

Low-Voltage SPDT Analog Switch, 2:1 Multiplexer / Demultiplexer Bus Switch

Features

- 1.65V to 5.5V Single Supply Operation
- Low ON-State Resistance: 4.5Ω(Typ.)
- -3dB Bandwidth: 300 MHz Typical
- Low Power Consumption
- Fast Switching Speed
- Break-Before-Make Operation
- Rail-to-Rail Operation
- TTL/CMOS Logic Compatible
- Supports Analog and Digital Signals
- Small Packaging: SOT23-6, SC70-6
- Extended Industrial Temperature Range: -40°C to +125°C

Applications

- Multiple-Purpose Signal Switching
- MP3/PDA
- Portable Devices
- Set-Top Box
- Signal Gating, Multiplexer/Demultiplexer
- Signal Modulation or Demodulation
- Sample and Hold Systems
- Telecom Signal Switching
- Battery Power Systems

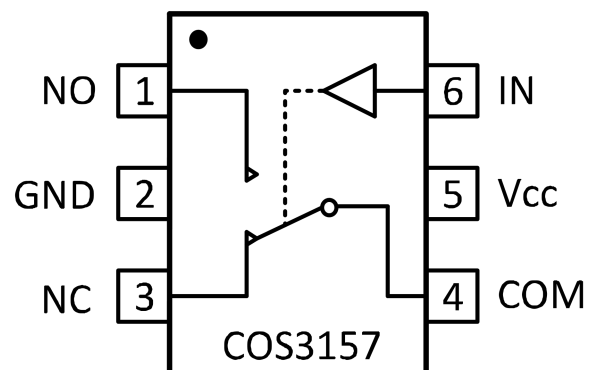
Rev1.0

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General Description

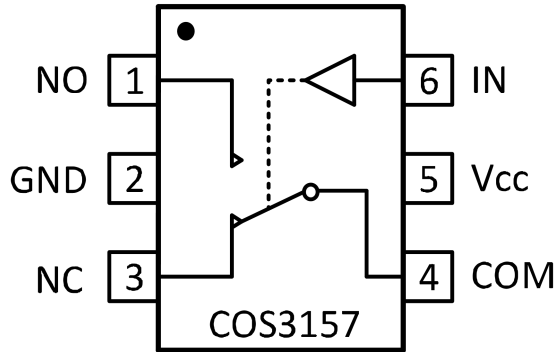
The COSTS5A3157 is a low voltage, high bandwidth single-pole / double-throw (SPDT) CMOS analog switch or 2:1 multiplexer / demultiplexer with single output enable control pin. The device can pass signals with rail-to-rail swing from a single supply 1.65V to 5.5V. The switches conduct equally well in both directions when it is on. The output enable pin place the signal paths in high impedance which isolates the bus when it is not in use and thus consume less current.

The COSTS5A3157 offers low ON-state resistance and high bandwidth with the break-before- make feature which prevents signal distortion during the transferring of a signal from one channel to another. The device is well suitable for the switching of high-speed signals in handset and consumer applications.

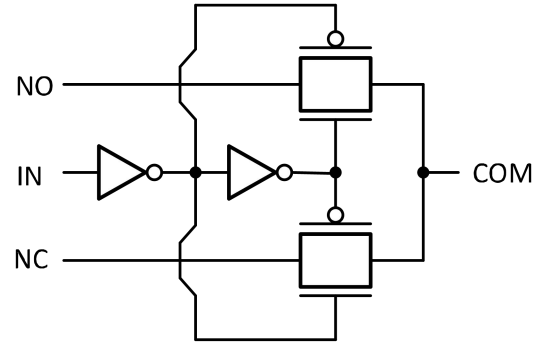


Pin Diagram

1. Pin Configuration and Functions



(a) Pin Diagram



(b) Simplified Schematic

Truth Table

| IN | NO | NC |
|----|-----|-----|
| 0 | OFF | ON |
| 1 | ON | OFF |

Pin Description

| PIN | NAME | FUNCTION |
|-----|-----------------|---|
| 1 | NO | Normally Open Terminal |
| 2 | GND | Ground |
| 3 | NC | Normally Closed Terminal |
| 4 | COM | Common Terminal |
| 5 | V _{CC} | Power supply |
| 6 | IN | Digital Control Pin, must be held HIGH or LOW |

