

# 4.5Ω Low Voltage SPDT Analog Switch

## 1 FEATURES

- **High Bandwidth: 340MHz**
- **High Speed:**
  - $t_{pd}$ : 2ns at  $V_{CC}=2.3V$  to 5.5V Typically
  - $t_{on}$ : 4ns at  $V_{CC}=5V$  Typically
  - $t_{off}$ : 3.5ns at  $V_{CC}=5V$  Typically
- **Supply Range: 1.65V to 5.5V**
- **Low ON-State Resistance: 4.5Ω(TYP)**
- **Break-Before-Make Switching**
- **Rail-to-Rail Operation**
- **Extended Industrial Temperature Range: -40°C to 125°C**
- **ESD Protection Exceeds JESD 22**
  - 3000-V Human-Body Model
  - 1000-V Charged-Device Model (JS-002)
- **Micro SIZE PACKAGES: SC70-6, SOT23-6**

## 2 APPLICATIONS

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

## 3 DESCRIPTIONS

The RS2057A is a single-pole double-throw (SPDT) analog switch that is designed to operate from 1.65 V to 5.5 V.

The RS2057A device can handle both analog and digital signals. It features high-bandwidth (340MHz) and low on-resistance (4.5Ω TYP).

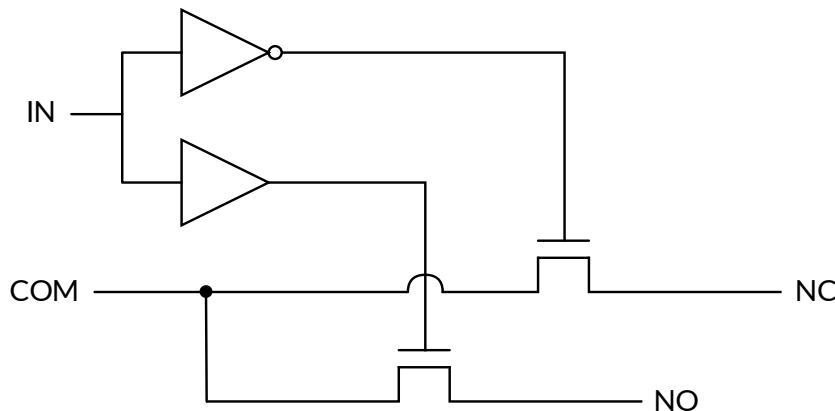
Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

**Device Information (1)**

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2057A	SOT23-6	2.92mm×1.60mm
	SC70-6	2.10mm×1.25mm

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

## 4 BLOCK DIAGRAM



## Table of Contents

<b>1 FEATURES</b> .....	1
<b>2 APPLICATIONS</b> .....	1
<b>3 DESCRIPTIONS</b> .....	1
<b>4 BLOCK DIAGRAM</b> .....	1
<b>5 REVISION HISTORY</b> .....	3
<b>6 PACKAGE/ORDERING INFORMATION</b> <sup>(1)</sup> .....	4
<b>7 PIN CONFIGURATION</b> .....	5
<b>8 SPECIFICATIONS</b> .....	6
8.1 Absolute Maximum Ratings .....	6
8.2 ESD Ratings .....	6
8.3 Recommended Operating Conditions .....	6
8.4 ELECTRICAL CHARACTERISTICS .....	7
8.5 TYPICAL CHARACTERISTICS .....	11
<b>9 PARAMETER MEASUREMENT INFORMATION</b> .....	12
<b>10 APPLICATION AND IMPLEMENTATION</b> .....	18
10.1 Application Information .....	18
10.2 Typical Application .....	18
<b>11 PACKAGE OUTLINE DIMENSIONS</b> .....	19
<b>12 TAPE AND REEL INFORMATION</b> .....	21

## 5 REVISION HISTORY

Note: Page numbers for previous revisions may differ from page numbers in the current version.

VERSION	Change Date	Change Item
A.0	2024/09/05	Preliminary version completed
A.1	2024/11/05	Initial version completed

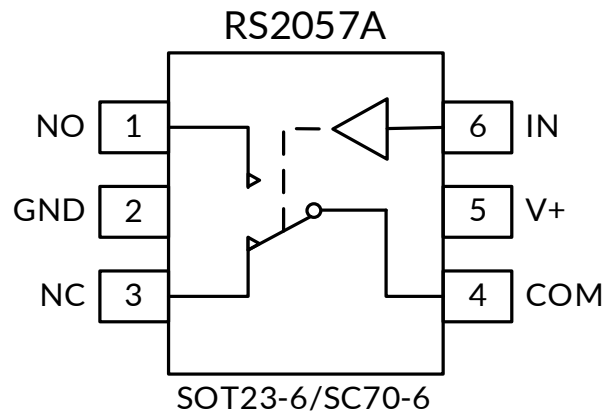
**6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>**

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING <sup>(2)</sup>	MSL <sup>(3)</sup>	PACKAGE OPTION
RS2057A	RS2057AXC6	-40°C ~125°C	SC70-6 <sup>(4)</sup>	2057A	MSL3	Tape and Reel,3000
	RS2057AXH	-40°C ~125°C	SOT23-6	2057A	MSL3	Tape and Reel,3000

## 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) Runic classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F, Please align with Runic if your end application is quite critical to the preconditioning setting or if you have special requirement.
- (4) Equivalent to SOT363.

## 7 PIN CONFIGURATION



NOTE: NO, NC and COM terminals may be an input or output

## PIN DESCRIPTION

NAME	PIN	FUNCTION
	SOT23-6/SC70-6	
NO	1	Normally-Open Terminal
GND	2	Ground
NC	3	Normally-Closed Terminal
COM	4	Common Terminal
V+	5	Power Supply
IN	6	Digital Control Pin

## 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	-0.5	6	V
V <sub>IN</sub>	Input Voltage	-0.5	6	
	Analog, Digital Voltage Range <sup>(2)</sup>	-0.5	(V <sub>+</sub> )+0.5	
	Continuous Current NO, NC, or COM	-50	50	mA
I <sub>+</sub>	Supply current		100	
I <sub>GND</sub>	Ground current	-100		
θ <sub>JA</sub>	Package thermal impedance <sup>(3)</sup>	SOT23-6	235	°C/W
		SC70-6	270	
T <sub>J</sub>	Junction Temperature <sup>(4)</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) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 100mA or less.

(3) The package thermal impedance is calculated in accordance with JESD-51.

