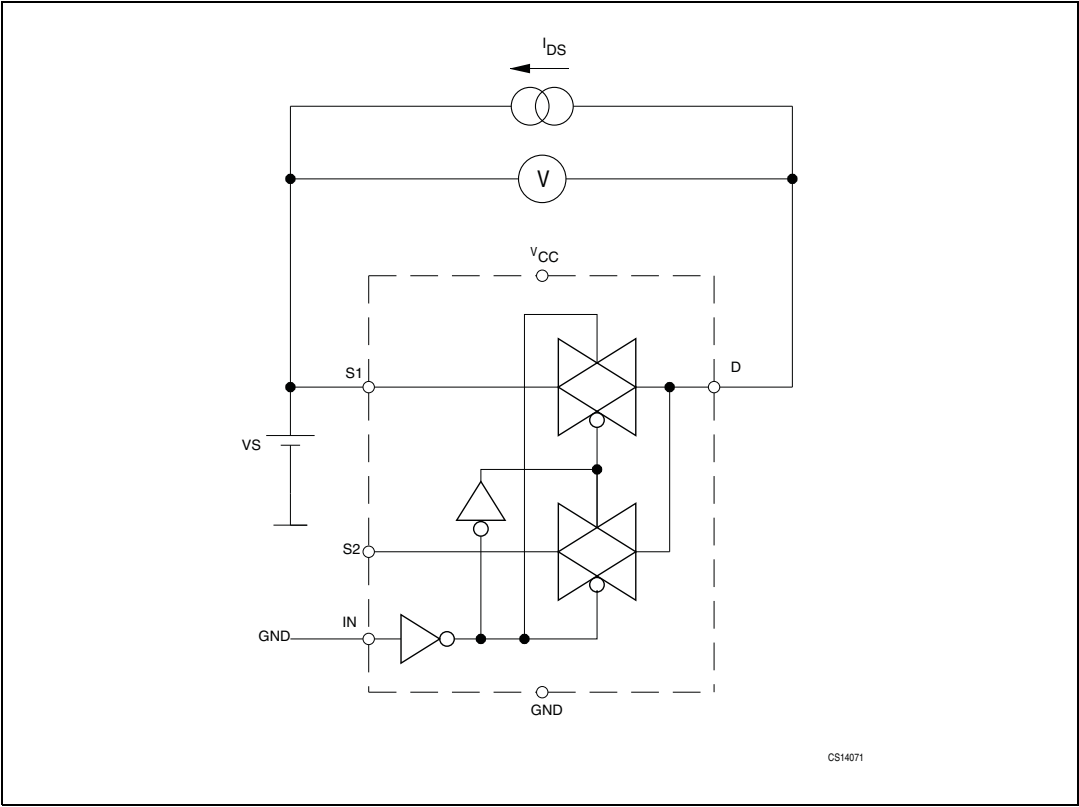


Figure 4. OFF leakage

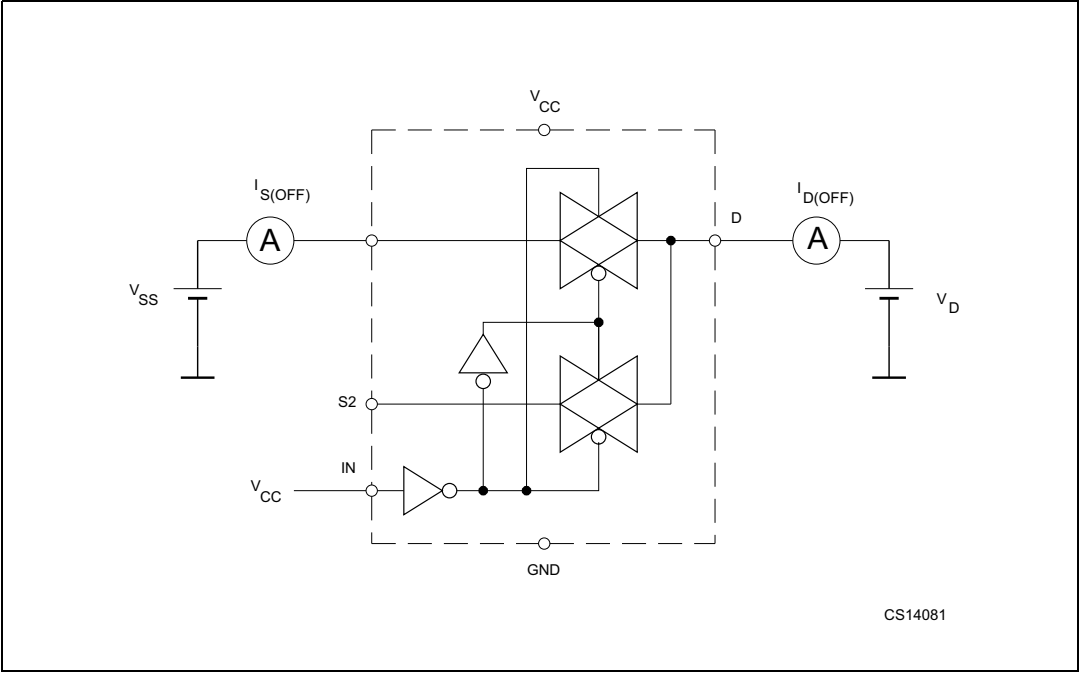


Figure 5. OFF isolation

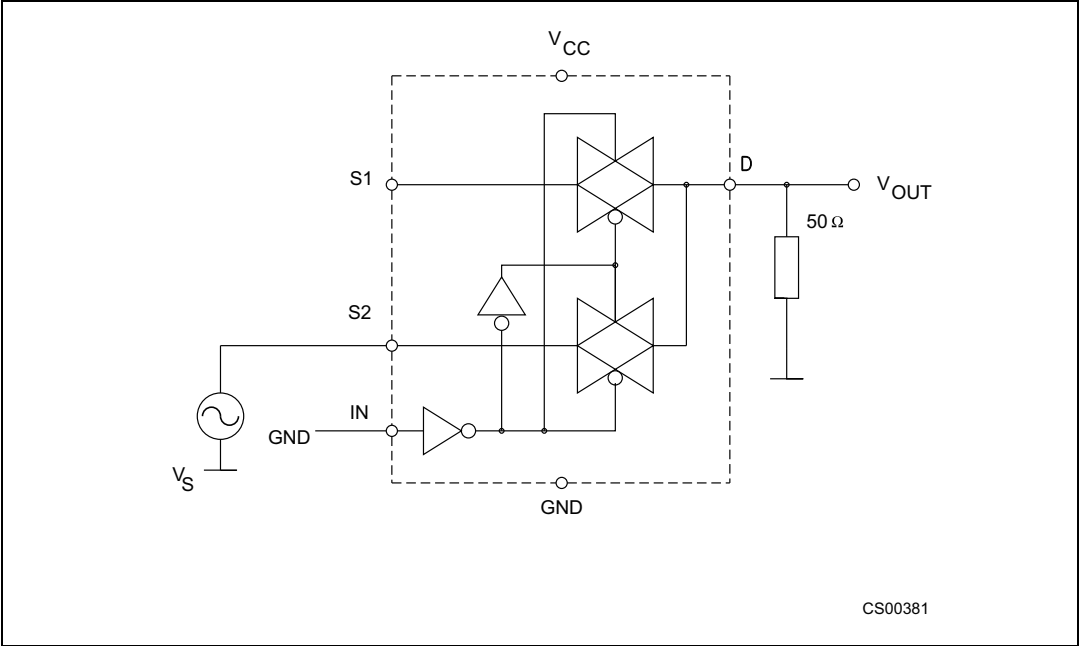


