0.9Ω, Single Channel Power-off Isolation SPDT Analog Switch

1 FEATURES

- **Isolation in Power-Down Mode, V_{CC}=0**
- **High Speed: Typically 11ns**
- **Supply Range: +1.65V to +5.5V**
- **Low ON-State Resistance: 0.9Ω(TYP)**
- **Break-Before-Make Switching**
- **Control Inputs Are 5.5V Tolerant**
- **1.8V Control Logic Compatible**
- **Extended Industrial Temperature Range: -40°C to 125°C**
- **Micro Size Packages: SC70-6, SOT23-6**

2 APPLICATIONS

- **Wearable Devices**
- **Low-Voltage Data Acquisition Systems**
- **Communication Circuits**
- **Portable Instrumentation**
- **Computer Peripherals**
- **Audio and Video Signal Routing**

3 DESCRIPTIONS

The RS2056 is a single-pole double-throw (SPDT) analog switch that is designed to operate from 1.65 V to 5.5 V.

RS2056 can handle both analog and digital signals and offers low-ON resistance (0.9Ω TYP) and features 100MHz bandwidth. The device also has an excellent total harmonic distortion (THD) performance and consumes very low power.

These features make RS2056 suitable for a wide variety of portable applications.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2056	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.

Table of Contents

4 REVISION HISTORY

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

VERSION	Change Date	Change Item
A.0	2024/05/07	Preliminary version completed
A.1	2024/07/31	Initial version completed

5 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL (3)	PACKAGE OPTION
RS2056	RS2056XC6	-40°C ~125°C	SC70-6 (4)	2056	MSL3	Tape and Reel, 3000
	RS2056XH	-40°C ~125°C	SOT23-6	2056	MSL3	Tape and Reel, 3000

NOTE:

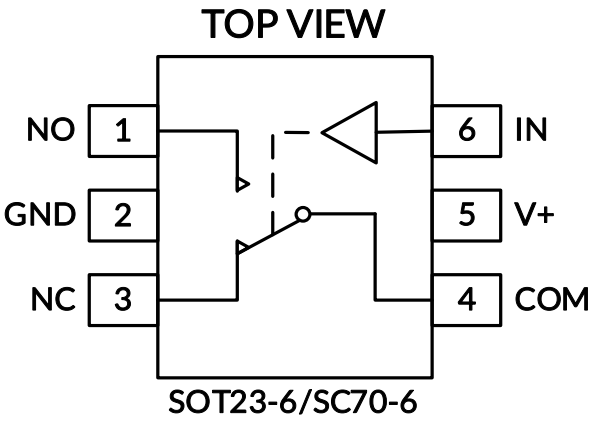
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(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.

6 PIN CONFIGURATIONS



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

6.1 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

6.2 Function Table

LOGIC	NO	NC
0	OFF	ON
1	ON	OFF

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_+	Supply Voltage		-0.5	6.5	V
V_{IN}	Input Voltage		-0.5	6.5	
V_{NO}, V_{NC}, V_{COM}	Analog, Digital Voltage Range (2)		-0.5	(V+) +0.5	
I_{NO}, I_{NC}, I_{COM}	Continuous Current NO, NC, or COM		-200	200	mA
I+	Continuous current through V+			100	
I_{GND}	Continuous current through GND		-100	100	
I_{PEAK}	Peak Current NO, NC, or COM		-400	400	
θ_{JA}	Package thermal impedance (3)	SC70-6		265	°C/W
		SOT23-6		230	
T_J	Junction Temperature (4)			150	°C
T_{stg}	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 10mA or less.

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

(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

7.2 ESD Ratings

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

		VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge	Human-Body Model (HBM), JEDEC EIA/JESD22-A114	±2500	V
	Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2018	±1000	V
	Machine Model (MM), JESD22-A115C(2010)	±200	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.

7.3 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Supply Voltage	1.65	5.5	V
T_A	Operating temperature	-40	+125	°C

7.4 Electrical Characteristics

T_A= -40°C to 125°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V+	T_A	MIN(2)	TYP(3)	MAX(2)	UNIT
ANALOG SWITCH								
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}			Full	0		V+	V
On-Resistance	R_{ON}	0≤ (V_{NO} or V_{NC}) ≤ V+, I_{COM}=-10mA, Switch ON	5V	+25°C		0.9	1.1	Ω
				Full			1.6	Ω
			3.3V	+25°C		1.3	1.6	Ω
				Full			2.2	Ω
			2.5V	+25°C		2.3	2.6	Ω
				Full			2.9	Ω
			1.8V	+25°C		15	20	Ω
				Full			30	Ω
On-Resistance Match Between Channels	ΔR_{ON}	0≤ (V_{NO} or V_{NC}) ≤V+, I_{COM}=-10mA, Switch ON, See Figure 13	5V	+25°C		0.05	0.1	Ω
				Full			0.2	Ω
			3.3V	+25°C		0.1	0.15	Ω
				Full			0.3	Ω
			2.5V	+25°C		0.15	0.25	Ω
				Full			0.4	Ω
			1.8V	+25°C		0.2	0.35	Ω
				Full			0.5	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	0≤ (V_{NO} or V_{NC}) ≤V+, I_{COM}=-10mA, Switch ON, See Figure 13	5V	+25°C		0.24	0.3	Ω
				Full			0.8	Ω
			3.3V	+25°C		0.47	0.6	Ω
				Full			1.5	Ω
			2.5V	+25°C		1.25	1.55	Ω
				Full			3	Ω
			1.8V	+25°C		14	18	Ω
				Full			30	Ω
NC, NO OFF Leakage Current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NO} or V_{NC} = 0.3V, V+/2 V_{COM} = V+/2, 0.3V See Figure 14	1.65 to 5.5V	Full			1	μA
	$I_{NC(PWROFF)}$, $I_{NO(PWROFF)}$	V_{NC} or V_{NO} = 0 to 3.6V, V_{COM} = 3.6V to 0, Switch off, See Figure 14	0V	Full			10	μA
NC, NO, COM ON Leakage Current	$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$	V_{NO} or V_{NC} = 0.3V, Open V_{COM} = Open, 0.3V See Figure 15	1.65 to 5.5V	Full			1	μA
DIGITAL CONTROL INPUTS (1)								
Input High Voltage	V_{INH}		5V	Full	2			V
			3.3V	Full	1.8			V
			2.5V	Full	1.6			V
			1.8V	Full	1.5			V
Input Low Voltage	V_{INL}		5V	Full			1	V
			3.3V	Full			0.8	V
			2.5V	Full			0.7	V
			1.8V	Full			0.6	V
Input Leakage Current	I_{IN}	V_{IN} = V_{IO} or 0	1.65 to 5.5V	Full			1	μA

