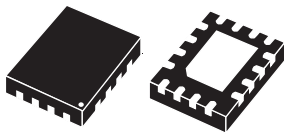
# STG3692

## Low voltage high bandwidth quad SPDT switch

## Features

- Ultra low power dissipation:
  - $I_{CC}$ = 0.2µA (Max.) at $T_A$ = 85°C
- Low “ON” resistance:
  - $R_{ON}$ = 4.6Ω ($T_A$ = 25°C) at $V_{CC}$ = 4.3V
  - $R_{ON}$ = 5.8Ω ($T_A$ = 25°C) at $V_{CC}$ = 3.0V
- 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 $V_{CC}$ = 2.3V to 3.0V
- Typical bandwidth (-3dB) at 800MHz on all channels
- Latch-up performance exceeds 100mA per JESD 78, Class II
- ESD performance exceeds JESD22
  - 2000-V Human body model (A114-A)
- USB (2.0) High speed (480Mbps) signal switching compliant



**QFN16L (2.6mm x 1.8mm)**

## Description

The STG3692 is a high-speed CMOS low voltage quad analog S.P.D.T. (Single Pole Dual Throw) Switch or 2:1 Multiplexer /Demultiplexer Switch fabricated in silicon gate $C^2MOS$ technology. It is designed to operate from 1.65V to 4.3V, making this device ideal for portable applications.

The nSEL inputs are provided to control the switch. The switch S1 is ON (they are connected to common Ports Dn) when the nSEL input is held high and OFF (high impedance state exists between the two ports) when SEL is held low; the switch S2 is ON (it is connected to common Port D) when the nSEL input is held low and OFF (high impedance state exists between the two ports) when nSEL 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.

**Table 1. Device summary**

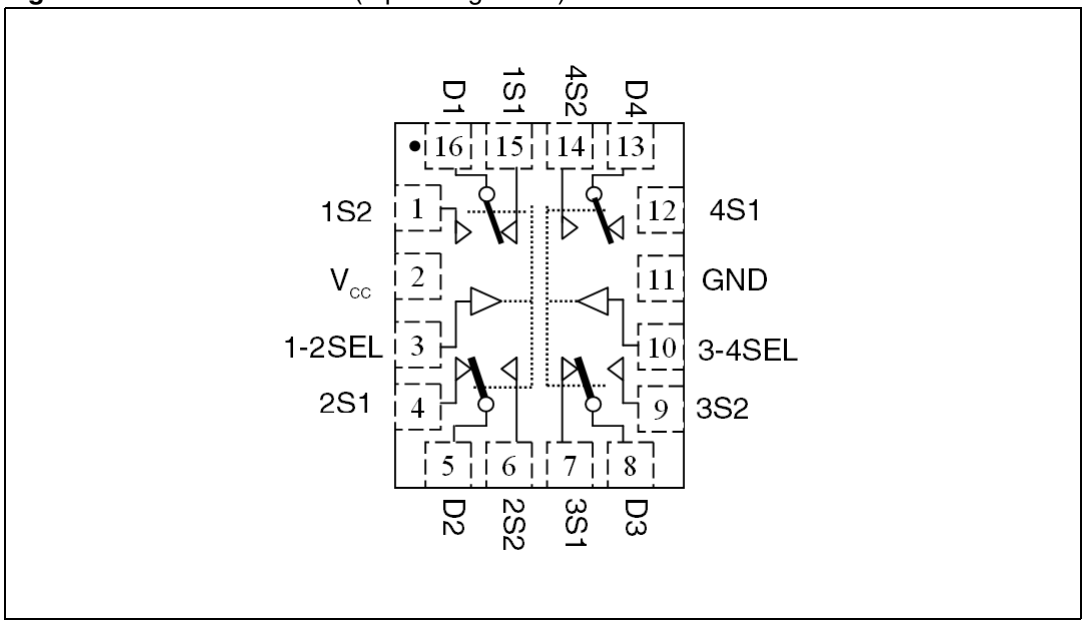
| Order code | Package | Packaging |
|---|---|---|
| STG3692QTR | QFN16L (2.6mm x 1.8mm) | Tape and reel |

# Contents

# 1 Pin settings

## 1.1 Pin connection

**Figure 1. Pin connection** (top through view)




## 1.2 Pin description

**Table 1. Pin description**

| Pin N° | Symbol | Name and function |
|---|---|---|
| 15,1, 4,6, 7,9, 12,14 | 1S1, 1S2, 2S1, 2S2, 3S1, 3S2, 4S1, 4S2 | Independent channels |
| 16,5,8,13 | D1, D2, D3, D4 | Common channels |
| 3, 10 | 1-2SEL, 3-4SEL | Control |
| 2 | $V_{CC}$ | Possitive supply voltage |

