



STG3689

Low Voltage 0.9Ω max dual SPDT Switch with break-before-make feature

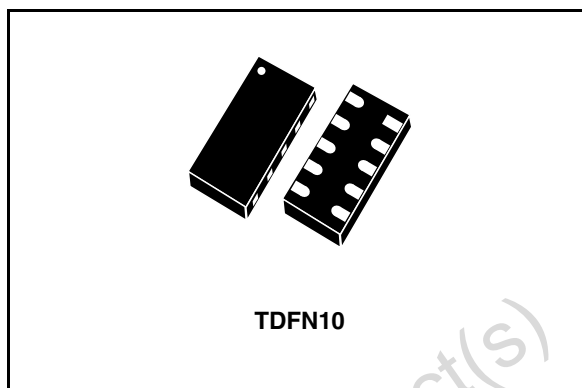
Features

- Low quiescent supply current:
 - Max $\pm 50\mu\text{A}$ for $V_{1\text{IN}}, V_{2\text{IN}} = 1.80\text{V}$ at $V_{\text{CC}} = 4.3\text{V}$
- Ultra low power dissipation:
 - $I_{\text{CC}} = 0.2\mu\text{A}$ (Max.) at $T_{\text{A}} = 85^{\circ}\text{C}$, $V_{\text{IN}} = 0\text{V}$
- Switch S1: Low “ON” resistance $V_{\text{IN}} = 0\text{V}$:
 - $R_{\text{ON}} = 0.7\Omega$ (Max. $T_{\text{A}} = 25^{\circ}\text{C}$) at $V_{\text{CC}} = 4.3\text{V}$
 - $R_{\text{ON}} = 0.9\Omega$ (Max. $T_{\text{A}} = 25^{\circ}\text{C}$) at $V_{\text{CC}} = 3\text{V}$
- Wide operating voltage range:
 - V_{CC} (OPR) = 1.65V to 4.3V single supply
- 4.3V Tolerant and 1.8V compatible threshold on digital control input at $V_{\text{CC}} = 1.65$ to 4.3V
- Latch-up performance exceed 300mA (JESD 17)
- ESD performance (Analog chan. Vs. GND):
 - HBM >2kV (MIL STD 883 method 3015)

Description

The STG3689 is a high-speed CMOS low-voltage dual analog S.P.D.T. (Single Pole Dual Throw) switch or 2:1 Multiplexer/Demultiplexer switch fabricated in silicon gate C²MOS technology. It is designed to operate from 1.65V to 4.3V, making this device ideal for portable applications.

The nIN inputs are provided to control the switches.



The switches nS1 are ON (they are connected to common Ports Dn) when the nIN input is held high and OFF (high impedance state exists between the two ports) when nIN is held low. The switches nS2 are ON (they are connected to common Ports Dn) when the nIN input is held low and OFF (high impedance state exists between the two ports) when IN is held high.

Additional key features are fast switching speed, 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.

Order codes

| Part number | Package | Packaging |
|-------------|------------------------|-------------|
| STG3689DTR | TDFN10 (2.5mm x 1.3mm) | Tape & Reel |

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1 Summary description

1.1 Pin connections and description

Figure 1. Pin connections (Top through view)

