

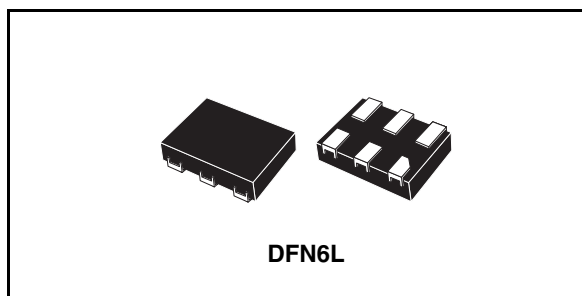


STG3159

Low voltage 1Ω max single SPDT switch with break-before-make feature

Features

- High speed:
 - $t_{PD} = 1.5\text{ns}$ (Typ.) at $V_{CC} = 3.0\text{V}$
 - $t_{PD} = 1.5\text{ns}$ (Typ.) at $V_{CC} = 2.3\text{V}$
- Ultra low power dissipation:
 - $I_{CC} = 0.2\mu\text{A}$ (Max.) at $T_A = 85^\circ\text{C}$
- Low "ON" resistance:
 - $R_{ON} = 1.0\Omega$ ($T_A = 25^\circ\text{C}$) at $V_{CC} = 4.3\text{V}$
 - $R_{ON} = 1.1\Omega$ ($T_A = 25^\circ\text{C}$) at $V_{CC} = 3.0\text{V}$
 - $R_{ON} = 1.7\Omega$ ($T_A = 25^\circ\text{C}$) at $V_{CC} = 1.8\text{V}$
- Wide operating voltage range:
 - V_{CC} (OPR) = 1.65V to 4.5V single supply
- 4.5V Tolerant and 1.8V compatible threshold on digital control input at $V_{CC} = 2.3\text{V}$ to 3.0V
- Latch-up performance exceeds 100mA per JESD 78, Class II
- ESD Performance tested per JESD22
 - 2000V Human-body model (A114-B, Class II)
 - 200V Machine model (A115-A)
 - 1000V Charged-device model (C101)



Description

The STG3159 is a high-speed CMOS low voltage single 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 device offers very low ON-Resistance (1Ω) at $V_{CC} = 4.3\text{V}$. The SEL inputs are provided to control the switch. The switch S1 is ON (they are connected to common Ports Dn) when the SEL 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 SEL input is held low and OFF (high impedance state exists between the two ports) when SEL 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.

Order codes

| Part number | Package | Packaging |
|-------------|---------------------|---------------|
| STG3159DTR | DFN6L (1.2mm x 1mm) | Tape and Reel |

Contents

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1 Pin connections and functions

Figure 1. Pin connections (top through view)

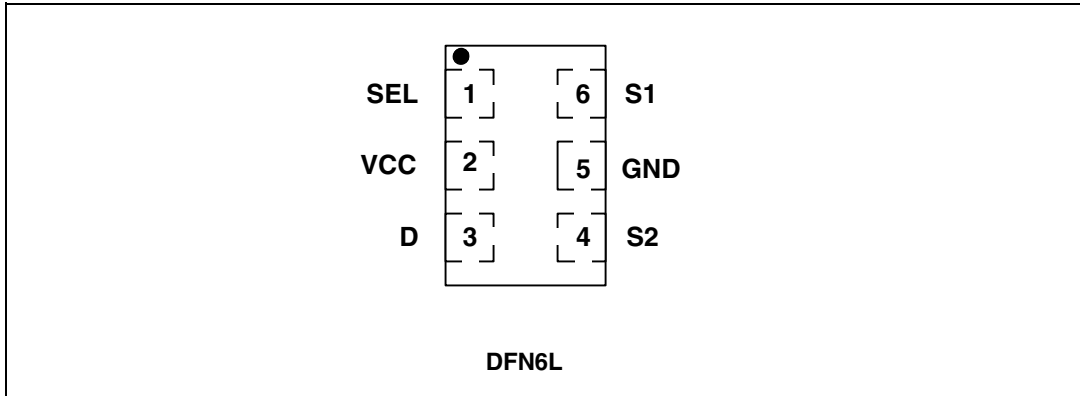


Table 1. Truth table

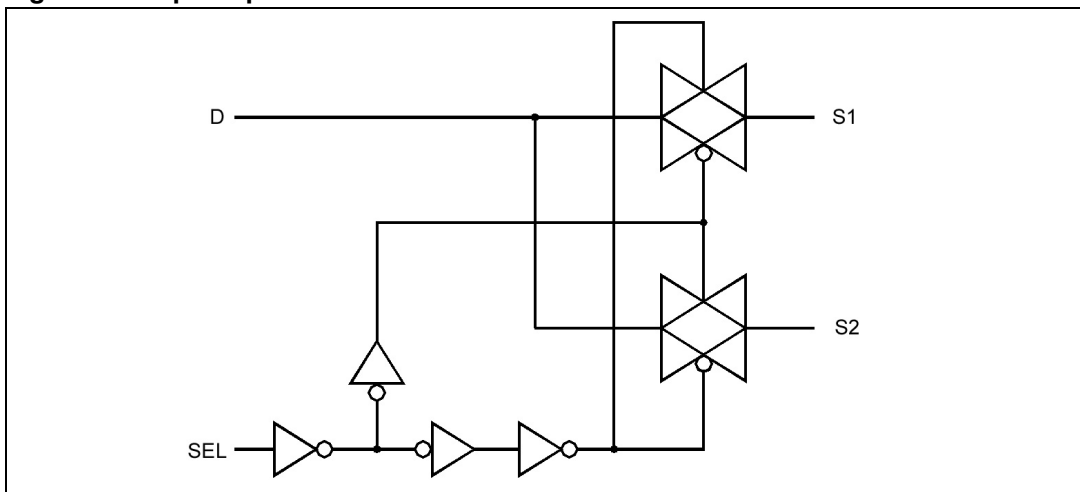
| Sel | Switch S1 | Switch S2 |
|-----|--------------------|--------------------|
| H | ON | OFF ⁽¹⁾ |
| L | OFF ⁽¹⁾ | ON |

