

# CMOS Triple 2-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(SOP16), SSOP-16, TSSOP-16 and QFN-3x3-16L**

## APPLICATIONS

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

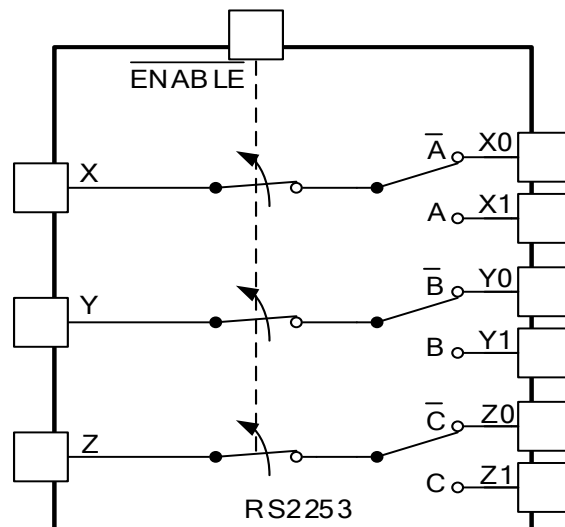
## DESCRIPTION

The RS2253 is a CMOS analog IC configured as three single-pole/double-throw (SPDT) switches. This CMOS device can operate from 2.5 V to 5.5 V.

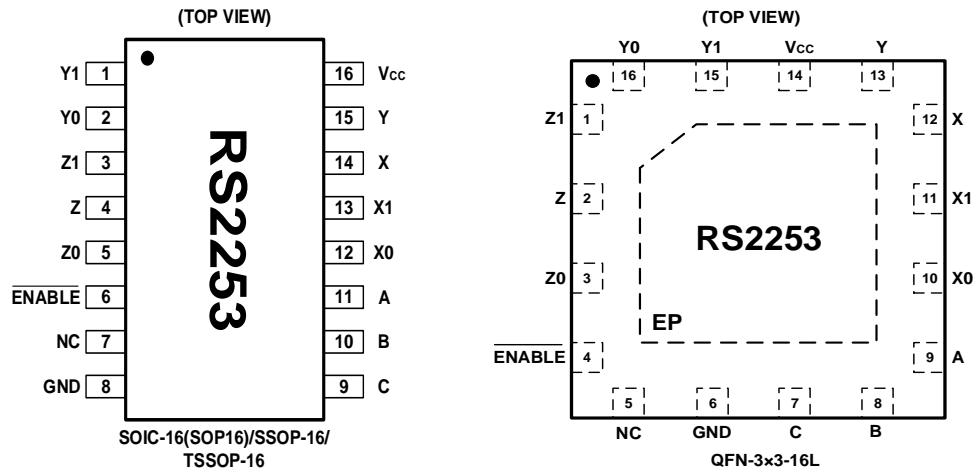
The RS2253 device are digitally-controlled analog switches. It has low on-resistance (48Ω TYP) and very low off-leakage current (1nA TYP).

The RS2253 is available in Green SOIC-16, SSOP-16, TSSOP-16 and QFN-3x3-16L packages. It operates over an ambient temperature range of -40°C to +125°C.

### Functional Diagrams of RS2253



## PIN CONFIGURATIONS



## PIN DESCRIPTION

NAME	PIN SOIC-16/SSOP-16/ TSSOP-16	PIN QFN-3x3-16L	FUNCTION
Y1	1	15	Analog Switch "Y" Normally Open Input.
Y0	2	16	Analog Switch "Y" Normally Closed Input.
Z1	3	1	Analog Switch "Z" Normally Open Input.
Z	4	2	Analog Switch "Z" Output.
Z0	5	3	Analog Switch "Z" Normally Closed Input.
$\overline{\text{ENABLE}}$	6	4	Digital Enable Input. Normally connected to GND.
NC	7	5	No Connect.
GND	8	6	Ground. Connect to digital ground.
C	9	7	Digital Address "C" Input.
B	10	8	Digital Address "B" Input.
A	11	9	Digital Address "A" Input.
X0	12	10	Analog Switch "X" Normally Closed Input.
X1	13	11	Analog Switch "X" Normally Open Input.
X	14	12	Analog Switch "X" Output.
Y	15	13	Analog Switch "Y" Output.
V <sub>cc</sub>	16	14	Positive Analog and Digital Supply Voltage Input
EP	—	Exposed Pad	Exposed Pad. Connect EP to GND.

