

# Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

## FEATURES

- **-3dB Bandwidth: 120MHz**
- **High Speed, Typically 29ns**
- **Supply Range: +1.8V to +5.5V**
- **Low ON-State Resistance, 3.0Ω(TYP)**
- **Break-Before-Make Switching**
- **Rail-to-Rail Operation**
- **TTL/CMOS Compatible**
- **Extended Industrial Temperature Range: -40°C to +125°C**

## APPLICATIONS

- **Wearable Devices**
- **Battery-Operated Equipment**
- **Signal Gating, Chopping, Modulation or Demodulation (Modem)**
- **Portable Computing**
- **Cell Phones**

## DESCRIPTION

The RS2102 is a dual, low on-resistance, single-pole double-throw (SPDT) analog switch that is designed to operate from 1.8 V to 5.5 V.

The RS2102 device can handle both analog and digital signals. It features fast switching speeds ( $t_{ON} = 29ns$ ,  $t_{OFF} = 17ns$ ) and low on-resistance (3.0Ω TYP).

These features make this device suitable for a wide variety of portable applications including cell phones, audio devices, and instrumentation.

Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

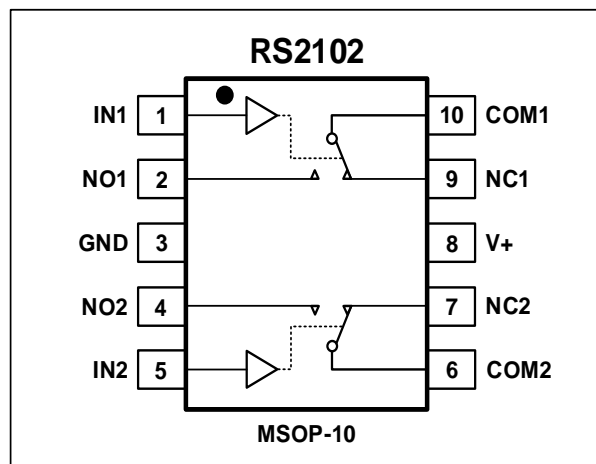
## FUNCTION TABLE

| LOGIC | NO1, NO2 | NC1, NC2 |
|-------|----------|----------|
| 0     | OFF      | ON       |
| 1     | ON       | OFF      |

## PIN DESCRIPTION

| NAME         | PIN   | FUNCTION                 |
|--------------|-------|--------------------------|
| V+           | 8     | Power Supply             |
| NO1, NO2     | 2, 4  | Normally-Open Terminal   |
| COM1<br>COM2 | 10, 6 | Common Terminal          |
| IN1, IN2     | 1, 5  | Digital Control Pin      |
| NC1, NC2     | 9, 7  | Normally-Closed Terminal |
| GND          | 3     | Ground                   |

## PIN CONFIGURATIONS



### ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

|   |                      |
|---|----------------------|
| V+, IN to GND.....                                  | -0.3V to 6.0V        |
| Analog, Digital Voltage Range <sup>(2)</sup> .....  | - 0.3 to (V+) + 0.3V |
| Continuous Current NO, NC, or COM.....              | ±300mA               |
| Peak Current NO, NC, or COM.....                    | ±500mA               |
| Storage Temperature .....                           | -65°C to +150°C      |
| Operating Temperature .....                         | -40°C to +125°C      |
| Junction Temperature.....                           | 150°C                |
| Package Thermal Resistance @ T <sub>A</sub> = +25°C |                      |
| MSOP-10.....  | 204°C/W              |
| Lead Temperature (Soldering, 10s) .....             | 260°C                |
| ESD Susceptibility                                  |                      |
| HBM .....   | 1000V                |
| MM .....  | 100V                 |

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.



### ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### PACKAGE/ORDERING INFORMATION

| PRODUCT | ORDERING NUMBER | TEMPERATURE RANGE | PACKAGE LEAD | PACKAGE MARKING | PACKAGE OPTION     |
|---------|-----------------|-------------------|--------------|-----------------|--------------------|
| RS2102  | RS2102XN        | -40°C~125°C       | MSOP-10      | RS2102          | Tape and Reel,3000 |

