

0.6Ω Quad SPDT Analog Switch 4-Channel 2:1 Multiplexer – Demultiplexer With Two Controls

1 FEATURES

- **Bandwidth: 30MHz**
- **High Speed, Typically 50ns**
- **Supply Range: +1.8V to +5.5V**
- **Low ON-State Resistance, 0.6Ω(TYP)**
- **Break-Before-Make Switching**
- **Rail-to-Rail Operation**
- **TTL/CMOS Compatible**
- **Extended Industrial Temperature Range: -40°C to +125°C**
- **ESD Protection Exceeds JESD 22**
 - **2000-V Human-Body Model (A114)**
 - **300-V Machine Model (A115)**
 - **1000-V Charged-Device Model (JS-002)**

2 APPLICATIONS

- **Video Switching**
- **Relay Replacements**
- **USB Switching**
- **Battery-Operated Equipment**
- **Cell Phones**

3 DESCRIPTIONS

The RS2099 is a bidirectional 4-channel single-pole double-throw (SPDT) analog switch with two control inputs, which is designed to operate from 1.8V to 5.5V. This device is also known as a 2 channels double-pole double-throw (DPDT) configuration.

The RS2099 device can handle both analog and digital signals. It features bandwidth(30MHz) and low on-resistance (0.6Ω TYP).

Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2099	QFN3X3-16	3.00mm×3.00mm
	TSSOP16	5.00mm×4.40mm

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

4 Block Diagram

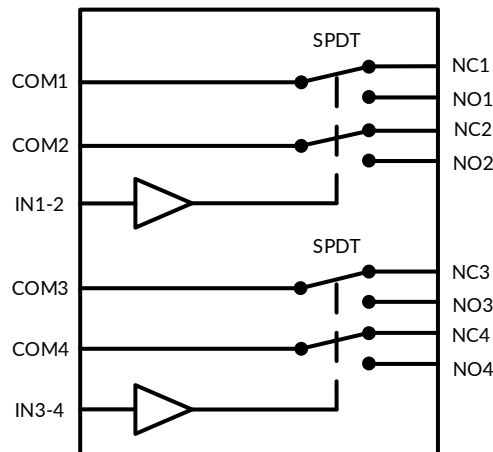


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5 Revision History

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

VERSION	Change Date	Change Item
C.3	2022/08/02	Update PACKAGE OPTION
C.4	2024/01/25	1. Added the TAPE AND REEL INFORMATION 2. Update FEATURES and ESD Ratings values 3. Add MSL on Page 4@RevC.3
C.4.1	2024/03/07	Modify packaging naming
C.4.2	2024/04/07	Add new ordering number

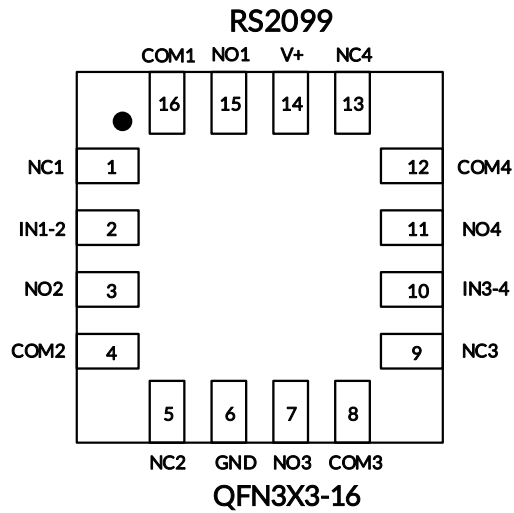
6 PACKAGE/ORDERING INFORMATION ⁽¹⁾

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING ⁽²⁾	MSL ⁽³⁾	PACKAGE OPTION
RS2099	RS2099XTQC16	-40°C ~125°C	QFN3X3-16	RS2099	MSL3	Tape and Reel, 5000
	RS2099XTSS16	-40°C ~125°C	TSSOP16	RS2099	MSL3	Tape and Reel, 4000
	RS2099XTQC16-EC	-40°C ~125°C	QFN3X3-16	RS2099	MSL3	Tape and Reel, 5000

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



7.1 PIN DESCRIPTION

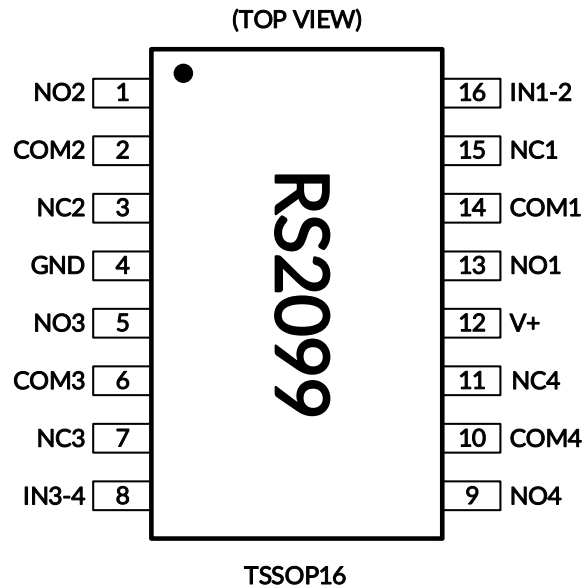
NAME	PIN	FUNCTION
V+	14	Power Supply
GND	6	Ground
IN1-2	2	Digital Control Pin
IN3-4	10	Digital Control Pin
COMx	16,4,8,12	Common Terminal
NOx	15,3,7,11	Normally-Open Terminal
NCx	1,5,9,13	Normally-Closed Terminal