(4) 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), per ANSI/ESDA/JEDEC JS001-2023	±3000	V
	Charged-Device Model (CDM), per ANSI/ESDA/JEDEC JS-002-2022	±1000	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)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V <sub>+</sub>	Supply Voltage	1.65	5.5	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 <sub>+</sub>	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>	V <sub>NO</sub> or V <sub>NC</sub> = 0V to V+, I <sub>COM</sub> = -10mA, Switch ON, See Figure 8	1.65V	+25°C		60	65	Ω			
				FULL			70	Ω			
			1.8V	+25°C		42	50	Ω			
				FULL			60	Ω			
			2.7V	+25°C		11	15	Ω			
				FULL			18	Ω			
			3.3V	+25°C		7.5	10	Ω			
				FULL			10.5	Ω			
			5V	+25°C		4.5	7.5	Ω			
				FULL			8.5	Ω			
			On-Resistance Match Between Channels	ΔR <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 0V to V+, I <sub>COM</sub> = -10mA, Switch ON, See Figure 8	1.65V	+25°C		1	1.2	Ω
							FULL			1.5	Ω
1.8V	+25°C					0.8	1	Ω			
	FULL						1.3	Ω			
2.7V	+25°C					0.25	0.35	Ω			
	FULL						0.5	Ω			
3.3V	+25°C					0.15	0.3	Ω			
	FULL						0.4	Ω			
5V	+25°C					0.15	0.3	Ω			
	FULL						0.4	Ω			
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 0V to V+, I <sub>COM</sub> = -10mA, Switch ON, See Figure 8				1.65V	+25°C		51	53	Ω
							FULL			55	Ω
			1.8V	+25°C		38	46	Ω			
				FULL			57	Ω			
			2.7V	+25°C		6	7	Ω			
				FULL			8	Ω			
			3.3V	+25°C		3	4	Ω			
				FULL			4.3	Ω			
			5V	+25°C		2	3	Ω			
				FULL			3.3	Ω			
			NC, NO OFF 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 V <sub>COM</sub> = V+/2, 0.3V See Figure 9	1.65V to 5.5V	FULL			1	μA
			NC, NO,COM ON Leakage Current	I <sub>NC(ON)</sub> , I <sub>NO(ON)</sub> , I <sub>COM(ON)</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 0.3V, Open V <sub>COM</sub> = Open, 0.3V See Figure 10	1.65V to 5.5V	FULL			1	μA

DIGITAL CONTROL INPUTS <sup>(1)</sup>								
Input High Voltage	V <sub>INH</sub>		1.65V to 1.95V	FULL	0.75V <sub>CC</sub>			V
			2.3V to 5.5V	FULL	0.7 V <sub>CC</sub>			V
Input Low Voltage	V <sub>INL</sub>		1.65V to 1.95V	FULL			0.25V <sub>CC</sub>	V
			2.3V to 5.5V	FULL			0.3V <sub>CC</sub>	V
Input Leakage Current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>+</sub> or 0	1.65V 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>												
Propagation delay	$t_{pd}$	$t_{PLH}$ & $t_{PHL}$ , $R_L=500\Omega$ , $C_L=50\text{pF}$ , See Figure 13	1.65V to 1.95V	FULL		6	9	ns				
			2.3V to 5.5V	FULL		2	2.4					
Turn-On Time	$t_{ON}$	$t_{PZH}$ & $t_{PZL}$ , $R_L=500\Omega$ , $C_L=50\text{pF}$ , See Figure 14	1.65V	+25°C		14.5	17	ns				
				FULL	6		28					
			1.8V	+25°C		12.5	13					
				FULL	5		20					
			2.7V	+25°C		7	8					
				FULL	2.5		12					
			3.3V	+25°C		5.5	6.5					
				FULL	2		10					
			5V	+25°C		4	5					
				FULL	1.5		7.5					
			Turn-Off Time	$t_{OFF}$	$t_{PLZ}$ & $t_{PHZ}$ , $R_L=500\Omega$ , $C_L=50\text{pF}$ , See Figure 14	1.65V	+25°C			10	13	ns
							FULL		5		21	
1.8V	+25°C					8.5	12					
	FULL	4					18					
2.7V	+25°C					5	7.5					
	FULL	2					12					
3.3V	+25°C					4	6					
	FULL	1.5					9					
5V	+25°C					3.5	4					
	FULL	1.5					6					
Break-Before-Make Time Delay	$t_{BBM}$	$R_L=50\Omega$ , $C_L=50\text{pF}$ , See Figure 15				1.65V to 1.95V	FULL		9		ns	
						2.3V to 5.5V	FULL		6			
Off Isolation	$O_{ISO}$	$R_L = 50\Omega$ , Switch OFF, See Figure 17		+25°C	f = 10MHz		-58	dB				
					f = 1MHz		-75	dB				
Cross talk	$X_{TALK}$	$R_L = 50\Omega$ , Switch OFF, See Figure 18		+25°C	f = 10MHz		-59	dB				
					f = 1MHz		-76	dB				
-3dB Bandwidth	BW	Switch ON, $R_L = 50\Omega$ , See Figure 16	1.65V to 1.95V	+25°C		340		MHz				
			2.3V to 5.5V	+25°C		340		MHz				
Charge injection	$Q_{INJ}$	$C_L = 0.1\text{nF}$ , See Figure 19	1.65V	+25°C		3.3		pC				
			1.8V	+25°C		3.5		pC				
			2.7V	+25°C		4		pC				
			3.3V	+25°C		5		pC				
			5V	+25°C		8		pC				

NC, NO OFF Capacitance	$C_{NC(OFF)}$ , $C_{NO(OFF)}$	$V_{NC}$ or $V_{NO}=V+/2$ or GND, Switch OFF, See Figure 11		+25°C		9		pF
NC, NO, COM ON Capacitance	$C_{NC(ON)}$ , $C_{NO(ON)}$ , $C_{COM(ON)}$	$V_{NC}$ or $V_{NO}=V+/2$ or GND, Switch ON, See Figure 11		+25°C		16		pF
<b>POWER REQUIREMENTS</b>								
Power Supply Range	$V_+$			FULL	1.65		5.5	V
Power Supply Current	$I_+$	$V_{IN} = \text{GND or } V_+$	5.5V	FULL			1	$\mu\text{A}$