**ELECTRICAL CHARACTERISTICS**
 $V+ = 5.0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                   | SYMBOL                                | CONDITIONS  | V+          | T <sub>A</sub> | MIN | TYP | MAX  | UNITS         |
|---|---------------------------------------|---|-------------|----------------|-----|-----|------|---------------|
| <b>ANALOG SWITCH</b>                        |                                       |   |             |                |     |     |      |               |
| Analog Signal Range                         | $V_{NO}, V_{NC}, V_{COM}$             |   |             | FULL           | 0   |     | V+   | V             |
| On-Resistance                               | $R_{ON}$                              | $0 \leq (V_{NO} \text{ or } V_{NC}) \leq V+$ ,<br>$I_{COM} = -10\text{mA}$ , Switch ON,<br>See Figure 1 | 5V          | +25°C          |     | 3.0 | 4.0  | $\Omega$      |
|   |                                       |   |             | FULL           |     |     | 5.0  | $\Omega$      |
|   |                                       |   | 3.3V        | +25°C          |     | 5.5 | 7.0  | $\Omega$      |
|   |                                       |   |             | FULL           |     |     | 7.5  | $\Omega$      |
| On-Resistance Match Between Channels        | $\Delta R_{ON}$                       | $0 \leq (V_{NO} \text{ or } V_{NC}) \leq V+$ ,<br>$I_{COM} = -10\text{mA}$ , Switch ON,<br>See Figure 1 | 5V          | +25°C          |     | 0.1 | 0.8  | $\Omega$      |
|   |                                       |   |             | FULL           |     |     | 0.9  | $\Omega$      |
|   |                                       |   | 3.3V        | +25°C          |     | 0.1 | 0.8  | $\Omega$      |
|   |                                       |   |             | FULL           |     |     | 0.9  | $\Omega$      |
| On-Resistance Flatness                      | $R_{FLAT(ON)}$                        | $0 \leq (V_{NO} \text{ or } V_{NC}) \leq V+$ ,<br>$I_{COM} = -10\text{mA}$ , Switch ON,<br>See Figure 1 | 5V          | +25°C          |     | 0.7 | 0.85 | $\Omega$      |
|   |                                       |   |             | FULL           |     |     | 0.95 | $\Omega$      |
|   |                                       |   | 3.3V        | +25°C          |     | 2.5 | 3.0  | $\Omega$      |
|   |                                       |   |             | FULL           |     |     | 3.2  | $\Omega$      |
| NC,NO OFF Leakage Current                   | $I_{NC(OFF)}, I_{NO(OFF)}$            | $V_{NO} \text{ or } V_{NC} = 0.3\text{V}$ , $V+/2$ $V_{COM} = V+/2$ , 0.3V See Figure 2                 | 1.8 to 5.5V | FULL           |     |     | 1    | $\mu\text{A}$ |
| NC,NO,COM ON Leakage Current                | $I_{NC(ON)}, I_{NO(ON)}, I_{COM(ON)}$ | $V_{NO} \text{ or } V_{NC} = 0.3\text{V}$ , Open $V_{COM} = \text{Open}$ , 0.3V See Figure 2            | 1.8 to 5.5V | FULL           |     |     | 1    | $\mu\text{A}$ |
| <b>DIGITAL CONTROL INPUTS<sup>(1)</sup></b> |                                       |   |             |                |     |     |      |               |
| Input High Voltage                          | $V_{INH}$                             |   | 5V          | FULL           | 1.5 |     |      | V             |
|   |                                       |   | 3.3V        | FULL           | 1.3 |     |      | V             |
| Input Low Voltage                           | $V_{INL}$                             |   | 5V          | FULL           |     |     | 0.6  | V             |
|   |                                       |   | 3.3V        | FULL           |     |     | 0.5  | V             |
| Input Leakage Current                       | $I_{IN}$                              | $V_{IN} = V_{IO} \text{ or } 0$   | 1.8 to 5.5V | FULL           |     |     | 1    | $\mu\text{A}$ |

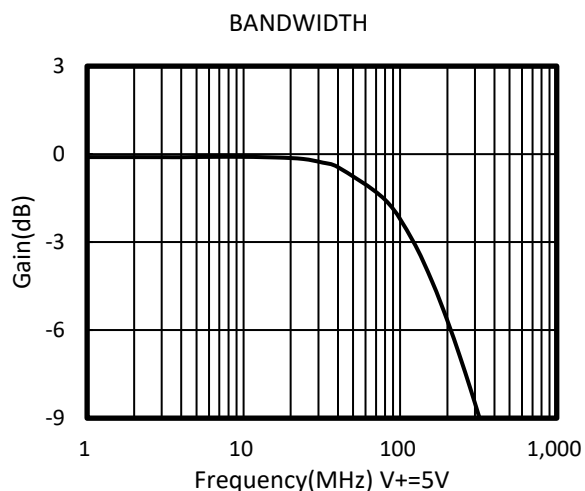
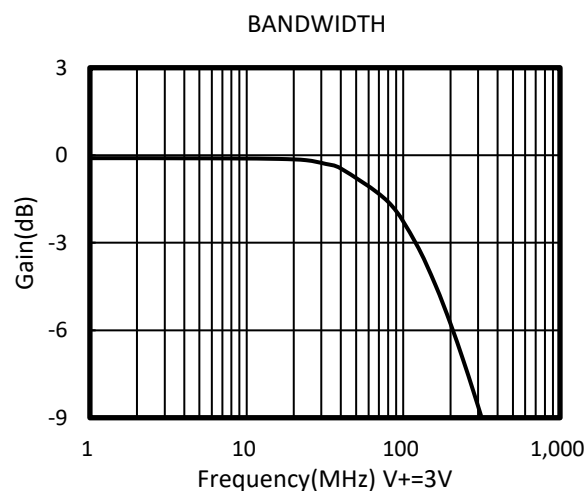
(1) All unused digital inputs of the device must be held at  $V_{IO}$  or GND to ensure proper device operation.

