

# 4.5Ω Quad SPDT Analog Switch 4-Channel 2:1 Multiplexer – Demultiplexer With Two Controls

## FEATURES

- High Bandwidth: 300MHz
- High Speed, Typically 30ns
- Supply Range: +1.8V to +5.5V
- Low ON-State Resistance, 4.5Ω(TYP)
- Break-Before-Make Switching
- Rail-to-Rail Operation
- TTL/CMOS Compatible
- Extended Industrial Temperature Range: -40°C to +125°C

## APPLICATIONS

- Video Switching
- Relay Replacements
- USB Switching
- Battery-Operated Equipment
- Cell Phones

## FUNCTION TABLE

| IN1-2 | NO1 and NO2 | NC1 and NC2 |
|-------|-------------|-------------|
| 0     | OFF         | ON          |
| 1     | ON          | OFF         |

| IN3-4 | NO3 and NO4 | NC3 and NC4 |
|-------|-------------|-------------|
| 0     | OFF         | ON          |
| 1     | ON          | OFF         |

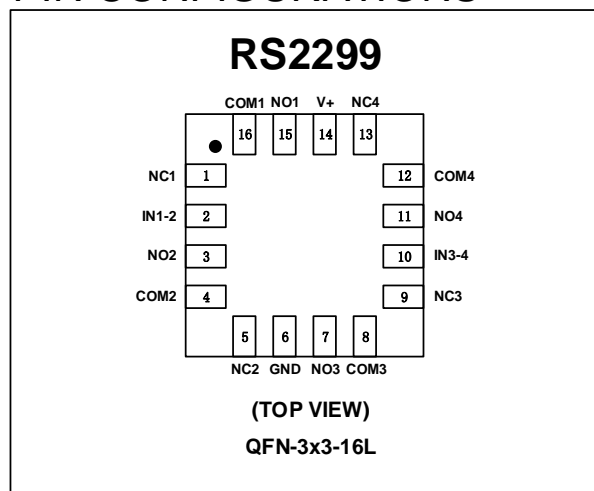
## DESCRIPTION

The RS2299 is a bidirectional 4-channel single-pole double-throw (SPDT) analog switch with two control inputs, which is designed to operate from 1.8V to 5.5V. This device is also known as a 2 channel double-pole double-throw (DPDT) configuration.

The RS2299 device can handle both analog and digital signals. It features high-bandwidth(300MHz) and low on-resistance (4.5Ω TYP).

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

## PIN CONFIGURATIONS



## PIN DESCRIPTION

| NAME  | PIN       | FUNCTION                 |
|-------|-----------|--------------------------|
| V+    | 14        | Power Supply             |
| GND   | 6         | Ground                   |
| IN1-2 | 2         | Digital Control Pin      |
| IN3-4 | 10        | Digital Control Pin      |
| COMx  | 16,4,8,12 | Common Terminal          |
| NOx   | 15,3,7,11 | Normally-Open Terminal   |
| NCx   | 1,5,9,13  | Normally-Closed Terminal |

## SPECIFICATIONS

### Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

| SYMBOL            | PARAMETER                         | MIN  | MAX                  | UNIT |
|-------------------|-----------------------------------|------|----------------------|------|
| V <sub>+</sub>    | Supply Voltage                    | -0.3 | 6.0                  | V    |
| V <sub>IN</sub>   | Input Voltage <sup>(2)</sup>      | -0.3 | 6.0                  |      |
|                   | Analog, Digital Voltage Range     | -0.3 | V <sub>CC</sub> +0.3 |      |
|                   | Continuous Current NO, NC, or COM | -300 | 300                  | mA   |
| I <sub>PEAK</sub> | Peak Current NO, NC, or COM       | -500 | 500                  |      |
| T <sub>J</sub>    | Junction Temperature              |      | 150                  | °C   |
| T <sub>stg</sub>  | Storage temperature               | -65  | 150                  |      |

(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) All voltages are with respect to ground, unless otherwise specified.

(3) The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(4) This value is limited to 5.5 V maximum.

### ESD Ratings

|                    |                         |                        | VALUE | UNIT |
|--------------------|-------------------------|------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM) | ±1000 | V    |
|                    |                         | Machine Model (MM)     | ±100  | V    |

### Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted) <sup>(3)</sup>

| SYMBOL          | PARAMETER             | MIN | MAX  | UNIT |
|-----------------|-----------------------|-----|------|------|
| V <sub>CC</sub> | Supply Voltage        | 1.8 | 5.5  | V    |
| T <sub>A</sub>  | Operating temperature | -40 | +125 | °C   |

