Wide-Bandwidth 4-Channel SPDT Video Analog Switch

1 FEATURES

- **Qualified for Automotive Applications**
- **AEC-Q100 Qualified with the Grade 1**
- **Wide Bandwidth: 220MHz**
- **Single Supply Operation +1.8V to +5.5V**
- **Low ON Resistance, 8Ω(TYP)**
  Low Crosstalk: -60dB at 10MHz (TYP)
- **Rail-to-Rail Operation**
- **Fast Switching Time**
- **Operating Temperature Range:**
  -40°C to +125°C
- **PACKAGES: TSSOP16**

2 APPLICATIONS

- **Automotive Zonal & Body Domain Controller**
- **HEV/EV Battery Management System (BMS)**

3 DESCRIPTIONS

The RS2233-Q1 is a CMOS analog IC configured as a quad, bidirectional, single-pole/double-throw (SPDT) switches. This CMOS device can operate from 1.8 V to 5.5 V.

The select (IN) input control the data flow. The FET multiplexers/demultiplexers are disabled when the output-enable ($\overline{OE}$) input is high.

The device are digitally-controlled analog switches. It has low on-resistance (8Ω TYP) and low crosstalk (-60dB at 10MHz TYP).

The RS2233-Q1 is available in Green TSSOP16 packages. It operates over an ambient temperature range of -40°C to +125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2233-Q1	TSSOP16	5.00mm×4.40mm

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

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4 REVISION HISTORY

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

Version	Change Date	Change Item
A.0	2022/09/21	Preliminary version completed
A.1	2023/06/09	Initial version completed
A.2	2023/08/10	1. Add ΔR_{ON} and $R_{FLAT(ON)}$ PARAMETER 2. Add Typical Ron as a Function of Input Voltage curve in 9 TYPICAL CHARACTERISTICS
A.2.1	2024/03/06	Modify packaging naming
A.3	2025/01/17	1. Delete SOP16 Package 2. Add t_{PD} PARAMETER 3. Add Test Circuit for Propagation Delay in 10 PARAMETER MEASUREMENT INFORMATION
A.4	2025/04/18	1. Add Switch current 2. Update Electrical Characteristics 3. Add TYPICAL CHARACTERISTICS

5 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	Lead finish/Ball material (2)	MSL Peak Temp (3)	PACKAGE MARKING (4)	PACKAGE OPTION
RS2233 -Q1	RS2233XT SS16-Q1	-40°C~125°C	TSSOP16	NIPDAUAG	MSL1-260°-Unlimited	RS2233	Tape and Reel,4000

NOTE:

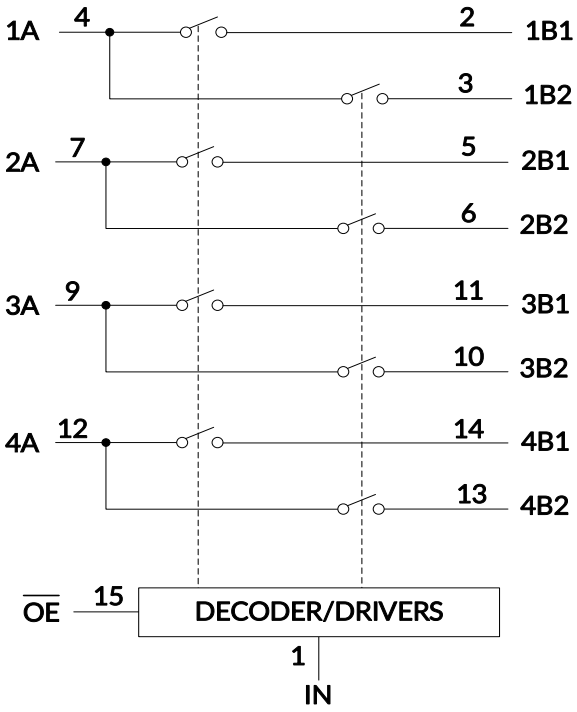
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) Lead finish/Ball material. Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F. Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

(4) 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.

