CMOS Two 4-Channel Analog Multiplexer/Demultiplexer

FEATURES

- **-3dB Bandwidth: 180MHz**
- **Single Supply Operation +2.5V to +5.5V**
- **Low ON Resistance, 48Ω(TYP) With 5V Supply**
- **High Off-Isolation: -83dB (RL = 50Ω, f = 1MHz)**
- **Break-Before-Make Switching**
- **Binary Address Decoding on Chip**
- **Operating Temperature Range: -40°C to +125°C**
- **PACKAGES: SOIC-16, SSOP-16, TSSOP-16 and QFN-3×3-16L**

APPLICATIONS

- **Sensors**
- **Analog and Digital Multiplexing and Demultiplexing**
- **A/D and D/A Conversion**
- **Signal Gating**
- **Battery-Operated Equipment**
- **Factory Automation**
- **Appliances**
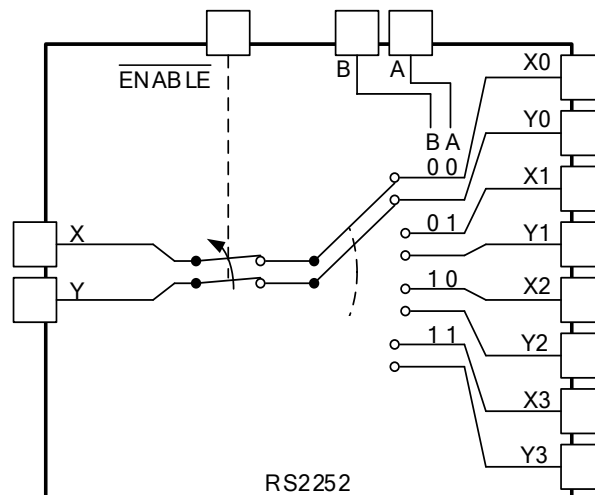- **Communications Circuits**

DESCRIPTION

The RS2252 is a CMOS analog IC configured as two 4-channel multiplexers. This CMOS device can operate from 2.5 V to 5.5 V.
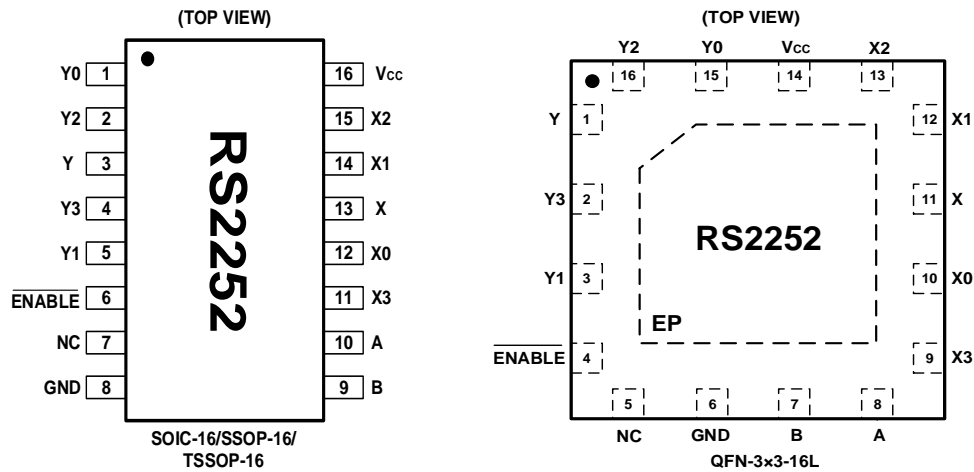
The RS2252 device are digitally-controlled analog switches. It has low on-resistance (48Ω TYP) and very low off-leakage current (1nA TYP).

The RS2252 is available in Green SOIC-16, SSOP-16, TSSOP-16 and QFN-3×3-16L packages. It operates over an ambient temperature range of -40°C to +125°C.

Functional Diagrams of RS2252

PIN CONFIGURATIONS

(TOP VIEW)

```
Y0    [1]          [16]  Vcc
Y2    [2]          [15]  X2
Y     [3]          [14]  X1
Y3    [4]    RS2252 [13]  X
Y1    [5]          [12]  X0
ENABLE [6]         [11]  X3
NC    [7]          [10]  A
GND   [8]          [9]   B
```
SOIC-16/SSOP-16/
TSSOP-16

(TOP VIEW)

```
        Y2   Y0   Vcc   X2
        [16] [15] [14] [13]
Y    [1]              [12]  X1
Y3   [2]    RS2252    [11]  X
Y1   [3]             [10]  X0
ENABLE [4]   EP       [9]   X3
        [5]  [6]  [7]  [8]
        NC   GND   B    A
```
QFN-3×3-16L