1. High impedance

Table 2. Pin descriptions

| Pin N° | Symbol | Name and function |
|--------|-----------------|-------------------------|
| 6, 4 | S1, S2 | Independent channels |
| 3 | D | Common channels |
| 1 | SEL | Control |
| 2 | V _{CC} | Positive supply voltage |
| 5 | GND | Ground (0V) |

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 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 | ± 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

Table 4. Recommended operating conditions

| Symbol | Parameter | Value | Unit | |
|----------|---|-----------------------------|------------|------|
| V_{CC} | Supply voltage ⁽¹⁾ | 1.65 to 4.5 | V | |
| V_I | Input voltage | 0 to V_{CC} | V | |
| V_{IC} | Control input voltage | 0 to 4.5 | V | |
| V_O | Output voltage | 0 to V_{CC} | V | |
| T_{op} | Operating temperature | -55 to 125 | $^\circ C$ | |
| 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 4.5V | 0 to 10 | |

1. Truth table guaranteed: 1.2V to 4.5V

3 Electrical characteristics

3.1 DC electrical characteristics

Table 5. 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. | Min. | Max. | Min. | | Max. |
| V _{IH} | High level input voltage | 1.65-1.95 | | 0.65V _{CC} | | | 0.65V _{CC} | | 0.65V _{CC} | | V |
| | | 2.3-2.5 | | 1.2 | | | 1.2 | | 1.2 | | |
| | | 2.7-3.0 | | 1.3 | | | 1.3 | | 1.3 | | |
| | | 3.3-3.6 | | 1.4 | | | 1.4 | | 1.4 | | |
| | | 4.3 | | 1.6 | | | 1.6 | | 1.6 | | |
| V _{IL} | Low level input voltage | 1.65-1.95 | | | | 0.40 | | 0.40 | | 0.40 | V |
| | | 2.3-2.5 | | | | 0.60 | | 0.60 | | 0.60 | |
| | | 2.7-3.0 | | | | 0.60 | | 0.60 | | 0.60 | |
| | | 3.3-3.6 | | | | 0.60 | | 0.60 | | 0.60 | |
| | | 4.3 | | | | 0.80 | | 0.80 | | 0.80 | |
| R _{PEAK} | Switch ON peak resistance | 1.8 | V _S = 0V to V _{CC} I _S = 100mA | | 2.2 | 3.0 | | 3.5 | | | Ω |
| | | 2.7 | | | 1.3 | 1.6 | | 1.8 | | | |
| | | 3.0 | | | 1.2 | 1.5 | | 1.7 | | | |
| | | 4.3 | | | 1.1 | 1.2 | | 1.4 | | | |
| R _{ON} | Switch On resistance | 1.8 | V _S = 0.9V I _S = 100mA | | 1.7 | 2.3 | | 2.7 | | | Ω |
| | | 2.7 | V _S = 1.3V I _S = 100mA | | 1.2 | 1.5 | | 1.7 | | | |
| | | 3.0 | V _S = 1.5V I _S = 100mA | | 1.1 | 1.2 | | 1.6 | | | |
| | | 4.3 | V _S = 2.5V I _S = 100mA | | 1.0 | 1.1 | | 1.3 | | | |
| ΔR _{ON} | ON resistance match between channels ⁽¹⁾ | 1.8 | V _S @ R _{ON} Max I _S = 100mA | | 0.06 | | | | | | Ω |
| | | 2.7 | | | 0.05 | | | | | | |
| | | 3.0 | | | 0.05 | | | | | | |
| | | 4.3 | | | 0.05 | | | | | | |
| R _{FLAT} | ON resistance flatness ⁽²⁾ | 1.8 | V _S = 0V to V _{CC} I _S = 100mA | | 1.0 | 1.5 | | 1.5 | | | Ω |
| | | 2.7 | | | 0.45 | 0.60 | | 0.70 | | | |
| | | 3.0 | | | 0.40 | 0.50 | | 0.60 | | | |
| | | 4.3 | | | 0.37 | 0.50 | | 0.60 | | | |

