

# 4Ω, 400MHz Bandwidth, Dual-Channel SPDT Analog Switch with Negative Signaling Capability

## FEATURES

- **-3dB Bandwidth: 400MHz**
- **Supply Range: +2.5V to +5.5V**
- **Negative Signal Swing Capability: -2V to V<sub>+</sub>**
- **Break-Before-Make Switching**
- **Fast t<sub>ON</sub>, t<sub>OFF</sub> Times**
- **1.8V Logic Control**
- **Extended Industrial Temperature Range: -40°C to +85°C**
- **Small Package Available in Green QFN-1.4x1.8-10L Package**

## DESCRIPTION

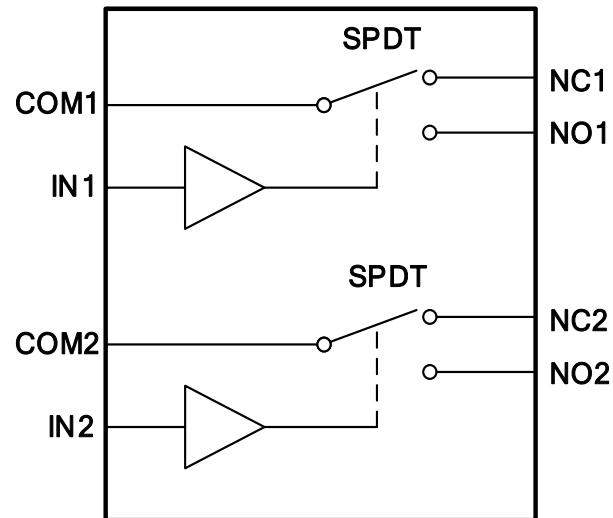
The RS2117 is a bidirectional, dual-channel single-pole double-throw (SPDT) analog switch that is designed to operate from 2.5V to 5.5V, and the switches can handle negative signal down to -2.0V.

The device also offers a low ON-state resistance of 4Ω (typical), which is matched to within 1 Ω between channels. This device is available packaged in QFN-1.4x1.8-10L.

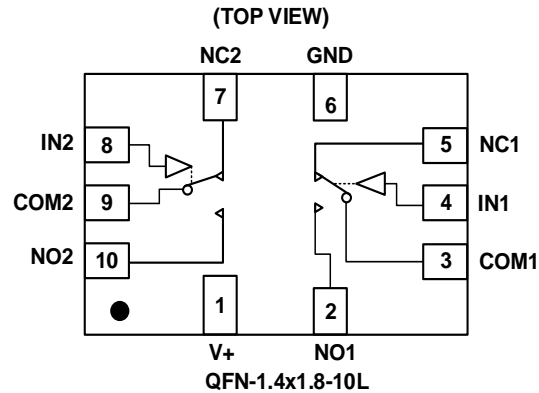
## APPLICATIONS

- **Wearable Devices**
- **Battery-Operated Equipment**
- **Signal Gating, Chopping, Modulation or Demodulation (Modem)**
- **Portable Computing**
- **Cell Phones**

## Functional Block Diagram



## PIN CONFIGURATIONS



### PIN DESCRIPTION

NAME	PIN	FUNCTION
V+	1	Power Supply
NO1, NO2	2,10	Normally-Open Terminal
COM1, COM2	3,9	Common Terminal
IN1, IN2	4,8	Digital Control Pin
NC1, NC2	5,7	Normally-Closed Terminal
GND	6	Ground

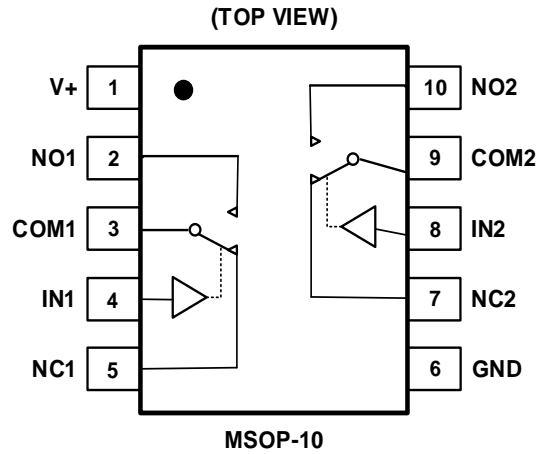
NOTE: NOX, NCX and COMX terminals may be an input or output.

