

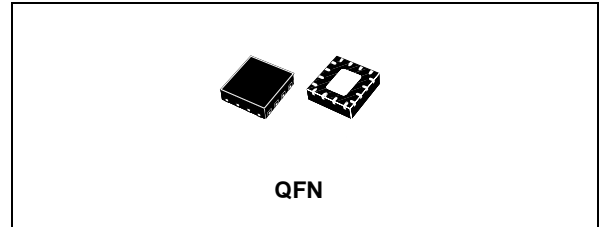
## LOW VOLTAGE 0.5/0.8Ω MAX DUAL SPDT SWITCH WITH BREAK BEFORE MAKE FEATURE

- HIGH SPEED:  
 $t_{PD} = 0.3ns$  (TYP.) at  $V_{CC} = 3.0V$   
 $t_{PD} = 0.4ns$  (TYP.) at  $V_{CC} = 2.3V$
- ULTRA LOW POWER DISSIPATION:  
 $I_{CC} = 0.2\mu A$  (MAX.) at  $T_A = 85^\circ C$
- LOW "ON" RESISTANCE  $V_{IN} = 0V$ :  
 $R_{ON-S1} = 0.5\Omega$  (MAX.  $T_A = 25^\circ C$ ) at  $V_{CC}=2.7V$   
 $R_{ON-S2} = 0.8\Omega$  (MAX.  $T_A = 25^\circ C$ ) at  $V_{CC}=2.7V$
- 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  $V_{CC} = 2.3$  to  $3.0V$
- LATCH-UP PERFORMANCE EXCEEDS 300mA (JESD 17)

### DESCRIPTION

The STG3680 is an high-speed CMOS DUAL ANALOG S.P.D.T. (Single Pole Dual Throw) SWITCH or DUAL 2:1 Multiplexer/Demultiplexer Bus 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.

It offers very low ON-Resistance (<0.5Ω 1S1 and 2S1 channels; <0.8Ω 1S2 and 2S2 channels) at  $V_{CC}=2.7V$ . The nIN inputs are provided to control the switches. The switches nS1 are ON (they are



QFN

### ORDER CODES

| PACKAGE | T & R      |
|---------|------------|
| QFN     | STG3680QTR |

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, 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. It's available in the commercial temperature range in the QFN package.