**FUNCTION TABLE**

ENABLE INPUT	INPUT STATES			ON CHANNEL(S)
	C	B	A	
1	X	X	X	NONE
0	0	0	0	X0, Y0, Z0
0	0	0	1	X1, Y0, Z0
0	0	1	0	X0, Y1, Z0
0	0	1	1	X1, Y1, Z0
0	1	0	0	X0, Y0, Z1
0	1	0	1	X1, Y0, Z1
0	1	1	0	X0, Y1, Z1
0	1	1	1	X1, Y1, Z1

X=Don't care

NOTE: Input and output pins are identical and inter-changeable. Either may be considered an input or output; signals pass equally well in either direction.

**ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>**

V <sub>CC</sub> to GND.....	-0.3 to 6V
Input Terminals, Voltage. <sup>(2)</sup> .....	- 0.3 to (V <sub>+</sub> ) + 0.3V
Continuous Current into Any Terminal.....	±20mA
Peak Current, X <sub>1</sub> (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 <sub>A</sub> = +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


**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.

- (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.

**PACKAGE/ORDERING INFORMATION**

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING	PACKAGE OPTION
RS2253	RS2253XS16	-40°C ~+125°C	SOIC-16(SOP16)	RS2253	Tape and Reel,3000
	RS2253XSS16	-40°C ~+125°C	SSOP-16	RS2253	Tape and Reel,3000
	RS2253XTSS16	-40°C ~+125°C	TSSOP-16	RS2253	Tape and Reel,3000
	RS2253XTQC16	-40°C ~+125°C	QFN-3×3 -16L	RS2253	Tape and Reel,3000

## ELECTRICAL CHARACTERISTICS

$V_{CC} = 5.0\text{ V}$  or  $3.3\text{ V}$ , FULL =  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , 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	$V_{X\_}, V_{Y\_}, V_{Z\_}$ $V_X, V_Y, V_Z$			FULL	GND		$V_{CC}$	V
On-Resistance	$R_{ON}$	$V_{CC}=5\text{V}, I_X, I_Y, I_Z=1\text{mA}$	5V	+25°C		48	65	$\Omega$
				FULL			70	$\Omega$
		$V_{CC}=3.3\text{V}, I_X, I_Y, I_Z=1\text{mA}$	3.3V	+25°C		100	130	$\Omega$
				FULL			140	$\Omega$
On-Resistance Match Between Channels	$\Delta R_{ON}$	$V_{CC}=5\text{V}, I_X, I_Y, I_Z=1\text{mA}$	5V	+25°C		1.5	5	$\Omega$
				FULL			5.3	$\Omega$
On-Resistance Flatness	$R_{FLAT(ON)}$	$V_{CC}=5\text{V}, I_X, I_Y, I_Z=1\text{mA}$	5V	+25°C		17	25	$\Omega$
				FULL			28	$\Omega$
X, Y, Z Off Leakage Current	$I_{X(OFF)} I_{Y(OFF)}$ $I_{Z(OFF)}$	$V_{X\_}, V_{Y\_}, V_{Z\_}=1\text{V}, 4.5\text{V}$ $V_X, V_Y, V_Z=4.5\text{V}, 1\text{V}$	5V	+25°C		1	100	nA
		$V_{X\_}, V_{Y\_}, V_{Z\_}=1\text{V}, 3\text{V}$ $V_X, V_Y, V_Z=3\text{V}, 1\text{V}$	3.3V	+25°C		1	100	nA
X, Y, Z Off Leakage Current	$I_{X(OFF)} I_{Y(OFF)}$ $I_{Z(OFF)}$	$V_{X\_}, V_{Y\_}, V_{Z\_}=1\text{V}, 4.5\text{V}$ $V_X, V_Y, V_Z=4.5\text{V}, 1\text{V}$	5V	+25°C		1	100	nA
		$V_{X\_}, V_{Y\_}, V_{Z\_}=1\text{V}, 3\text{V}$ $V_X, V_Y, V_Z=3\text{V}, 1\text{V}$	3.3V	+25°C		1	100	nA
X, Y, Z On Leakage Current	$I_{X(ON)} I_{Y(ON)} I_{Z(ON)}$	$V_{CC}=5\text{V}, V_X, V_Y, V_Z=4.5\text{V}, 1\text{V}$	5V	+25°C		1	100	nA
		$V_{CC}=3.3\text{V}, V_X, V_Y, V_Z=3\text{V}, 1\text{V}$	3.3V	+25°C		1	100	nA
<b>DIGITAL CONTROL INPUTS<sup>(1)</sup></b>								
Logic Input Logic Threshold High	$V_{AH}, V_{BH}, V_{CH},$ $V_{ENABLE}$		5V	+25°C	1.7			V
			3.3V	+25°C	1.7			V
Logic Input Logic Threshold Low	$V_{AL}, V_{BL}, V_{CL},$ $V_{ENABLE}$		5V	+25°C			0.5	V
			3.3V	+25°C			0.5	V
Input-Current High	$I_{AH}, I_{BH}, I_{CH}$ $I_{ENABLE}$	$V_A, V_B, V_C, V_{ENABLE} = V_{CC}$	3.3V to 5V	+25°C		1	100	nA
Input-Current Low	$I_{AL}, I_{BL}, I_{CL}$ $I_{ENABLE}$	$V_A, V_B, V_C, V_{ENABLE} = 0\text{V}$	3.3V to 5V	+25°C		1	100	nA

