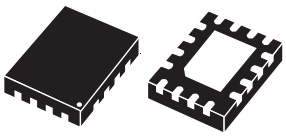
STG3692

Low voltage high bandwidth quad SPDT switch

Features

- Ultra low power dissipation:
  - I_{CC} = 0.2 µA (max.) at T_A = 85 °C
- Low “ON” resistance:
  - R_{ON} = 4.6 Ω (T_A = 25 °C) at V_{CC} = 4.3 V
  - R_{ON} = 5.8 Ω (T_A = 25 °C) at V_{CC} = 3.0 V
- Wide operating voltage range:
  - V_{CC} (opr) = 1.65 V 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 V to 3.0 V
- Typical bandwidth (-3 dB) at 800 MHz on all channels
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- ESD performance exceeds JESD22
  - 2000-V human body model (A114-A)
- USB (2.0) high-speed (480 Mbps) 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 1.65 V to 4.3 V, making this device ideal for portable applications.

The nSEL inputs are provided to control the switch. The switch S1 is ON (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

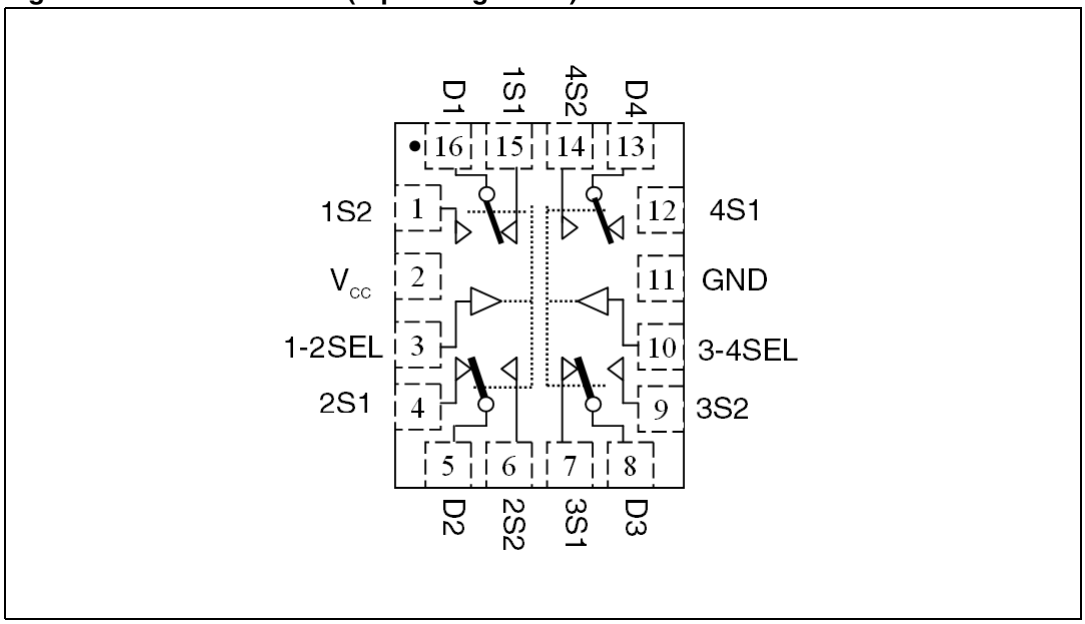
Order code	Package	Packing
STG3692QTR	QFN16L (2.6 x 1.8 mm)	Tape and reel

Contents

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
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}	Positive 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