2. Package and Ordering Information

| Order Number | Package | Package Option | Marking Information |
|-----------------|-----------------|---------------------|---------------------|
| COSTS5A3157DBVR | SOT23-6 | Tape and Reel, 3000 | C3157 |
| COSTS5A3157DCKR | SC70-6 (SOT363) | Tape and Reel, 3000 | C3157 |

3. Product Specification

3.1 Absolute Maximum Ratings ⁽¹⁾

| Parameter | Min | Max | Unit |
|--|-------|----------------|------|
| Supply voltage range (V_{CC}) | -0.3 | 6.0 | V |
| Analog voltage range (V_{NC} , V_{NO} , V_{COM}) | -0.3 | $V_{CC} + 0.3$ | V |
| Digital input voltage range (V_{IN}) | -0.3 | 6.0 | V |
| Continuous current into any terminal | -50 | 50 | mA |
| Peak current into any terminal | -80 | 80 | mA |
| Operating junction temperature | -40 | +125 | °C |
| Storage temperature | -55 | +150 | °C |
| ESD (HBM) | -2000 | +2000 | V |
| ESD (MM) | -400 | +400 | V |

(1) Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

3.2 Thermal Data

| Parameter | Rating | Unit |
|--|-------------------------------|------|
| Package Thermal Resistance, $R_{\theta JA}$ (Junction-to-ambient) | 190 (SOT23-6) 270 (SC70-6) | °C/W |

3.3 Recommended Operating Conditions

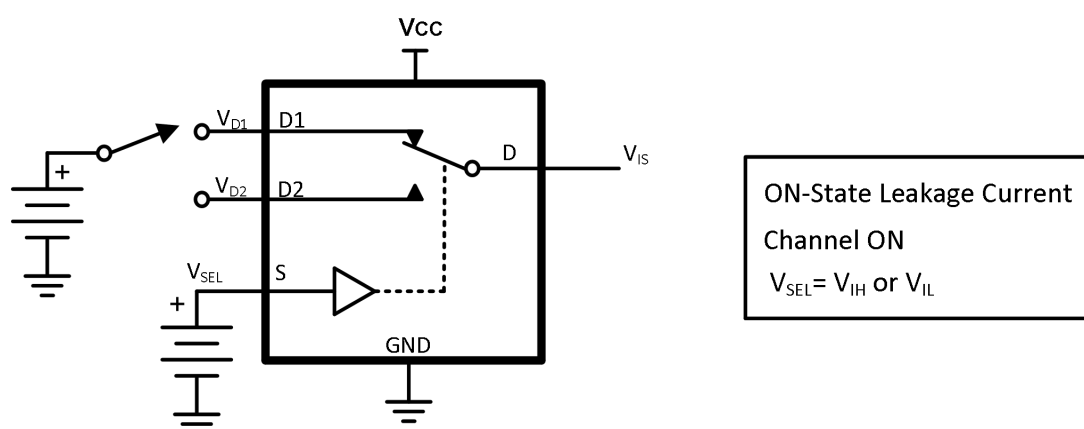
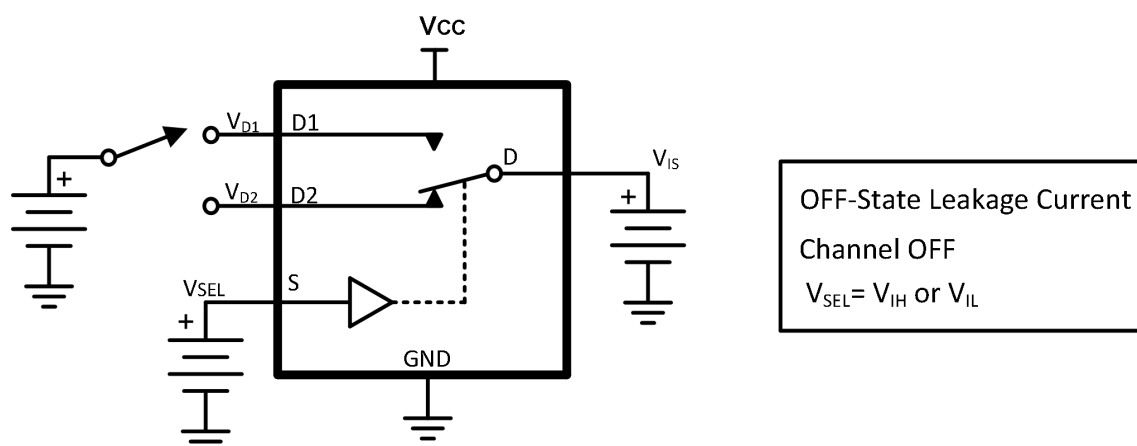
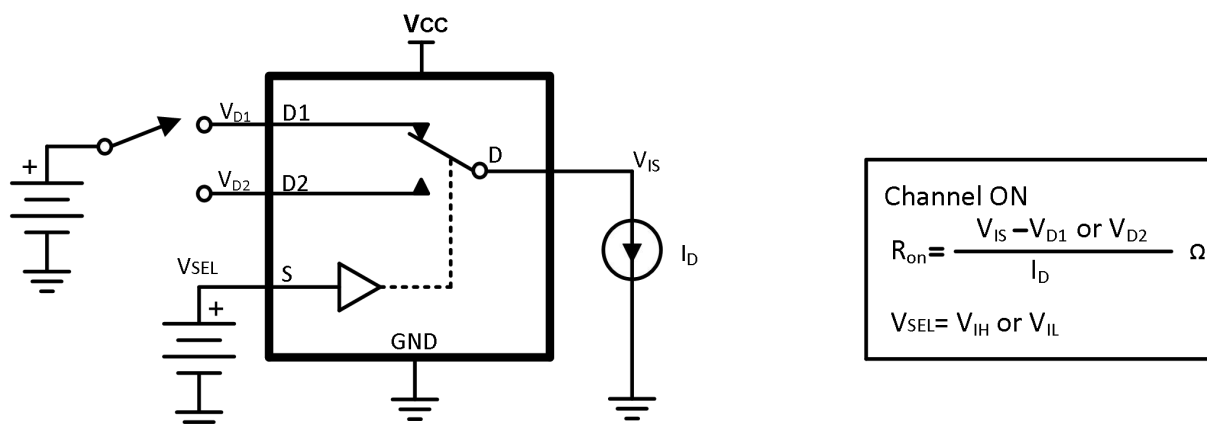
| Parameter | Min | Max | Unit |
|--|------|----------|------|
| V_{CC} | 1.65 | 5.5 | V |
| V_{NC} , V_{NO} , V_{COM} | 0 | V_{CC} | |
| V_{IN} | 0 | V_{CC} | |
| T_A , Operating free-air temperature | -40 | +85 | °C |