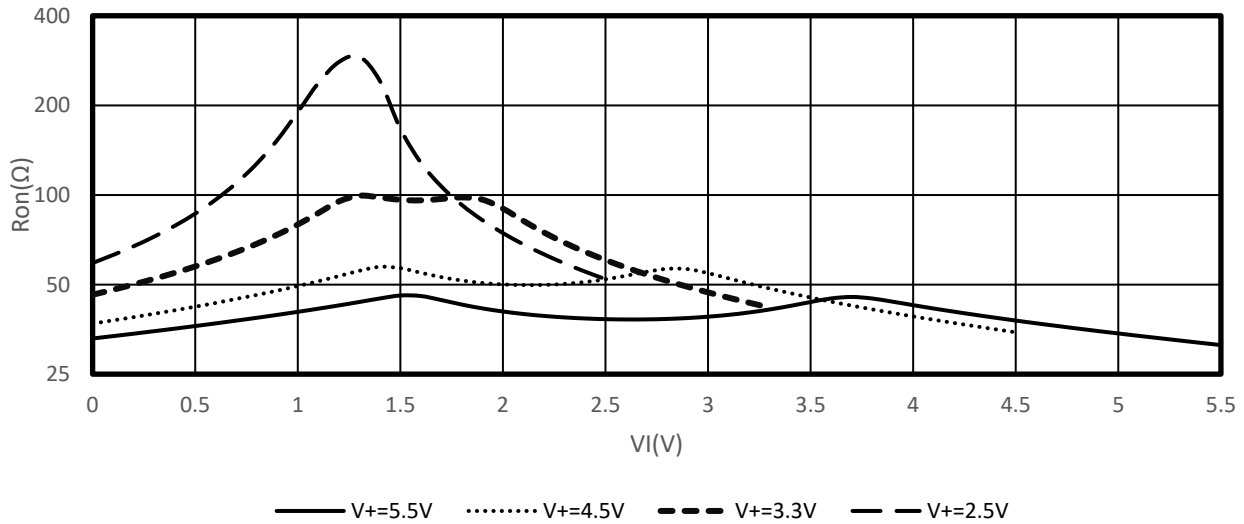
(1) All unused digital inputs of the device must be held at  $V_{IO}$  or GND to ensure proper device operation.

**ELECTRICAL CHARACTERISTICS (continued)**
 $V_{CC} = 5.0\text{ V or }3.3\text{ V}$ , FULL =  $-40^{\circ}\text{C to }+125^{\circ}\text{C}$  Typical values are at  $T_A = +25^{\circ}\text{C}$  (unless otherwise noted)

