

# CMOS Quad Bilateral Analog Switch

## FEATURES

- **-3dB Bandwidth: 180MHz**
- **Single Supply Operation +2.5V to +5.5V**
- **Low ON Resistance, 24Ω(TYP) With 5V Supply**
- **High Off-Isolation: -83dB ( $R_L = 50\Omega$ ,  $f = 1\text{MHz}$ )**
- **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: SOIC-14(SOP14) and TSSOP-14**

## 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**

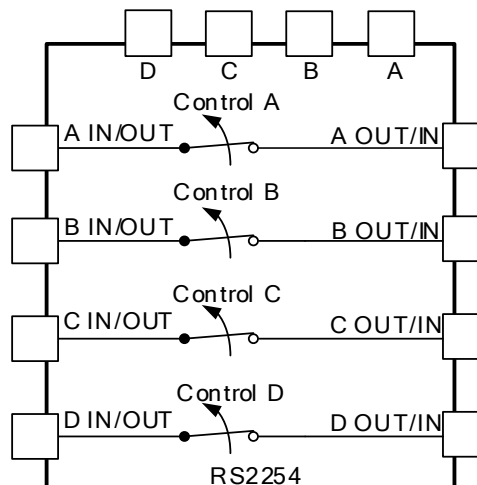
## DESCRIPTION

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.

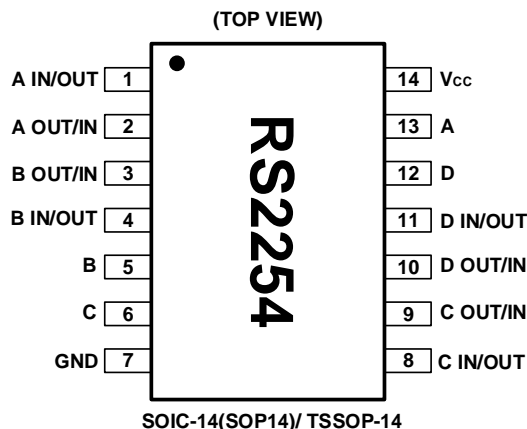
The RS2254 device consists of four bilateral switches, each with independent controls. It has low on-resistance (24Ω TYP) and very low off-leakage current (1nA TYP).

The RS2254 is available in Green SOIC-14 and TSSOP-14 packages. It operates over an ambient temperature range of -40°C to +125°C.

## Functional Diagrams of RS2254



## PIN CONFIGURATIONS



## 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

## 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.



## SPECIFICATIONS

### 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	
T <sub>J</sub>	Junction Temperature			150	°C
T <sub>stg</sub>	Storage temperature		-65	+150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

### ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM)	±4500	V
		Charged-device Model (CDM)	±1500	V

### Recommended Operating Conditions

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

SYMBOL	PARAMETER	MIN	MAX	UNIT
V <sub>CC</sub>	Supply Voltage	2.5	5.5	V
T <sub>A</sub>	Operating temperature	-40	+125	°C

### Thermal Information

THERMAL METRIC		RS2254		UNIT
		14PINS		
		SOIC-14 (SOP-14)	TSSOP-14	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	89.5	119.5	°C/W
R <sub>θJC(top)</sub>	Junction-to-case(top) thermal resistance	49.7	48.2	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	43.8	61.2	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	17.4	5.5	°C/W
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	43.5	60.6	°C/W
R <sub>θJC(bot)</sub>	Junction-to-case(bottom) thermal resistance	N/A	NA	°C/W



---

## PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING	PACKAGE OPTION
RS2254	RS2254XP	-40°C ~+125°C	SOIC-14(SOP-14)	RS2254	Tape and Reel,2500
	RS2254XQ	-40°C ~+125°C	TSSOP-14	RS2254	Tape and Reel,3000



## 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	TYP	MAX	UNITS
<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  $V_{IO}$  or GND to ensure proper device operation.