7.2 FUNCTION TABLE

IN1-2	NO1 and NO2	NC1 and NC2
0	OFF	ON
1	ON	OFF

IN3-4	NO3 and NO4	NC3 and NC4
0	OFF	ON
1	ON	OFF

PIN CONFIGURATIONS



PIN DESCRIPTION

NAME	PIN	FUNCTION
V+	12	Power Supply
GND	4	Ground
IN1-2	16	Digital Control Pin
IN3-4	8	Digital Control Pin
COMx	2,6,10,14	Common Terminal
NOx	1,5,9,13	Normally-Open Terminal
NCx	3,7,11,15	Normally-Closed Terminal

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

SYMBOL	PARAMETER	MIN	MAX	UNIT	
V ₊	Supply Voltage	-0.3	6.0	V	
V _{IN}	Input Voltage (All inputs)	-0.3	(V ₊)+0.3		
I _{IN}	Continuous Current NO, NC, or COM	-500	+500	mA	
I _{PEAK}	Peak Current NO, NC, or COM	-800	+800		
θ _{JA}	Package thermal impedance ⁽²⁾	QFN3X3-16		46	°C/W
		TSSOP16		108	
T _J	Junction Temperature ⁽³⁾		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_{θJA}, and T_A. The maximum allowable power dissipation at any ambient temperature is P_D = (T_{J(MAX)} - T_A) / R_{θJA}. 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 ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000	V
	Charged-device model (CDM)	±1000	V
	Machine model (MM)	±300	V

(1) JEDEC document JEP155 states that 500 V HBM allows safe manufacturing with a standard ESD control process.



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+ = 5.0 V, T_A = -40°C to 125°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V+	T _A	MIN ⁽²⁾	TYP ⁽³⁾	MAX ⁽²⁾	UNIT
ANALOG SWITCH								
Analog Signal Range	V _{NO} , V _{NC} , V _{COM}			FULL	0		V+	V
On-Resistance	R _{ON}	V _{NO} or V _{NC} = V+/2, I _{COM} = -10mA, Switch ON, See Figure 4	5V	+25°C	0.6		1.0	Ω
				FULL			1.2	Ω
			3.3V	+25°C	1.0		1.5	Ω
				FULL			1.7	Ω
On-Resistance Match Between Channels	ΔR _{ON}	V _{NO} or V _{NC} = V+/2, I _{COM} = -10mA, Switch ON, See Figure 4	5V	+25°C	0.04		0.1	Ω
				FULL			0.12	Ω
			3.3V	+25°C	0.04		0.1	Ω
				FULL			0.12	Ω
On-Resistance Flatness	R _{FLAT(ON)}	0 ≤ (V _{NO} or V _{NC}) ≤ V+/2, I _{COM} = -10mA, Switch ON, See Figure 4	5V	+25°C	0.18		0.3	Ω
				FULL			0.4	Ω
			3.3V	+25°C	0.54		0.7	Ω
				FULL			0.8	Ω
NC, NO OFF Leakage Current	I _{NC(OFF)} , I _{NO(OFF)}	V _{NO} or V _{NC} = 0.3V, V+/2 V _{COM} = V+/2, 0.3V See Figure 5	1.8 to 5.5V	FULL			1	μA
NC, NO, COM ON Leakage Current	I _{NC(ON)} , I _{NO(ON)} , I _{COM(ON)}	V _{NO} or V _{NC} = 0.3V, Open V _{COM} = Open, 0.3V See Figure 6	1.8 to 5.5V	FULL			1	μA
DIGITAL CONTROL INPUTS ⁽¹⁾								
Input High Voltage	V _{INH}		5V	FULL	1.5			V
			3.3V	FULL	1.3			V
Input Low Voltage	V _{INL}		5V	FULL			0.6	V
			3.3V	FULL			0.5	V
Input Leakage Current	I _{IN}	V _{IN} = V _{IO} or 0	1.8 to 5.5V	FULL			1	μA

(1) All unused digital inputs of the device must be held at V_{IO} 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)

$V_+ = 5.0\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V_+	T_A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS								
Turn-On Time	t_{ON}	$V_{COM} = V_+$, $R_L = 300\Omega$, $C_L = 35\text{pF}$, See Figure 8	5V	+25°C	50			ns
			3.3V					
Turn-Off Time	t_{OFF}	$V_{COM} = V_+$, $R_L = 300\Omega$, $C_L = 35\text{pF}$, See Figure 8	5V	+25°C	15			ns
			3.3V					
Break-Before-Make Time Delay	t_{BBM}	$V_{NO1} = V_{NC1} = V_{NO2} = V_{NC2} = 3\text{V}$, $R_L = 300\Omega$, $C_L = 35\text{pF}$, See Figure 9	5V	+25°C	10			ns
			3.3V					
Off Isolation	O_{ISO}	$R_L = 50\Omega$, Switch OFF, See Figure 11		+25°C	-68			dB
				+25°C	-86			dB
-3dB Bandwidth	BW	Switch ON, $R_L = 50\Omega$, See Figure 10		+25°C	30			MHz
NC, NO OFF Capacitance	$C_{NC(OFF)}$, $C_{NO(OFF)}$	V_{NC} or $V_{NO} = V_+/2$ or GND, Switch OFF See Figure 7		+25°C	80			pF
NC, NO, COM ON Capacitance	$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$	V_{NC} or $V_{NO} = V_+/2$ or GND, Switch ON See Figure 7		+25°C	350			pF
POWER REQUIREMENTS								
Power Supply Range	V_+			FULL	1.8		5.5	V
Power Supply Current	I_+	$V_{IN} = \text{GND or } V_+$	5.5V	FULL			1	μA

8.5 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.

