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

1 FEATURES

- **-3dB Bandwidth: 110MHz**
- **High Speed: Typically 55ns**
- **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**
- **Micro SIZE PACKAGES: QFN3X3-16**

2 APPLICATIONS

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

3 DESCRIPTIONS

The RS2099H 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 RS2099H device can handle both analog and digital signals. It features bandwidth (110MHz) and low on-resistance (0.6Ω TYP).

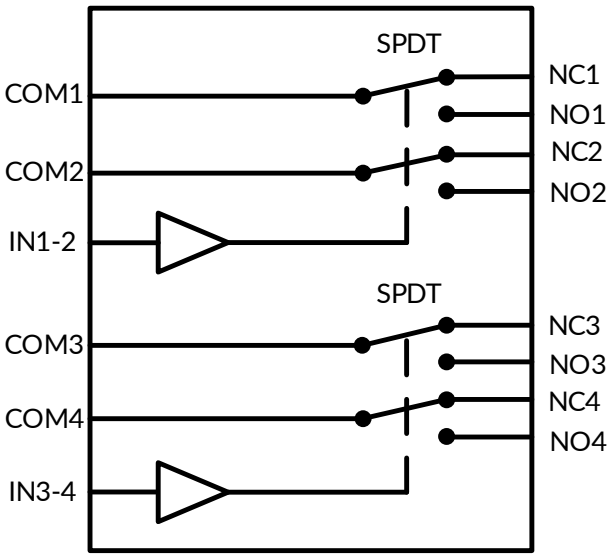
Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2099H	QFN3X3-16	3.00mm×3.00mm

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

4 Functional Block Diagram



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5 Revision History

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

VERSION	Change Date	Change Item
A.1	2022/08/04	Initial version completed
A.1.1	2024/03/07	Modify packaging naming

6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL (3)	PACKAGE OPTION
RS2099H	RS2099HXTQC16	-40°C ~125°C	QFN3X3-16	RS2099	MSL3	Tape and Reel,5000

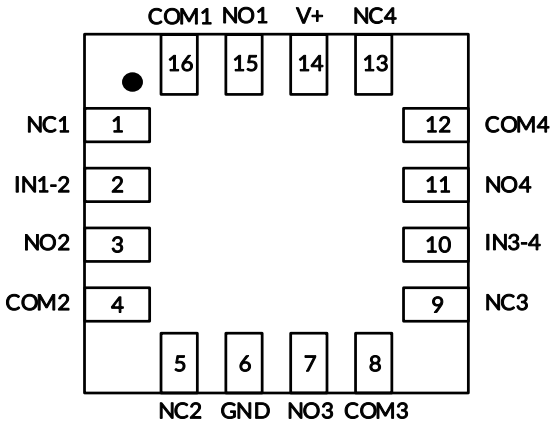
NOTE:

(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 Configuration and Functions (Top View)



QFN3X3-16

7.1 PIN DESCRIPTION

NAME	PIN	FUNCTION
	QFN3X3-16	
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

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 (2)		-0.3	6	V
V_{IN}	Control Input voltage (2)		-0.3	6	
$V_{I/O}$	Switch I/O voltage (3) (4)		-0.3	(V+)+0.3	
I_{IN}	Continuous Current NO, NC or COM		-500	+500	mA
$I_{I/O}$	Peak Current NO, NC, or COM		-800	+800	
θ_{JA}	Package thermal impedance (5)	QFN3X3-16		70	°C/W
T_J	Junction temperature (6)		-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) All voltages are with respect to ground, unless otherwise specified.
(3) The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
(4) This value is limited to 5.5 V maximum.
(5) The package thermal impedance is calculated in accordance with JESD-51.
(6) 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 ANSI/ESDA/JEDEC JS-001(1)	±2000	V
		Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002(2)	±1000	

(1) JEDEC document JEP155 states that 500 V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250 V CDM 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_+	Supply voltage	1.8	5.5	V
IN	Analog voltage	0	5.5	V
NO, NC, COM	Analog voltage	0	V+	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	TYP	MAX	UNIT
ANALOG SWITCH								
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}			FULL	0		V+	V
On-Resistance	R_{ON}	0 ≤ (V_{NO} or V_{NC}) ≤V+, I_{COM} = -10mA, Switch ON, See Figure 16	5V	+25°C		0.6	1.0	Ω
				FULL			1.2	Ω
		V_{NO} or V_{NC}=2V, I_{COM} = -10mA, Switch ON, See Figure 16	3.3V	+25°C		1.4	1.8	Ω
				FULL			2.0	Ω
On-Resistance Match Between Channels	ΔR_{ON}	0 ≤ (V_{NO} or V_{NC}) ≤V+, I_{COM} = -10mA, Switch ON, See Figure 16	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+, I_{COM} = -10mA, Switch ON, See Figure 16	5V	+25°C		0.18	0.3	Ω
				FULL			0.4	Ω
			3.3V	+25°C		0.85	1.0	Ω
				FULL			1.2	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 Figure17	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 18	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.