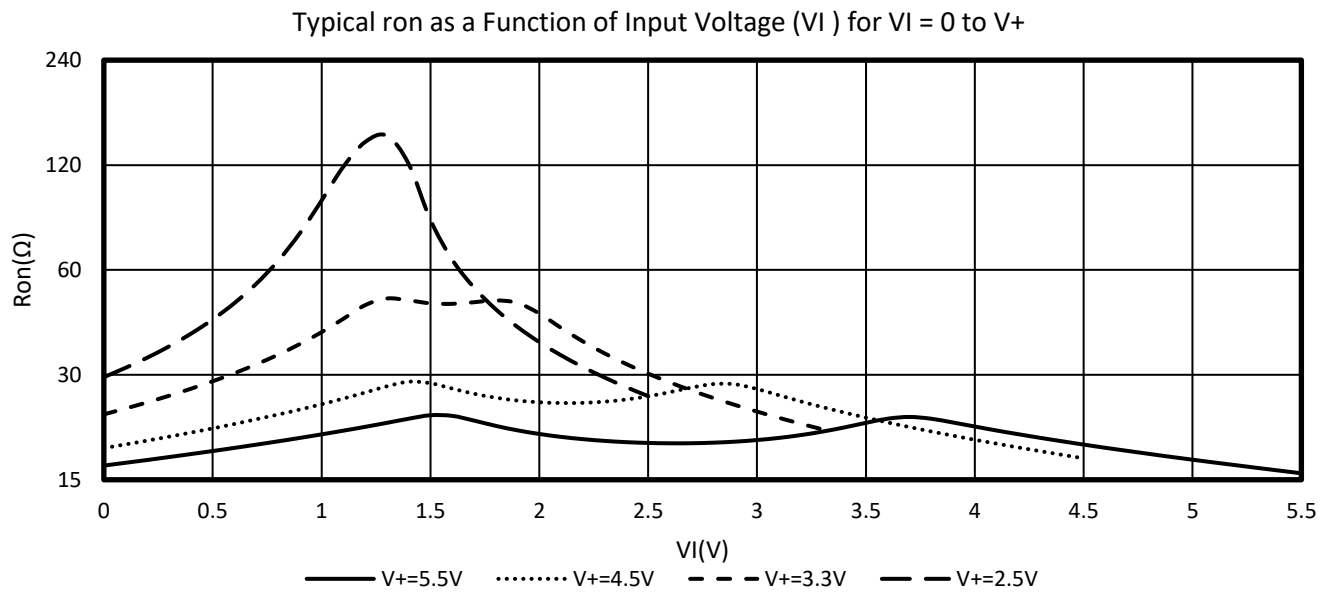


## ELECTRICAL CHARACTERISTICS (continued)

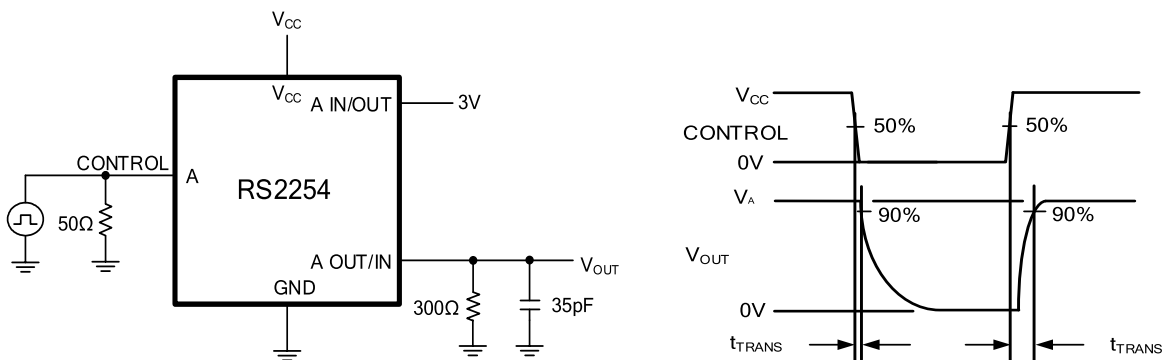
$V_{CC} = 5.0\text{ V}$  or  $3.3\text{ V}$ , FULL =  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , x=A, B, C and D switch in/out or out/in, Typical values are at  $T_A = +25^{\circ}\text{C}$  (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	$V_{CC}$	TEMP	MIN	TYP	MAX	UNITS
<b>DYNAMIC CHARACTERISTICS</b>								
Address Transition Time	$t_{TRANS}$	$V_{X\_} = 3\text{V}/0\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 1	5V	$+25^{\circ}\text{C}$		160		ns
		$V_{X\_} = 3\text{V}/0\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 1	3.3V	$+25^{\circ}\text{C}$		240		ns
Turn-On Time	$t_{ON}$	$V_{X\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 2	5V	$+25^{\circ}\text{C}$		90		ns
			3.3V			140		
Turn-Off Time	$t_{OFF}$	$V_{X\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 2	5V	$+25^{\circ}\text{C}$		70		ns
			3.3V			100		
Input Transition Rise Time	$t_R$		5V	$+25^{\circ}\text{C}$		50		ns
			3.3V			80		
Input Transition Fall Time	$t_F$		5V	$+25^{\circ}\text{C}$		60		ns