### FUNCTION TABLE

LOGIC	NO	NC
0	OFF	ON
1	ON	OFF

NOTE: Switches shown for logic "0" input.

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## SPECIFICATIONS

### Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

SYMBOL	PARAMETER	MIN	MAX	UNIT
V <sub>+</sub>	Supply Voltage	-0.3	6.0	V
V <sub>IN</sub>	Input Voltage <sup>(2)</sup>	-0.3	6.0	
	Analog Voltage Range	-2.0	(V <sub>+</sub> )+0.3	
	Digital Voltage Range	-0.3	(V <sub>+</sub> )+0.3	
	Continuous Current NO, NC, or COM	-100	+100	mA
I <sub>PEAK</sub>	Peak Current NO, NC, or COM	-150	+150	
T <sub>J</sub>	Junction Temperature		150	°C
T <sub>stg</sub>	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) 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.

### ESD Ratings

		VALUE	UNIT	
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM)	±2000	V
		Machine Model (MM)	±200	V

### Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted) <sup>(3)</sup>

SYMBOL	PARAMETER	MIN	MAX	UNIT
V <sub>CC</sub>	Supply Voltage	2.5	5.5	V
T <sub>A</sub>	Operating temperature	-40	+85	°C

### Thermal Information

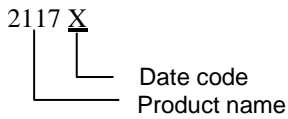
THERMAL METRIC		RS2117		UNIT
		10 PINS		
		MSOP-10	QFN-1.4x1.8-10L	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	180.7	120	°C/W
R <sub>θJC(top)</sub>	Junction-to-case(top) thermal resistance	66.2	46.0	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	103.2	44.5	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	11.2	1.5	°C/W
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	101.3	44.5	°C/W
R <sub>θJC(bot)</sub>	Junction-to-case(bottom) thermal resistance	N/A	31.2	°C/W

**PACKAGE/ORDERING INFORMATION**

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING <sup>(1/2)</sup>	PACKAGE OPTION
RS2117	RS2117YUTQK10	-40°C ~+85°C	QFN-1.4x1.8-10L	2117 $\underline{X}$	Tape and Reel,4000
RS2117	RS2117YN	-40°C ~+85°C	MSOP-10	RS2117	Tape and Reel,4000

**NOTE:**

- (1) 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.
- (2)  $\underline{X}$  = Date Code.