Figure 6. Bandwidth

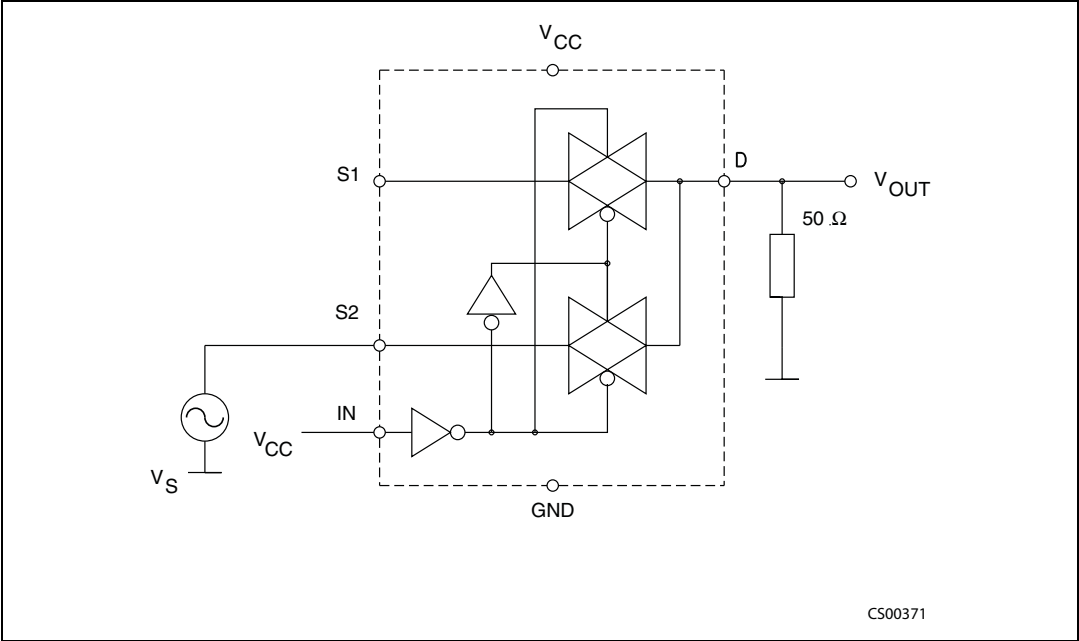


Figure 7. Channel-to-channel crosstalk

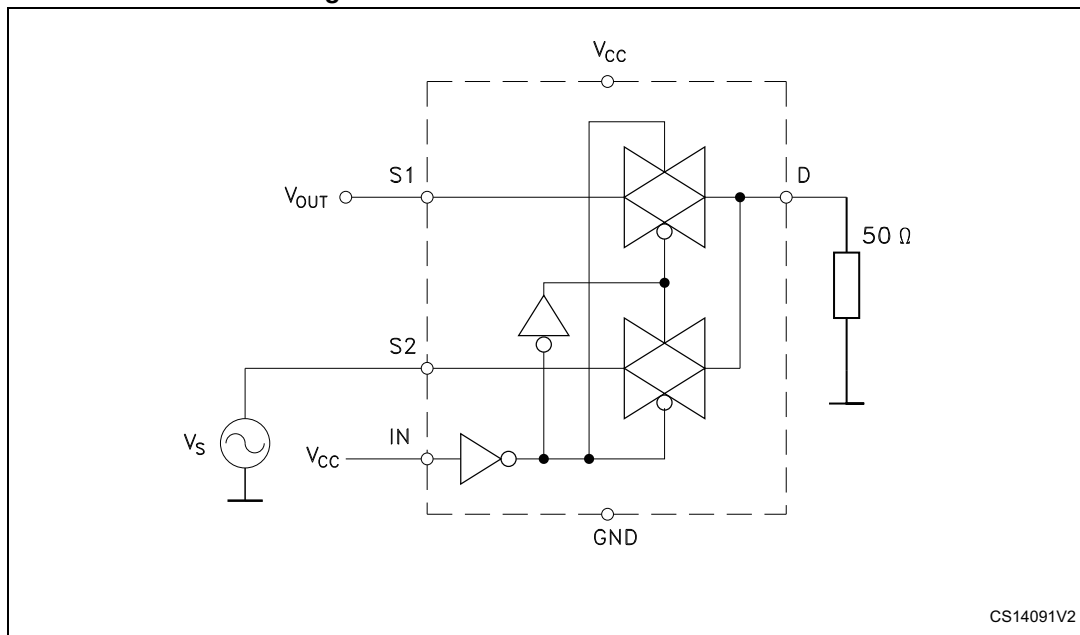
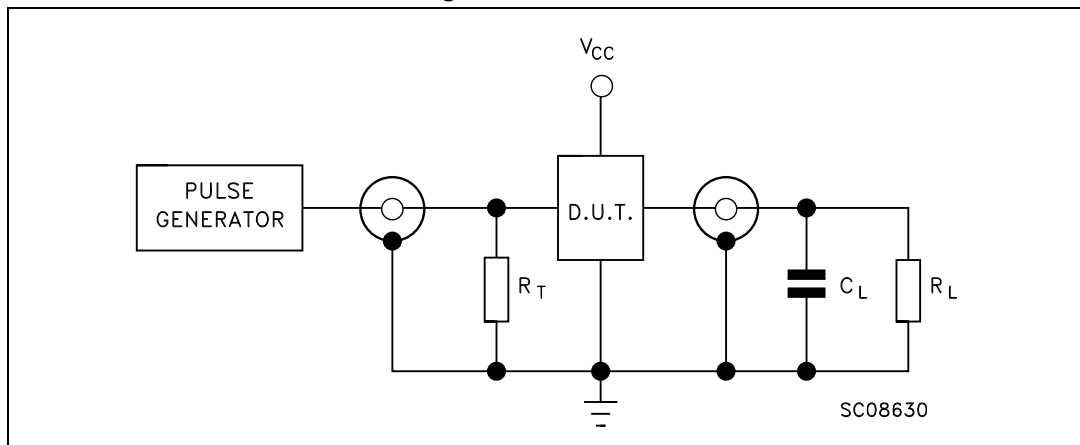