ELECTRICAL CHARACTERISTICS (continued)

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

ARAMETER	SYMBOL	CONDITIONS		V+	T_A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS									
Turn-On Time	t_{ON}	V_{COM} = V+, R_L = 300Ω, C_L = 35pF, See Figure 20		5V	+25°C		35		ns
					FULL			50	
				3.3V	+25°C		55		
					FULL			70	
Turn-Off Time	t_{OFF}	V_{COM} = V+, R_L = 300Ω, C_L = 35pF, See Figure 20		5V	+25°C		7.5		ns
					FULL			15	
				3.3V	+25°C		12		
					FULL			17	
Crosstalk	X_{TALK}	V+=5.5V, Switch on, R_L=50Ω, F=100KHz		5.5V	+25°C		-80		dB
Break before make time	t_{BBM}	V+=V_{COM}=5V, R_L=300Ω, C_L=35pF		5V	+25°C		2.5		ns
					FULL	1			
Off Isolation	O_{ISO}	R_L = 50Ω, Switch ON, See Figure 23	f= 100KHz	5.5V	+25°C		-70		dB
			f= 10KHz	5.5V	+25°C		-86		dB
-3dB Bandwidth	BW	Switch ON, R_L = 50Ω, See Figure 22		5.5V	+25°C		110		MHz
NC, NO OFF Capacitance	$C_{NC(OFF)}$, $C_{NO(OFF)}$	V_{NC} or V_{NO}=V+/2 or GND, Switch OFF See Figure 19		5V	+25°C		30		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 19		5V	+25°C		100		pF
POWER REQUIREMENTS									
Power Supply Range	V_+				FULL	1.8		5.5	V
Power Supply Current	I_+	V_{IN} = GND or V_+		5.5V	+25°C			1	µA
					FULL			1	
Supply-Current Change	$\triangle I_+$	V+=5.5V,V_{IN}=3.4V		5.5V	FULL			10	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.