### Thermal Information

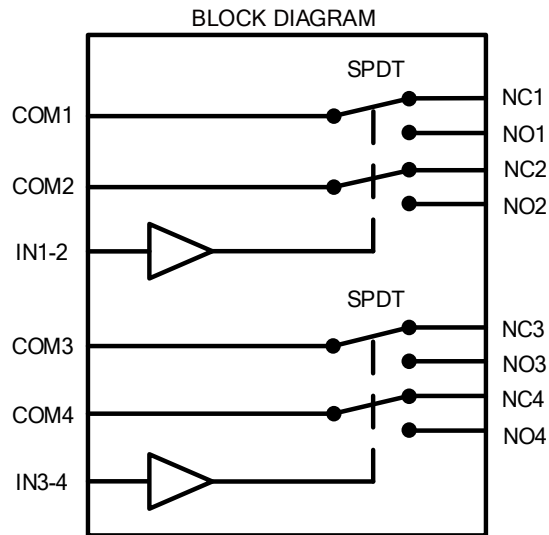
| THERMAL METRIC   |  | RS2299      | UNIT |
|------------------|--|-------------|------|
|                  |  | 16PINS      |      |
|                  |  | QFN-3x3-16L |      |
| R <sub>θJA</sub> | Junction-to-ambient thermal resistance | 41          | °C/W |

### PACKAGE/ORDERING INFORMATION

| PRODUCT | ORDERING NUMBER | TEMPERATURE RANGE | PACKAGE LEAD | PACKAGE MARKING <sup>(1)</sup> | PACKAGE OPTION     |
|---------|-----------------|-------------------|--------------|--------------------------------|--------------------|
| RS2299  | RS2299XTQC16    | -40°C~125°C       | QFN-3x3-16L  | RS2299                         | Tape and Reel,5000 |

NOTE:

- (1) There may be additional marking, which relates to the lot trace code information(data code and vendor code), the logo or the environmental category on the device.



## 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                               | $R_{ON}$                              | $V_{NO}$ or $V_{NC} = V_+/2$ ,<br>$I_{COM} = -10\text{mA}$ , Switch ON,<br>See Figure 1             | 5V          | +25°C          |     | 4.5  | 8     | $\Omega$      |
|   |                                       |   |             | FULL           |     |      | 8.5   | $\Omega$      |
|   |                                       |   | 3.3V        | +25°C          |     | 7    | 10    | $\Omega$      |
|   |                                       |   |             | FULL           |     |      | 10.5  | $\Omega$      |
| On-Resistance Match Between Channels        | $\Delta R_{ON}$                       | $V_{NO}$ or $V_{NC} = V_+/2$ ,<br>$I_{COM} = -10\text{mA}$ , Switch ON,<br>See Figure 1             | 5V          | +25°C          |     | 0.15 | 0.3   | $\Omega$      |
|   |                                       |   |             | FULL           |     |      | 0.4   | $\Omega$      |
|   |                                       |   | 3.3V        | +25°C          |     | 0.15 | 0.3   | $\Omega$      |
|   |                                       |   |             | FULL           |     |      | 0.4   | $\Omega$      |
| On-Resistance Flatness                      | $R_{FLAT(ON)}$                        | $0 \leq (V_{NO}$ or $V_{NC}) \leq V_+/2$ ,<br>$I_{COM} = -10\text{mA}$ , Switch ON,<br>See Figure 1 | 5V          | +25°C          |     | 2    | 3     | $\Omega$      |
|   |                                       |   |             | FULL           |     |      | 3.3   | $\Omega$      |
|   |                                       |   | 3.3V        | +25°C          |     | 3    | 4     | $\Omega$      |
|   |                                       |   |             | FULL           |     |      | 4.3   | $\Omega$      |
| NC,NO OFF Leakage Current                   | $I_{NC(OFF)}, I_{NO(OFF)}$            | $V_{NO}$ or $V_{NC} = 0.3\text{V}$ , $V_+/2$ $V_{COM} = V_+/2$ , $0.3\text{V}$ See Figure 2         | 1.8 to 5.5V | FULL           |     |      | 1     | $\mu\text{A}$ |
| NC,NO,COM ON Leakage Current                | $I_{NC(ON)}, I_{NO(ON)}, I_{COM(ON)}$ | $V_{NO}$ or $V_{NC} = 0.3\text{V}$ , Open $V_{COM} =$ Open, $0.3\text{V}$ 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                       | $I_{IN}$                              | $V_{IN} = V_{IO}$ or 0  | 1.8 to 5.5V | FULL           |     |      | 1     | $\mu\text{A}$ |

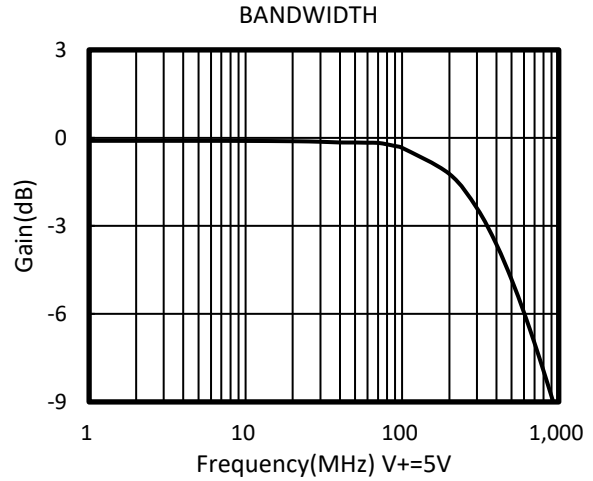
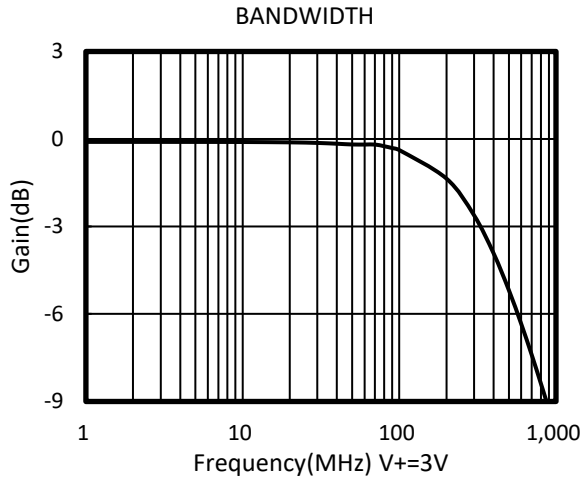
(1) All unused digital inputs of the device must be held at  $V_{IO}$  or GND to ensure proper device operation.