Figure 8. Test circuit



1.  $C_L = 5/35$  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

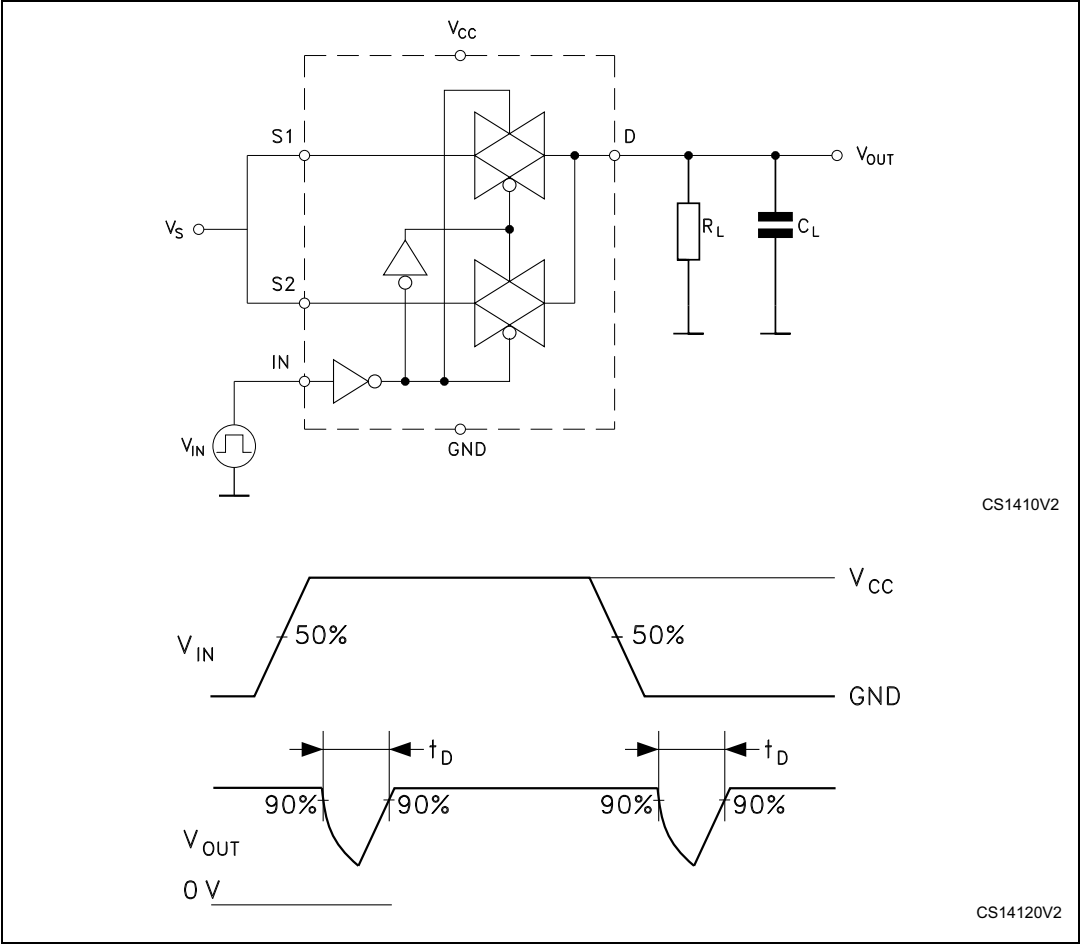


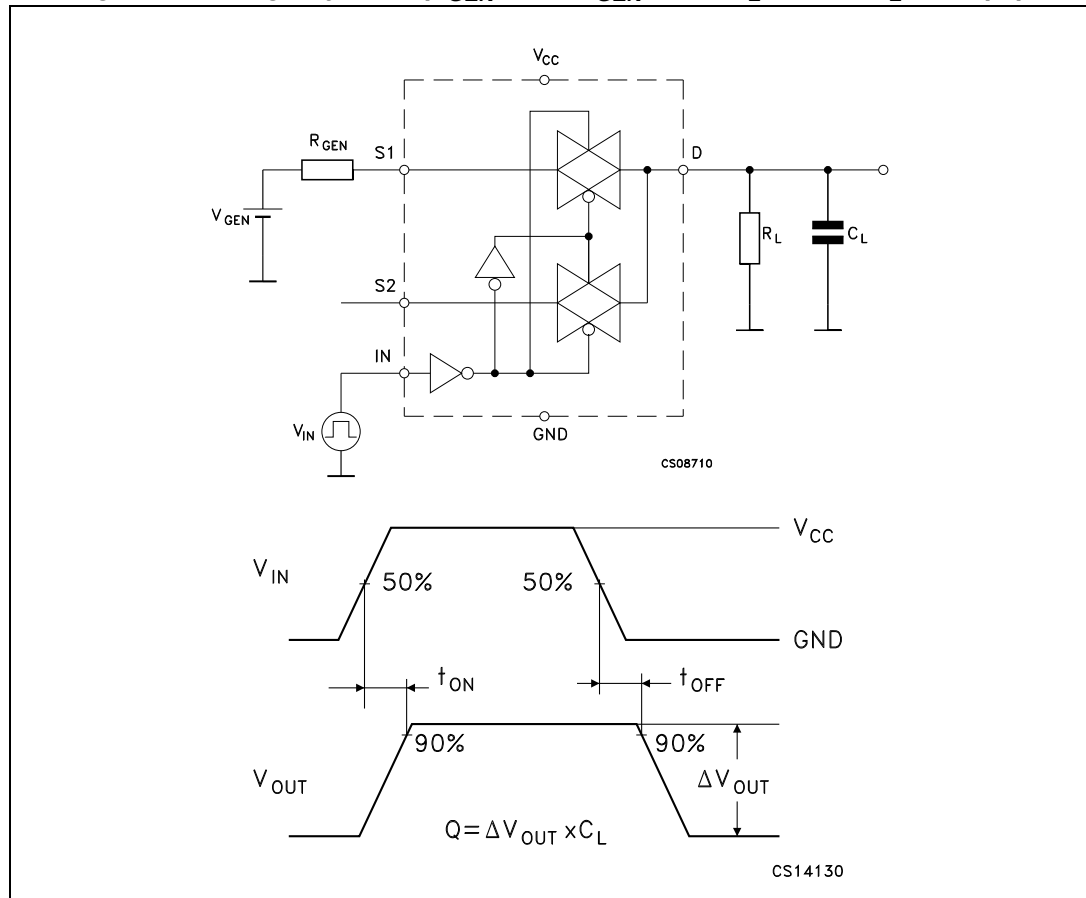