(1) All unused digital inputs of the device must be held at V_{IO} 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)

T_A= -40°C to 125°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS		V_+	T_A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS									
Turn-On Time	t_{ON}	V_{COM} = V+, R_L = 50Ω, C_L = 35pF, See Figure 17		5V	Full	4	11	20	ns
				3.3V		6	15	27	
				2.5V		9	20	36	
				1.8V		19	40	63	
Turn-Off Time	t_{OFF}	V_{COM} = V+, R_L = 50Ω, C_L = 35pF, See Figure 17		5V	Full	3	7	33	ns
				3.3V		4	11	27	
				2.5V		6	14	21	
				1.8V		8	20	30	
Break-Before-Make Time Delay	t_{BBM}	V_{NO} = V_{NC} =V+, R_L = 300Ω, C_L = 35pF, See Figure 18		5V	Full	4	9	15	ns
				3.3V		5	10	16	
				2.5V		6	12	21	
				1.8V		10	22	36	
Off Isolation	O_{ISO}	R_L = 50Ω, Switch OFF, See Figure 20	f = 1MHz	5V	+25°C		-64		dB
			f = 1MHz	3.3V	+25°C		-64		dB
			f = 1MHz	2.5V	+25°C		-64		dB
			f = 1MHz	1.8V	+25°C		-64		dB
Crosstalk	XTALK	R_L = 50Ω, Switch OFF, See Figure 21	f = 1MHz	5V	+25°C		-64		dB
			f = 1MHz	3.3V	+25°C		-64		dB
			f = 1MHz	2.5V	+25°C		-64		dB
			f = 1MHz	1.8V	+25°C		-64		dB
-3dB Bandwidth	BW	Switch ON, R_L = 50Ω, See Figure 19		1.65V to 5.5V	+25°C		100		MHz
Total Harmonic Distortion	THD	R_L=600Ω, Switch ON, C_L=50pF		5V	+25°C		0.005		%
				3.3V	+25°C		0.03		%
				2.5V	+25°C		0.04		%
				1.8V	+25°C		0.35		%
Charge Injection	QC	V_{GEN} = 0, R_{GEN} = 0, C_L = 1nF, See Figure 22		5V	+25°C		22		pC
				3.3V	+25°C		17		pC
				2.5V	+25°C		14		pC
				1.8V	+25°C		10		pC
NC, NO OFF Capacitance	$C_{NC(OFF)}$, $C_{NO(OFF)}$	V_{NC} or V_{NO}=V+ or GND, Switch OFF, See Figure 16			+25°C		13		pF
NC, NO, COM ON Capacitance	$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$	V_{NC} or V_{NO}=V+ or GND, Switch ON, See Figure 16			+25°C		46		pF
Digital Input Capacitance	C_i	V_I = V+ or GND, See Figure 16			+25°C		4		pF
POWER REQUIREMENTS									
Power Supply Range	V_+				Full	1.65		5.5	V
Power Supply Current	I_+	V_{IN} = GND or V_+		5.5V	Full			1	μA

7.5 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.