6 PIN CONFIGURATION AND FUNCTION



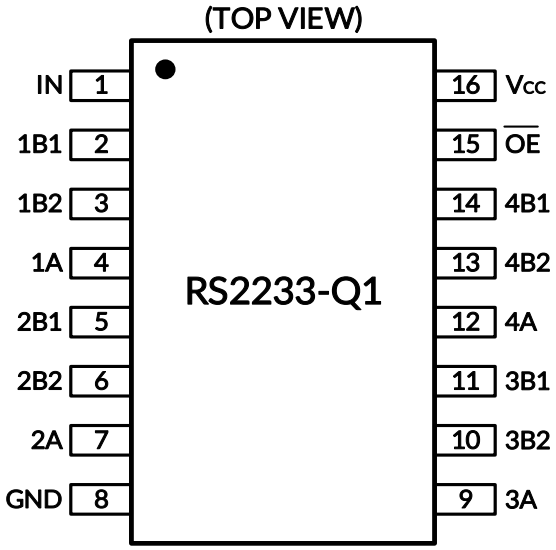
FUNCTION TABLE

INPUTS		FUNCTION
$\overline{OE}$	IN	
L	L	A port =B1 port
L	H	A port =B2 port
H	X	Disconnect

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.

7 PIN CONFIGURATIONS



TSSOP16

PIN DESCRIPTION

NAME	PIN	FUNCTION
	TSSOP16	
IN	1	Select Input.
1B1	2	Analog Video I/O.
1B2	3	Analog Video I/O.
1A	4	Analog Video I/O.
2B1	5	Analog Video I/O.
2B2	6	Analog Video I/O.
2A	7	Analog Video I/O.
GND	8	Ground.
3A	9	Analog Video I/O.
3B2	10	Analog Video I/O.
3B1	11	Analog Video I/O.
4A	12	Analog Video I/O.
4B2	13	Analog Video I/O.
4B1	14	Analog Video I/O.
$\overline{OE}$	15	Switch-Enable Input.
V_{CC}	16	Power Supply.

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings (1)

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_{IK}	Input clamp current	V_{IO} < 0		-50	mA
I_{SW}	Switch current	V_{SW}=0V to V_{CC}		±50	mA
θ_{JA}	Package thermal impedance (2)	TSSOP16		45	°C/W
T_J	Junction temperature (3)		-40	150	°C
T_{stg}	Storage temperature		-65	+150	°C

(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), per AEC Q100-002 (1)	±2000	V
		Charged-Device Model (CDM), per AEC Q100-011	±1000	
		Latch-Up (LU), per AEC Q100-004	±100	mA

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

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	1.8	5.5	V
T_A	Operating temperature	-40	+125	°C