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

# 2 Device summary

**Figure 2. Input equivalent circuit**

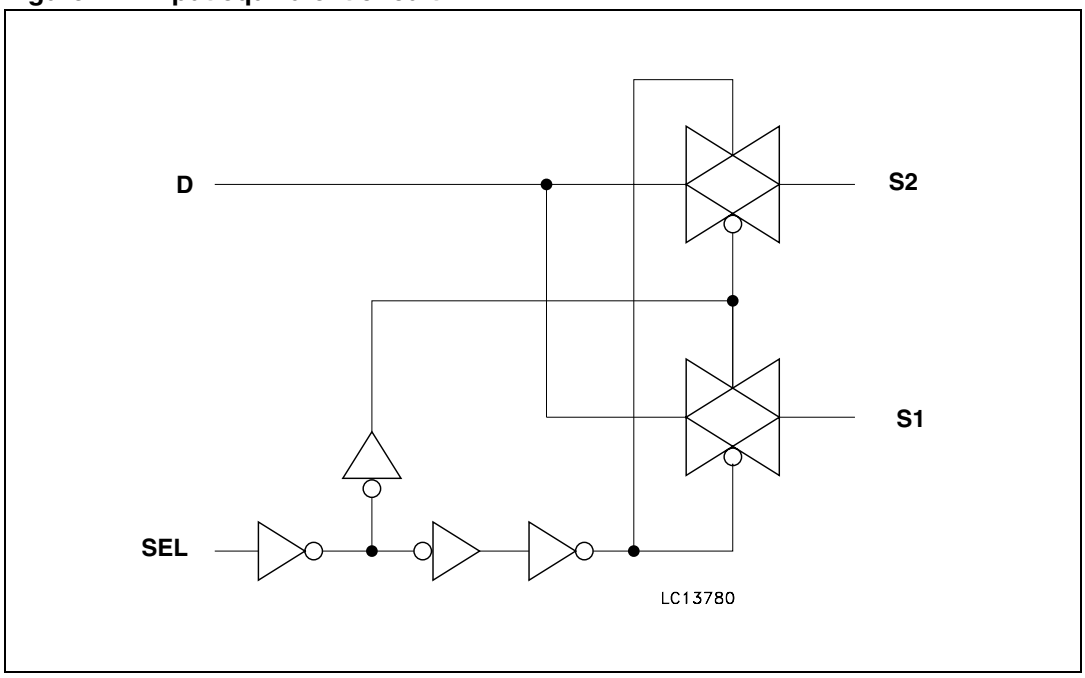



**Table 2. Truth table**

| SEL | Switch S1 | Switch S2 |
|---|---|---|
| H | ON | OFF (1) |
| L | OFF (1) | 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 3. 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 ($V_{SEL}$<0V) | -50 | mA |
| $I_{IK}$ | DC input diode current ($V_{SEL}$<0V) | ±50 | mA |
| $I_{OK}$ | DC output diode current | ±20 | mA |
| $I_O$ | DC output current | ±128 | mA |
| $I_{OP}$ | DC output current peak (pulse at 1ms, 10% duty cycle) | ±300 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or ground current | ±100 | mA |
| $P_D$ | Power dissipation at $T_A$ = 70°C (1) | 1120 | mW |
| $T_{stg}$ | Storage temperature | -65 to 150 | °C |
| $T_L$ | Lead temperature (10 sec) | 300 | °C |

1. Derate above 70ºC by 18.5mW/C

## 3.1 Recommended operating conditions

**Table 4. Recommended operating conditions**

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage(1) | | 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 | $V_{CC}$ = 1.65V 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

# 4 Electrical characteristics

**Table 5. DC specifications**

| Symbol | Parameter | Test conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | Vcc (V) | | $T_A$ = 25°C | | | -40 to 85°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| $V_{IH}$ | High level input voltage | 1.65 -1.95 | | $0.65V_{CC}$ | | | $0.65V_{CC}$ | | V |
| | | 2.3-2.5 | | 1.2 | | | 1.2 | | |
| | | 2.7-3.0 | | 1.3 | | | 1.3 | | |
| | | 3.3-3.6 | | 1.4 | | | 1.4 | | |
| | | 4.3 | | 1.6 | | | 1.6 | | |
| $V_{IL}$ | Low level input voltage | 1.65-1.95 | | | | 0.25 | | | V |
| | | 2.3-2.5 | | | | 0.25 | | | |
| | | 2.7-3.0 | | | | 0.25 | | | |
| | | 3.3-3.6 | | | | 0.30 | | | |
| | | 4.3 | | | | 0.40 | | | |
| $R_{PEAK}$ | Switch ON peak resistance | 1.8 | $V_S$ = 0V to $V_{CC}$ $I_S$ = 8mA | | 12.0 | 16.0 | | | Ω |
| | | 2.7 | | | 6.3 | 8.0 | | | |
| | | 3.0 | | | 5.8 | 7.5 | | | |
| | | 3.7 | | | 5.0 | 6.5 | | | |
| | | 4.3 | | | 4.6 | 6.0 | | | |
| $R_{ON}$ | Switch On resistance | 3.0 | $V_S$ = 3V $I_S$ = 8mA | | 4.0 | 5.2 | | | Ω |
| | | 3.0 | $V_S$ = 0.8V $I_S$ = 8mA | | 5.0 | 6.5 | | | |
| $\Delta R_{ON}$ | ON resistance match between channels (1) | 1.8 | $V_S$ @ $R_{ON}$ Max $I_S$ = 8mA | | | | | | Ω |
| | | 2.7 | | | | | | | |
| | | 3.0 | | | 0.3 | | | | |
| | | 3.7 | | | | | | | |
| | | 4.3 | | | | | | | |
| $R_{FLAT}$ | ON resistance flatness (2) | 1.8 | $V_S$ = 0V to $V_{CC}$ $I_S$ = 8mA | | 6.6 | | | | Ω |
| | | 2.7 | | | 2.0 | | | | |
| | | 3.0 | | | 1.7 | | | | |
| | | 3.7 | | | 1.5 | | | | |
| | | 4.3 | | | 1.6 | | | | |
| $I_{OFF}$ | OFF state leakage current (SN), (D) | 4.3 | $V_S$ = 0.3 or 4V | | | ±20 | | ±100 | nA |

