

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

## 1 FEATURES

- **-3dB Bandwidth: 110MHz**
- **High Speed, Typically 50ns**
- **Supply Range: +1.8V to +5.5V**
- **Low ON-State Resistance, 0.6Ω(TYP)**
- **Break-Before-Make Switching**
- **Rail-to-Rail Operation**
- **TTL/CMOS Compatible**
- **Extended Industrial Temperature Range:  
-40°C to +125°C**
- **Micro Size Packages: UQFN1.4X1.8-10**

## 2 APPLICATIONS

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

## 3 DESCRIPTIONS

The RES5223 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 RES5223 device can handle both analog and digital signals. It features fast switching speeds (50ns) and low on-resistance (0.6Ω TYP).

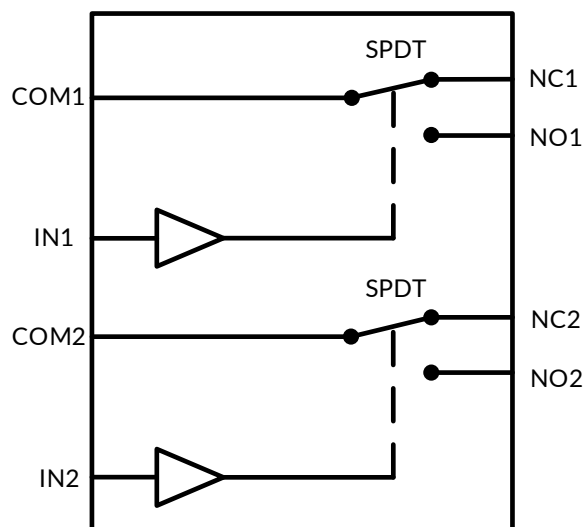
Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

**Device Information <sup>(1)</sup>**

| PART NUMBER | PACKAGE        | BODY SIZE (NOM) |
|-------------|----------------|-----------------|
| RES5223IDR  | UQFN1.4X1.8-10 | 1.80mm×1.40mm   |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

## 4 FUNCTIONAL BLOCK DIAGRAM



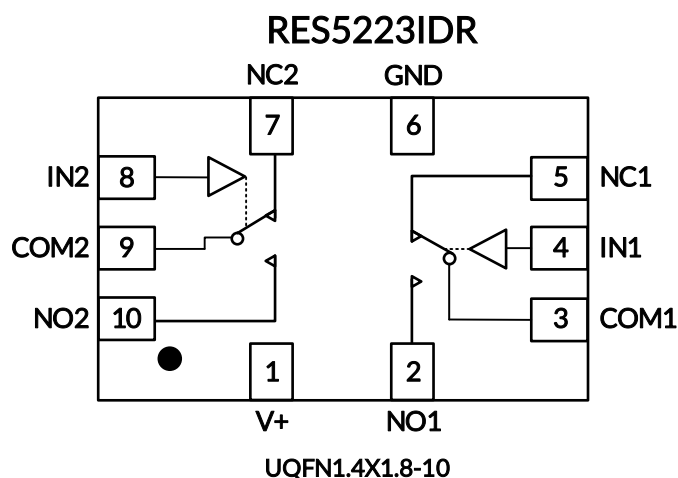
## 6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>

| PRODUCT | ORDERING NUMBER | TEMPERATURE RANGE | PACKAGE LEAD   | PACKAGE MARKING <sup>(2)</sup> | MSL <sup>(3)</sup> | PACKAGE OPTION      |
|---------|-----------------|-------------------|----------------|--------------------------------|--------------------|---------------------|
| RES5223 | RES5223IDR      | -40°C ~125°C      | UQFN1.4X1.8-10 | RES5223IDR                     | MSL3               | Tape and Reel, 4000 |

NOTE:

- (1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.
- (2) 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.
- (3) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

## 7 PIN CONFIGURATION AND FUNCTIONS (TOP VIEW)



### 7.1 Pin Description

| NAME       | PIN            | FUNCTION                                                          |
|------------|----------------|-------------------------------------------------------------------|
|            | UQFN1.4X1.8-10 |                                                                   |
| V+         | 1              | Power Supply                                                      |
| NO1, NO2   | 2,10           | Normally-open terminal                                            |
| COM1, COM2 | 3,9            | Common terminal                                                   |
| IN1, IN2   | 4,8            | Digital control pin to connect COM terminal to NO or NC terminals |
| NC1, NC2   | 5,7            | Normally-closed terminal                                          |
| GND        | 6              | Ground                                                            |

### 7.2 Function Table

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

## 8 SPECIFICATIONS

### 8.1 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 <sup>(2)</sup>            |                | -0.3 | 6                     | V    |
| V <sub>IN</sub>  | Control Input voltage <sup>(2)</sup>     |                | -0.3 | 6                     |      |
| V <sub>I/O</sub> | Switch I/O voltage <sup>(3)(4)</sup>     |                | -0.3 | (V <sub>+</sub> )+0.3 |      |
| I <sub>IN</sub>  | Continuous Current NO, NC or COM         |                | -500 | +500                  | mA   |
| I <sub>I/O</sub> | Peak Current NO, NC, or COM              |                | -800 | +800                  |      |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(5)</sup> | UQFN1.4X1.8-10 |      | 115                   | °C/W |
| T <sub>J</sub>   | Junction temperature <sup>(6)</sup>      |                |      | 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.

(5) The package thermal impedance is calculated in accordance with JEDEC-51.

(6) The maximum power dissipation is a function of T<sub>J(MAX)</sub>, R<sub>θJA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any ambient temperature is P<sub>D</sub> = (T<sub>J(MAX)</sub> - T<sub>A</sub>) / R<sub>θJA</sub>. All numbers apply for packages soldered directly onto a PCB.

### 8.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

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



#### 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.

### 8.3 Recommended Operating Conditions

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

| SYMBOL         | PARAMETER             | MIN | MAX            | UNIT |
|----------------|-----------------------|-----|----------------|------|
| V <sub>+</sub> | Supply voltage        | 1.8 | 5.5            | V    |
| I <sub>N</sub> | Analog voltage        | 0   | 5.5            | V    |
| NO, NC, COM    | Analog voltage        | 0   | V <sub>+</sub> | V    |
| T <sub>A</sub> | Operating temperature | -40 | +125           | °C   |