## ELECTRICAL CHARACTERISTICS (continued)

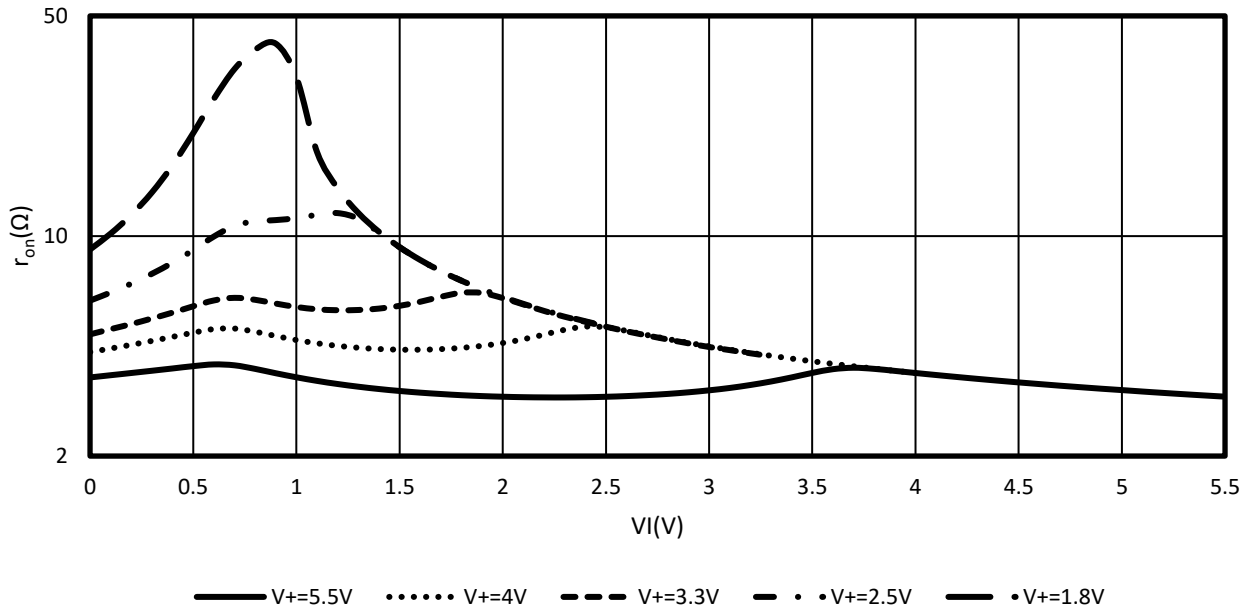
V<sub>+</sub> = 5.0 V, TEMP = -40°C to 125°C (unless otherwise noted)

| PARAMETER                      | SYMBOL  | CONDITIONS   | V <sub>+</sub> | TEMP  | MIN | TYP | MAX | UNITS |
|--------------------------------|---|--|----------------|-------|-----|-----|-----|-------|
| <b>DYNAMIC CHARACTERISTICS</b> |   |  |                |       |     |     |     |       |
| Turn-On Time                   | t <sub>ON</sub>   | V <sub>COM</sub> = V <sub>+</sub> , R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, See Figure 5   | 5V             | +25°C |     | 30  |     | ns    |
|                                |   |  | 3.3V           |       |     | 40  |     |       |
| Turn-Off Time                  | t <sub>OFF</sub>  | V <sub>COM</sub> = V <sub>+</sub> , R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, See Figure 5   | 5V             | +25°C |     | 25  |     | ns    |
|                                |   |  | 3.3V           |       |     | 30  |     |       |
| Break-Before-Make Time Delay   | t <sub>BBM</sub>  | V <sub>NO1</sub> = V <sub>NC1</sub> = V <sub>NO2</sub> = V <sub>NC2</sub> = 3V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, See Figure 6 | 5V             | +25°C |     | 5   |     | ns    |
|                                |   |  | 3.3V           |       |     | 8   |     |       |
| Off Isolation                  | O <sub>ISO</sub>  | R <sub>L</sub> = 50Ω, Switch OFF, See Figure 8   | f = 10MHz      | +25°C |     | -52 |     | dB    |
|                                |   |  | f = 1MHz       | +25°C |     | -71 |     | dB    |
| -3dB Bandwidth                 | BW  | Switch ON, R <sub>L</sub> = 50Ω<br>See Figure 7  |                | +25°C |     | 300 |     | MHz   |
| NC, NO OFF Capacitance         | C <sub>NC(OFF)</sub> ,<br>C <sub>NO(OFF)</sub>                      | V <sub>NC</sub> or V <sub>NO</sub> = V <sub>+</sub> /2 or GND, Switch OFF See Figure 4   |                | +25°C |     | 5   |     | pF    |
| NC, NO, COM ON Capacitance     | C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> ,<br>C <sub>COM(ON)</sub> | V <sub>NC</sub> or V <sub>NO</sub> = V <sub>+</sub> /2 or GND, Switch ON See Figure 4  |                | +25°C |     | 15  |     | pF    |
| <b>POWER REQUIREMENTS</b>      |   |  |                |       |     |     |     |       |
| Power Supply Range             | V <sub>+</sub>  |  |                | FULL  | 1.8 |     | 5.5 | V     |
| Power Supply Current           | I <sub>+</sub>  | V <sub>IN</sub> = GND  | 5.5V           | FULL  |     |     | 1   | μA    |
|                                |   | V <sub>IN</sub> = V <sub>+</sub>   | 5.5V           | FULL  |     |     | 1   | μA    |