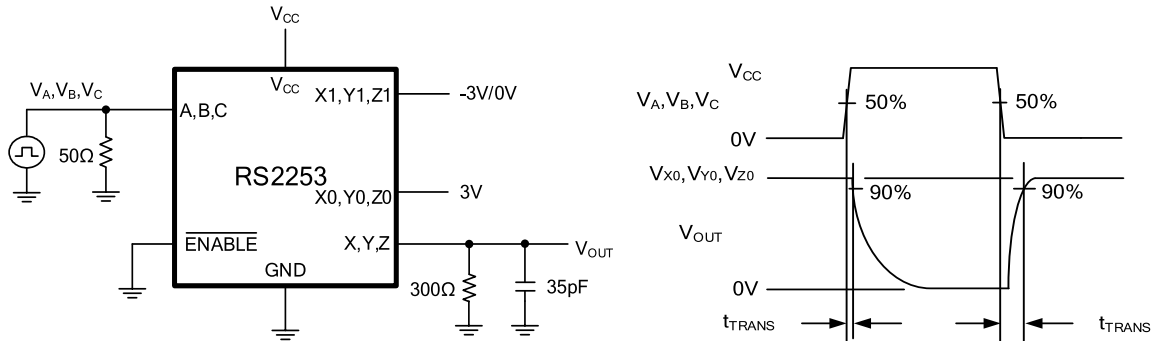
PARAMETER	SYMBOL	CONDITIONS	$V_{CC}$	TEMP	MIN	TYP	MAX	UNITS
<b>DYNAMIC CHARACTERISTICS</b>								
Address Transition Time	$t_{TRANS}$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 3\text{V}/0\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 1	5V	$+25^{\circ}\text{C}$		160		ns
		$V_{X\_}, V_{Y\_}, V_{Z\_} = 3\text{V}/0\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 1	3.3V	$+25^{\circ}\text{C}$		240		ns
$\overline{\text{ENABLE}}$ Turn-On Time	$t_{ON}$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 2	5V 3.3V	$+25^{\circ}\text{C}$		90 140		ns
$\overline{\text{ENABLE}}$ Turn-Off Time	$t_{OFF}$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 2	5V 3.3V	$+25^{\circ}\text{C}$		70 100		ns
Internal A, B, C Rise Time	$t_R$		5V	$+25^{\circ}\text{C}$		50		ns
			3.3V	$+25^{\circ}\text{C}$		80		ns
Internal A, B, C Fall Time	$t_F$		5V	$+25^{\circ}\text{C}$		60		ns
			3.3V	$+25^{\circ}\text{C}$		85		ns
Break-Before-Make Time Delay	$t_D$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 3\text{V}$ , $R_L = 300\Omega$ , $C_L = 35\text{pF}$ , Test Circuit 3	5V	$+25^{\circ}\text{C}$		60		ns
			3.3V	$+25^{\circ}\text{C}$		90		ns
Charge Injection	Q	$R_S = 0\Omega$ , $C_L = 1\text{nF}$ , Test Circuit 4	5V	$+25^{\circ}\text{C}$		6		pC
			3.3V	$+25^{\circ}\text{C}$		4		pC
Off Isolation	$O_{ISO}$	$R_L = 50\Omega$ , $f = 1\text{MHz}$ , Test Circuit 5	5V	$+25^{\circ}\text{C}$		-83		dB
Channel-to-Channel Crosstalk	$X_{TALK}$	$R_L = 50\Omega$ , $f = 1\text{MHz}$ , Test Circuit 5	5V	$+25^{\circ}\text{C}$		-110		dB
-3dB Bandwidth	BW	$R_L = 50\Omega$	5V	$+25^{\circ}\text{C}$		180		MHz
			3.3V	$+25^{\circ}\text{C}$		180		MHz
Input Off-Capacitance	$C_{X(OFF)}$ $C_{Y(OFF)}$ $C_{Z(OFF)}$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 0\text{V}$ , $f = 1\text{MHz}$ , Test Circuit 6	5V	$+25^{\circ}\text{C}$		4.7		pF
Output Off-Capacitance	$C_{X(OFF)}$ $C_{Y(OFF)}$ $C_{Z(OFF)}$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 0\text{V}$ , $f = 1\text{MHz}$ , Test Circuit 6	5V	$+25^{\circ}\text{C}$		12.7		pF
Output On- Capacitance	$C_{X(ON)}$ $C_{Y(ON)}$ $C_{Z(ON)}$	$V_{X\_}, V_{Y\_}, V_{Z\_} = 0\text{V}$ , $f = 1\text{MHz}$ , Test Circuit 6	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	$I_{CC}$	$V_{CC} = 5.0\text{V}$ , $V_A, V_B, V_C$ , $V_{ENABLE} = V_{CC}$ or 0	5V	$+25^{\circ}\text{C}$		0.001	2	$\mu\text{A}$
		$V_{CC} = 3.3\text{V}$ , $V_A, V_B, V_C$ , $V_{ENABLE} = V_{CC}$ or 0	3.3V	$+25^{\circ}\text{C}$		0.001	1	$\mu\text{A}$

TYPICAL CHARACTERISTICS

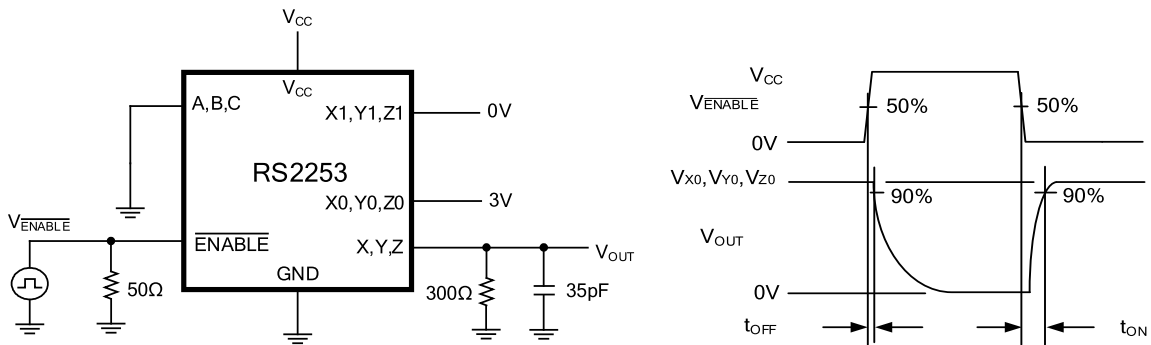
Typical  $r_{on}$  as a Function of Input Voltage ( $V_I$ ) for  $V_I = 0$  to  $V_+$



