CMOS Triple 2-Channel
Analog Multiplexer/Demultiplexer

1 FEATURES

- **-3dB Bandwidth: 180MHz**
- **Single Supply Operation +2.5V to +5.5V**
- **Low ON Resistance: 48Ω(TYP) With 5V Supply**
- **High Off-Isolation: -83dB (R_L = 50Ω, f = 1MHz)**
- **Break-Before-Make Switching**
- **Binary Address Decoding on Chip**
- **Operating Temperature Range: -40°C to +125°C**
- **PACKAGES: SOP16, SSOP16, TSSOP16**

2 APPLICATIONS

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

3 DESCRIPTIONS

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).
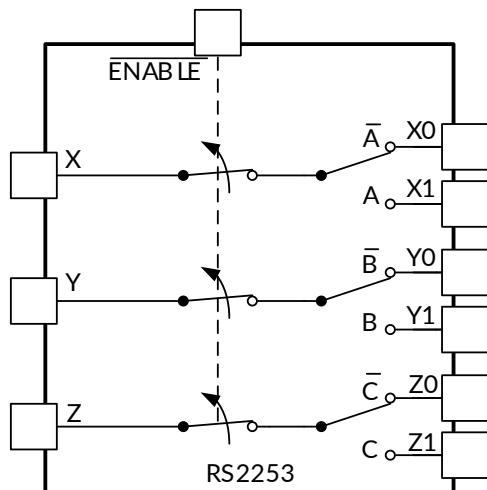
The RS2253 is available in Green SOP16, SSOP16, TSSOP16 packages. It operates over an ambient temperature range of -40°C to +125°C.

Device Information [1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2253	SOP16	9.90mm×3.91mm
	SSOP16	4.90mm×3.90mm
	TSSOP16	5.00mm×4.40mm

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

4 Functional Diagrams of RS2253

Table of Contents

5 Revision History

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

| VERSION	Change Date	Change Item
C.4	2021/12/20	official version datasheet
C.5	2024/01/03	1. Added the TAPE AND REEL INFORMATION 2. Update PIN DESCRIPTION on Page 2@RevC.4 3. Add MSL on Page 5@RevC.4 4. Update ELECTRICAL CHARACTERISTICS
C.5.1	2024/03/08	Modify packaging naming
C.6	2024/04/17	Delete QFN3X3-16 Package
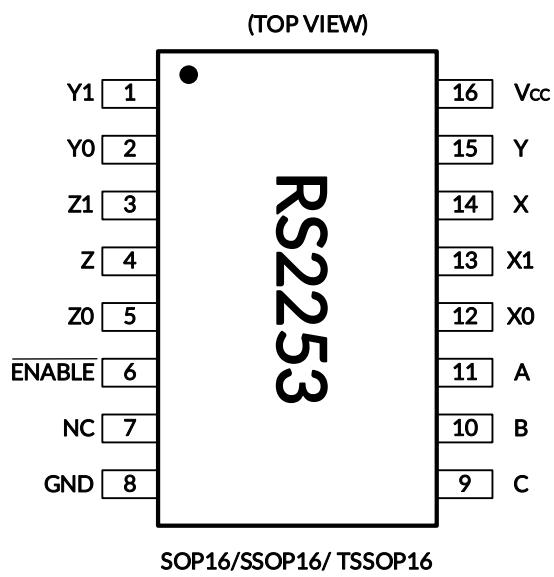
6 PACKAGE/ORDERING INFORMATION [1]

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING [2]	MSL [3]	PACKAGE OPTION
RS2253	RS2253XS16	-40°C ~+125°C	SOP16	RS2253	MSL3	Tape and Reel,4000
	RS2253XSS16	-40°C ~+125°C	SSOP16	RS2253	MSL3	Tape and Reel,4000
	RS2253XTSS16	-40°C ~+125°C	TSSOP16	RS2253	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 (Top View)