PIN DESCRIPTION

NAME	PIN (SOIC-16/SSOP-16/TSSOP-16)	PIN (QFN-3×3-16L)	FUNCTION
X0-X3	12,14,15,11	10,12,13,9	Analog Switch Inputs X0-X3.
Y0-Y3	1,5,2,4	15,3,16,2	Analog Switch Inputs Y0-Y3.
X	13	11	Analog Switch "X" Output.
Y	3	1	Analog Switch "Y" Output.
V_{CC}	16	14	Positive Analog and Digital Supply Voltage Input.
A	10	8	Digital Address "A" Input.
B	9	7	Digital Address "B" Input.
GND	8	6	Ground. Connect to digital ground.
NC	7	5	No Connect.
$\overline{ENABLE}$	6	4	Digital Enable Input. Normally connected to GND.
EP	—	Exposed Pad	Exposed Pad. Connect EP to GND.

FUNCTION TABLE

$\overline{ENABLE}$ INPUT	INPUT STATES		ON CHANNEL(S)
	B	A	
1	X	X	NONE
0	0	0	X0, Y0
0	0	1	X1, Y1
0	1	0	X2, Y2
0	1	1	X3, Y3

X=Don't care
NOTE: Input and output pins are identical and interchangeable. Either may be considered an input or output; signals pass equally well in either direction.

ABSOLUTE MAXIMUM RATINGS [(1)]

V_{CC} to GND...−0.3 to 6V

Input Terminals, Voltage. [(2)] ....− 0.3 to (V+) + 0.3V

Continuous Current into Any Terminal.....................±20mA

Peak Current, X_

(Pulsed at 1ms,10% duty cycle)…………………….. ±40mA

Storage Temperature ……….…………… −65°C to +150°C

Operating Temperature …………….…… −40°C to +125°C

Junction Temperature...+150°C

Package Thermal Resistance @ T_A = +25°C

QFN-3×3-16L……………….……………………….. 80°C/W

SSOP-16……………….…….....................................64°C/W

SOIC-16, TSSOP-16………………….……………100°C/W

Lead Temperature (Soldering, 10s) …………….........260°C
ESD Susceptibility
HBM …..1000V
MM ……………………….......……………….…………100V

(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 0.3V beyond the supply rails should
    be current-limited to 10mA or less.

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.

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING	PACKAGE OPTION
RS2252	RS2252XS16	-40°C ~+125°C	SOIC-16	RS2252	Tape and Reel,3000
	RS2252XSS16	-40°C ~+125°C	SSOP-16	RS2252	Tape and Reel,3000
	RS2252XTSS16	-40°C ~+125°C	TSSOP-16	RS2252	Tape and Reel,3000
	RS2252XTQC16	-40°C ~+125°C	QFN-3×3 -16L	RS2252	Tape and Reel,3000

ELECTRICAL CHARACTERISTICS

V_{CC} = 5.0 V or 3.3V, FULL= –40°C to +125°C, Typical values are at TA = +25°C. (unless otherwise noted)