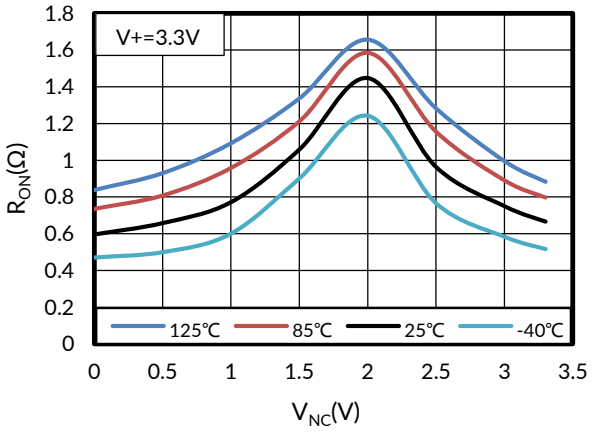


Figure 1. On-Resistance vs NC Voltage

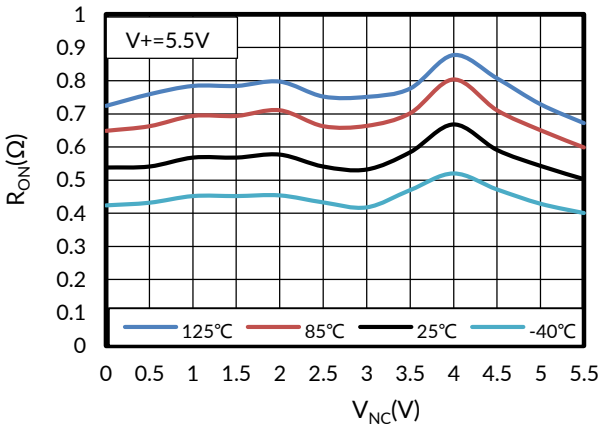


Figure 2. On-Resistance vs NC Voltage

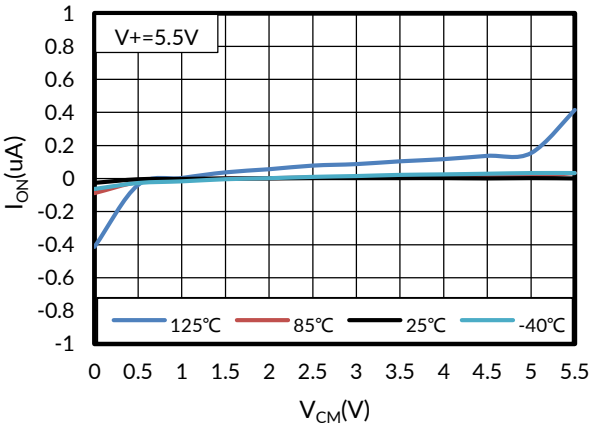


Figure 3. ON-State leakage current vs Common-Mode Voltage

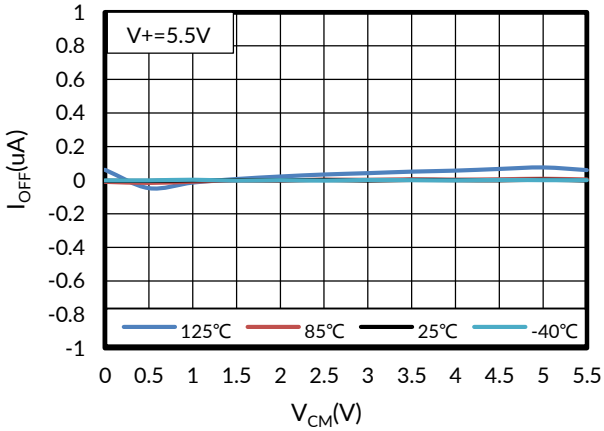


Figure 4. OFF-State leakage current vs Common-Mode Voltage

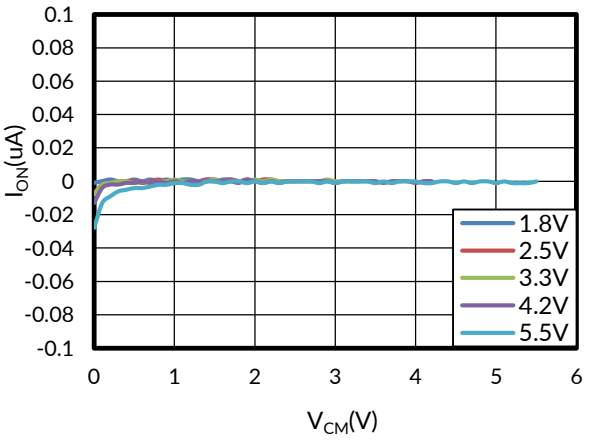


Figure 5. ON-State leakage current vs Common-Mode Voltage

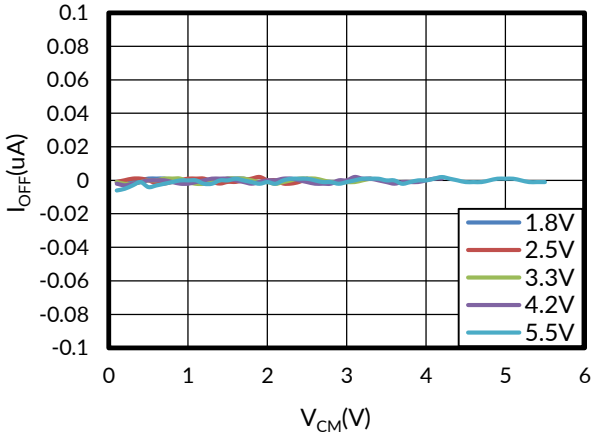


Figure 6. OFF-State leakage current vs Common-Mode Voltage

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.

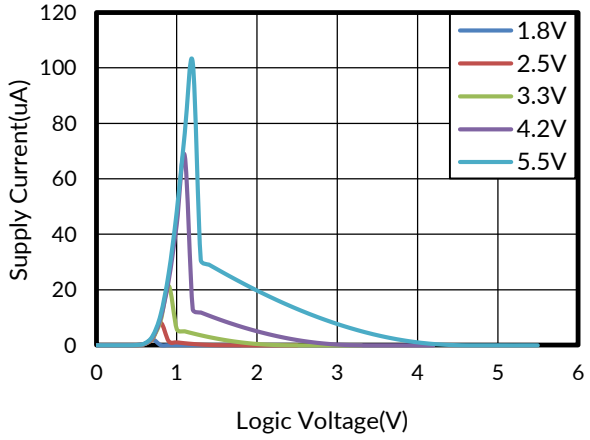


Figure 7. Supply Current vs Logic Voltage

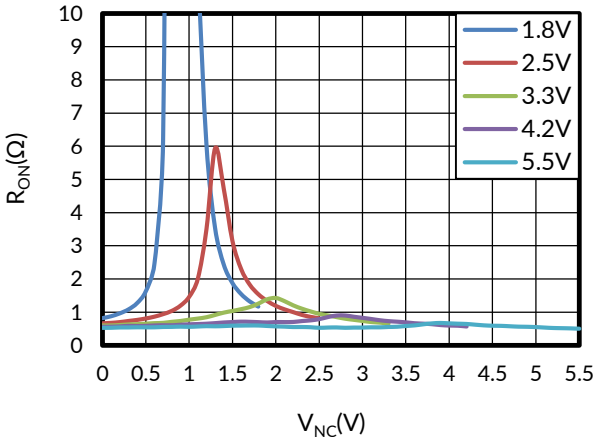


Figure 8. On-Resistance vs NC Voltage

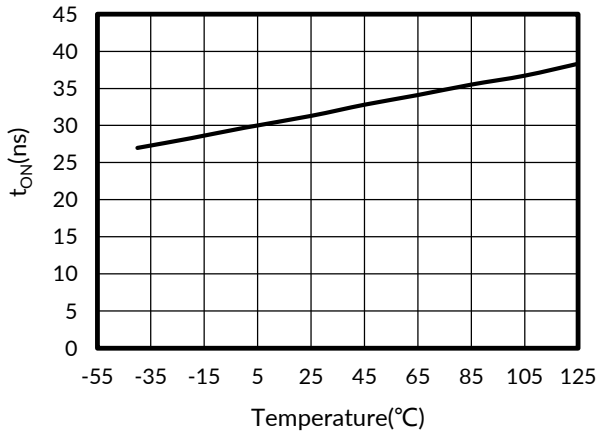


Figure 9. Turn on Time vs Temperature

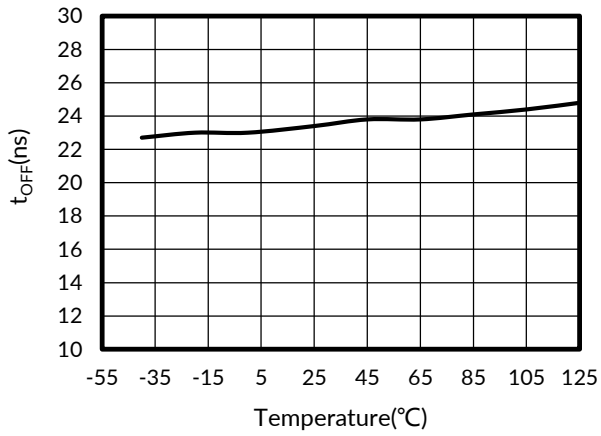


Figure 10. Turn-off Time vs Temperature

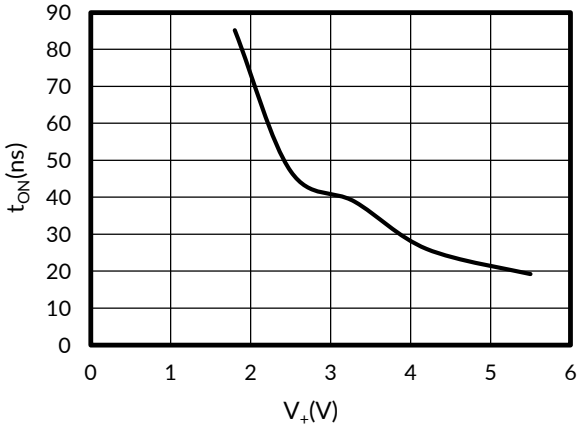


Figure 11. Turn On Time vs Supply Voltage

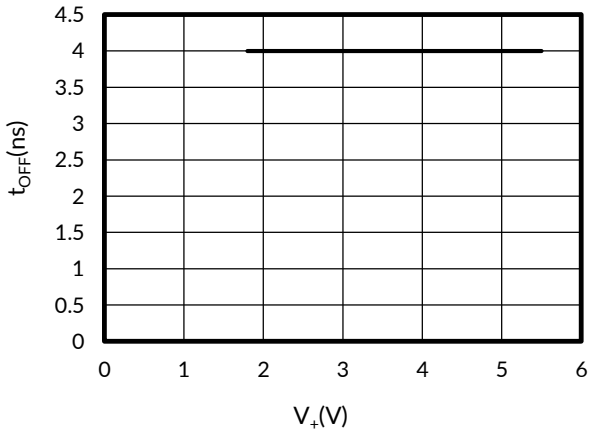


Figure 12. Turn-Off Time vs Supply Voltage

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.