(TOP VIEW)

| Y1 | 1 | | 16 | V_{CC} |

Pin			Pin	
Y1	1		16	Vcc
Y0	2		15	Y
Z1	3		14	X
Z	4		13	X1
Z0	5		12	X0
ENABLE	6		11	A
NC	7		10	B
GND	8		9	C

RS2253

SOP16/SSOP16/ TSSOP16

7.1 PIN DESCRIPTION

NAME	PIN	FUNCTION
	SOP16/SSOP16/TSSOP16	
Y1	1	Analog Switch "Y" Normally Open Input or Output.
Y0	2	Analog Switch "Y" Normally Closed Input or Output.
Z1	3	Analog Switch "Z" Normally Open Input or Output.
Z	4	Analog Switch "Z" Input or Output.
Z0	5	Analog Switch "Z" Normally Closed Input or Output.
$\overline{\text{ENABLE}}$	6	Digital Enable Input. Normally connected to GND.
NC	7	No Connect.
GND	8	Ground. Connect to digital ground.
C	9	Digital Address "C" Input.
B	10	Digital Address "B" Input.
A	11	Digital Address "A" Input.
X0	12	Analog Switch "X" Normally Closed Input or Output.
X1	13	Analog Switch "X" Normally Open Input or Output.
X	14	Analog Switch "X" Input or Output.
Y	15	Analog Switch "Y" Input or Output.
V_{CC}	16	Positive Analog and Digital Supply Voltage Input

7.2 FUNCTION TABLE

$\overline{\text{ENABLE}}$ 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.

8 SPECIFICATIONS

8.1 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	
θ_{JA}	Package thermal impedance [2]	SOP16		150	°C/W
		SSOP16		110	
		TSSOP16		45	
T_J	Junction Temperature [3]		-40	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.
(2) The package thermal impedance is calculated in accordance with JESD-51.
(3) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. 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
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	±3000	V
		Machine Model (MM)	±200	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_{CC}	Supply Voltage	2.5	5.5	V
T_A	Operating temperature	-40	+125	°C

8.4 ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	CONDITIONS	V_{CC}	T_A	MIN[2]	TYP[3]	MAX[2]	UNIT
ANALOG SWITCH								
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}=5V, I_X, I_Y, I_Z =1mA	5V	+25°C		48	65	Ω
				FULL			70	Ω
		V_{CC}=3.3V, I_X, I_Y, I_Z =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, I_Z =1mA	5V	+25°C		1.5	5	Ω
				FULL			5.3	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	V_{CC}=5V, I_X, I_Y, I_Z =1mA	5V	+25°C		17	25	Ω
				FULL			28	Ω
X_, Y_, Z_ Off Leakage Current	$I_{X\_(OFF)}$ $I_{Y\_(OFF)}$ $I_{Z\_(OFF)}$	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$=1V, 4.5V V_X, V_Y, V_Z =4.5V, 1V	5V	+25°C		1	100	nA
		$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$=1V, 3V V_X, V_Y, V_Z =3V, 1V	3.3V	+25°C		1	100	nA
X, Y, Z Off Leakage Current	$I_{X(OFF)}$ $I_{Y(OFF)}$ $I_{Z(OFF)}$	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$=1V, 4.5V V_X, V_Y, V_Z =4.5V, 1V	5V	+25°C		1	100	nA
		$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$=1V, 3V V_X, V_Y, V_Z =3V, 1V	3.3V	+25°C		1	100	nA
X, Y, Z On Leakage Current	$I_{X(ON)}$ $I_{Y(ON)}$ $I_{Z(ON)}$	V_{CC}=5V, V_X, V_Y, V_Z =4.5V, 1V	5V	+25°C		1	100	nA
		V_{CC}=3.3V, V_X, V_Y, V_Z =3V, 1V	3.3V	+25°C		1	100	nA
DIGITAL CONTROL INPUTS [1]								
Logic Input Logic Threshold High	V_{AH}, V_{BH}, V_{CH}, $V_{\overline{ENABLE}}$		5V	+25°C	1.7			V
			3.3V	+25°C	1.7			V
Logic Input Logic Threshold Low	V_{AL}, V_{BL}, V_{CL} $V_{\overline{ENABLE}}$		5V	+25°C			0.5	V
			3.3V	+25°C			0.5	V
Input-Current High	I_{AH}, I_{BH}, I_{CH} $I_{\overline{ENABLE}}$	V_A, V_B, V_C, $V_{\overline{ENABLE}}$ = V_{CC}	3.3V to 5V	+25°C		1	100	nA
Input-Current Low	I_{AL}, I_{BL}, I_{CL} $I_{\overline{ENABLE}}$	V_A, V_B, V_C, $V_{\overline{ENABLE}}$= 0V	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 V or 3.3V, FULL= -40°C to +125°C Typical values are at T_A = +25°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V_{CC}	T_A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS								
Address Transition Time	t_{TRANS}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 3V/0V, R_L = 300Ω, C_L = 35pF, See Figure 2	5V	+25°C		160		ns
		$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 3V/0V, R_L = 300Ω, C_L = 35pF, See Figure 2	3.3V	+25°C		240		ns
$\overline{ENABLE}$ Turn-On Time	t_{ON}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 3V, R_L = 300Ω, C_L = 35pF, See Figure 3	5V	+25°C		90		ns
			3.3V			140		
$\overline{ENABLE}$ Turn-Off Time	t_{OFF}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 3V, R_L = 300Ω, C_L = 35pF, See Figure 3	5V	+25°C		70		ns
			3.3V			100		
Break-Before-Make Time Delay	t_D	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 3V, R_L = 300Ω, C_L = 35pF, See Figure 4	5V	+25°C		60		ns
			3.3V			90		ns
Charge Injection	Q	R_S = 0Ω, C_L = 1nF, See Figure 5	5V	+25°C		6		pC
		R_S = 0Ω, C_L = 1nF, See Figure 5	3.3V			4		pC
Off Isolation	O_{ISO}	R_L = 50Ω, f = 1MHz, See Figure 6	5V	+25°C		-83		dB
Channel-to-Channel Crosstalk	X_{TALK}	R_L = 50Ω, f = 1MHz, See Figure 6	5V	+25°C		-85		dB
-3dB Bandwidth	BW	R_L = 50Ω	5V	+25°C		180		MHz
			3.3V			180		MHz
Input Off-Capacitance	$C_{X\_(OFF)}$ $C_{Y\_(OFF)}$ $C_{Z\_(OFF)}$	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 0V, f = 1MHz, See Figure 7	5V	+25°C		4		pF
Output Off-Capacitance	$C_{X(OFF)}$ $C_{Y(OFF)}$ $C_{Z(OFF)}$	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 0V, f = 1MHz, See Figure 7	5V	+25°C		5		pF
Output On- Capacitance	$C_{X(ON)}$ $C_{Y(ON)}$ $C_{Z(ON)}$	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$= 0V, f = 1MHz, See Figure 7	5V	+25°C		11		pF
Total Harmonic Distortion	THD	R_L = 600Ω,5V_{P-P}, f = 20Hz to 20kHz	5V	+25°C		1.4		%
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_C, $V_{\overline{ENABLE}}$ = V_{CC} or 0	5V	+25°C		0.001	2	uA
		V_{CC} = 3.3V, V_A, V_B, V_C, $V_{\overline{ENABLE}}$ = V_{CC} or 0	3.3V	+25°C		0.001	1	uA