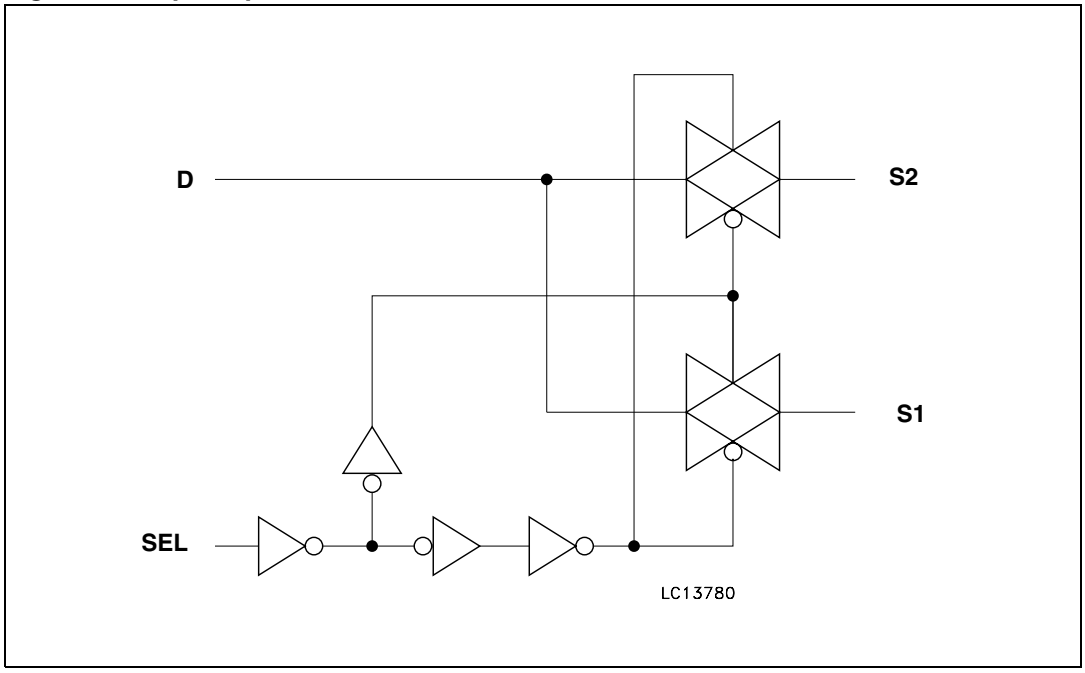


Table 3. Truth table

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.

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_{SEL}<0 V)	-50	mA
I_{IK}	DC input diode current (V_{SEL}<0 V)	±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 1 ms, 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 70 °C by 18.5 mW/C.

3.1 Recommended operating conditions

Table 5. 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} = 1.65 V to 2.7 V	0 to 20	ns/V
		V_{CC} = 3.0 to 4.3 V	0 to 10	

1. Truth table guaranteed: 1.2 V to 4.3 V.

4 Electrical characteristics

Table 6. DC specifications

Symbol	Parameter	V_{CC} (V)	Test conditions	Value					Unit
				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 = 0 V to V_{CC} I_S = 8 mA	–	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 = 3 V I_S = 8 mA	–	4.0	5.2	–	–	Ω
		3.0	V_S = 0.8 V I_S = 8 mA	–	5.0	6.5	–	–	
ΔR_{ON}	ON resistance match between channels (1)	1.8	V_S at R_{ON} max I_S = 8 mA	–	–	–	–	–	Ω
		2.7		–	–	–	–	–	
		3.0		–	0.3	–	–	–	
		3.7		–	–	–	–	–	
		4.3		–	–	–	–	–	
R_{FLAT}	ON resistance flatness (2)	1.8	V_S = 0 V to V_{CC} I_S = 8 mA	–	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 4 V	–	–	±20	–	±100	nA

Table 6. DC specifications (continued)

Symbol	Parameter	V_{CC} (V)	Test conditions	Value					Unit
				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 4.3 V	–	–	±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	$V_{1\text{-}2SEL}$, $V_{3\text{-}4SEL}$ = 1.65 V	–	±37	±50	–	±100	µA
			$V_{1\text{-}2SEL}$, $V_{3\text{-}4SEL}$ = 1.80 V	–	±33	±40	–	±50	
			$V_{1\text{-}2SEL}$, $V_{3\text{-}4SEL}$ = 2.60 V	–	±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 7. AC electrical characteristics (C_L = 35 pF, R_L = 50 Ω, t_r = t_f ≤ 5 ns)

Symbol	Parameter	V_{CC} (V)	Test conditions	Value					Unit
				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 = 0.8 V	–	31	–	–	–	ns
		2.3 – 2.7	V_S = 1.5 V	–	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 = 1.5 V	–	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 = 35 pF, R_L = 50 Ω, V_S = 1.5 V	1	7	–	–	–	ns
		2.3 – 2.7		1	5	–	–	–	
		3.0 – 3.3		1	4	–	–	–	
		3.6 – 4.3		1	3	–	–	–	

Table 7. AC electrical characteristics (C_L = 35 pF, R_L = 50 Ω, $t_r = t_f \leq$ 5 ns) (continued)