**MARKING INFORMATION**


## ELECTRICAL CHARACTERISTICS

$V_+ = 5.0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V+	T <sub>A</sub>	MIN	TYP	MAX	UNITS
<b>ANALOG SWITCH</b>								
Analog Signal Range	$V_{NO}, V_{NC}, V_{COM}$	$2.5\text{V} \leq V_+ \leq 3.5\text{V}$		FULL	-2.0		V+	V
		$3.5\text{V} \leq V_+ \leq 5.5\text{V}$			(V+)-5.5	V+		
On-Resistance	$R_{ON}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -10\text{mA}$ , Switch ON, See Figure 1	5V	+25°C		4	7	$\Omega$
				FULL			7.5	$\Omega$
			3.3V	+25°C		6	9	$\Omega$
				FULL			9.5	$\Omega$
On-Resistance Match Between Channels	$\Delta R_{ON}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -10\text{mA}$ , Switch ON, See Figure 1	5V	+25°C		0.15	0.5	$\Omega$
				FULL			0.6	$\Omega$
			3.3V	+25°C		0.25	0.85	$\Omega$
				FULL			1.0	$\Omega$
On-Resistance Flatness	$R_{FLAT(ON)}$	$0 \leq (V_{NO} \text{ or } V_{NC}) \leq V_+$ , $I_{COM} = -10\text{mA}$ , Switch ON, See Figure 1	5V	+25°C		1	2	$\Omega$
				FULL			2.5	$\Omega$
			3.3V	+25°C		3	5	$\Omega$
				FULL			5.4	$\Omega$
NC, NO OFF Leakage Current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_{NO} \text{ or } V_{NC} = 0.3\text{V}$ , $V_+/2$ $V_{COM} = V_+/2$ , 0.3V See Figure 2	2.5V to 5.5V	FULL			1	$\mu\text{A}$
NC, NO, COM ON Leakage Current	$I_{NC(ON)}, I_{NO(ON)}, I_{COM(ON)}$	$V_{NO} \text{ or } V_{NC} = 0.3\text{V}$ , Open $V_{COM} = \text{Open}$ , 0.3V See Figure 3	2.5V to 5.5V	FULL			1	$\mu\text{A}$
<b>DIGITAL CONTROL INPUTS<sup>(1)</sup></b>								
Input High Voltage	$V_{INH}$		5V	FULL	1.5			V
			3.3V	FULL	1.3			V
Input Low Voltage	$V_{INL}$		5V	FULL			0.5	V
			3.3V	FULL			0.4	V
Input Leakage Current	$I_{IN}$	$V_{IN} = V_{IO} \text{ or } 0$	2.5V to 5.5V	FULL			1	$\mu\text{A}$

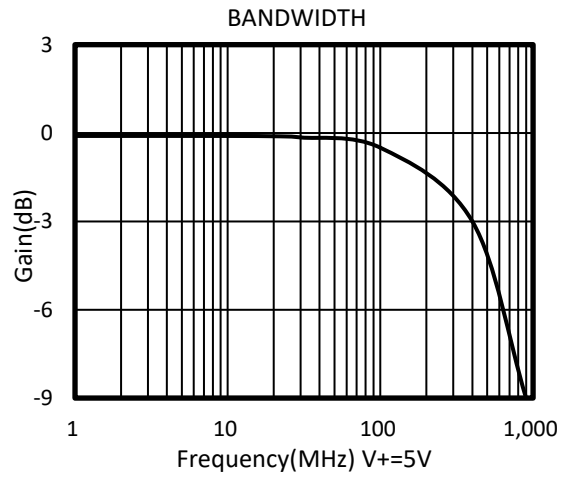
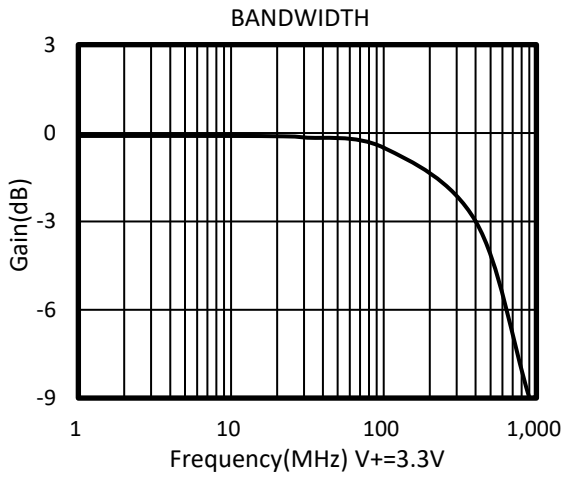
(1) All unused digital inputs of the device must be held at  $V_{IO}$  or GND to ensure proper device operation.