**ELECTRICAL CHARACTERISTICS (continued)**
 $V_+ = 5.0\text{ V}$ , TEMP=  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

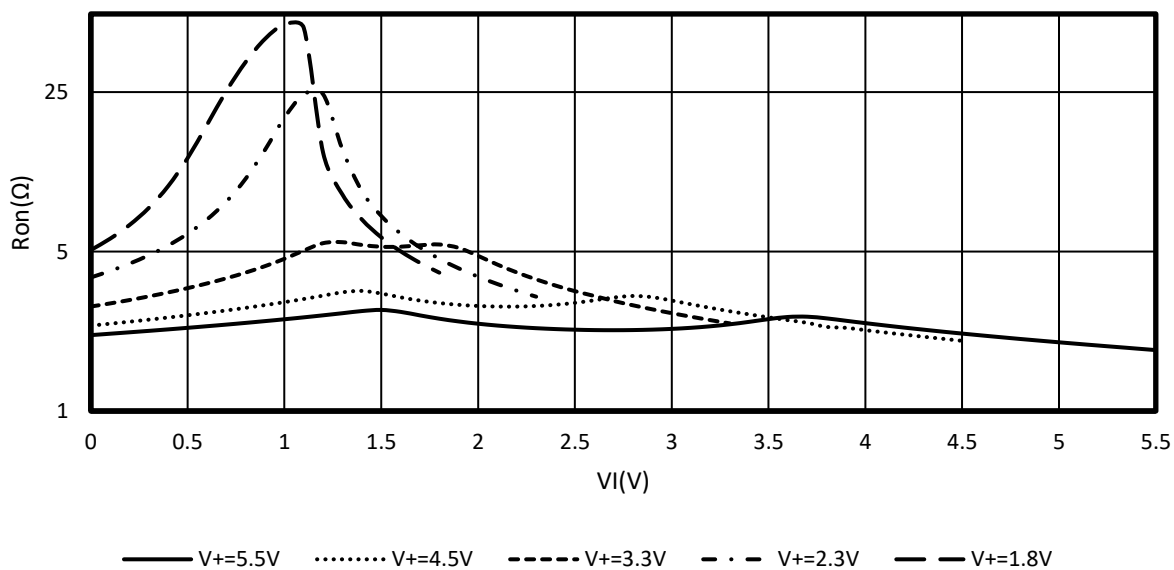
| PARAMETER                       | SYMBOL   | CONDITIONS  | V+        | TEMP  | MIN | TYP | MAX | UNITS         |
|---------------------------------|--|---|-----------|-------|-----|-----|-----|---------------|
| <b>DYNAMIC CHARACTERISTICS</b>  |  |   |           |       |     |     |     |               |
| Turn-On Time                    | $t_{ON}$                                       | $V_{COM} = V_+$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ ,<br>See Figure 5                                     | 5V        | +25°C |     | 29  |     | ns            |
|                                 |  |   | 3.3V      |       |     | 33  |     |               |
| Turn-Off Time                   | $t_{OFF}$                                      | $V_{COM} = V_+$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ ,<br>See Figure 5                                     | 5V        | +25°C |     | 17  |     | ns            |
|                                 |  |   | 3.3V      |       |     | 18  |     |               |
| Break-Before-Make<br>Time Delay | $t_{BBM}$                                      | $V_{NO1} = V_{NC1} = V_{NO2} = V_{NC2} = 3\text{V}$ ,<br>$R_L = 300\Omega$ , $C_L = 35\text{pF}$ , See Figure 6 | 5V        | +25°C |     | 10  |     | ns            |
|                                 |  |   | 3.3V      |       |     | 11  |     |               |
| Off Isolation                   | $O_{ISO}$                                      | $R_L = 50\Omega$ , Switch OFF,<br>See Figure 8  | f = 10MHz | +25°C |     | -43 |     | dB            |
|                                 |  |   | f = 1MHz  | +25°C |     | -67 |     | dB            |
| -3dB Bandwidth                  | BW   | Switch ON, $R_L = 50\Omega$<br>See Figure 7   |           | +25°C |     | 120 |     | MHz           |
| NC,NO OFF<br>Capacitance        | $C_{NC(OFF)}$ ,<br>$C_{NO(OFF)}$               | $V_{NC}$ or $V_{NO} = V_+/2$ or GND, Switch<br>OFF See Figure 4   |           | +25°C |     | 15  |     | pF            |
| NC,NO,COM ON<br>Capacitance     | $C_{NC(ON)}$ , $C_{NO(ON)}$ ,<br>$C_{COM(ON)}$ | $V_{NC}$ or $V_{NO} = V_+/2$ or GND, Switch<br>ON See Figure 4  |           | +25°C |     | 50  |     | pF            |
| <b>POWER REQUIREMENTS</b>       |  |   |           |       |     |     |     |               |
| Power Supply Range              | $V_+$  |   |           | FULL  | 1.8 |     | 5.5 | V             |
| Power Supply Current            | $I_+$  | $V_{IN} = \text{GND}$ or $V_+$  | 5.5V      | FULL  |     |     | 1   | $\mu\text{A}$ |

### TYPICAL CHARACTERISTICS

$V+ = 5.0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)



Typical  $r_{on}$  as a Function of Input Voltage ( $V_I$ ) for  $V_I = 0$  to  $V+$