Symbol	Parameter	V_{CC} (V)	Test conditions	Value					Unit
				T_A = 25°C			-40 to 85°C		
				Min	Typ	Max	Min	Max	
Q	Charge injection	1.65	C_L = 100 pF V_{GEN} = 0 V R_{GEN} = 0 Ω	–	2.8	–	–	–	pC
		2.3		–	3.5	–	–	–	
		3.0		–	3.8	–	–	–	
		4.3		–	5.0	–	–	–	

Table 8. Analog switch characteristics (C_L = 5 pF, R_L = 50 Ω, 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	
O_{IRR}	OFF isolation (1)	1.65 -4.3	V_S = 1V_{RMS}, f = 1 MHz Signal = 0 dBm	–	-79	–	–	–	dB
			V_S = 1V_{RMS}, f = 10 MHz Signal = 0 dBm	–	-60	–	–	–	
X_{talk}	Crosstalk	1.65 - 4.3	V_S = 1V_{RMS}, f = 1 MHz Signal = 0 dBm	–	-78	–	–	–	dB
			V_S = 1V_{RMS}, f = 10 MHz Signal = 0 dBm	–	-61	–	–	–	
B_W	-3dB bandwidth	3.0 - 4.3	R_L = 50Ω Signal = 0 dBm	–	800	–	–	–	MHz
D_G	Differential gain	3.0 - 4.3	R_L = 150 Ω	–	0.64	–	–	–	%
D_P	Differential phase	3.0 - 4.3	R_L = 150 Ω	–	0.1	–	–	–	deg
C_{IN}	Control pin input capacitance		V_{CC} = 0 V	–	6.2	–	–	–	pF
C_{ON}	Sn port capacitance when switch is enabled	3.3	f = 1 MHz	–	12	–	–	–	
C_{OFF}	Sn port capacitance when switch is disabled	3.3	f = 1 MHz	–	5	–	–	–	

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

Table 9. USB related AC electrical characteristics

Symbol	Parameter	V_{CC} (V)	Test conditions	Value					Unit
				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=10 pF	–	26	–	–	–	ps
$t_{SK(P)}$	Skew of opposite transition of the same output	3.0 to 3.6	C_L=10 pF	–	60	–	–	–	ps
T_J	Total jitter	3.0 to 3.6	R_L = 50 Ω, C_L= 10 pF, $t_R = t_F$ = 750 ps at 480 Mbps	–	130	–	–	–	ps