## ELECTRICAL CHARACTERISTICS (continued)

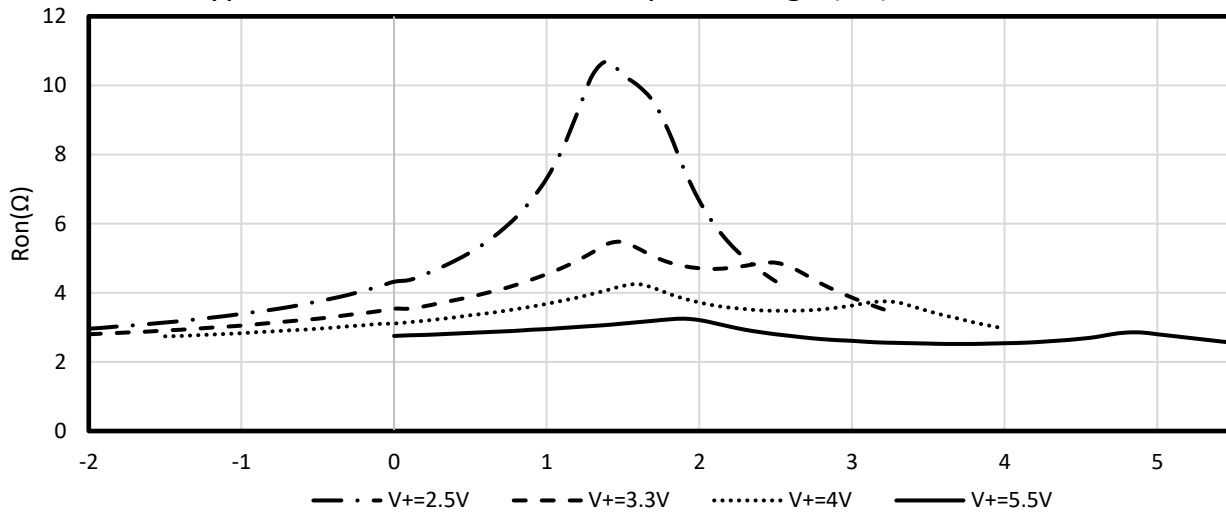
V+ = 5.0 V, TEMP= -40°C to 85°C (unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	V+	TEMP	MIN	TYP	MAX	UNITS
<b>DYNAMIC CHARACTERISTICS</b>								
Turn-On Time	t <sub>ON</sub>	V <sub>COM</sub> = V+, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, See Figure 5	5V	+25°C		15		ns
			3.3V			25		
Turn-Off Time	t <sub>OFF</sub>	V <sub>COM</sub> = V+, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, See Figure 5	5V	+25°C		10		ns
			3.3V			15		
Break-Before-Make Time Delay	t <sub>BBM</sub>	V <sub>NO1</sub> = V <sub>NC1</sub> = V <sub>NO2</sub> = V <sub>NC2</sub> = V+/2, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, See Figure 6	5V	+25°C		5		ns
			3.3V			10		
Charge Injection	Q	V <sub>G</sub> =GND, R <sub>G</sub> =0Ω, C <sub>L</sub> =1.0nF, See Figure 10	5V	+25°C		15		pC
			3.3V	+25°C		10		
Off Isolation	O <sub>ISO</sub>	R <sub>L</sub> = 50Ω, Switch OFF, See Figure 8	f = 1MHz			-70		dB
			f = 10MHz			-50		dB
-3dB Bandwidth	BW	Switch ON, R <sub>L</sub> = 50Ω See Figure 7		+25°C		400		MHz
Channel-to-Channel Crosstalk	X <sub>TALK</sub>	Signal=0dBm, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, See Figure 9	f = 1MHz			-72		dB
			f = 10MHz			-52		dB
NC, NO OFF Capacitance	C <sub>NC(OFF)</sub> , C <sub>NO(OFF)</sub>	V <sub>NC</sub> or V <sub>NO</sub> =V+/2 or GND, Switch OFF See Figure 4		+25°C		10		pF
NC, NO, COM ON Capacitance	C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> , C <sub>COM(ON)</sub>	V <sub>NC</sub> or V <sub>NO</sub> =V+/2 or GND, Switch ON See Figure 4		+25°C		25		pF
<b>POWER REQUIREMENTS</b>								
Power Supply Range	V+			FULL	2.5		5.5	V
Power Supply Current	I+	V <sub>IN</sub> = GND or V+	5.5V	FULL			1	μA