## 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.

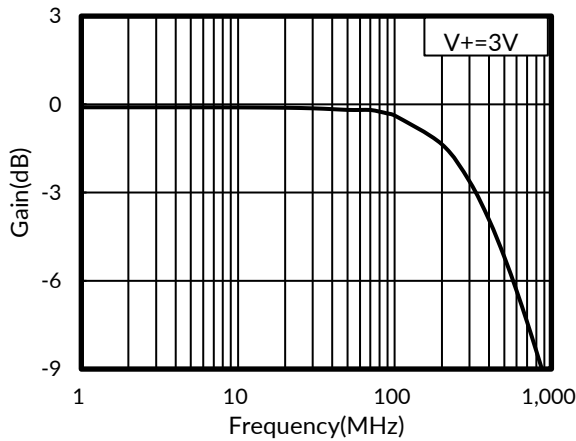


Figure 1. Bandwidth vs Frequency

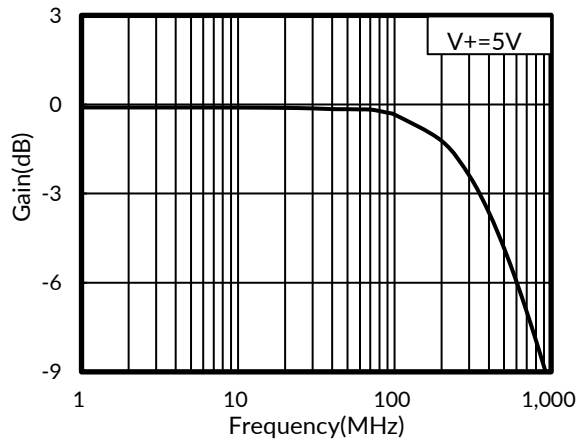


Figure 2. Bandwidth vs Frequency

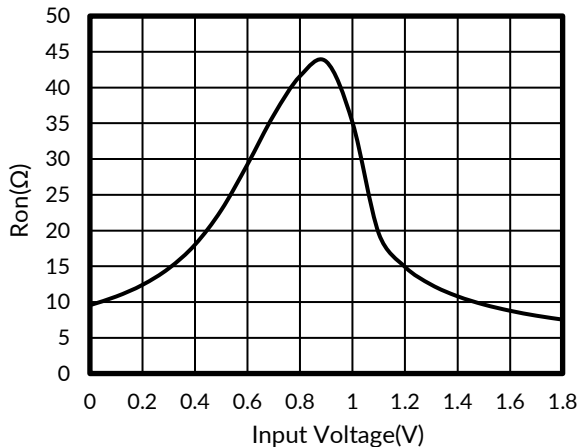


Figure 3. Typical Ron as a Function of Input Voltage (V+= 1.8 V)

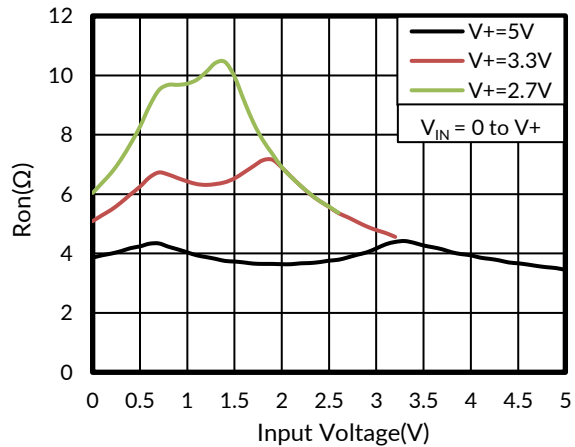


Figure 4. Typical Ron as a Function of Input Voltage

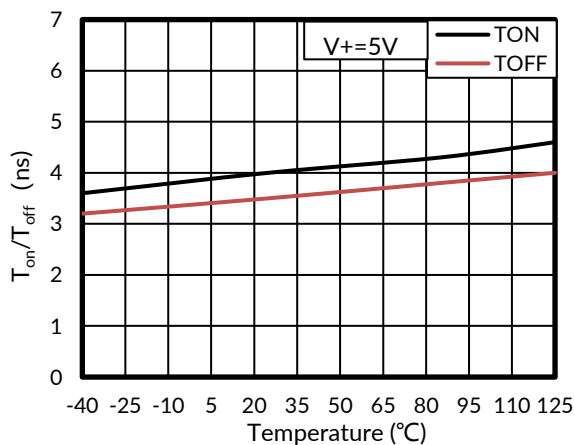


Figure 5.  $T_{on}$  and  $T_{off}$  vs Temperature

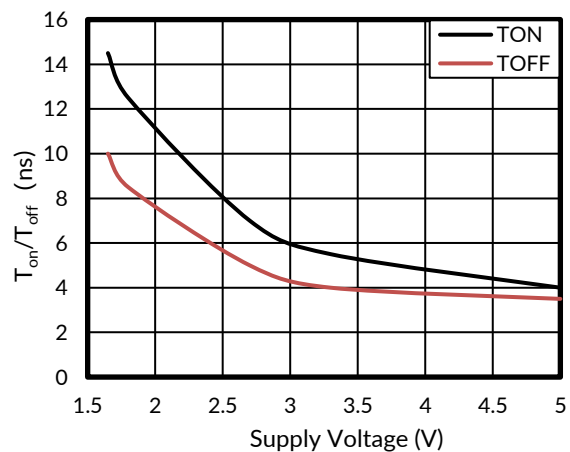
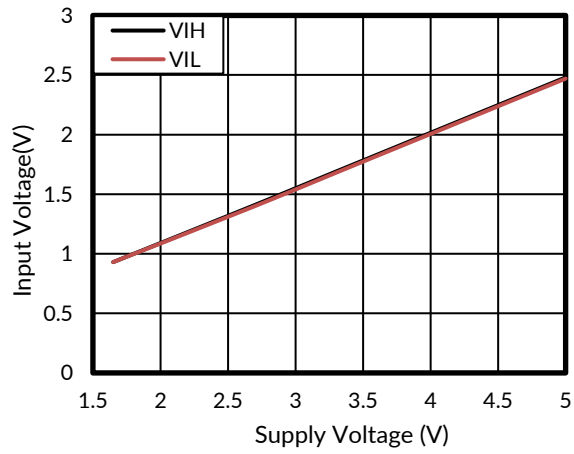


