

# CMOS Quad Bilateral Analog Switch

## 1 FEATURES

- **-3dB Bandwidth: 180MHz**
- **Single Supply Operation +2.5V to +5.5V**
- **Low ON Resistance: 24Ω(TYP) With 5V Supply**
- **High Off-Isolation: -77dB ( $R_L = 50\Omega$ ,  $f = 1\text{MHz}$ )**
- **Guaranteed On-Resistance Match Between Channels**
- **Extremely Low Off-State Switch Leakage: 1nA (TYP) at 25°C**
- **Operating Temperature Range: -40°C to +125°C**
- **PACKAGES: TSSOP14**

## 2 APPLICATIONS

- **Transmission-Gate Logic Implementation**
- **Analog and Digital Multiplexing and Demultiplexing**
- **A/D and D/A Conversion**
- **Signal Gating**
- **Battery-Operated Equipment**
- **Factory Automation**
- **Communications Circuits**

## 3 DESCRIPTIONS

The RS2254 device is a CMOS analog IC configured as quad bilateral single-pole/single-throw (SPST) switches. It intended for the transmission or multiplexing of analog or digital signals. This CMOS device can operate from 2.5 V to 5.5 V.

The RS2254 device consists of four bilateral switches, each with independent controls. It has low on-resistance (24Ω TYP) and very low off-leakage current (1nA TYP).

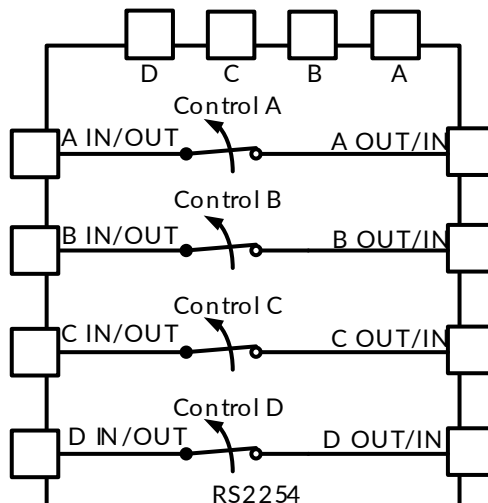
The RS2254 is available in Green TSSOP14 packages. It operates over an ambient temperature range of -40°C to +125°C.

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

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2254	TSSOP14	5.00mm×4.40mm

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

## 4 Functional Diagrams of RS2254



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## 5 Revision History

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

VERSION	Change Date	Change Item
B.1	2021/12/17	official version datasheet
C.1	2024/01/03	1. Update PACKAGE OPTION on Page 4@RevB.1 2. Add Revision History and TAPE AND REEL INFORMATION 3. Add MSL on Page 4@RevB.1 4. Update ELECTRICAL CHARACTERISTICS
C.1.1	2024/03/08	Modify packaging naming
C.2	2024/04/17	Delete SOP14 Package

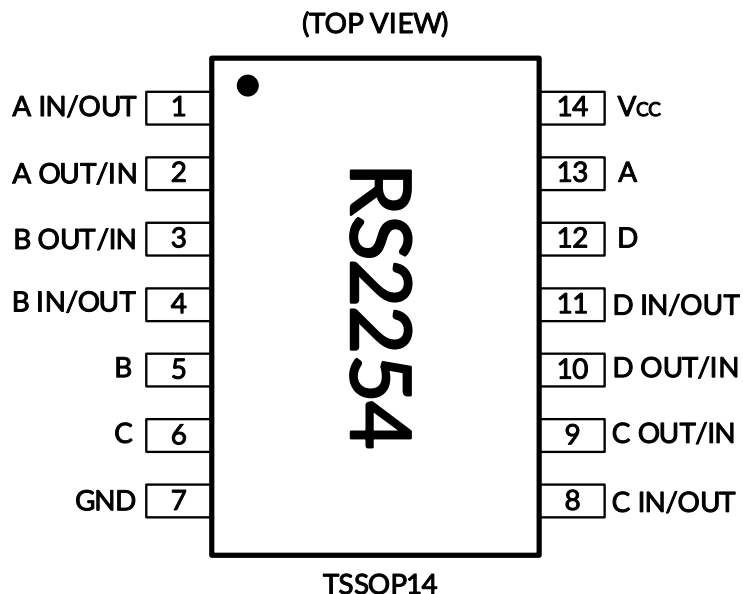
## 6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING <sup>(2)</sup>	MSL <sup>(3)</sup>	PACKAGE OPTION
RS2254	RS2254XQ	-40°C ~+125°C	TSSOP14	RS2254	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 CONFIGURATIONS