3.4 Electrical Characteristics

($V_{CC}=1.8V$ to $5.5V$, $T_A=-40^{\circ}C$ to $125^{\circ}C$, Typical values are at $V_{CC}=5.0V$, $T_A=+25^{\circ}C$, unless otherwise noted)

| Parameter | Symbol | Conditions | Vcc | T _A | Min. | Typ. | Max. | Unit |
|--|--|---|--------------------|----------------|------|------|-----------------|------|
| Analog Switch | | | | | | | | |
| Analog signal range | V _{IS} | | | FULL | 0 | | V _{CC} | V |
| On-state resistance | R _{ON} | V _{NO} or V _{NC} = V _{CC} /2, I _{COM} = -10mA, Switch On, See Figure 1 | 5V | +25°C | | 4.5 | 8 | Ω |
| | | | | FULL | | | 8.5 | |
| | | | 3.3V | +25°C | | 7 | 10 | Ω |
| | | | | FULL | | | 10.5 | |
| On-state resistance match between channels | ΔR _{ON} | V _{NO} or V _{NC} = V _{CC} /2, I _{COM} = -10mA, Switch On, See Figure 1 | 5V | +25°C | | 0.15 | 0.3 | Ω |
| | | | | FULL | | | 0.4 | |
| | | | 3.3V | +25°C | | 0.15 | 0.3 | Ω |
| | | | | FULL | | | 0.4 | |
| On-state resistance flatness | R _{ON(flat)} | V _{NO} or V _{NC} = 0 to V _{CC} /2, I _{COM} = -10mA, Switch On, See Figure 1 | 5V | +25°C | | 2 | 3 | Ω |
| | | | | FULL | | | 3.5 | |
| | | | 3.3V | +25°C | | 3 | 4 | Ω |
| | | | | FULL | | | 4.5 | |
| OFF-state leakage current | I _{NC(OFF)} I _{NO(OFF)} | V _{NO} or V _{NC} = 0.3V, V _{CC} /2, V _{COM} = V _{CC} /2, 0.3V, Switch OFF, See Figure 2 | 1.8V to 5.5V | FULL | | | 1 | μA |
| Channel ON leakage current | I _{NC(ON)} I _{NO(ON)} I _{COM(ON)} | V _{NO} or V _{NC} = 0.3V, V _{CC} /2, V _{COM} = 0.3V, V _{CC} /2, Switch ON, See Figure 3 | 1.8V to 5.5V | FULL | | | 1 | μA |
| Digital Control Input | | | | | | | | |
| Input logic high | V _{IH} | | 5V | FULL | 2.6 | | | V |
| | | | 3.3V | FULL | 1.7 | | | V |
| Input logic low | V _{IL} | | 5V | FULL | | | 0.8 | V |
| | | | 3.3V | FULL | | | 0.7 | V |
| Input leakage current | I _{IH} , I _{IL} | V _{IN} = 0 or V _{IO} | 1.8V to 5.5V | FULL | | | 1 | μA |