| PARAMETER	SYMBOL	CONDITIONS	V_{CC}	T_A	MIN	TYP	MAX	UNITS
ANALOG SWITCH								
Analog Signal Range	$V_{X\_}$, V_X $V_{Y\_}$, V_Y			FULL	0		V_{CC}	V
On-Resistance	R_{ON}	V_{CC}=5V, I_X, I_Y=1mA	5V	+25°C		48	65	Ω
				FULL			70	Ω
		V_{CC}=3.3V, I_X, I_Y =1mA	3.3V	+25°C		100	130	Ω
				FULL			140	Ω
On-Resistance Match Between Channels	ΔR_{ON}	V_{CC}=5V, I_X, I_Y =1mA Switch ON	5V	+25°C		1.5	5	Ω
				FULL			5.3	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	V_{CC}=5V, I_X, I_Y =1mA Switch ON	5V	+25°C		17	25	Ω
				FULL			28	Ω
X_ Off, Y_ Off, X Off, Y Off, X On, Y On Leakage Current	$I_{X\_(OFF)}$, $I_{Y\_(OFF)}$ $I_{X(OFF)}$, $I_{Y(OFF)}$ $I_{X(ON)}$, $I_{Y(ON)}$	V_{CC}=5V, $V_{X\_}$, $V_{Y\_}$=1V, 4.5V V_X, V_Y =4.5V, 1V	5V	+25°C		1	100	n A
		V_{CC}=3.3V, $V_{X\_}$, $V_{Y\_}$=1V, 3V V_X, V_Y =3V, 1V	3.3V	+25°C		1	100	n A
DIGITAL CONTROL INPUTS[1]								
Logic Input Logic Threshold High	V_{AH}, V_{BH}, $V_{\overline{ENABLE}}$		5V	+25°C	1.7			V
			3.3V	+25°C	1.7			V
Logic Input Logic Threshold Low	V_{AL}, V_{BL}, $V_{\overline{ENABLE}}$		5V	+25°C			0.5	V
			3.3V	+25°C			0.5	V
Input-Current High	I_{AH}, I_{BH}, $I_{\overline{ENABLE}}$	V_A, V_B, $V_{\overline{ENABLE}}$ = V_{CC}	3.3V to 5V	+25°C		1	100	n A
Input-Current Low	I_{AL}, I_{BL}, $I_{\overline{ENABLE}}$	V_A, V_B, $V_{\overline{ENABLE}}$= 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 V or 3.3V, FULL= –40°C to +125°C Typical values are at TA = +25°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V_{CC}	TEMP	MIN	TYP	MAX	UNITS
DYNAMIC CHARACTERISTICS								
Address Transition Time	t_{TRANS}	$V_{X\_}$, $V_{Y\_}$= 3V/0V, R_L = 300Ω, C_L = 35pF, Test Circuit 1	5V	+25°C		120		ns
		$V_{X\_}$, $V_{Y\_}$= 3V/0V, R_L = 300Ω, C_L = 35pF, Test Circuit 1	3.3V	+25°C		210		ns
$\overline{ENABLE}$ Turn-On Time	t_{ON}	$V_{X\_}$, $V_{Y\_}$ = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 2	5V	+25°C		70		ns
			3.3V			130		
$\overline{ENABLE}$ Turn-Off Time	t_{OFF}	$V_{X\_}$, $V_{Y\_}$ = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 2	5V	+25°C		80		ns
			3.3V			120		
Internal A, B, C Rise Time	t_R		5V	+25°C		50		ns
			3.3V			80		
Internal A, B, C Fall Time	t_F		5V	+25°C		60		ns
			3.3V			85		ns
Break-Before-Make Time Delay	t_D	$V_{X\_}$, $V_{Y\_}$ = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 3	5V	+25°C		50		ns
			3.3V			80		ns
Charge Injection	Q	R_S = 0Ω, C_L = 1nF, Test Circuit 4	5V	+25°C		6		pC
		R_S = 0Ω, C_L = 1nF, Test Circuit 4	3.3V			4		pC
Crosstalk	X_{TALK}	f = 1MHz, Test Circuit 5	5V	+25°C		-110		dB
Off Isolation	O_{ISO}	R_L = 50Ω, f = 1MHz, Test Circuit 5	5V	+25°C		-83		dB
-3dB Bandwidth	BW	R_L = 50Ω	5V	+25°C		180		MHz
			3.3V			180		MHz
Input Off-Capacitance	$C_{X\_(OFF)}$ $C_{X\_(OFF)}$	f = 1MHz, Test Circuit 6	5V	+25°C		4.7		pF
Output Off-Capacitance	$C_{X(OFF)}$ $C_{Y(OFF)}$	f = 1MHz, Test Circuit 6	5V	+25°C		12.7		pF
Output On- Capacitance	$C_{X(ON)}$ $C_{Y(ON)}$	f = 1MHz, Test Circuit 6	5V	+25°C		16		pF
Total Harmonic Distortion	THD	R_L = 600Ω,$5V_{P-P}$, f = 20Hz to 20kHz	5V	+25°C		0.7		%
POWER REQUIREMENTS								
Power Supply Range	V_{CC}			FULL	2.5		5.5	V
Power Supply Current	I_{CC}	V_{CC} = 5.0V, V_A, V_B, $V_{\overline{ENABLE}}$ = V_{CC} or 0	5V	+25°C		0.001	2	μ A
		V_{CC} = 3.3V, V_A, V_B, $V_{\overline{ENABLE}}$ = V_{CC} or 0	3.3V	+25°C		0.001	1	μ A