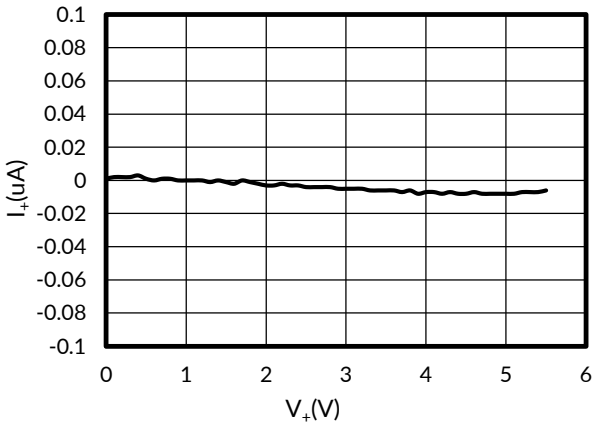


Figure 13. Supply Current vs Supply Voltage

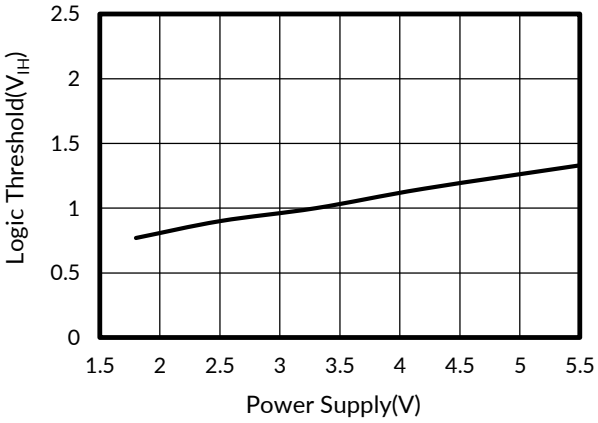


Figure 14. Logic Threshold vs Power Supply

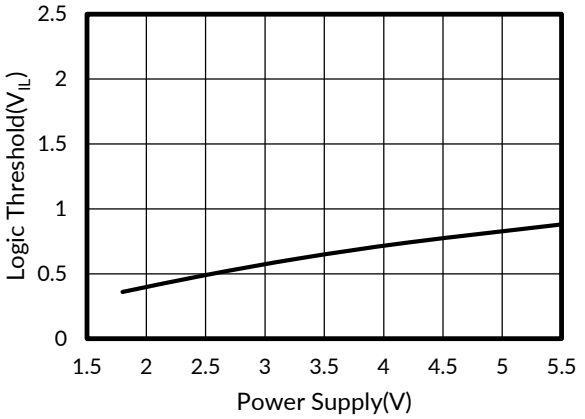


Figure 15. Logic Threshold vs Power Supply

9 Parameter Measurement Information

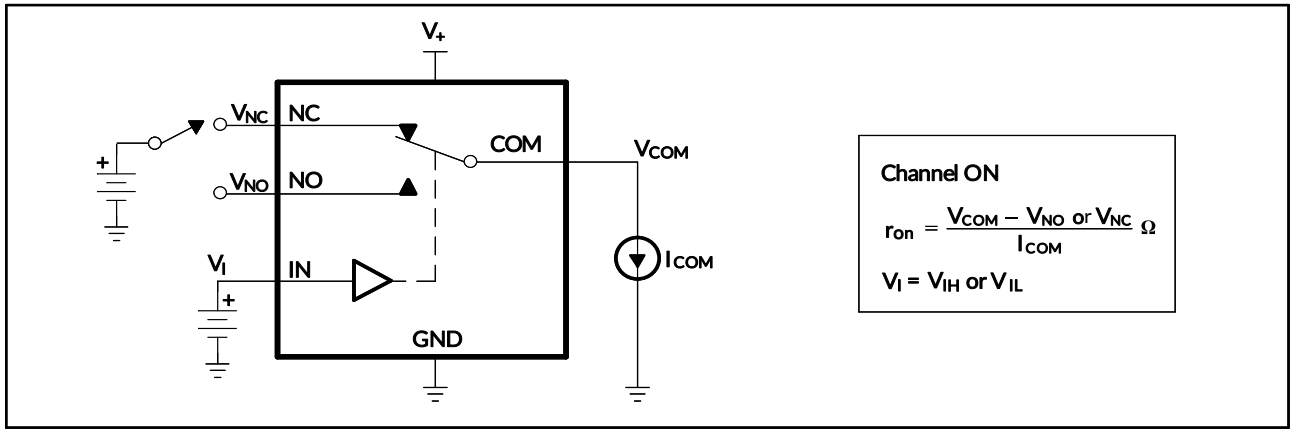


Figure 16. ON-State Resistance (r_{on})

