



## STG3689

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

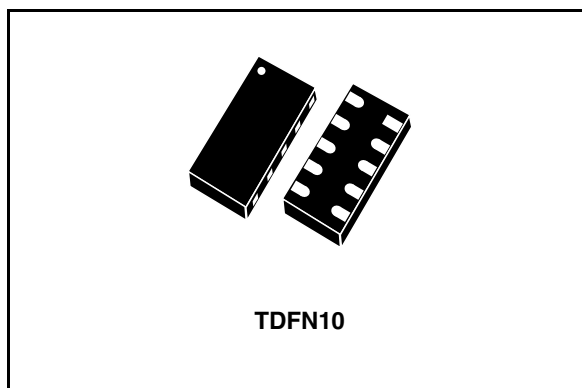
#### Features

- 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:
  - $V_{\text{CC}}$  (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 C<sup>2</sup>MOS 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)

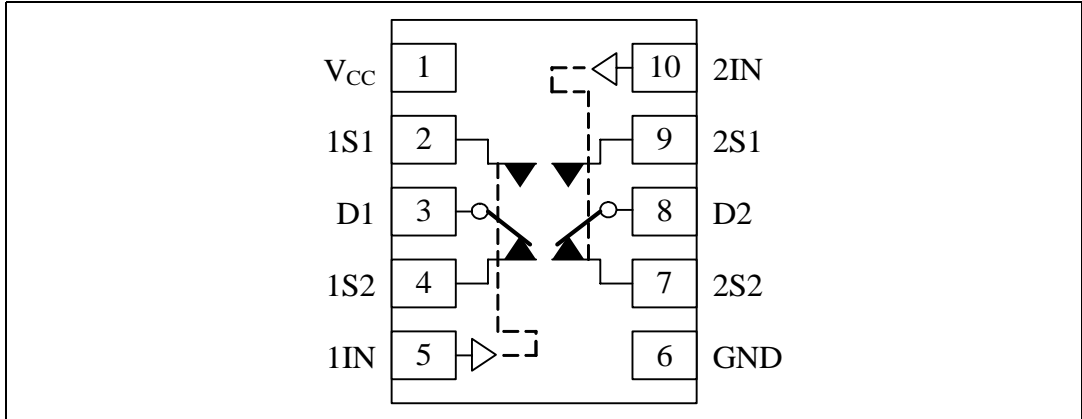
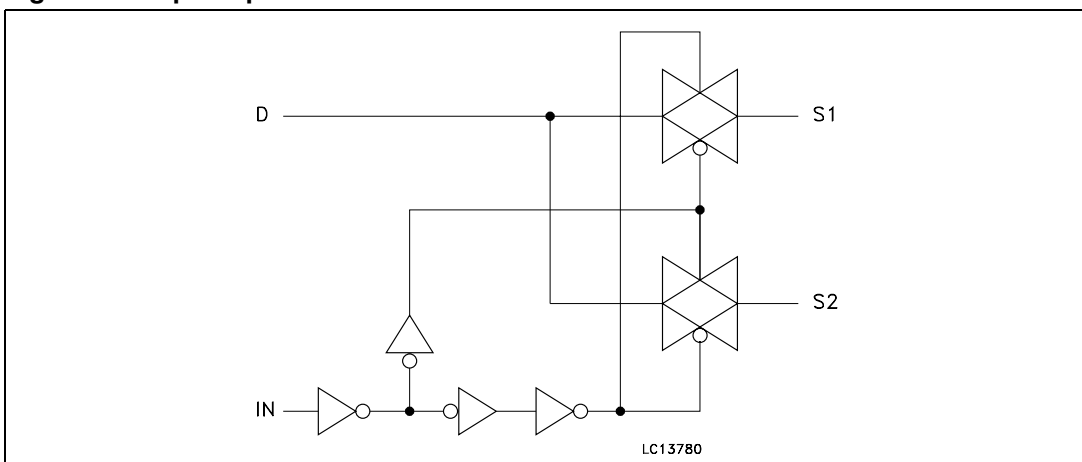