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.
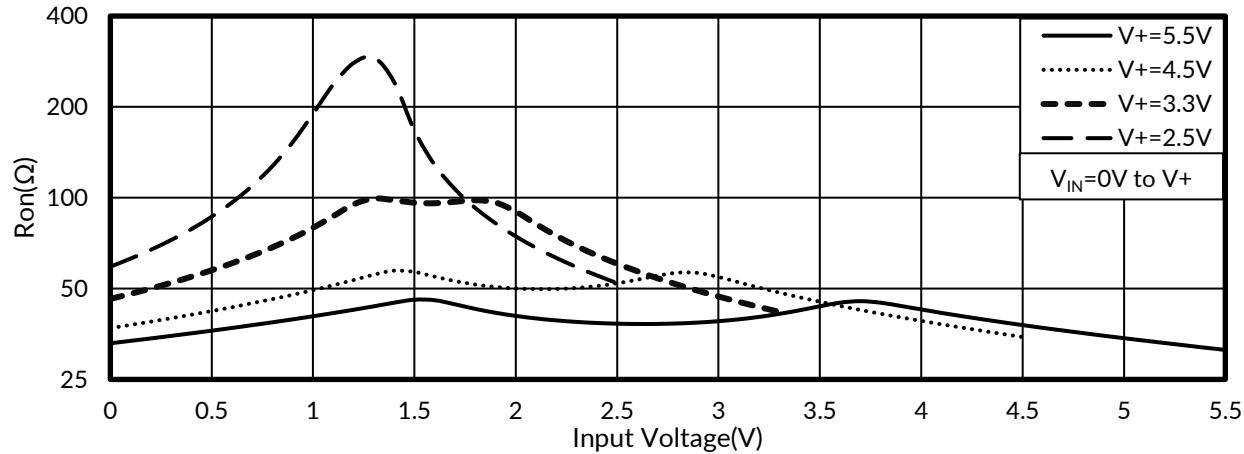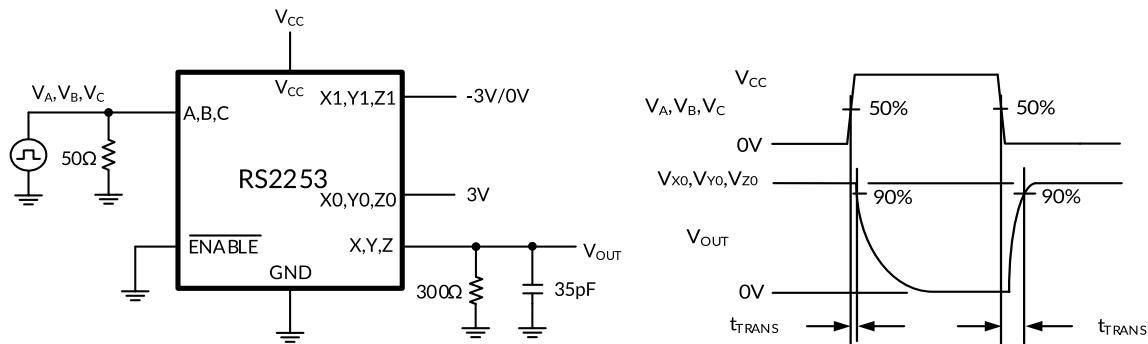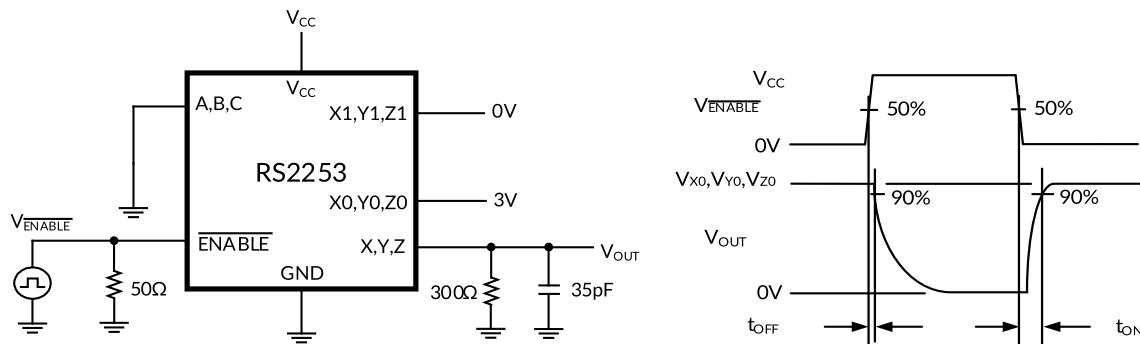
Figure 1. Typical Ron as a Function of Input Voltage
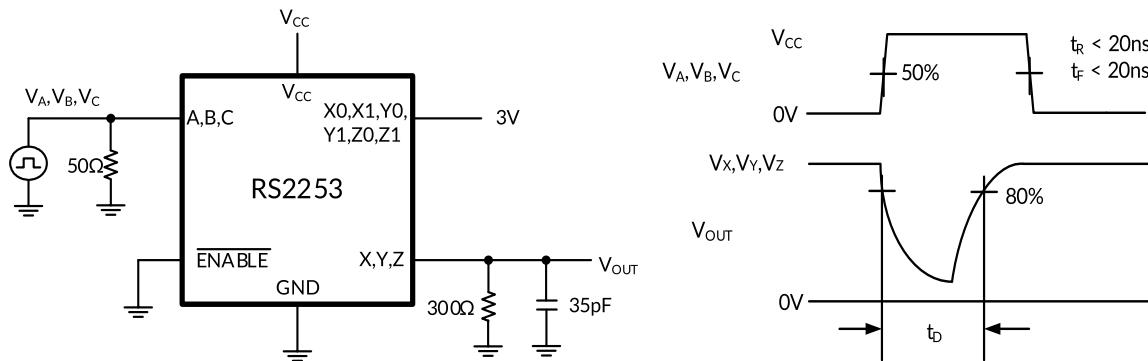
10 Parameter Measurement Information