8.4 Electrical Characteristics

V_{CC} = +1.8V to +5.5 V, 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(1)	TYP(2)	MAX(1)	UNIT
DC CHARACTERISTICS								
On-Resistance	R_{ON}	I_A =13mA	5V	+25°C		8	11	Ω
				FULL			14	
			3.3V	+25°C		11	16	Ω
				FULL			22	
			1.8V	+25°C		50	75	Ω
				FULL			90	
On-Resistance Match Between Channels	ΔR_{ON} (3)	I_A=13mA	5V	+25°C		0.05	0.2	Ω
				FULL			0.25	
			3.3V	+25°C		0.3	0.5	Ω
				FULL			1	
			1.8V	+25°C		1.5	3	Ω
				FULL			5	
On-Resistance Flatness	$R_{FLAT(ON)}$(4)		5V	+25°C		4.5	6	Ω
				FULL			8	
			3.3V	+25°C		7	12	Ω
				FULL			16	
			1.8V	+25°C		43	60	Ω
				FULL			70	
High-level control input Voltage	V_{IH}		1.8V	FULL	1.1			V
			2.5V to 5.5V	FULL	2			
Low-level control input Voltage	V_{IL}		1.8V	FULL			0.4	V
			2.5V to 5.5V	FULL			0.5	
Input High Current	I_{IH}	V_{IN} and $V_{\overline{OE}}$ = V_{CC}	5.5V	+25°C			±1	μA
				FULL			±2	
Input Low Current	I_{IL}	V_{IN} and $V_{\overline{OE}}$ = 0V	5.5V	+25°C			±1	μA
				FULL			±2	
Analog Output Leakage Current	I_O	V_{B1} or V_{B2} =3.3V/0.3V V_A= 0.3V/3.3V	5.5V	+25°C			±1	μA
				FULL			±2	
Clamp Diode Voltage	V_{IK}	I_I = -18mA	5.5V	+25°C		-0.9		V
DYNAMIC CHARACTERISTICS								
Turn-On Time	t_{ON}	R_L = 75Ω, C_L = 20pF, Test Circuit 1	5.5V	+25°C		13	20	ns
				FULL			23	
			3.3V	+25°C		19	29	ns
				FULL			32	
Turn-Off Time	t_{OFF}	R_L = 75Ω, C_L = 20pF, Test Circuit 1	5.5V	+25°C		30	55	ns
				FULL			60	
			3.3V	+25°C		40	60	ns
				FULL			68	
Propagation Delay	t_{PD}	R_L = 75Ω, C_L = 20pF, Test Circuit 2	5.5V	+25°C		0.4	1	ns
				FULL			1.5	

			3.3V	+25°C		0.5	1.5	ns
				FULL			2	
-3dB Bandwidth	BW	R_L = 150Ω, Test Circuit 4	5.5V	+25°C		220		MHz
Channel-to-Channel Crosstalk	X_{TALK}	R_{IN} = 10Ω, R_L = 150Ω, f = 10MHz, Test Circuit 5	5.5V	+25°C		-60		dB
Off Isolation	O_{IRR}	R_L = 150Ω, f = 10MHz, Test Circuit 6	5.5V	+25°C		-52		dB
Input/Enable Capacitance	C_{IN}	f = 1MHz, Test Circuit 6	5.5V	+25°C		5		pF
Switch OFF Capacitance	C_{OFF}	f = 1MHz, Test Circuit 6	5.5V	+25°C		9		pF
Switch ON Capacitance	C_{ON}	f = 1MHz, Test Circuit 6	5.5V	+25°C		18		pF
Differential Gain	D_G	R_L = 150Ω, f = 3.58MHz, Test Circuit 3	5.5V	+25°C		0.5		%
Differential Phase	D_P	R_L = 150Ω, f = 3.58MHz, Test Circuit 3	5.5V	+25°C		0.05		°
POWER REQUIREMENTS								
Power Supply Range	V_{CC}			FULL	1.8		5.5	V
Power Supply Current	I_{CC}	V_{IN} and $V_{\overline{OE}}$ = 5V/0V	5.5V	+25°C		0.1	1	μA
				FULL			2	
Supply Current per Input at TTL HIGH	ΔI_{CC}	V_{IN} or $V_{\overline{OE}}$ = 3.4V	5.5V	+25°C			100	μA
				FULL			200	

(1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
(2) 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.
(3) This parameter is ensured by design and/or characterization and is not tested in production.
(4) Flatness is defined as the difference between the maximum and minimum values of ON-state resistance over the specified range of conditions.

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.