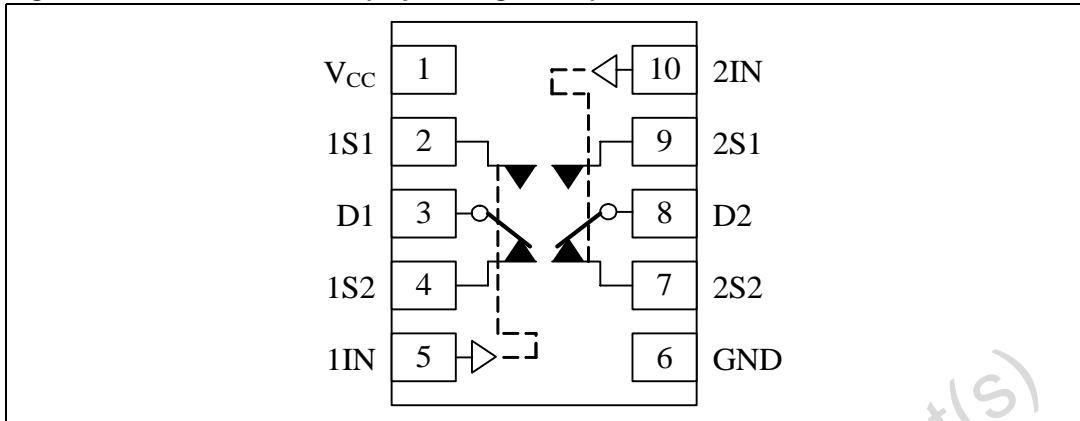
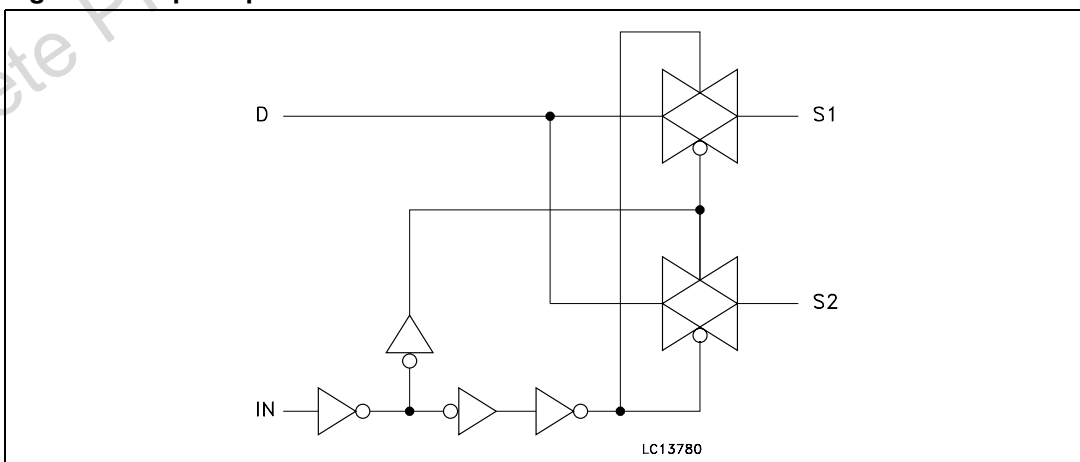


Table 1. Pin function

| Pin N° | Symbol | Name and function |
|------------|----------------------|-------------------------|
| 5, 10 | 1IN, 2IN | Controls |
| 2, 4, 9, 7 | 1S1, 1S2 2S1, 2S2 | Independent channels |
| 3, 8 | D1, D2 | Common channels |
| 1 | V _{CC} | Positive supply voltage |
| 6 | GND | Ground (0V) |

1.2 Input equivalent circuit

Figure 2. Input equivalent circuit



2 Electrical ratings

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 2. 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 ($V_{IN} < 0V$) | -50 | mA |
| I_{IK} | DC input diode current ($V_{IN} < 0V$) | ± 50 | mA |
| I_{OK} | DC output diode current | ± 20 | mA |
| I_O | DC output current | ± 200 | mA |
| I_{OP} | DC output current peak (pulse at 1ms, 10% duty cycle) | ± 400 | mA |
| I_{CC} or I_{GND} | DC V_{CC} or ground current | ± 100 | mA |
| P_D | Power dissipation at $T_A = 70^\circ C$ ⁽¹⁾ | 1120 | mW |
| T_{stg} | Storage temperature | -65 to 150 | $^\circ C$ |
| T_L | Lead temperature (10 sec.) | 300 | $^\circ C$ |

1. Derate above 70°C by 18.5mW/C

3 Electrical characteristics

3.1 Recommended operating conditions

Table 3. Recommended operating conditions

| Symbol | Parameter | Value | Unit | |
|-----------|--|----------------------------|---------|------|
| V_{CC} | Supply voltage ⁽¹⁾ | 1.4 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 | -55 to 125 | °C | |
| d_t/d_v | Input rise and fall time control Input | $V_{CC} = 1.65V$ to $2.7V$ | 0 to 20 | ns/V |
| | | $V_{CC} = 3.0$ to $4.3V$ | 0 to 10 | |

1. Truth Table guaranteed: 1.2V to 4.3V

3.2 DC Specifications

Table 4. DC specifications

| Symbol | Parameter | Test conditions | | Value | | | | | | Unit | |
|----------|--------------------------|-----------------|--|--------------------|-----|------|-----------------------|------|------------------------|------|------|
| | | $V_{CC}(V)$ | | $T_A = 25^\circ C$ | | | -40 to $85^\circ C$ | | -55 to $125^\circ C$ | | |
| | | | | Min. | Typ | Max. | Typ | Max. | Typ | | Max. |
| V_{IH} | High level input voltage | 1.65-1.95 | | 0.65 | | | 0.65 | | 0.65 | | V |
| | | 2.3-2.5 | | 1.4 | | | 1.4 | | 1.4 | | |
| | | 2.7-3.0 | | 1.4 | | | 1.4 | | 1.4 | | |
| | | 3.3 – 4.3 | | 1.5 | | | 1.5 | | 1.5 | | |
| V_{IL} | Low level input voltage | 1.65-1.95 | | | | 0.40 | | 0.40 | | 0.40 | V |
| | | 2.3-2.5 | | | | 0.50 | | 0.50 | | 0.50 | |
| | | 2.7-3.0 | | | | 0.50 | | 0.50 | | 0.50 | |
| | | 3.3 – 4.3 | | | | 0.50 | | 0.50 | | 0.50 | |