TYPICAL CHARACTERISTICS
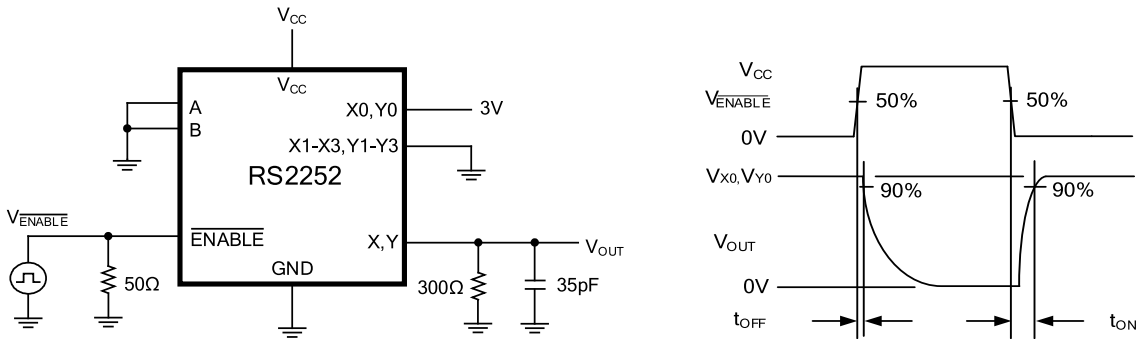
Typical ron as a Function of Input Voltage (VI) for VI = 0 to V+
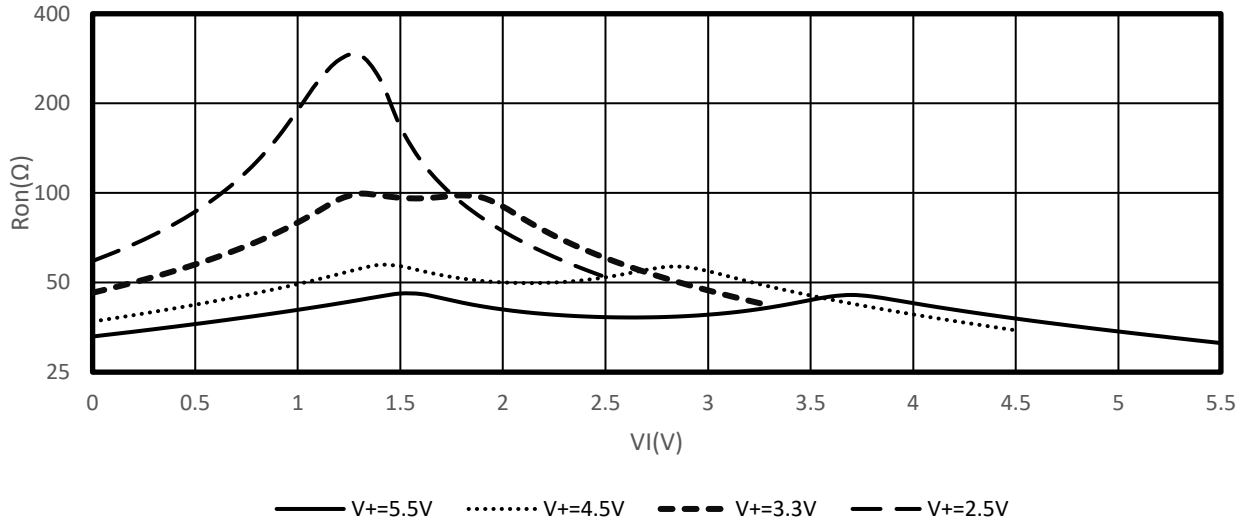
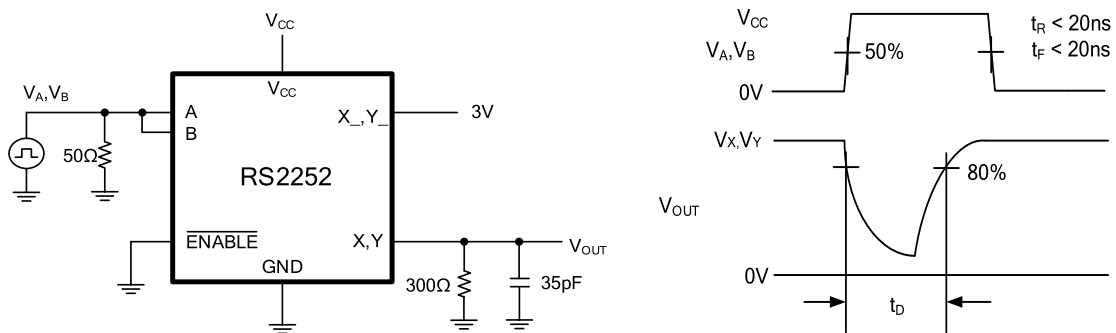## Parameter Measurement Information
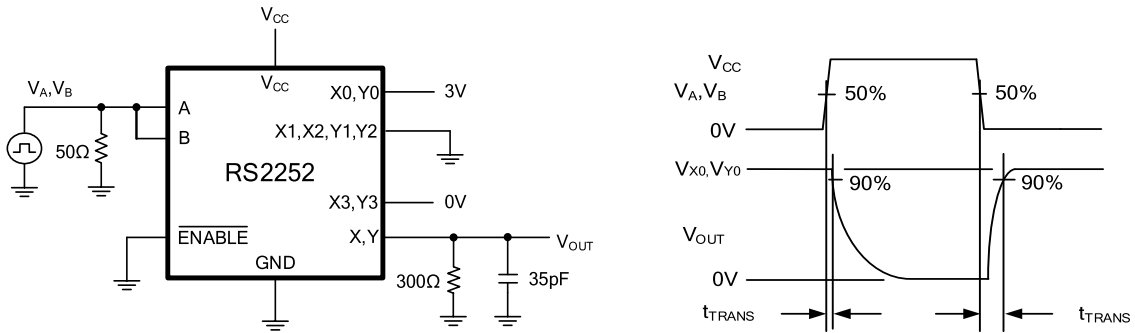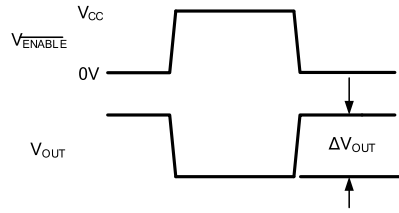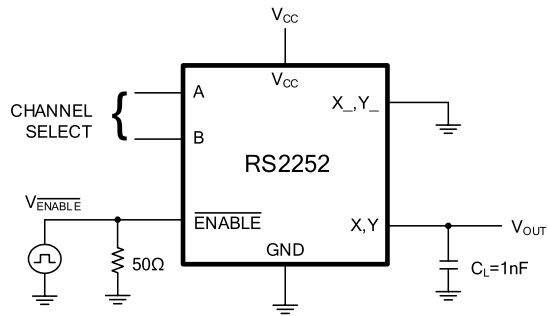