			3.3V			85		ns
Charge Injection	Q	$R_S = 0\Omega$ , $C_L = 1\text{nF}$ , Test Circuit 3	5V	$+25^{\circ}\text{C}$		6		pC
		$R_S = 0\Omega$ , $C_L = 1\text{nF}$ , Test Circuit 3	3.3V			4		pC
Off Isolation	$O_{ISO}$	$R_L = 50\Omega$ , $f = 1\text{MHz}$ , Test Circuit 4	5V	$+25^{\circ}\text{C}$		-83		dB
Channel-to-Channel Crosstalk	$X_{TALK}$	$R_L = 50\Omega$ , $f = 1\text{MHz}$ , Test Circuit 4	5V	$+25^{\circ}\text{C}$		-110		dB
-3dB Bandwidth	BW	$R_L = 50\Omega$	5V	$+25^{\circ}\text{C}$		180		MHz
			3.3V			180		MHz
Input Off-Capacitance	$C_{X(OFF)}$	$V_{X\_} = 0\text{V}$ , $f = 1\text{MHz}$ , Test Circuit 5	5V	$+25^{\circ}\text{C}$		4.7		pF
Output Off-Capacitance	$C_{X(OFF)}$	$V_{X\_} = 0\text{V}$ , $f = 1\text{MHz}$ , Test Circuit 5	5V	$+25^{\circ}\text{C}$		12.7		pF
Output On- Capacitance	$C_{X(ON)}$	$V_{X\_} = 0\text{V}$ , $f = 1\text{MHz}$ , Test Circuit 5	5V	$+25^{\circ}\text{C}$		16		pF
Total Harmonic Distortion	THD	$R_L = 600\Omega$ , $5V_{P-P}$ , $f = 20\text{Hz}$ to $20\text{kHz}$	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	$\mu\text{A}$