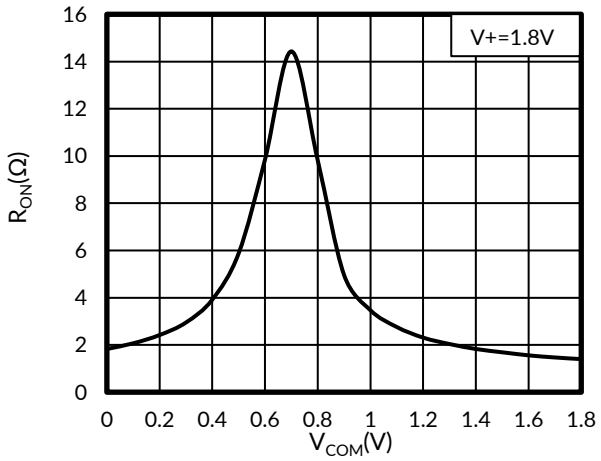


Figure 1. R_{ON} vs V_{COM}

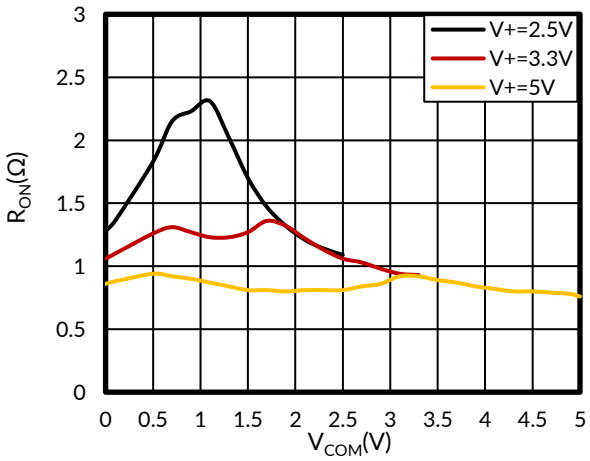


Figure 2. R_{ON} vs V_{COM}

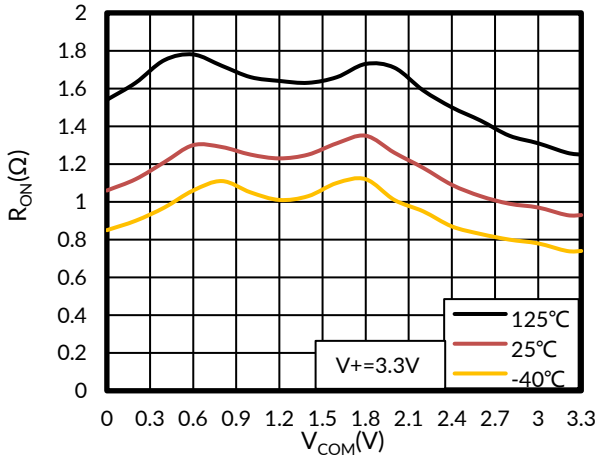


Figure 3. R_{ON} vs V_{COM}

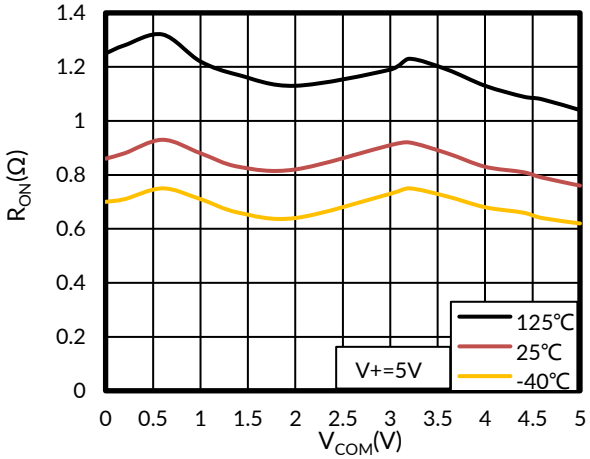


Figure 4. R_{ON} vs V_{COM}

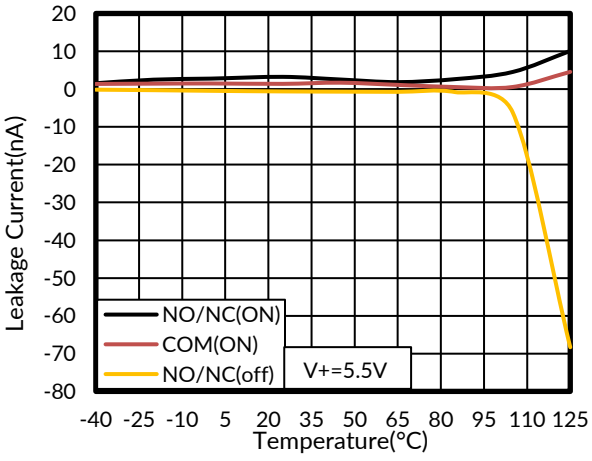


Figure 5. Leakage Current vs Temperature

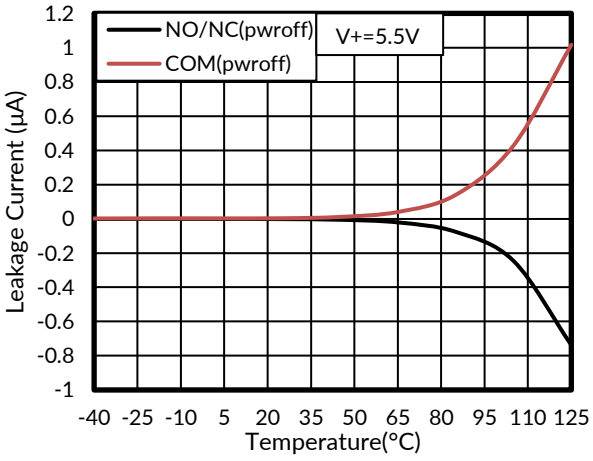


Figure 6. Leakage Current vs Temperature

Typical Characteristics (Continued)

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.