### TYPICAL CHARACTERISTICS



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



### Parameter Measurement Information

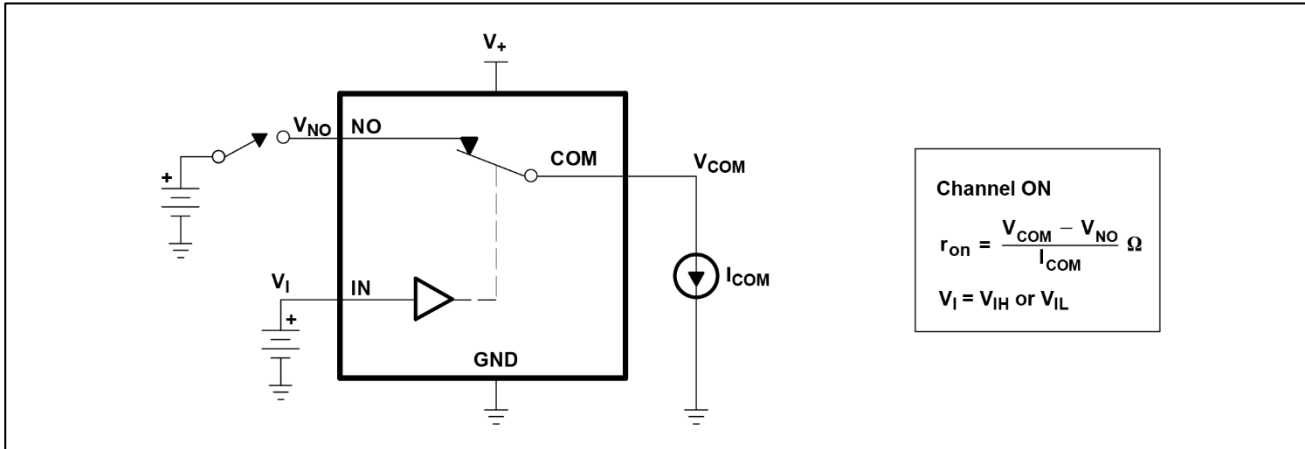


Figure 1.ON-State Resistance ( $r_{on}$ )

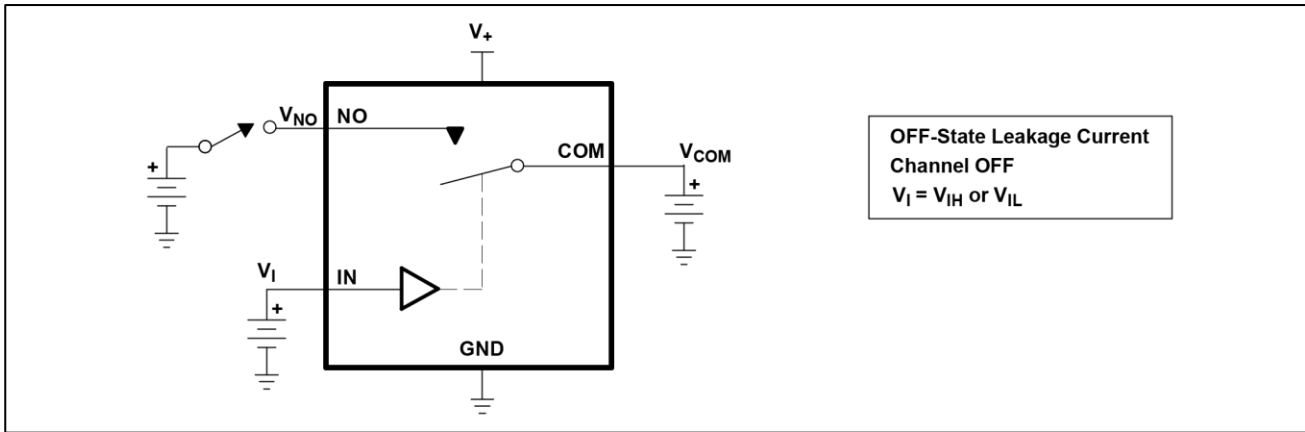


Figure 2.OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NO(OFF)}$ )