Test Circuit 1. Address Transition Times (t_TRANS)
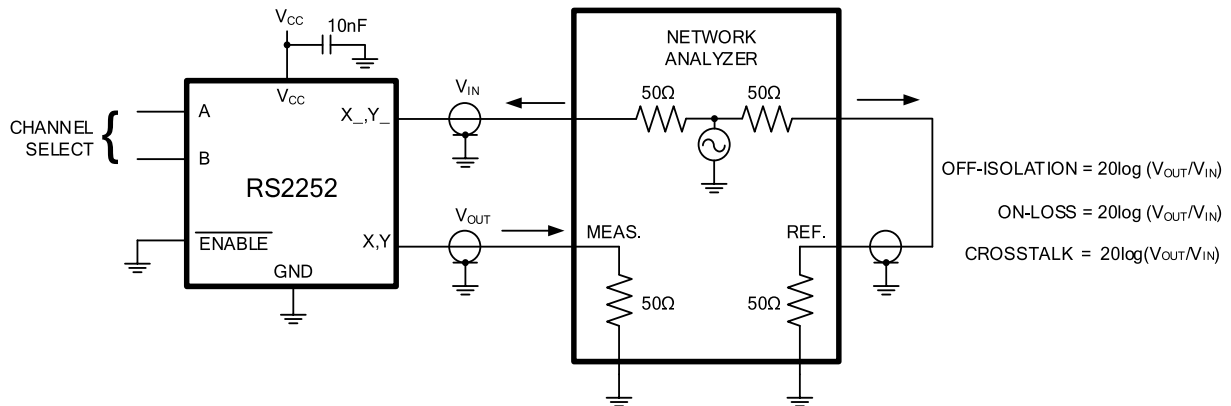

Test Circuit 2. Switching Times (t_ON, t_OFF)

Test Circuit 3. Break-Before-Make Time Delay (t_D)

Parameter Measurement Information (continued)

ΔV_{OUT} IS THE MEASURED VOLTAGE DUE TO CHARGE
TRANSFER ERROR Q WHEN THE CHANNEL TURNS OFF
Q = $\Delta V_{OUT} \times C_L$

Test Circuit 4. Charge Injection (Q)

OFF-ISOLATION = 20log (V_{OUT}/V_{IN})

ON-LOSS = 20log (V_{OUT}/V_{IN})

CROSSTALK = 20log(V_{OUT}/V_{IN})

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.
SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

Test Circuit 5. Off Isolation, On Loss
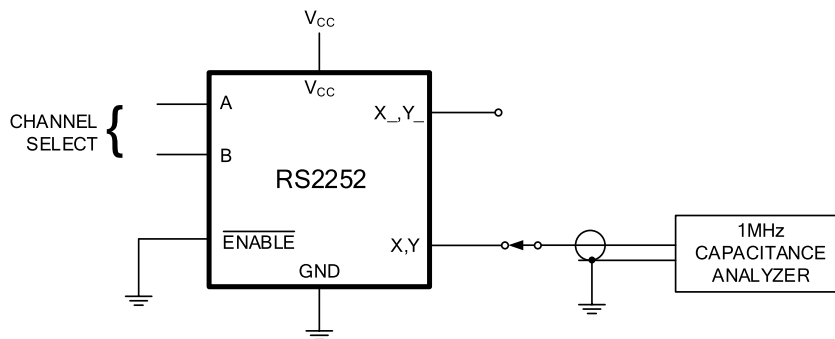
Test Circuit 6. Capacitance

APPLICATION NOTES

The RS2252 device is a differential 4-channel multiplexer having two binary control inputs, A and B, and an inhibit input. The two binary input signals select 1 of 4 pairs of channels to be turned on and connect the analog inputs to the outputs.