Table 5. DC specifications (continued)

| Symbol | Parameter | Test conditions | | Value | | | | | | Unit | |
|-------------------|--|-----------------|---|-----------------------|------|-------|-------------|------|--------------|------|------|
| | | Vcc (V) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| I _{OFF} | OFF state leakage current (SN), (D) | 4.3 | V _S = 0.3 or 4V | | | ±20 | | ±100 | | | nA |
| I _{IN} | Input leakage current | 0 – 4.3 | V _{SEL} = 0 to 4.3V | | | ±0.1 | | ±1 | | | µA |
| I _{CC} | Quiescent supply current | 1.65 – 4.3 | V _{SEL} = V _{CC} or GND | | | ±0.05 | | ±0.2 | | ±1 | µA |
| I _{CCLV} | Quiescent supply current low voltage driving | 4.3 | V _{SEL} = 1.65V | | ±17 | ±35 | | ±70 | | | µA |
| | | 4.3 | V _{SEL} = 1.80V | | ±15 | ±30 | | ±60 | | | |
| | | 4.3 | V _{SEL} = 2.60V | | ±5 | ±10 | | ±20 | | | |

1. $\Delta R_{ON} = R_{ON(Max)} - R_{ON(Min)}$
2. Flatness is defined as the difference between the maximum and minimum value of ON-resistance as measured over the specified analog signal ranges.

3.2 AC electrical characteristics

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 conditions | | Value | | | | | | Unit | |
|--------------------------|------------------------------|-----------------|--|--------------------------|------|------|-------------|------|--------------|------|------|
| | | Vcc (V) | | $T_A = 25^\circ\text{C}$ | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t_{PLH} , t_{PHL} | Propagation delay | 1.65-1.95 | $V_S = \text{OPEN}$ | | 0.15 | | | | | | ns |
| | | 2.3-2.7 | | | 0.14 | | | | | | |
| | | 3.0-3.3 | | | 0.13 | | | | | | |
| | | 3.6-4.3 | | | 0.13 | | | | | | |
| t_{ON} | Turn-ON time | 1.65-1.95 | $V_S = 0.8\text{V}$ | | 36 | | | | | | ns |
| | | 2.3-2.7 | $V_S = 1.5\text{V}$ | | 22 | 32 | | 42 | | | |
| | | 3.0-3.3 | | | 16 | 26 | | 36 | | | |
| | | 3.6-4.3 | | | 13 | 23 | | 33 | | | |
| t_{OFF} | Turn-OFF time | 1.65-1.95 | $V_S = 0.8$ | | 29 | | | | | | ns |
| | | 2.3-2.7 | $V_S = 1.5\text{V}$ | | 17 | 27 | | 37 | | | |
| | | 3.0-3.3 | | | 12 | 23 | | 33 | | | |
| | | 3.6-4.3 | | | 11 | 21 | | 31 | | | |
| t_D | Break before make time delay | 1.65-1.95 | $C_L = 35\text{pF}$ $R_L = 50\Omega$ $V_S = 1.5\text{V}$ | | 15 | | | | | | ns |
| | | 2.3-2.7 | | | 10 | | | | | | |
| | | 3.0-3.3 | | | 8 | | | | | | |
| | | 3.6-4.3 | | | 6 | | | | | | |
| Q | Charge injection | 1.65 | $C_L = 100\text{pF}$ $V_{GEN} = 0\text{V}$ $R_{GEN} = 0\Omega$ | | 16 | | | | | | pC |
| | | 2.3 | | | 22 | | | | | | |
| | | 3 | | | 26 | | | | | | |
| | | 4.3 | | | 33 | | | | | | |

3.3 Analog switch characteristics

Table 7. Analog switch characteristics ($C_L = 5\text{pF}$, $R_L = 50\Omega$, $T_A = 25^\circ\text{C}$)

| Symbol | Parameter | Test conditions | | Value | | | | | | Unit | | |
|------------------|---|-----------------|--|-----------------------|------|------|-------------|------|--------------|------|------|-----|
| | | Vcc (V) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. | |
| OIRR | Off Isolation (1) | 1.65-4.3 | V _S = 1V _{RMS} f = 100kHz | | -80 | | | | | | | dB |
| Xtalk | Crosstalk | 1.6-4.3 | V _S = 1V _{RMS} f = 100kHz | | -80 | | | | | | | dB |
| THD | Total harmonic distortion | 2.3-4.3 | R _L = 600Ω V _S = 2V _{PP} f = 20Hz to 20 kHz | | 0.03 | | | | | | | % |
| BW | -3dB bandwidth | 1.65-4.3 | R _L = 50Ω | | 150 | | | | | | | MHz |
| C _{IN} | Control pin input capacitance | | | | 6 | | | | | | | pF |
| C _{ON} | Sn port capacitance when switch is enabled | 3.3 | f = 1MHz | | 52 | | | | | | | |
| C _{OFF} | Sn port capacitance when switch is disabled | 3.3 | f = 1MHz | | 25 | | | | | | | |
| C _D | D Port Capacitance when Switch is Enabled | 3.3 | f = 1MHz | | 50 | | | | | | | |