### PIN CONNECTION

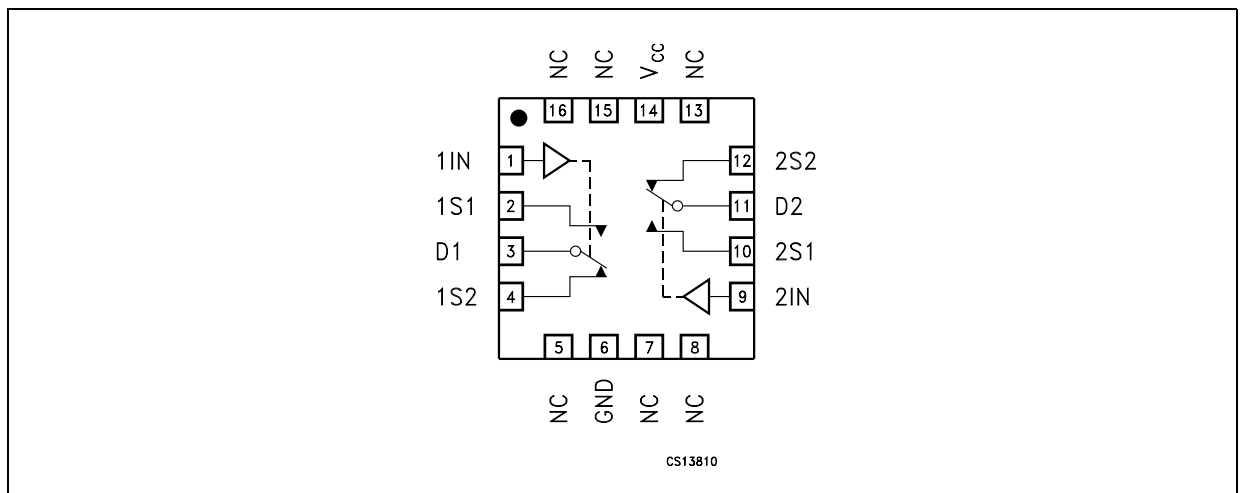


Figure 1: Input Equivalent Circuit

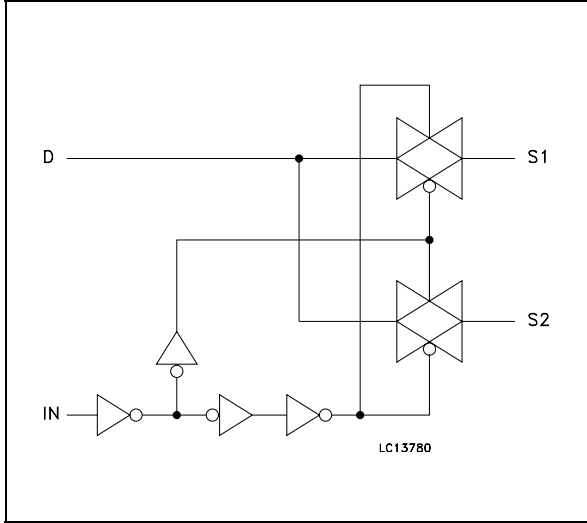


Table 1: Pin Description

| QFN PIN N°     | SYMBOL                   | NAME AND FUNCTION       |
|----------------|--------------------------|-------------------------|
| 1, 9           | 1IN, 2IN                 | Controls                |
| 2, 10<br>4, 12 | 1S1 to 2S1<br>1S2 to 2S2 | Independent Channels    |
| 3, 11          | D1, D2                   | Common Channels         |
| 5,7,8,13,15,16 | NC                       | Not Connected           |
| 6              | GND                      | Ground (0V)             |
| 14             | V <sub>CC</sub>          | Positive Supply Voltage |

Table 2: Truth Table

| IN | SWITCH S1 | SWITCH S2 |
|----|-----------|-----------|
| H  | ON        | OFF(*)    |
| L  | OFF(*)    | ON        |

(\*) High Impedance

Table 3: Absolute Maximum Ratings

| Symbol                              | Parameter  | Value                         | Unit |
|-------------------------------------|--|-------------------------------|------|
| V <sub>CC</sub>                     | Supply Voltage   | -0.5 to 4.6                   | V    |
| V <sub>I</sub>                      | DC Input Voltage   | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| V <sub>IC</sub>                     | DC Control Input Voltage                                     | -0.5 to 4.6                   | V    |
| V <sub>O</sub>                      | DC Output Voltage  | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| I <sub>IKC</sub>                    | DC Input Diode Current on control pin (V <sub>IN</sub> < 0V) | - 50                          | mA   |
| I <sub>IK</sub>                     | DC Input Diode Current (V <sub>IN</sub> < 0V)                | ± 50                          | mA   |
| I <sub>OK</sub>                     | DC Output Diode Current                                      | ± 20                          | mA   |
| I <sub>O</sub>                      | DC Output Current  | ± 300                         | mA   |
| I <sub>OP</sub>                     | DC Output Current Peak (pulse at 1ms, 10% duty cycle)        | ± 500                         | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current                         | ± 100                         | mA   |
| P <sub>D</sub>                      | Power Dissipation at T <sub>a</sub> =70°C (1)                | 1120                          | mW   |
| T <sub>stg</sub>                    | Storage Temperature  | -65 to 150                    | °C   |
| T <sub>L</sub>                      | Lead Temperature (10 sec)                                    | 300                           | °C   |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

(1) Derate above 70°C: by 18.5mW/°C.

Table 4: Recommended Operating Conditions

| Symbol          | Parameter                              | Value                           | Unit    |
|-----------------|--|---------------------------------|---------|
| V <sub>CC</sub> | Supply Voltage (note 1)                | 1.65 to 4.3                     | V       |
| V <sub>I</sub>  | Input Voltage                          | 0 to V <sub>CC</sub>            | V       |
| V <sub>IC</sub> | Control Input Voltage                  | 0 to 4.3                        | V       |
| V <sub>O</sub>  | Output Voltage                         | 0 to V <sub>CC</sub>            | V       |
| T <sub>op</sub> | Operating Temperature                  | -55 to 125                      | °C      |
| dt/dv           | Input Rise and Fall Time Control Input | V <sub>CC</sub> = 1.65V to 2.7V | 0 to 20 |
|                 |  | V <sub>CC</sub> = 3.0V to 4.3V  | 0 to 10 |

1) Truth Table guaranteed: 1.2V to 4.3V.