One application of the RS2252 is to use it in conjunction with a microcontroller to poll a keypad. Figure 1 shows the basic schematic for such a polling system. The microcontroller uses the channel select pins to cycle through the different channels while reading the input to see if a user is pressing any of the keys. This is a very robust setup, allowing for multiple simultaneous key-presses with very little power consumption. It also utilizes very few pins on the microcontroller. The down side of polling is that the microcontroller must continually scan the keys for a press and can do little else during this process.
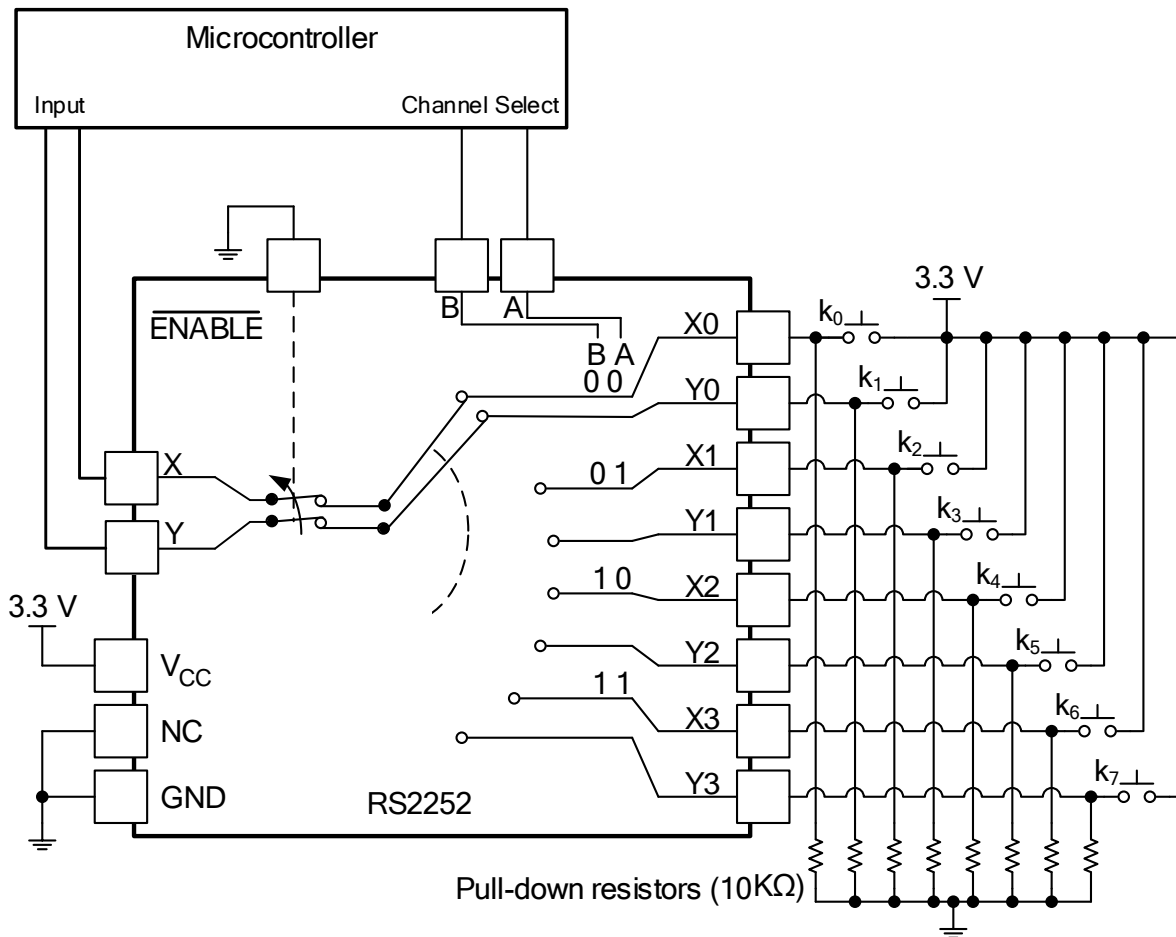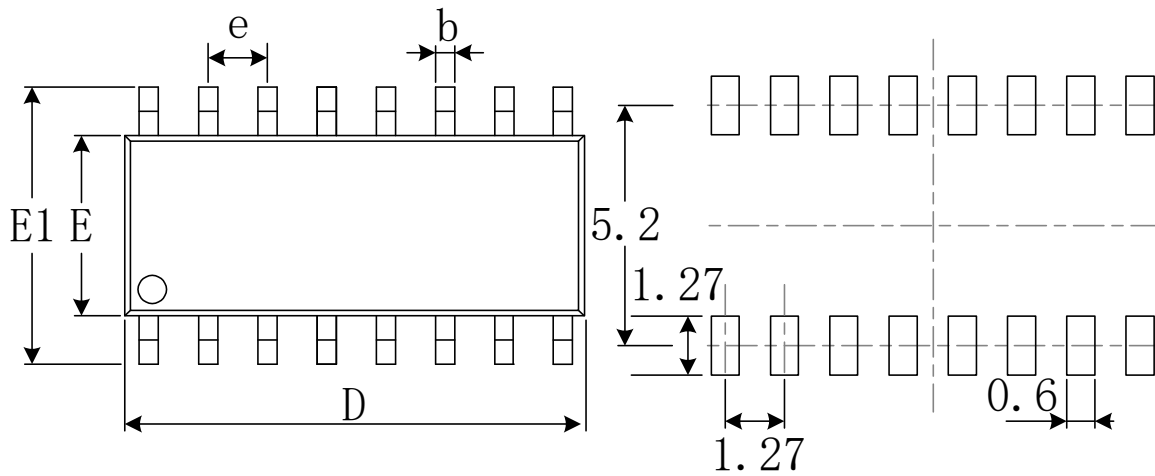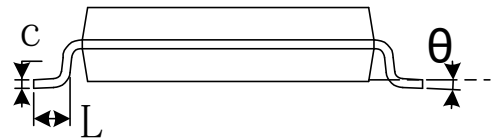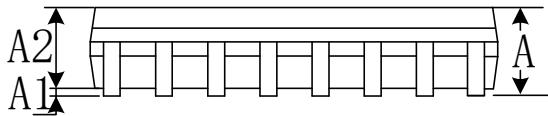

