

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**

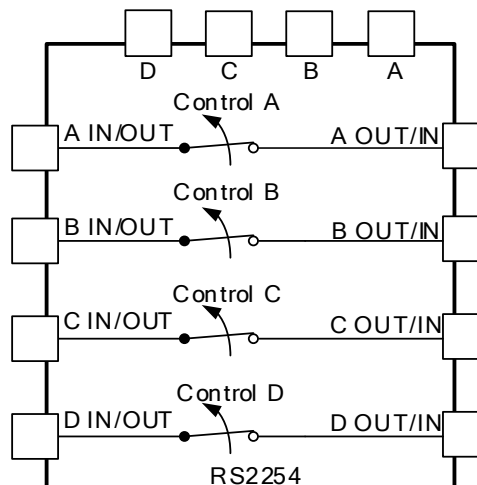
DESCRIPTION

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.

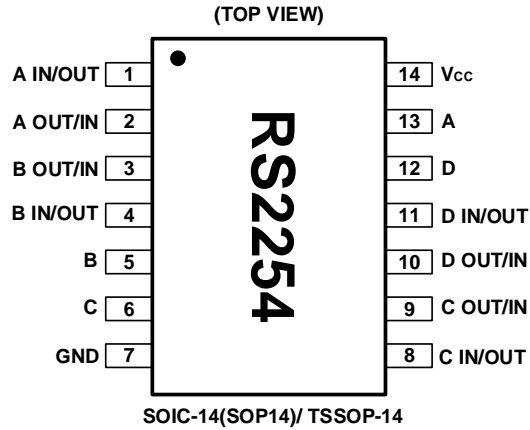
The RS2254 device consists of four bilateral switches, each with independent controls. It has low on-resistance (24Ω TYP) and very low off-leakage current (1nA TYP).

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 _{CC} | - | 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) ⁽¹⁾

| SYMBOL | PARAMETER | | MIN | MAX | UNIT |
|-------------------|----------------------------|---|------|----------------------|------|
| V _{CC} | Supply Voltage | | -0.3 | 6 | V |
| V _{IN} | Input Voltage (All inputs) | | -0.3 | V _{CC} +0.3 | |
| I _{IN} | Switch Input Current | Any one input | -20 | +20 | mA |
| I _{PEAK} | Peak Switch Current | Pulsed at 1ms Duration, <10% Duty Cycle | -40 | +40 | |
| T _J | Junction Temperature | | | 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.

ESD Ratings

| | | | VALUE | UNIT |
|--------------------|-------------------------|----------------------------|-------|------|
| V _(ESD) | 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) ⁽³⁾

| SYMBOL | PARAMETER | MIN | MAX | UNIT |
|-----------------|-----------------------|-----|------|------|
| V _{CC} | Supply Voltage | 2.5 | 5.5 | V |
| T _A | Operating temperature | -40 | +125 | °C |

Thermal Information

| THERMAL METRIC | | RS2254 | | UNIT |
|-----------------------|--|------------------|----------|------|
| | | 14PINS | | |
| | | SOIC-14 (SOP-14) | TSSOP-14 | |
| R _{ΘJA} | Junction-to-ambient thermal resistance | 89.5 | 119.5 | °C/W |
| R _{ΘJC(top)} | Junction-to-case(top) thermal resistance | 49.7 | 48.2 | °C/W |
| R _{ΘJB} | Junction-to-board thermal resistance | 43.8 | 61.2 | °C/W |
| Ψ _{JT} | Junction-to-top characterization parameter | 17.4 | 5.5 | °C/W |
| Ψ _{JB} | Junction-to-board characterization parameter | 43.5 | 60.6 | °C/W |
| R _{ΘJC(bot)} | Junction-to-case(bottom) thermal resistance | N/A | NA | °C/W |