Table 5: DC Specifications

| Symbol             | Parameter                                | Test Conditions        |  | Value                 |      |       |                     |      |                     | Unit |      |
|--------------------|--|------------------------|--|-----------------------|------|-------|---------------------|------|---------------------|------|------|
|                    |  | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |      |       | -40 to 85°C         |      | -55 to 125°C        |      |      |
|                    |  |                        |  | Min.                  | Typ. | Max.  | Min.                | Max. | Min.                |      | Max. |
| V <sub>IH</sub>    | High Level Input Voltage                 | 1.65-1.95              |  | 0.65V <sub>CC</sub>   |      |       | 0.65V <sub>CC</sub> |      | 0.65V <sub>CC</sub> |      | V    |
|                    |  | 2.3-2.5                |  | 1.4                   |      |       | 1.4                 |      | 1.4                 |      |      |
|                    |  | 2.7-3.0                |  | 1.4                   |      |       | 1.4                 |      | 1.4                 |      |      |
|                    |  | 3.3                    |  | 1.5                   |      |       | 1.5                 |      | 1.5                 |      |      |
|                    |  | 3.6                    |  | 1.7                   |      |       | 1.7                 |      | 1.7                 |      |      |
| V <sub>IL</sub>    | 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 |      |
|                    |  | 2.7-3.6                |  |                       |      | 0.50  |                     | 0.50 |                     | 0.50 |      |
|                    |  | 3.3                    |  |                       |      | 0.50  |                     | 0.50 |                     | 0.50 |      |
|                    |  | 3.6                    |  |                       |      | 0.50  |                     | 0.50 |                     | 0.50 |      |
| R <sub>ON-S1</sub> | Switch ON-S1 Resistance (1)              | 4.3                    | V <sub>S</sub> =0V to V <sub>CC</sub><br>I <sub>S</sub> =100mA |                       |      | 0.80  |                     | 0.80 |                     |      | Ω    |
|                    |  | 3.0                    |  |                       |      | 0.80  |                     | 0.80 |                     |      |      |
|                    |  | 2.7                    |  |                       |      | 0.80  |                     | 0.80 |                     |      |      |
|                    |  | 2.3                    |  |                       |      | 2     |                     | 2    |                     |      |      |
|                    |  | 1.8                    |  |                       |      | 4.0   |                     | 5.0  |                     |      |      |
|                    |  | 1.65                   |  |                       |      | 4.0   |                     | 5.0  |                     |      |      |
| R <sub>ON-S2</sub> | Switch ON-S2 Resistance (1)              | 4.3                    | V <sub>S</sub> =0V to V <sub>CC</sub><br>I <sub>S</sub> =100mA |                       | 0.40 | 0.50  |                     | 0.60 |                     |      | Ω    |
|                    |  | 3.0                    |  |                       | 0.40 | 0.50  |                     | 0.60 |                     |      |      |
|                    |  | 2.7                    |  |                       | 0.40 | 0.50  |                     | 0.60 |                     |      |      |
|                    |  | 2.3                    |  |                       | 0.50 | 0.80  |                     | 0.80 |                     |      |      |
|                    |  | 1.8                    |  |                       | 0.70 | 3.0   |                     | 4.0  |                     |      |      |
|                    |  | 1.65                   |  |                       | 0.80 | 3.0   |                     | 4.0  |                     |      |      |
| ΔR <sub>ON</sub>   | ON Resist. Match between channels (1, 2) | 2.7                    | V <sub>S</sub> =1.5V<br>I <sub>S</sub> =100mA                  |                       | 0.06 |       |                     |      |                     |      | Ω    |
| R <sub>FLAT</sub>  | ON Resistance FLATNESS (3)               | 4.3                    | V <sub>S</sub> =1.5V<br>I <sub>S</sub> =100mA                  |                       |      |       |                     |      |                     |      | Ω    |
|                    |  | 3.0                    |  |                       |      |       |                     |      |                     |      |      |
|                    |  | 2.7                    |  |                       | 0.07 | 0.15  |                     | 0.15 |                     |      |      |
|                    |  | 2.3                    |  |                       |      |       |                     |      |                     |      |      |
|                    |  | 1.65                   | V <sub>S</sub> =0.8V<br>I <sub>S</sub> =100mA                  |                       |      |       |                     |      |                     |      |      |
| 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 Leak. Current                      | 0 - 4.3                | V <sub>IN</sub> = 0 to 3.6V                                    |                       |      | ±0.1  |                     | ±1   |                     |      | μA   |
| I <sub>CC</sub>    | Quiescent Supply Current (1)             | 1.65-4.3               | V <sub>IN</sub> =V <sub>CC</sub> or GND                        |                       |      | ±0.05 |                     | ±0.2 |                     | ±1   | μA   |

Note 1: Guaranteed by design

Note 2: ΔR<sub>ON</sub> = R<sub>ON(MAX)</sub> - R<sub>ON(MIN)</sub>

Note 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 6: AC Electrical Characteristics** ( $C_L = 35\text{pF}$ ,  $R_L = 50\Omega$ ,  $t_r = t_f \leq 5\text{ns}$ )