Figure 2. Address Transition Times (t$_{TRANS}$)
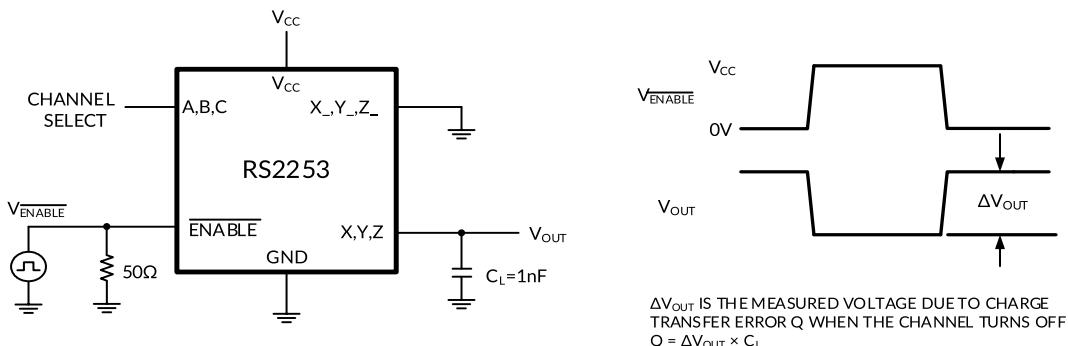