### TYPICAL CHARACTERISTICS



Typical Ron as a Function of Input Voltage ( $V_I$ ) for  $V_I = 0$  to  $V+$





### Parameter Measurement Information

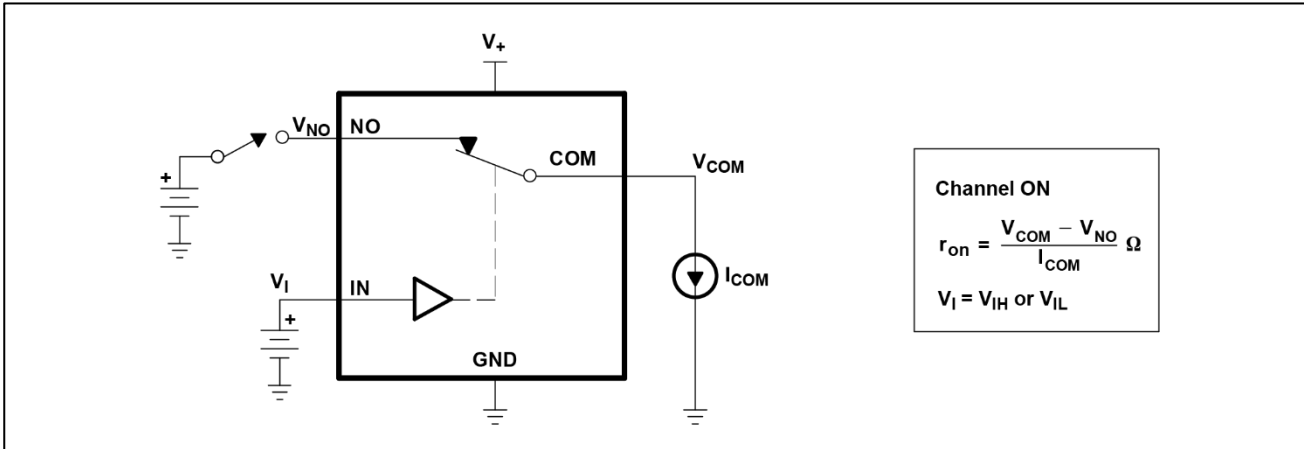


Figure 1.ON-State Resistance ( $r_{on}$ )