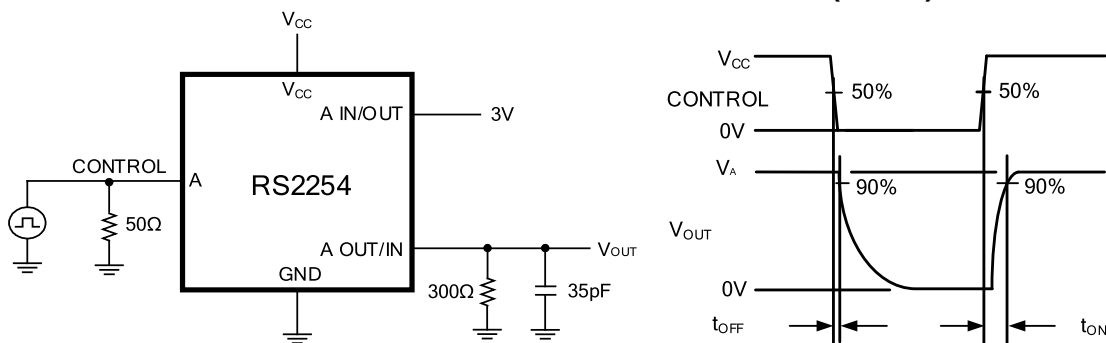
## TYPICAL CHARACTERISTICS



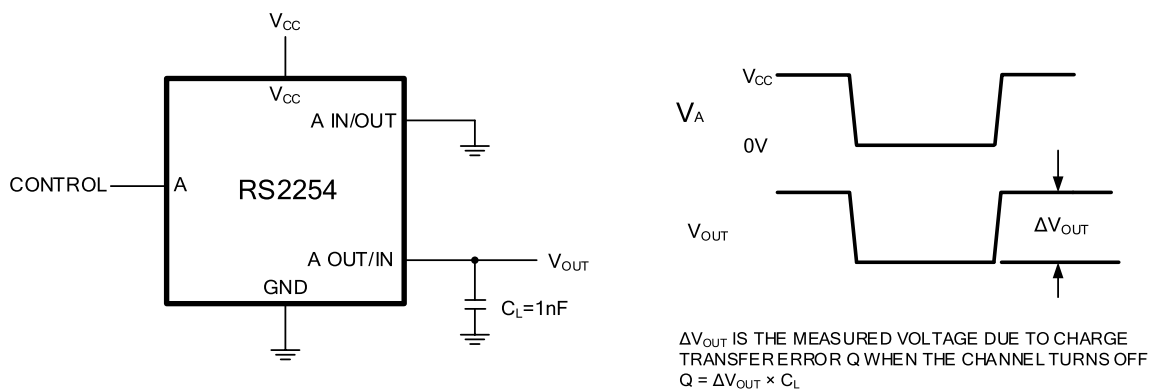
## Parameter Measurement Information



**Test Circuit 1. Address Transition Times ( $t_{TRANS}$ )**



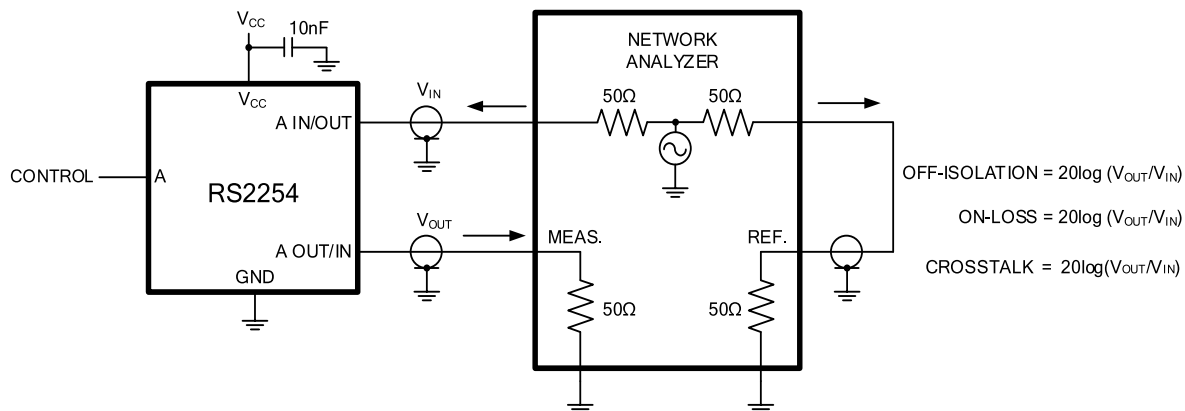
**Test Circuit 2. Switching Times ( $t_{ON}$ ,  $t_{OFF}$ )**