Figure 3. Switching Times (t$_{ON}$, t$_{OFF}$)
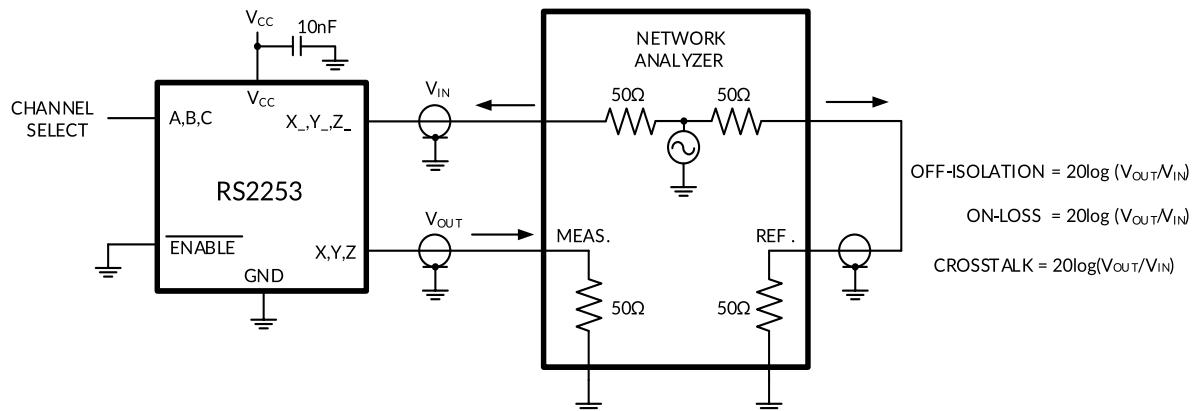
Figure 4. Break-Before-Make Time Delay (t$_{D}$)

Parameter Measurement Information (continued)

ΔV_{OUT} IS THE MEASURED VOLTAGE DUE TO CHARGE TRANSFER ERROR Q WHEN THE CHANNEL TURNS OFF
$Q = \Delta V_{OUT} \times C_L$
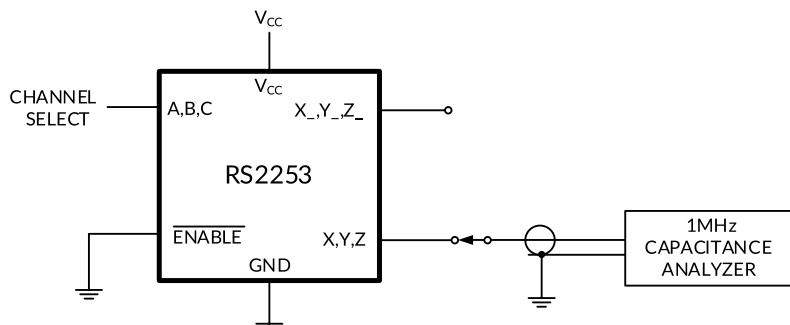
Figure 5. Charge Injection (Q)

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

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

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

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 .
CROSSTALK IS MEASURED FROM ONE CHANNEL(A,B,C) TO ALL OTHER CHANNELS.