RS2254

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 V , FULL= -40°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 |
|---------------------------------------|--|---|-----------------|----------------|-----|-----|-----------------|-------|
| ANALOG SWITCH | | | | | | | | |
| Analog Signal Range | V _{X_} , V _X | | | FULL | GND | | V _{CC} | V |
| On-Resistance | R _{ON} | V _{CC} =5V, I _X =1mA | 5V | +25°C | | 24 | 30 | Ω |
| | | | | FULL | | | 35 | Ω |
| | | V _{CC} =3.3V, I _X =1mA | 3.3V | +25°C | | 50 | 60 | Ω |
| | | | | FULL | | | 65 | Ω |
| On-Resistance Match Between Channels | ΔR _{ON} | V _{CC} =5V, I _X =1mA | 5V | +25°C | | 1 | 4 | Ω |
| | | | | FULL | | | 5.3 | Ω |
| On-Resistance Flatness | R _{FLAT(ON)} | V _{CC} =5V, I _X =1mA | 5V | +25°C | | 8 | 11 | Ω |
| | | | | FULL | | | 14 | Ω |
| X_ Off Leakage Current | I _{X_(OFF)} | V _{X_} =1V, 4.5V V _X =4.5V, 1V | 5V | +25°C | | 1 | 100 | n A |
| | | V _{X_} =1V, 3V V _X =3V, 1V | 3.3V | +25°C | | 1 | 100 | n A |
| X Off Leakage Current | I _{X(OFF)} | V _{X_} =1V, 4.5V V _X =4.5V, 1V | 5V | +25°C | | 1 | 100 | n A |
| | | V _{X_} =1V, 3V V _X =3V, 1V | 3.3V | +25°C | | 1 | 100 | n A |
| X On Leakage Current | I _{X(ON)} | V _{CC} =5V, V _X =4.5V, 1V | 5V | +25°C | | 1 | 100 | n A |
| | | V _{CC} =3.3V, V _X =3V, 1V | 3.3V | +25°C | | 1 | 100 | n A |
| DIGITAL CONTROL INPUTS ⁽¹⁾ | | | | | | | | |
| 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 | n A |
| Input-Current Low | I _{AL} , I _{BL} , I _{CL} , I _{DL} | V _A , V _B , V _C , V _D = 0V | 3.3V to 5V | +25°C | | 1 | 100 | n A |

(1) All unused digital inputs of the device must be held at V_{IO} or GND to ensure proper device operation.



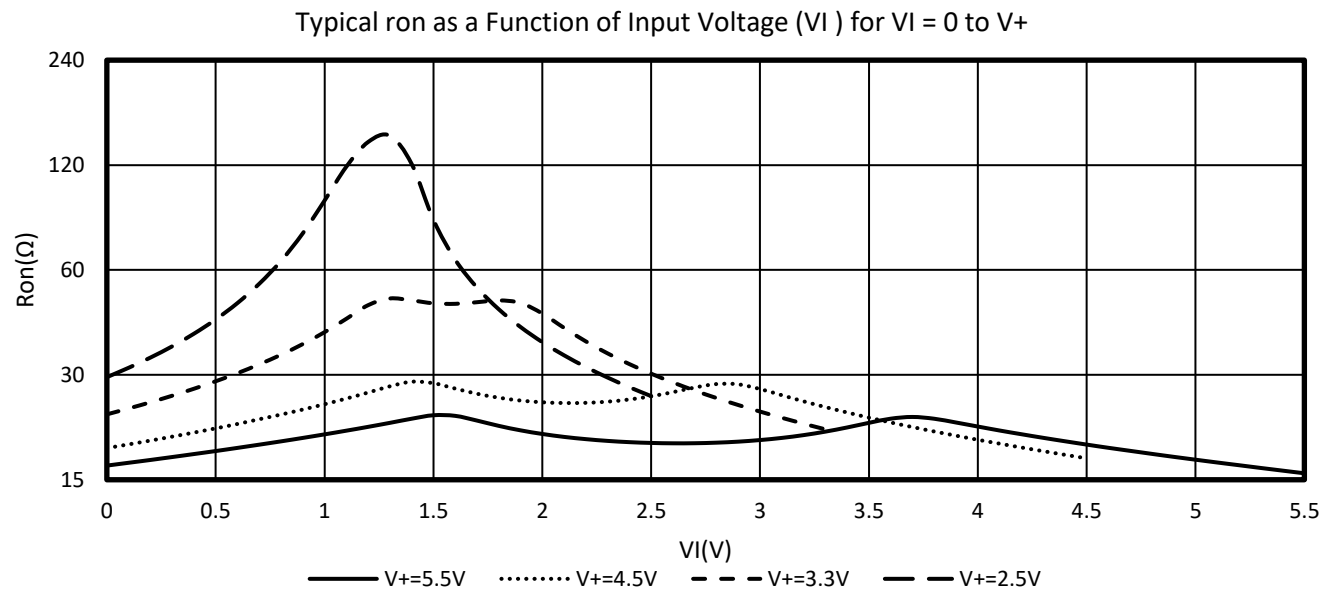
ELECTRICAL CHARACTERISTICS (continued)

$V_{CC} = 5.0\text{ V}$ or 3.3 V , FULL = -40°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)