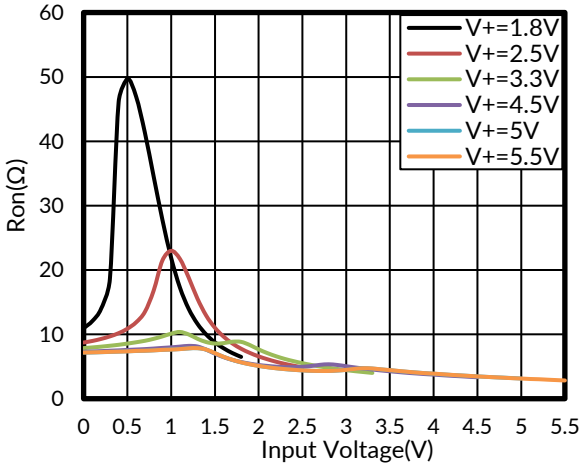


Figure 1. Typical Ron as a Function of Input Voltage

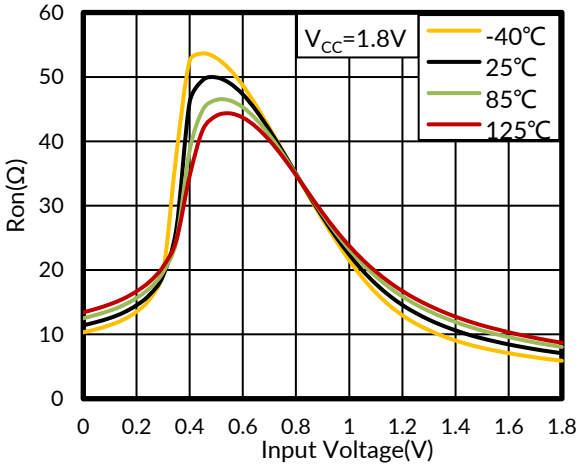


Figure 2. Typical Ron as a Function of Input Voltage

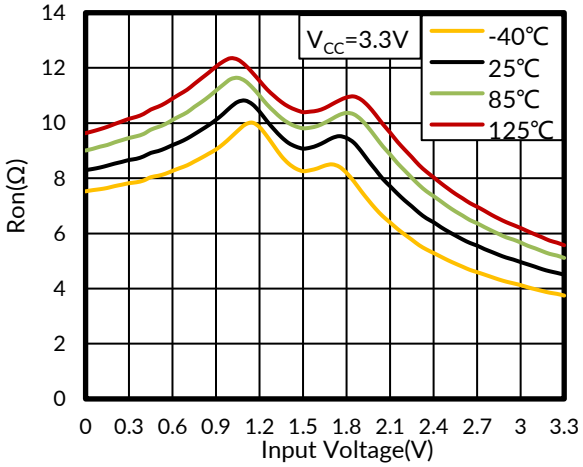


Figure 3. Typical Ron as a Function of Input Voltage