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

Figure 6. Off Isolation, On Loss
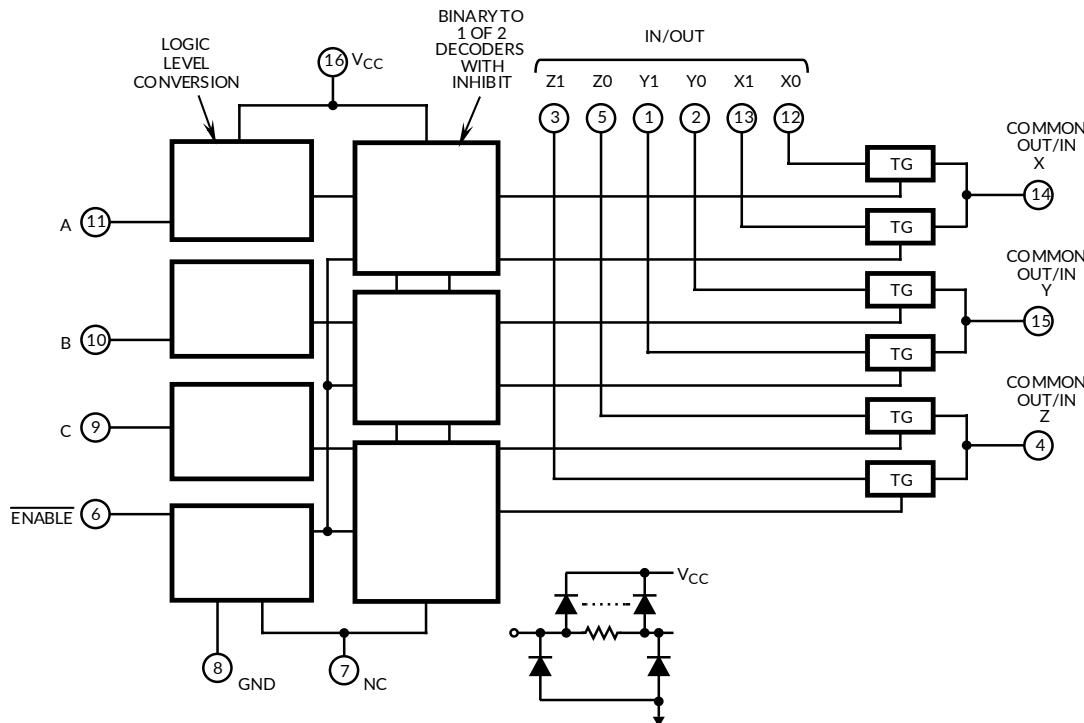
Figure 7. Capacitance

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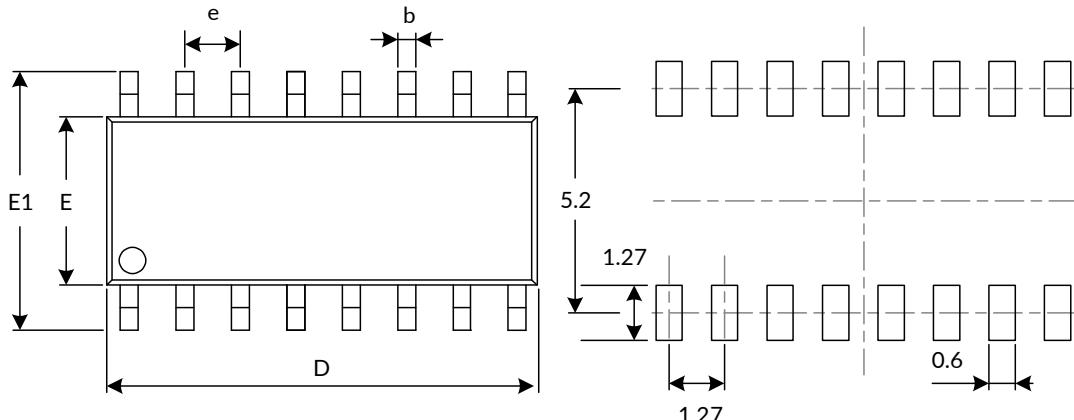
The RS2253 device is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a single-pole, double-throw configuration.