Figure 6.  $T_{on}$  and  $T_{off}$  vs Supply Voltage

## 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 7. Logic-Level Threshold vs V+**

## 9 PARAMETER MEASUREMENT INFORMATION

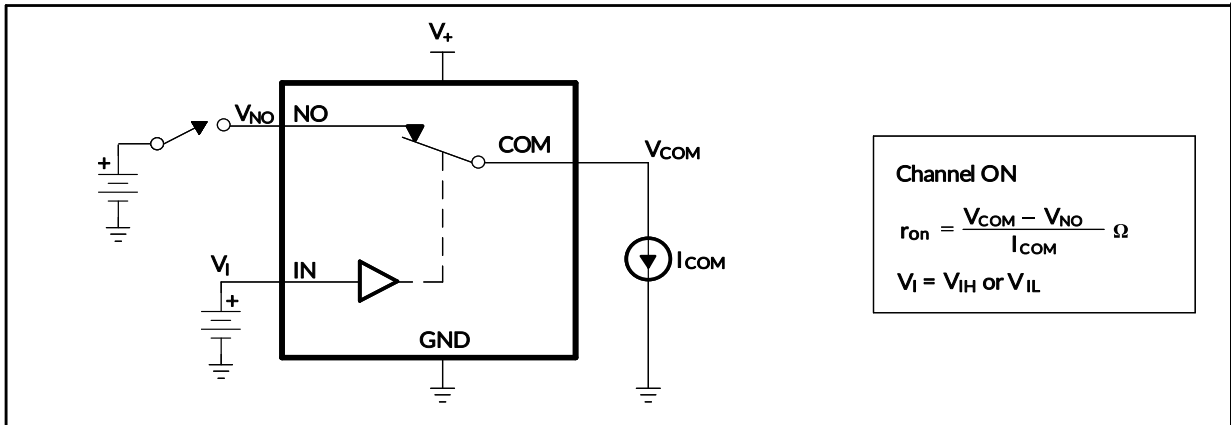


Figure 8. ON-State Resistance ( $R_{on}$ )

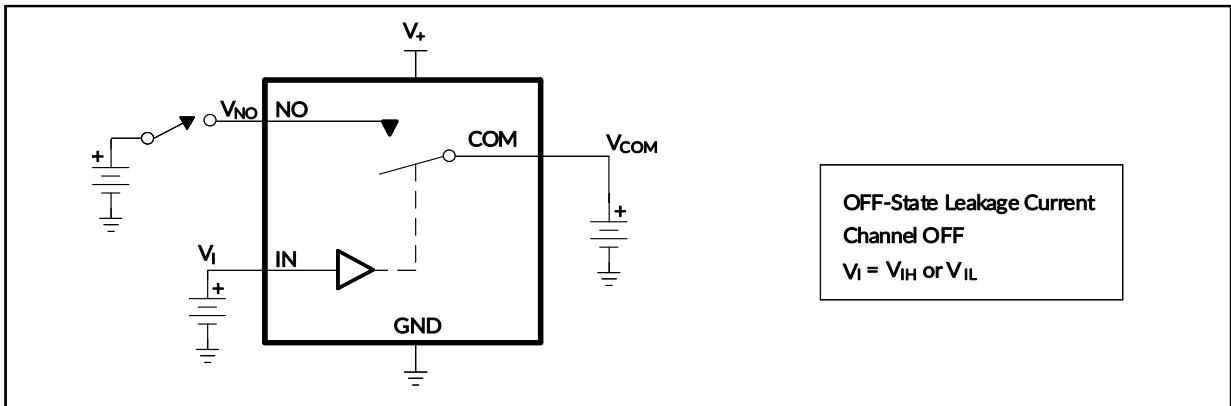


Figure 9. OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NO(OFF)}$ )

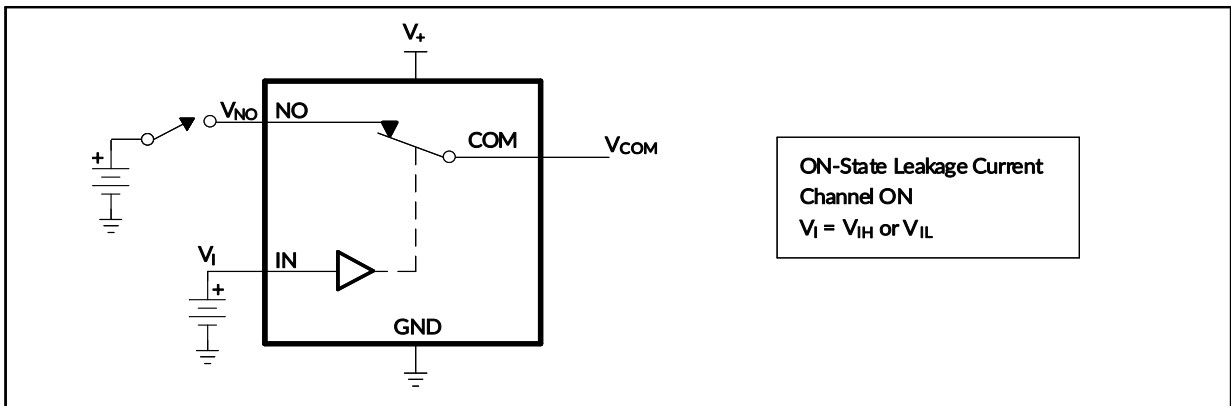


Figure 10. ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NO(ON)}$ )

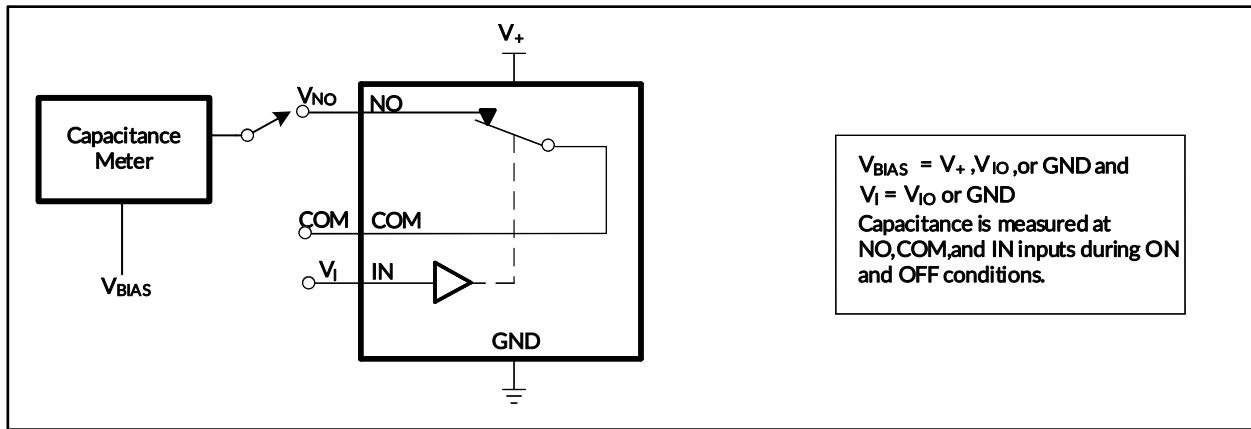


Figure 11. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NO(OFF)}$ ,  $C_{NO(ON)}$ )