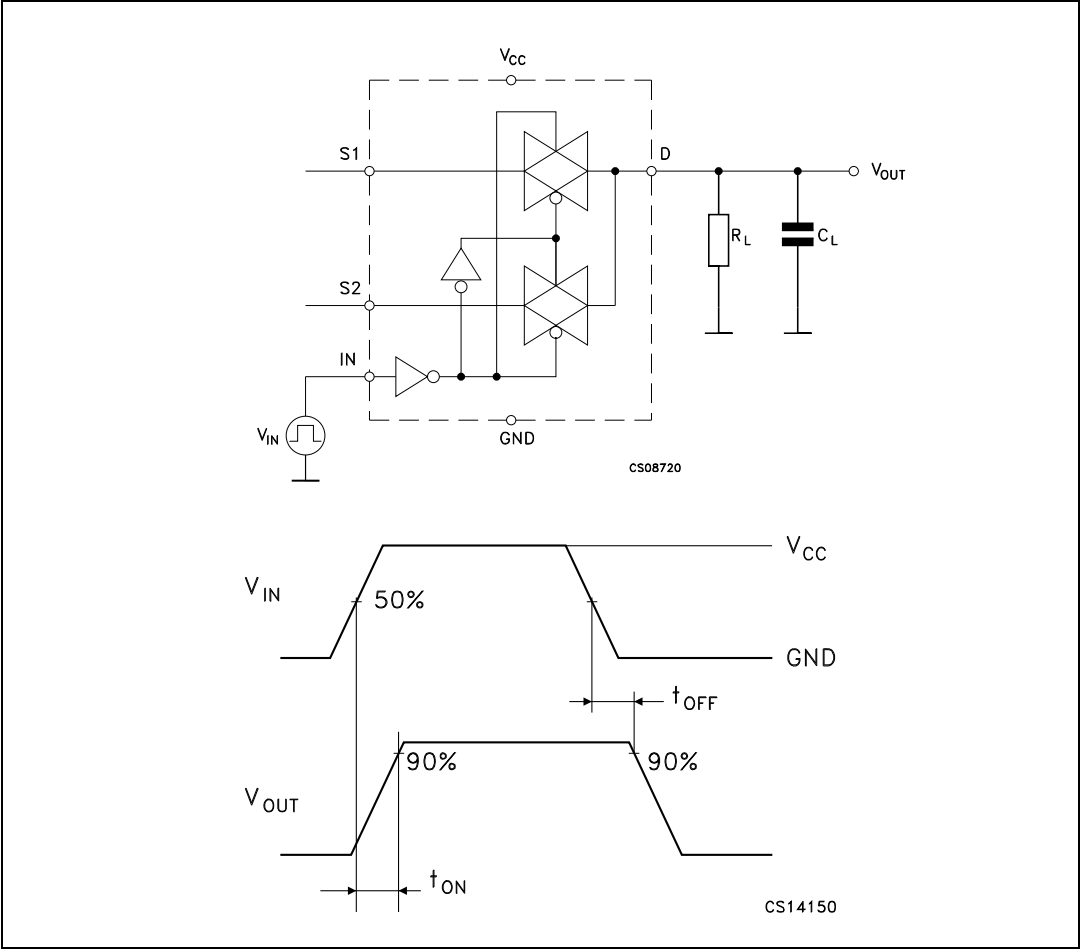
Figure 10. Charge injection ( $V_{GEN} = 0\text{ V}$ ,  $R_{GEN} = 0\ \Omega$ ,  $R_L = 1\text{ M}\Omega$ ,  $C_L = 100\text{ pF}$ )