Table 4. DC specifications

| Symbol | Parameter | Test conditions | | Value | | | | | | Unit | |
|-------------------|--|---------------------|--|-----------------------|------|-------|-------------|------|--------------|------|------|
| | | V _{CC} (V) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ | Max. | Typ | Max. | Typ | | Max. |
| R _{ON} | Switch ON resistance | 4.3 | V _S =0V to V _{CC} I _S =100 mA | | 0.5 | 0.7 | | 1.4 | | | Ω |
| | | 3.0 | | | 0.7 | 0.9 | | 1.4 | | | |
| | | 2.7 | | | 0.7 | 0.9 | | 1.7 | | | |
| | | 2.3 | | | 0.9 | 1.2 | | 1.7 | | | |
| | | 1.8 | | | 1.3 | 1.6 | | 1.9 | | | |
| | | 1.65 | | | 1.60 | 2.5 | | 2.2 | | | |
| ΔR _{ON} | ON Resistance match between channels 1Sn and 2Sn | 2.7 | V _S @ R _{ON} Max I _S =100 mA | | 0.6 | | | | | | Ω |
| R _{FLAT} | ON resistance FLATNESS (1) (2) | 4.3 | V _S = 0V to V _{CC} I _S =100 mA | | 0.18 | 0.21 | | | | | Ω |
| | | 3.0 | | | 0.16 | 0.19 | | | | | |
| | | 2.7 | | | 0.16 | 0.19 | | | | | |
| | | 2.3 | | | 0.18 | 0.21 | | | | | |
| | | 1.65 | | | 0.38 | 0.44 | | | | | |
| I _{OFF} | OFF state leakage current (nSN), (Dn) | 4.3 | V _S = 0.3 or 4V | | | ±10 | | ±100 | | | nA |
| I _{IN} | Input leakage current | 0 – 4.3 | V _{IN} = 0 to 4.3V | | | ±0.1 | | ±1 | | | μA |
| I _{CC} | Quiescent supply current | 1.65–4.3 | V _{IN} = V _{CC} or GND | | | ±0.05 | | ±0.2 | | ±1 | μA |
| I _{CCLV} | Quiescent supply current low voltage driving | 4.3 | V _{1IN} , V _{2IN} = 1.65V | | 42 | 55 | | | | | μA |
| | | | V _{1IN} , V _{2IN} = 1.80V | | 38 | 50 | | | | | |

1. ΔRON = 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.

3.3 AC electrical characteristics

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

| Symbol | Parameter | Test conditions | | Value | | | | | | Unit | |
|--------------------------|------------------------------|-----------------|---|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | $V_{CC}(V)$ | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | Min. | Typ. | Max. | Typ. | Max. | Typ. | | Max. |
| t_{PLH} , t_{PHL} | 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_{ON} | TURN-ON time | 1.65-1.95 | $V_S = 0.8V$ | | 70 | | | | | | ns |
| | | 2.3-2.7 | $V_S = 1.5V$ | | 30 | 60 | | 75 | | | |
| | | 3.0-3.3 | | | 25 | 50 | | 60 | | | |
| | | 3.6-4.3 | | | 25 | 50 | | 60 | | | |
| t_{OFF} | TURN-OFF time | 1.65-1.95 | $V_S = 0.8$ | | 45 | | | | | | ns |
| | | 2.3-2.7 | $V_S = 1.5V$ | | 25 | 30 | | 40 | | | |
| | | 3.0-3.3 | | | 25 | 30 | | 40 | | | |
| | | 3.6-4.3 | | | 25 | 30 | | 40 | | | |
| t_D | Break before make time delay | 1.65 – 1.95 | $C_L = 35\text{pF}$ $R_L = 50\Omega$ $V_S = 1.5V$ | | | | | | | | ns |
| | | 2.3 – 2.7 | | 2 | 15 | | | | | | |
| | | 3.0 – 3.6 | | 2 | 15 | | | | | | |
| | | 3.6 – 4.3 | | 2 | 15 | | | | | | |
| Q | Charge Injection | 1.65-1.95 | $C_L = 100\text{pF}$ $R_L = 1M\Omega$ $V_{GEN} = 0V$ $R_{GEN} = 0\Omega$ | | 23 | | | | | | pC |
| | | 2.3 - 2.7 | | | 32 | | | | | | |
| | | 3.0 - 3.3 | | | 40 | | | | | | |
| | | 3.6 - 4.3 | | | 44 | | | | | | |