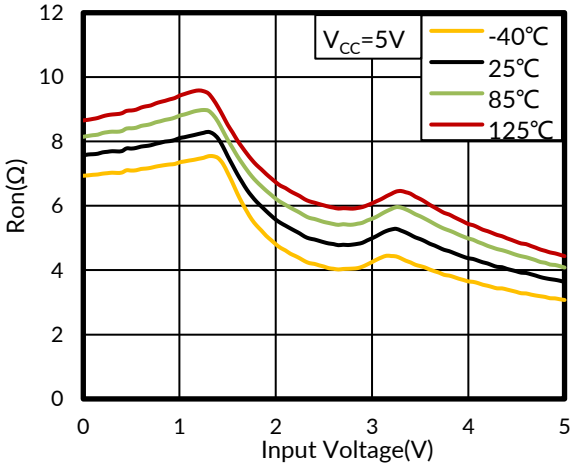


Figure 4. Typical Ron as a Function of Input Voltage

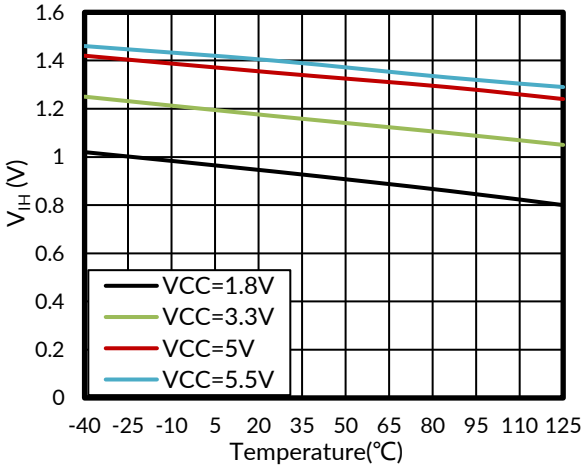


Figure 5. V_{IH} vs Temperature

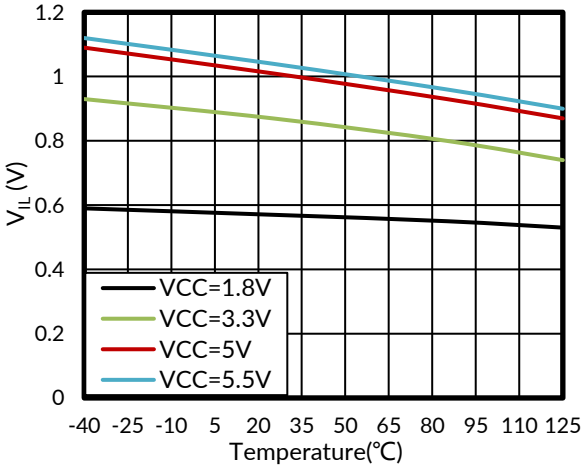
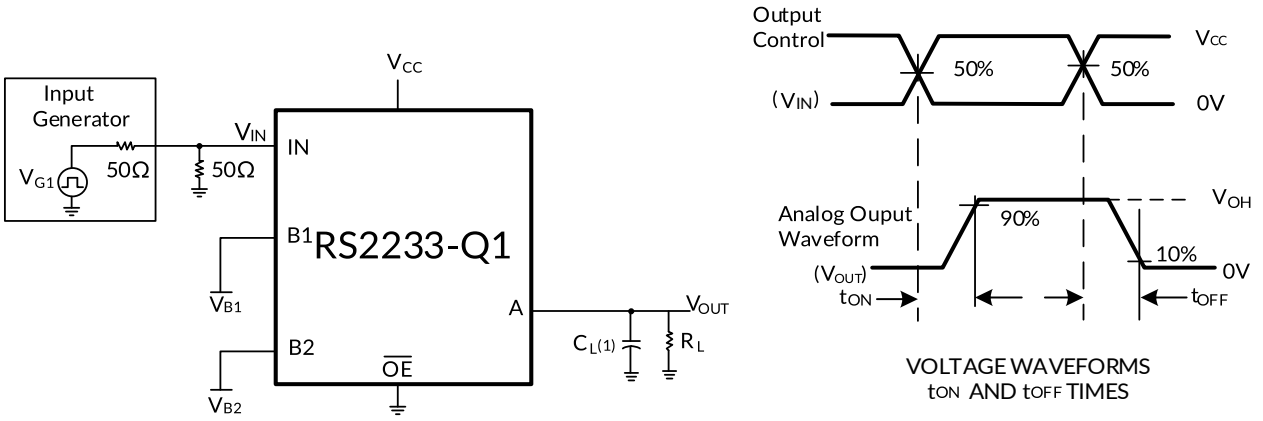