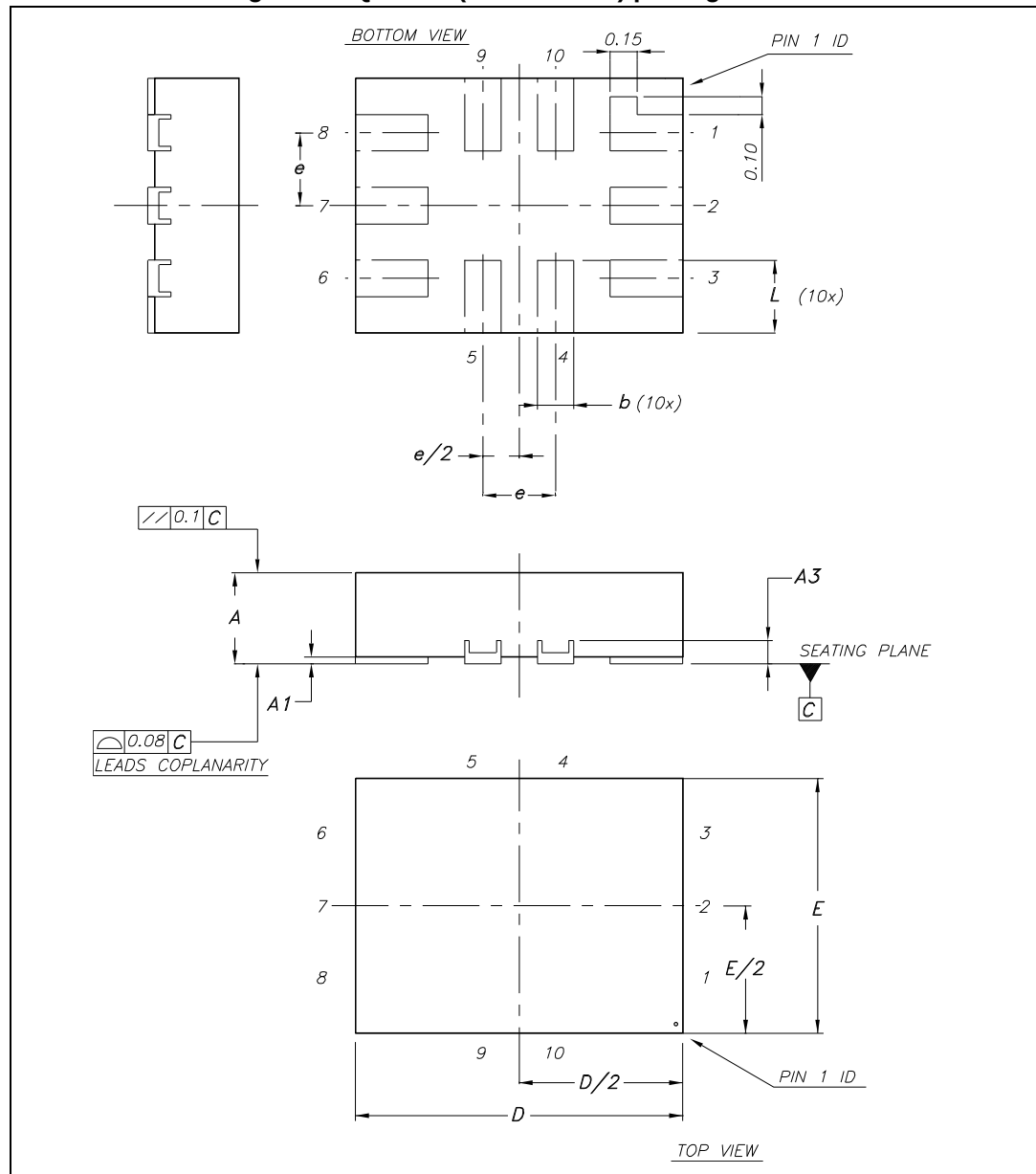
Figure 11. Turn-on, turn-off delay time



## 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**

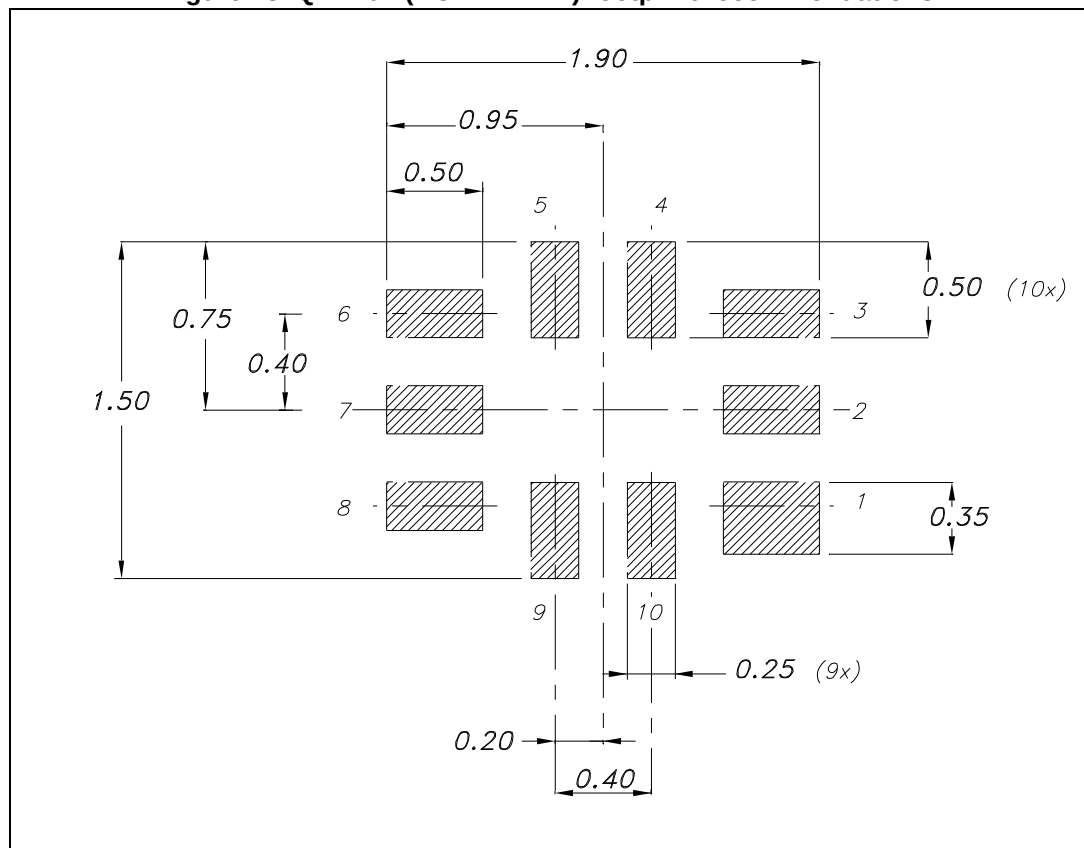


1. Drawing not to scale.

Table 9. QFN10L (1.8 x 1.4 mm) mechanical data

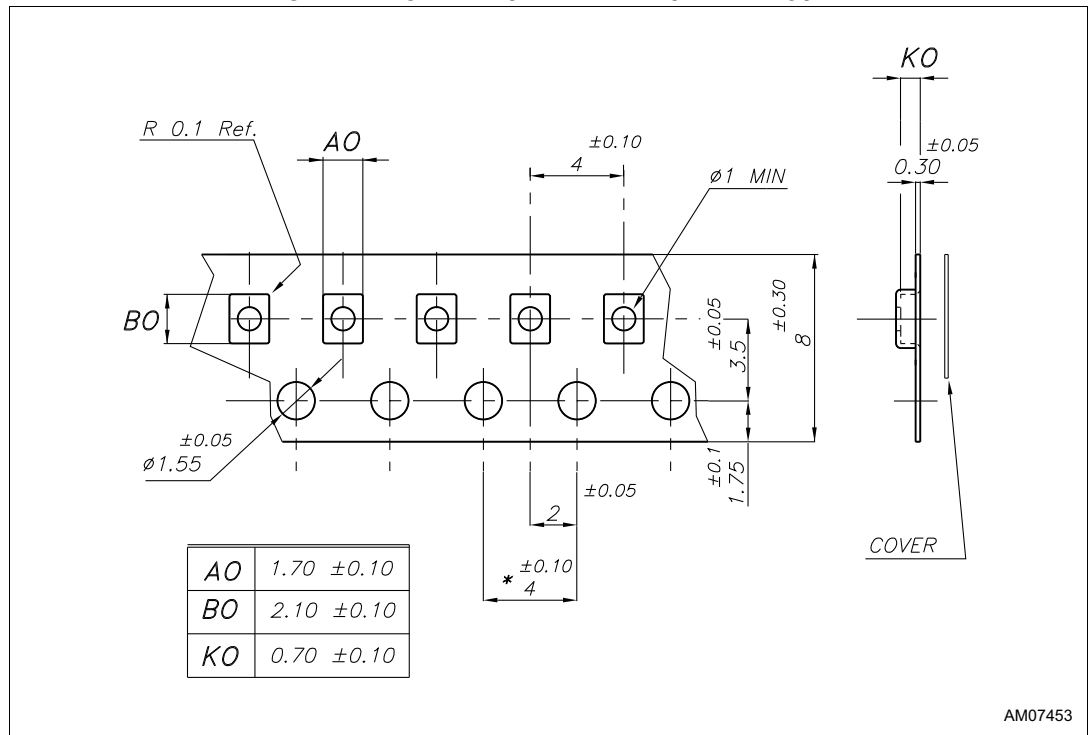
| Symbol | millimeters |      |      | inches |       |       |