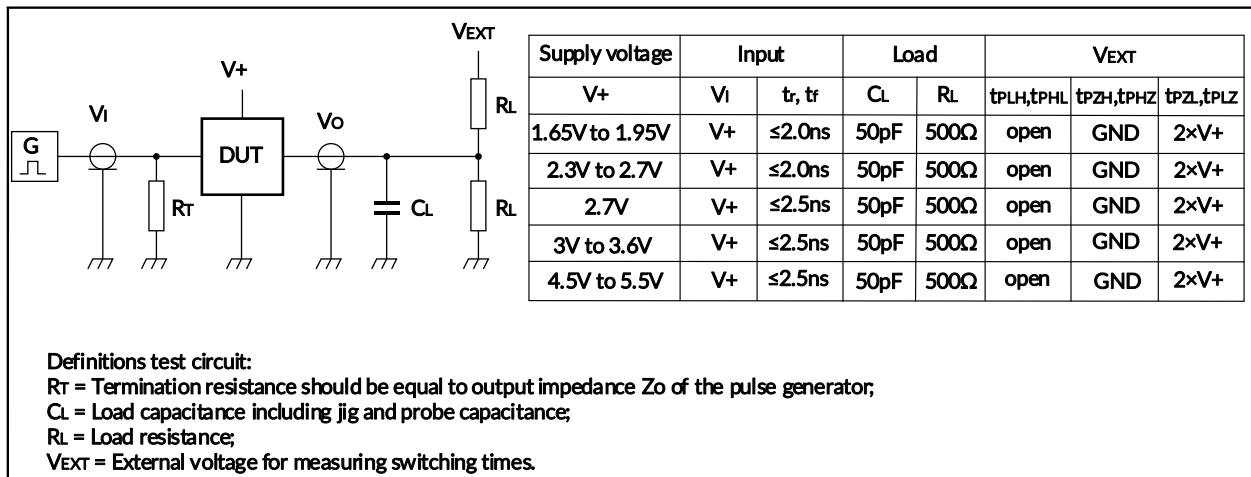


Figure 12. Test circuit for measuring switching times

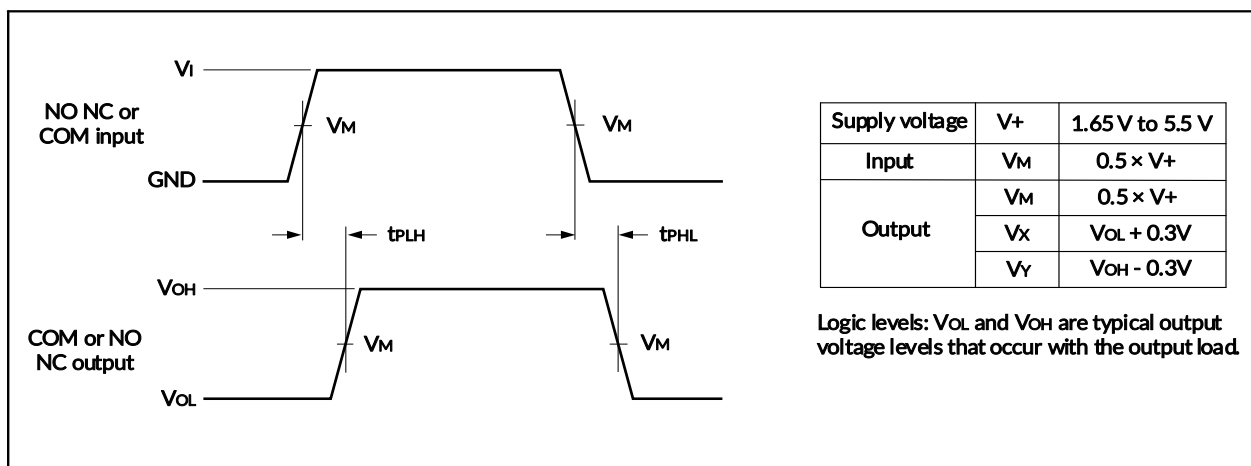


Figure 13. Propagation delay ( $t_{pd}$ )

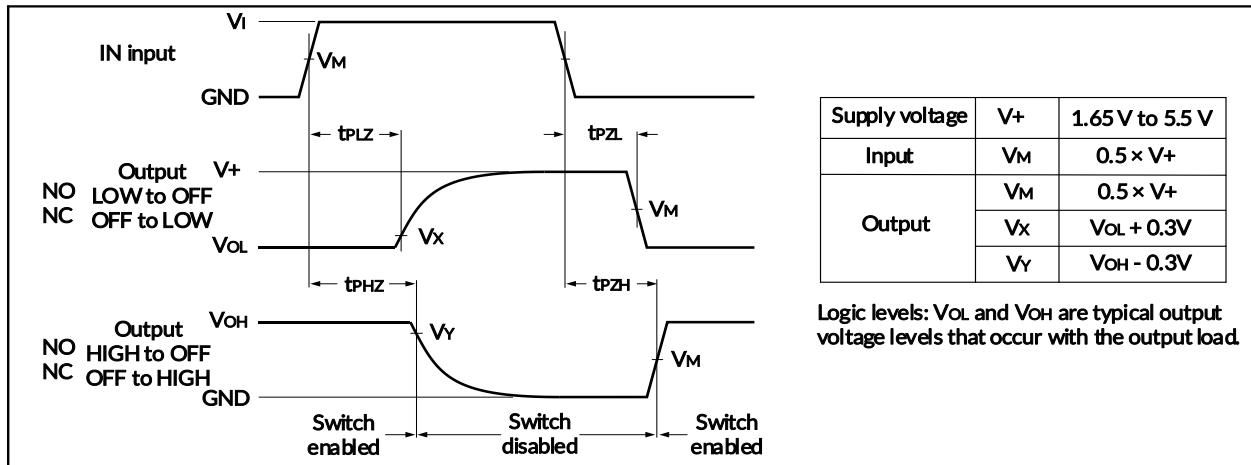


Figure 14. Turn-On (t<sub>ON</sub>) and Turn-Off Time (t<sub>OFF</sub>)