Table 1. Pin function

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 <sub>CC</sub>	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 ( $V_{IN} < 0V$ )	$\pm 50$	mA
$I_{OK}$	DC output diode current	$\pm 20$	mA
$I_O$	DC output current	$\pm 200$	mA
$I_{OP}$	DC output current peak (pulse at 1ms, 10% duty cycle)	$\pm 400$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or ground current	$\pm 100$	mA
$P_D$	Power dissipation at $T_A = 70^\circ C$ <sup>(1)</sup>	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 <sup>(1)</sup>	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 <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ	Max.	Typ	Max.	Typ		Max.
R <sub>ON</sub>	Switch ON resistance	4.3	V <sub>S</sub> =0V to V <sub>CC</sub> I <sub>S</sub> =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 <sub>ON</sub>	ON Resistance match between channels 1Sn and 2Sn	2.7	V <sub>S</sub> @ R <sub>ON</sub> Max I <sub>S</sub> =100 mA		0.6						Ω
R <sub>FLAT</sub>	ON resistance FLATNESS (1) (2)	4.3	V <sub>S</sub> = 0V to V <sub>CC</sub> I <sub>S</sub> =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 <sub>OFF</sub>	OFF state leakage current (nSN), (Dn)	4.3	V <sub>S</sub> = 0.3 or 4V			±10		±100			nA
I <sub>IN</sub>	Input leakage current	0 – 4.3	V <sub>IN</sub> = 0 to 4.3V			±0.1		±1			μA
I <sub>CC</sub>	Quiescent supply current	1.65–4.3	V <sub>IN</sub> = V <sub>CC</sub> or GND			±0.05		±0.2		±1	μA
I <sub>CCLV</sub>	Quiescent supply current low voltage driving	4.3	V <sub>1IN</sub> , V <sub>2IN</sub> = 1.65V		42	55					μA
			V <sub>1IN</sub> , V <sub>2IN</sub> = 1.80V		38	50					

1. ΔRON = R<sub>ON</sub>(MAX) - R<sub>ON</sub>(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 <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Typ.	Max.	Typ.		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> = 0.8V		70						ns
		2.3-2.7	V <sub>S</sub> = 1.5V		30	60		75			
		3.0-3.3			25	50		60			
		3.6-4.3			25	50		60			
t <sub>OFF</sub>	TURN-OFF time	1.65-1.95	V <sub>S</sub> = 0.8		45						ns
		2.3-2.7	V <sub>S</sub> = 1.5V		25	30		40			
		3.0-3.3			25	30		40			
		3.6-4.3			25	30		40			
t <sub>D</sub>	Break before make time delay	1.65 – 1.95	C <sub>L</sub> = 35pF R <sub>L</sub> = 50Ω V <sub>S</sub> = 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 <sub>L</sub> =100pF R <sub>L</sub> = 1MΩ V <sub>GEN</sub> = 0V R <sub>GEN</sub> =0Ω		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		
		$V_{CC}(V)$		$T_A = 25^\circ\text{C}$			$-40\text{ to }85^\circ\text{C}$		$-55\text{ to }125^\circ\text{C}$			
				Min.	Typ.	Max.	Typ.	Max.	Typ.		Max.	
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	$R_L = 600\Omega$ $V_{IN} = 2V_{PP}$ $f = 20\text{Hz to }20\text{ kHz}$		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**

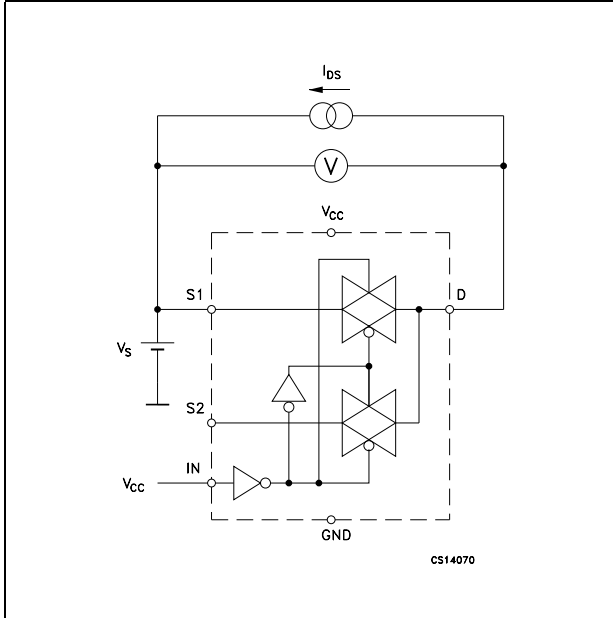
IN	Switch S1	Switch S2
H	ON	OFF (1)
L	OFF (1)	ON