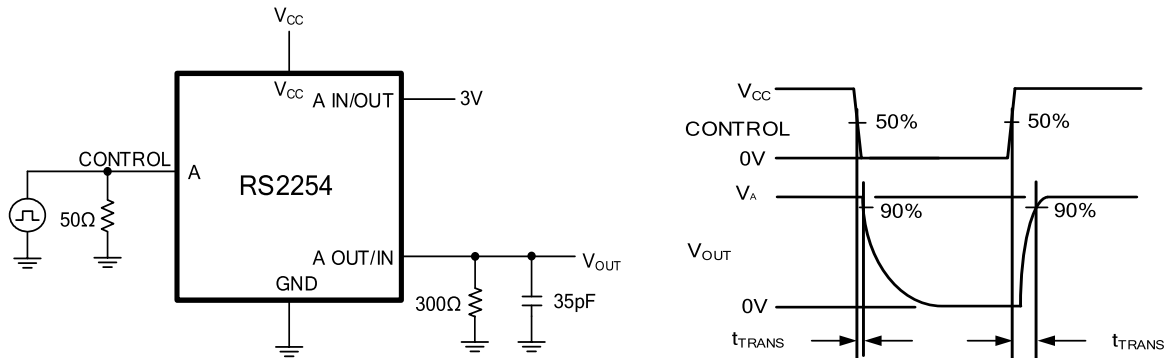
| PARAMETER | SYMBOL | CONDITIONS | V_{CC} | TEMP | MIN | TYP | MAX | UNITS |
|--------------------------------|--------------|--|----------|-----------------------|-----|-------|-----|---------------|
| DYNAMIC CHARACTERISTICS | | | | | | | | |
| Address Transition Time | t_{TRANS} | $V_{X_} = 3\text{V}/0\text{V}$, $R_L = 300\Omega$, $C_L = 35\text{pF}$, 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 20kHz | 5V | $+25^{\circ}\text{C}$ | | 0.7 | | % |
| POWER REQUIREMENTS | | | | | | | | |
| 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 | μA |
| | | $V_A, V_B, V_C, V_D = V_{CC}$ or 0 | 3.3V | $+25^{\circ}\text{C}$ | | 0.001 | 1 | μA |