Figure 6. V_{IL} vs Temperature

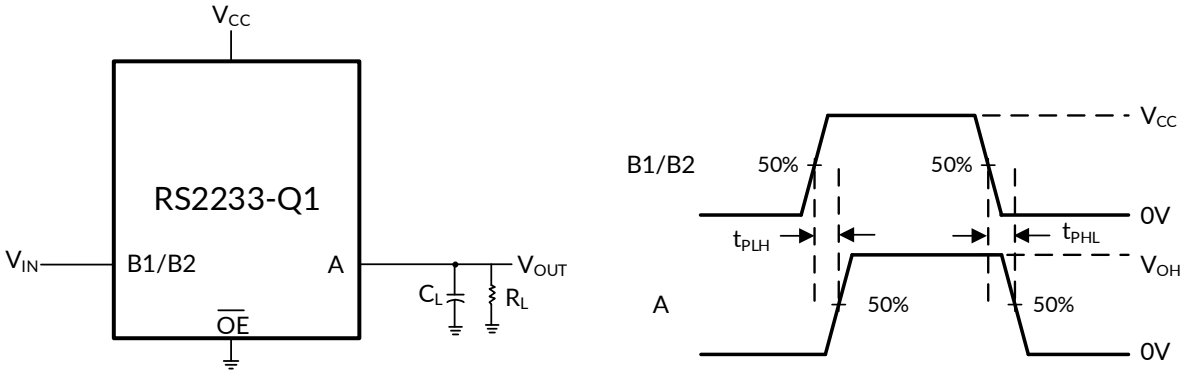
10 PARAMETER MEASUREMENT INFORMATION



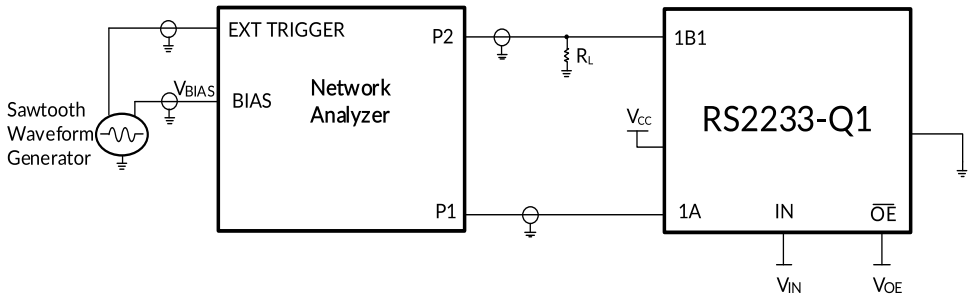
Test	V_{CC}	R_L	C_L	V_{B1}	V_{B2}
t_{ON}	5V±0.5V	75Ω	20pF	GND	3V
	5V±0.5V	75Ω	20pF	3V	GND
t_{OFF}	5V±0.5V	75Ω	20pF	GND	3V
	5V±0.5V	75Ω	20pF	3V	GND

NOTES:
1.CL includes probe and jig capacitance.
2.All input pulses are supplied by generators having the following characteristics: PRR≤10MHz,Z_O=50Ω，t_r≤2.5ns,t_f≤2.5ns.
3. The outputs are measured one at a time, with one transition per measurement.

Test Circuit 1. Test Circuit for Voltage Waveform and Switch Time



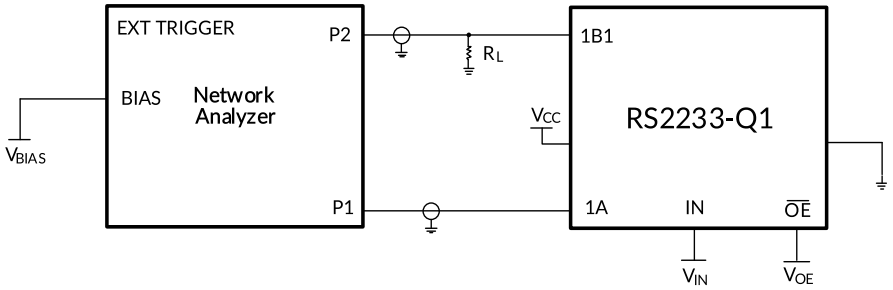
Test Circuit 2. Test Circuit for Propagation Delay



NOTES: Differential gain and phase are measured at the output of the ON channel. For example, when V_{IN} = 0, V_{OE} = 0, and 1A is the input, the output is measured at 1B1.

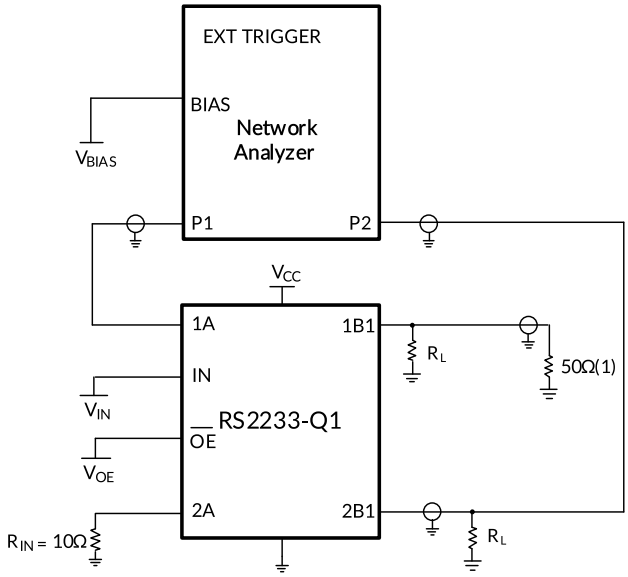
Test Circuit 3. Test Circuit for Differential Gain/Phase Measurement