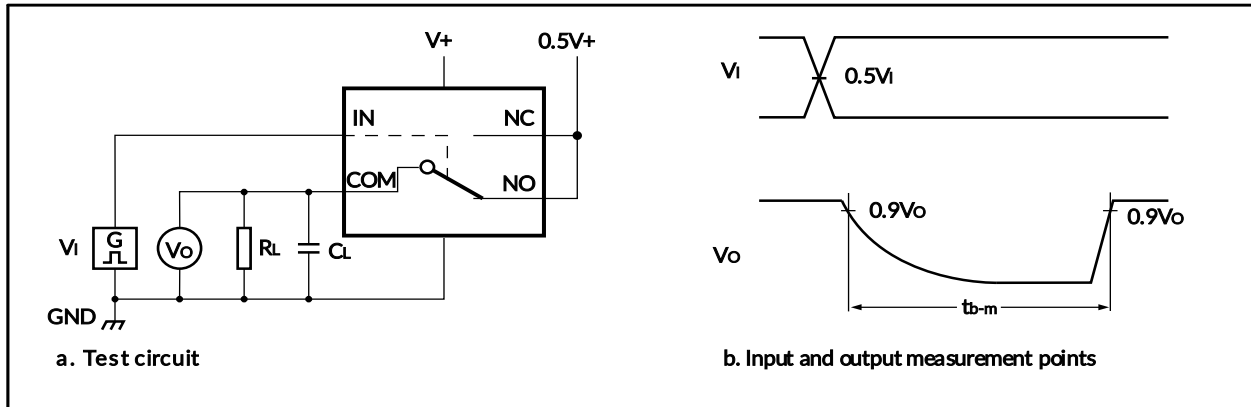


Figure 15. Break-Before-Make Time (t<sub>BBM</sub>)

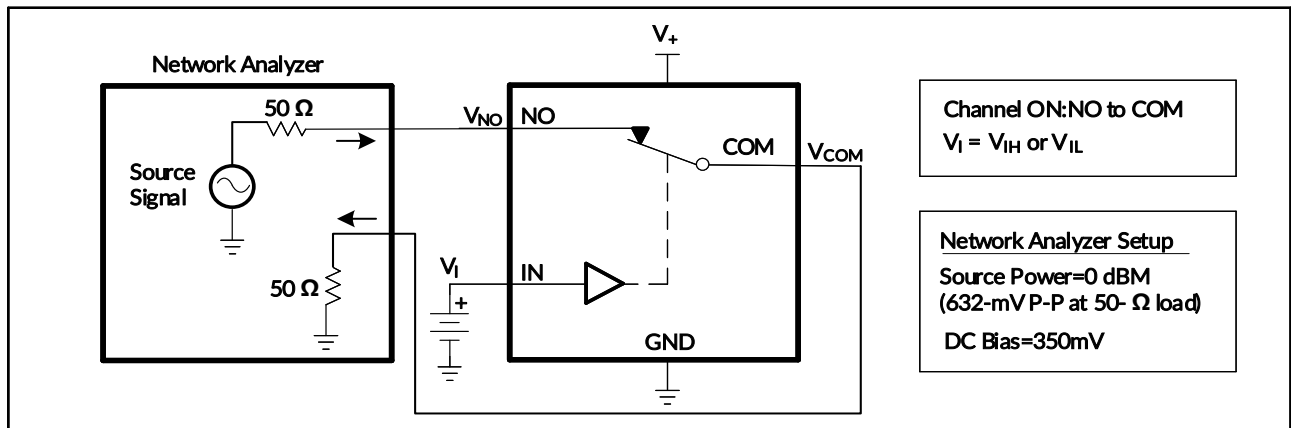


Figure 16. Bandwidth (BW)

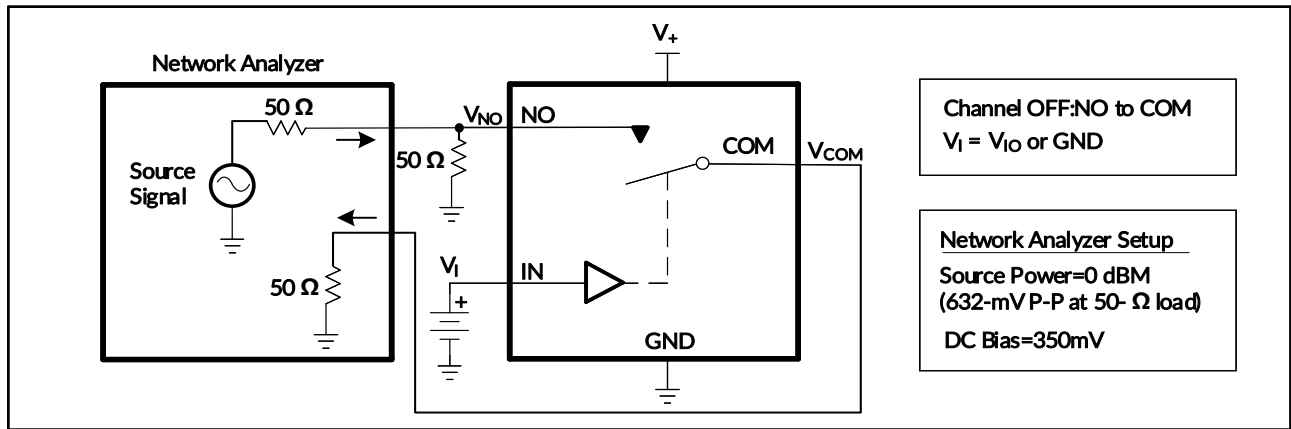


Figure 17. OFF Isolation ( $O_{ISO}$ )

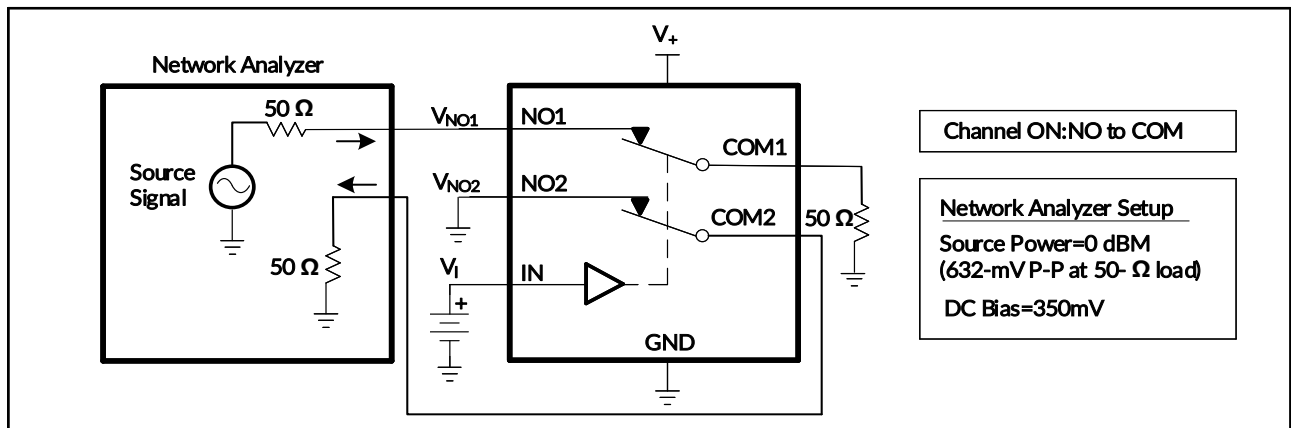


Figure 18. Crosstalk ( $X_{TALK}$ )