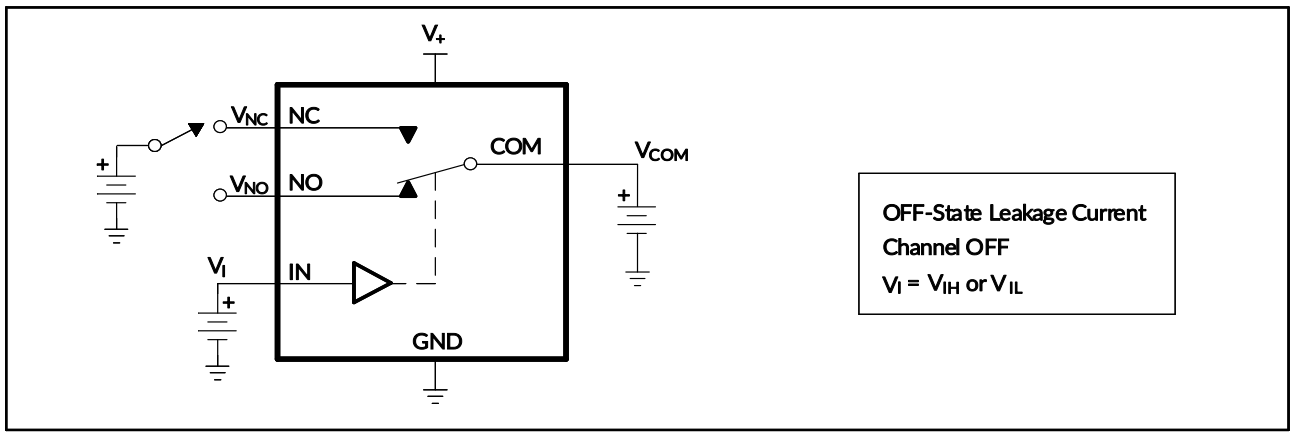


Figure 17. OFF-State Leakage Current ($I_{NC(OFF)}$, $I_{NO(OFF)}$)

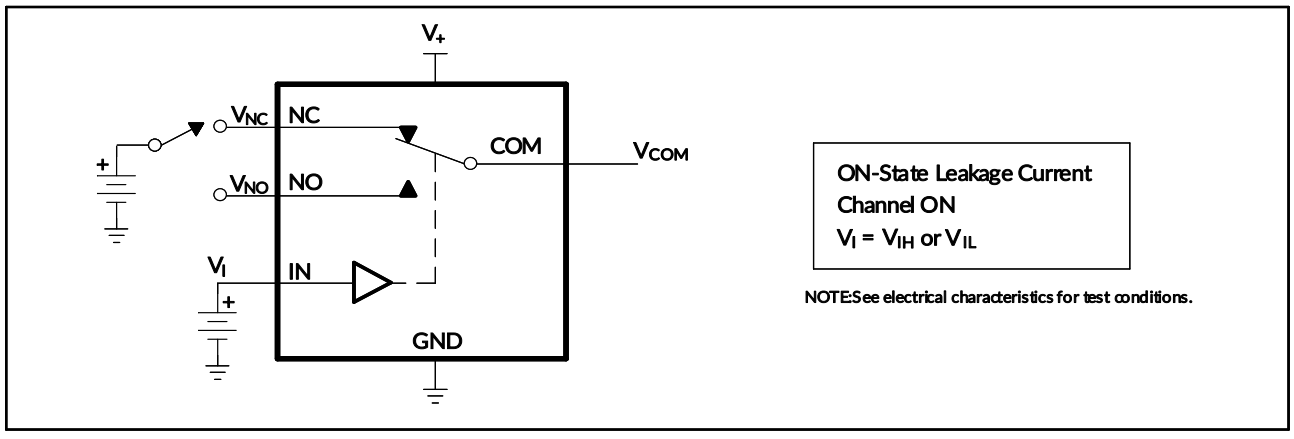


Figure 18. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$, $I_{NO(ON)}$)

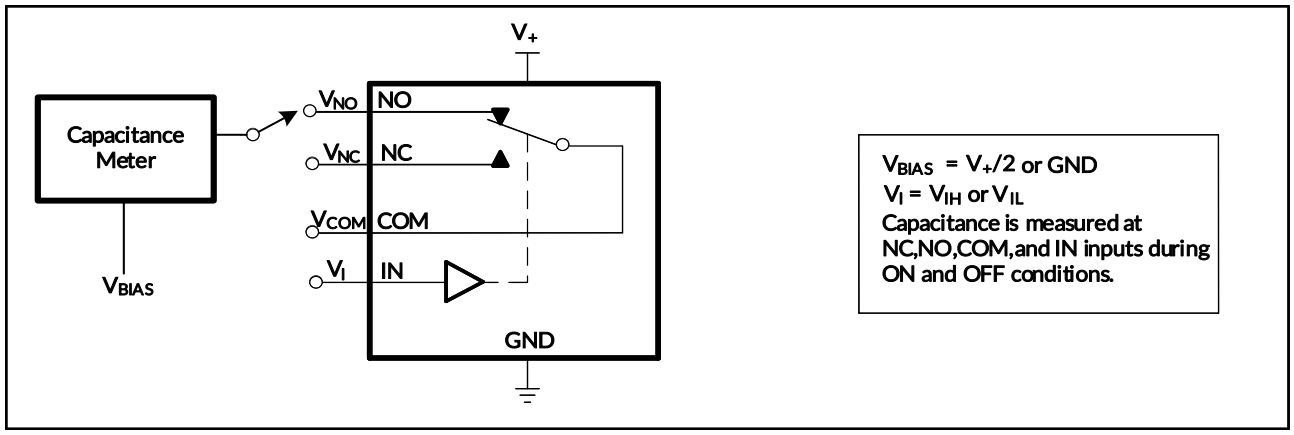
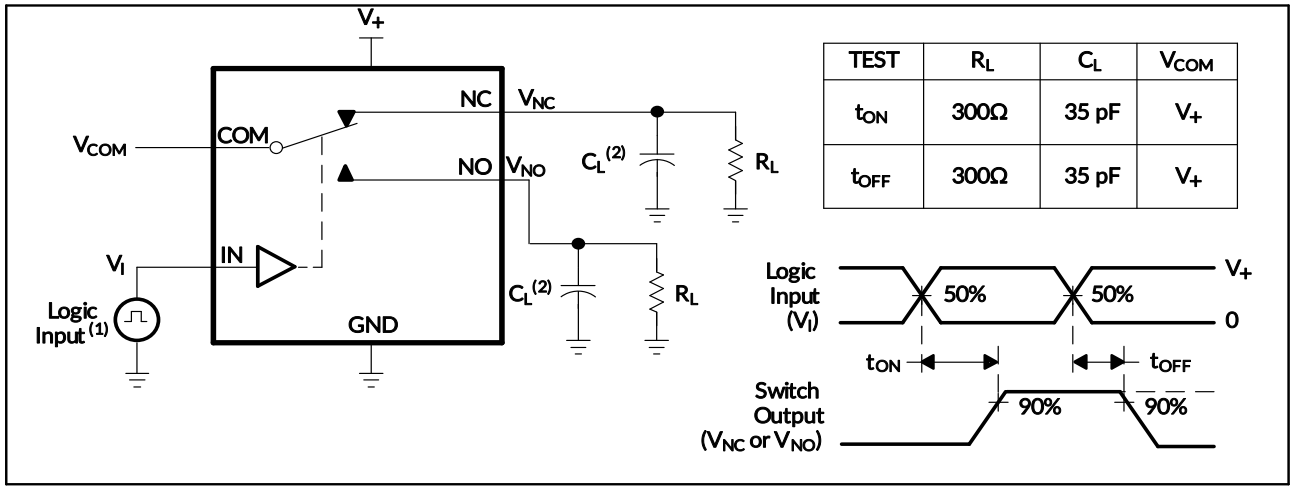