5 Test circuits

Figure 3. ON-resistance

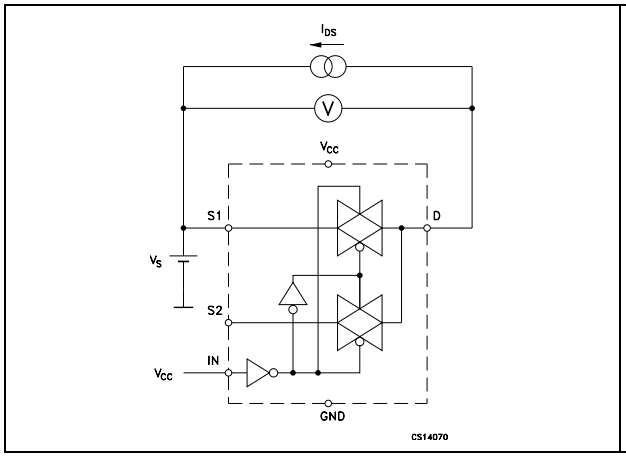


Figure 4. Bandwidth

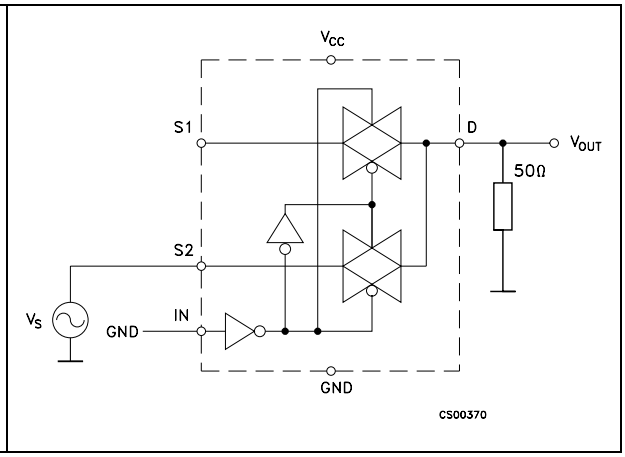


Figure 5. OFF leakage

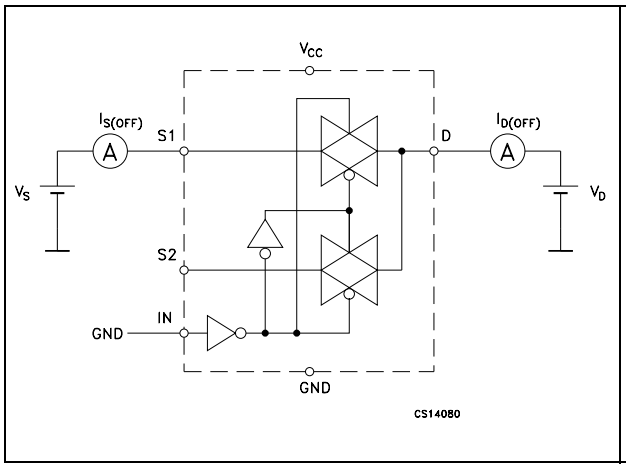


Figure 6. Channel to channel crosstalk

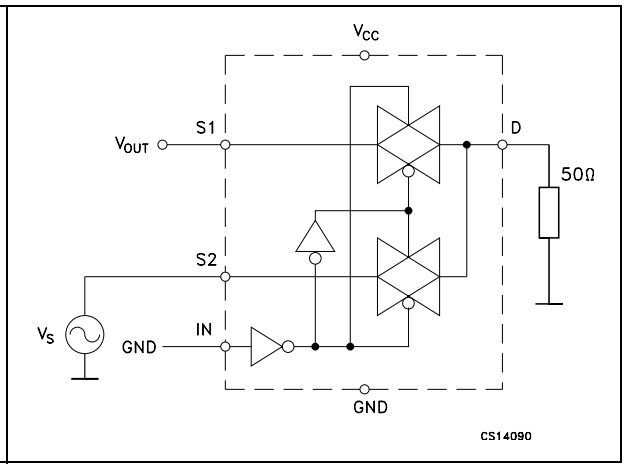


Figure 7. OFF isolation

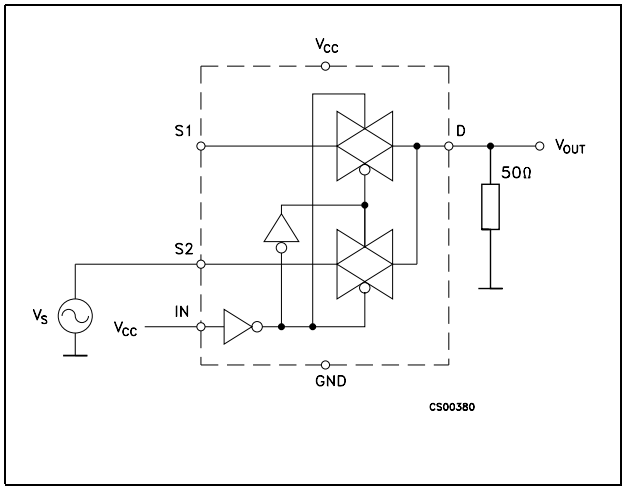
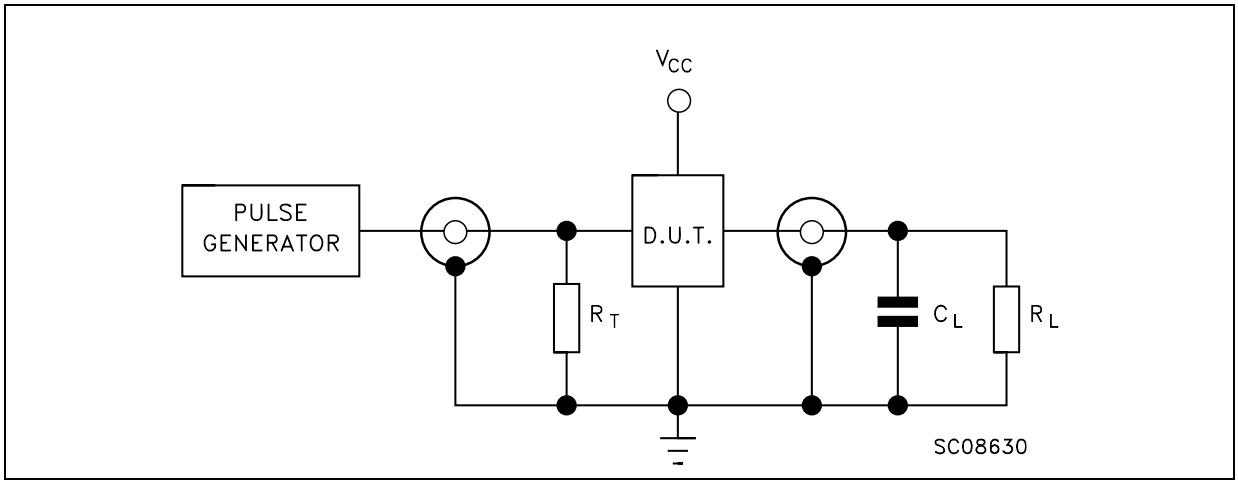