### Parameter Measurement Information

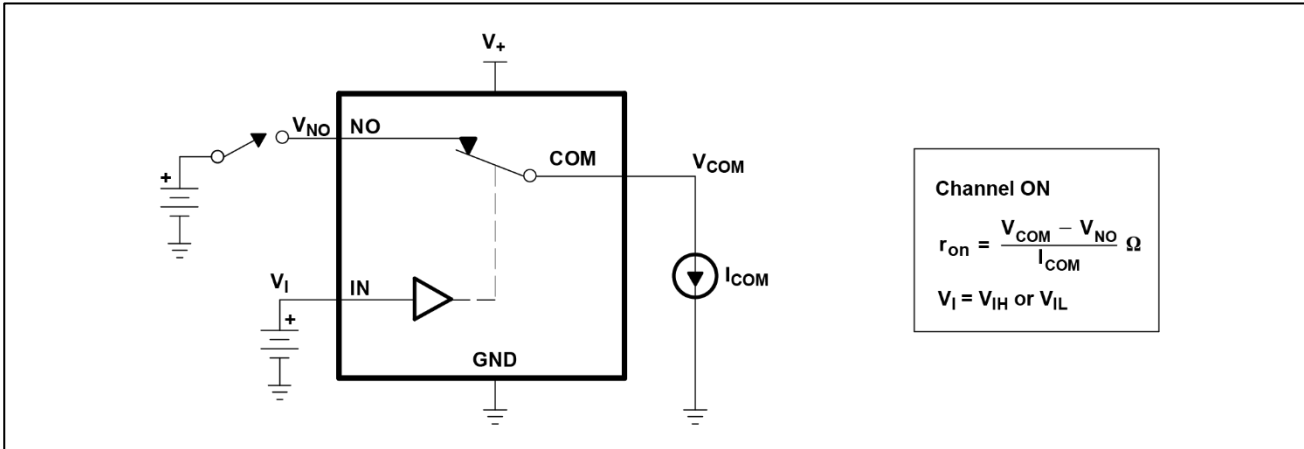


Figure 1.ON-State Resistance ( $r_{on}$ )

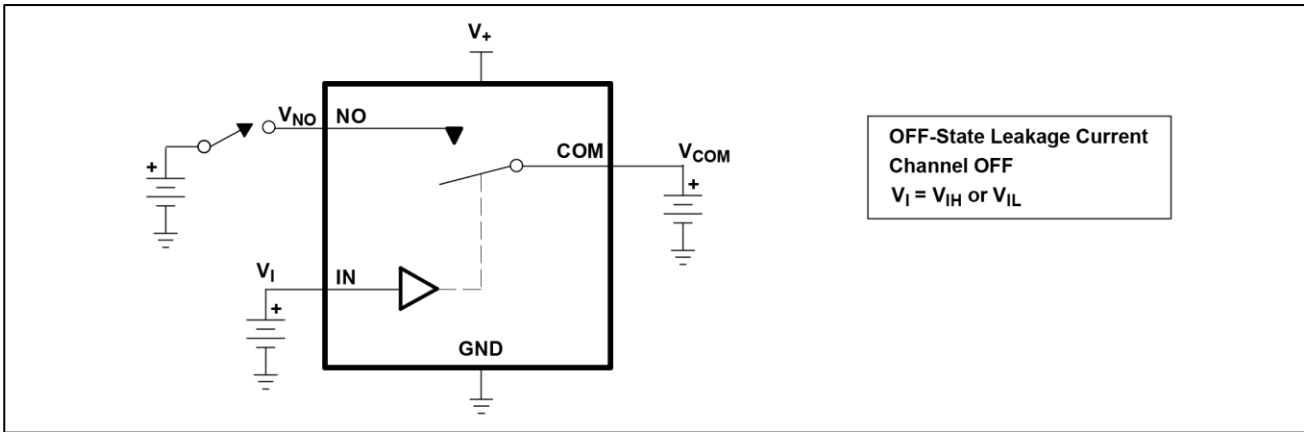


Figure 2.OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NO(OFF)}$ )