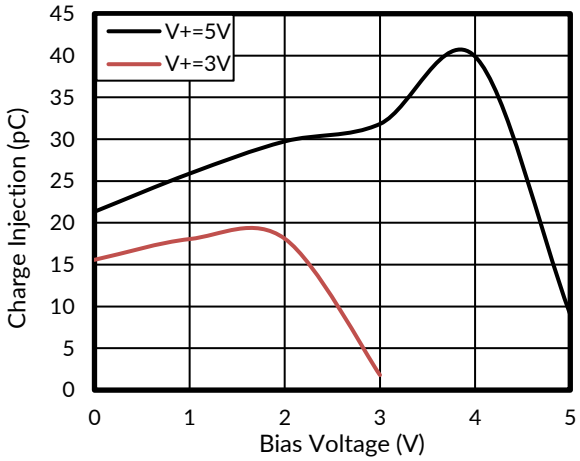


Figure 7. Charge Injection vs Bias Voltage

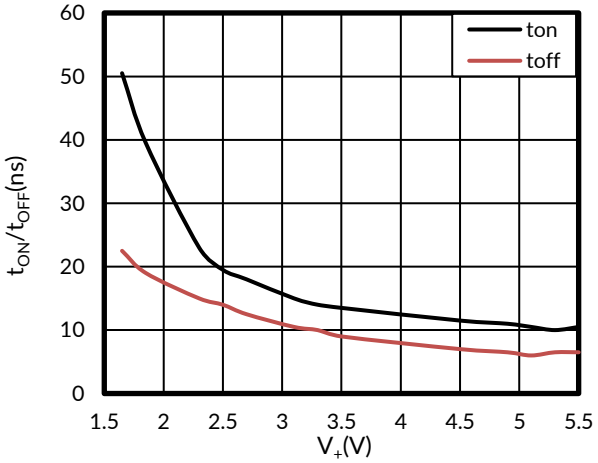


Figure 8. t_{ON} and t_{OFF} vs Supply Voltage

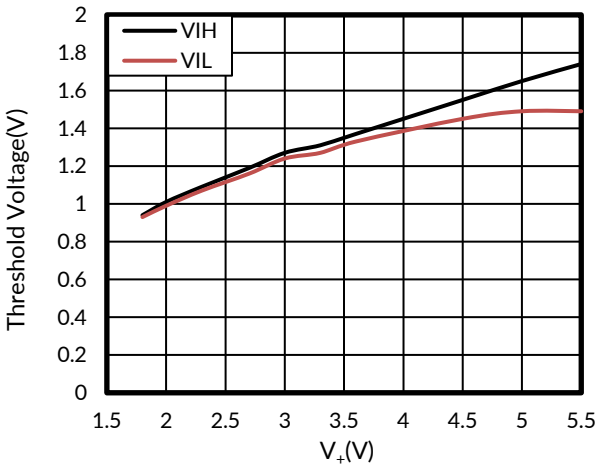


Figure 9. Threshold Voltage vs Supply Voltage

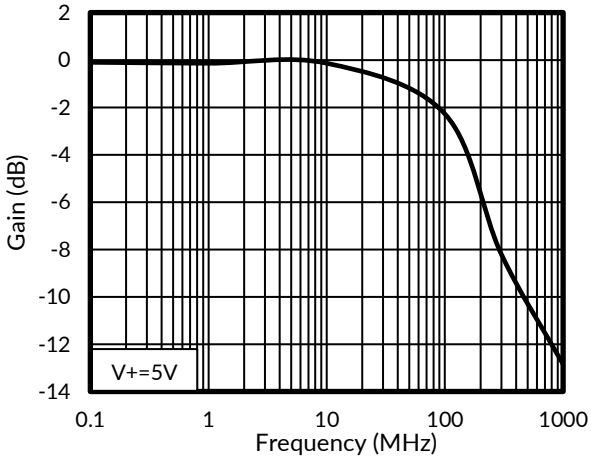


Figure 10. Bandwidth

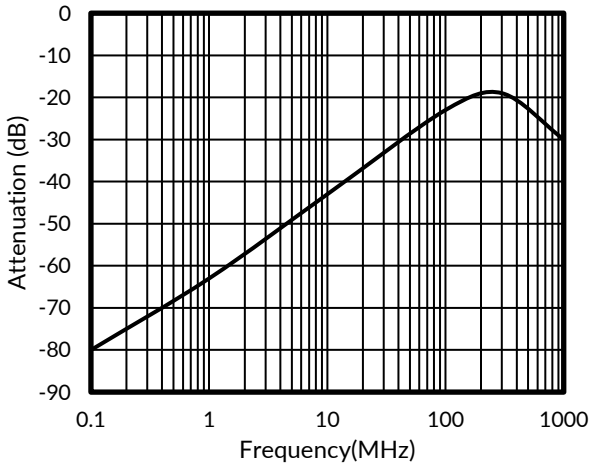


Figure 11. Off Isolation vs Frequency

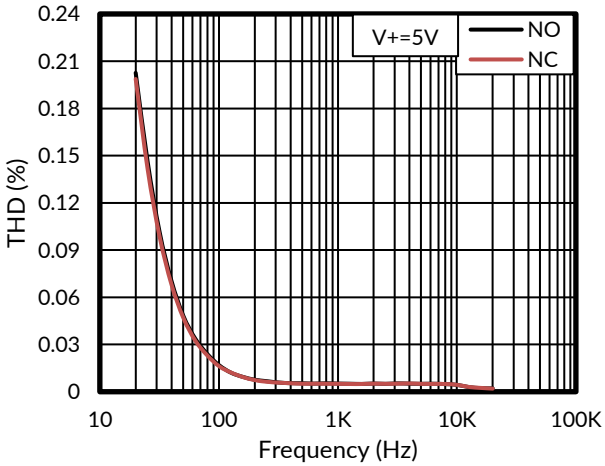


Figure 12. Total Harmonic Distortion vs Frequency

8 PARAMETER MEASUREMENT INFORMATION

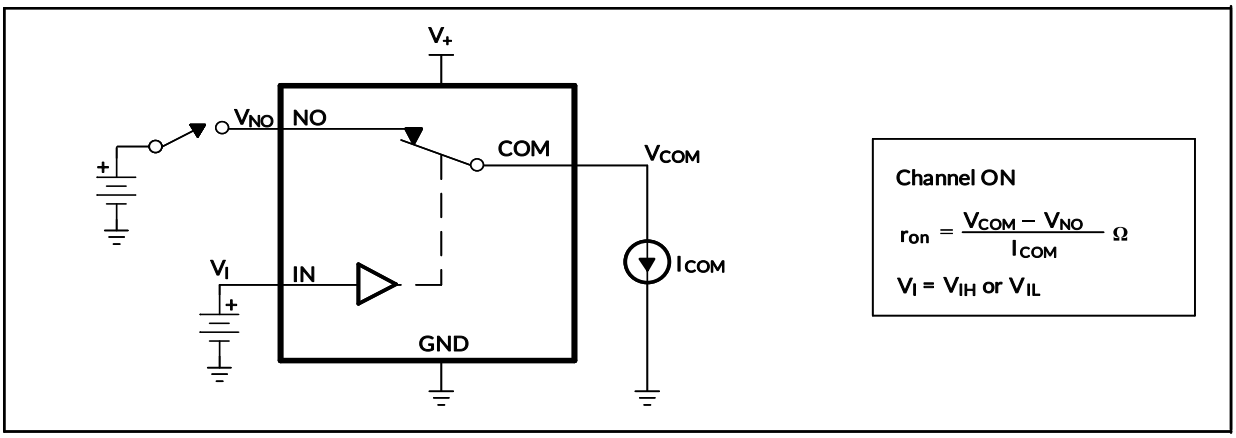


Figure 13. ON-State Resistance (R_{on})

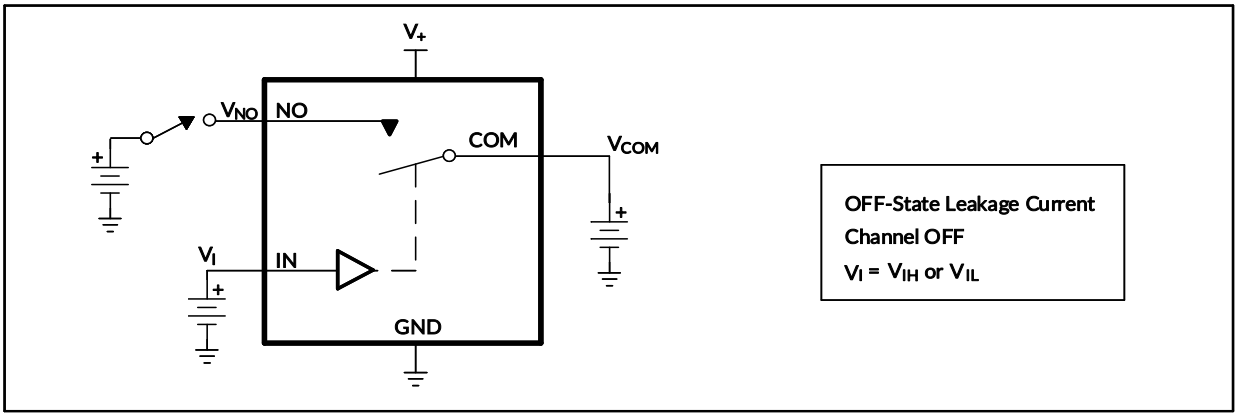


Figure 14. OFF-State Leakage Current ($I_{NC\ (OFF)}$, $I_{NC\ (PWROFF)}$, $I_{NO\ (OFF)}$, $I_{NO\ (PWROFF)}$, $I_{COM\ (OFF)}$, $I_{COM\ (PWROFF)}$)