Figure 8. Test circuit



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

2 R_L = 50 Ω or equivalent

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

Figure 9. Break-before-make time delay

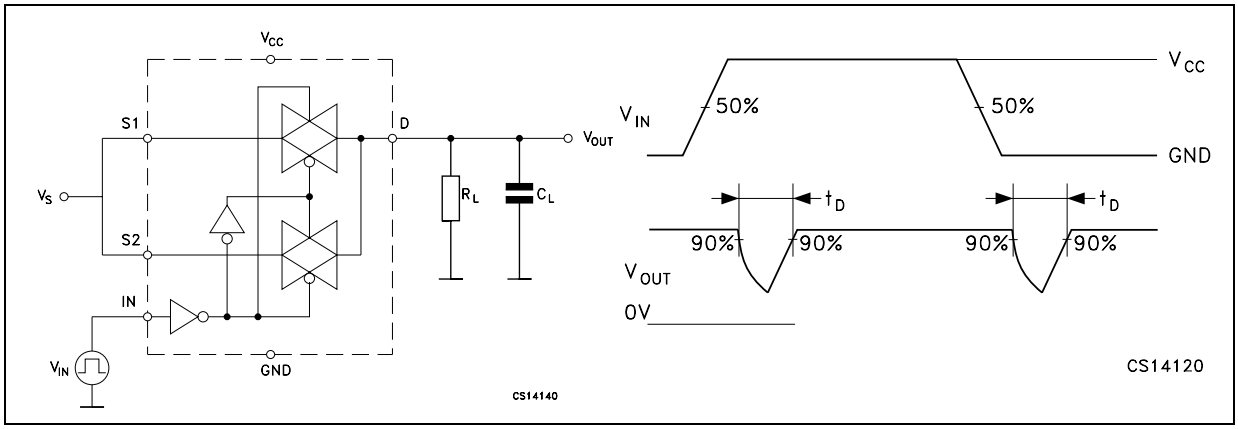


Figure 10. Switching time and charge injection
(V_{GEN} = 0 V, R_{GEN} = 0 Ω, R_L = 1MΩ, C_L = 100 pF)