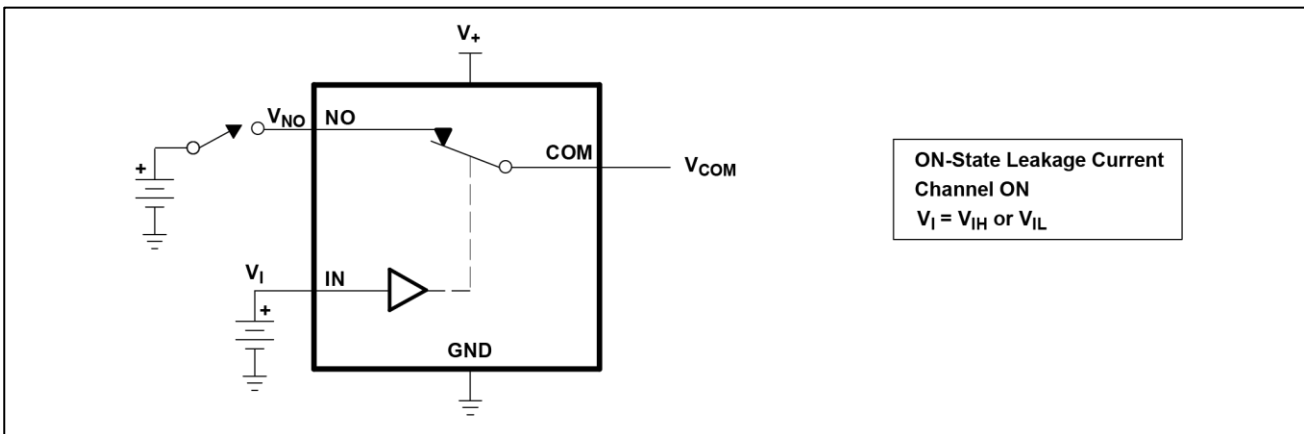


Figure 3.ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NO(ON)}$ )

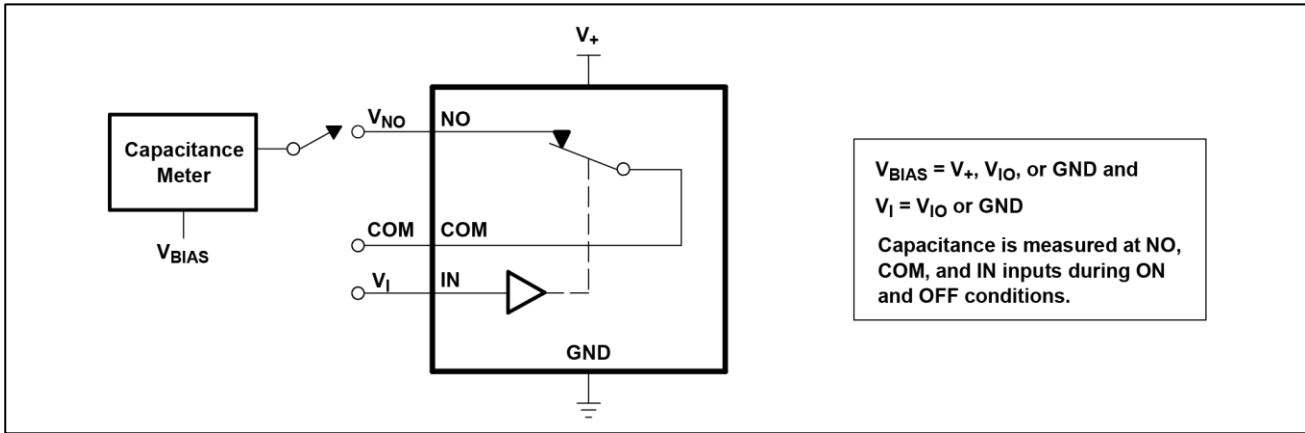


Figure 4. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NO(OFF)}$ ,  $C_{NO(ON)}$ )

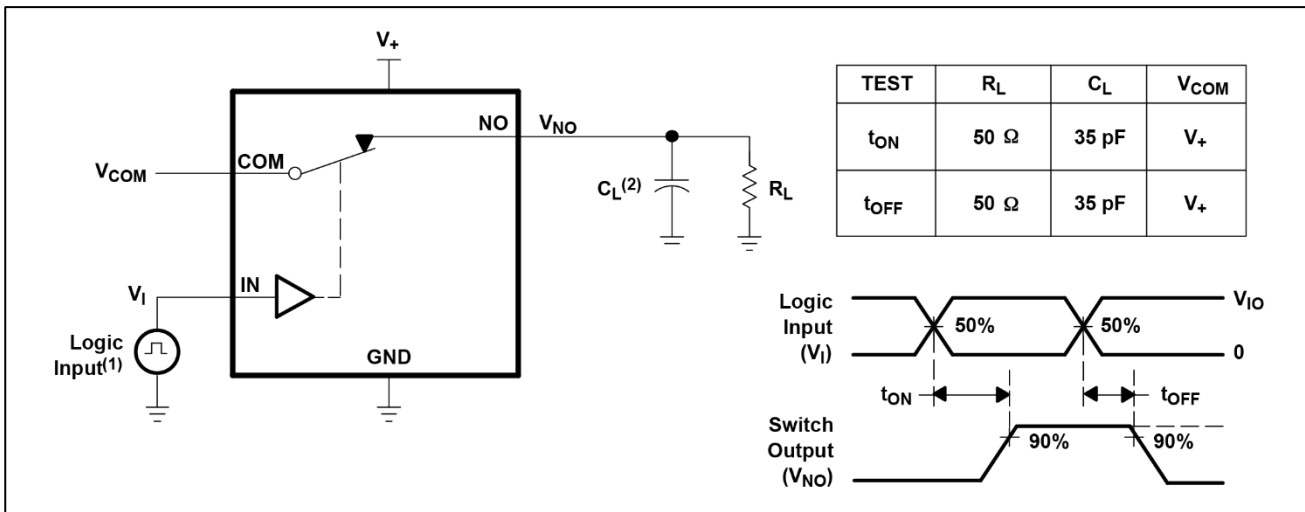


Figure 5. Turn-On ( $t_{ON}$ ) and Turn-Off Time ( $t_{OFF}$ )