**Table 5. DC specifications**

| Symbol | Parameter | Test conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | Vcc (V) | | $T_A$ = 25°C | | | -40 to 85°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| $I_{IN}$ | Input leakage current | 0 to 4.3 | $V_{SEL}$ = 0 to 4.3V | | | ±0.1 | | ±1 | µA |
| $I_{CC}$ | Quiescent supply current | 1.65 to 4.3 | $V_{SEL}$ = $V_{CC}$ or GND | | | ±0.1 | | ±1.0 | µA |
| $I_{CCLV}$ | Quiescent supply current low voltage driving | 4.3 | $V_{1\text{-}2SEL}$, $V_{3\text{-}4SEL}$ = 1.65V | | ±37 | ±50 | | ±100 | µA |
| | | | $V_{1\text{-}2SEL}$, $V_{3\text{-}4SEL}$ = 1.80V | | ±33 | ±40 | | ±50 | |
| | | | $V_{1\text{-}2SEL}$, $V_{3\text{-}4SEL}$ = 2.60V | | ±11 | ±20 | | ±30 | |

1. Note 1: ΔRon = max |mSN-nSNI, where m = 1..4 and n = 1..4, N = 1..2
2. 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** ($C_L$ = 35pF, $R_L$ = 50Ω, $t_r = t_f \leq$ 5ns)

| Symbol | Parameter | Test conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | Vcc (V) | | $T_A$ = 25°C | | | -40 to 85°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| $t_{PLH}$, $t_{PHL}$ | Propagation delay | 1.65-1.95 | | | 0.30 | | | | ns |
| | | 2.3-2.7 | | | 0.30 | | | | |
| | | 3.0-3.3 | | | 0.25 | | | | |
| | | 3.6-4.3 | | | 0.25 | | | | |
| $t_{ON}$ | Turn-ON time | 1.65-1.95 | $V_S$ = 0.8V | | 31 | | | | ns |
| | | 2.3-2.7 | $V_S$ = 1.5V | | 20 | 26 | | 34 | |
| | | 3.0-3.3 | | | 15 | 20 | | 26 | |
| | | 3.6-4.3 | | | 12 | 15 | | 20 | |
| $t_{OFF}$ | Turn-OFF time | 1.65-1.95 | $V_S$ = 0.8 | | 22 | | | | ns |
| | | 2.3-2.7 | $V_S$ = 1.5V | | 14 | 18 | | 23 | |
| | | 3.0-3.3 | | | 11 | 14 | | 18 | |
| | | 3.6-4.3 | | | 10 | 13 | | 17 | |
| $t_D$ | Break before make time delay | 1.65-1.95 | $C_L$ = 35pF<br>$R_L$ = 50Ω<br>$V_S$ = 1.5V | 1 | 7 | | | | ns |
| | | 2.3-2.7 | | 1 | 5 | | | | |
| | | 3.0-3.3 | | 1 | 4 | | | | |
| | | 3.6-4.3 | | 1 | 3 | | | | |
| Q | Charge injection | 1.65 | $C_L$ = 100pF<br>$V_{GEN}$ = 0V<br>$R_{GEN}$ = 0Ω | | 2.8 | | | | pC |
| | | 2.3 | | | 3.5 | | | | |
| | | 3.0 | | | 3.8 | | | | |
| | | 4.3 | | | 5.0 | | | | |

**Table 7. Analog switch characteristics** ($C_L$ = 5pF, $R_L$ = 50Ω, $T_A$ = 25°C)

| Symbol | Parameter | Test conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | Vcc (V) | | $T_A$ = 25°C | | | -40 to 85°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| OIRR | OFF Isolation (1) | 1.65 - 4.3 | $V_S$ = 1$V_{RMS}$, f = 1MHz Signal = 0 dBm | | -79 | | | | dB |
| | | | $V_S$ = 1$V_{RMS}$, f = 10MHz Signal = 0 dBm | | -60 | | | | |
| Xtalk | Crosstalk | 1.65 - 4.3 | $V_S$ = 1$V_{RMS}$, f = 1MHz Signal = 0 dBm | | -78 | | | | dB |
| | | | $V_S$ = 1$V_{RMS}$, f = 10MHz Signal = 0 dBm | | -61 | | | | |
| BW | -3dB bandwidth | 3.0 - 4.3 | $R_L$ = 50Ω Signal = 0dBm | | 800 | | | | MHz |
| $D_G$ | Differential gain | 3.0 - 4.3 | RL = 150Ω | | 0.64 | | | | % |
| $D_P$ | Differential phase | 3.0 - 4.3 | RL = 150Ω | | 0.1 | | | | deg |
| $C_{IN}$ | Control pin input capacitance | | $V_{CC}$ = 0V | | 6.2 | | | | pF |
| $C_{ON}$ | Sn Port capacitance when switch is enabled | 3.3 | f = 1MHz | | 12 | | | | |
| $C_{OFF}$ | Sn Port capacitance when switch is disabled | 3.3 | f = 1MHz | | 5 | | | | |