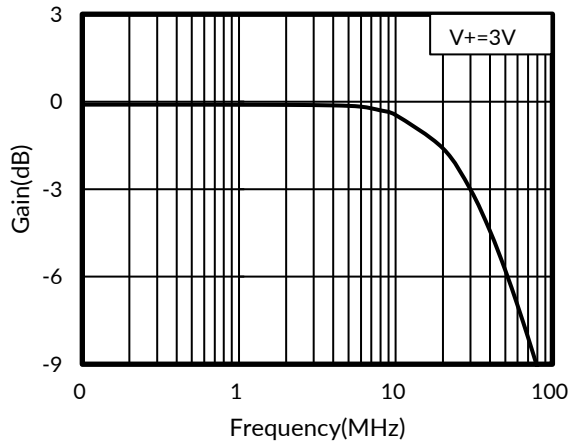


Figure 1. Bandwidth vs Frequency

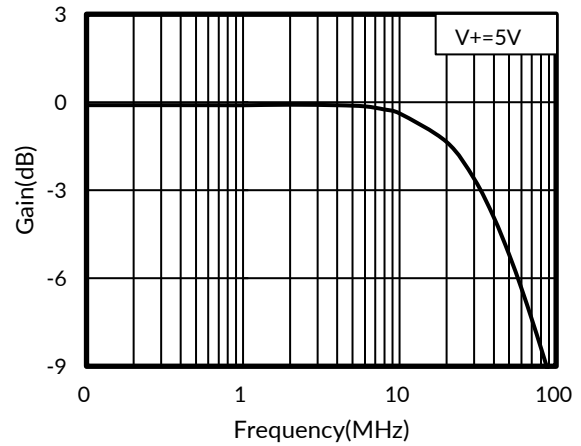


Figure 2. Bandwidth vs Frequency

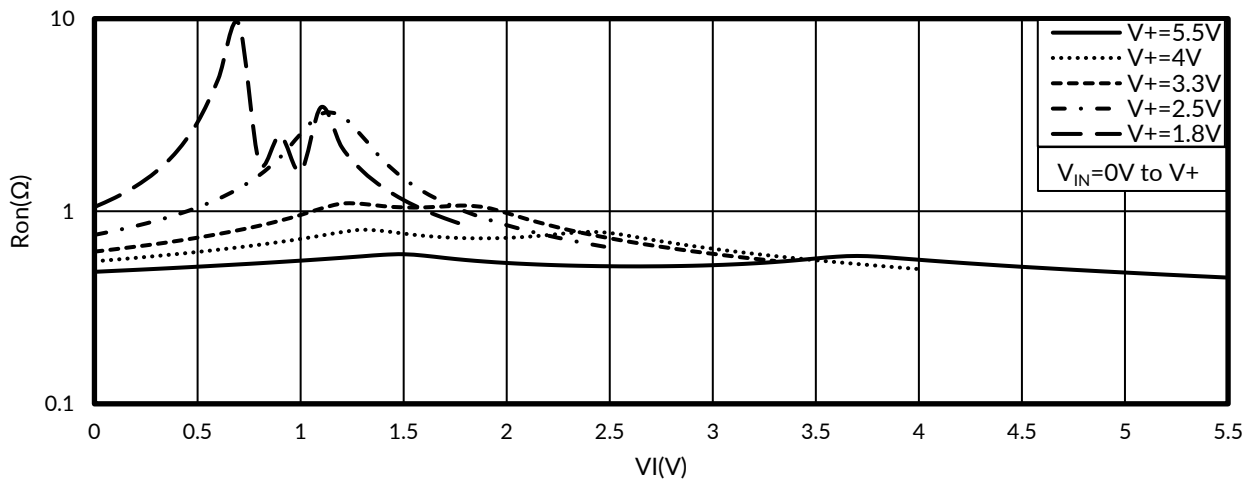


Figure 3. Typical Ron as a Function of Input Voltage

9 Parameter Measurement Information

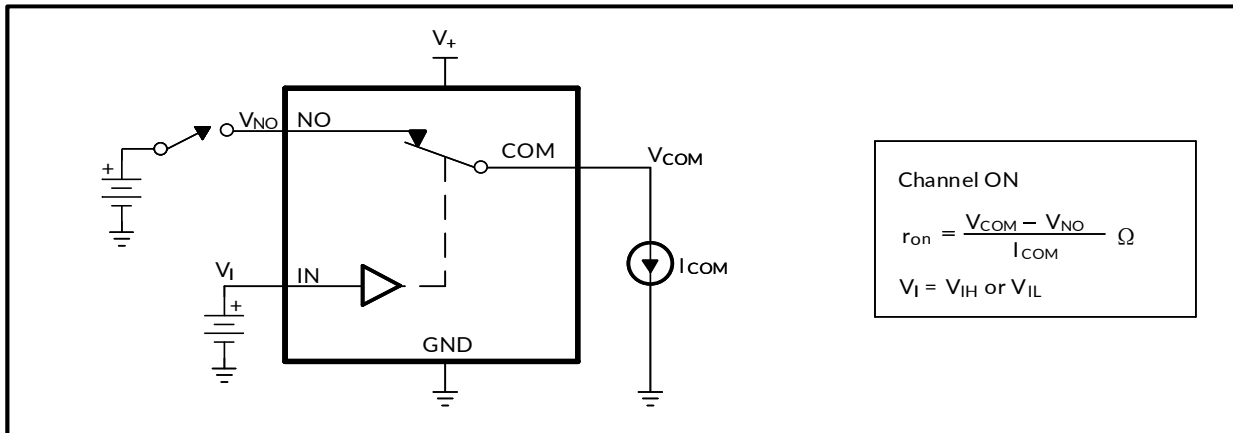


Figure 4. ON-State Resistance (r_{on})