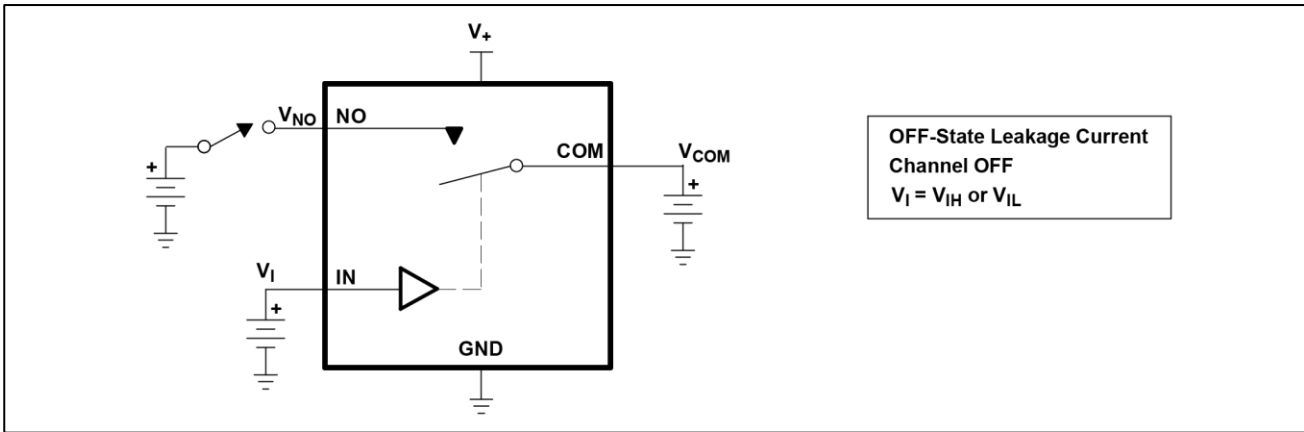


Figure 2.OFF-State Leakage Current ( $I_{COM(OFF)}$ ,  $I_{NO(OFF)}$ )

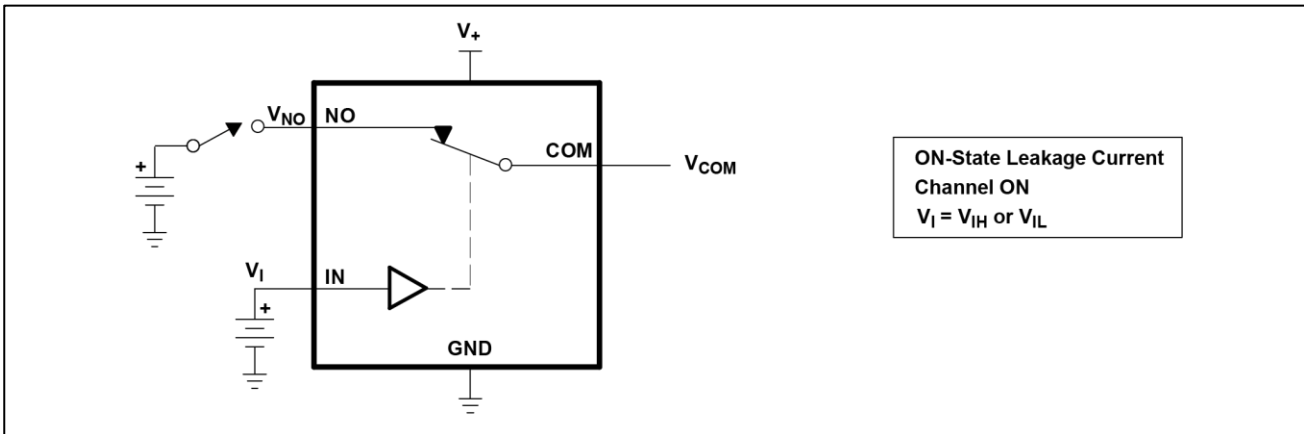


Figure 3.ON-State Leakage Current ( $I_{COM(ON)}$ ,  $I_{NO(ON)}$ )