Figure 1. The RS2252 Being Used to Help Read Button Presses on a Keypad.

PACKAGE OUTLINE DIMENSIONS
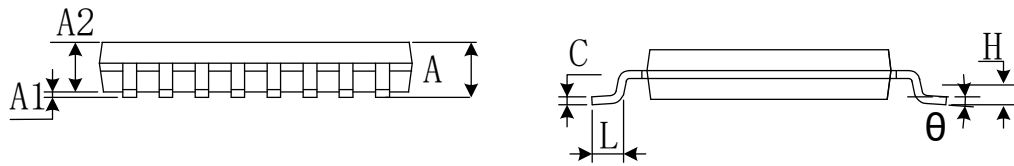# SOIC-16

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	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°
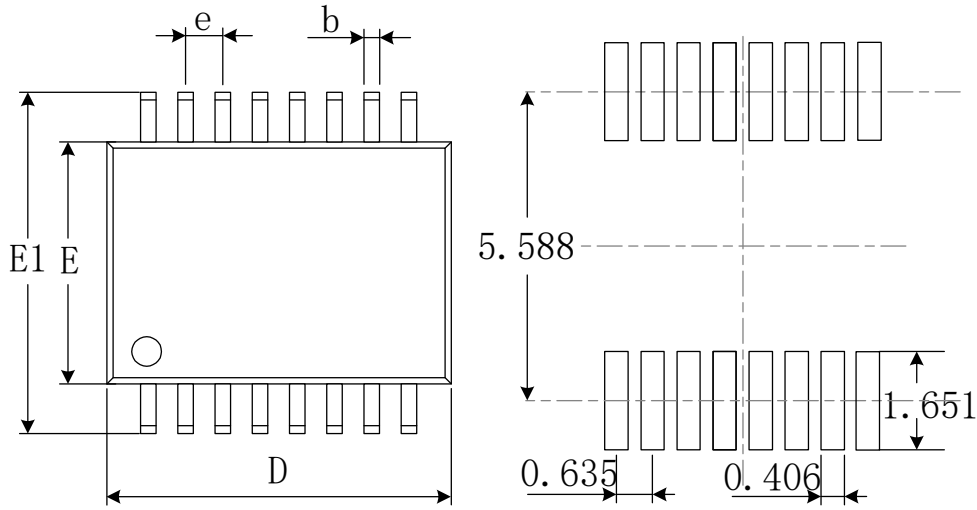
SSOP-16

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	0.200	0.300	0.008	0.012
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	0.635(BSC)		0.025(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP-16