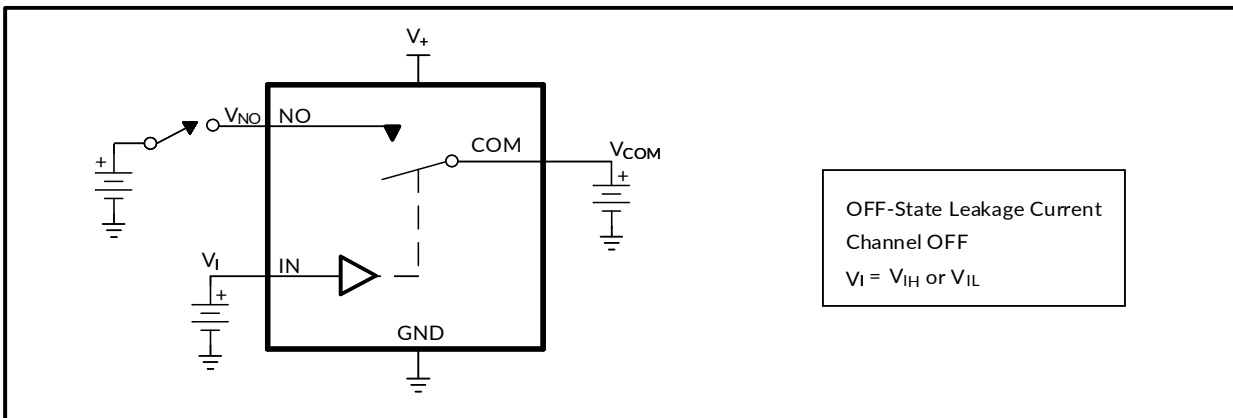


Figure 5. OFF-State Leakage Current ($I_{COM(OFF)}$, $I_{NO(OFF)}$)