|--------|-------------|------|------|--------|-------|-------|
|        | Nom         | Min  | Max  | Nom    | Min   | Max   |
| A      | 0.50        | 0.45 | 0.55 | 0.020  | 0.017 | 0.021 |
| A1     | 0.02        | 0    | 0.05 | 0.001  | 0     | 0.002 |
| A3     | 0.127       |      |      | 0.005  | 0     | 0     |
| b      | 0.20        | 0.15 | 0.25 | 0.007  | 0.006 | 0.010 |
| D      | 1.80        | 1.70 | 1.90 | 0.070  | 0.066 | 0.074 |
| E      | 1.40        | 1.30 | 1.50 | 0.055  | 0.051 | 0.059 |
| e      | 0.40        |      |      | 0.015  |       |       |
| L      | 0.40        | 0.30 | 0.50 | 0.015  | 0.011 | 0.020 |

Figure 13. QFN10L (1.8 x 1.4 mm) footprint recommendations



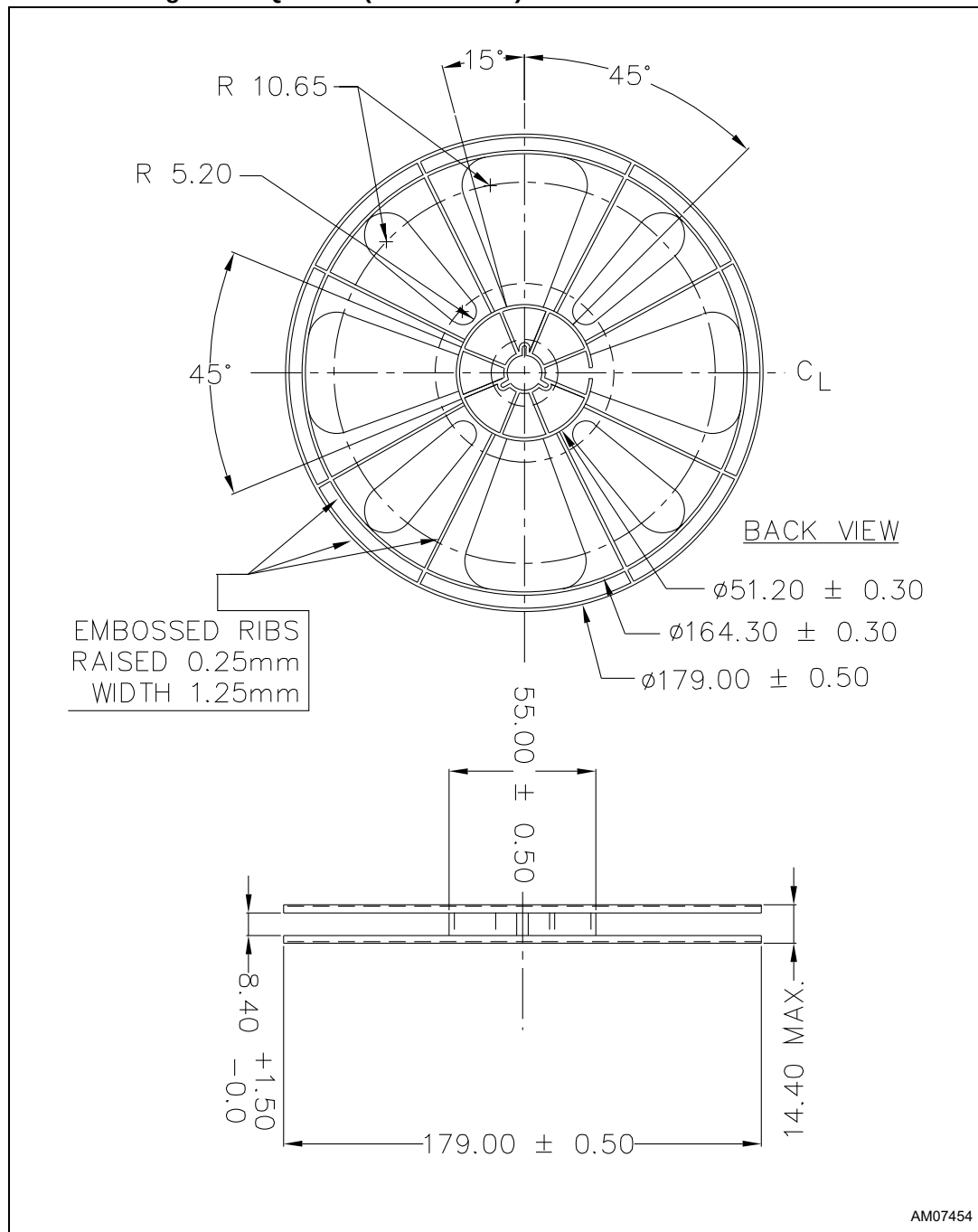
1. Drawing not to scale.