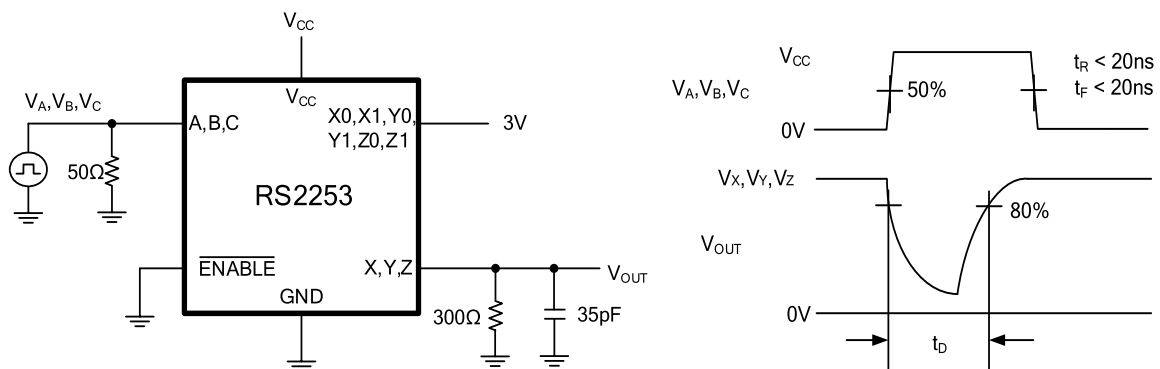
## Parameter Measurement Information



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



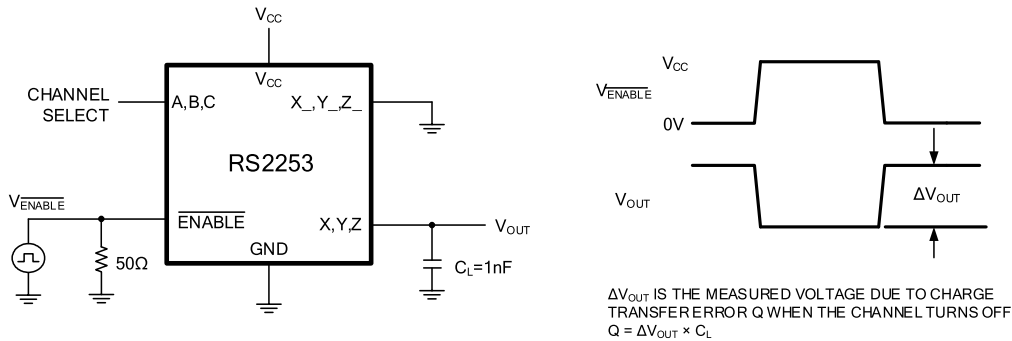
**Test Circuit 2. Switching Times ( $t_{ON}$ ,  $t_{OFF}$ )**



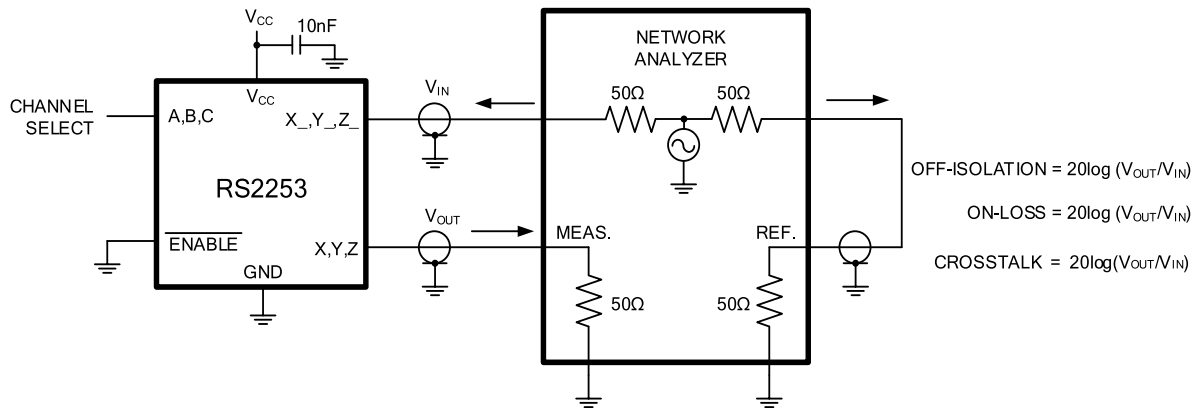
**Test Circuit 3. Break-Before-Make Time Delay ( $t_D$ )**