3.4 Analog switch characteristics

Table 6. Analog switch characteristics ($C_L = 5\text{pF}$, $R_L = 50\Omega$, $T_A = 25^\circ\text{C}$)

| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | | |
|----------|---|--------------------|--|--------------------------|------|------|-----------------------------|------|------------------------------|------|------|-----|
| | | $V_{CC}(\text{V})$ | | $T_A = 25^\circ\text{C}$ | | | -40 to 85°C | | -55 to 125°C | | | |
| | | | | Min. | Typ. | Max. | Typ. | Max. | Typ. | | Max. | |
| OIRR | Off Isolation ⁽¹⁾ | 1.65 - 4.3 | $V_S = 1V_{RMS}$ $f = 100\text{kHz}$ | | -90 | | | | | | | dB |
| Xtalk | Crosstalk | 1.6 - 4.3 | $V_S = 1V_{RMS}$ $f = 100\text{kHz}$ | | -76 | | | | | | | dB |
| THD | Total harmonic distortion | 3.0 | $R_L = 600\Omega$ $V_{IN} = 2V_{PP}$ $f = 20\text{Hz}$ to 20kHz | | 0.03 | | | | | | | % |
| BW | -3dB Bandwidth | 1.65 - 4.3 | $R_L = 50\Omega$ | | 85 | | | | | | | MHz |
| C_{IN} | Control pin input capacitance | | | | 7 | | | | | | | pF |
| C_{Sn} | Sn port capacitance | 3.3 | $f = 1\text{MHz}$ | | 35 | | | | | | | pF |
| C_D | D port capacitance when switch is enabled | 3.3 | $f = 1\text{MHz}$ | | 99 | | | | | | | pF |