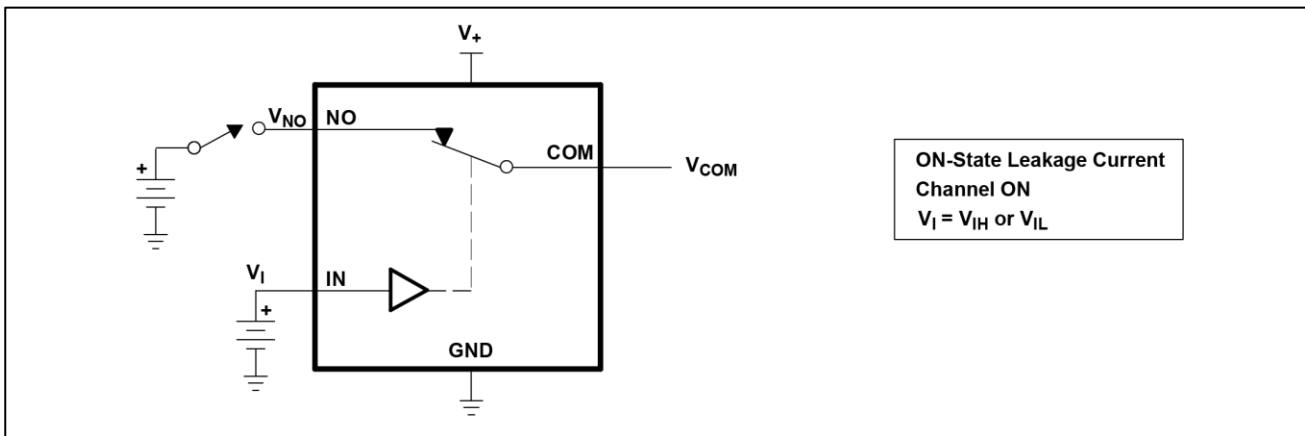


Figure 3.ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NO(ON)}$ )

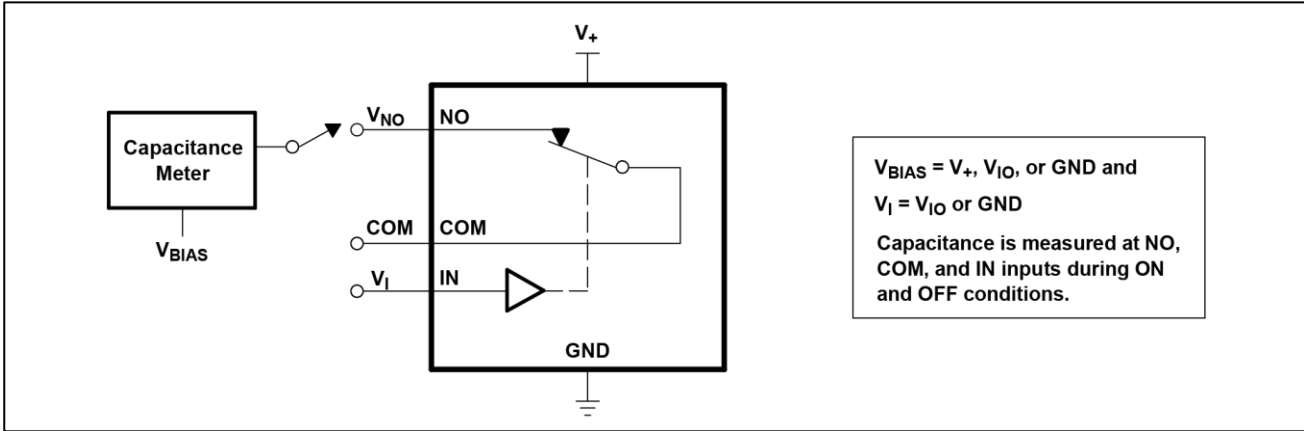


Figure 4. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NO(OFF)}$ ,  $C_{NO(ON)}$ )