1. High Impedance

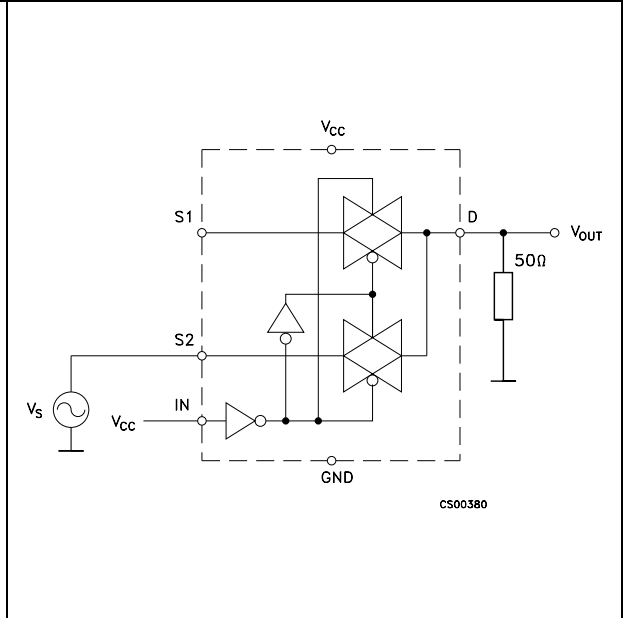


# 4 Application circuits

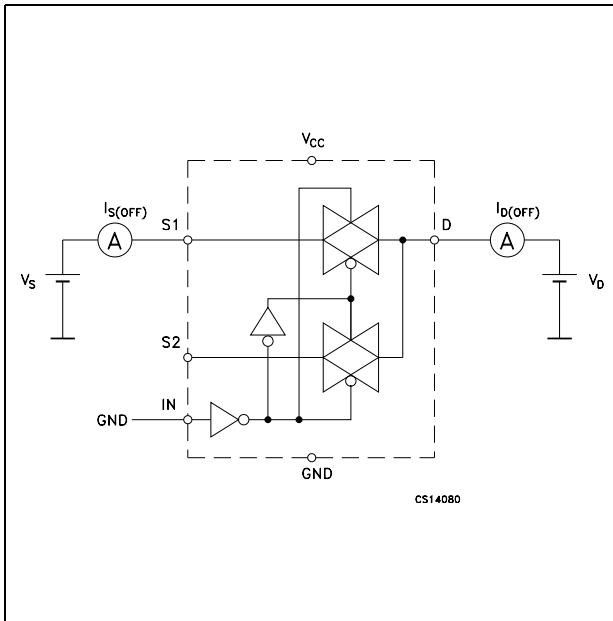
**Figure 3. ON Resistance**



**Figure 4. OFF Isolation**



**Figure 5. OFF