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



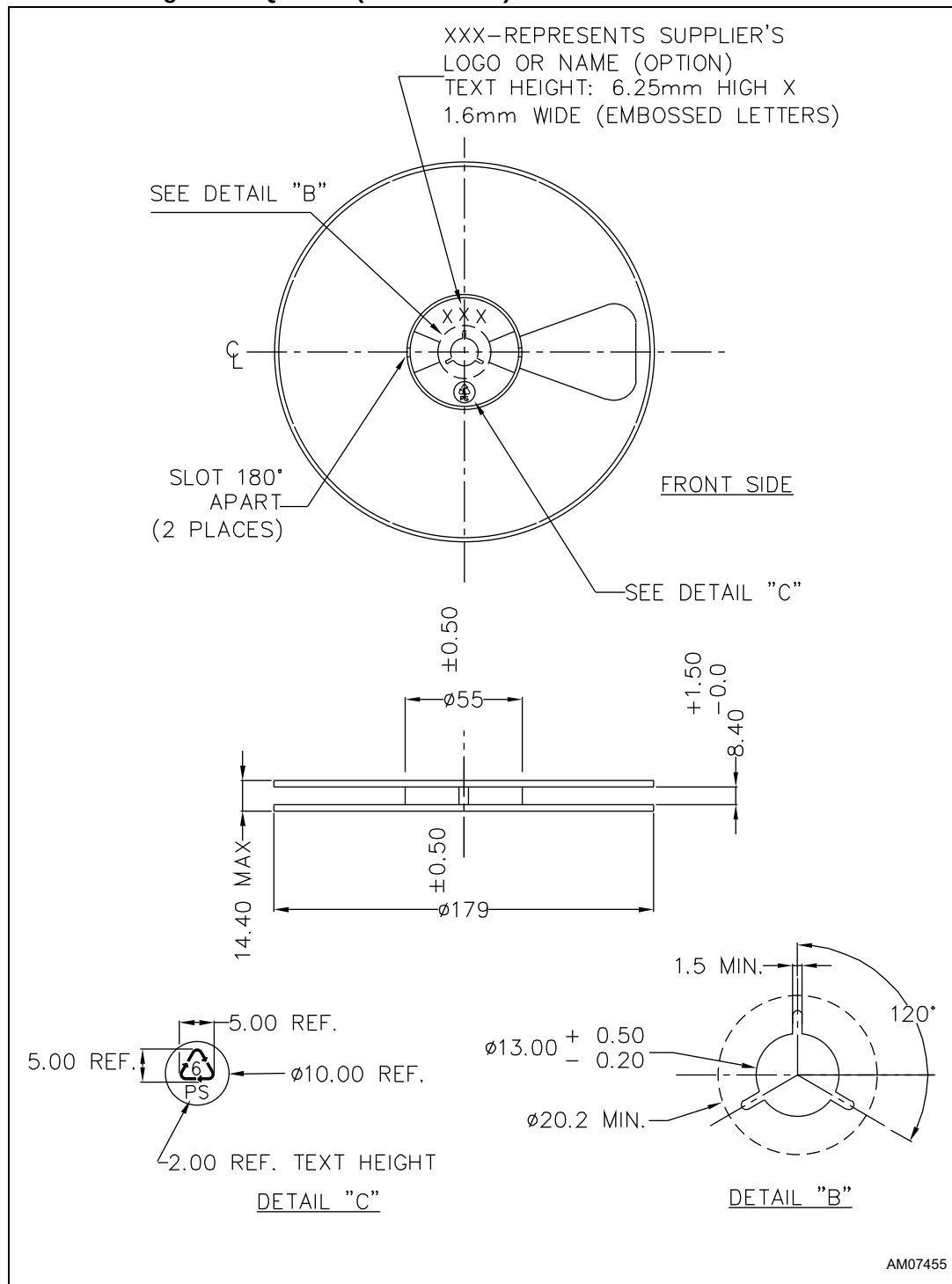
1. Drawing not to scale.

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



1. Drawing not to scale.

Figure 16. QFN10L (1.8 x 1.4 mm) reel information - front side



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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