| Symbol                | Parameter                    | Test Condition  |   | Value                    |      |      |                             |      |                              | Unit |      |
|-----------------------|------------------------------|-----------------|---|--------------------------|------|------|-----------------------------|------|------------------------------|------|------|
|                       |                              | $V_{CC}$<br>(V) |   | $T_A = 25^\circ\text{C}$ |      |      | $-40$ to $85^\circ\text{C}$ |      | $-55$ to $125^\circ\text{C}$ |      |      |
|                       |                              |                 |   | Min.                     | Typ. | Max. | Min.                        | Max. | Min.                         |      | Max. |
| $t_{PLH}$ , $t_{PHL}$ | Propagation Delay            | 1.65-1.95       | $V_I = \text{OPEN}$   |                          | 0.45 |      |                             |      |                              |      | ns   |
|                       |                              | 2.3-2.7         |   | 0.40                     |      |      |                             |      |                              |      |      |
|                       |                              | 3.0-3.6         |   | 0.30                     |      |      |                             |      |                              |      |      |
|                       |                              | 3.6-4.3         |   | 0.30                     |      |      |                             |      |                              |      |      |
| $t_{ON}$              | TURN-ON time                 | 1.65-1.95       | $V_S = 0.8\text{V}$   |                          | 70   |      |                             |      |                              |      | ns   |
|                       |                              | 2.3-2.7         | $V_S = 1.5\text{V}$   |                          | 30   | 50   |                             | 60   |                              |      |      |
|                       |                              | 3.0-3.6         | $V_S = 1.5\text{V}$   |                          | 30   | 50   |                             | 60   |                              |      |      |
|                       |                              | 3.6-4.3         | $V_S = 1.5\text{V}$   |                          | 30   | 50   |                             | 60   |                              |      |      |
| $t_{OFF}$             | TURN-OFF time                | 1.65-1.95       | $V_S = 0.8\text{V}$   |                          | 45   |      |                             |      |                              |      | ns   |
|                       |                              | 2.3-2.7         | $V_S = 1.5\text{V}$   |                          | 25   | 30   |                             | 40   |                              |      |      |
|                       |                              | 3.0-3.6         | $V_S = 1.5\text{V}$   |                          | 25   | 30   |                             | 40   |                              |      |      |
|                       |                              | 3.6-4.3         | $V_S = 1.5\text{V}$   |                          | 25   | 30   |                             | 40   |                              |      |      |
| $t_D$                 | Break Before Make Time Delay | 1.65-1.95       | $C_L = 35\text{pF}$<br>$R_L = 50\Omega$<br>$V_S = 1.5\text{V}$                                  |                          |      |      |                             |      |                              |      | 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       | $C_L = 100\text{pF}$<br>$R_L = 1\text{M}\Omega$<br>$V_{GEN} = 0\text{V}$<br>$R_{GEN} = 0\Omega$ |                          |      |      |                             |      |                              |      | pC   |
|                       |                              | 2.3-2.7         |   |                          | 200  |      |                             |      |                              |      |      |
|                       |                              | 3.0-3.6         |   |                          | 200  |      |                             |      |                              |      |      |
|                       |                              | 3.6-4.3         |   |                          | 200  |      |                             |      |                              |      |      |

**Table 7: Analog Switch Characteristics** ( $C_L = 5\text{pF}$ ,  $R_L = 50\Omega$ ,  $T_A = 25^\circ\text{C}$ )

| Symbol   | Parameter                                 | Test Condition  |  | Value                    |      |      |                             |      |                              | Unit |      |
|----------|---|-----------------|--|--------------------------|------|------|-----------------------------|------|------------------------------|------|------|
|          |   | $V_{CC}$<br>(V) |  | $T_A = 25^\circ\text{C}$ |      |      | $-40$ to $85^\circ\text{C}$ |      | $-55$ to $125^\circ\text{C}$ |      |      |
|          |   |                 |  | Min.                     | Typ. | Max. | Min.                        | Max. | Min.                         |      | Max. |
| OIRR     | Off Isolation (1)                         | 1.65-4.3        | $V_S = 1V_{RMS}$<br>$f = 100\text{KHz}$  |                          | -64  |      |                             |      |                              |      | dB   |
| Xtalk    | Crosstalk                                 | 1.65-4.3        | $V_S = 1V_{RMS}$<br>$f = 100\text{KHz}$  |                          | -54  |      |                             |      |                              |      | dB   |
| THD      | Total Harmonic Distortion                 | 2.3-4.3         | $R_L = 600\Omega$<br>$V_{IN} = 2V_{PP}$<br>$f = 20\text{Hz}$ to $20\text{kHz}$ |                          | 0.03 |      |                             |      |                              |      | %    |
| BW       | -3dB Bandwidth                            | 1.65-4.3        | $R_L = 50\Omega$   |                          | 50   |      |                             |      |                              |      | MHz  |
| $C_{IN}$ | Control Pin Input Capacitance             |                 |  |                          | 5    |      |                             |      |                              |      | pF   |
| $C_{Sn}$ | Sn Port Capacitance                       | 3.3             | $f = 1\text{MHz}$  |                          | 37   |      |                             |      |                              |      |      |
| $C_D$    | D Port Capacitance when Switch is Enabled | 3.3             | $f = 1\text{MHz}$  |                          | 84   |      |                             |      |                              |      |      |