Leakage**



**Figure 6. Bandwidth**

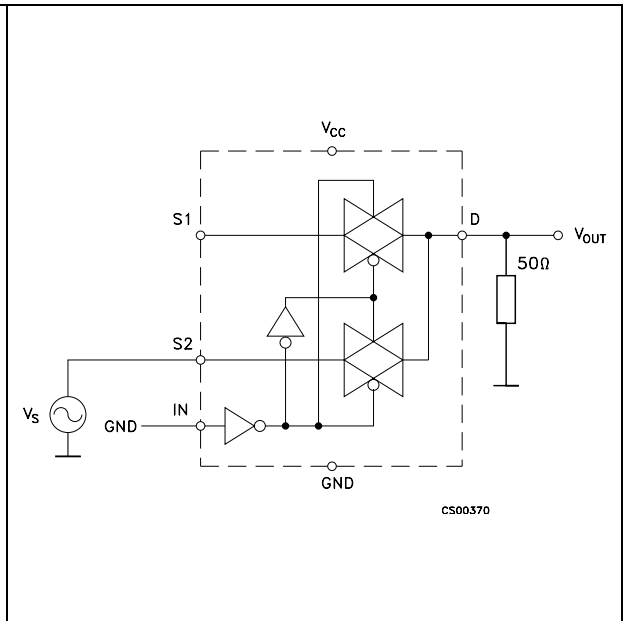


Figure 7. Channel to channel crosstalk

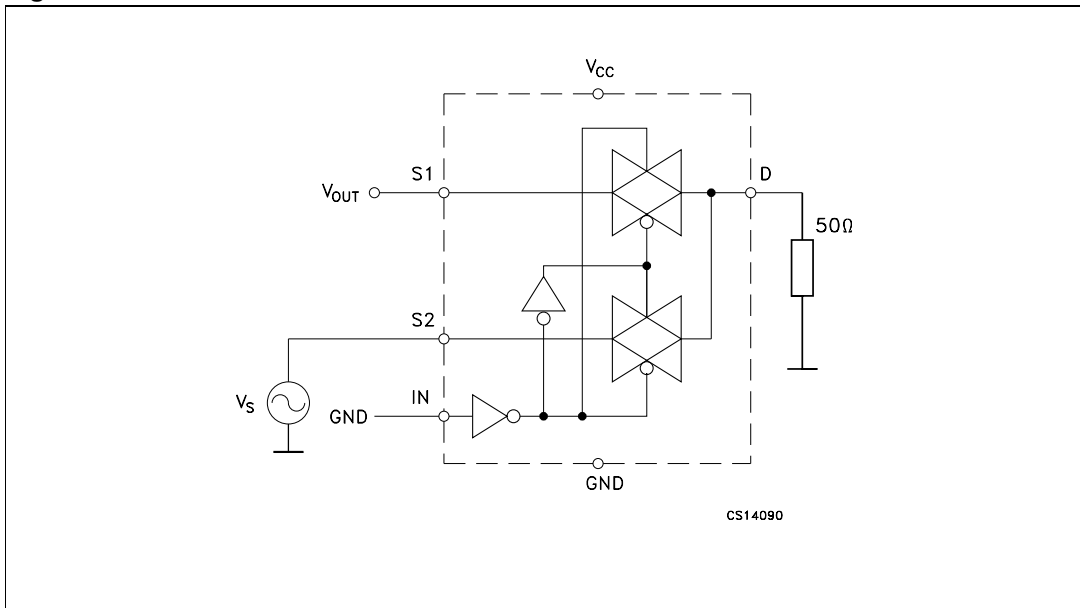
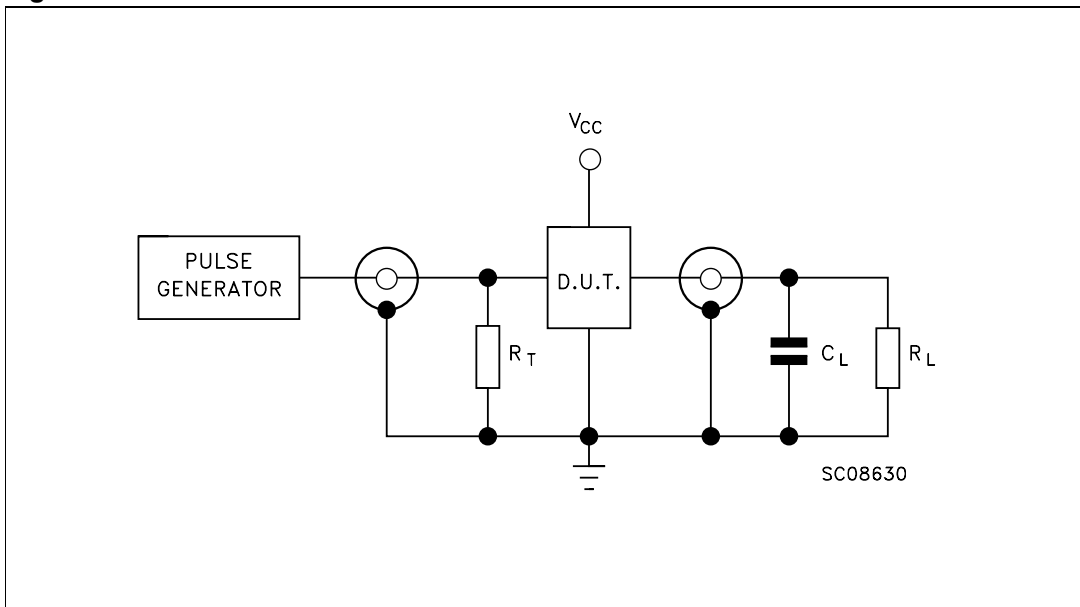