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

4 Test circuits

Figure 3. ON-Resistance

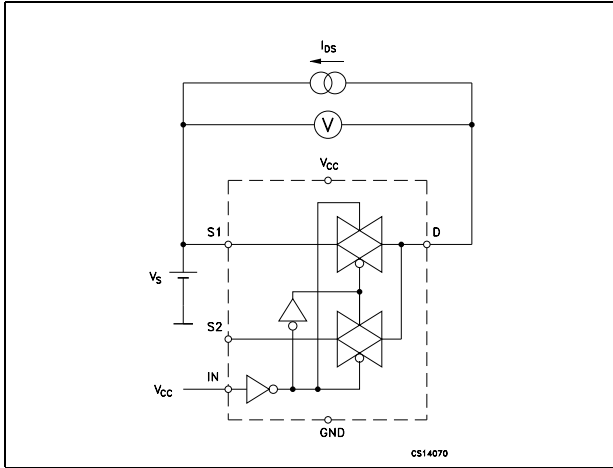


Figure 4. Bandwidth

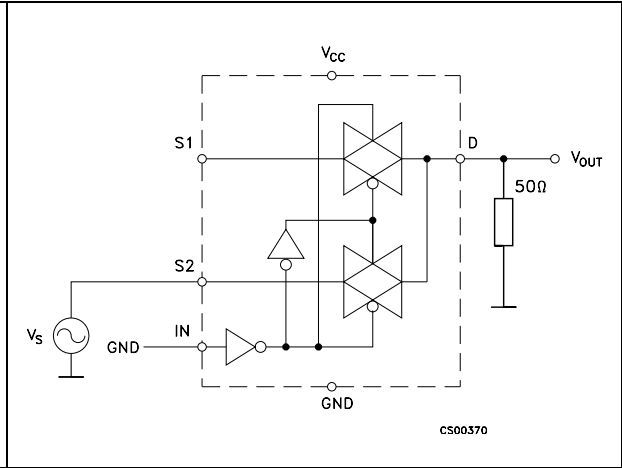


Figure 5. OFF Leakage

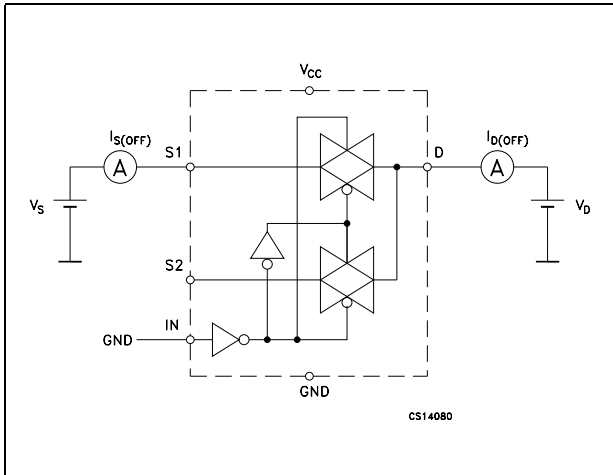


Figure 6. Channel to channel crosstalk

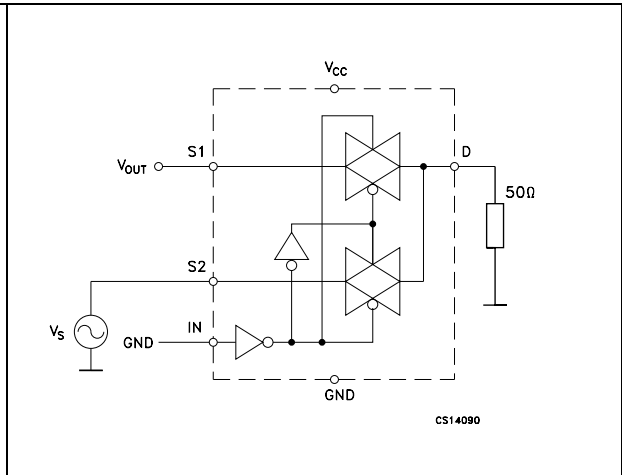


Figure 7. OFF Isolation

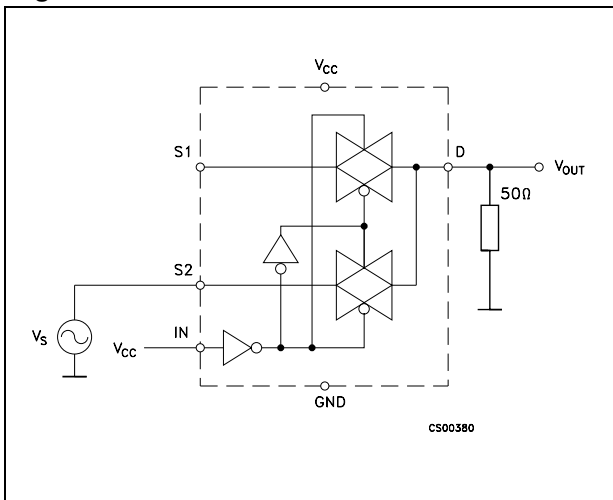
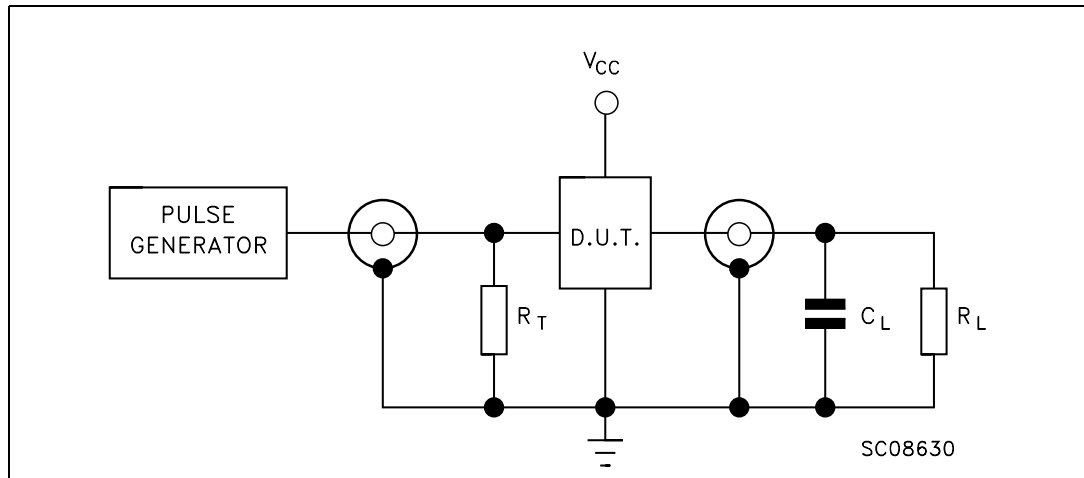