### Parameter Measurement Information (continued)

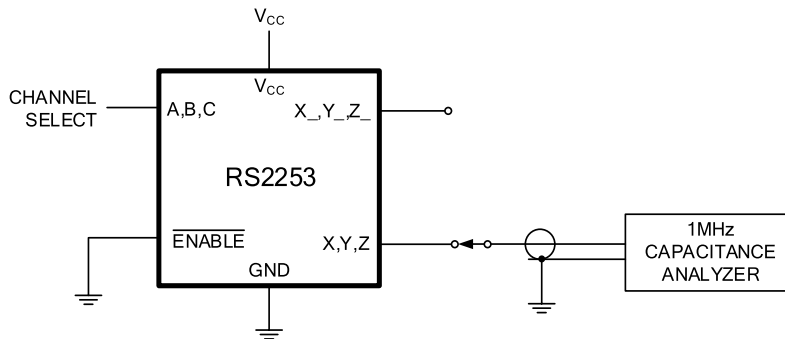


### Test Circuit 4. Charge Injection (Q)



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 5. Off Isolation, On Loss



### Test Circuit 6. Capacitance

## APPLICATION NOTES

The RS2253 device is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a single-pole, double-throw configuration.

When the devices are used as demultiplexers, the CHANNEL IN/OUT terminals are the outputs and the COMMON OUT/IN terminals are the inputs.

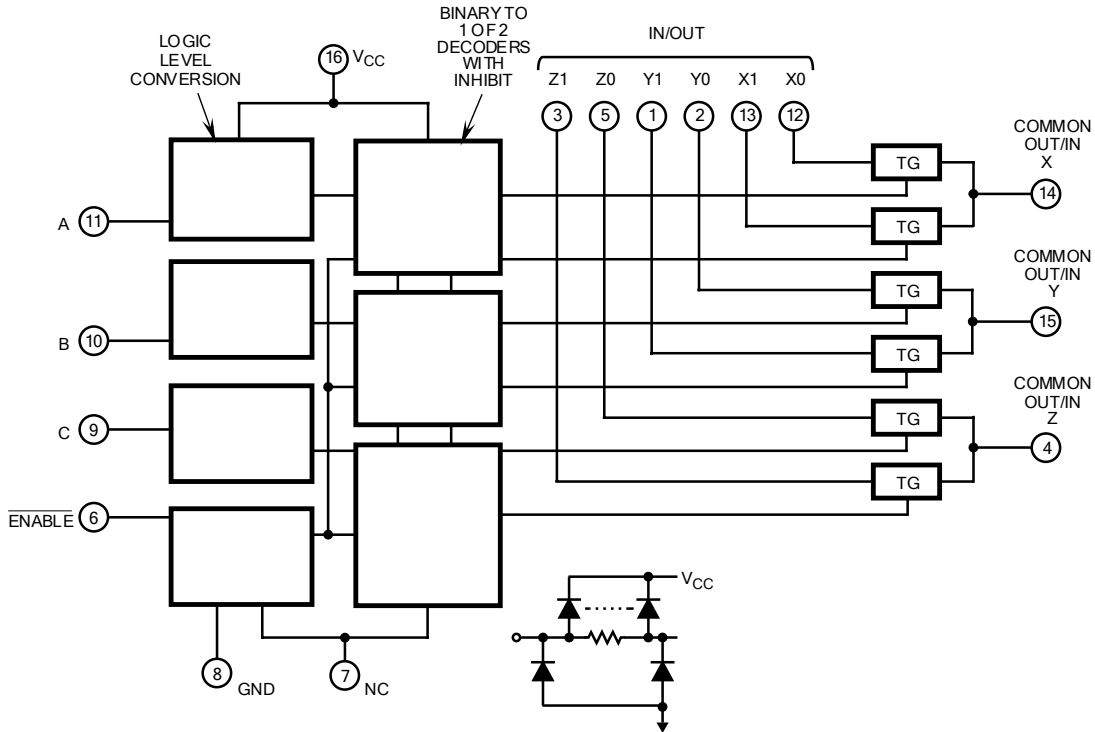
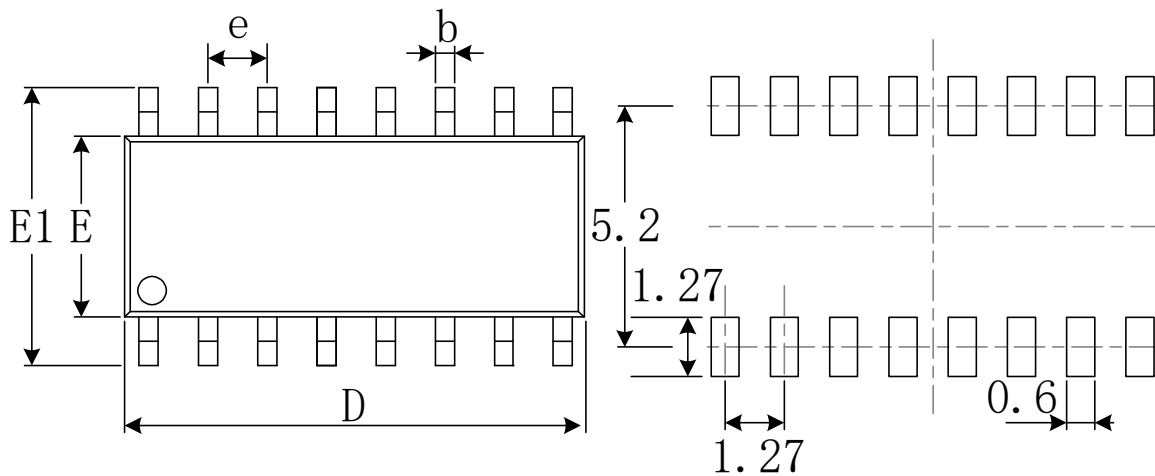