| Switch Dynamic Characteristics | | | | | | | | |
|--------------------------------|--------------------------------|--|------|-------|------|-----|-----|---------|
| Turn-on time | t_{ON} | V_{NC} or $V_{NO} = V_{CC}$, $R_L = 300\Omega$, $C_L = 35pF$, See Figure 4 | 5V | +25°C | | 26 | | ns |
| | | | 3.3V | | | 30 | | |
| Turn-off time | t_{OFF} | V_{NC} or $V_{NO} = V_{CC}$, $R_L = 300\Omega$, $C_L = 35pF$, See Figure 4 | 5V | +25°C | | 8 | | ns |
| | | | 3.3V | | | 9 | | |
| Propagation delay | t_{PHL} t_{PLH} | $V_{IS} = 3V$, $R_L = 300\Omega$, $C_L = 35pF$, See Figure 5 | 5V | +25°C | | 1.4 | | ns |
| | | | 3.3V | | | 1.3 | | |
| Break-before-make delay | t_{BBM} | $V_{IS} = 3V$, $R_L = 300\Omega$, $C_L = 35pF$, See Figure 6 | 5V | +25°C | | 5 | | ns |
| | | | 3.3V | | | 8 | | |
| Charge injection | Q | $V_{GEN} = 0V$, $R_{GEN} = 0\Omega$, $C_L = 0.1nF$, See Figure 7 | 5V | +25°C | | 10 | | pC |
| | | | 3.3V | | | 3 | | |
| OFF-state capacitance | $C_{NC(OFF)}$ $C_{NO(OFF)}$ | $V_{CC} = 3.3V$, $V_{I/O} = V_{CC}$ or 0, Switch OFF, See Figure 8 | | +25°C | | 6 | | pF |
| ON-state capacitance | $C_{NC(ON)}$ $C_{NO(ON)}$ | $V_{CC} = 3.3V$, $V_{I/O} = V_{CC}$ or 0, Switch ON, See Figure 8 | | +25°C | | 15 | | pF |
| Digital input capacitance | C_i | $V_{CC} = 0V$, $V_{IN} = V_{CC}$ or 0, See Figure 8 | | +25°C | | 2 | | pF |
| OFF-isolation | V_{ISO} | $R_L = 50\Omega$, $C_L = 5pF$, $V_{I/O} = 0dBm$, $f = 1MHz$ Switch OFF, See Figure 9 | | +25°C | | -70 | | dB |
| Crosstalk | X_{TALK} | $R_L = 50\Omega$, $C_L = 5pF$, $V_{I/O} = 0dBm$, $f = 1MHz$ Switch ON, See Figure 10 | | +25°C | | -72 | | dB |
| Bandwidth | BW | $R_L = 50\Omega$, $C_L = 5pF$, $V_{I/O} = 0dBm$, $f = 1MHz$ Switch ON, See Figure 11 | | +25°C | | 300 | | MHz |
| Power Supply | | | | | | | | |
| V_{CC} supply range | V_{CC} | | | FULL | 1.65 | | 5.5 | V |
| V_{CC} supply current | I_{CC} | $I_{I/O} = 0$, Switch ON or OFF | 5.5V | FULL | | | 5 | μA |