## 8.4 Electrical Characteristics

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

| PARAMETER                                    | SYMBOL                                                              | CONDITIONS                                                                                               | V+          | T <sub>A</sub> | MIN <sup>(2)</sup> | TYP <sup>(3)</sup> | MAX <sup>(2)</sup> | UNIT |
|----------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------|----------------|--------------------|--------------------|--------------------|------|
| <b>ANALOG SWITCH</b>                         |                                                                     |                                                                                                          |             |                |                    |                    |                    |      |
| Analog Signal Range                          | V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>                |                                                                                                          |             | FULL           | 0                  |                    | V+                 | V    |
| On-Resistance                                | R <sub>ON</sub>                                                     | 0 ≤ (V <sub>NO</sub> or V <sub>NC</sub> ) ≤ V+,<br>I <sub>COM</sub> = -10mA, Switch ON,<br>See Figure 16 | 5V          | +25°C          |                    | 0.6                | 1.0                | Ω    |
|                                              |                                                                     |                                                                                                          |             | FULL           |                    |                    | 1.2                | Ω    |
|                                              |                                                                     | V <sub>NO</sub> or V <sub>NC</sub> = 2V,<br>I <sub>COM</sub> = -10mA, Switch ON,<br>See Figure 16        | 3.3V        | +25°C          |                    | 1.4                | 1.8                | Ω    |
|                                              |                                                                     |                                                                                                          |             | FULL           |                    |                    | 2.0                | Ω    |
| On-Resistance Match<br>Between Channels      | ΔR <sub>ON</sub>                                                    | 0 ≤ (V <sub>NO</sub> or V <sub>NC</sub> ) ≤ V+,<br>I <sub>COM</sub> = -10mA, Switch ON,<br>See Figure 16 | 5V          | +25°C          |                    | 0.04               | 0.1                | Ω    |
|                                              |                                                                     |                                                                                                          |             | FULL           |                    |                    | 0.12               | Ω    |
|                                              |                                                                     |                                                                                                          | 3.3V        | +25°C          |                    | 0.04               | 0.1                | Ω    |
|                                              |                                                                     |                                                                                                          |             | FULL           |                    |                    | 0.12               | Ω    |
| On-Resistance Flatness                       | R <sub>FLAT(ON)</sub>                                               | 0 ≤ (V <sub>NO</sub> or V <sub>NC</sub> ) ≤ V+,<br>I <sub>COM</sub> = -10mA, Switch ON,<br>See Figure 16 | 5V          | +25°C          |                    | 0.18               | 0.3                | Ω    |
|                                              |                                                                     |                                                                                                          |             | FULL           |                    |                    | 0.4                | Ω    |
|                                              |                                                                     |                                                                                                          | 3.3V        | +25°C          |                    | 0.85               | 1.0                | Ω    |
|                                              |                                                                     |                                                                                                          |             | FULL           |                    |                    | 1.2                | Ω    |
| NC, NO OFF<br>Leakage Current                | I <sub>NC(OFF)</sub> , I <sub>NO(OFF)</sub>                         | V <sub>NO</sub> or V <sub>NC</sub> = 0.3V, V+/2<br>V <sub>COM</sub> = V+/2, 0.3V See<br>Figure 17        | 1.8 to 5.5V | FULL           |                    |                    | 1                  | μA   |
| NC, NO, COM ON<br>Leakage Current            | I <sub>NC(ON)</sub> , I <sub>NO(ON)</sub> ,<br>I <sub>COM(ON)</sub> | V <sub>NO</sub> or V <sub>NC</sub> = 0.3V, Open<br>V <sub>COM</sub> = Open, 0.3V<br>See Figure 18        | 1.8 to 5.5V | FULL           |                    |                    | 1                  | μA   |
| <b>DIGITAL CONTROL INPUTS <sup>(1)</sup></b> |                                                                     |                                                                                                          |             |                |                    |                    |                    |      |
| Input High Voltage                           | V <sub>INH</sub>                                                    |                                                                                                          | 5V          | FULL           | 1.5                |                    |                    | V    |
|                                              |                                                                     |                                                                                                          | 3.3V        | FULL           | 1.3                |                    |                    | V    |
| Input Low Voltage                            | V <sub>INL</sub>                                                    |                                                                                                          | 5V          | FULL           |                    |                    | 0.6                | V    |
|                                              |                                                                     |                                                                                                          | 3.3V        | FULL           |                    |                    | 0.5                | V    |
| Input Leakage Current                        | I <sub>IN</sub>                                                     | V <sub>IN</sub> = V <sub>IO</sub> or 0                                                                   | 1.8 to 5.5V | FULL           |                    |                    | 1                  | μA   |

(1) All unused digital inputs of the device must be held at V<sub>IO</sub> or GND to ensure proper device operation.

(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

## Electrical Characteristics (continued)

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

| PARAMETER                      | SYMBOL                                            | CONDITIONS                                                                   | $V_+$ | $T_A$ | MIN | TYP | MAX | UNIT          |
|--------------------------------|---------------------------------------------------|------------------------------------------------------------------------------|-------|-------|-----|-----|-----|---------------|
| <b>DYNAMIC CHARACTERISTICS</b> |                                                   |                                                                              |       |       |     |     |     |               |
| Turn-On Time                   | $t_{ON}$                                          | $V_{COM} = V_+$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ ,<br>See Figure 20 | 5V    | +25°C |     | 35  |     | ns            |
|                                |                                                   |                                                                              |       | FULL  |     |     | 50  |               |
|                                |                                                   |                                                                              | 3.3V  | +25°C |     | 55  |     |               |
|                                |                                                   |                                                                              |       | FULL  |     |     | 70  |               |
| Turn-Off Time                  | $t_{OFF}$                                         | $V_{COM} = V_+$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ ,<br>See Figure 20 | 5V    | +25°C |     | 7.5 |     | ns            |
|                                |                                                   |                                                                              |       | FULL  |     |     | 15  |               |
|                                |                                                   |                                                                              | 3.3V  | +25°C |     | 12  |     |               |
|                                |                                                   |                                                                              |       | FULL  |     |     | 17  |               |
| Crosstalk                      | $X_{TALK}$                                        | $V_+ = 5.5\text{V}$ , Switch on, $R_L = 50\Omega$ , $F = 100\text{KHz}$      | 5.5V  | +25°C |     | -80 |     | dB            |
| Break before make time         | $t_{BBM}$                                         | $V_+ = V_{COM} = 5\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$        | 5V    | +25°C |     | 2.5 |     | ns            |
|                                |                                                   |                                                                              |       | FULL  | 1   |     |     |               |
| Off Isolation                  | $O_{ISO}$                                         | $R_L = 50\Omega$ , Switch ON,<br>See Figure 23                               | 5.5V  | +25°C |     | -70 |     | dB            |
|                                |                                                   |                                                                              | 5.5V  | +25°C |     | -86 |     | dB            |
| -3dB Bandwidth                 | BW                                                | Switch ON, $R_L = 50\Omega$ , See Figure 22                                  | 5.5V  | +25°C |     | 110 |     | MHz           |
| NC, NO OFF Capacitance         | $C_{NC(OFF)}$ ,<br>$C_{NO(OFF)}$                  | $V_{NC}$ or $V_{NO} = V_+/2$ or GND, Switch OFF<br>See Figure 19             | 5V    | +25°C |     | 30  |     | pF            |
| NC, NO, COM ON Capacitance     | $C_{NC(ON)}$ ,<br>$C_{NO(ON)}$ ,<br>$C_{COM(ON)}$ | $V_{NC}$ or $V_{NO} = V_+/2$ or GND, Switch ON<br>See Figure 19              | 5V    | +25°C |     | 100 |     | 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  | +25°C |     |     | 1   | $\mu\text{A}$ |
|                                |                                                   |                                                                              |       | FULL  |     |     | 1   |               |
| Supply-Current Change          | $\Delta I_+$                                      | $V_+ = 5.5\text{V}$ , $V_{IN} = 3.4\text{V}$                                 | 5.5V  | FULL  |     |     | 10  | $\mu\text{A}$ |