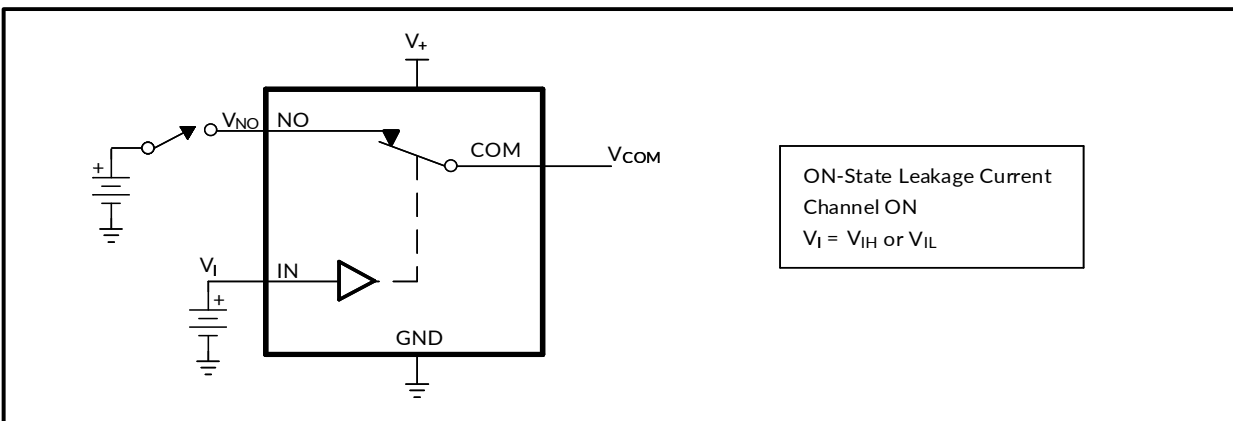
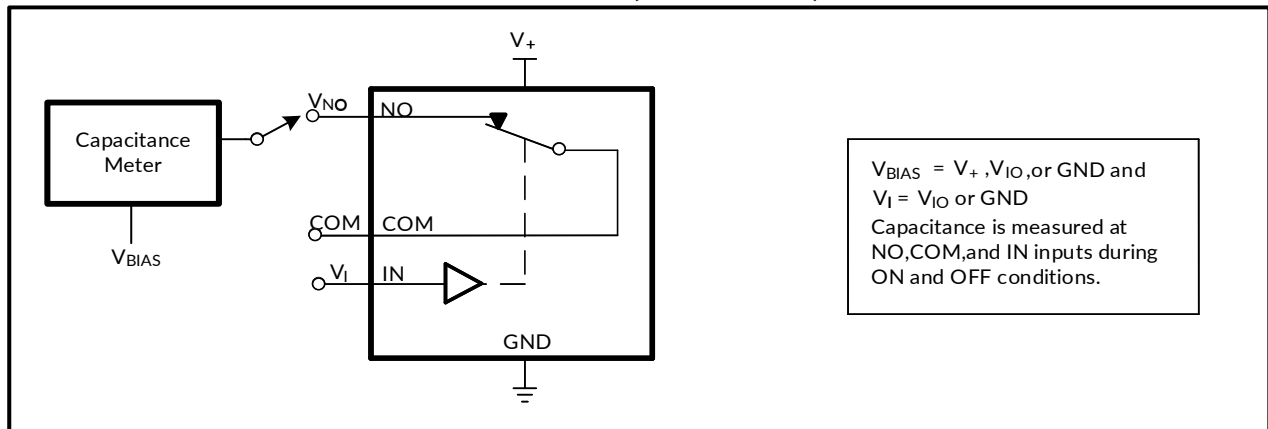
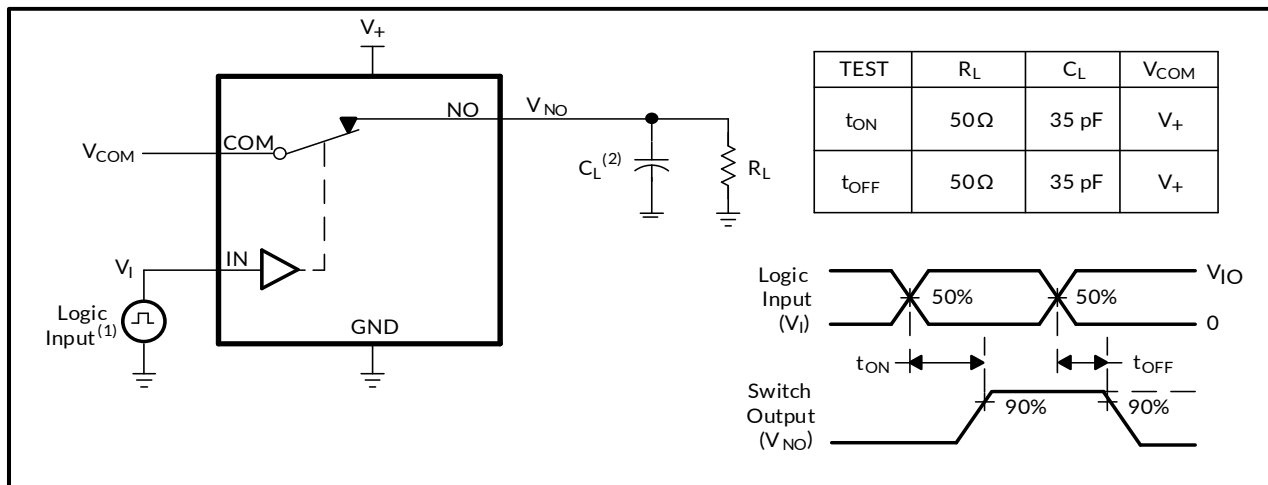
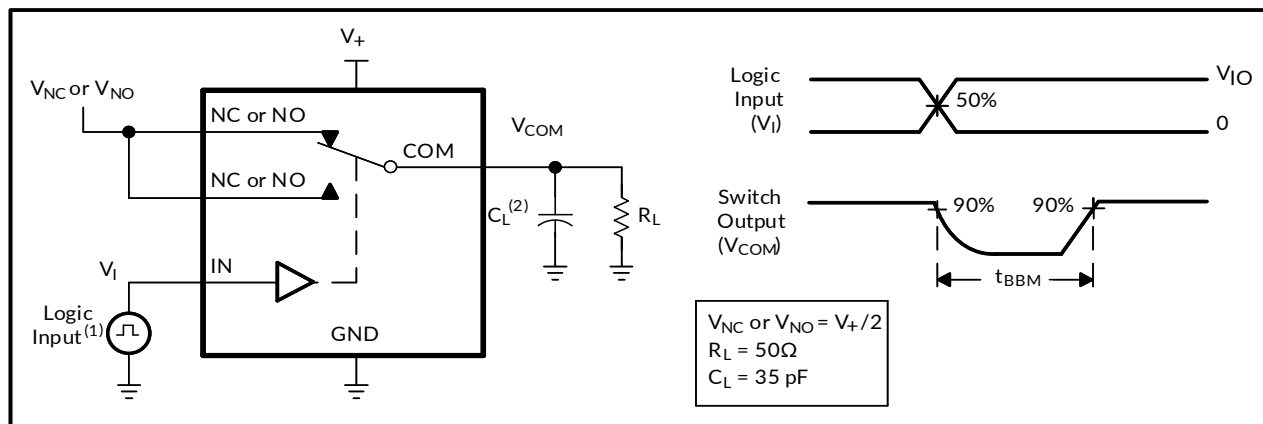