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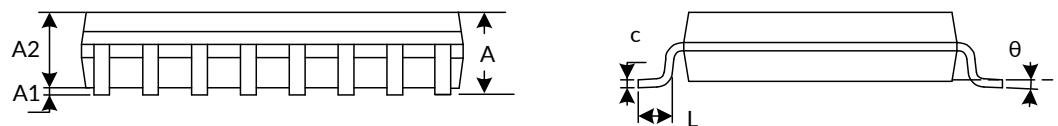

Figure 8. The RS2253 Functional Block Diagram

12 PACKAGE OUTLINE DIMENSIONS
SOP16 [3]
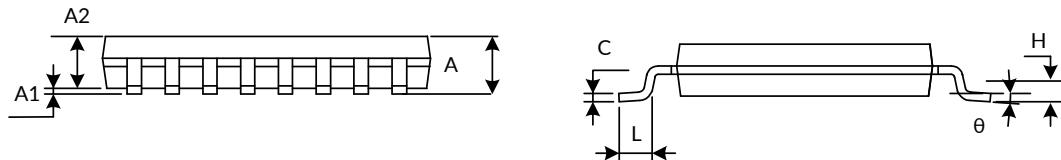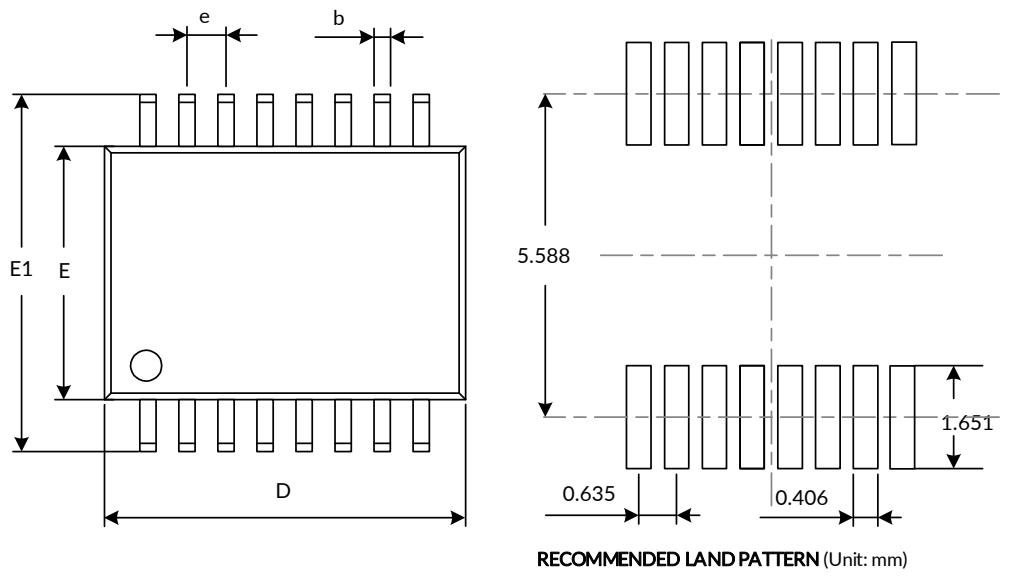
RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
A [1]	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 [1]	9.800	10.200	0.386	0.402
E [1]	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27(BSC) [2]		0.050(BSC) [2]	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°
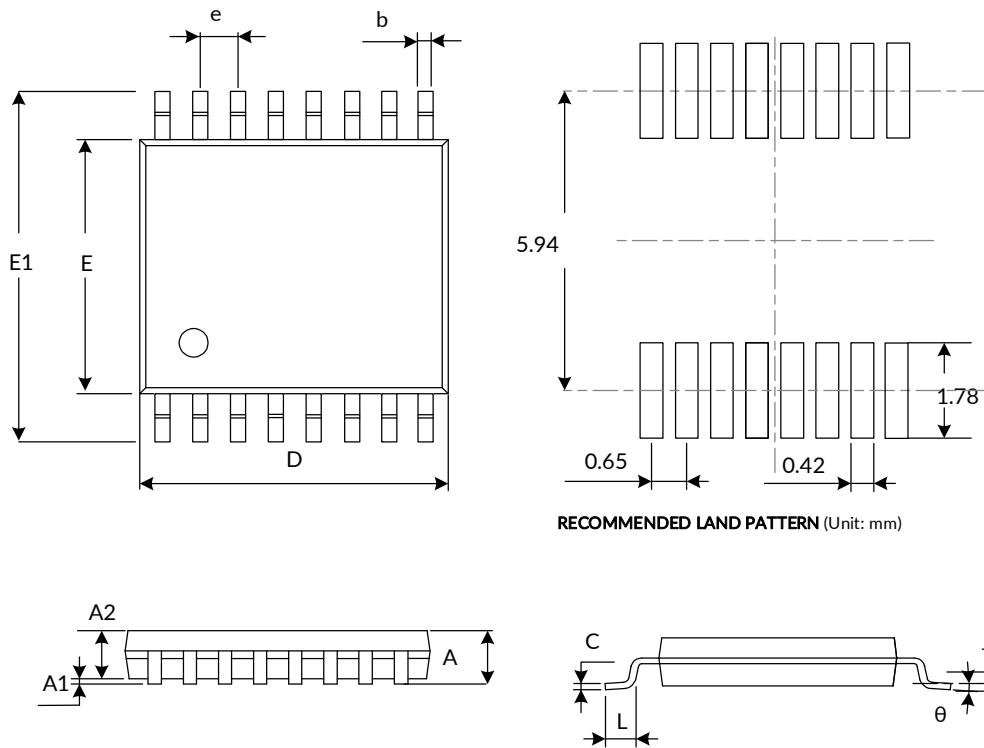
NOTE:
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