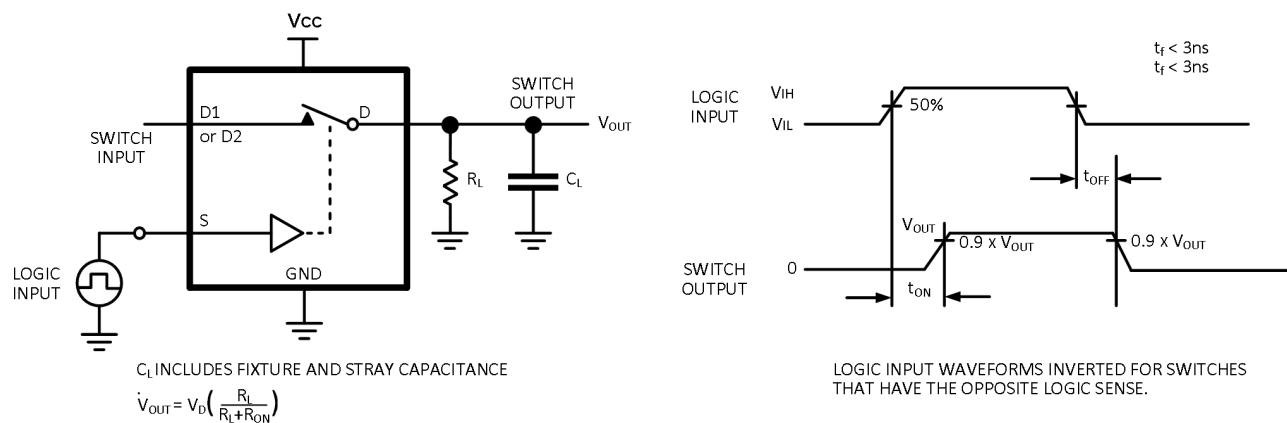
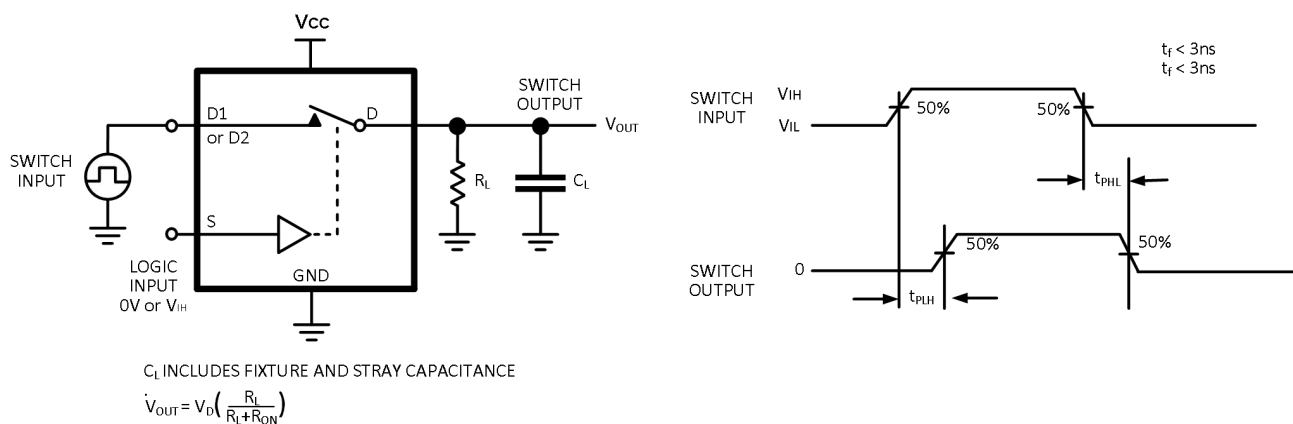
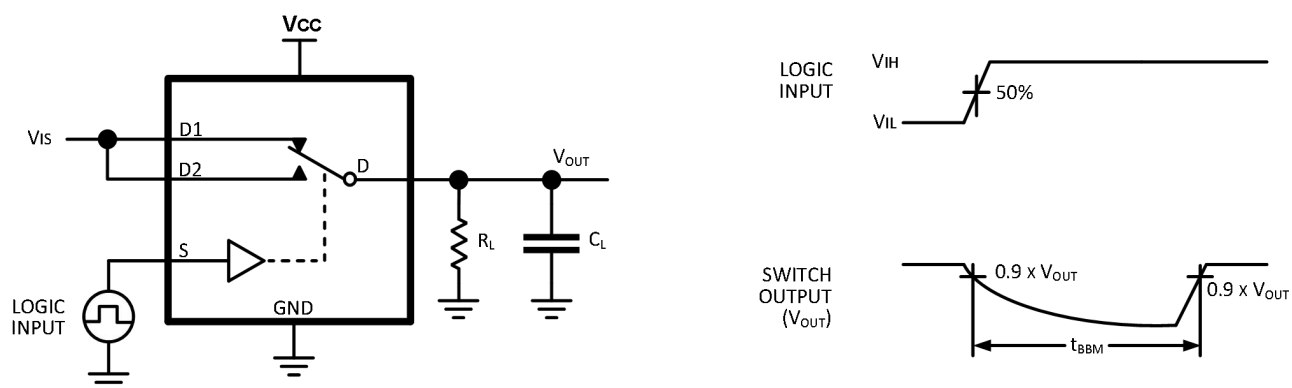