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

3.5 Truth table

Table 7. Truth table

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

1. High Impedance

4 Application circuits

Figure 3. ON Resistance

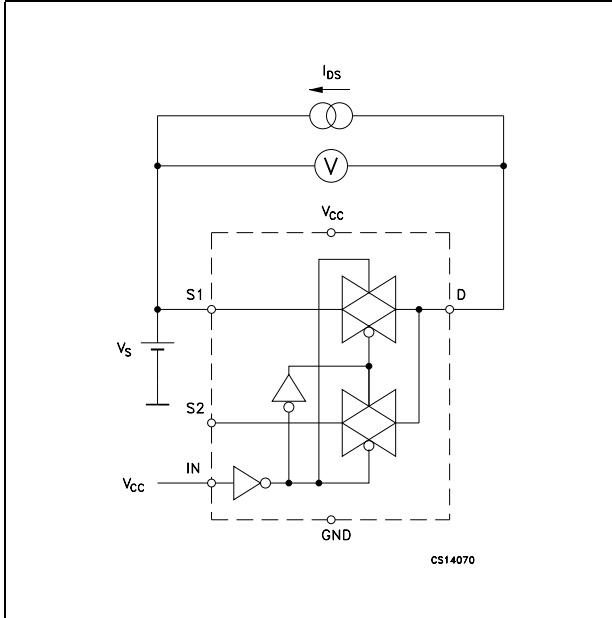


Figure 4. OFF Isolation

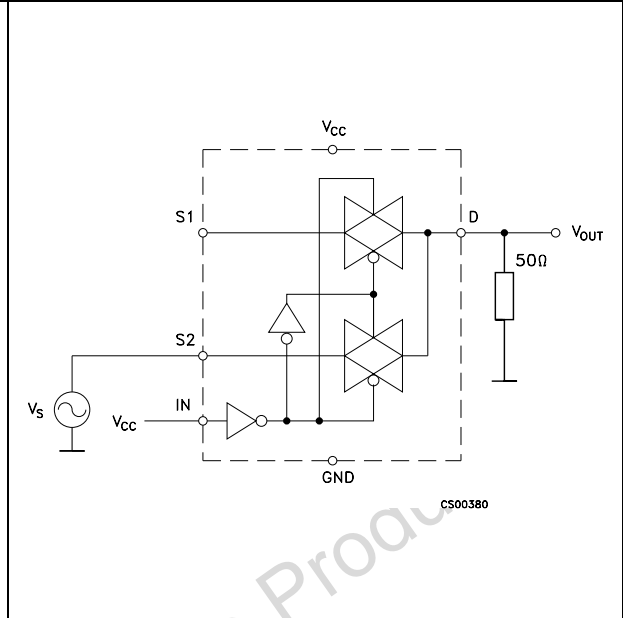


Figure 5. OFF Leakage

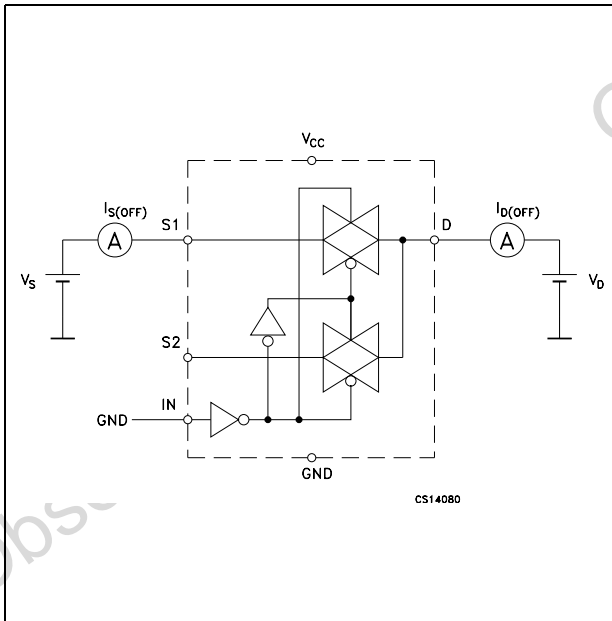


Figure 6. Bandwidth

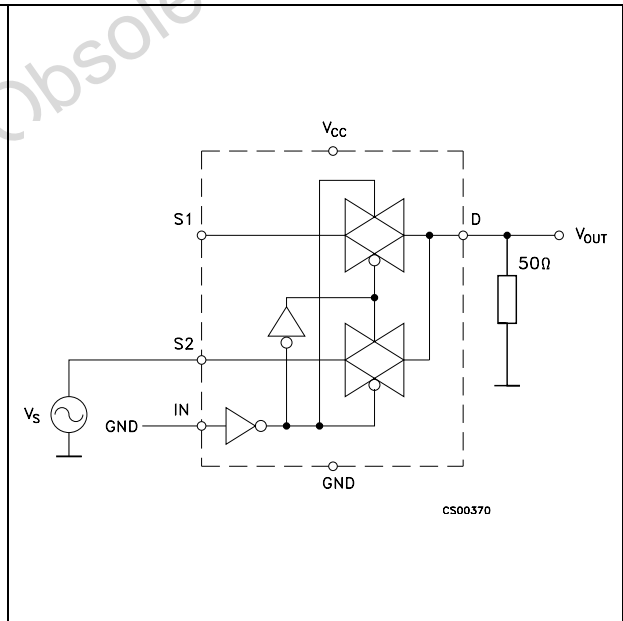


Figure 7. Channel to channel crosstalk

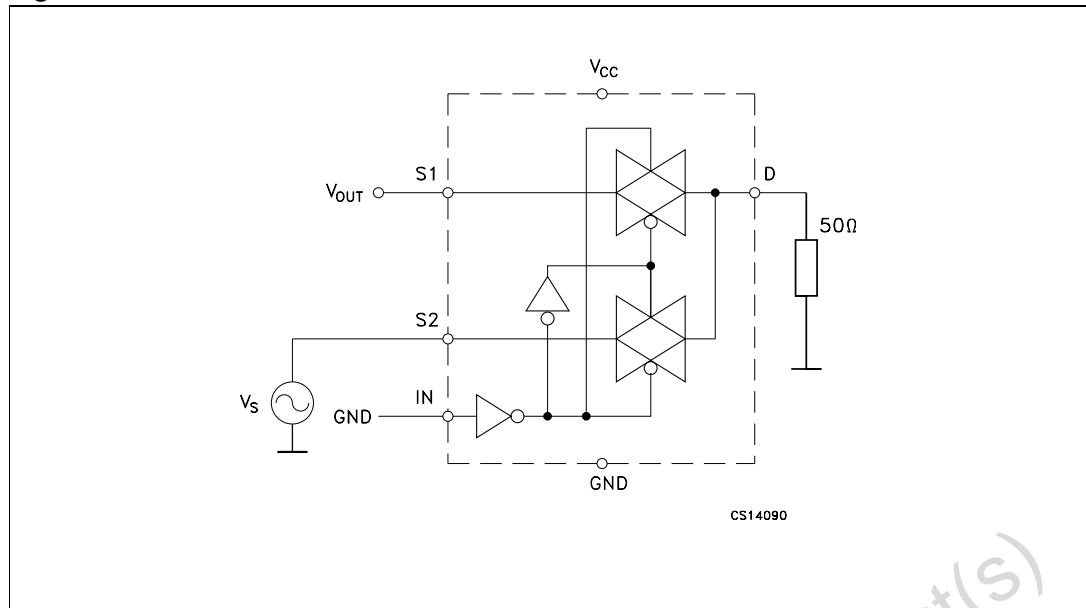
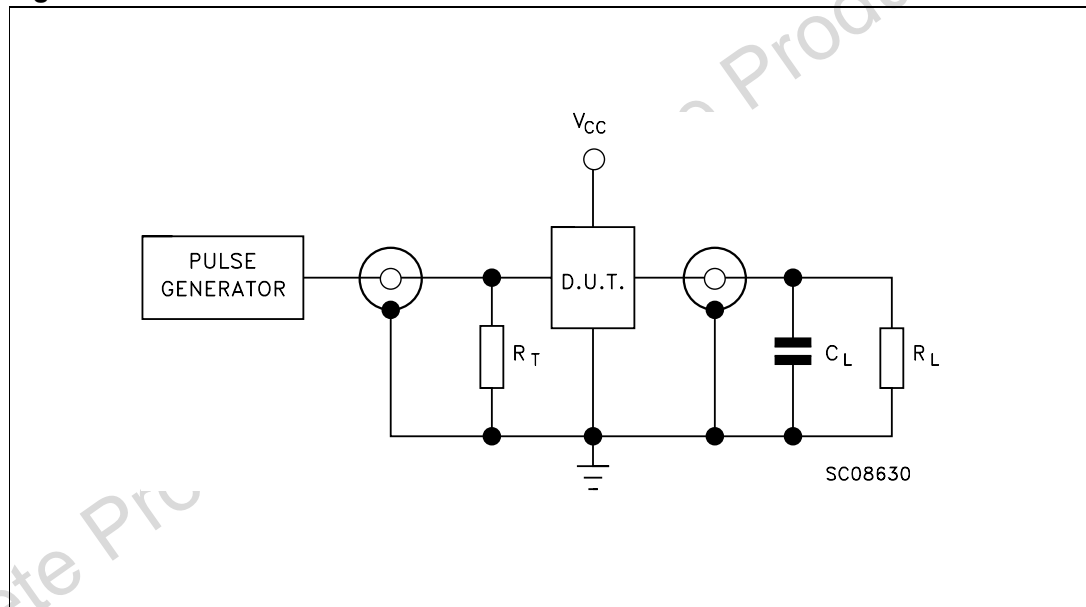