## 8.5 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

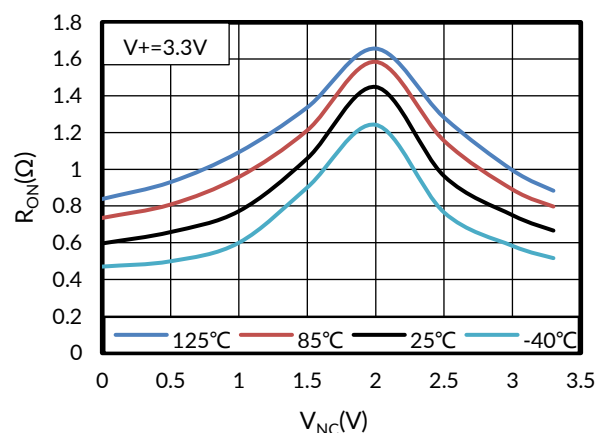


Figure 1. On-Resistance vs NC Voltage

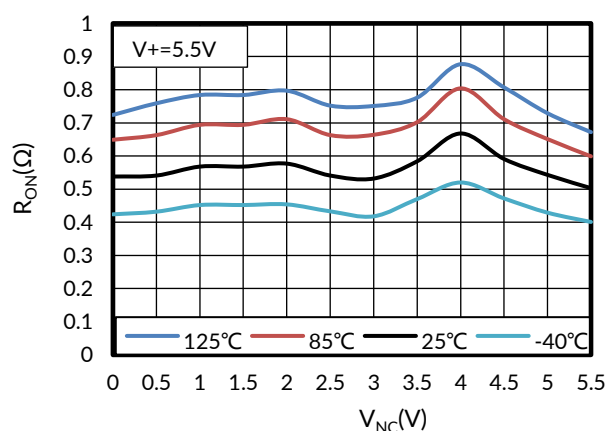


Figure 2. On-Resistance vs NC Voltage

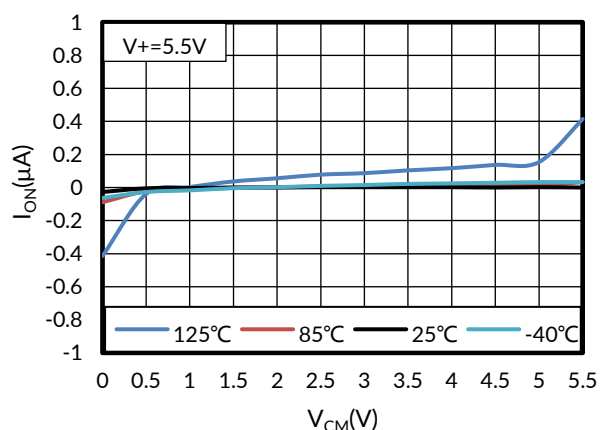


Figure 3. ON-State Leakage Current vs Common-Mode Voltage

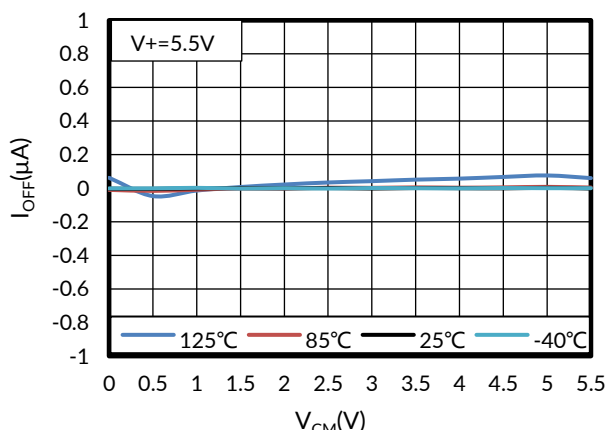


Figure 4. OFF-State Leakage Current vs Common-Mode Voltage

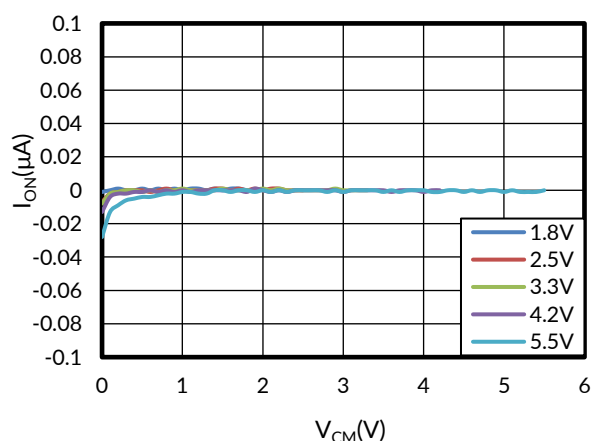


Figure 5. ON-State Leakage Current vs Common-Mode Voltage

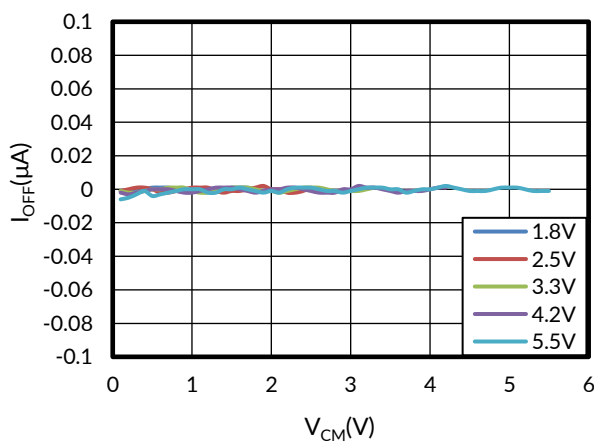


Figure 6. OFF-State Leakage Current vs Common-Mode Voltage

## Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

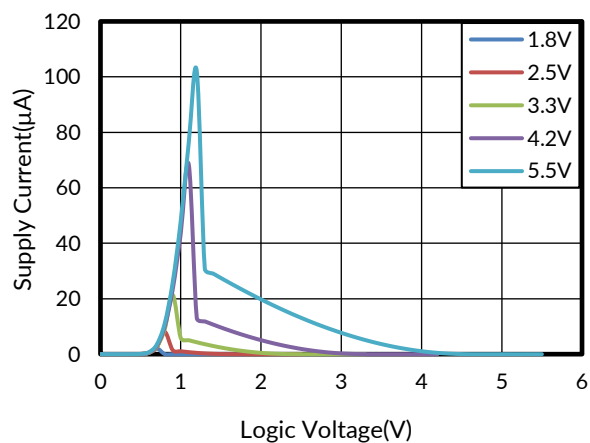


Figure 7. Supply Current vs Logic Voltage

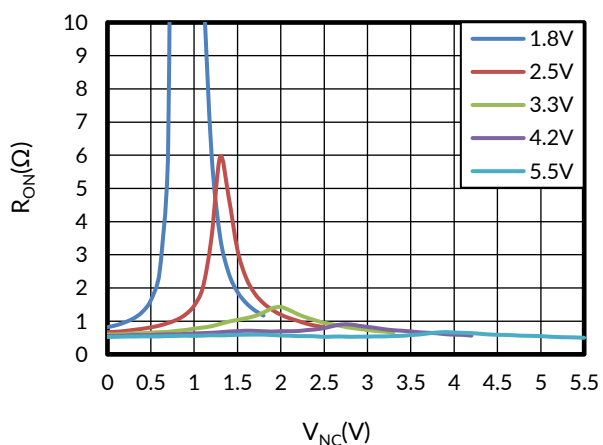


Figure 8. On-Resistance vs NC Voltage

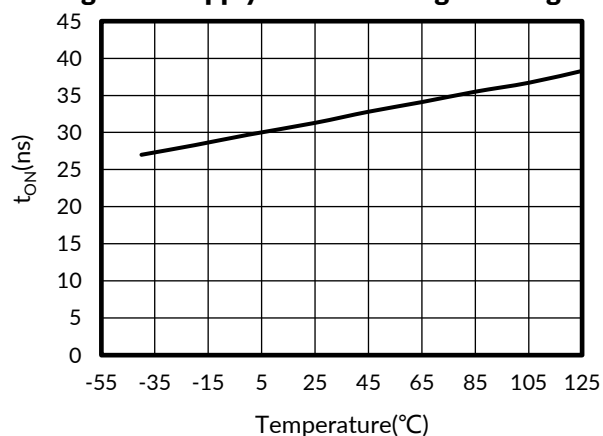


Figure 9. Turn on Time vs Temperature

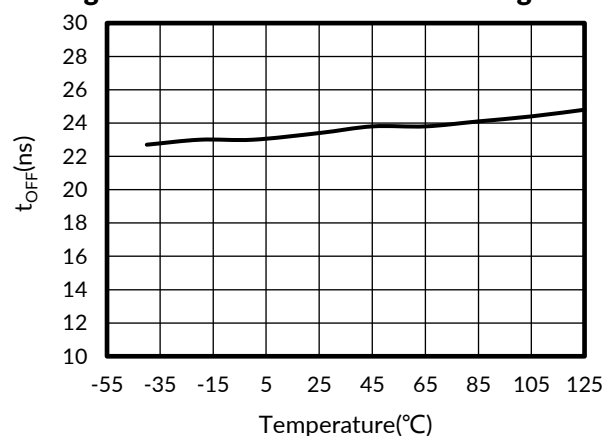


Figure 10. Turn-off Time vs Temperature

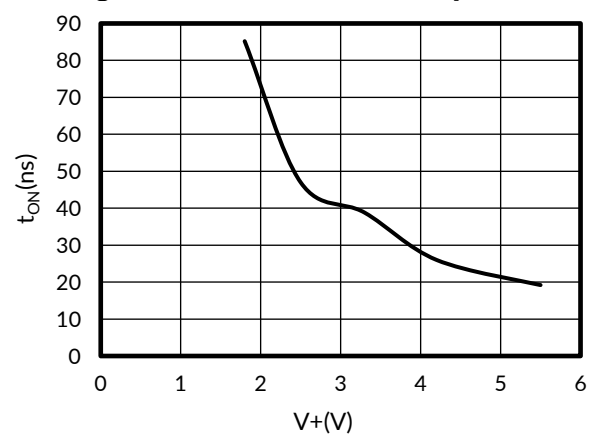


Figure 11. Turn On Time vs Supply Voltage

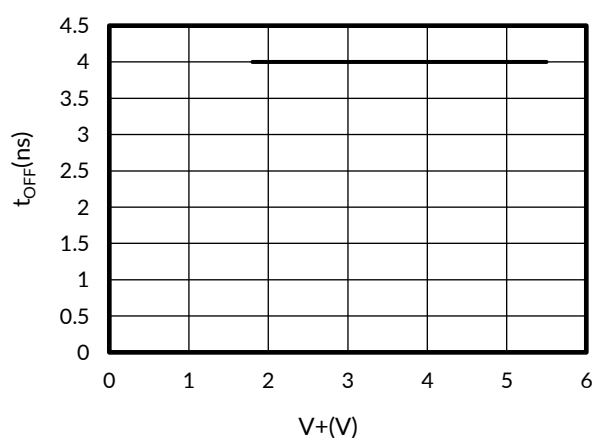


Figure 12. Turn-Off Time vs Supply Voltage

## Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