1. Off Isolation = 20Log10 ($V_D$/$V_S$), $V_D$ = output. $V_S$ = input to off switch.

**Table 8. USB related AC electrical characteristics**

| Symbol | Parameter | Test conditions | | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| $t_{SK(0)}$ | Channel-to-channel skew | 3.0 to 3.6 | $C_L$=10pF | | 26 | | | | ps |
| $t_{SK(P)}$ | Skew of opposite transition of the same output | 3.0 to 3.6 | $C_L$=10pF | | 60 | | | | ps |
| $T_J$ | Total jitter | 3.0 to 3.6 | $R_L$ = 50Ω, $C_L$= 10pF, $t_R$ = $t_F$ = 750ps at 480Mbps | | 130 | | | | ps |

# 5 Test circuits

**Figure 3. ON-resistance**

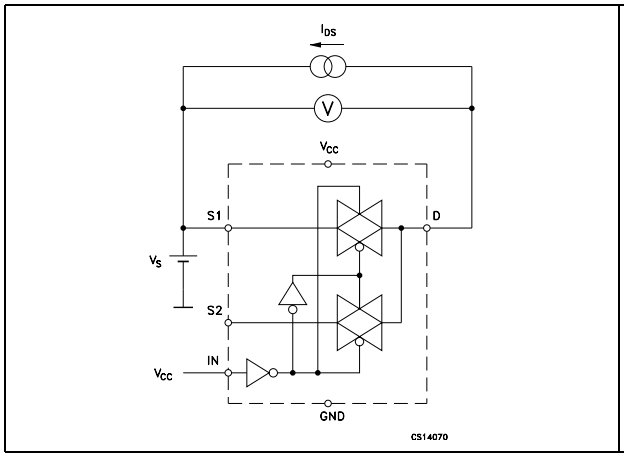



**Figure 4. Bandwidth**

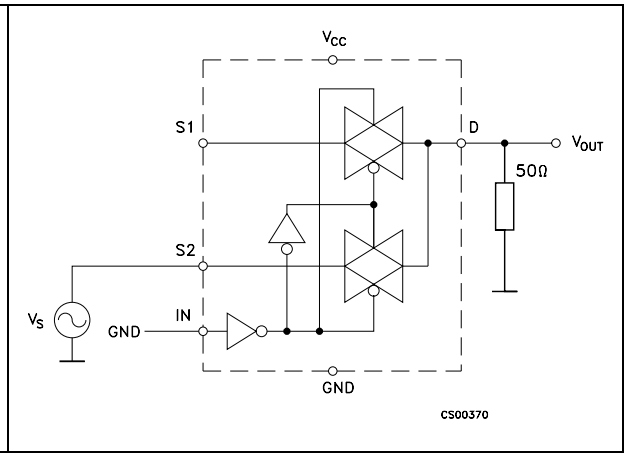



**Figure 5. OFF leakage**

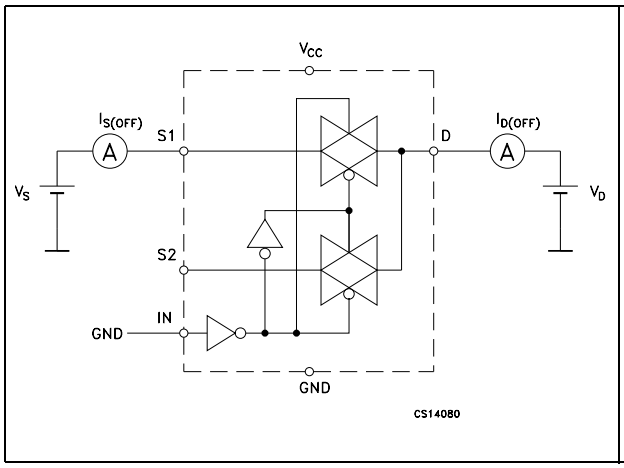



**Figure 6. Channel to channel crosstalk**

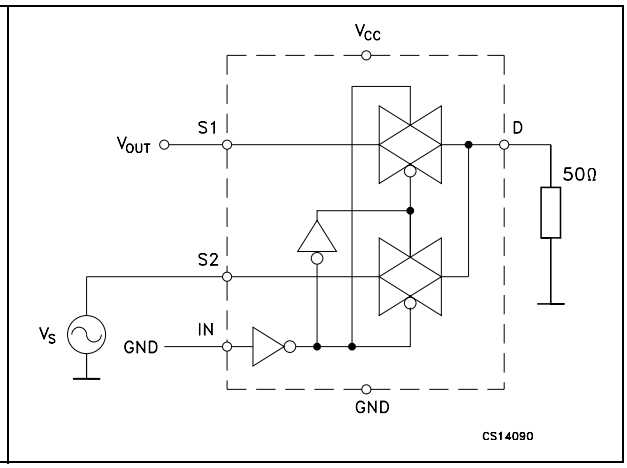



**Figure 7. OFF isolation**

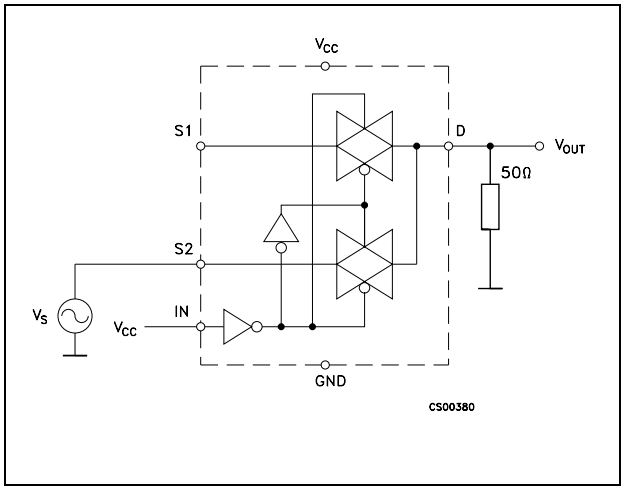
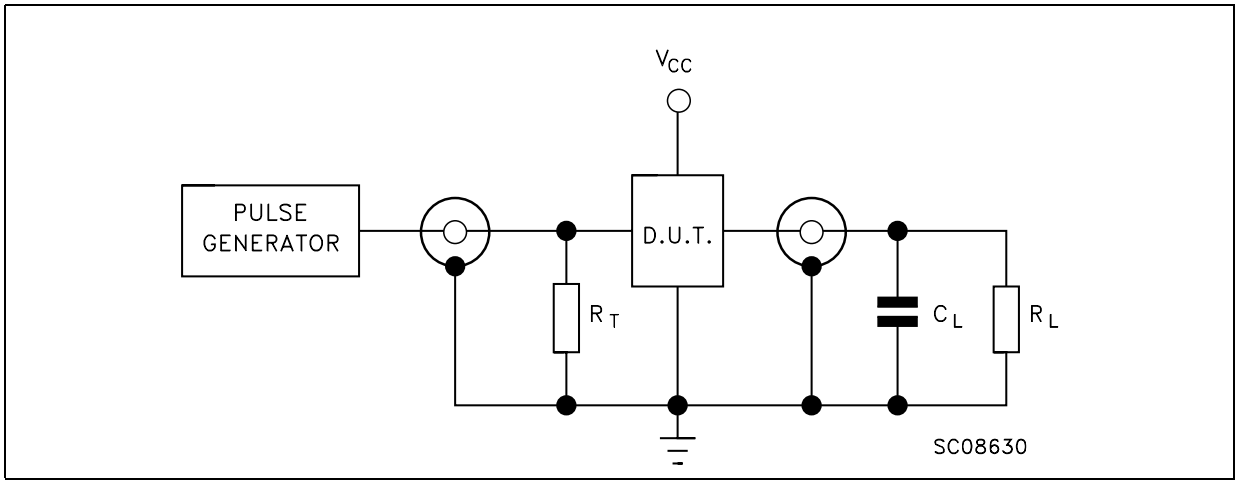


**Figure 8. Test circuit**




*Note: 1* $C_L$ = 5/35pF or equivalent: (includes jig capacitance)