PARAMETER MEASUREMENT INFORMATION



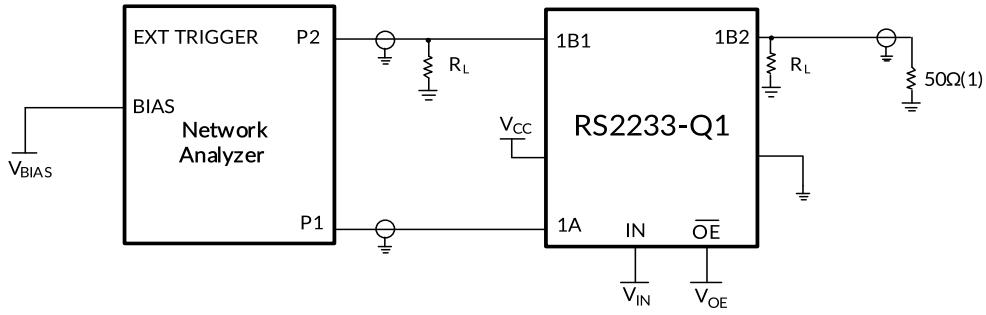
NOTES: Frequency response is measured at the output of the ON channel. For example, when V_{IN} = 0, V_{EN} = 0, and 1A is the input, the output is measured at 1B1. All unused analog I/O ports are left open.

Test Circuit 4. Test Circuit for Frequency Response (BW)



NOTE: 1. A 50Ω termination resistor is needed for the network analyzer.

Test Circuit 5. Test Circuit for Crosstalk (X_{TALK})