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

Figure 2: ON Resistance

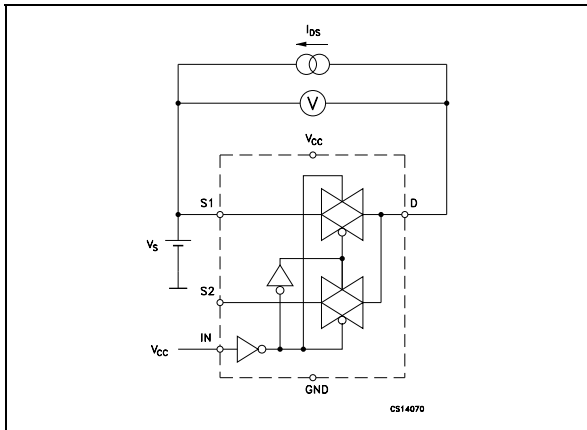


Figure 5: Bandwidth

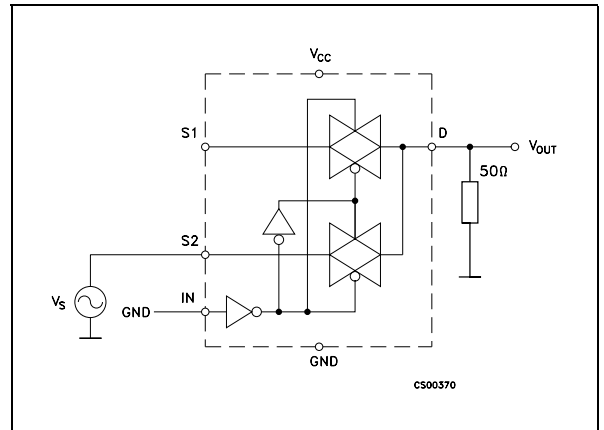


Figure 3: OFF Leakage

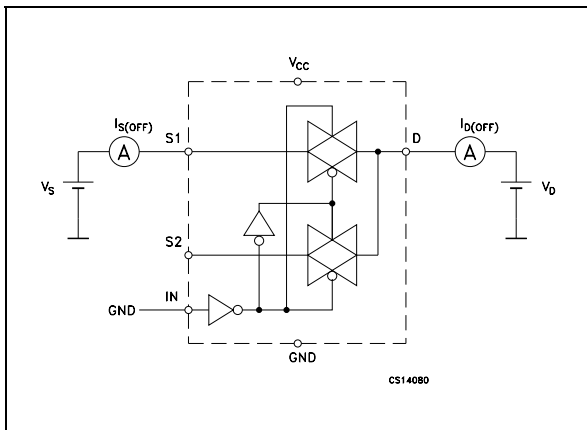


Figure 6: Channel To Channel Crosstalk

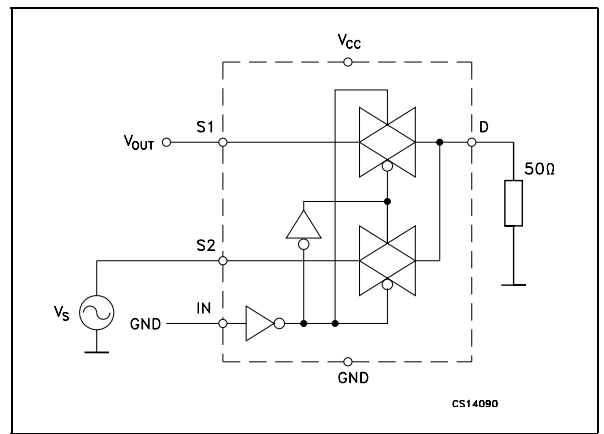


Figure 4: OFF Isolation

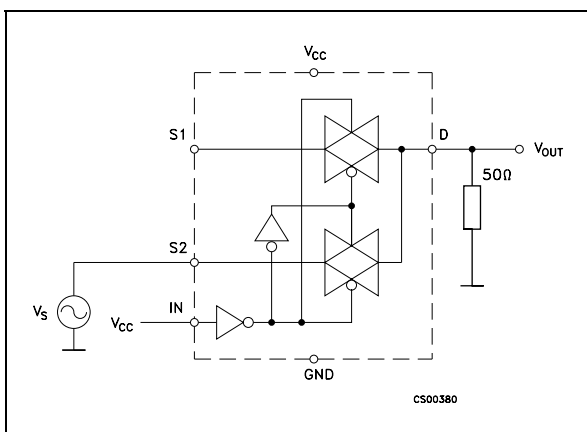
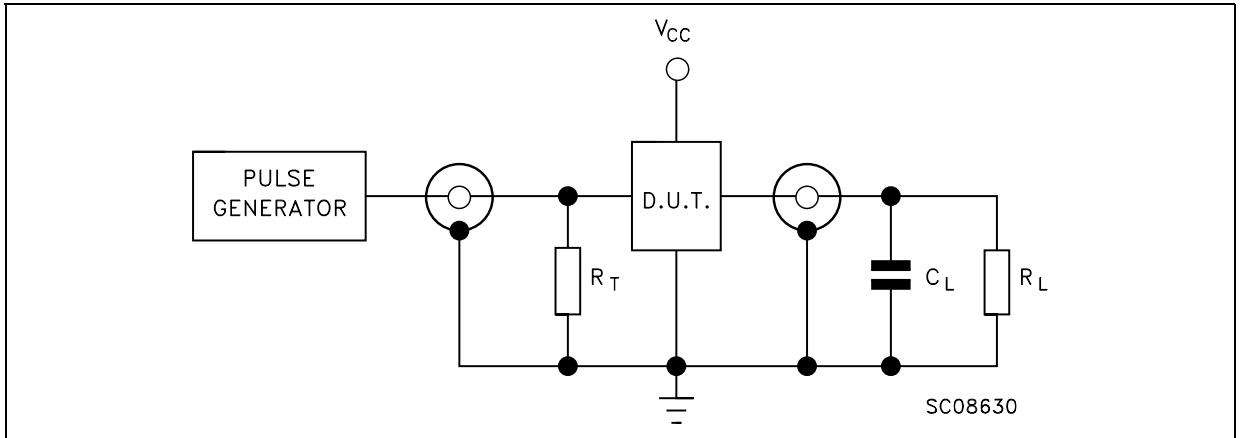