Figure 8. Test circuit



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

Figure 9. Break-before-make time delay

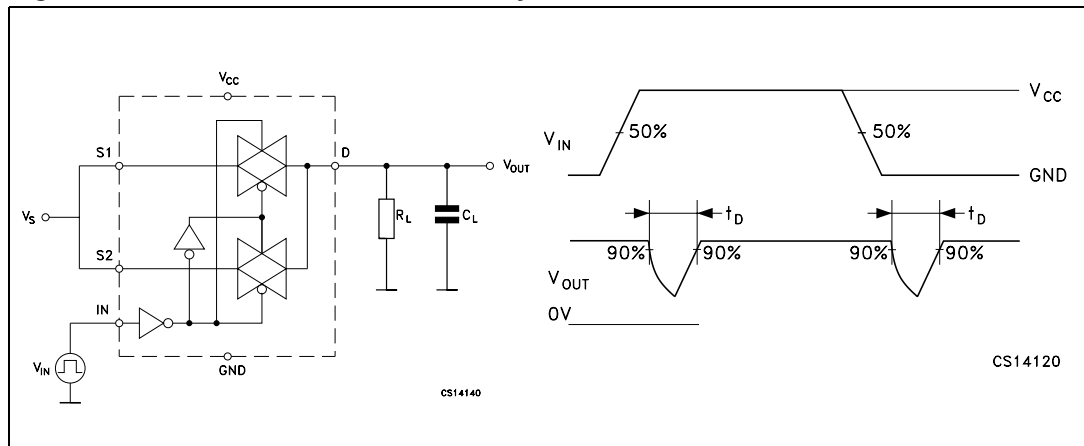


Figure 10. Switching time and charge injection
 $(V_{GEN} = 0V, R_{GEN} = 0\Omega, R_L = 1M\Omega, C_L = 100\text{pF})$

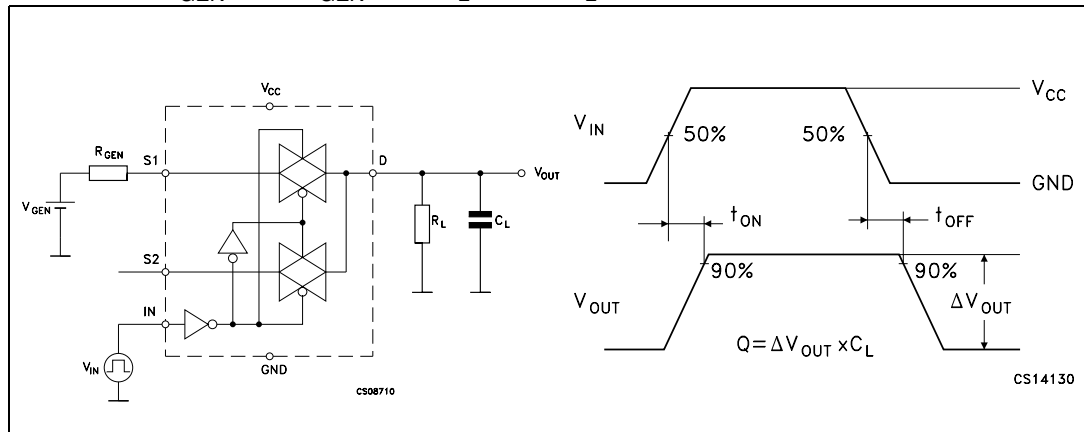
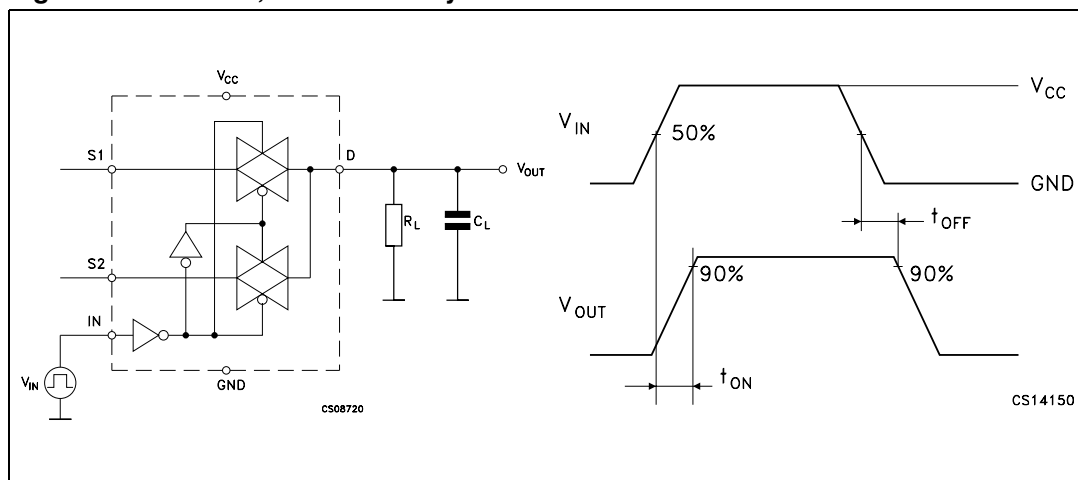