### 7.1 PIN DESCRIPTION

PIN	NAME	I/O	DESCRIPTION
1	A IN/OUT	I/O	Input/Output for Switch A
2	A OUT/IN	I/O	Output/Input for Switch A
3	B OUT/IN	I/O	Output/Input for Switch B
4	B IN/OUT	I/O	Input/Output for Switch B
5	B	I	Control pin for Switch B
6	C	I	Control pin for Switch C
7	GND	-	Ground
8	C IN/OUT	I/O	Input/Output for Switch C
9	C OUT/IN	I/O	Output/Input for Switch C
10	D OUT/IN	I/O	Output/Input for Switch D
11	D IN/OUT	I/O	Input/Output for Switch D
12	D	I	Control pin for Switch D
13	A	I	Control pin for Switch A
14	V <sub>CC</sub>	-	Power Supply

### 7.2 FUNCTION TABLE

SELECT INPUTS	SWITCH STATUS
A/B/C/D	
High	All Switches ON
Low	All Switches OFF

NOTE: Input and output pins are identical and interchangeable. Any may be considered an input or output; signals pass equally well in both directions.

## 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>CC</sub>	Supply Voltage		-0.3	6	V
V <sub>IN</sub>	Input Voltage (All inputs)		-0.3	V <sub>CC</sub> +0.3	
I <sub>IN</sub>	Switch Input Current	Any one input	-20	+20	mA
I <sub>PEAK</sub>	Peak Switch Current	Pulsed at 1ms Duration, <10% Duty Cycle	-40	+40	
θ <sub>JA</sub>	Package thermal impedance <sup>(2)</sup>	TSSOP14		90	°C/W
T <sub>J</sub>	Junction Temperature <sup>(3)</sup>		-40	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) The package thermal impedance is calculated in accordance with JESD-51.

(3) 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)	±4500	V
		Charged-device Model (CDM)	±1500	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>CC</sub>	Supply Voltage	2.5	5.5	V
T <sub>A</sub>	Operating temperature	-40	+125	°C