Figure 8. Test circuit



$C_L = 5/35\text{pF}$ or equivalent (includes jig and probe capacitance)

$R_L = 50\Omega$ or equivalent

$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 9. Break-before-make time delay

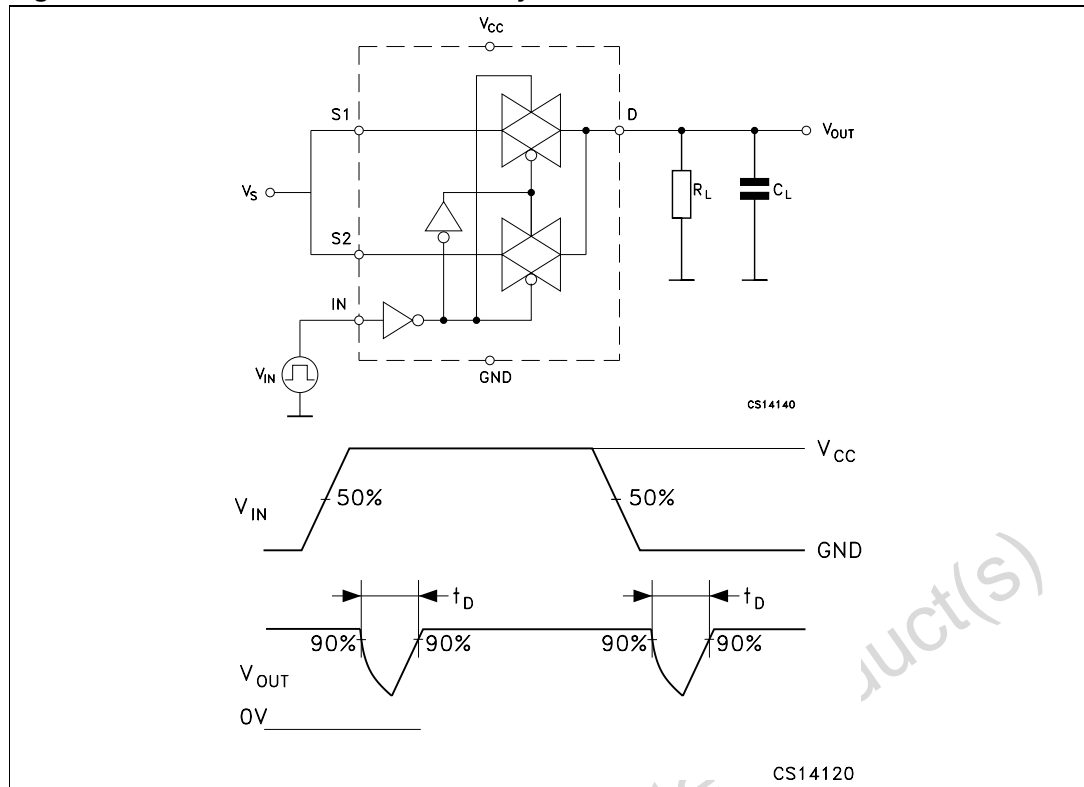


Figure 10. Switching time and charge injection
 ($V_{GEN} = 0V$, $R_{GEN} = 0\Omega$, $R_L = 1M\Omega$, $C_L = 100pF$)