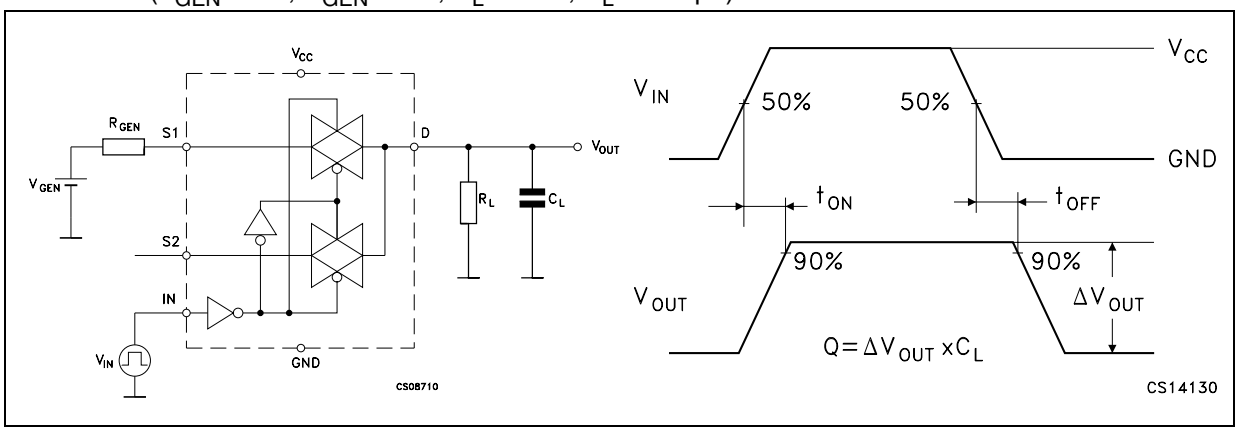
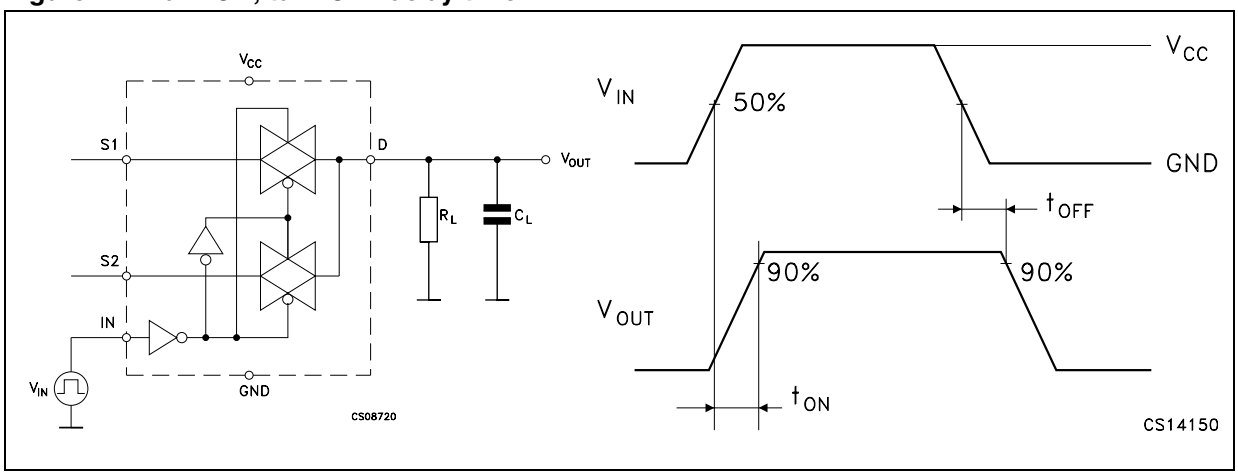


Figure 11. Turn ON, turn OFF delay time



6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

Figure 12. Package outline for QFN16L (2.6 x 1.8 mm)