## 8.4 ELECTRICAL CHARACTERISTICS

$V_{CC} = 5.0\text{ V}$  or  $3.3\text{V}$ , FULL=  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , x = A, B, C and D switch in/out or out/in, Typical values are at  $T_A = +25^{\circ}\text{C}$ . (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	$V_{CC}$	$T_A$	MIN <sup>(2)</sup>	TYP <sup>(3)</sup>	MAX <sup>(2)</sup>	UNIT
<b>ANALOG SWITCH</b>								
Analog Signal Range	$V_{X\_}, V_X$			FULL	GND		$V_{CC}$	V
On-Resistance	$R_{ON}$	$V_{CC}=5\text{V}, I_X = 1\text{mA}$	5V	+25°C	24	30	$\Omega$	
				FULL		35	$\Omega$	
		$V_{CC}=3.3\text{V}, I_X = 1\text{mA}$	3.3V	+25°C	50	60	$\Omega$	
				FULL		65	$\Omega$	
On-Resistance Match Between Channels	$\Delta R_{ON}$	$V_{CC}=5\text{V}, I_X = 1\text{mA}$	5V	+25°C	1	4	$\Omega$	
				FULL		5.3	$\Omega$	
On-Resistance Flatness	$R_{FLAT(ON)}$	$V_{CC}=5\text{V}, I_X = 1\text{mA}$	5V	+25°C	8	11	$\Omega$	
				FULL		14	$\Omega$	
X_ Off Leakage Current	$I_{X(OFF)}$	$V_{X\_}=1\text{V}, 4.5\text{V}, V_X = 4.5\text{V}, 1\text{V}$	5V	+25°C	1	100	nA	
		$V_{X\_}=1\text{V}, 3\text{V}, V_X = 3\text{V}, 1\text{V}$	3.3V	+25°C	1	100	nA	
X Off Leakage Current	$I_{X(OFF)}$	$V_{X\_}=1\text{V}, 4.5\text{V}, V_X = 4.5\text{V}, 1\text{V}$	5V	+25°C	1	100	nA	
		$V_{X\_}=1\text{V}, 3\text{V}, V_X = 3\text{V}, 1\text{V}$	3.3V	+25°C	1	100	nA	
X On Leakage Current	$I_{X(ON)}$	$V_{CC}=5\text{V}, V_X = 4.5\text{V}, 1\text{V}$	5V	+25°C	1	100	nA	
		$V_{CC}=3.3\text{V}, V_X = 3\text{V}, 1\text{V}$	3.3V	+25°C	1	100	nA	
<b>DIGITAL CONTROL INPUTS <sup>(1)</sup></b>								
Logic Input Logic Threshold High	$V_{AH}, V_{BH}, V_{CH}, V_{DH}$		5V	+25°C	1.7			V
			3.3V	+25°C	1.7			V
Logic Input Logic Threshold Low	$V_{AL}, V_{BL}, V_{CL}, V_{DL}$		5V	+25°C			0.5	V
			3.3V	+25°C			0.5	V
Input-Current High	$I_{AH}, I_{BH}, I_{CH}, I_{DH}$	$V_A, V_B, V_C, V_D = V_{CC}$	3.3V to 5V	+25°C		1	100	nA
Input-Current Low	$I_{AL}, I_{BL}, I_{CL}, I_{DL}$	$V_A, V_B, V_C, V_D = 0\text{V}$	3.3V to 5V	+25°C		1	100	nA

(1) All unused digital inputs of the device must be held at VIO 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)

$V_{CC} = 5.0\text{ V}$  or  $3.3\text{ V}$ , FULL=  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , x = A, B, C and D switch in/out or out/in, Typical values are at  $T_A = +25^{\circ}\text{C}$ . (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	$V_{CC}$	$T_A$	MIN	TYP	MAX	UNIT
<b>DYNAMIC CHARACTERISTICS</b>								
Address Transition Time	$t_{TRANS}$	$V_{X\_} = 3\text{V}/0\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , See Figure 2	5V	$+25^{\circ}\text{C}$		160		ns
		$V_{X\_} = 3\text{V}/0\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , See Figure 2	3.3V	$+25^{\circ}\text{C}$		240		ns
Turn-On Time	$t_{ON}$	$V_{X\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , See Figure 3	5V	$+25^{\circ}\text{C}$		90		ns
			3.3V			140		
Turn-Off Time	$t_{OFF}$	$V_{X\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , See Figure 3	5V	$+25^{\circ}\text{C}$		70		ns
			3.3V			100		
Charge Injection	Q	$R_S = 0\Omega$ , $C_L = 1\text{nF}$ , See Figure 4	5V	$+25^{\circ}\text{C}$		6		pC
			3.3V			4		pC
Off Isolation	$O_{ISO}$	$R_L = 50\Omega$ , $f = 1\text{MHz}$ , See Figure 5	5V	$+25^{\circ}\text{C}$		-77		dB
Channel-to-Channel Crosstalk	$X_{TALK}$	$R_L = 50\Omega$ , $f = 1\text{MHz}$ , See Figure 5	5V	$+25^{\circ}\text{C}$		-83		dB
-3dB Bandwidth	BW	$R_L = 50\Omega$	5V	$+25^{\circ}\text{C}$		180		MHz
			3.3V			180		MHz
Input Off-Capacitance	$C_{X(OFF)}$	$V_{X\_} = 0\text{V}$ , $f = 1\text{MHz}$ , See Figure 6	5V	$+25^{\circ}\text{C}$		5		pF
Output Off-Capacitance	$C_{X(OFF)}$	$V_{X\_} = 0\text{V}$ , $f = 1\text{MHz}$ , See Figure 6	5V	$+25^{\circ}\text{C}$		5		pF
Output On- Capacitance	$C_{X(ON)}$	$V_{X\_} = 0\text{V}$ , $f = 1\text{MHz}$ , See Figure 6	5V	$+25^{\circ}\text{C}$		12		pF
Total Harmonic Distortion	THD	$R_L = 600\Omega$ , $5\text{V}_{P-P}$ , $f = 20\text{Hz}$ to 20kHz	5V	$+25^{\circ}\text{C}$		0.7		%
<b>POWER REQUIREMENTS</b>								
Power Supply Range	$V_{CC}$			FULL	2.5		5.5	V
Power Supply Current	$I_{CC}$	$V_A, V_B, V_C, V_D = V_{CC}$ or 0	5V	$+25^{\circ}\text{C}$		0.001	2	$\mu\text{A}$
		$V_A, V_B, V_C, V_D = V_{CC}$ or 0	3.3V	$+25^{\circ}\text{C}$		0.001	1	$\mu\text{A}$