*2* $R_L$ = 50Ω or equivalent

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

**Figure 9. Break-before-make time delay**

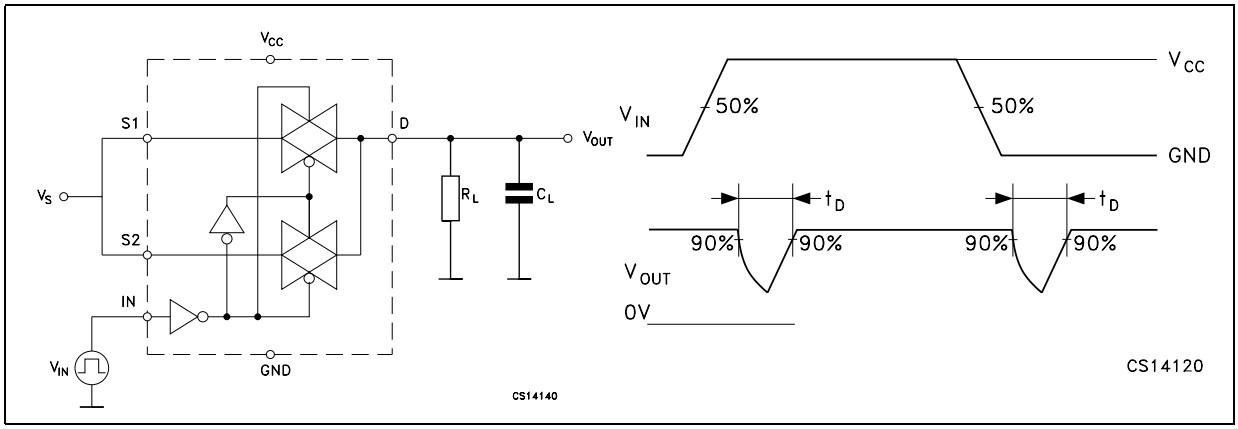



**Figure 10. Switching time and charge injection**
($V_{GEN}$ = 0V, $R_{GEN}$ = 0Ω, $R_L$ = 1MΩ, $C_L$ = 100pF)

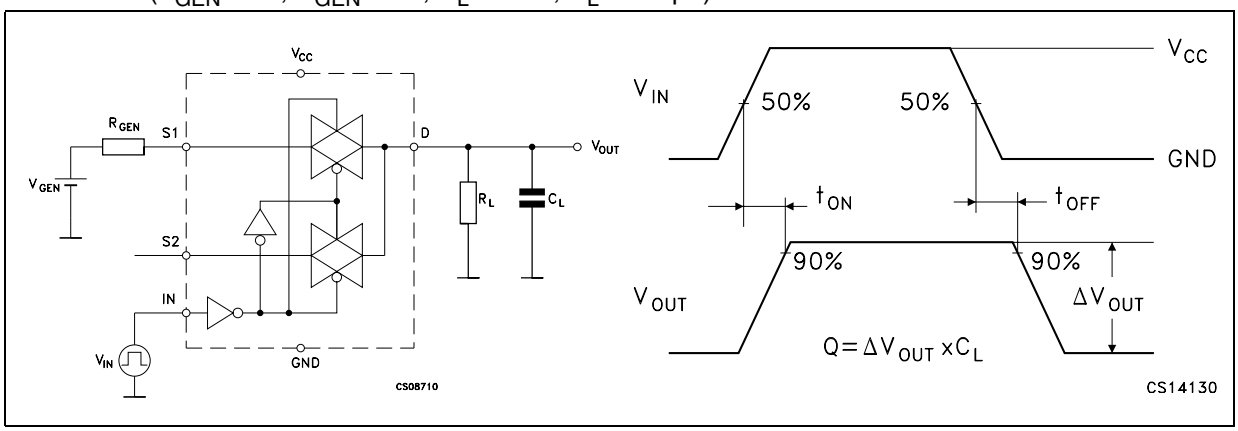
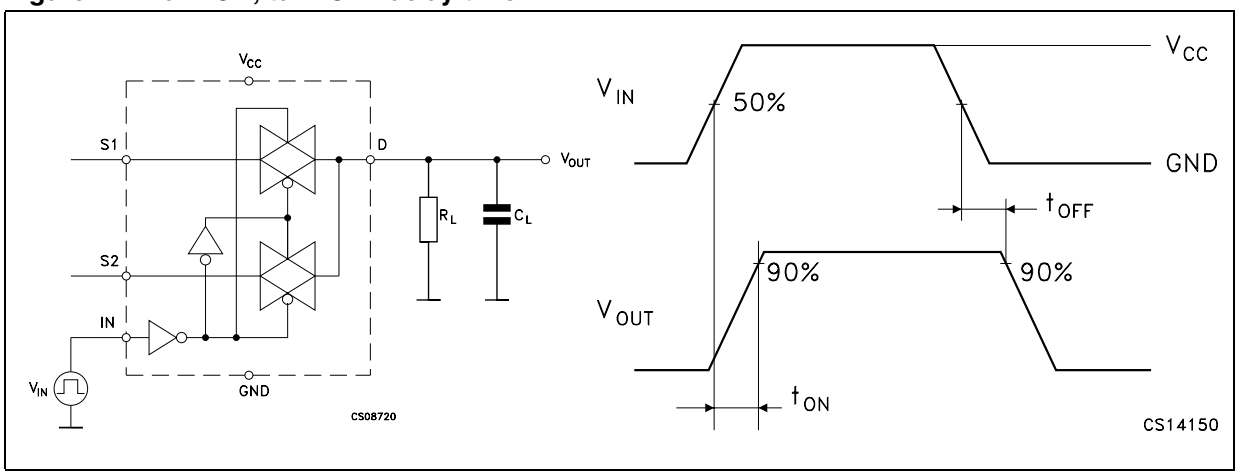



**Figure 11. Turn ON, turn OFF delay time**



# 6 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

**Table 9. QFN16L (2.6x1.8mm) mechanical data**

| Dim. | mm. | | |
|---|---|---|---|
| | Min | Typ | Max |
| A | 0.45 | 0.50 | 0.55 |
| A1 | 0 | 0.02 | 0.05 |
| A3 | | 0.127 | |
| b | 0.15 | 0.20 | 0.25 |
| D | 2.50 | 2.60 | 2.70 |
| D2 | 1.40 | 1.50 | 1.60 |
| E | 1.70 | 1.80 | 1.90 |
| E2 | 0.60 | 0.70 | 0.80 |
| e | | 0.40 | |
| L | 0.25 | 0.30 | 0.35 |

*Note: 1 VFQFPN - Standard for thermally enhanced vey fine pitch quad flat package no leads.*

*2 The leads size is comprehensive of the thickness of the leads finishing material.*