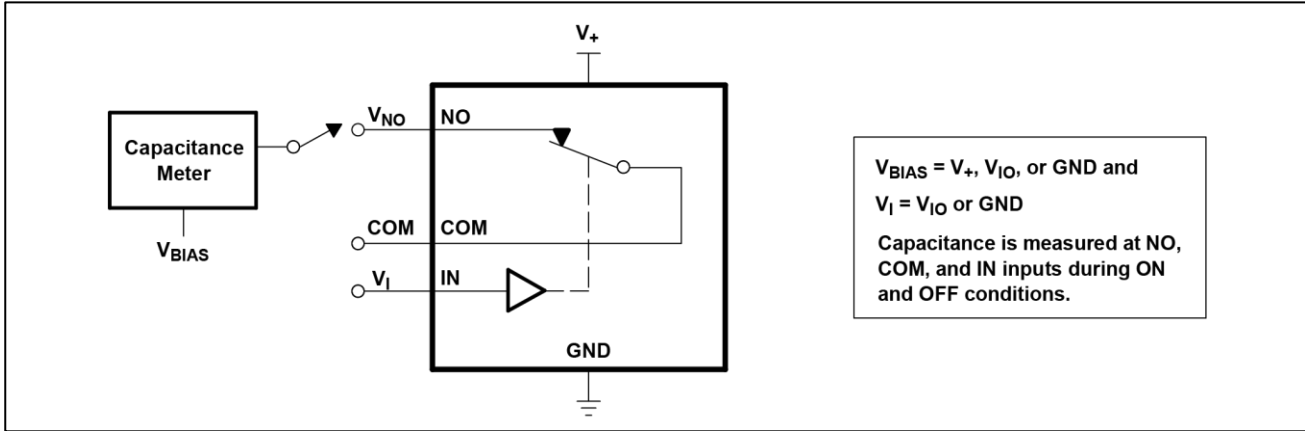


Figure 4. Capacitance ( $C_I$ ,  $C_{COM(OFF)}$ ,  $C_{COM(ON)}$ ,  $C_{NO(OFF)}$ ,  $C_{NO(ON)}$ )

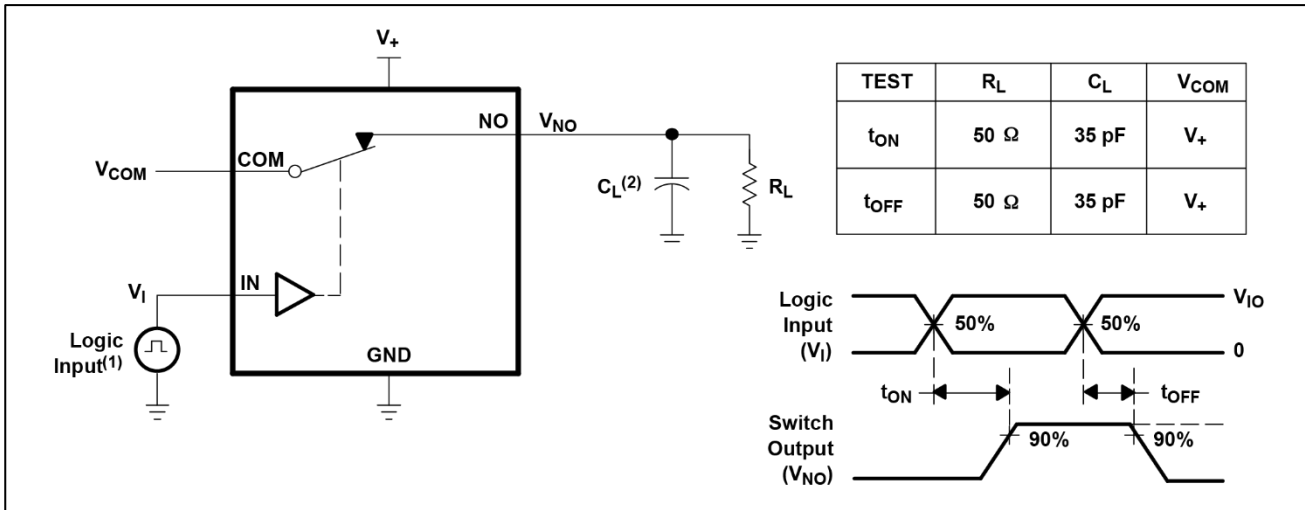


Figure 5. Turn-On ( $t_{ON}$ ) and Turn-Off Time ( $t_{OFF}$ )