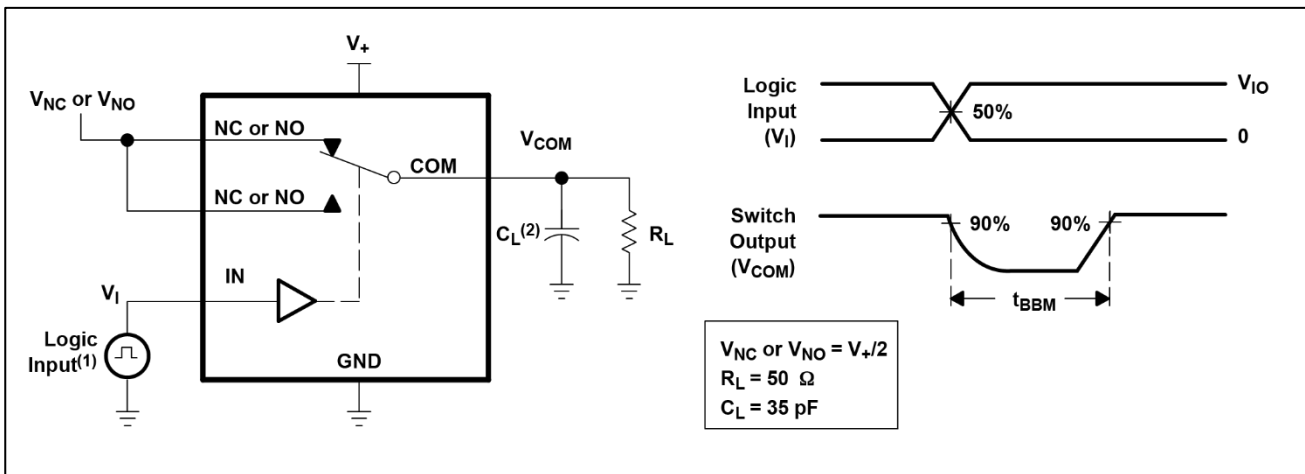


Figure 6. Break-Before-Make Time ( $t_{BBM}$ )

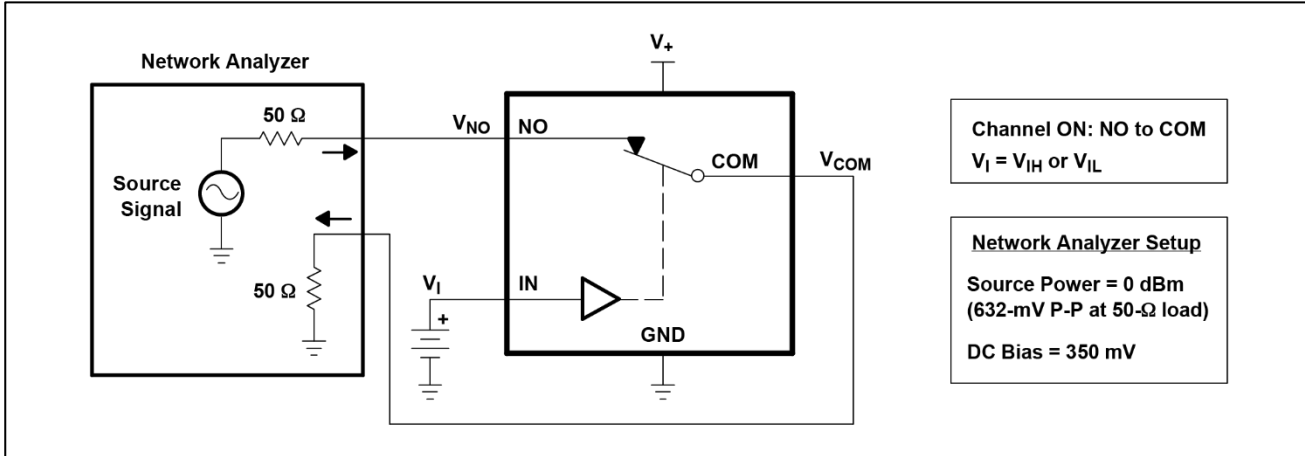


Figure 7. Bandwidth (BW)