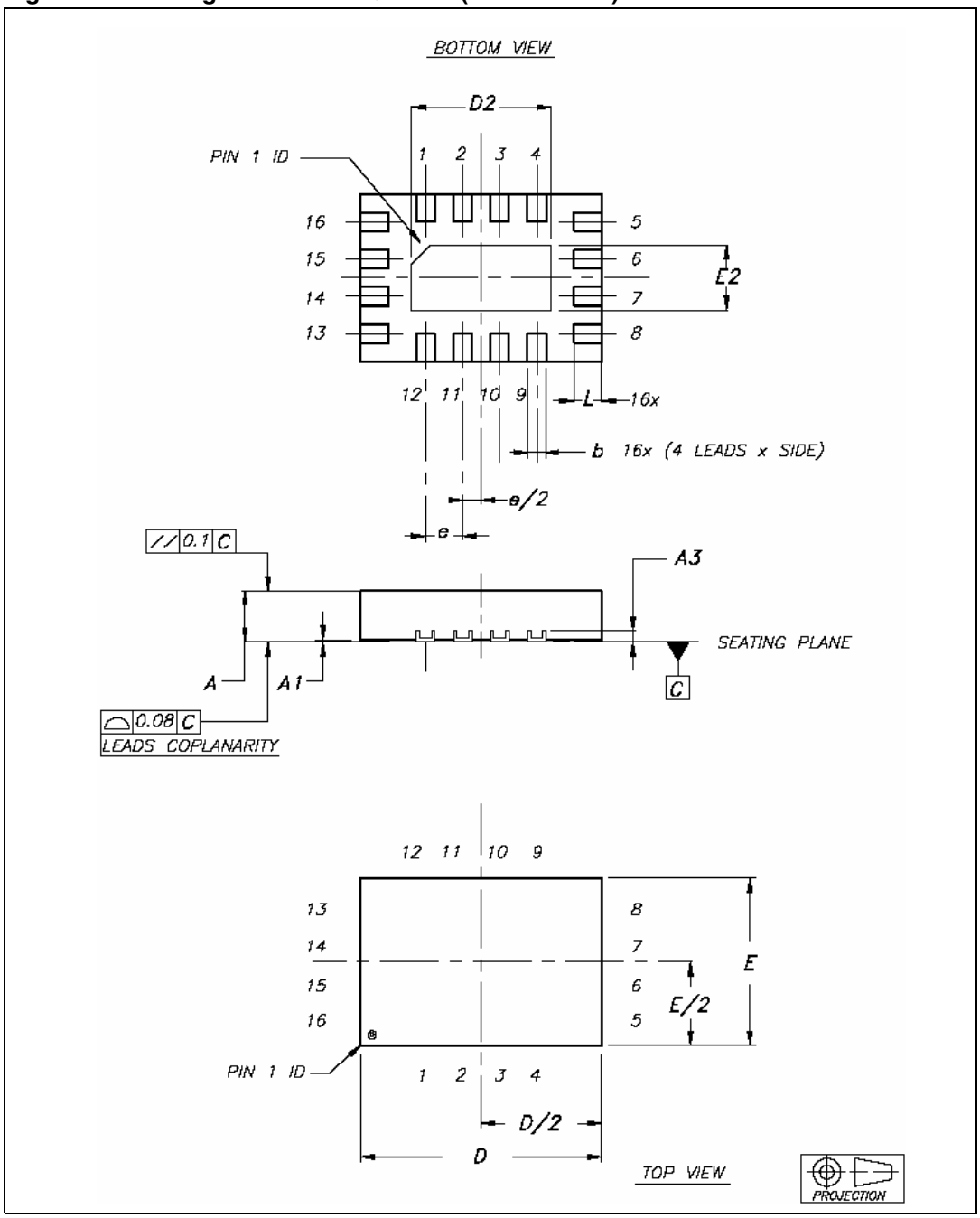


Table 10. QFN16L (2.6 x 1.8 mm) mechanical data

Symbol	Millimeters		
	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 13. Footprint recommendation