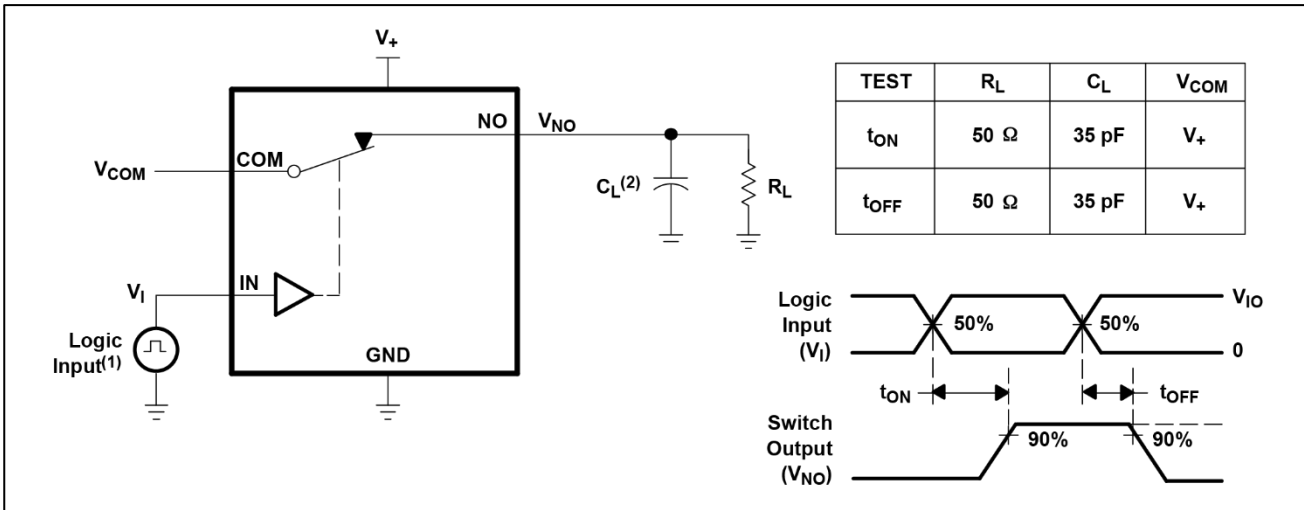


Figure 5. Turn-On ( $t_{ON}$ ) and Turn-Off Time ( $t_{OFF}$ )

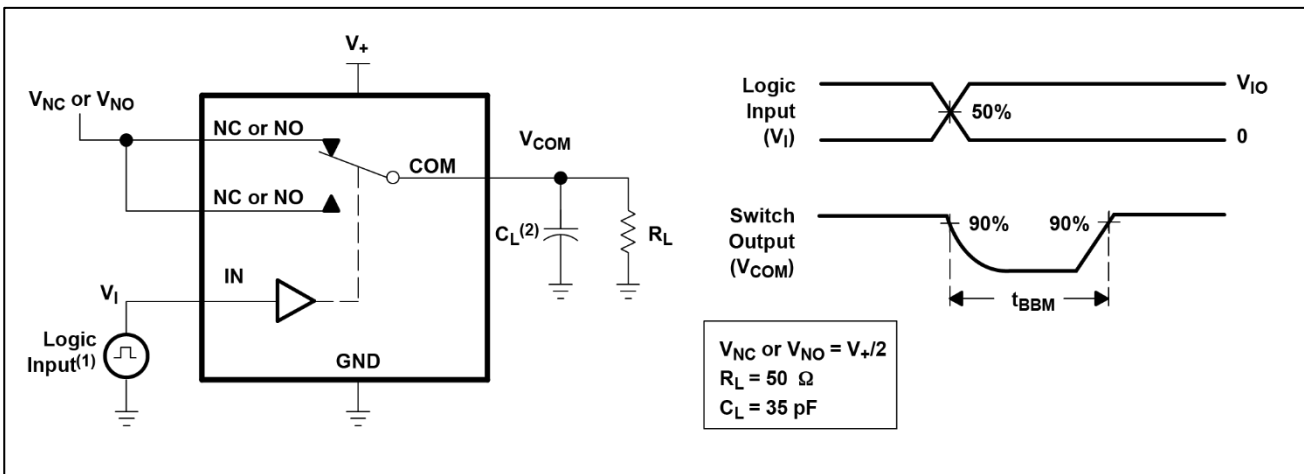


Figure 6. Break-Before-Make Time ( $t_{BBM}$ )



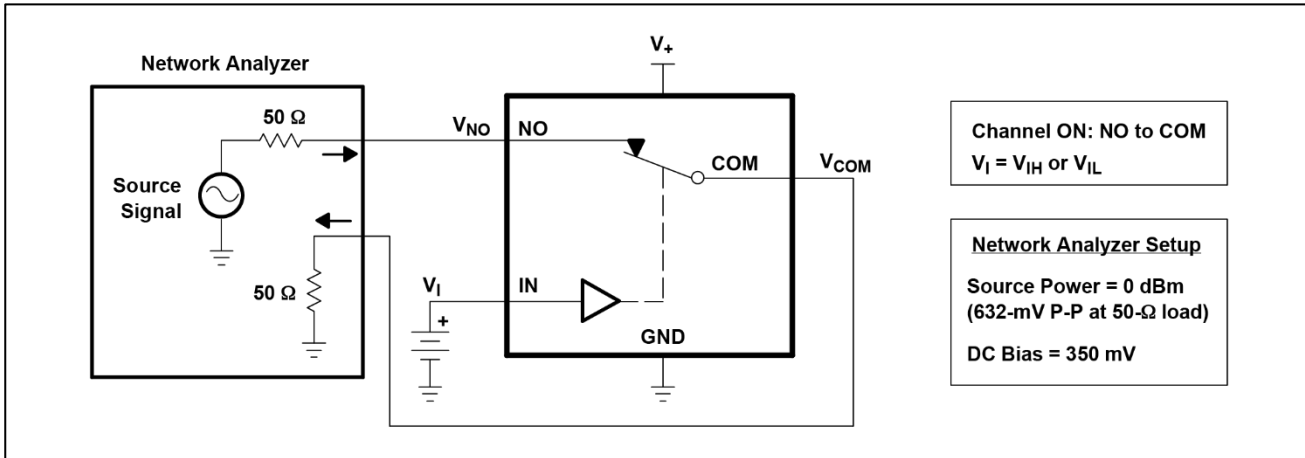


Figure 7. Bandwidth (BW)