Figure 19. Capacitance (C_I, $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NC(ON)}$, $C_{NO(OFF)}$, $C_{NO(ON)}$)



TEST	R_L	C_L	V_{COM}
t_{ON}	300Ω	35 pF	V+
t_{OFF}	300Ω	35 pF	V+

Figure 20. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

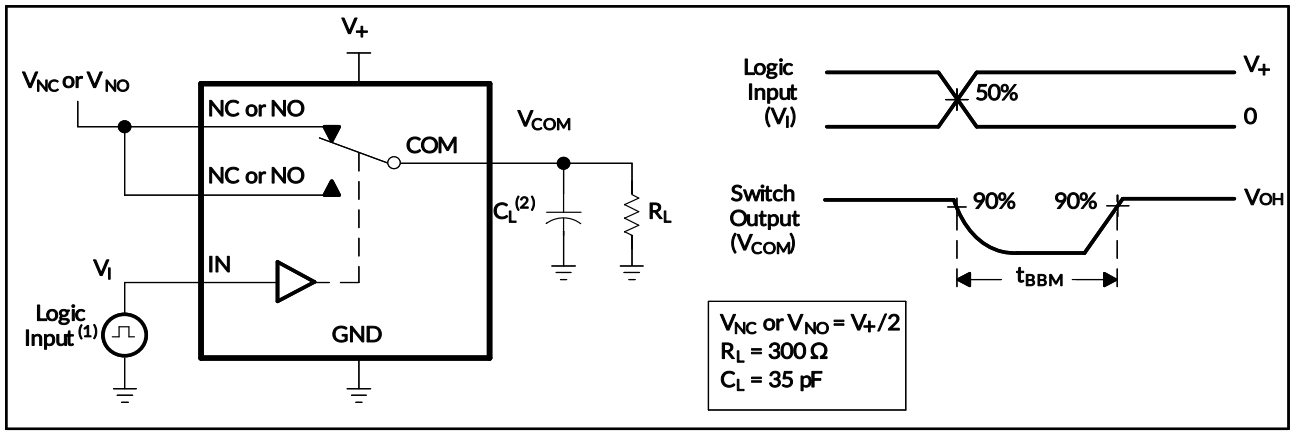


Figure 21. Break-Before-Make Time (t_{BBM})

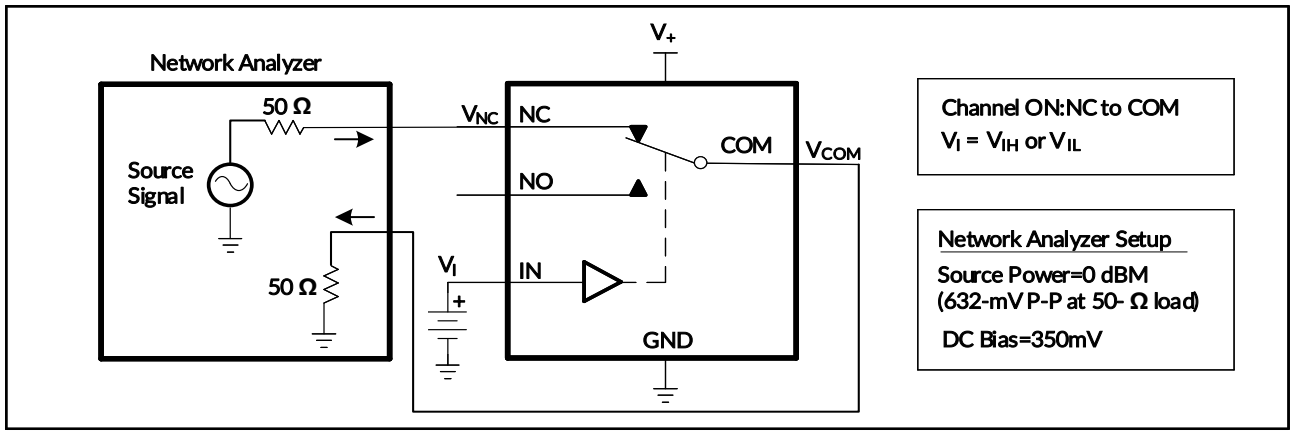


Figure 22. Bandwidth (BW)