## 9 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.

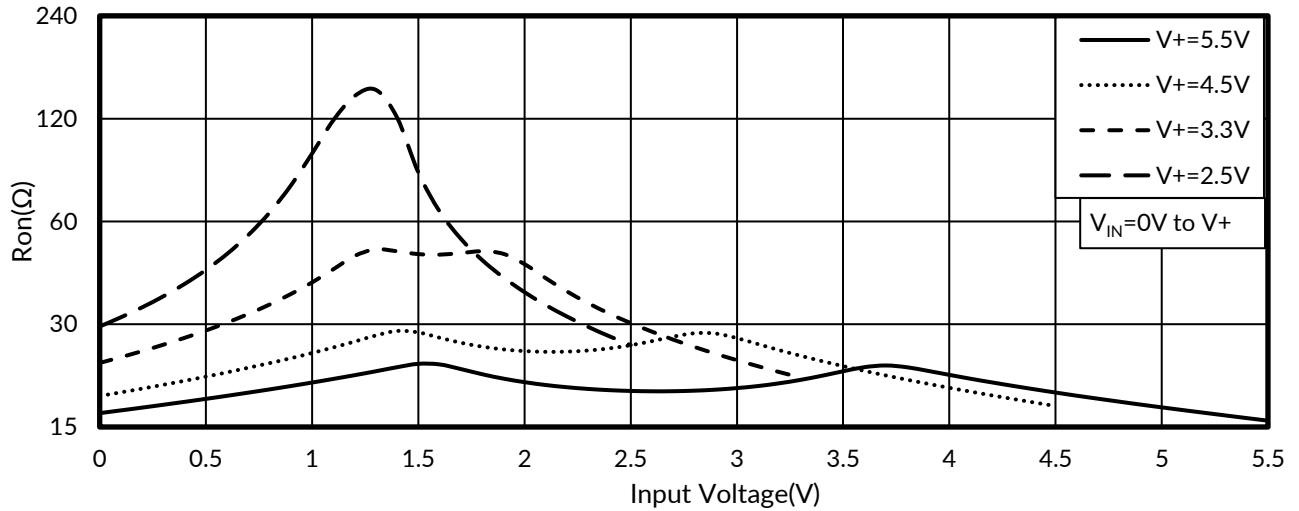
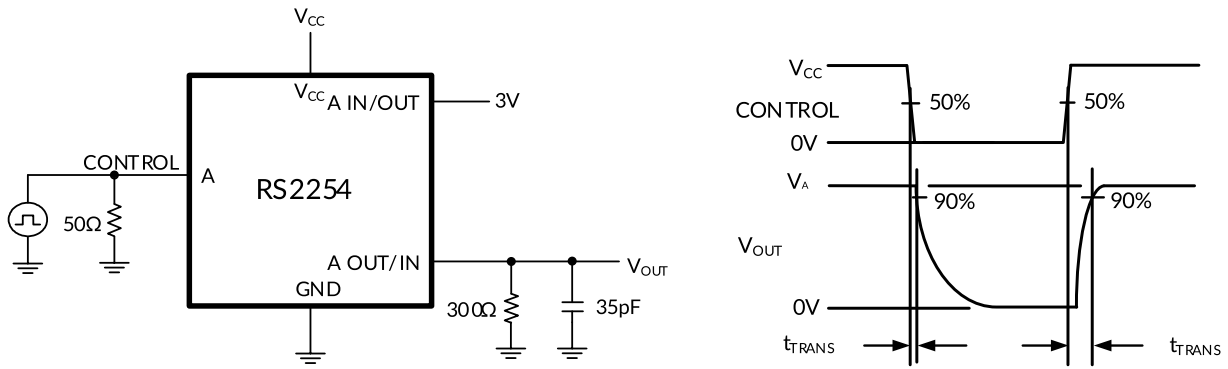
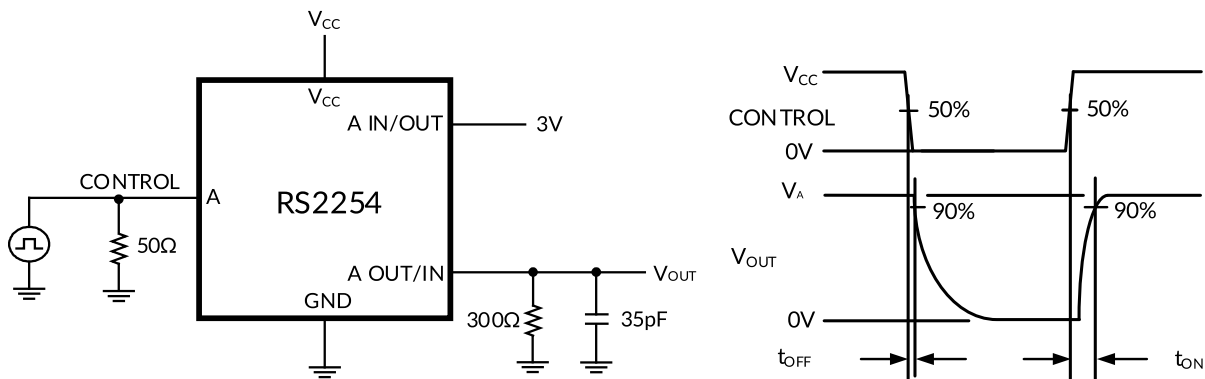