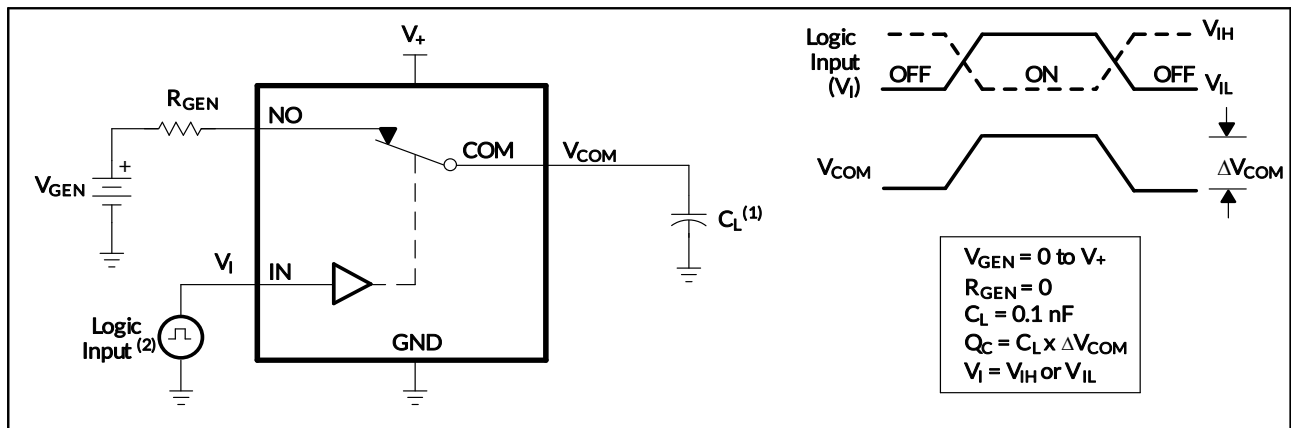
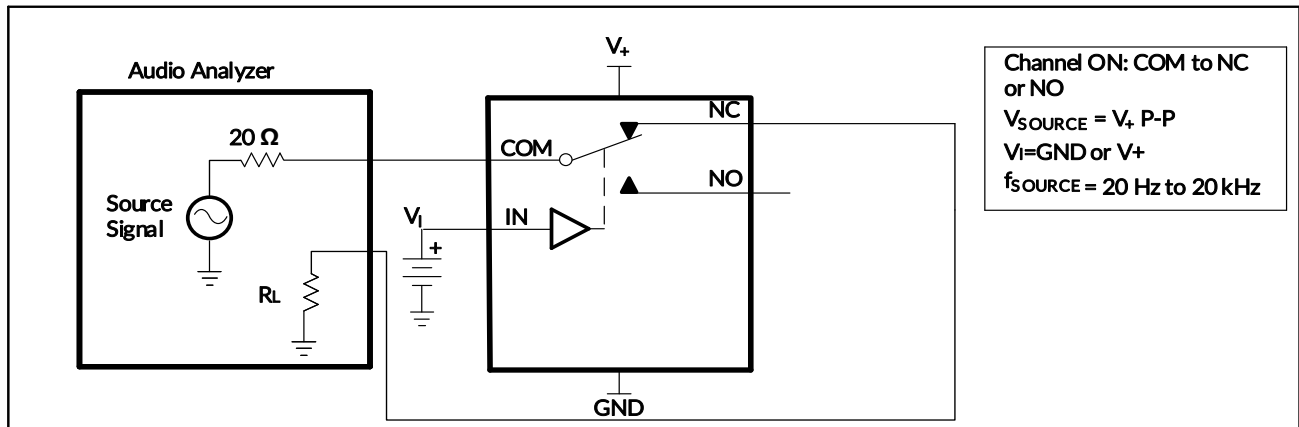


Figure 19. Charge Injection ( $Q_C$ )





**Figure 20. Total Harmonic Distortion (THD)**

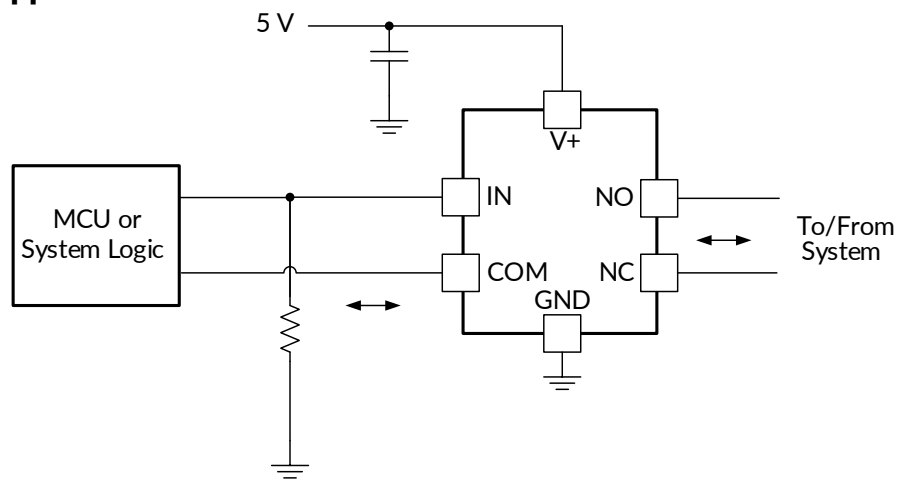
## 10 APPLICATION AND IMPLEMENTATION

Information in the following applications sections is not part of the Runic component specification, and Runic does not warrant its accuracy or completeness. Runic's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 10.1 Application Information

The RS2057A can be used in a variety of customer systems. The RS2057A can be used anywhere multiple analog or digital signals must be selected to pass across a single line.