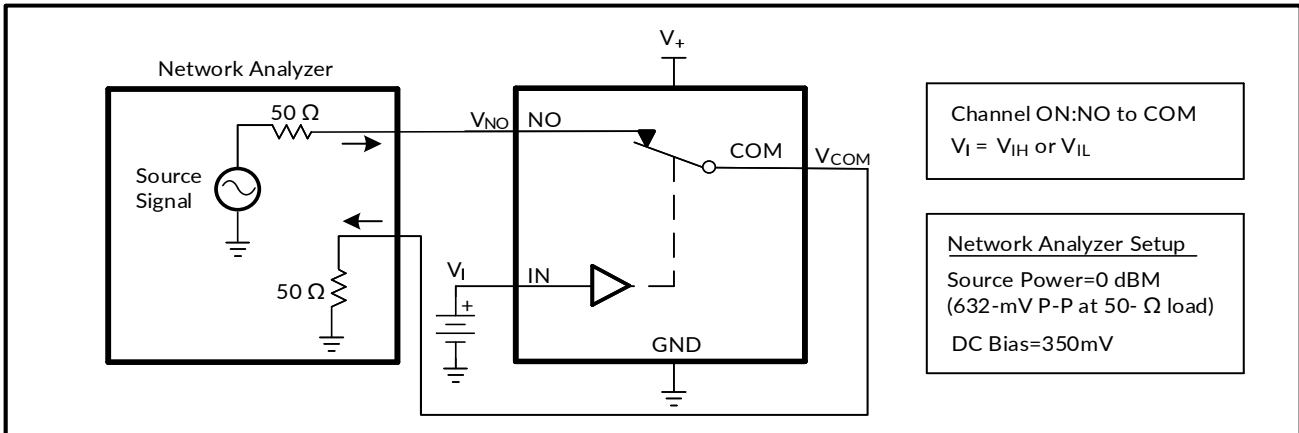
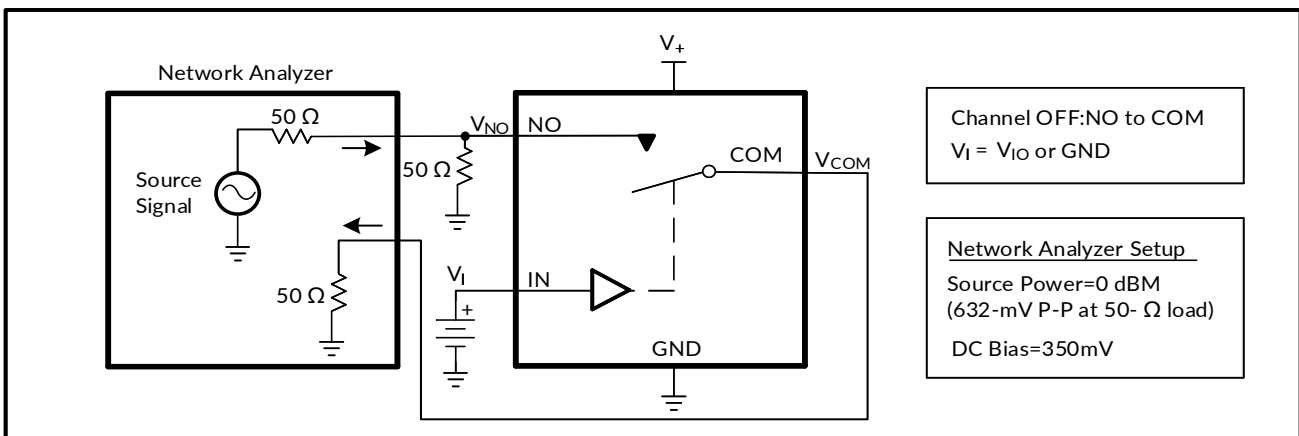
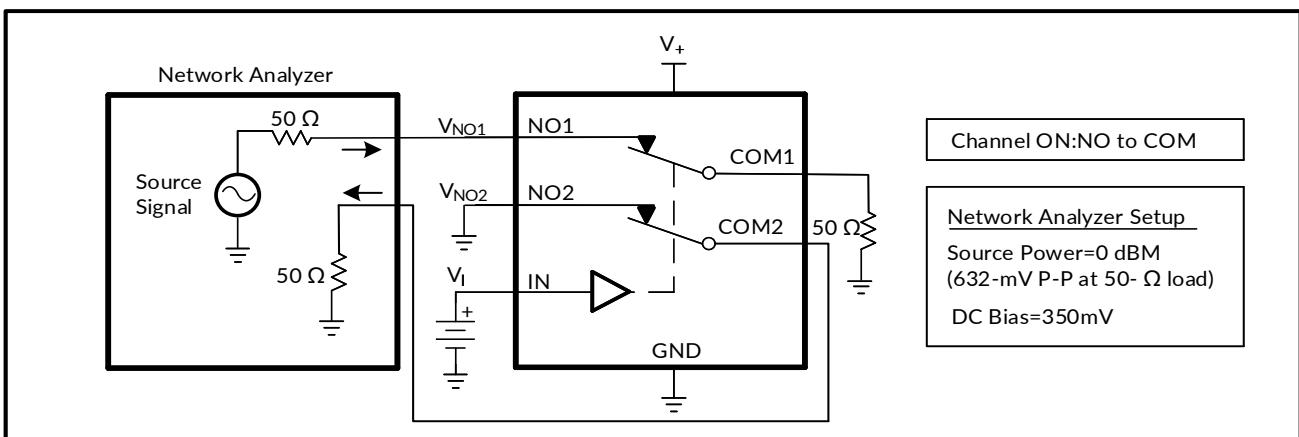