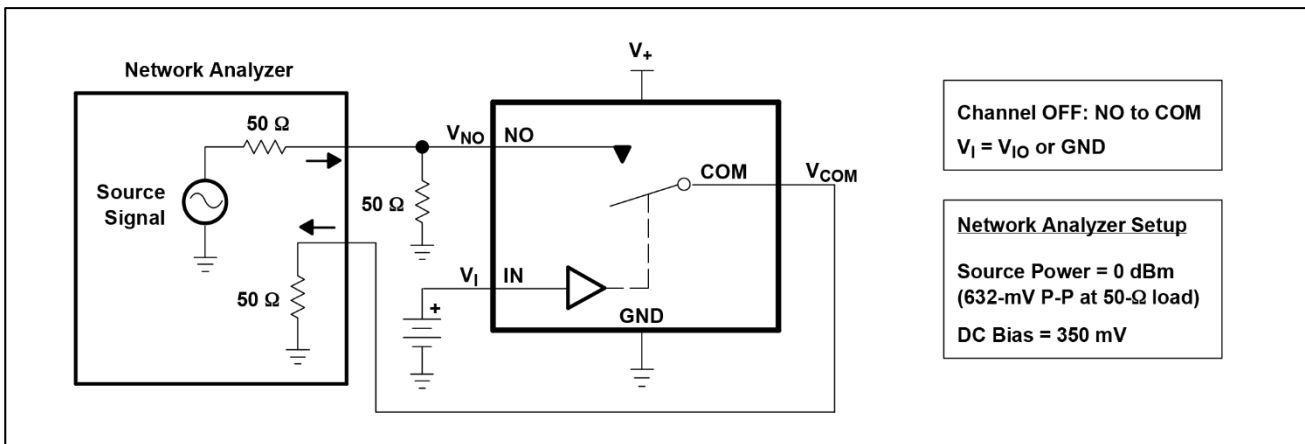


Figure 8. OFF Isolation ( $O_{iso}$ )

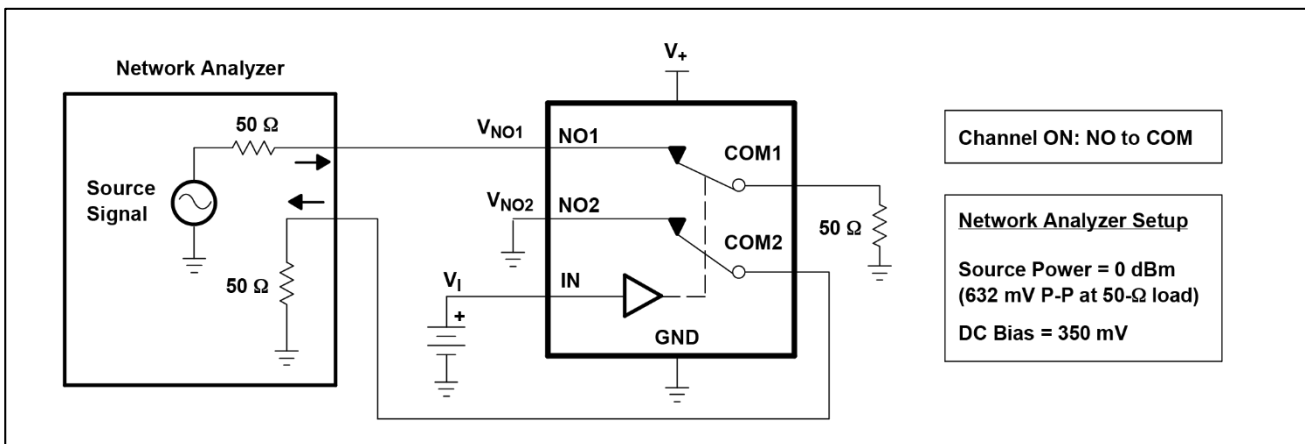
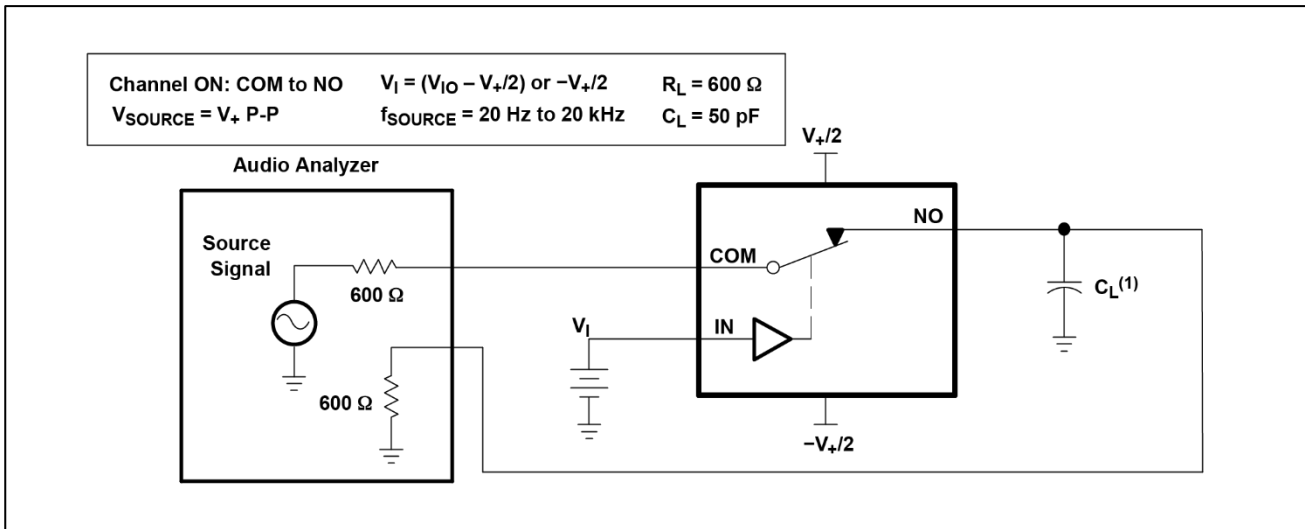
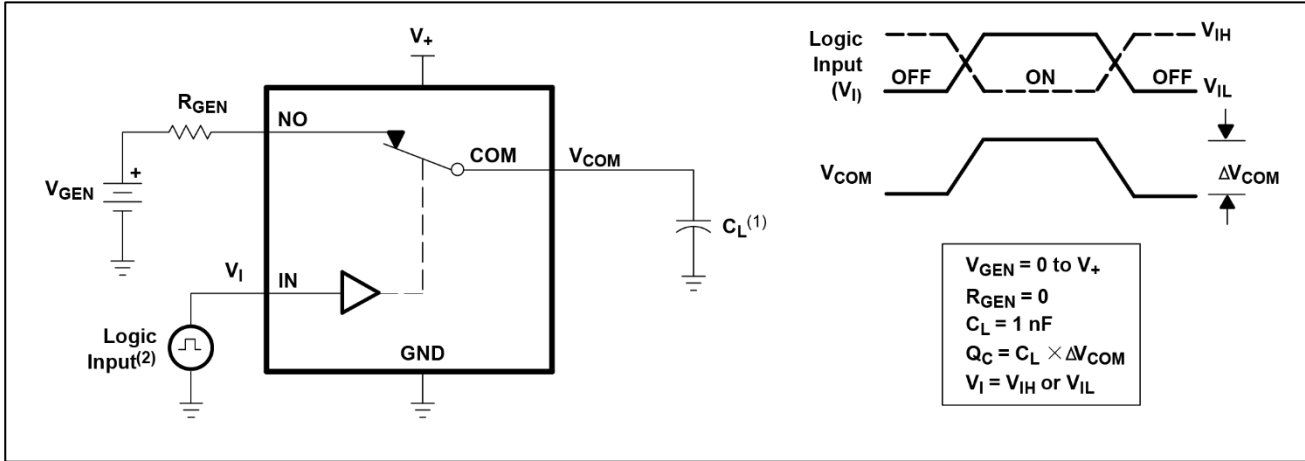