Figure 1. Typical Ron as a Function of Input Voltage

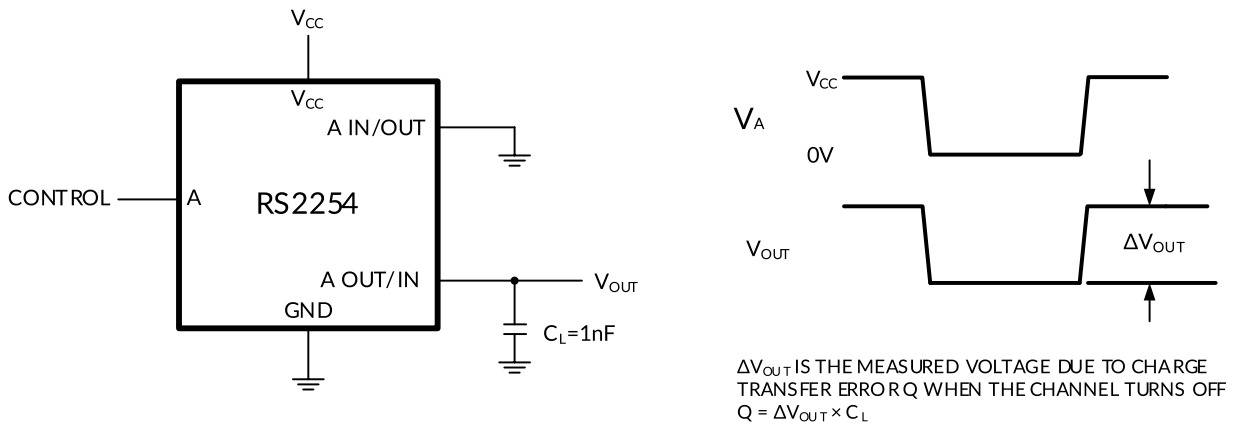
# 10 Parameter Measurement Information



**Figure 2. Address Transition Times ( $t_{TRANS}$ )**

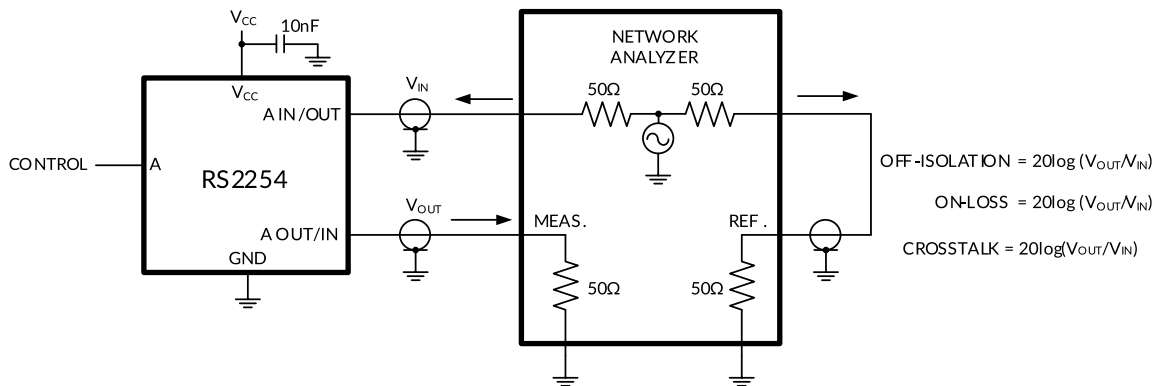


**Figure 3. Switching Times ( $t_{ON}$ ,  $t_{OFF}$ )**



**Figure 4. Charge Injection ( $Q$ )**

Parameter Measurement Information (continued)



MEASUREMENTS ARE STANDARDIZED AGAINST SHORT AT SOCKET TERMINALS .  
 OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" NO TERMINAL ON EACH SWITCH .  
 ON-LOSS IS MEASURED BETWEEN COM AND "ON" NO TERMINAL ON EACH SWITCH .  
 CROSSTALK IS MEASURED FROM ONE CHANNEL(A,B,C) TO ALL OTHER CHANNELS.  
 SIGNAL DIRECTION THROUGH SWITCH IS REVERSED ; WORST VALUES ARE RECORDED.

Figure 5. Off Isolation, On Loss and Crosstalk

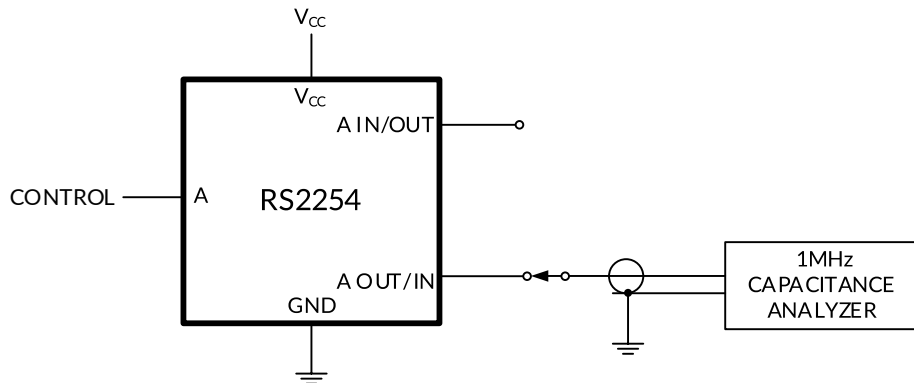
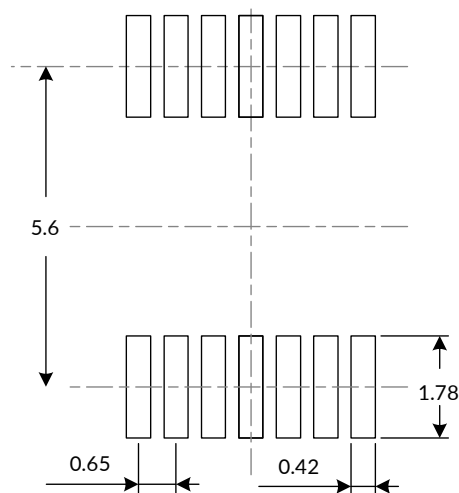
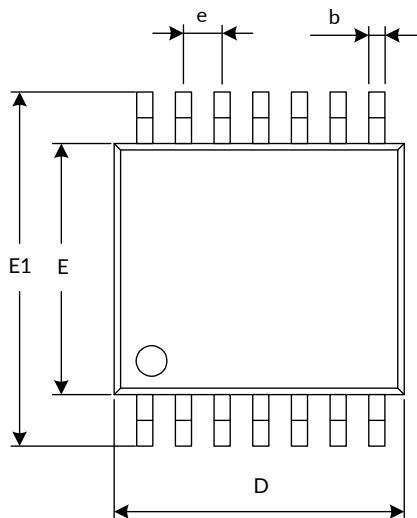