Figure 6. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NO(ON)}$)

Parameter Measurement Information (continued)

Figure 7. Capacitance (C_I , $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NO(OFF)}$, $C_{NO(ON)}$)

Figure 8. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

Figure 9. Break-Before-Make Time (t_{BBM})

Parameter Measurement Information (continued)

Figure 10. Bandwidth (BW)

Figure 11. OFF Isolation (O_{iso})

Figure 12. Crosstalk (X_{TALK})

Parameter Measurement Information (continued)

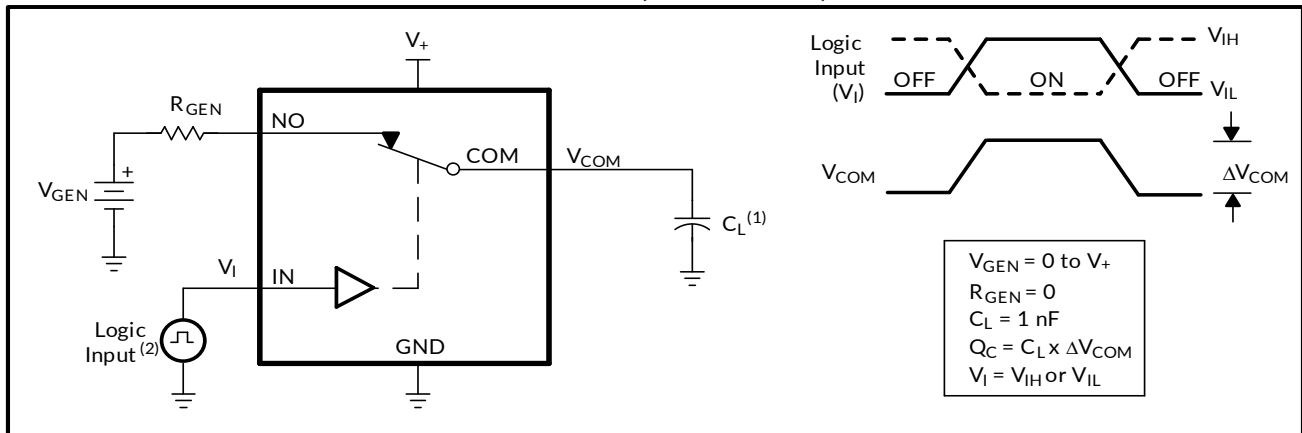


Figure 13. Charge Injection (Q_c)

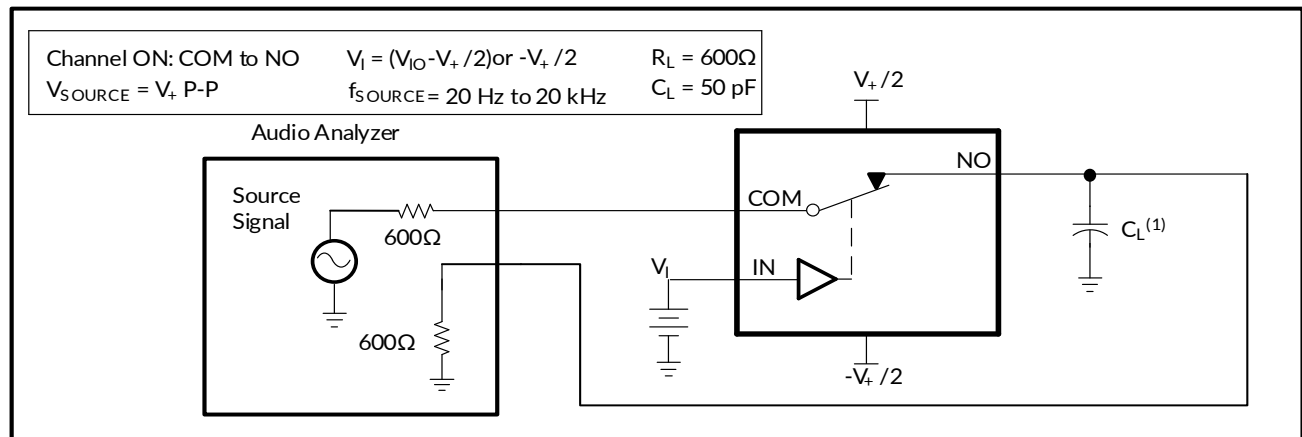
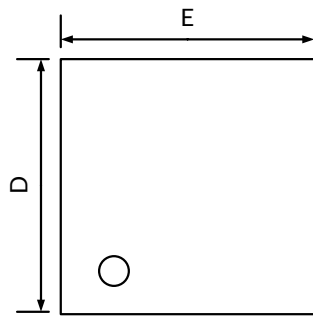


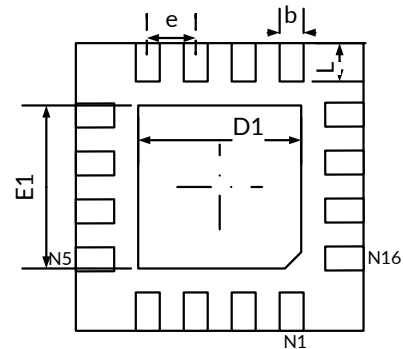
Figure 14. Total Harmonic Distortion (THD)