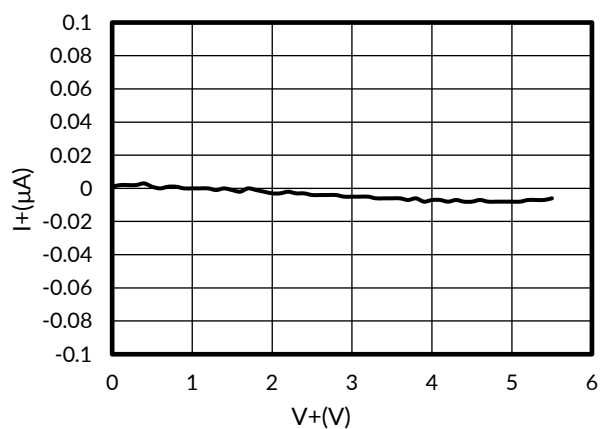


Figure 13. Supply Current vs Supply Voltage

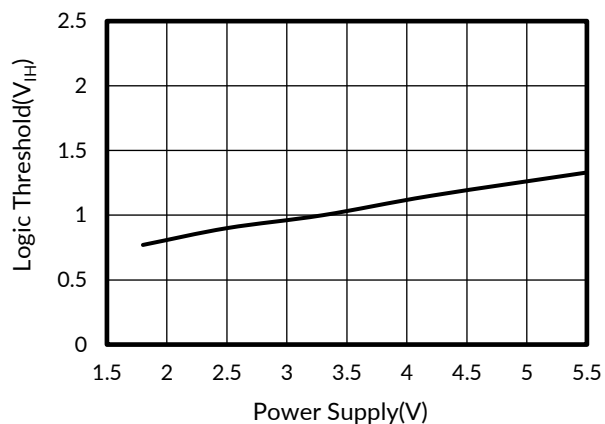


Figure 14. Logic Threshold vs Power Supply

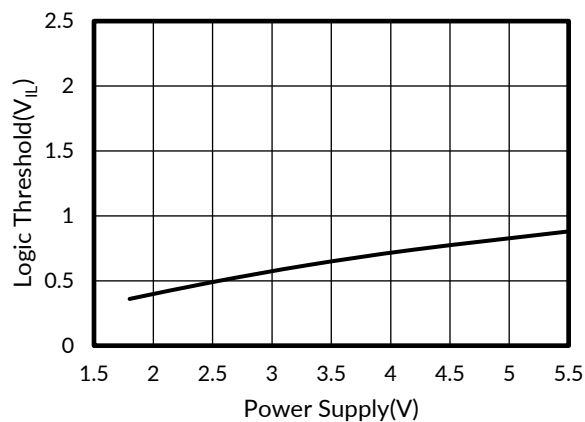


Figure 15. Logic Threshold vs Power Supply



## 9 PARAMETER MEASUREMENT INFORMATION

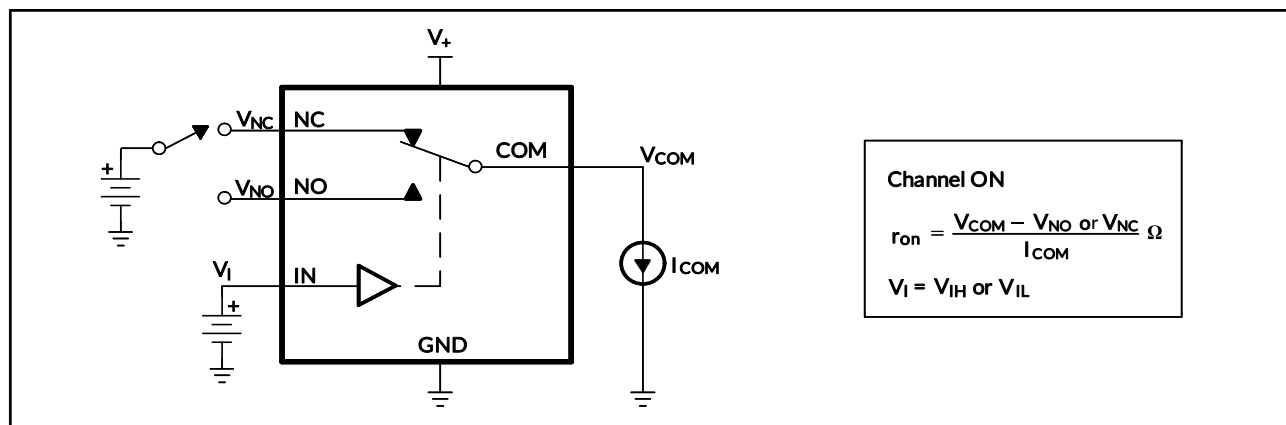


Figure 16. ON-State Resistance ( $r_{on}$ )

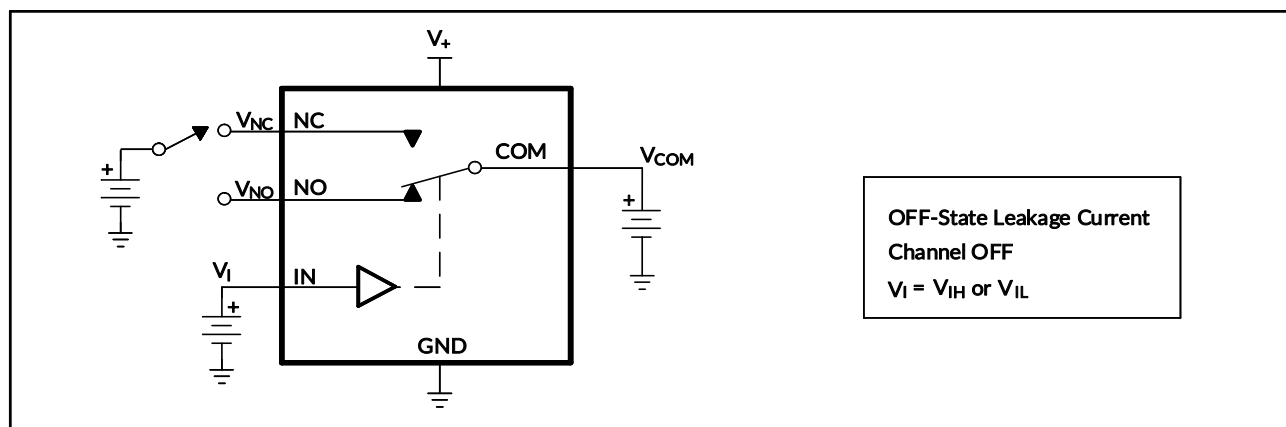


Figure 17. OFF-State Leakage Current ( $I_{NC(OFF)}$ ,  $I_{NO(OFF)}$ )

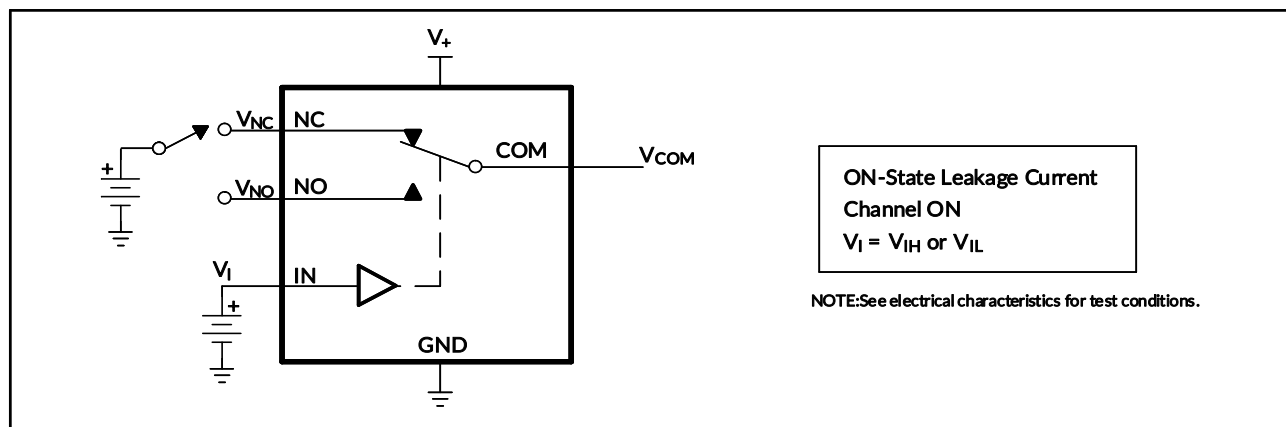


Figure 18. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NC(ON)}$ ,  $I_{NO(ON)}$ )