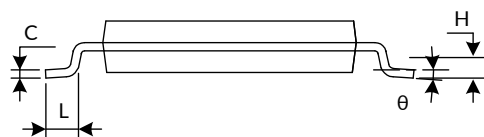
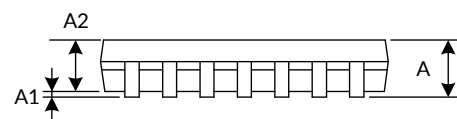
Figure 6. Capacitance

# 11 PACKAGE OUTLINE DIMENSIONS

## TSSOP14<sup>(3)</sup>



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D <sup>(1)</sup>	4.860	5.100	0.191	0.201
E <sup>(1)</sup>	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC) <sup>(2)</sup>		0.026(BSC) <sup>(2)</sup>	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
$\theta$	1°	7°	1°	7°

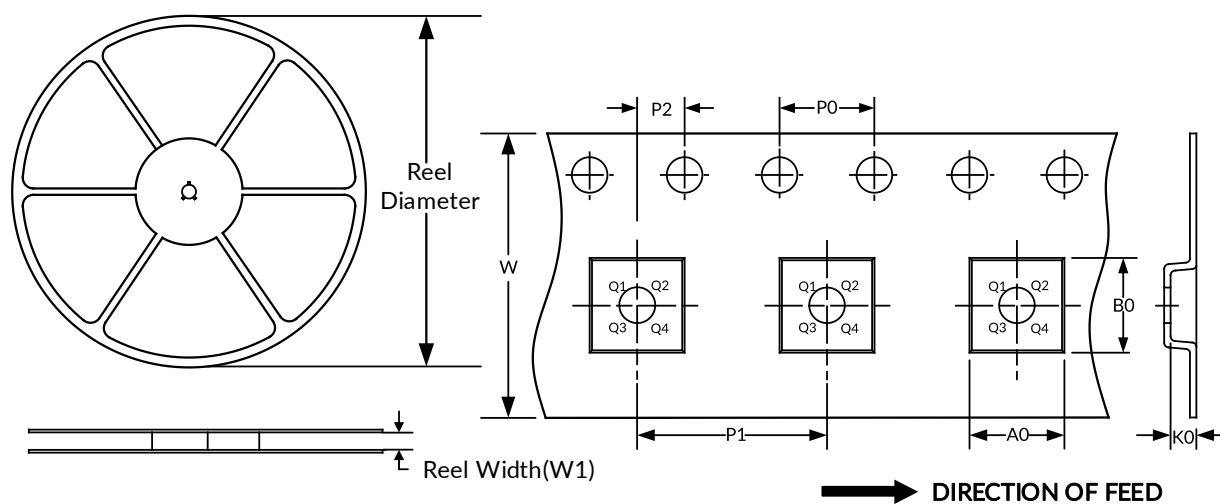
NOTE:

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
TSSOP14	13"	12.4	6.95	5.60	1.20	4.0	8.0	2.0	12.0	Q1

NOTE:

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

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