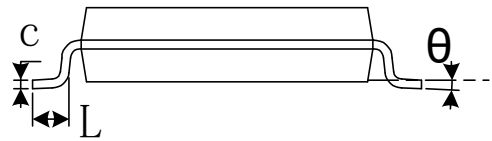
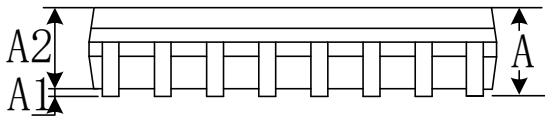
Figure 1. The RS2253 Functional Block Diagram

# PACKAGE OUTLINE DIMENSIONS

## SOIC-16

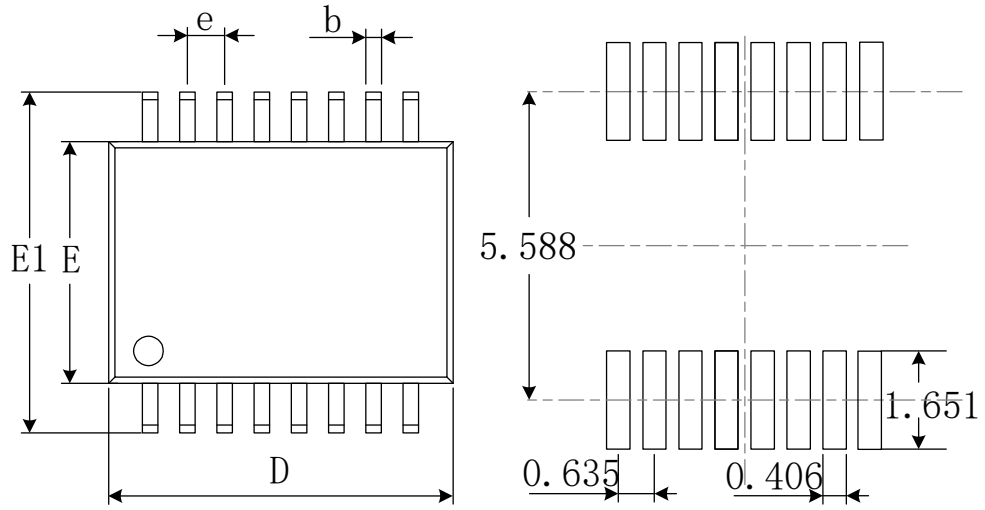


RECOMMENDED LAND PATTERN (Unit: mm)

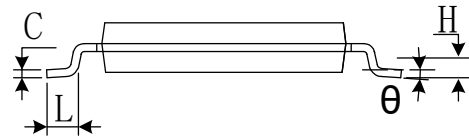
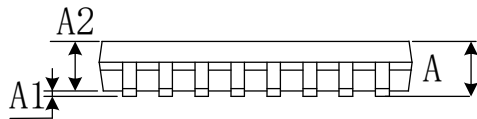