Figure 11. Turn ON, turn OFF delay time



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

Table 8. DFN6 (1.2mm x 1mm) Mechanical data

| Dim. | mm. | | | inch | | |
|------|-------|------|------|-------|-------|-------|
| | Typ. | Min. | Max. | Typ. | Min. | Max. |
| A | 0.50 | 0.45 | 0.55 | 0.019 | 0.017 | 0.021 |
| A1 | 0.02 | 0 | 0.05 | 0.001 | 0 | 0.002 |
| A3 | 0.127 | | | 0.005 | | |
| b | 0.20 | 0.15 | 0.25 | 0.007 | 0.006 | 0.010 |
| D | 1.20 | 1.10 | 1.30 | 0.047 | 0.043 | 0.051 |
| E | 1 | 0.90 | 1.10 | 0.039 | 0.035 | 0.043 |
| e | 0.40 | | | 0.015 | | |
| L | 0.35 | 0.30 | 0.40 | 0.013 | 0.011 | 0.015 |
| L1 | 0.45 | 0.40 | 0.50 | 0.017 | 0.015 | 0.019 |

Figure 12. Package dimensions

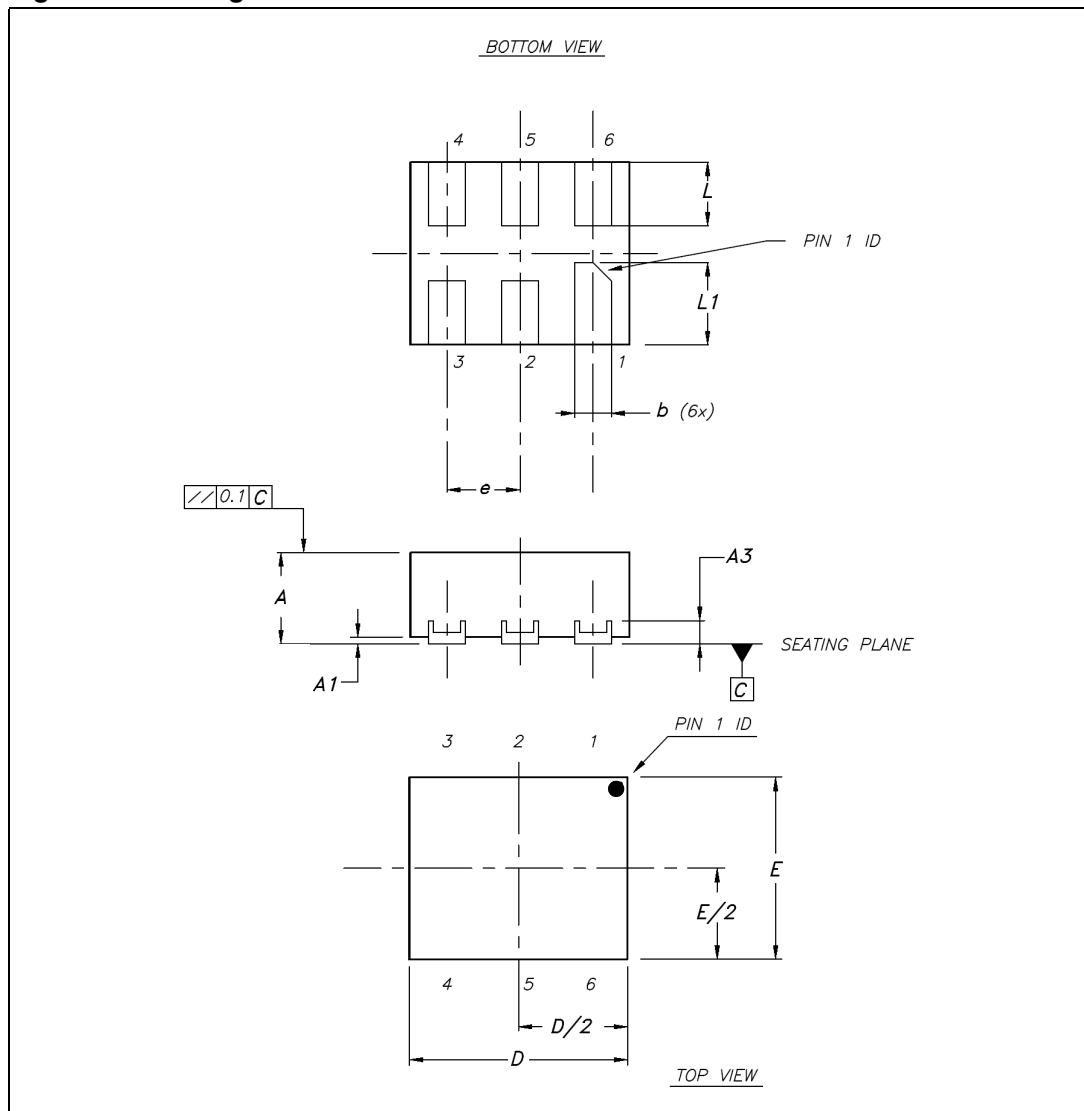


Table 9. DFN6 Foot print recommendation

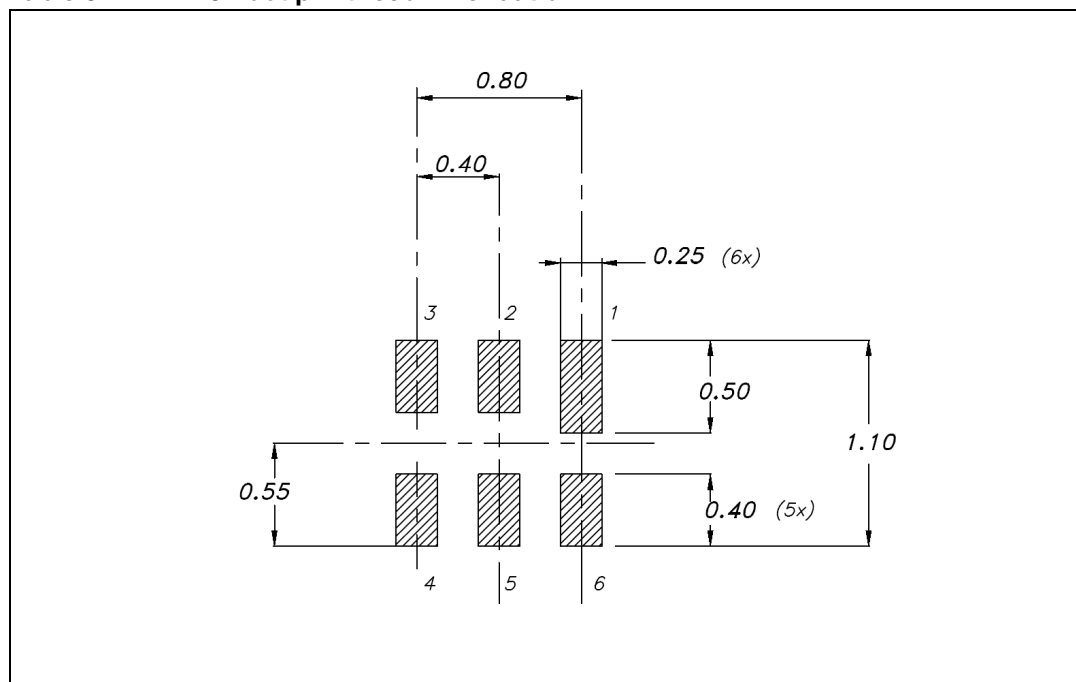


Table 10. DFN6L Tape information

| Dim | mm. | inch |
|------------|-----------------------|-------------------------|
| D | 1.50 +0.1/0 | 0.059 +0.004/0 |
| E | 1.75 ±0.1 | 0.069 ±0.004 |
| Po | 4.00 ±0.1 | 0.157 ±0.004 |
| T max. | 0.40 | 0.016 |
| D1 min. | 1 | 0.039 |
| F | 3.5 ±0.05 | 0.138 ±0.002 |
| K max. | 2.40 | 0.094 |
| P2 | 2.00 ±0.05 | 0.079 ±0.002 |
| R | 25 | 0.984 |
| W | 8.00 ±0.30 | 0.315 ±0.012 |
| P1 | 4.00 | 0.157 |
| Ao, Bo, Ko | 0.05 min to 0.50 max. | 0.002 min to 0.020 max. |