Figure 7: Test Circuit



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

Figure 8: Break Before Make Time Delay

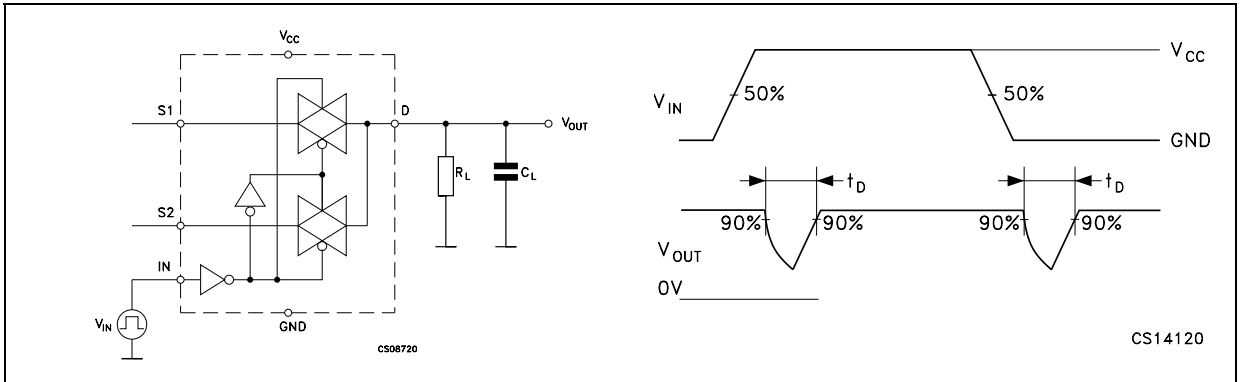


Figure 9: Charge Injection ( $V_{GEN}=0V$ ,  $R_{GEN}=0\Omega$ ,  $R_L=1M\Omega$ ,  $C_L=100\text{pF}$ )