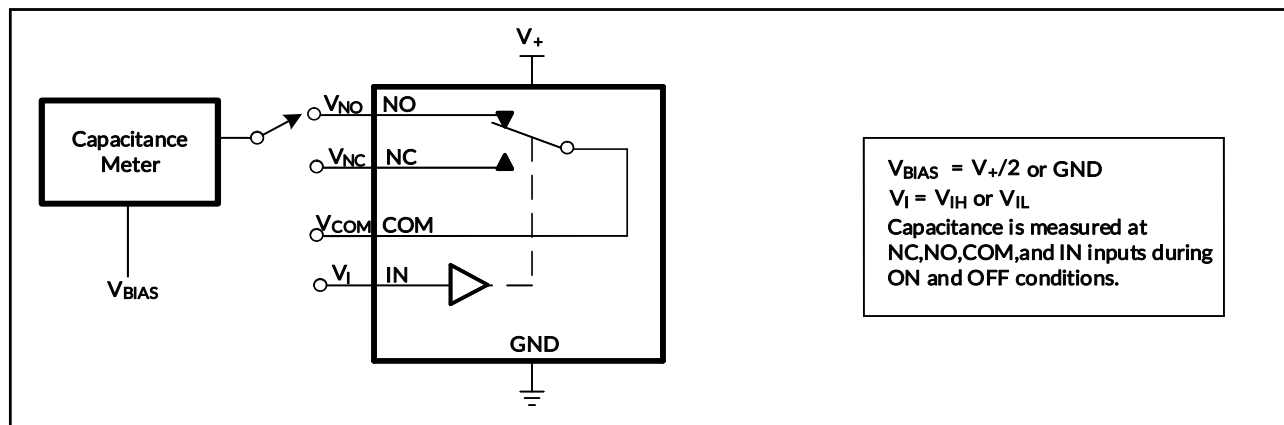


Figure 19. Capacitance ( $C_I$ ,  $C_{COM(ON)}$ ,  $C_{NC(OFF)}$ ,  $C_{NC(ON)}$ ,  $C_{NO(OFF)}$ ,  $C_{NO(ON)}$ )

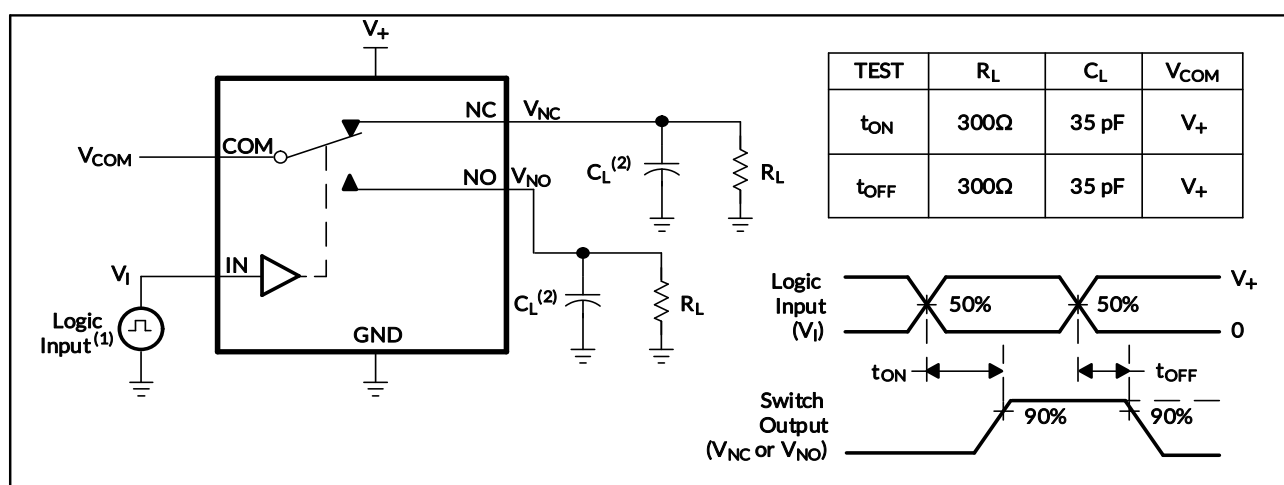


Figure 20. Turn-On ( $t_{ON}$ ) and Turn-Off Time ( $t_{OFF}$ )

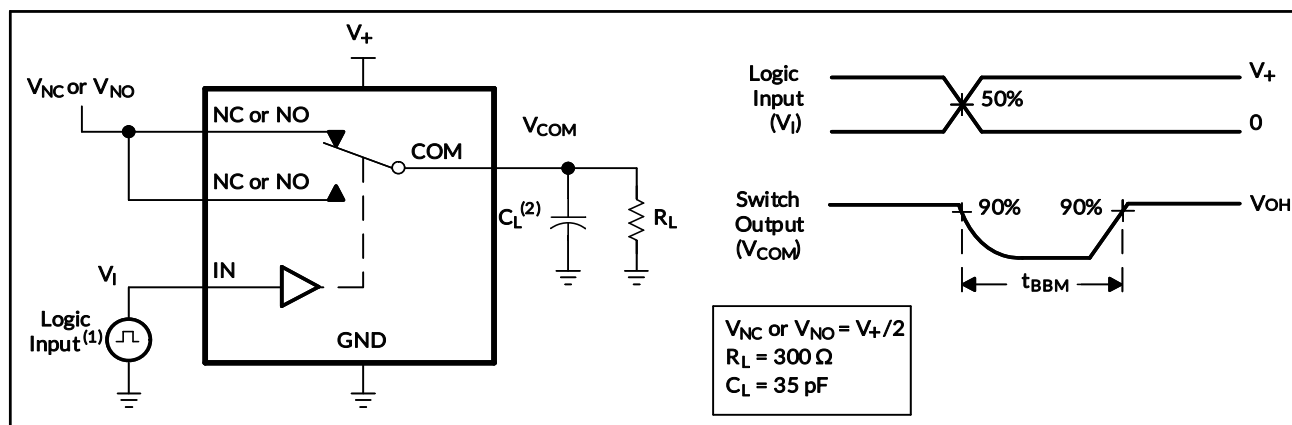


Figure 21. Break-Before-Make Time ( $t_{BBM}$ )

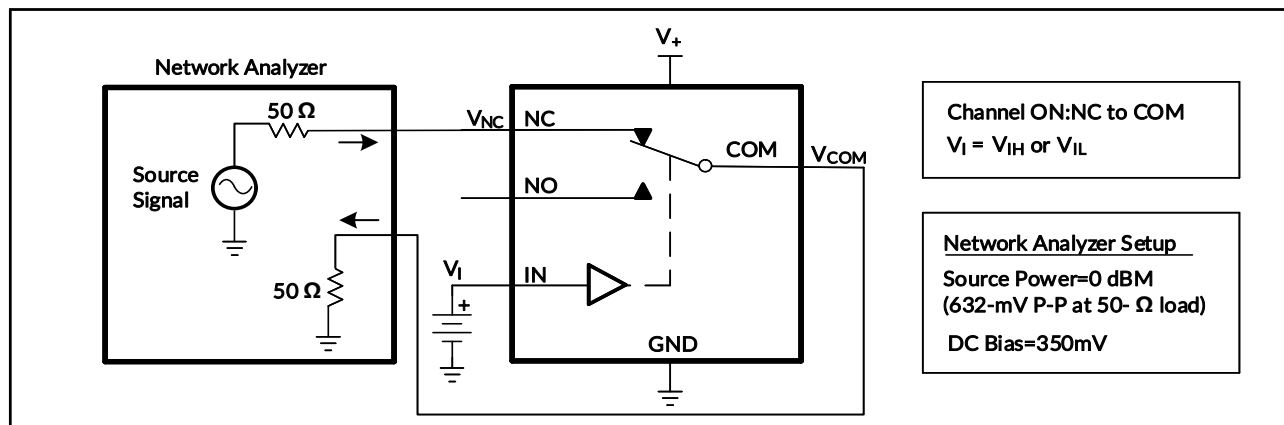


Figure 22. Bandwidth (BW)