Figure 8. Test circuit



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

$R_L = 50\Omega$  or equivalent

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

Figure 9. Break-before-make time delay

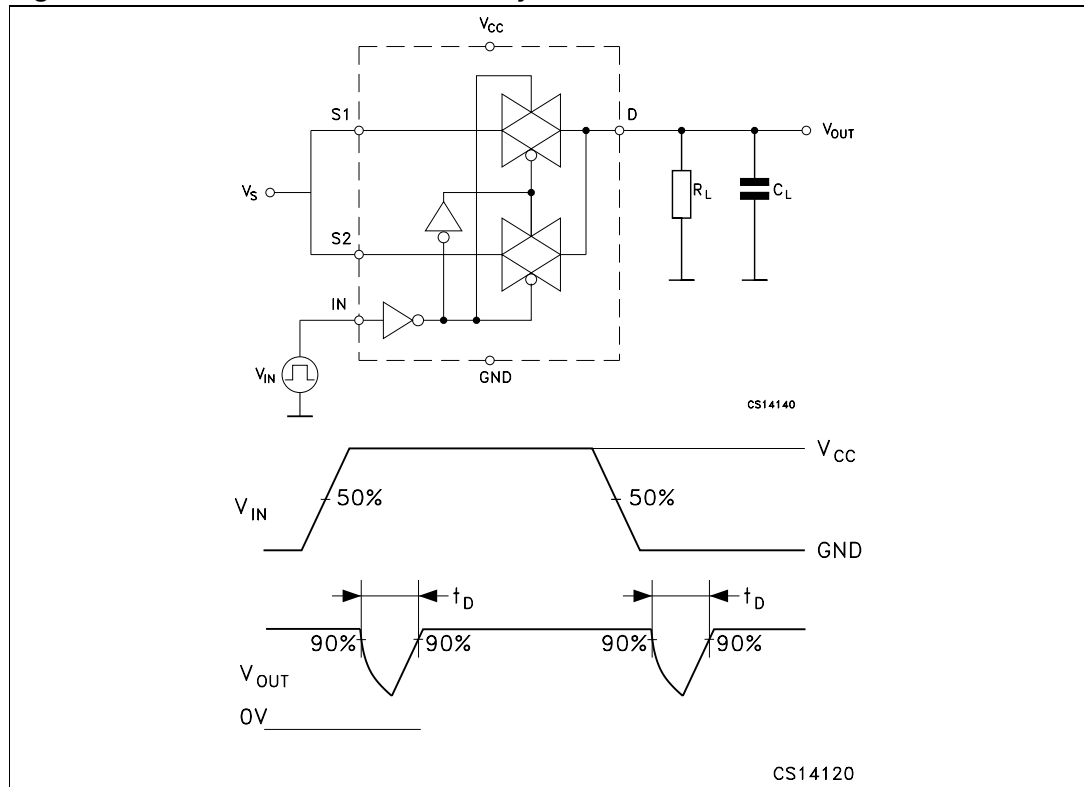


Figure 10. Switching time and charge injection  
 ( $V_{GEN} = 0V$ ,  $R_{GEN} = 0\Omega$ ,  $R_L = 1M\Omega$ ,  $C_L = 100pF$ )