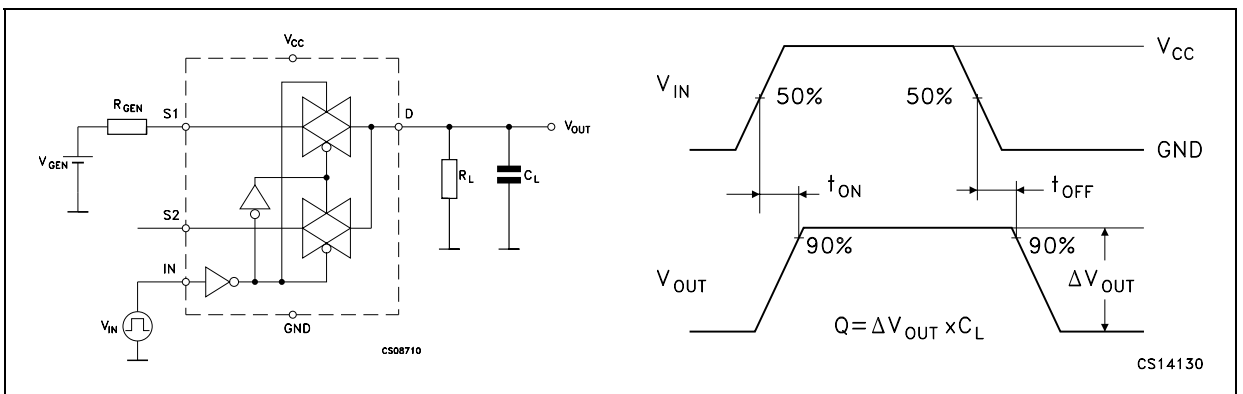
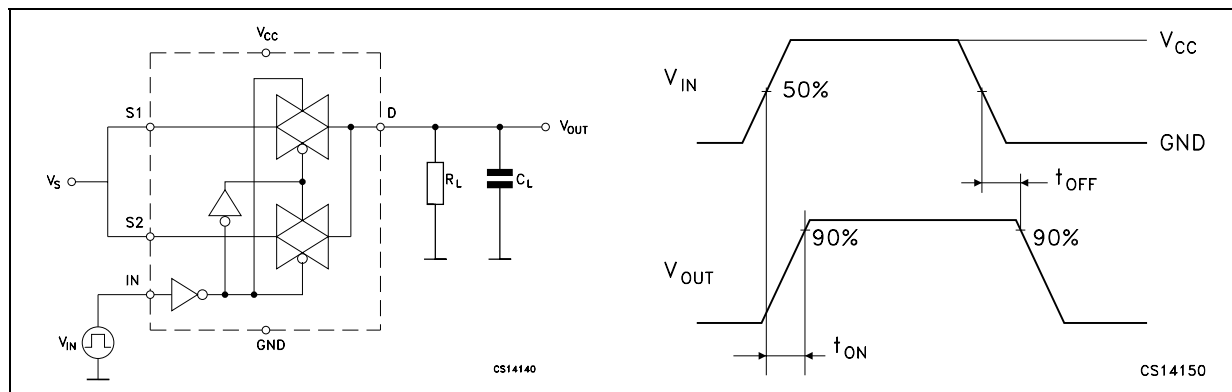
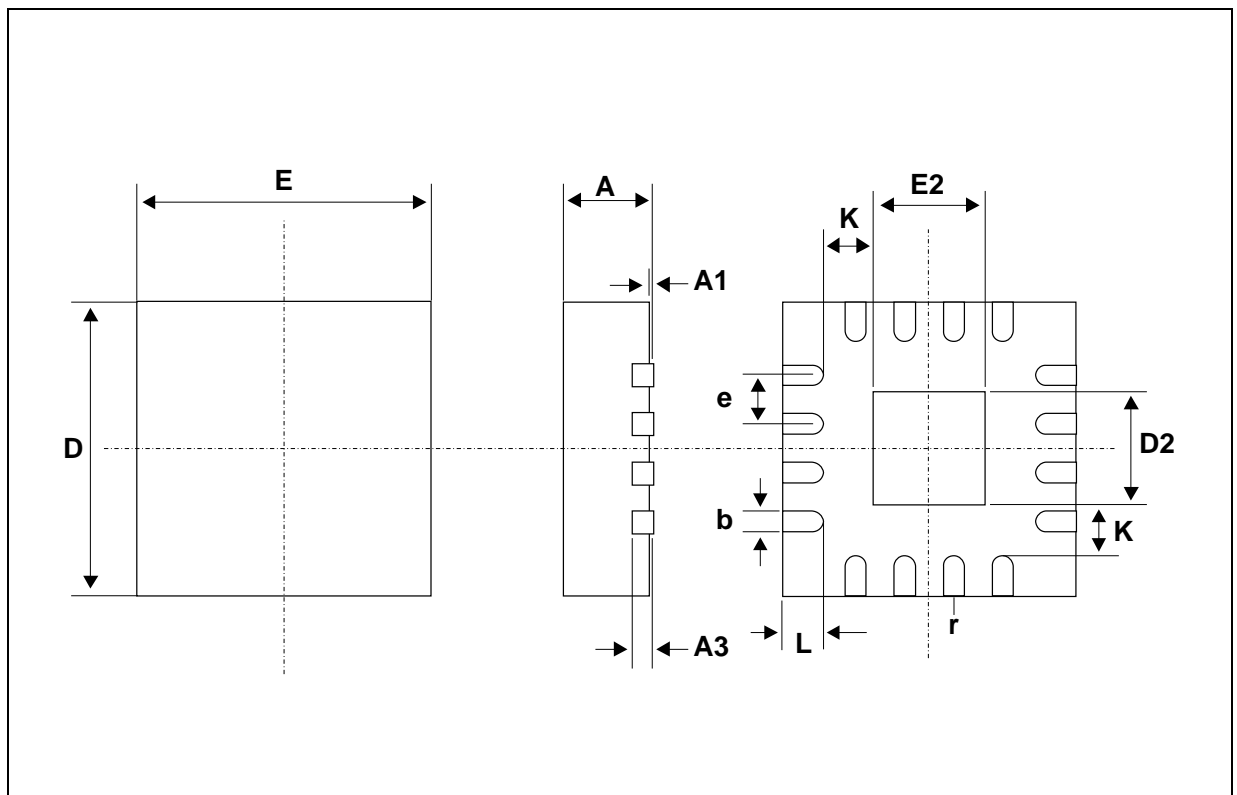