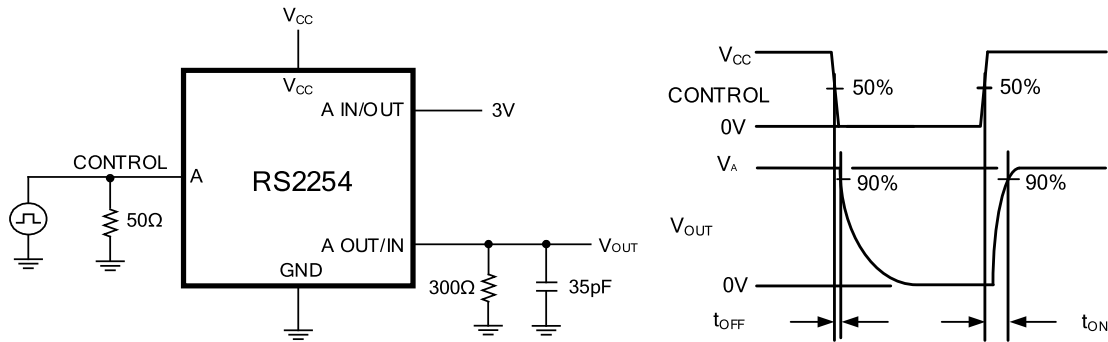
TYPICAL CHARACTERISTICS



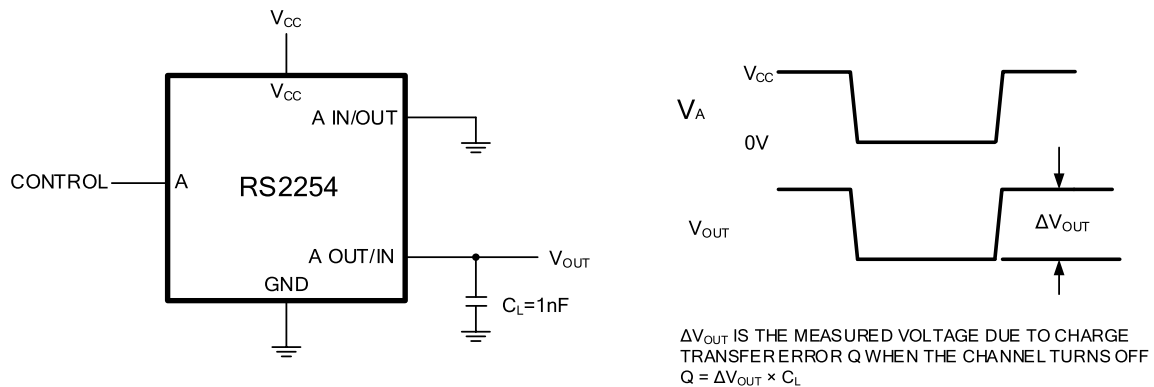
Parameter Measurement Information



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

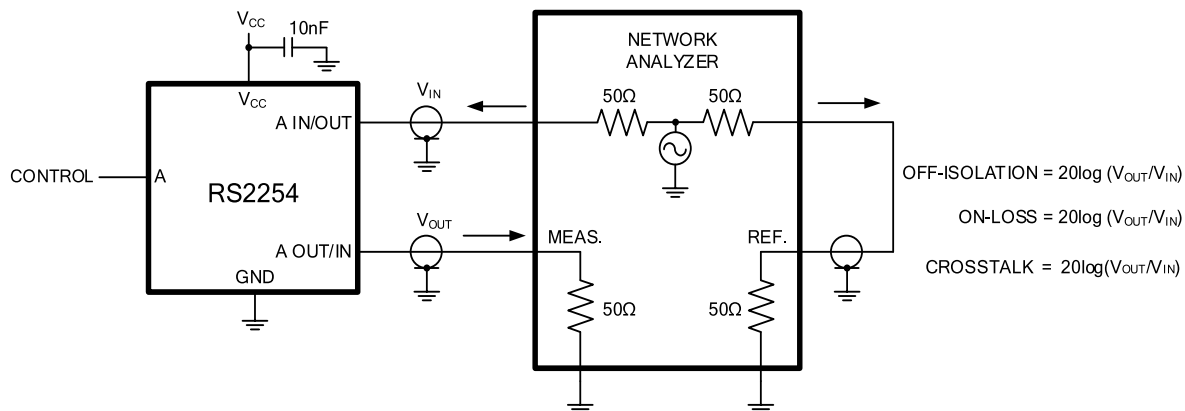


Test Circuit 2. Switching Times (t_{ON} , t_{OFF})



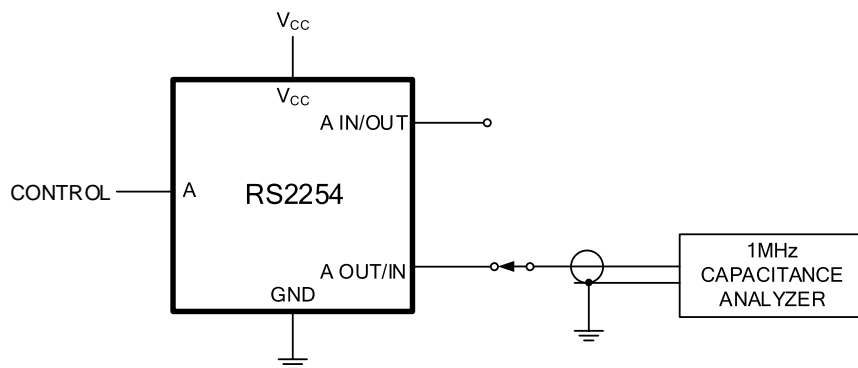
Test Circuit 3. Charge Injection (Q)

Parameter Measurement Information (continued)



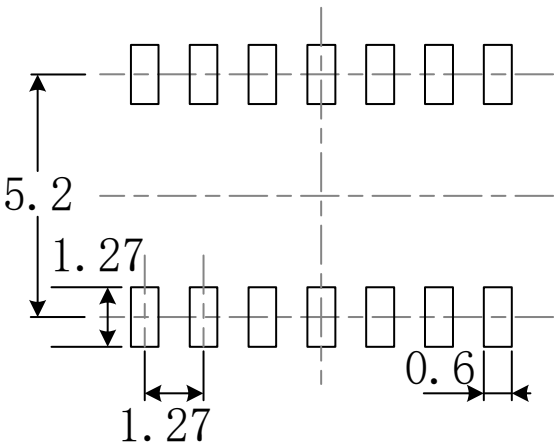
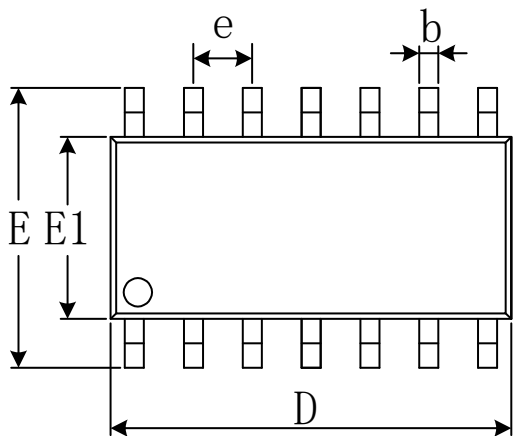
MEASUREMENTS ARE STANDARDIZED AGAINST SHORT AT SOCKET TERMINALS.
OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" NO TERMINAL ON EACH SWITCH.
ON-LOSS IS MEASURED BETWEEN COM AND "ON" NO TERMINAL ON EACH SWITCH.
CROSSTALK IS MEASURED FROM ONE CHANNEL(A,B,C) TO ALL OTHER CHANNELS.
SIGNAL DIRECTION THROUGH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