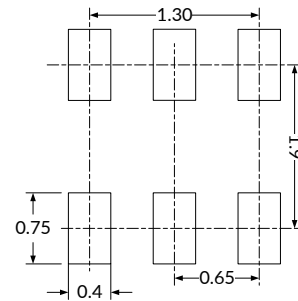
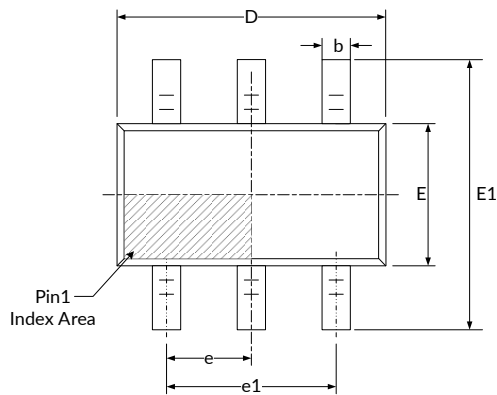
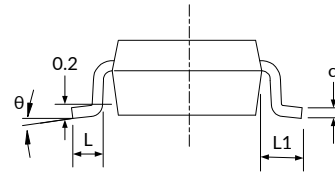
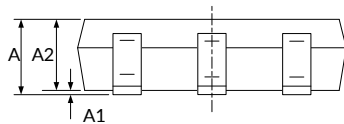
### 10.2 Typical Application



**Figure 21. System Schematic for RS2057A**

# 11 PACKAGE OUTLINE DIMENSIONS

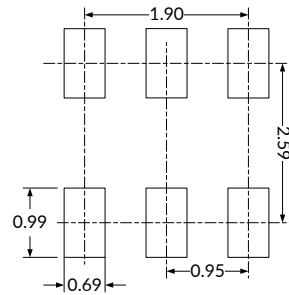
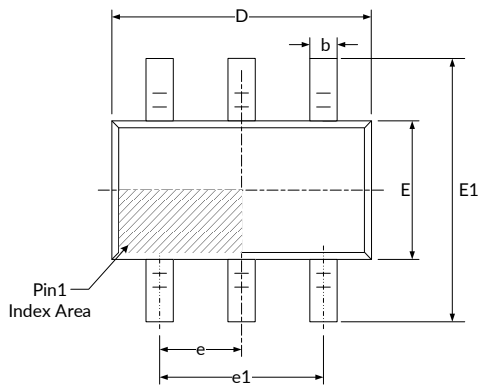
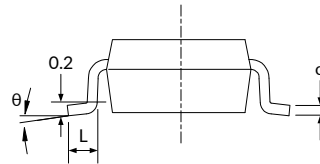
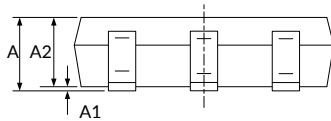
## SC70-6<sup>(3)</sup>


**RECOMMENDED LAND PATTERN (Unit: mm)**


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>	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 <sup>(1)</sup>	2.000	2.200	0.079	0.087
E <sup>(1)</sup>	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650(BSC) <sup>(2)</sup>		0.026(BSC) <sup>(2)</sup>	
e1	1.300(BSC) <sup>(2)</sup>		0.051(BSC) <sup>(2)</sup>	
L	0.260	0.460	0.010	0.018
L1	0.525		0.021	
θ	0°	8°	0°	8°

**NOTE:**

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

**SOT23-6<sup>(3)</sup>**

**RECOMMENDED LAND PATTERN (Unit: mm)**


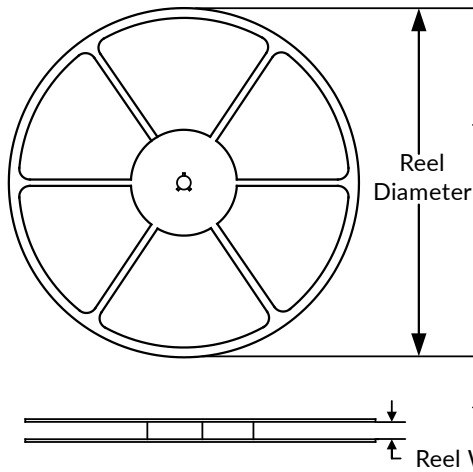
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D <sup>(1)</sup>	2.820	3.020	0.111	0.119
E <sup>(1)</sup>	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC) <sup>(2)</sup>		0.037(BSC) <sup>(2)</sup>	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

**NOTE:**

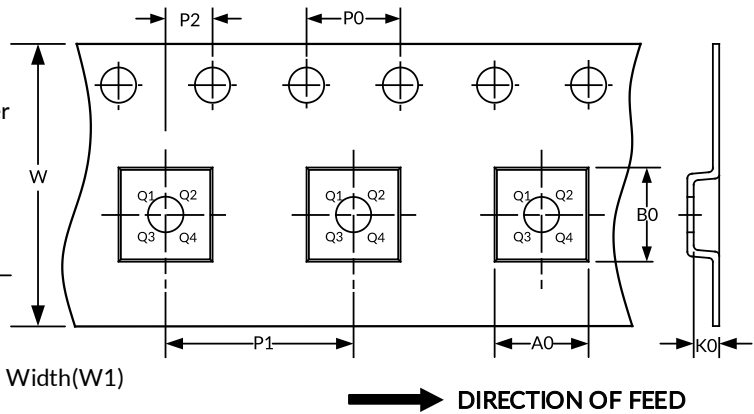
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

## 12 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
SC70-6	7"	9.5	2.40	2.50	1.20	4.0	4.0	2.0	8.0	Q3
SOT23-6	7"	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3

NOTE:

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

## **IMPORTANT NOTICE AND DISCLAIMER**

Jiangsu Runic Technology Co., Ltd. will accurately and reliably provide technical and reliability data (including data sheets), design resources (including reference designs), application or other design advice, WEB tools, safety information and other resources, without warranty of any defect, and will not make any express or implied warranty, including but not limited to the warranty of merchantability Implied warranty that it is suitable for a specific purpose or does not infringe the intellectual property rights of any third party.

These resources are intended for skilled developers designing with Runic products You will be solely responsible for: (1) Selecting the appropriate products for your application; (2) Designing, validating and testing your application; (3) Ensuring your application meets applicable standards and any other safety, security or other requirements; (4) Runic and the Runic logo are registered trademarks of Runic Incorporated. All trademarks are the property of their respective owners; (5) For change details, review the revision history included in any revised document. The resources are subject to change without notice. Our company will not be liable for the use of this product and the infringement of patents or third-party intellectual property rights due to its use.