Table 8: Turn ON, Turn OFF Delay Time



### QFN16 (3x3) MECHANICAL DATA

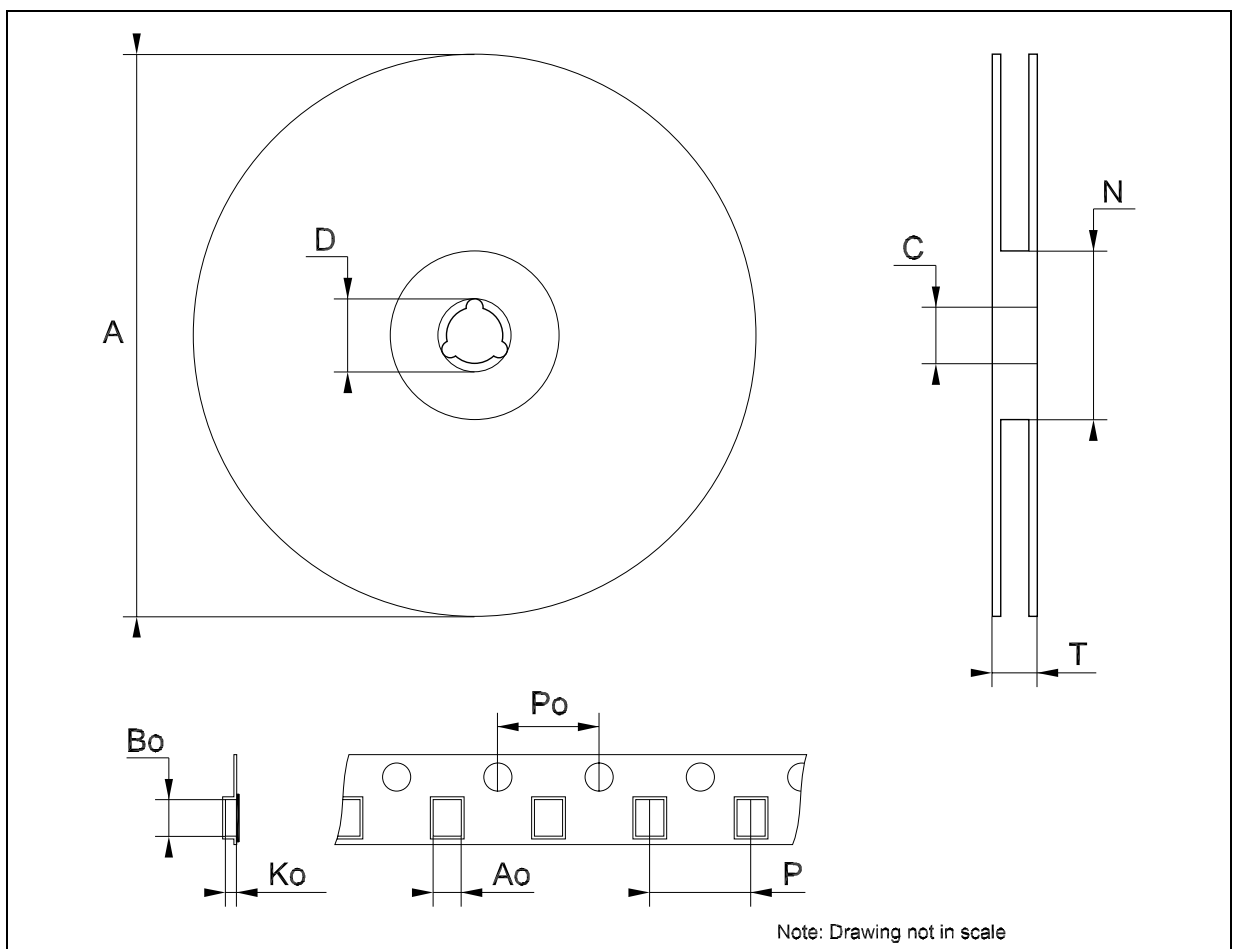
| DIM. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 0.80 | 0.90 | 1.00 | 0.032 | 0.035 | 0.039 |
| A1   |      | 0.02 | 0.05 |       | 0.001 | 0.002 |
| A3   |      | 0.20 |      |       | 0.008 |       |
| b    | 0.18 | 0.25 | 0.30 | 0.007 | 0.010 | 0.012 |
| D    |      | 3.00 |      |       | 0.118 |       |
| D2   | 1.55 | 1.70 | 1.80 | 0.061 | 0.067 | 0.071 |
| E    |      | 3.00 |      |       | 0.118 |       |
| E2   | 1.55 | 1.70 | 1.80 | 0.061 | 0.067 | 0.071 |
| e    |      | 0.50 |      |       | 0.020 |       |
| K    |      | 0.20 |      |       | 0.008 |       |
| L    | 0.30 | 0.40 | 0.50 | 0.012 | 0.016 | 0.020 |
| r    | 0.09 |      |      | 0.006 |       |       |





## Tape & Reel QFNxx/DFNxx (3x3) MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |       |        |
|------|------|-----|------|-------|-------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP.  | MAX.   |
| A    |      |     | 330  |       |       | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |       | 0.519  |
| D    | 20.2 |     |      | 0.795 |       |        |
| N    | 60   |     |      | 2.362 |       |        |
| T    |      |     | 18.4 |       |       | 0.724  |
| Ao   |      | 3.3 |      |       | 0.130 |        |
| Bo   |      | 3.3 |      |       | 0.130 |        |
| Ko   |      | 1.1 |      |       | 0.043 |        |
| Po   |      | 4   |      |       | 0.157 |        |
| P    |      | 8   |      |       | 0.315 |        |



**Table 9: Revision History**

| <b>Date</b> | <b>Revision</b> | <b>Description of Changes</b>   |
|-------------|-----------------|---|
| 17-May-2004 | 3               | Characteristics at $V_{CC} = 4.3$ V Added on Tables 3, 4, 5, 6 and 7. |

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