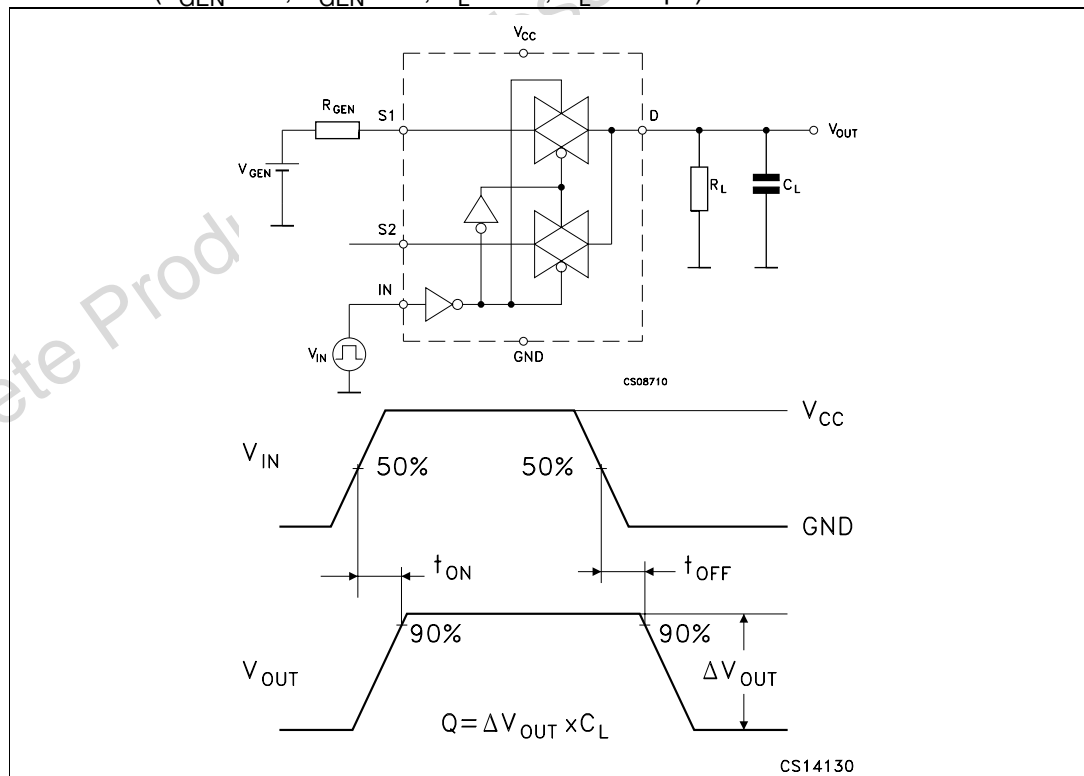
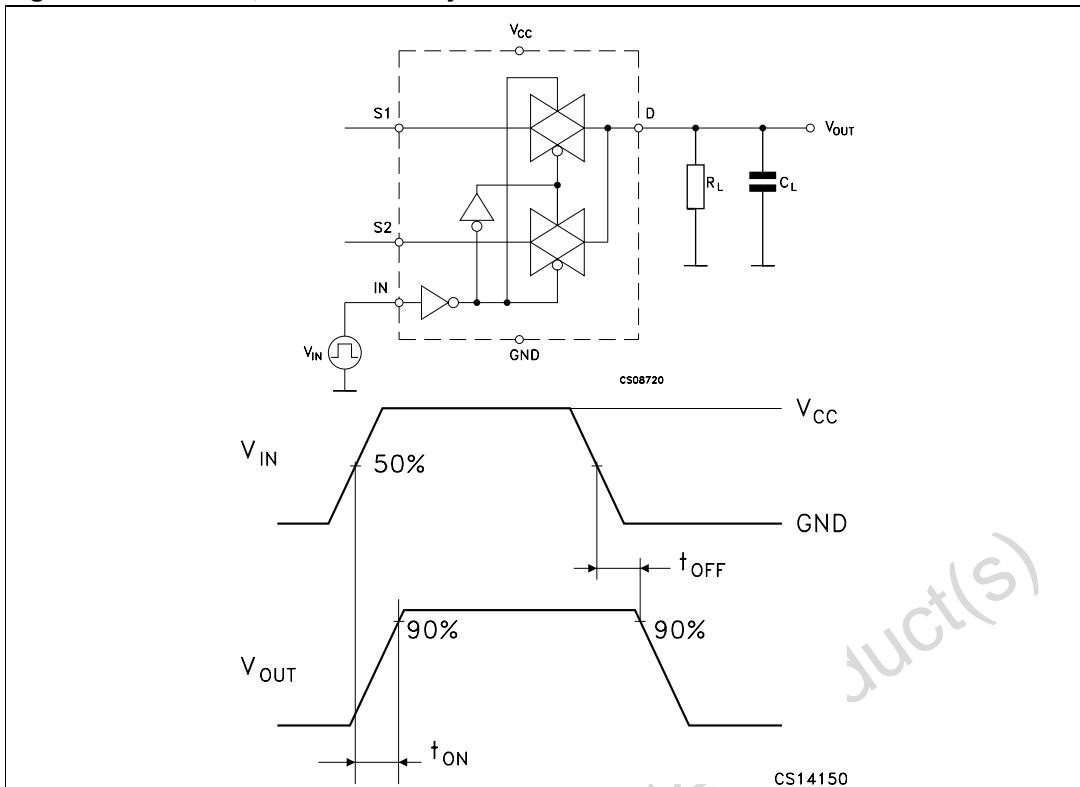