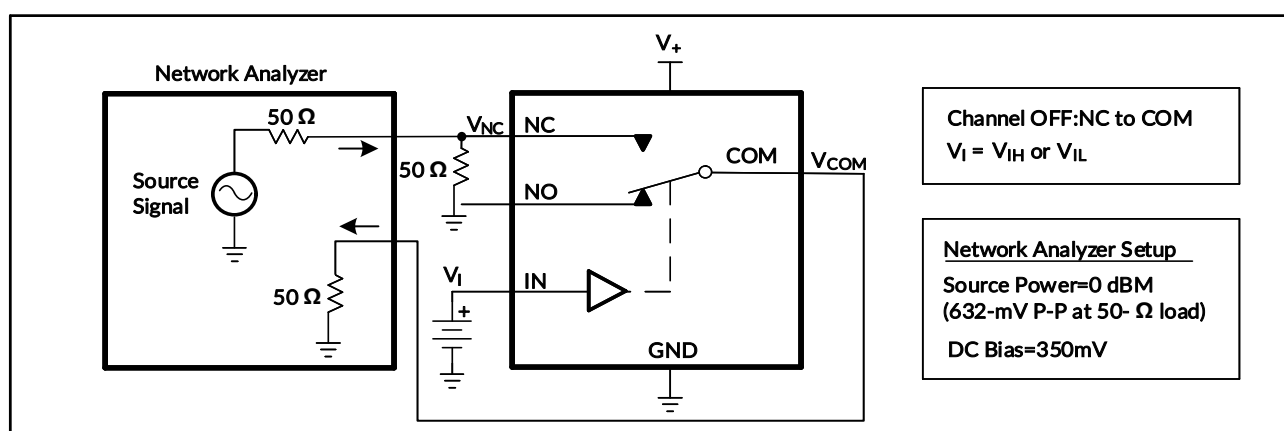


Figure 23. OFF Isolation ( $O_{Iso}$ )

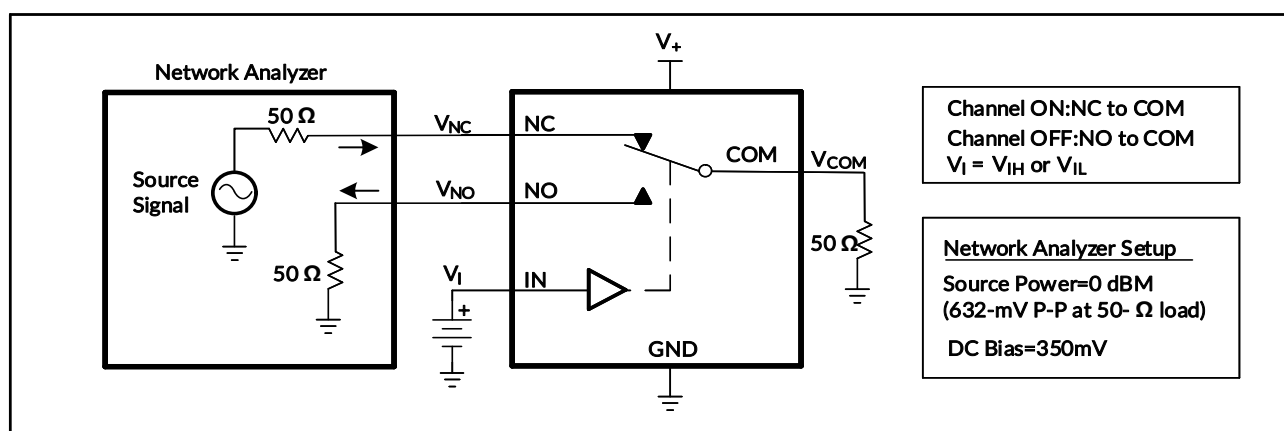


Figure 24. Crosstalk ( $X_{TALK}$ )

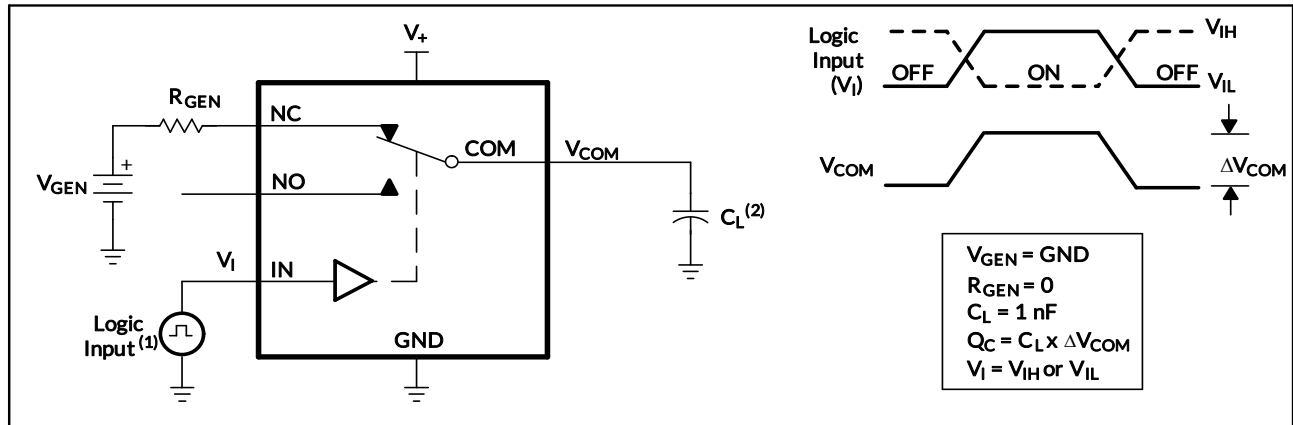


Figure 25. Charge Injection ( $Q_C$ )