SSOP16 [3]

RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A [1]	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 [1]	4.700	5.100	0.185	0.200
E [1]	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	0.635(BSC) [2]		0.025(BSC) [2]	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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.

TSSOP16 [3]

RECOMMENDED LAND PATTERN (Unit: mm)

| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A [1]		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 [1]	4.860	5.100	0.191	0.201
E [1]	4.300	4.500	0.169	0.177
E1	6.200	6.600	0.244	0.260
e	0.650(BSC) [2]		0.026(BSC) [2]	
L	0.500	0.700	0.02	0.028
H	0.25TYP		0.01TYP	
θ	1°	7°	1°	7°
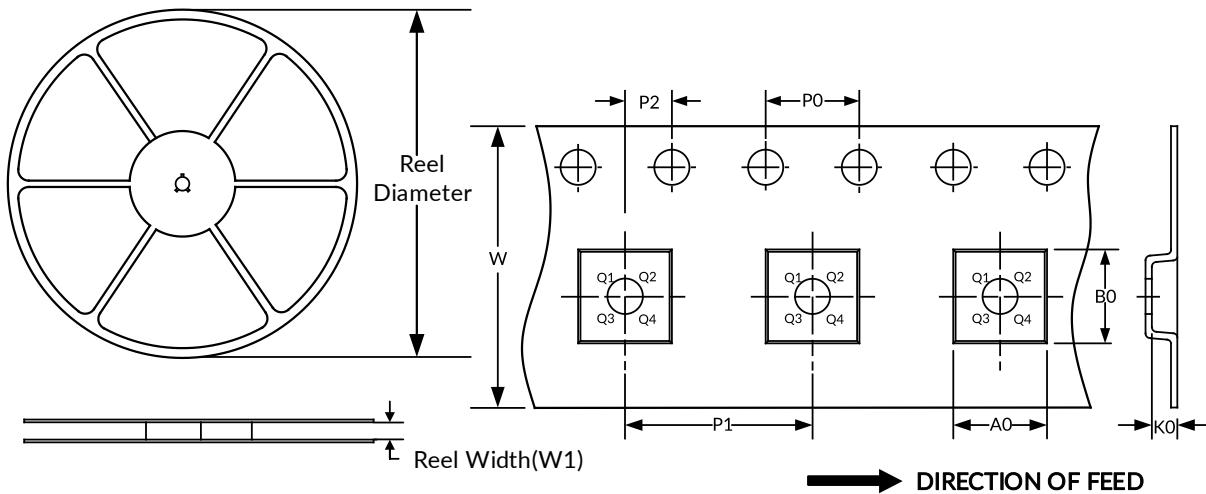
NOTE:
    1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
    2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
    3. This drawing is subject to change without notice.

13 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
SOP16	13"	16.4	6.50	10.30	2.10	4.0	8.0	2.0	16.0	Q1
SSOP16	13"	12.4	8.30	6.70	2.10	4.0	8.0	2.0	12.0	Q1
TSSOP16	13"	12.4	6.90	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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