**Test Circuit 3. Charge Injection (Q)**

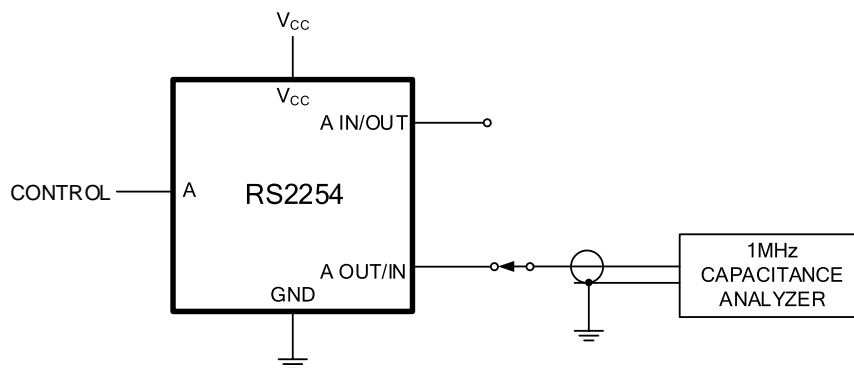


## Parameter Measurement Information (continued)



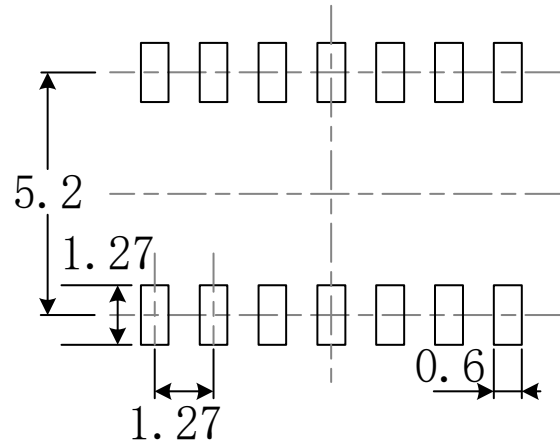
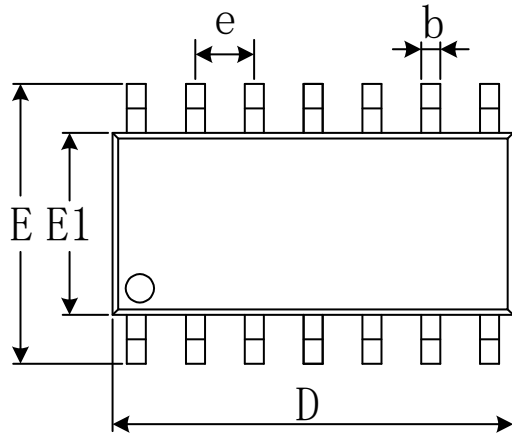
MEASUREMENTS ARE STANDARDIZED AGAINST SHORT AT SOCKET TERMINALS.  
 OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" NO TERMINAL ON EACH SWITCH.  
 ON-LOSS IS MEASURED BETWEEN COM AND "ON" NO TERMINAL ON EACH SWITCH.  
 CROSSTALK IS MEASURED FROM ONE CHANNEL(A,B,C) TO ALL OTHER CHANNELS.  
 SIGNAL DIRECTION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

### Test Circuit 4 Off Isolation, On Loss and Crosstalk

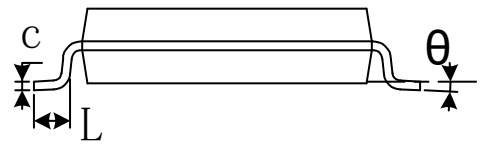
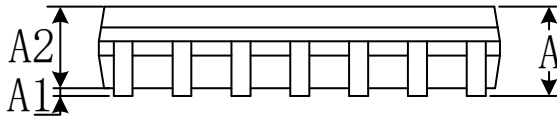


### Test Circuit 5 Capacitance

## PACKAGE OUTLINE DIMENSIONS SOIC-14(SOP14)

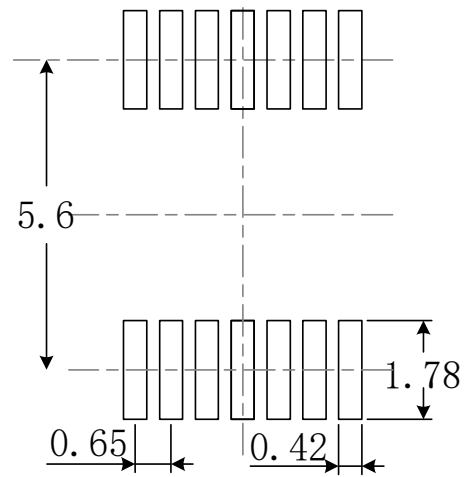
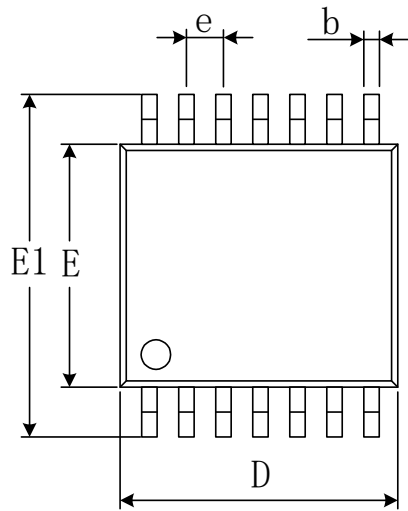


RECOMMENDED LAND PATTERN (Unit: mm)

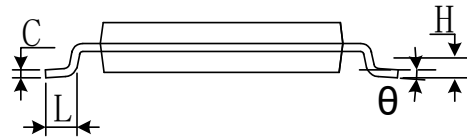
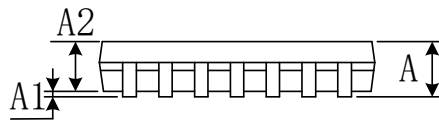


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
$\theta$	0°	8°	0°	8°

# TSSOP-14



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		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	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
$\theta$	1°	7°	1°	7°