Figure 4. Turn-On (T_{ON}) and Turn-Off Time (T_{OFF})


Figure 5. Propagation Delay


Figure 6. Break-Before-Make Time (T_{BBM})

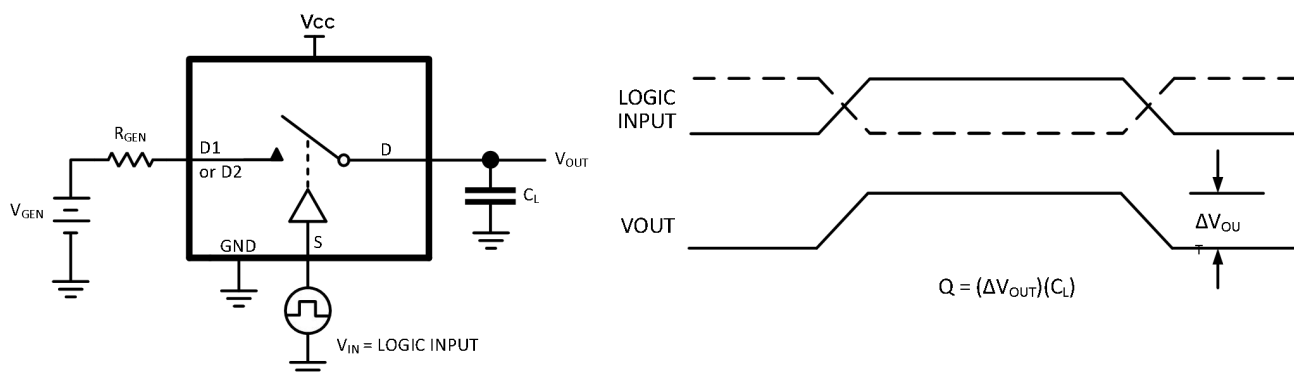
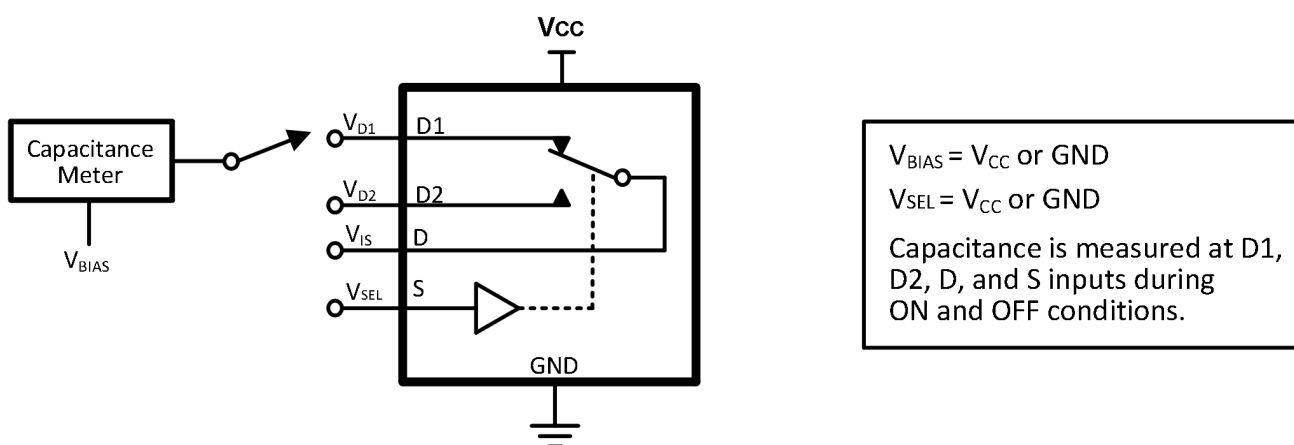
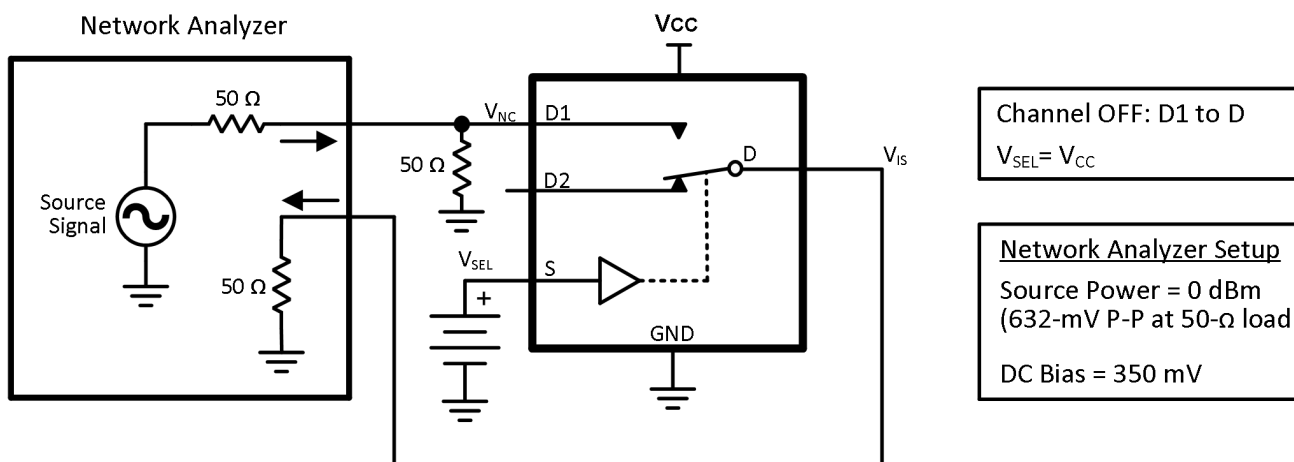