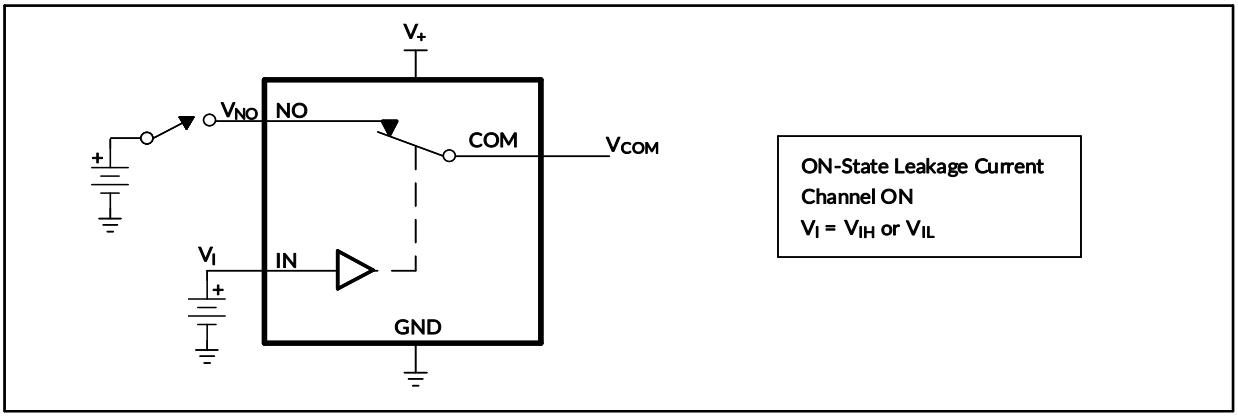


Figure 15. ON-State Leakage Current ($I_{COM\ (ON)}$, $I_{NO\ (ON)}$)

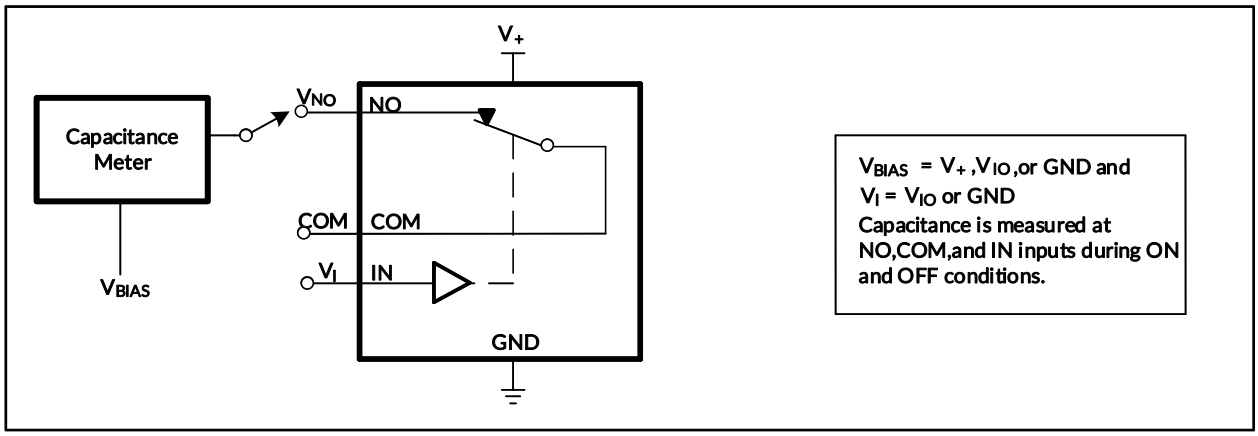


Figure 16. Capacitance (C_I, $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NO(OFF)}$, $C_{NO(ON)}$)