10 PACKAGE OUTLINE DIMENSIONS

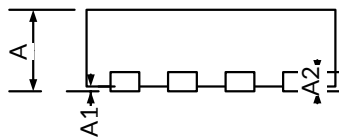
QFN3X3-16⁽²⁾



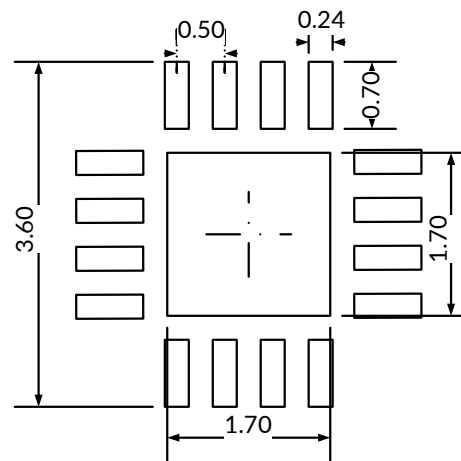
TOP VIEW



BOTTOM VIEW



SIDE VIEW

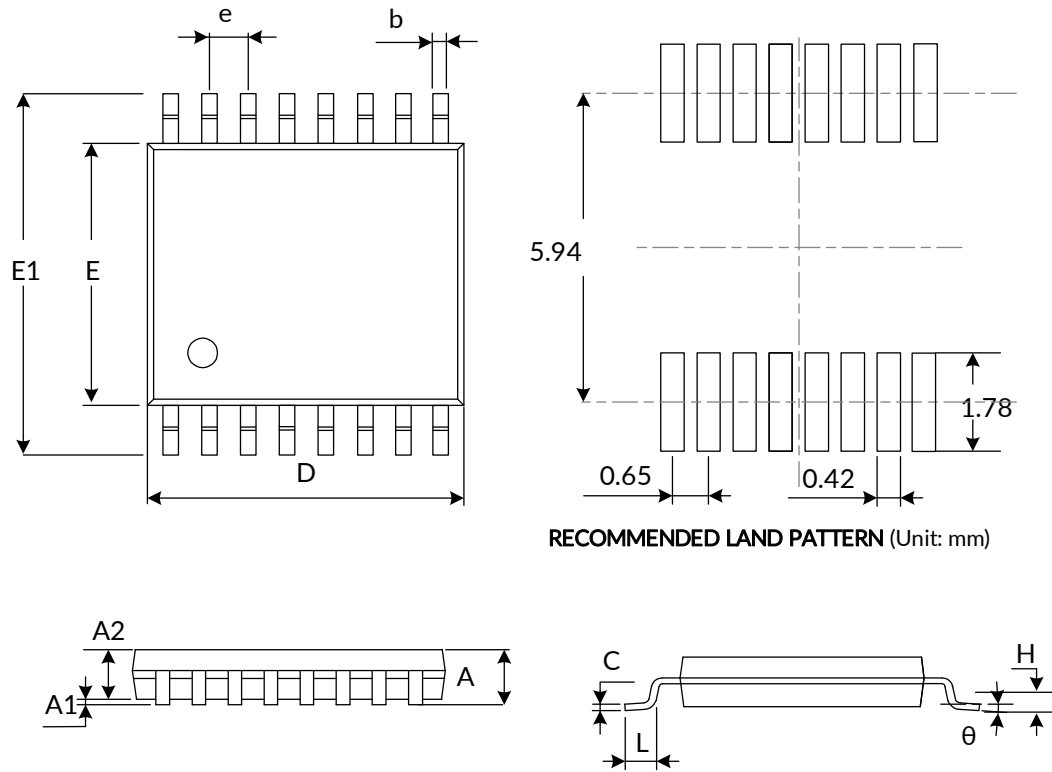


RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾	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 ⁽¹⁾	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E ⁽¹⁾	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

NOTE:

1. Plastic or metal protrusions of 0.075mm maximum per side are not included.
2. This drawing is subject to change without notice.

TSSOP16⁽³⁾


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	
theta	1°	7°	1°	7°

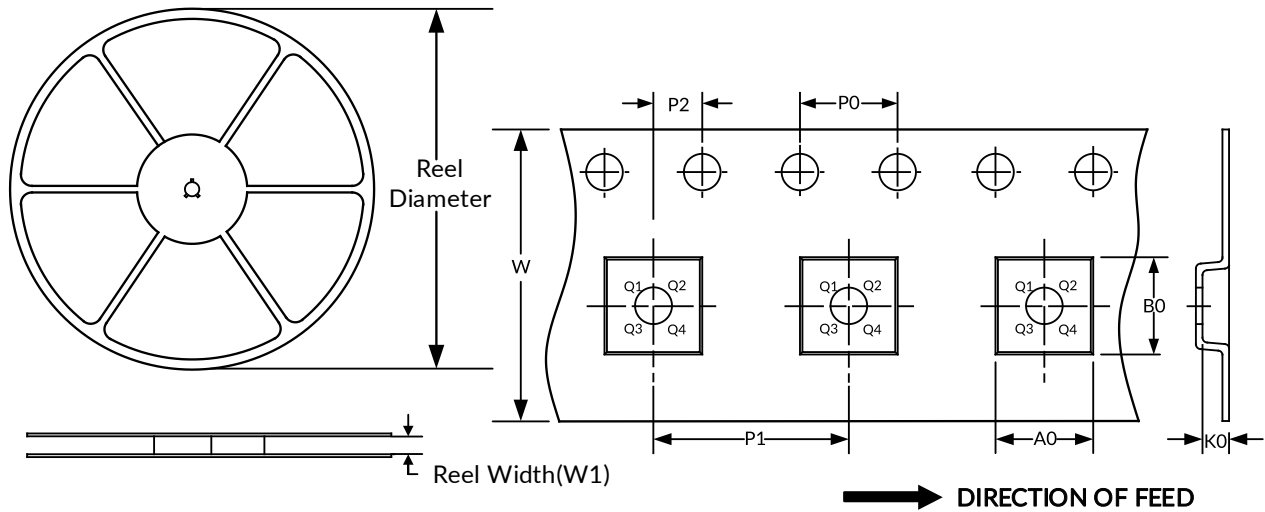
NOTE:

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.

11 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
QFN3X3-16	13"	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q1
TSSOP16	13"	12.4	6.90	5.6	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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