Figure 7. Charge Injection (Q_c)


Figure 8. Capacitance


Figure 9. OFF Isolation (O_{ISO})

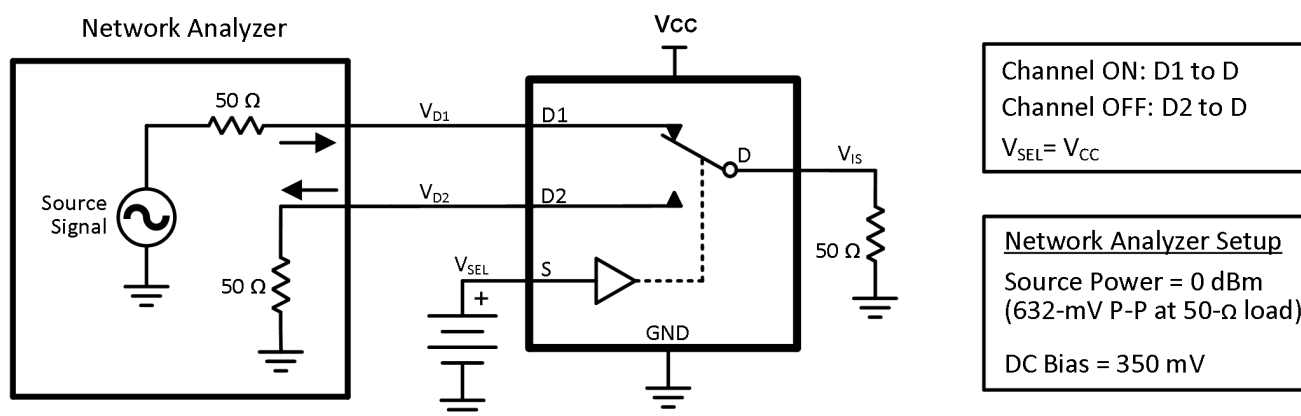
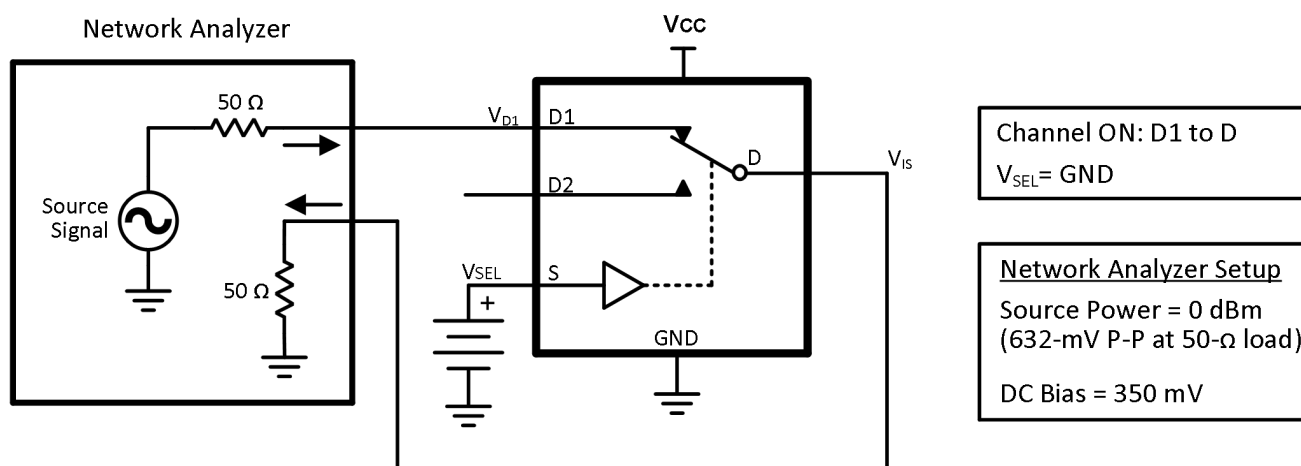
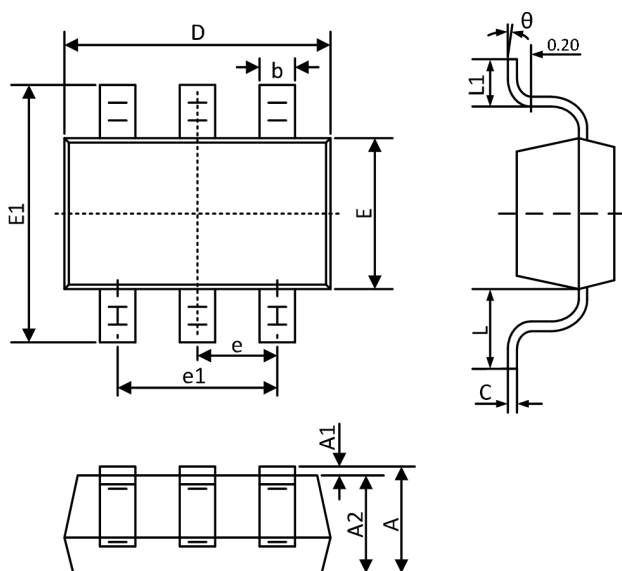