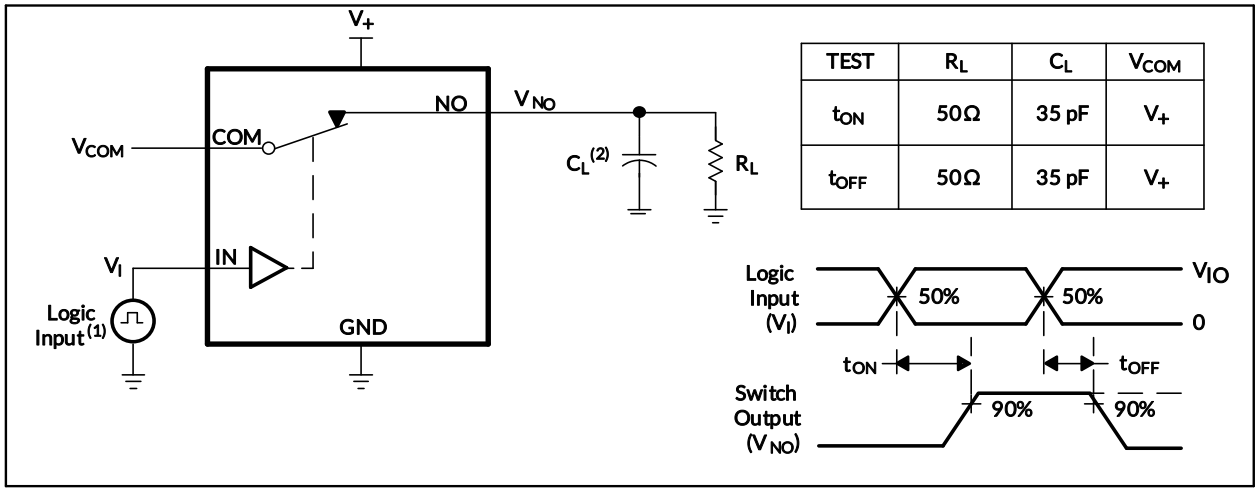


Figure 17. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

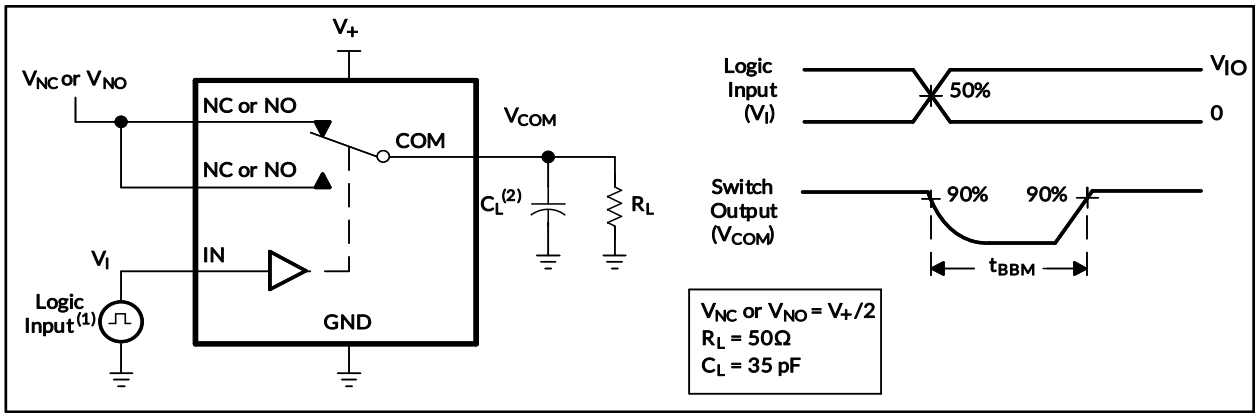


Figure 18. Break-Before-Make Time (t_{BBM})

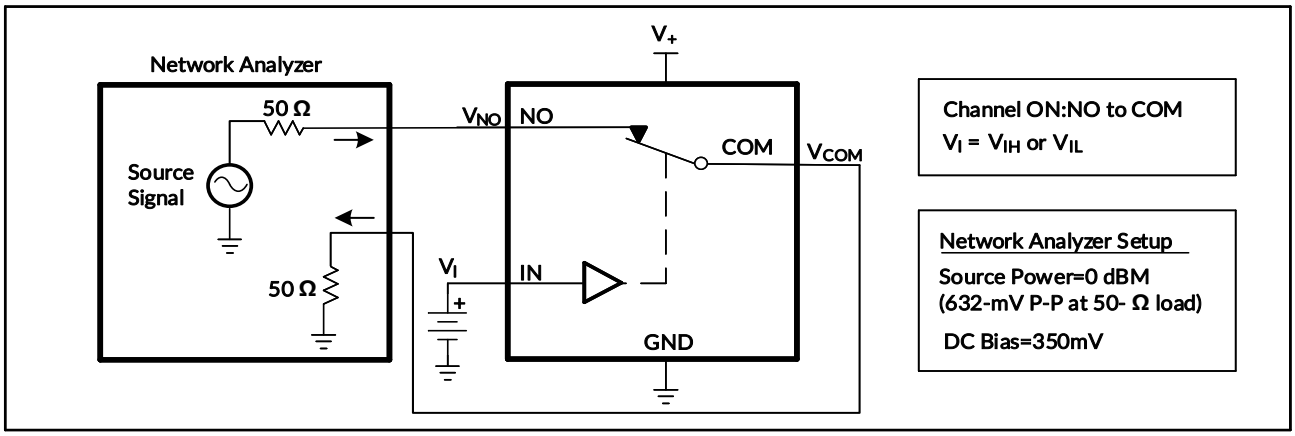


Figure 19. Bandwidth (BW)

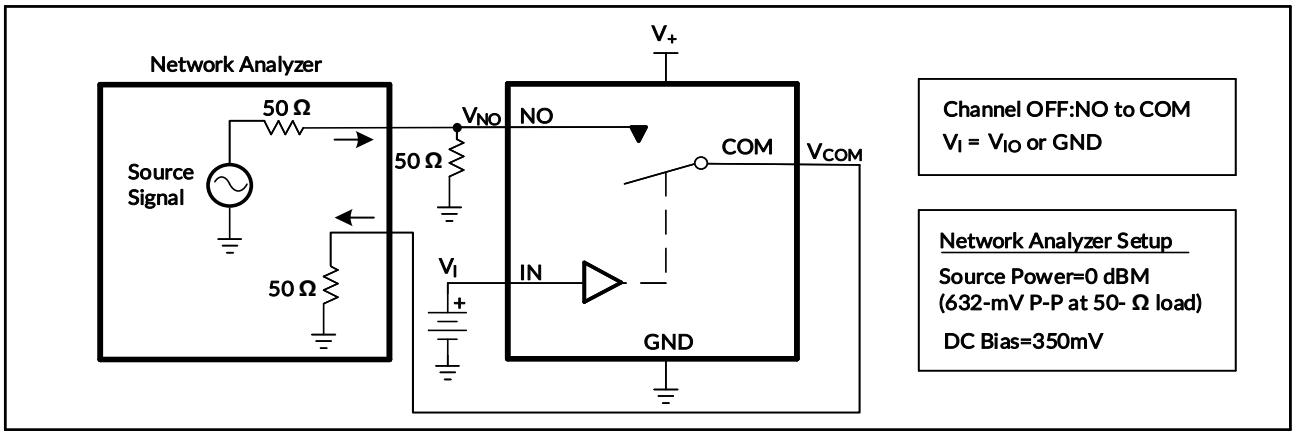


Figure 20. OFF Isolation (O_{ISO})

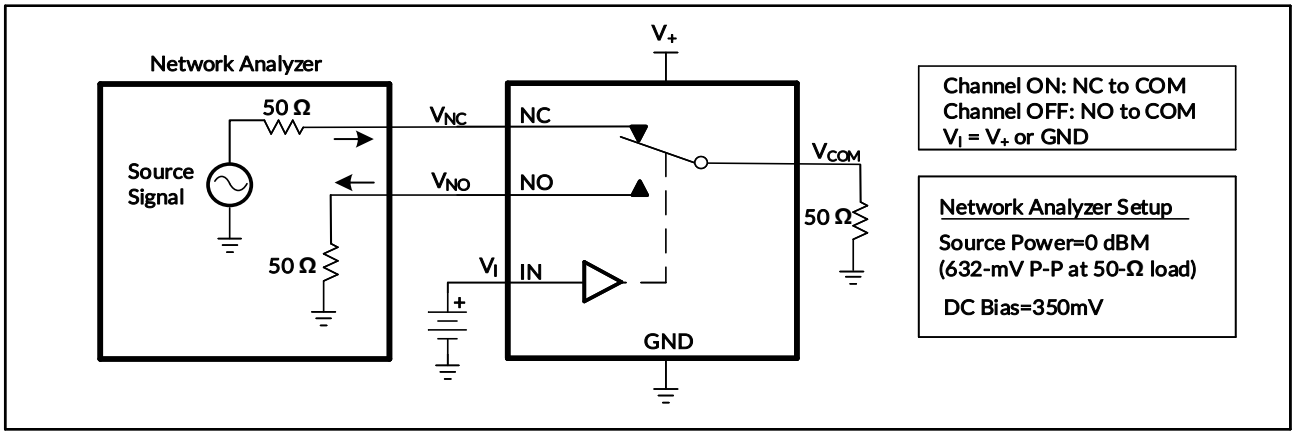


Figure 21. Crosstalk (X_{TALK})