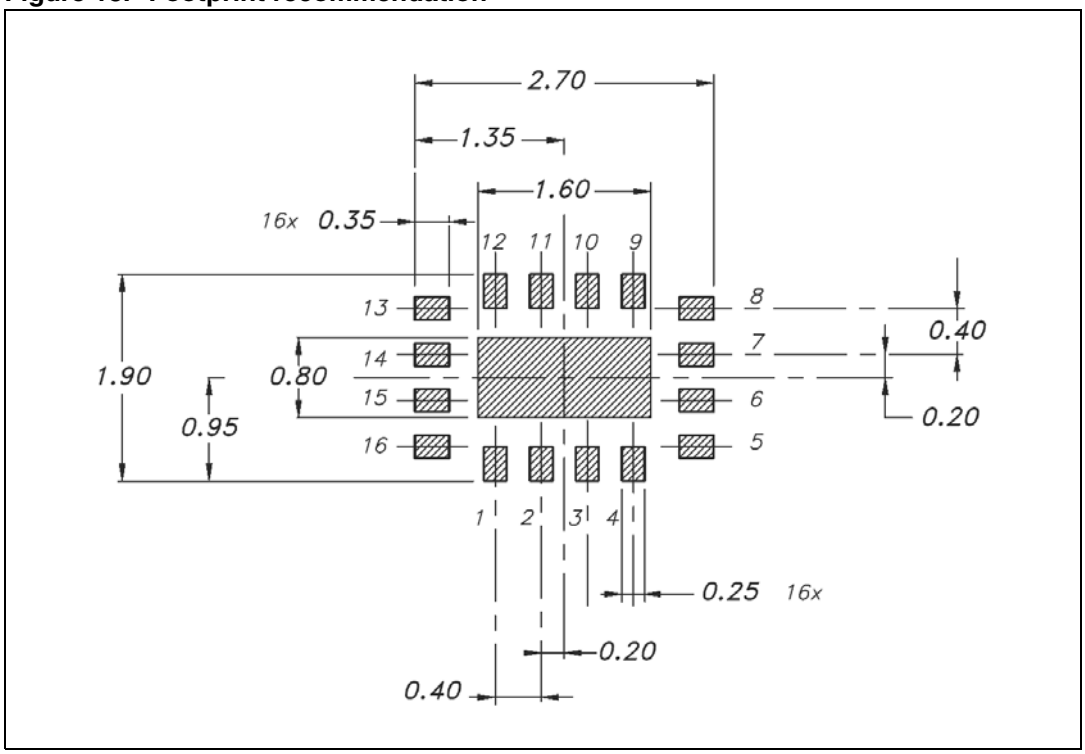
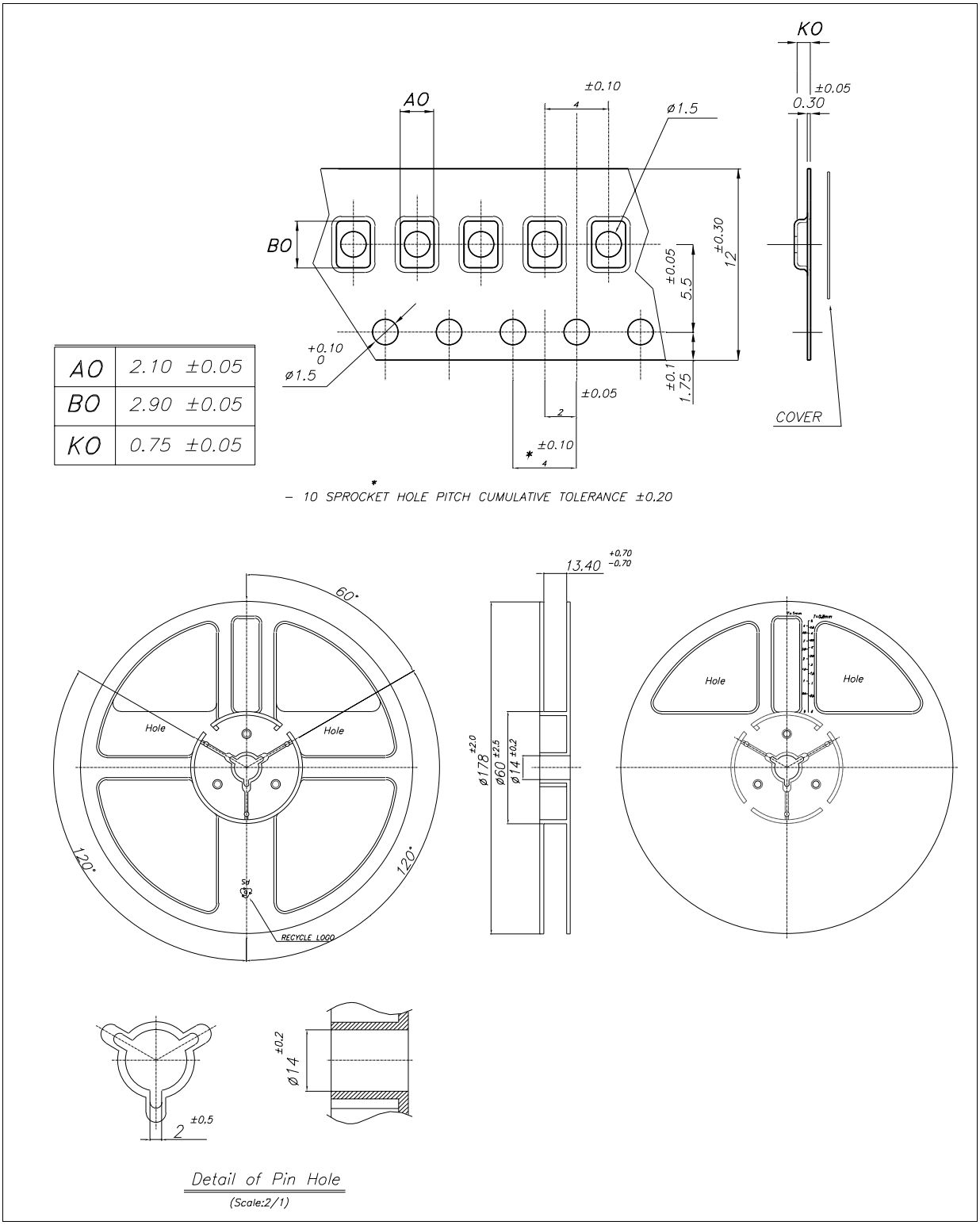


Figure 14. QFN16L (2.6 x 1.8 mm) tape & reel



7 Revision history

Table 11. Document revision history

Date	Revision	Changes
11-Oct-2006	1	Initial release.
08-Nov-2006	2	Added feature in cover page.
08-Jan-2007	3	Mechanical data updated.
03-Jul-2007	4	C_{ON} and C_{OFF} values updated on *Table 8 on page 8*.
05-May-2010	5	Document reformatted no content change.
30-Jun-2010	6	Update of product maturity.

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