Figure 11. Turn ON, Turn OFF delay time



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5 Package mechanical data

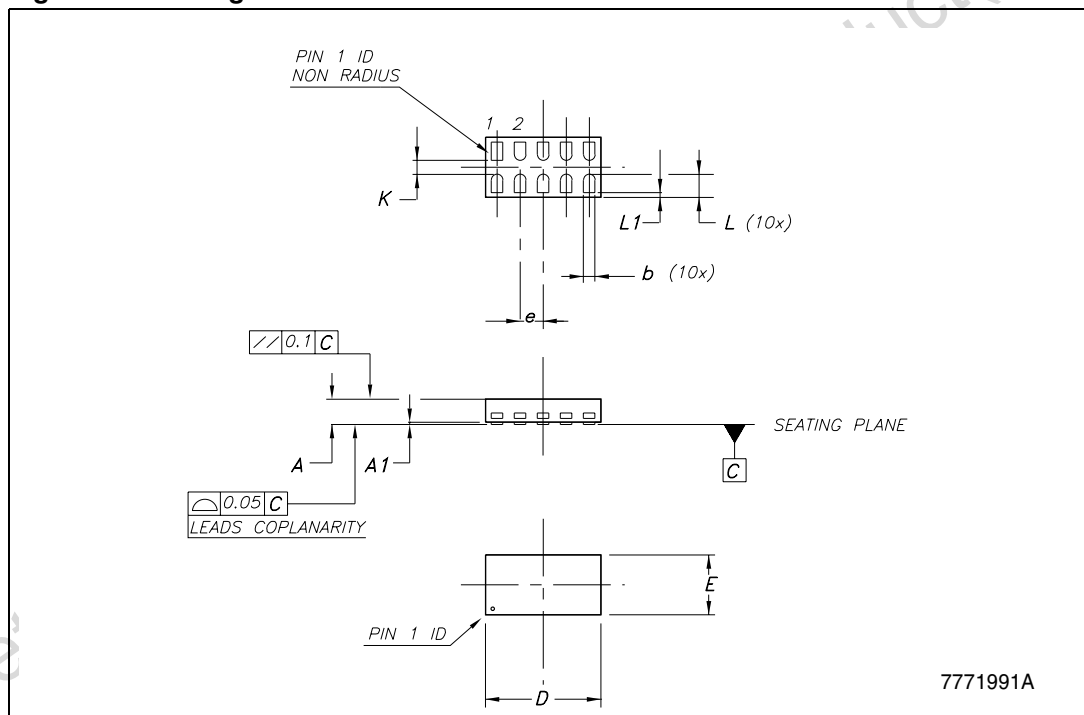
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Obsolete Product(s) - Obsolete Product(s)

Table 8. DFN10L (2.5mm x 1.3mm) Mechanical data

| Dim. | mm. | | | inch | | |
|------|------|------|------|------|------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.50 | 0.55 | 0.60 | 19.7 | 21.7 | 23.6 |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.8 | 2.0 |
| b | 0.18 | 0.23 | 0.30 | 7.1 | 9.1 | 11.8 |
| D | 2.40 | 2.50 | 2.60 | 94.5 | 98.4 | 102.4 |
| E | 1.30 | 1.40 | 1.50 | 51.2 | 55.1 | 59.1 |
| e | | 0.50 | | | 19.7 | |
| K | 0.20 | | | 7.9 | | |
| L | 0.45 | 0.50 | 0.55 | 17.7 | 19.7 | 21.6 |
| L1 | | | 0.15 | | | 5.9 |

Figure 12. Package dimensions



6 Revision history

Table 9. Revision history

| Date | Revision | Changes |
|-------------|-----------------|--|
| 23-Feb-2006 | 1 | Initial release. |
| 01-Aug-2006 | 2 | Final version, small text changes for entire document. |

Obsolete Product(s) - Obsolete Product(s)

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