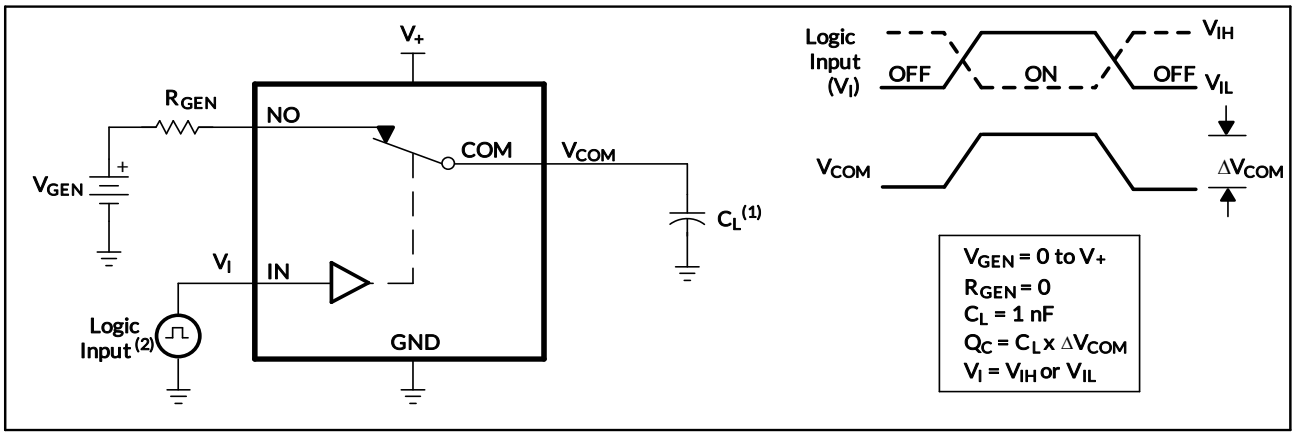


Figure 22. Charge Injection (Q_C)

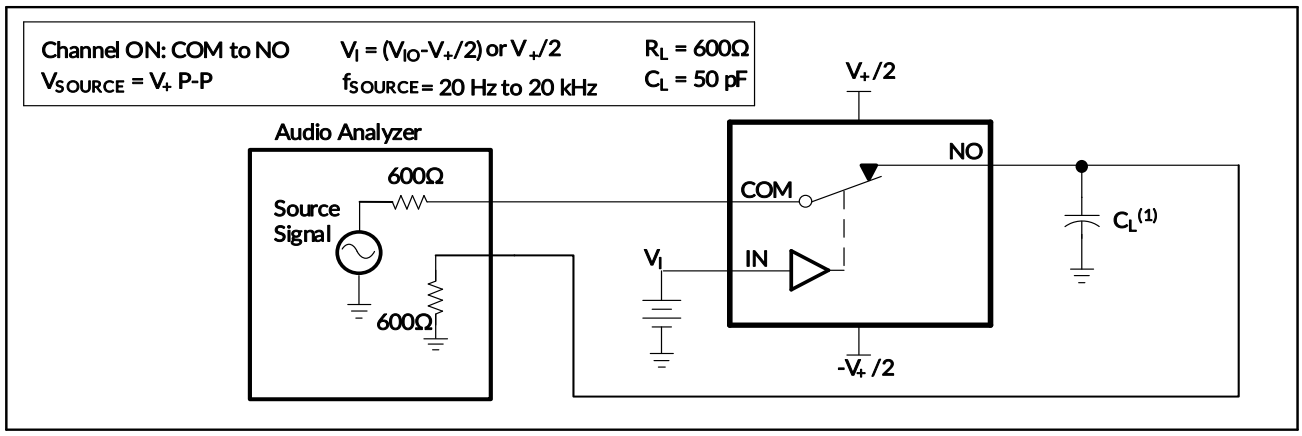


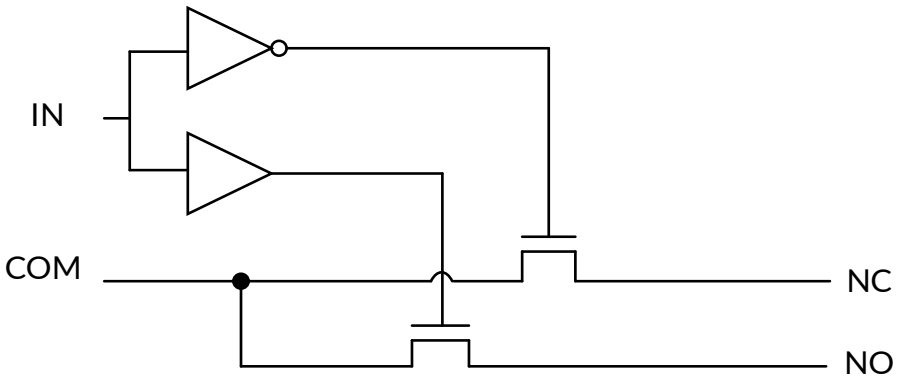
Figure 23. Total Harmonic Distortion (THD)

9 DETAILED DESCRIPTION

9.1 Overview

The RS2056 is a single-pole-double-throw (SPDT) solid-state analog switch. The RS2056, like all analog switches, is bidirectional. When powered on, each COM pin is connected to the NC pin. For this device, NC stands for normally closed and NO stands for normally open. If IN is low, COM is connected to NC. If IN is high, COM is connected to NO. The RS2056 is a break-before-make switch. This means that during switching, a connection is broken before a new connection is established. The NC and NO pins are never connected to each other.