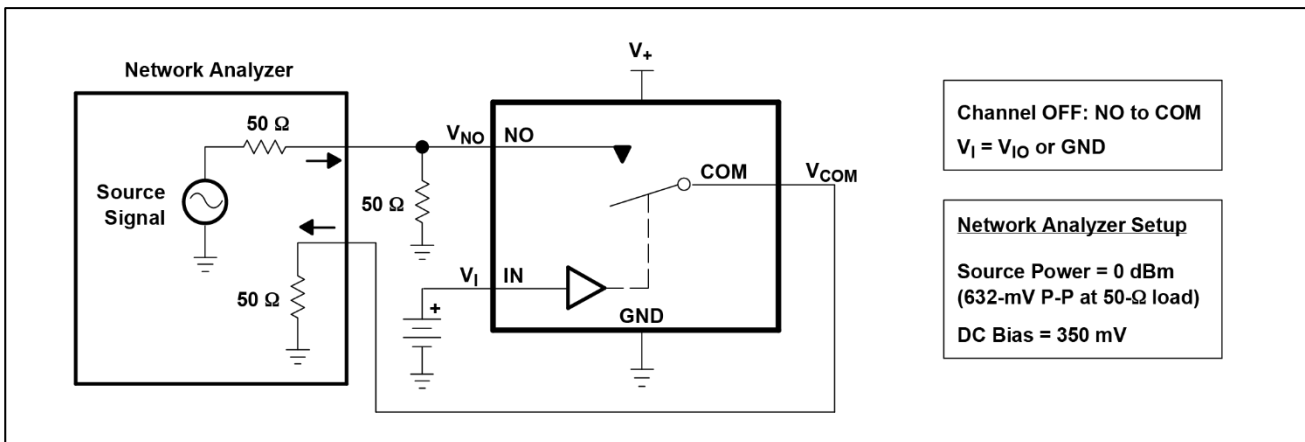


Figure 8. OFF Isolation ( $O_{iso}$ )

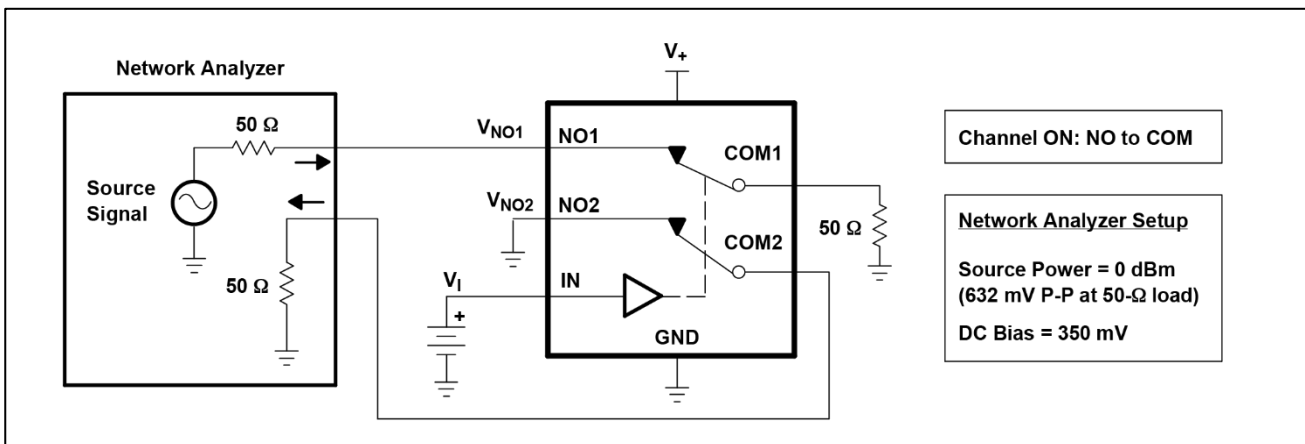


Figure 9. Crosstalk ( $X_{TALK}$ )