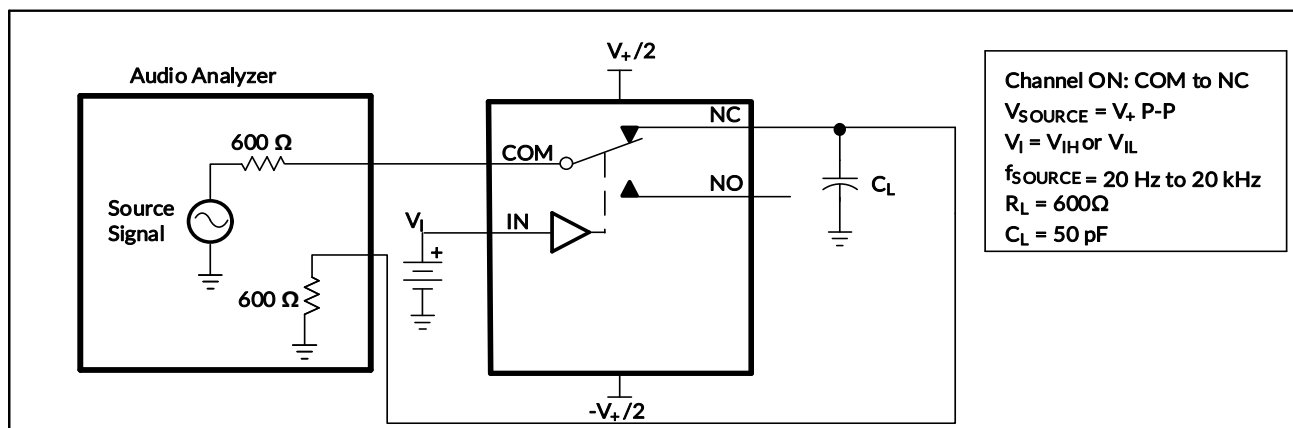
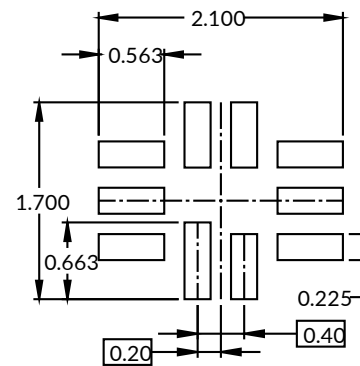
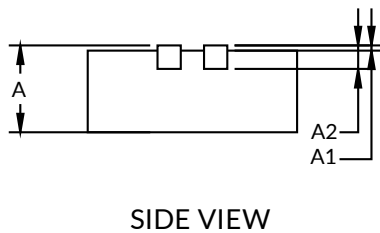
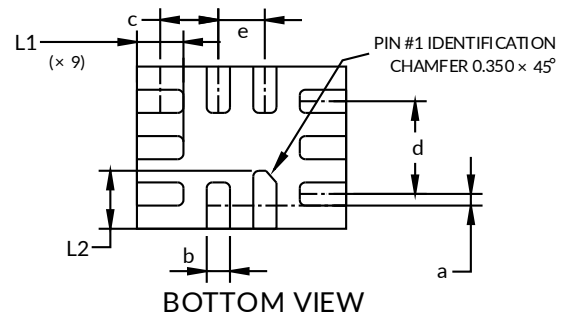
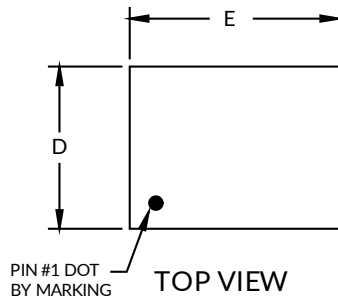


Figure 26. Total Harmonic Distortion (THD)

## 10 PACKAGE OUTLINE DIMENSIONS

### UQFN1.4X1.8-10<sup>(3)</sup>



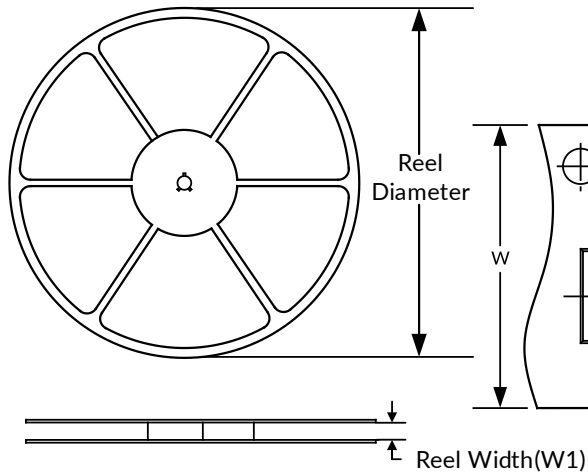
| Symbol           | Dimensions In Millimeters |       | Dimensions In Inches     |       |
|------------------|---------------------------|-------|--------------------------|-------|
|                  | Min                       | Max   | Min                      | Max   |
| A <sup>(1)</sup> | 0.500                     | 0.600 | 0.020                    | 0.024 |
| A1               | 0.000                     | 0.050 | 0.000                    | 0.002 |
| A2               | 0.203 REF <sup>(2)</sup>  |       | 0.008 REF <sup>(2)</sup> |       |
| a                | 0.050                     | 0.150 | 0.002                    | 0.006 |
| b                | 0.150                     | 0.250 | 0.006                    | 0.010 |
| c                | 0.450                     | 0.550 | 0.018                    | 0.022 |
| d                | 0.800 REF <sup>(2)</sup>  |       | 0.031 REF <sup>(2)</sup> |       |
| D <sup>(1)</sup> | 1.350                     | 1.450 | 0.053                    | 0.057 |
| E <sup>(1)</sup> | 1.750                     | 1.850 | 0.069                    | 0.073 |
| e                | 0.400 TYP                 |       | 0.016 TYP                |       |
| L1               | 0.350                     | 0.450 | 0.014                    | 0.018 |
| L2               | 0.450                     | 0.550 | 0.018                    | 0.022 |

NOTE:

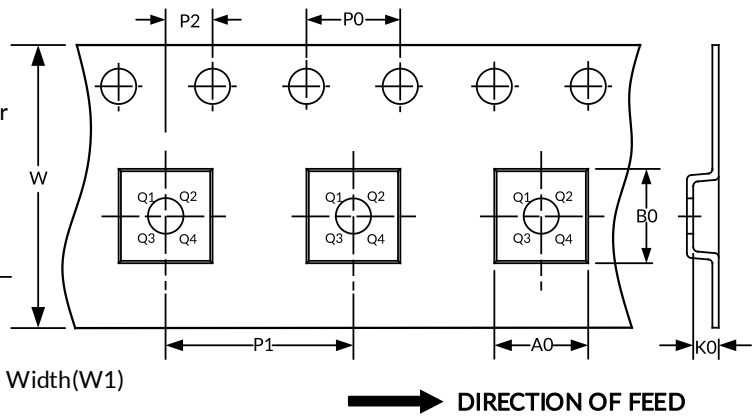
1. Plastic or metal protrusions of 0.075mm maximum per side are not included.
2. REF is the abbreviation for Reference.
3. This drawing is subject to change without notice.

## 11 TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF TAPE AND REEL

| Package Type   | Reel Diameter | Reel Width (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|----------------|---------------|-----------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| UQFN1.4X1.8-10 | 7"            | 9.0             | 1.60    | 2.00    | 0.85    | 4.0     | 4.0     | 2.0     | 8.0    | Q1            |

NOTE:

1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.