Figure 10. Crosstalk (X_{TALK})


Figure 11. Bandwidth (BW)

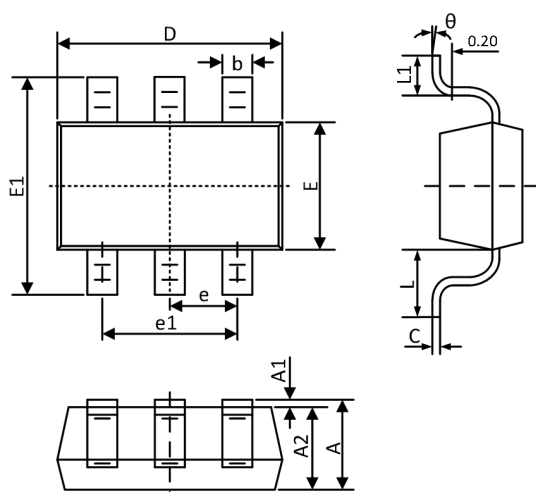
5. Package Information

5.1 SOT23-6 (Package Outline Dimensions)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.400 | 0.012 | 0.016 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950TYP | | 0.037TYP | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.700REF | | 0.028REF | |
| L1 | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

5.2 SC70-6 / SOT363 (Package Outline Dimensions)



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.900 | 1.100 | 0.035 | 0.043 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 0.900 | 1.000 | 0.035 | 0.039 |
| b | 0.150 | 0.350 | 0.006 | 0.014 |
| c | 0.080 | 0.150 | 0.003 | 0.006 |
| D | 2.000 | 2.200 | 0.079 | 0.087 |
| E | 1.150 | 1.350 | 0.045 | 0.053 |
| E1 | 2.150 | 2.450 | 0.085 | 0.096 |
| e | 0.65 TYP | | 0.026 TYP | |
| e1 | 1.300 BSC | | 0.051 BSC | |
| L | 0.525 REF | | 0.021 REF | |
| L1 | 0.260 | 0.460 | 0.010 | 0.018 |
| θ | 0° | 8° | 0° | 8° |