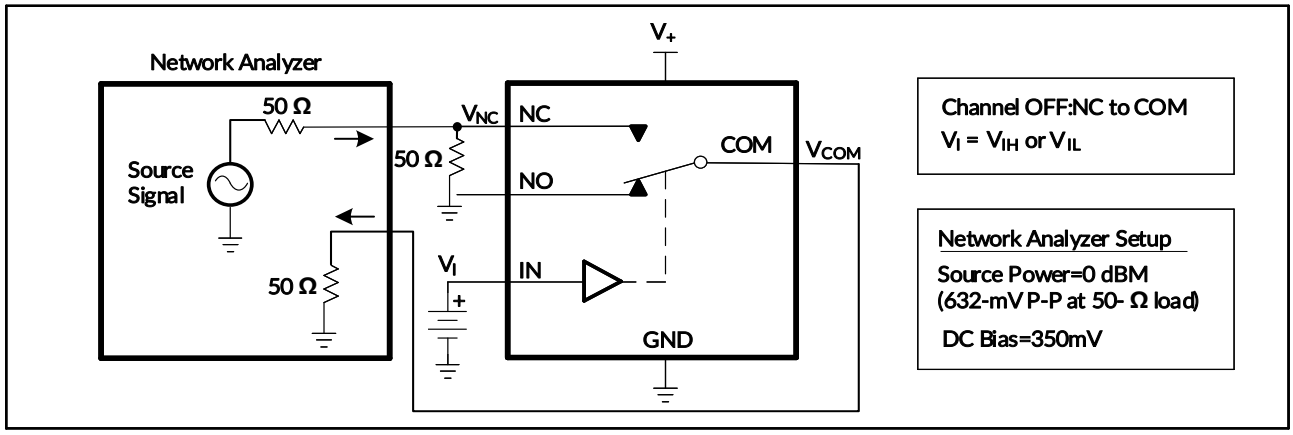


Figure 23. OFF Isolation (O_{ISO})

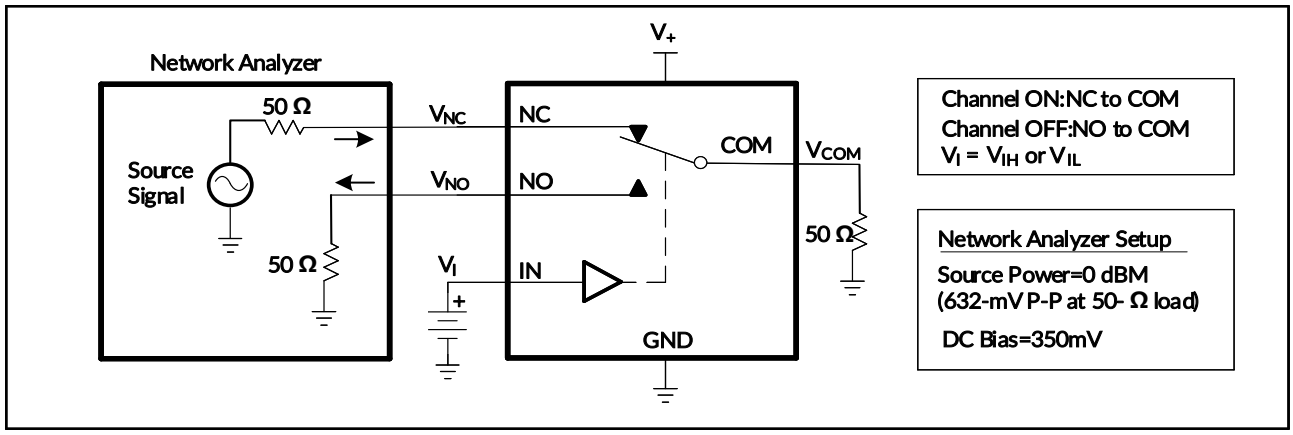


Figure 24. Crosstalk (X_{TALK})

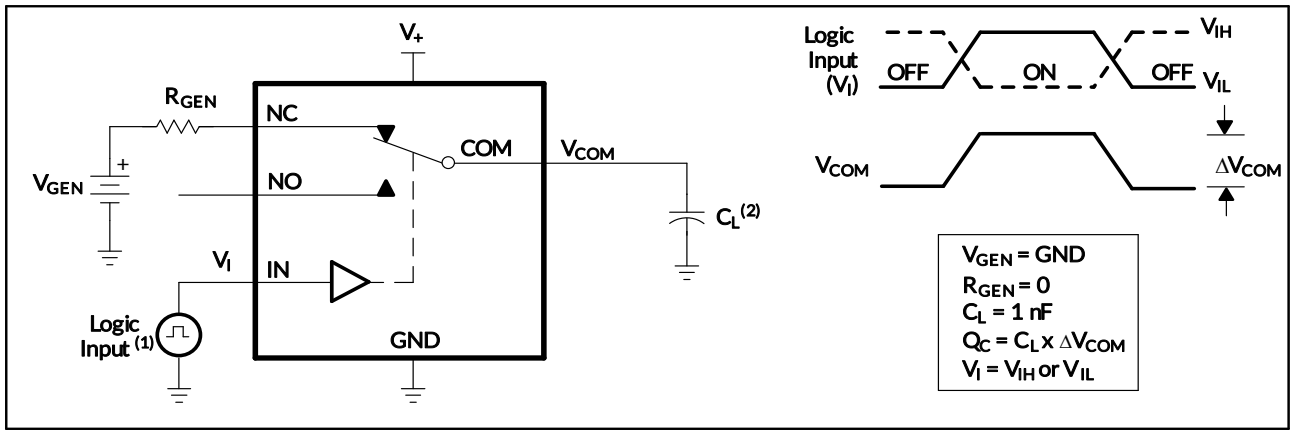


Figure 25. Charge Injection (Q_C)