9.2 Functional Block Diagram

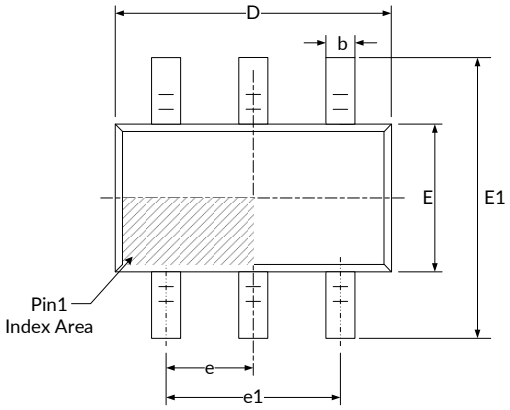


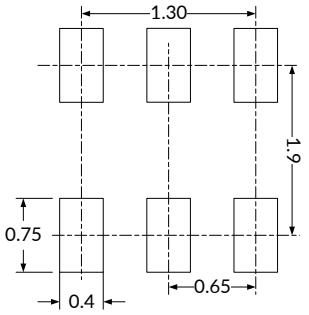
9.3 Feature Description

The low ON-state resistance, ON-state resistance matching, and charge injection in the RS2056 make this switch an excellent choice for analog signals that require minimal distortion. In addition, the low THD allows audio signals to be preserved more clearly as they pass through the device. The 1.65 V to 5.5 V operation allows compatibility with more logic levels, and the bidirectional I/Os can pass analog signals from 0 V to V+ with low distortion.

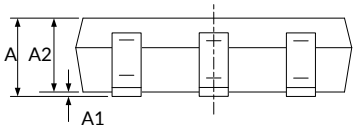
10 PACKAGE OUTLINE DIMENSIONS

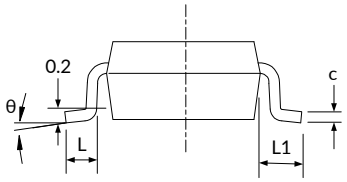
SC70-6 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



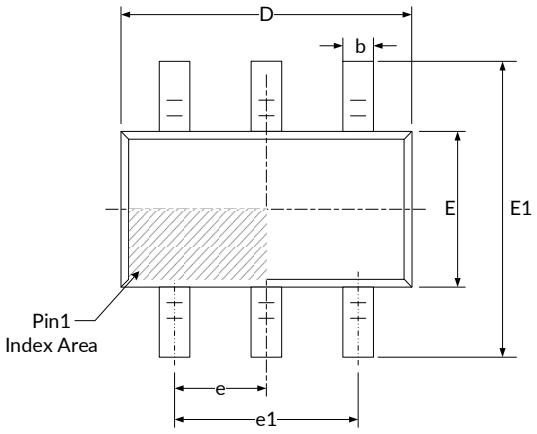


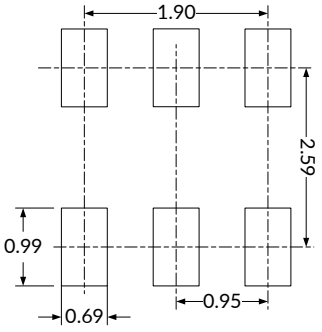
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D (1)	2.000	2.200	0.079	0.087
E (1)	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650(BSC) (2)		0.026(BSC) (2)	
e1	1.300(BSC) (2)		0.051(BSC) (2)	
L	0.260	0.460	0.010	0.018
L1	0.525		0.021	
θ	0°	8°	0°	8°

NOTE:

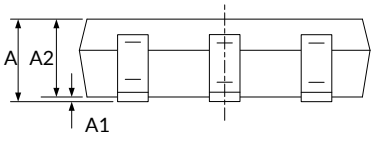
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

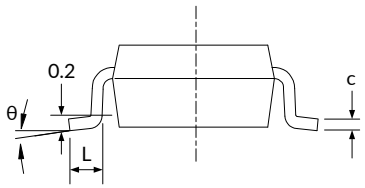
SOT23-6 (3)





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	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 (1)	2.820	3.020	0.111	0.119
E (1)	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC) (2)		0.037(BSC) (2)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

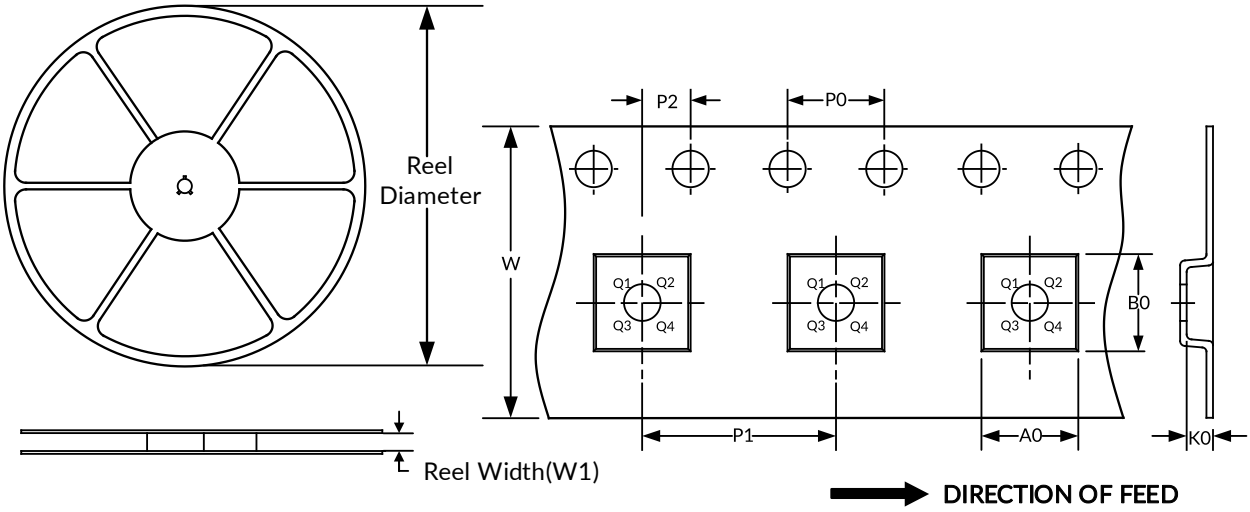
NOTE:

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.

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
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.

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