RECOMMENDED LAND PATTERN (Unit: mm)
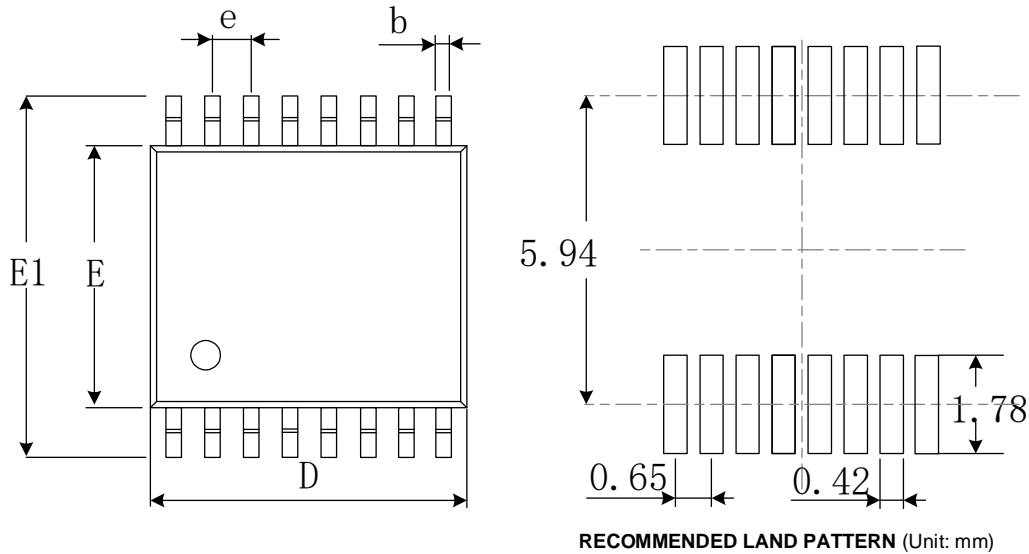
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.200	6.600	0.244	0.260
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.02	0.028
H	0.25TYP		0.01TYP	
θ	1°	7°	1°	7°

QFN-3x3-16L

TOP VIEW

BOTTOM VIEW

SIDE VIEW

RECOMMENDED LAND PATTERN
(Unit: mm)
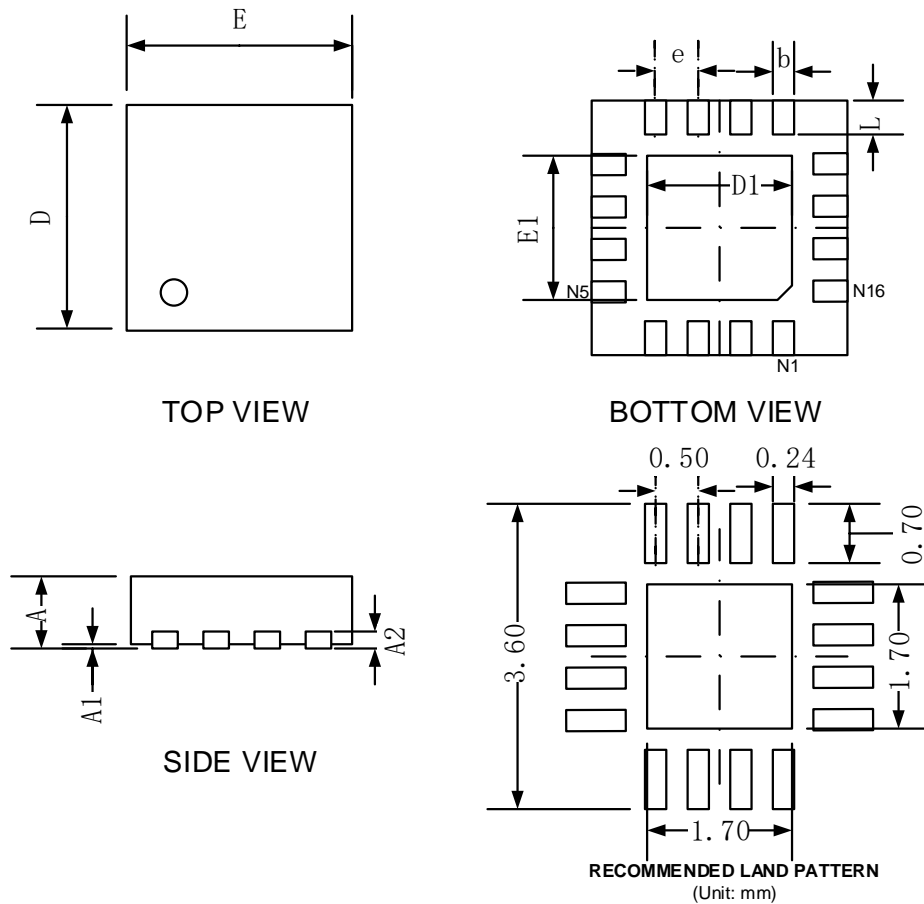
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203		0.008	
b	0.180	0.300	0.007	0.012
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020