Figure 13. DFN6L Tape information

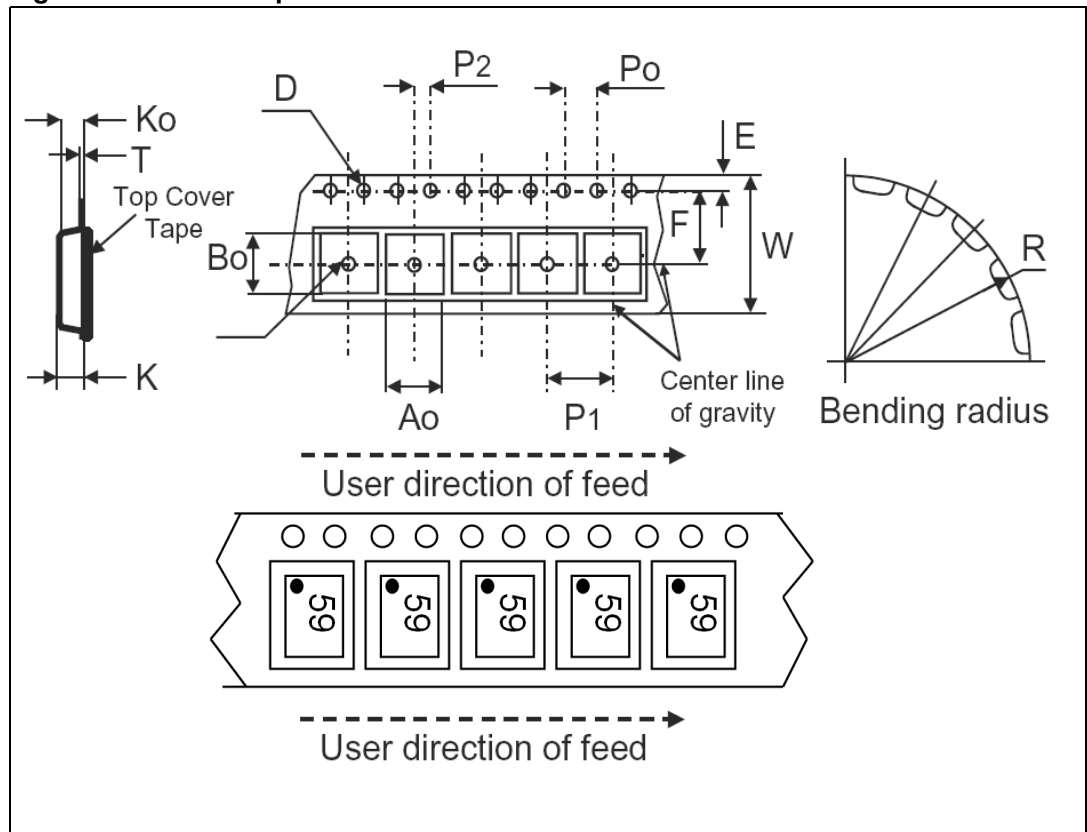
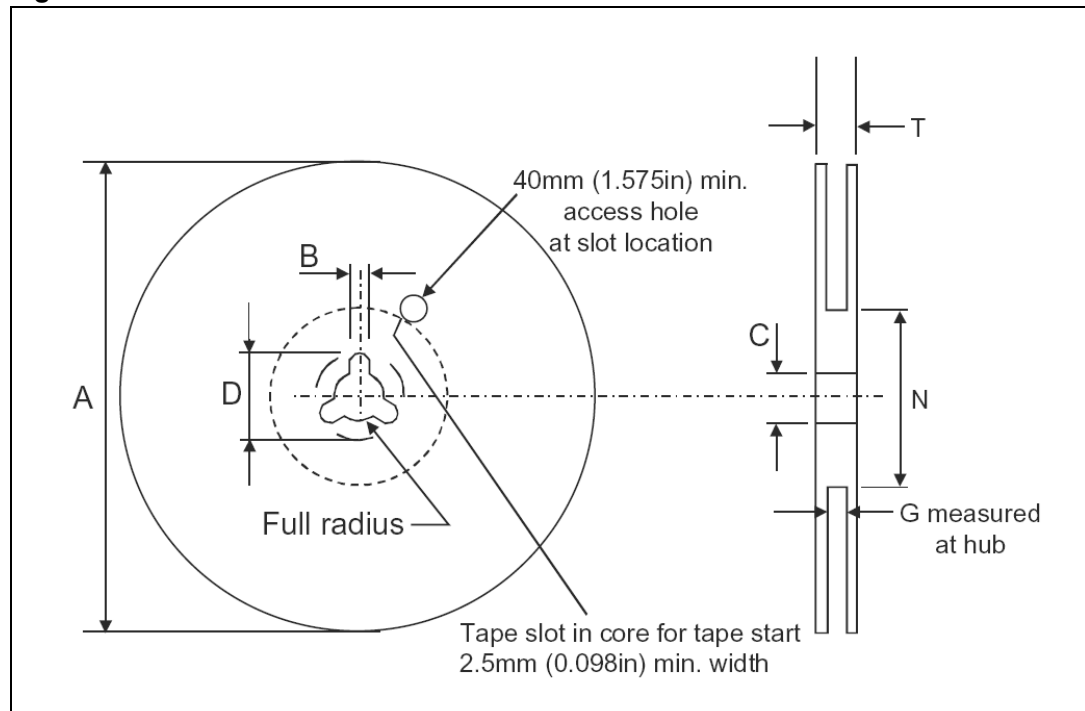


Table 11. DFN6L Reel information

| Dim | mm. | inch |
|-----------|------------|-----------------|
| Tape size | 8.0 ±0.30 | 0.315 ±0.012 |
| A max. | 180.0 | 7.086 |
| B min. | 1.5 | 0.059 |
| C | 13.0 ±0.20 | 0.512 ±0.008 |
| D min. | 20.2 | 0.795 |
| N min. | 60 | 2.362 |
| G | 8.4 +2/-0 | 0.319 +0.079/-0 |
| T max. | 14.4 | 0.567 |

Figure 14. DFN6L Reel information



6 Revision history

Table 12. Revision history

| Date | Revision | Changes |
|-------------|----------|---------------|
| 06-Dec-2006 | 1 | First release |

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