Test Circuit 4 Off Isolation, On Loss and Crosstalk

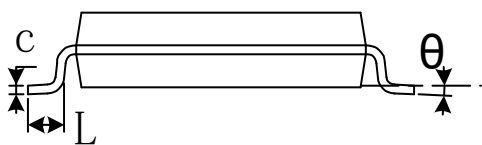
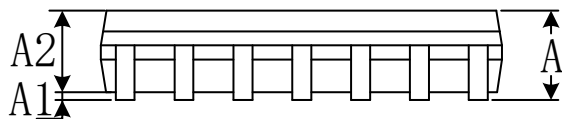


Test Circuit 5 Capacitance

PACKAGE OUTLINE DIMENSIONS
SOIC-14(SOP14)

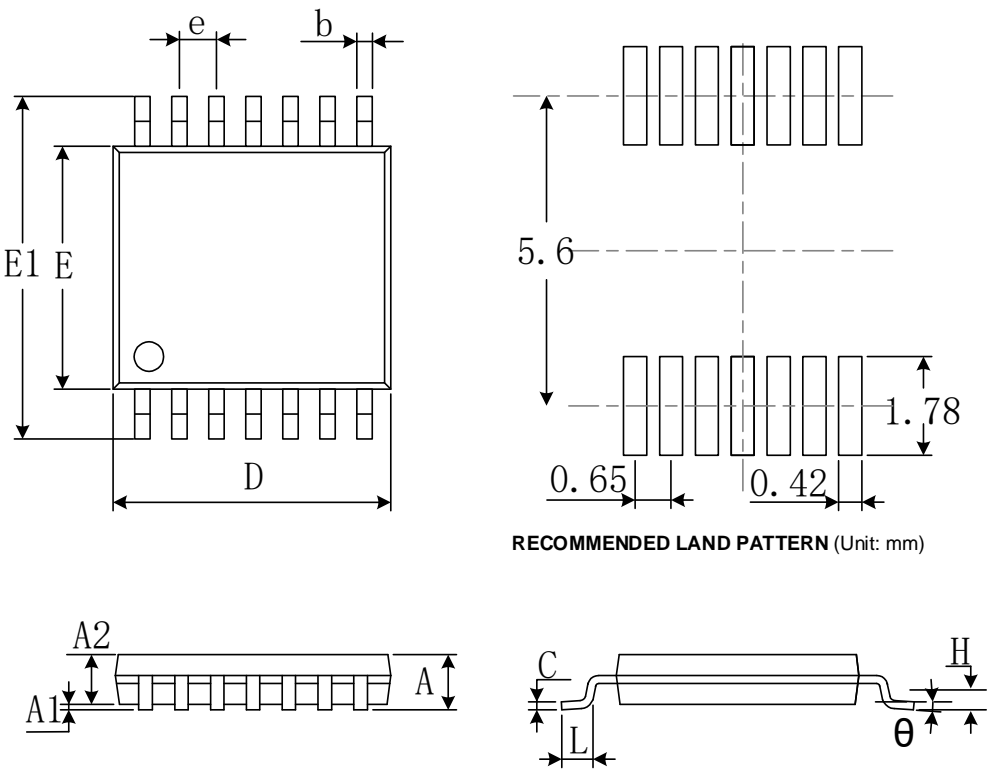


RECOMMENDED LAND PATTERN (Unit: mm)



| 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 |
| θ | 0° | 8° | 0° | 8° |

TSSOP-14



| 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) | |
| θ | 1° | 7° | 1° | 7° |

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[TS5A3157DBVR\(UMW\)](#) [SN74LVC1G66DBVR](#)