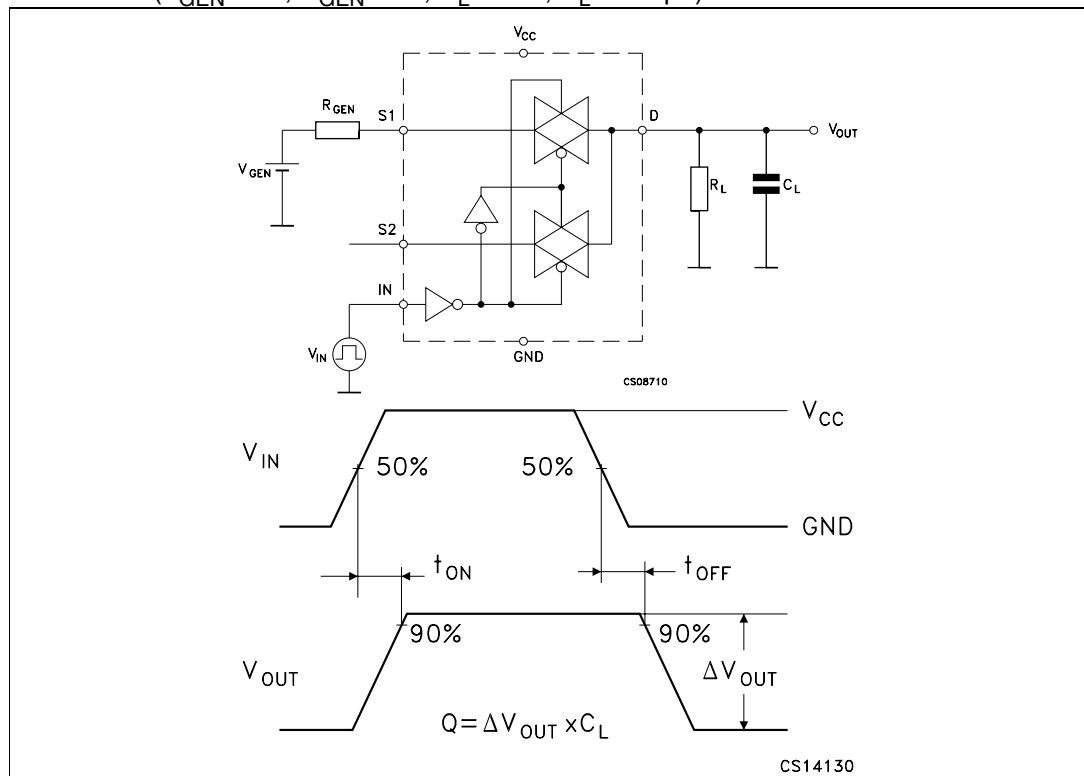
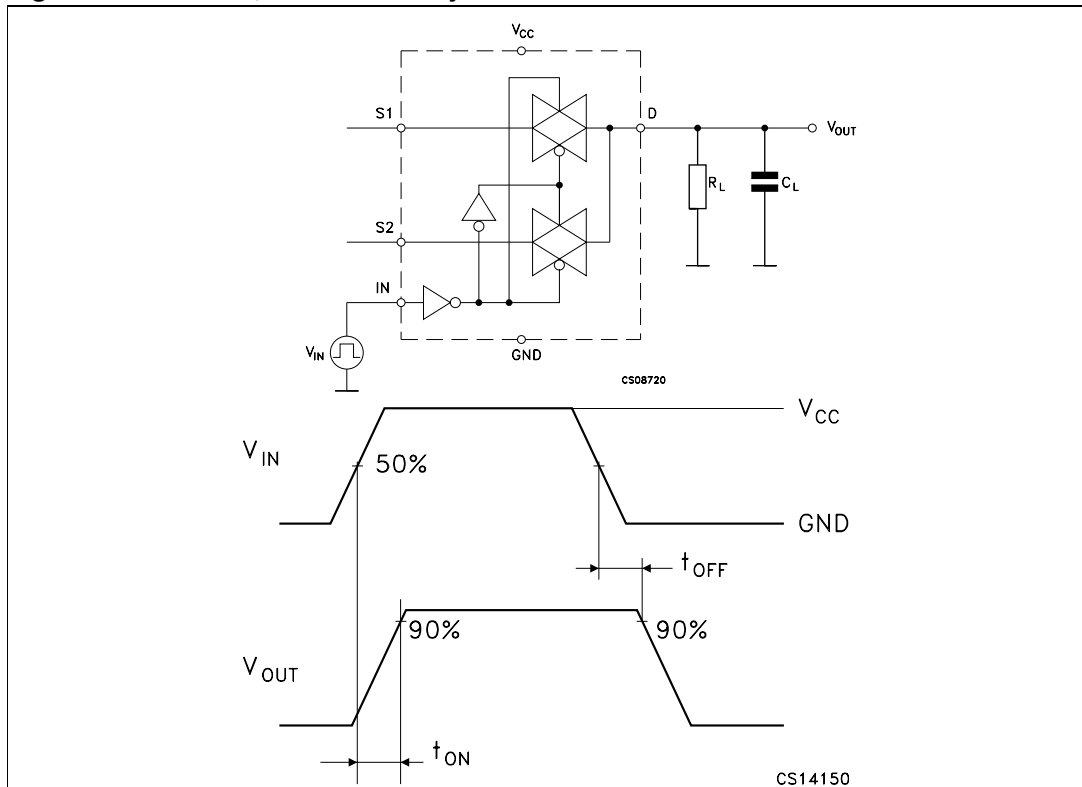