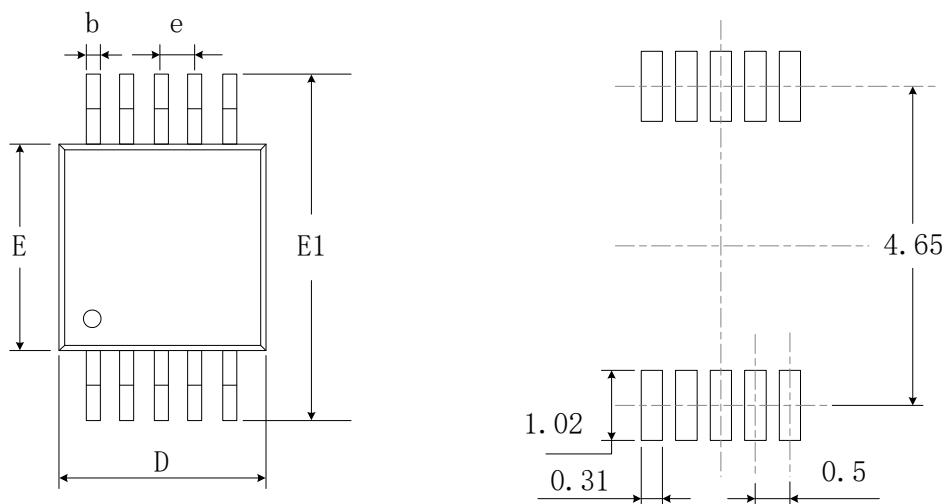
Figure 9. Crosstalk ( $X_{TALK}$ )



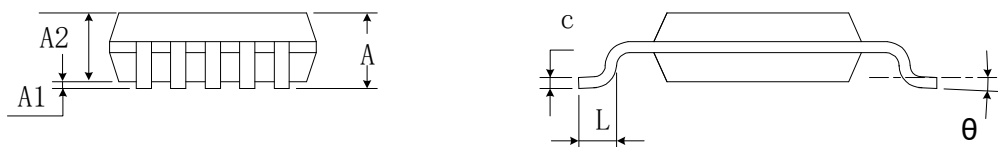


# PACKAGE OUTLINE DIMENSIONS

## MSOP-10



RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 0.820                     | 1.100 | 0.032                | 0.043 |
| A1     | 0.020                     | 0.150 | 0.001                | 0.006 |
| A2     | 0.750                     | 0.950 | 0.030                | 0.037 |
| b      | 0.180                     | 0.280 | 0.007                | 0.011 |
| c      | 0.090                     | 0.230 | 0.004                | 0.009 |
| D      | 2.900                     | 3.100 | 0.114                | 0.122 |
| e      | 0.50(BSC)                 |       | 0.020(BSC)           |       |
| E      | 2.900                     | 3.100 | 0.114                | 0.122 |
| E1     | 4.750                     | 5.050 | 0.187                | 0.199 |
| L      | 0.400                     | 0.800 | 0.016                | 0.031 |
| θ      | 0°                        | 6°    | 0°                   | 6°    |