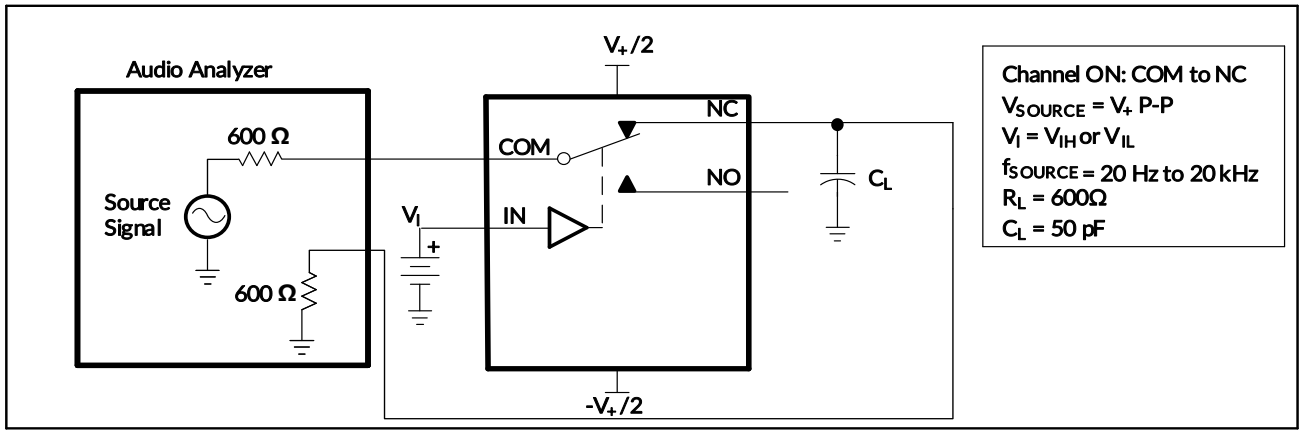
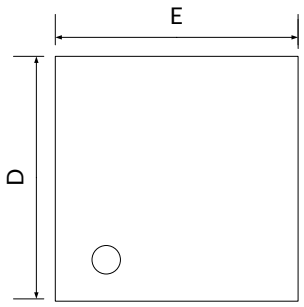


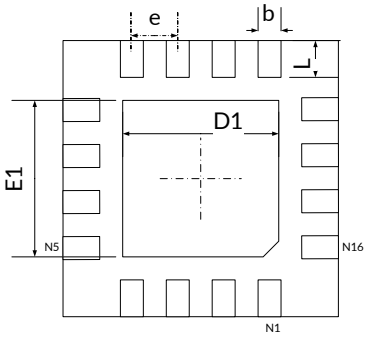
Figure 26. Total Harmonic Distortion (THD)

10 PACKAGE OUTLINE DIMENSIONS

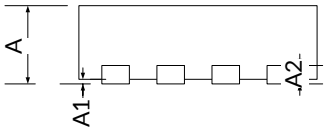
QFN3X3-16 (2)



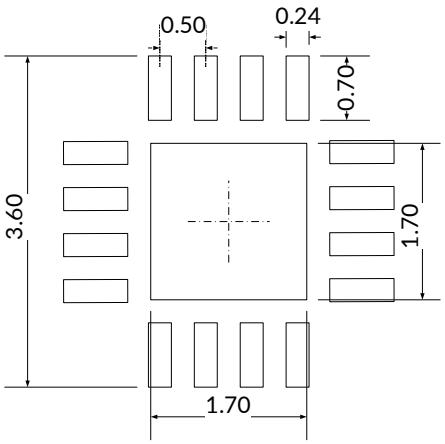
TOP VIEW



BOTTOM VIEW



SIDE VIEW



RECOMMENDED LAND PATTERN (Unit: mm)

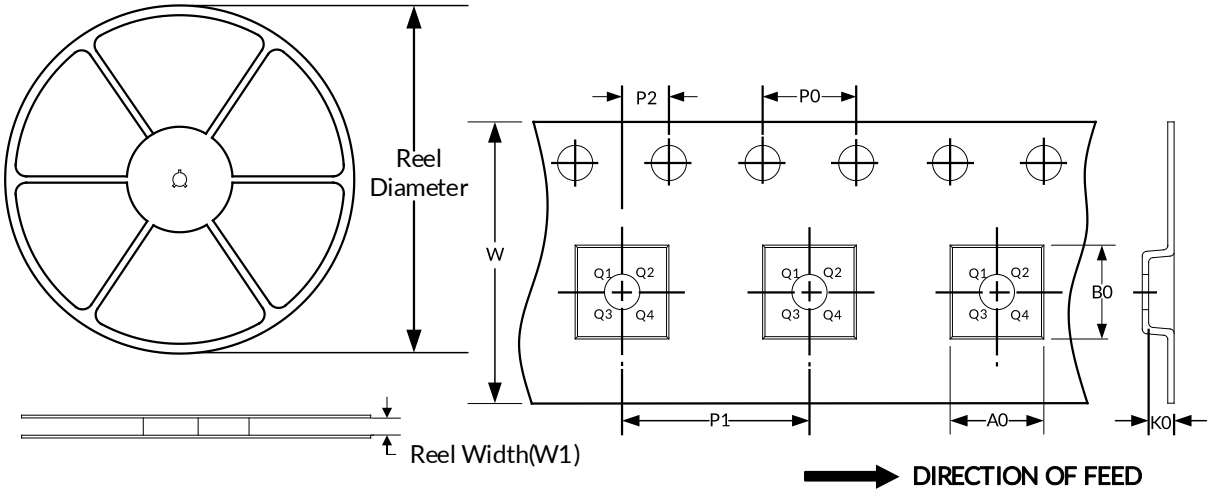
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203		0.008	
b	0.180	0.300	0.007	0.012
D (1)	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E (1)	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
e	0.500 TYP		0.020 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.

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

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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