Figure 11. Turn ON, Turn OFF delay time



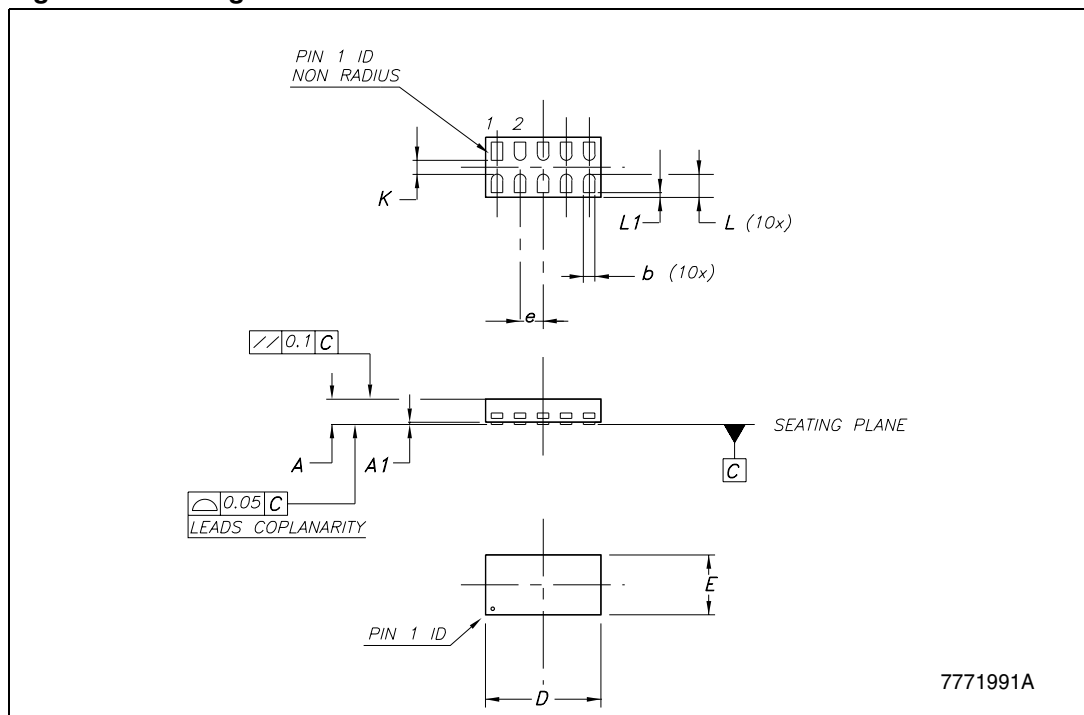
## 5 Package mechanical data

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](http://www.st.com)

**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**

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

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