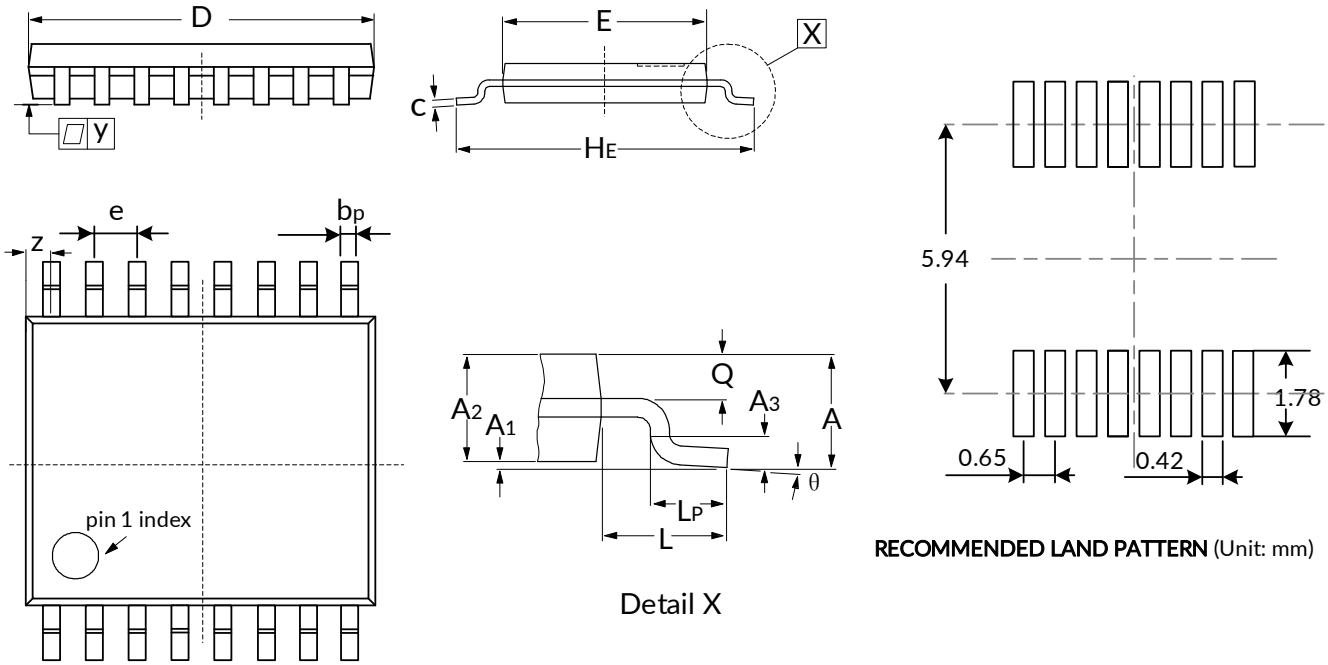


NOTE: 1. A 50Ω termination resistor is needed for the network analyzer.

Test Circuit 6. Test Circuit for Off Isolation (O_{IRR})

11 PACKAGE OUTLINE DIMENSIONS

TSSOP16 (2)



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.100		0.043
A_1	0.050	0.150	0.002	0.006
A_2	0.800	0.950	0.031	0.037
A_3	0.25		0.010	
b_p	0.190	0.300	0.007	0.012
c	0.100	0.200	0.004	0.008
D (1)	4.900	5.100	0.193	0.201
E (1)	4.300	4.500	0.169	0.177
H_E	6.200	6.600	0.244	0.260
e	0.650		0.026	
L	1		0.039	
L_P	0.500	0.750	0.020	0.030
Q	0.300	0.400	0.012	0.016
Z	0.060	0.400	0.002	0.016
y	0.1		0.004	
θ	0°	8°	0°	8°

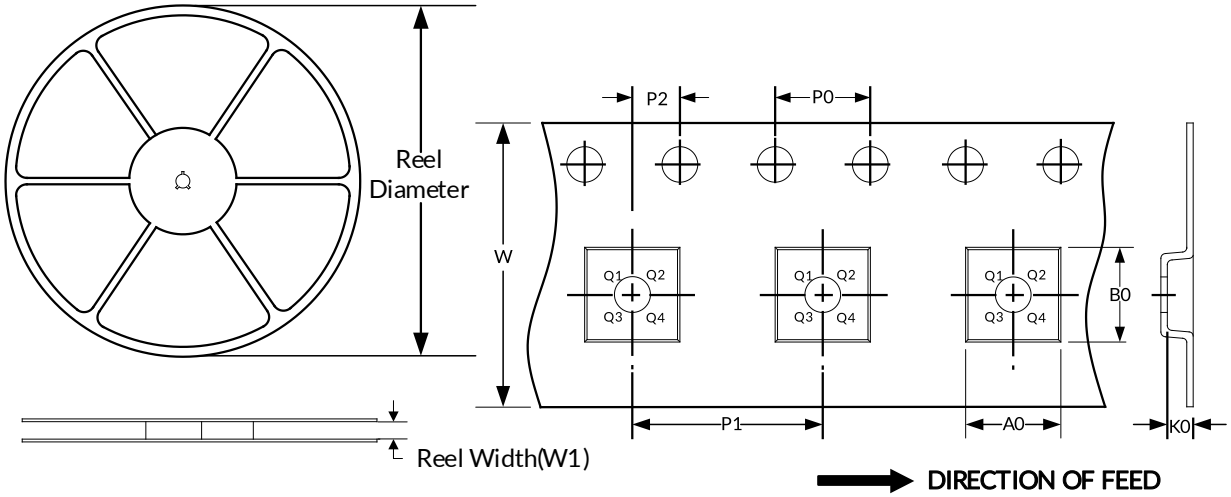
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. This drawing is subject to change without notice.

12 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
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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