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
$\theta$	0°	8°	0°	8°

# SSOP-16

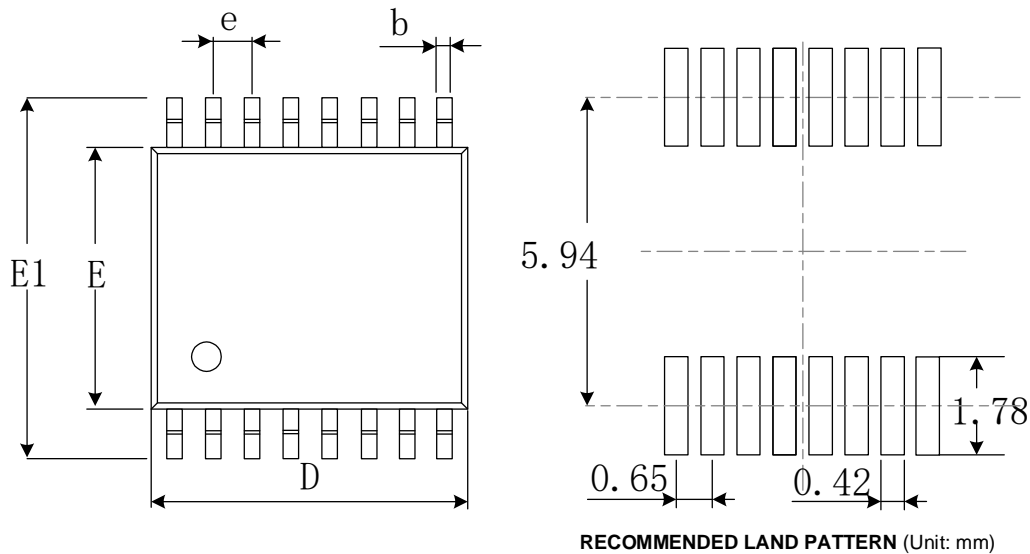


RECOMMENDED LAND PATTERN (Unit: mm)



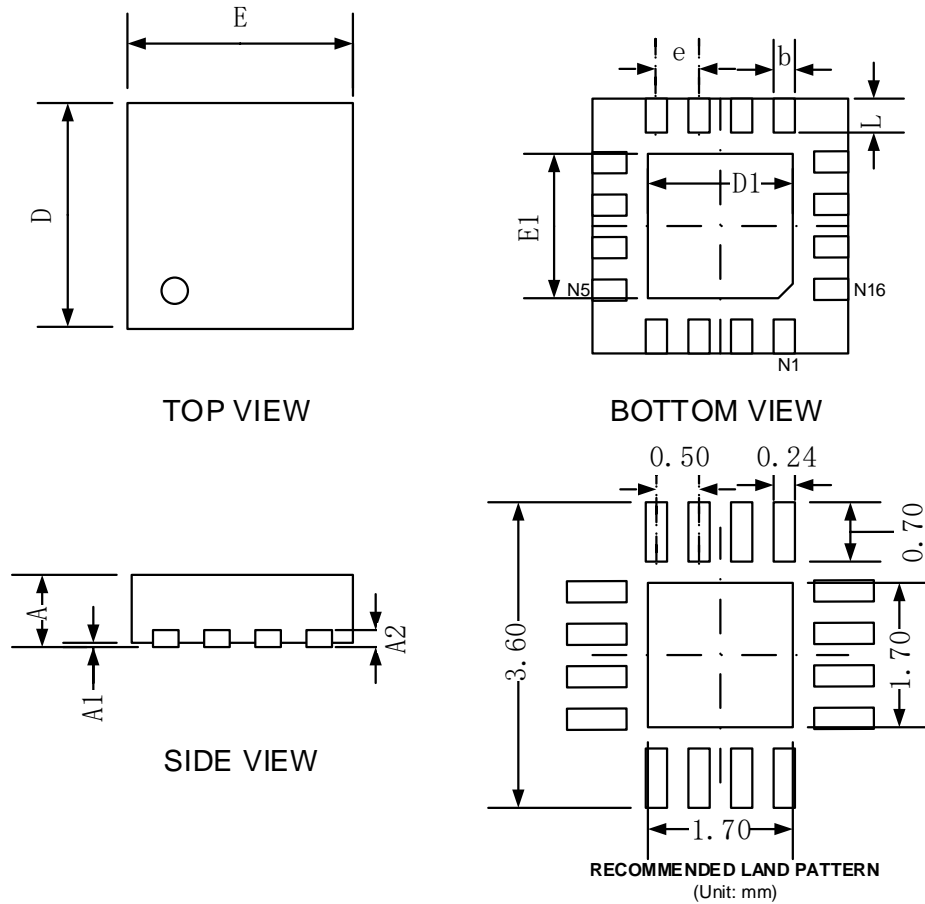
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.200	0.300	0.008	0.012
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	0.635(BSC)		0.025(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

# TSSOP-16



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	
$\theta$	1°	7°	1°	7°

# QFN-3x3-16L



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