*3 Dimensions do not include mold protusion.*

*4 Package outline exclusive of metal burrs dimensions.*

*5 Shipping media tape and reel units: 3000*

**Figure 12. Foot print recommendation**

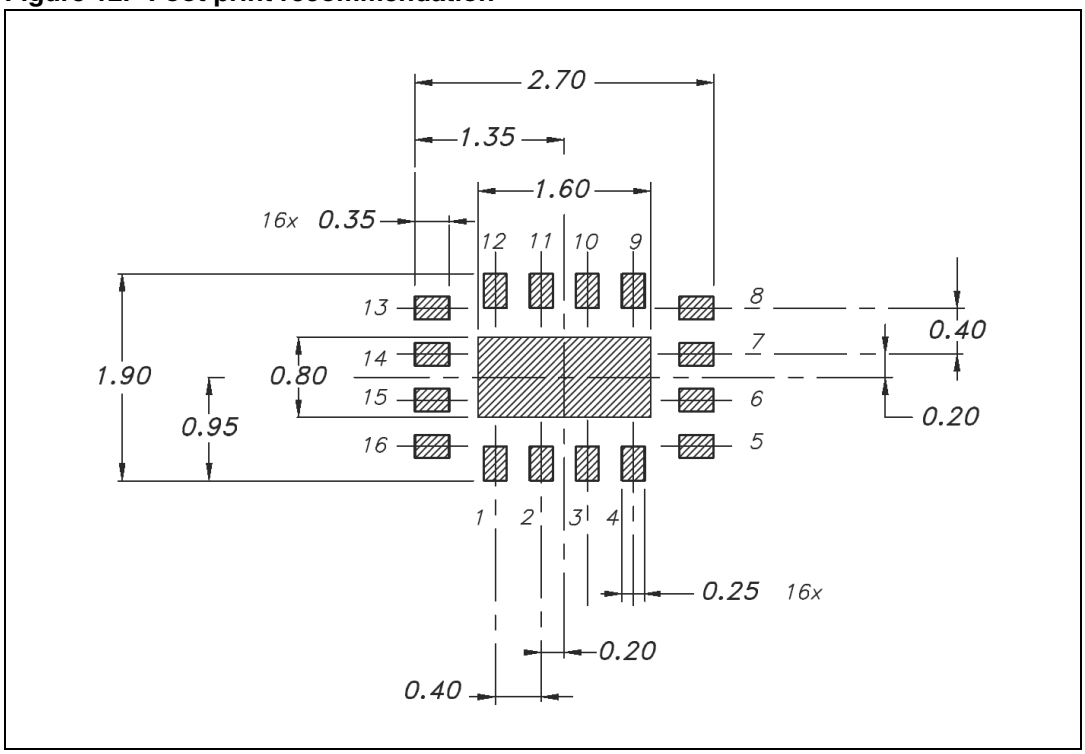


**Figure 13. Package information**

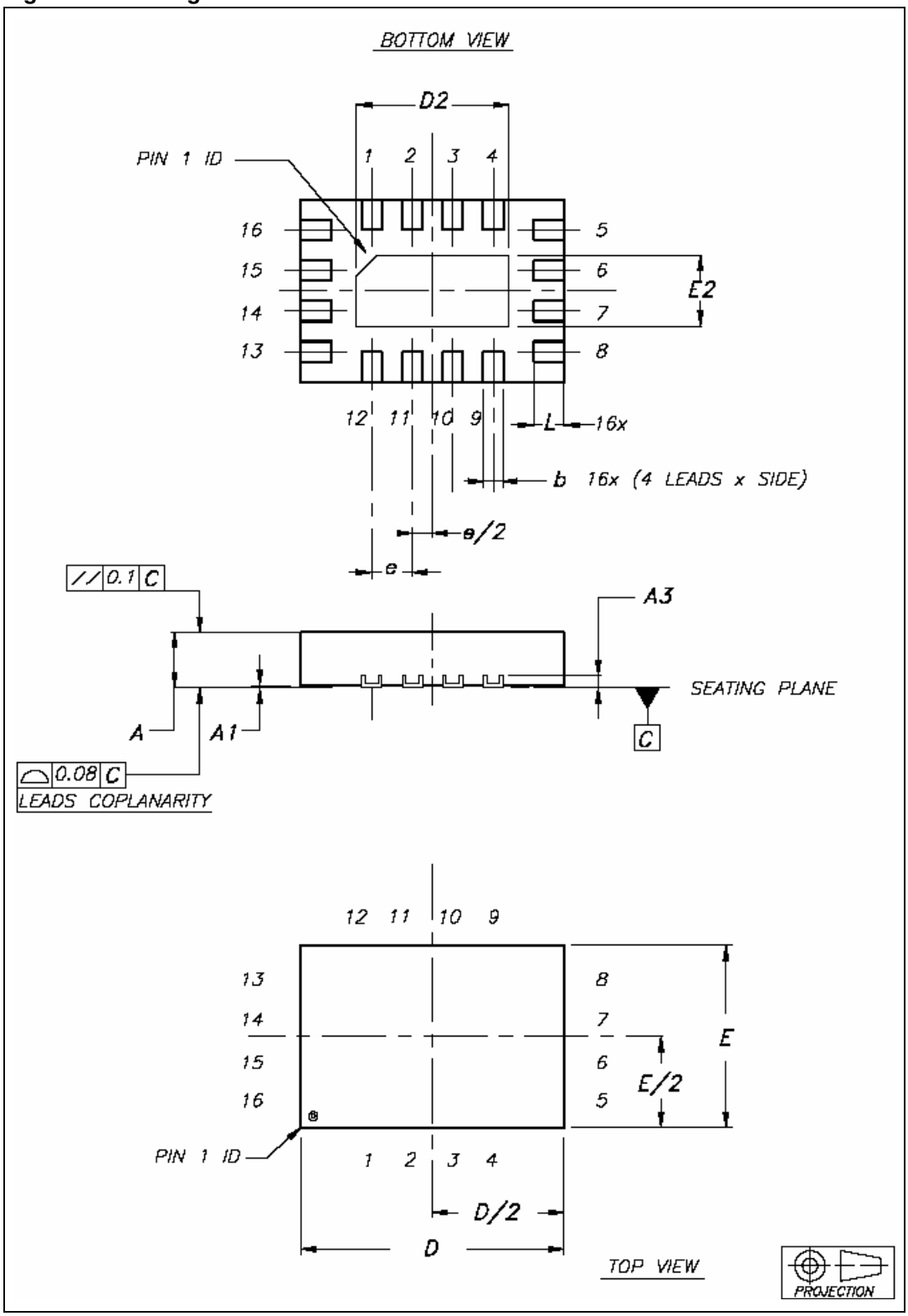
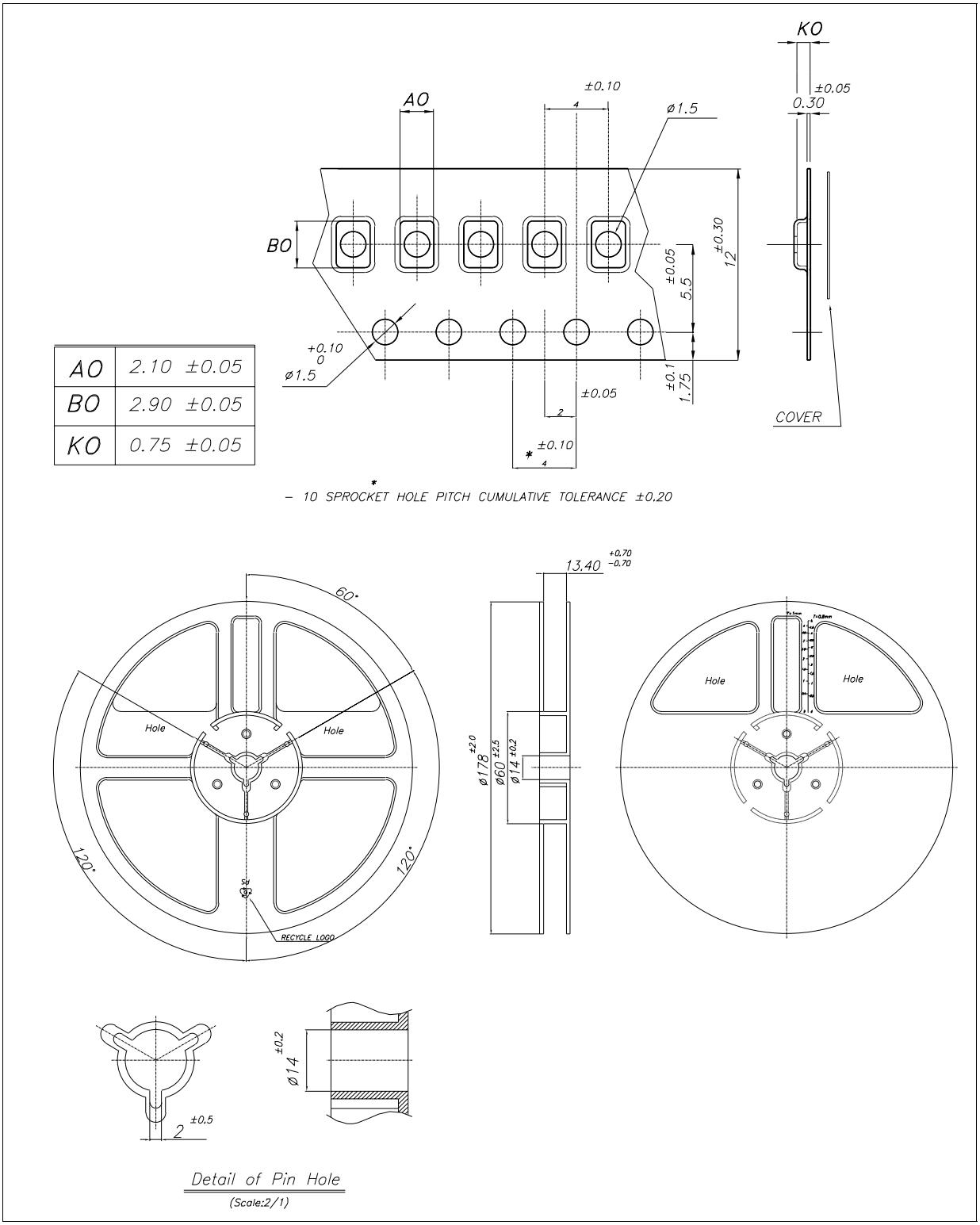


**Figure 14. QFN16L (2.6mmx1.8mm) tape & reel**




| | |
|---|---|
| AO | 2.10 ±0.05 |
| BO | 2.90 ±0.05 |
| KO | 0.75 ±0.05 |

# 7 Revision history

**Table 10. Revision history**

| Date | Revision | Changes |
|---|---|---|
| 11-Oct-2006 | 1 | First release |
| 08-Nov-2006 | 2 | Added feature in cover page |
| 08-Jan-2007 | 3 | Mechanical data updated |
| 03-Jul-2007 | 4 | $C_{ON}$ & $C_{OFF}$ values updated on *Table 7 on page 9* |

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