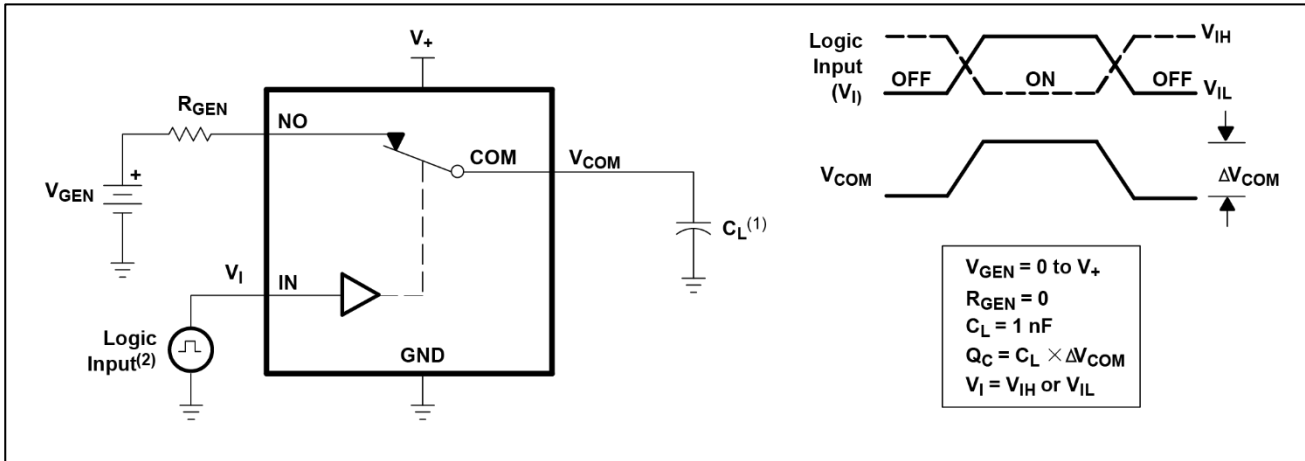


Figure 10.Charge Injection ( $Q_c$ )

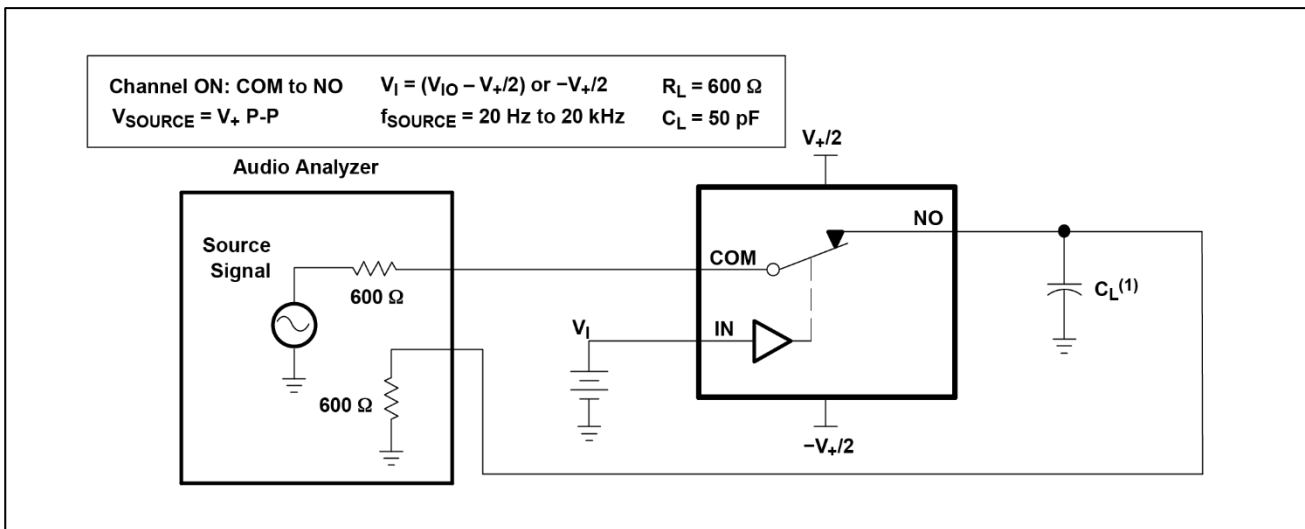
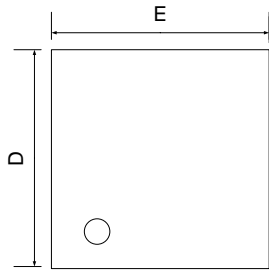


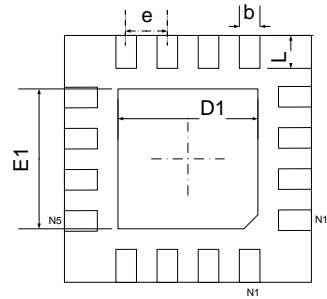
Figure11.Total Harmonic Distortion (THD)

# PACKAGE OUTLINE DIMENSIONS

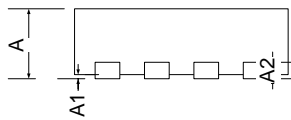
## QFN-3x3-16L



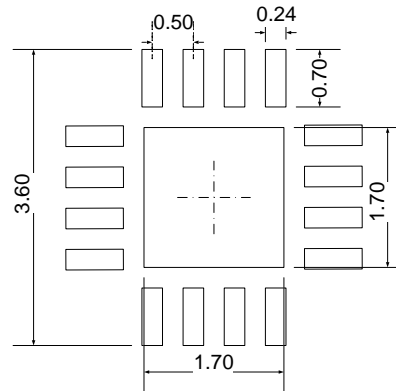
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 0.700                     | 0.800 | 0.028                | 0.031 |
| A1     | 0.000                     | 0.050 | 0.000                | 0.002 |
| A2     | 0.203                     |       | 0.008                |       |
| b      | 0.180                     | 0.300 | 0.007                | 0.012 |
| D      | 2.900                     | 3.100 | 0.114                | 0.122 |
| D1     | 1.600                     | 1.800 | 0.063                | 0.071 |
| E      | 2.900                     | 3.100 | 0.114                | 0.122 |
| E1     | 1.600                     | 1.800 | 0.063                | 0.071 |
| e      | 0.500 TYP                 |       | 0.020 TYP            |       |
| L      | 0.300                     | 0.500 | 0.012                | 0.020 |