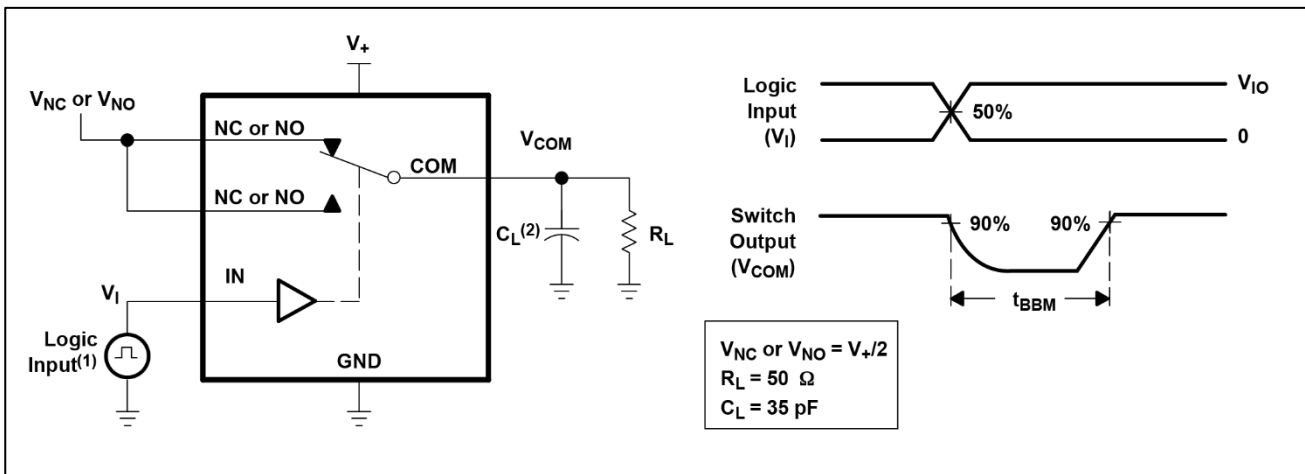


Figure 6. Break-Before-Make Time ( $t_{BBM}$ )

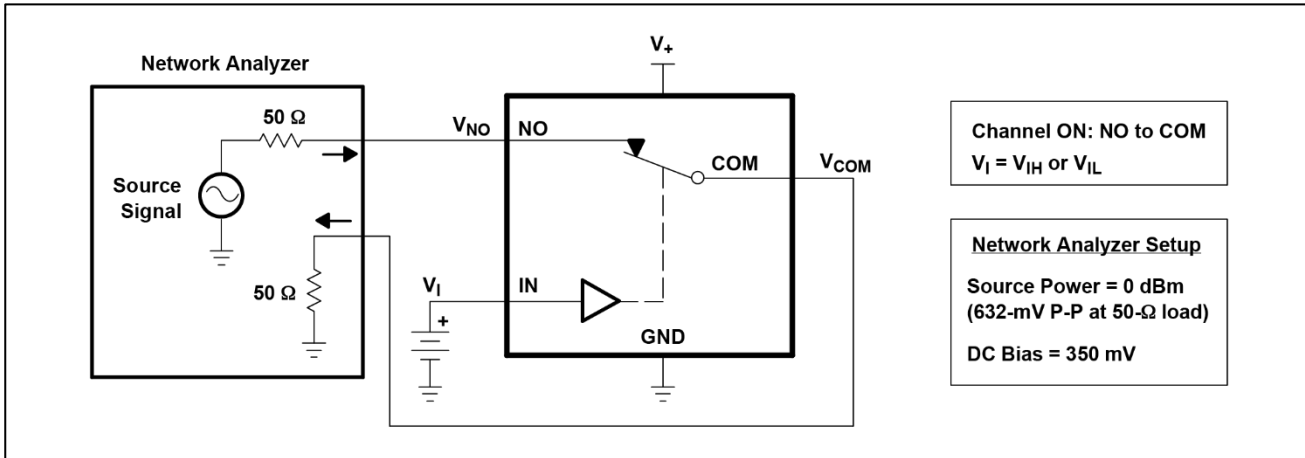


Figure 7. Bandwidth (BW)

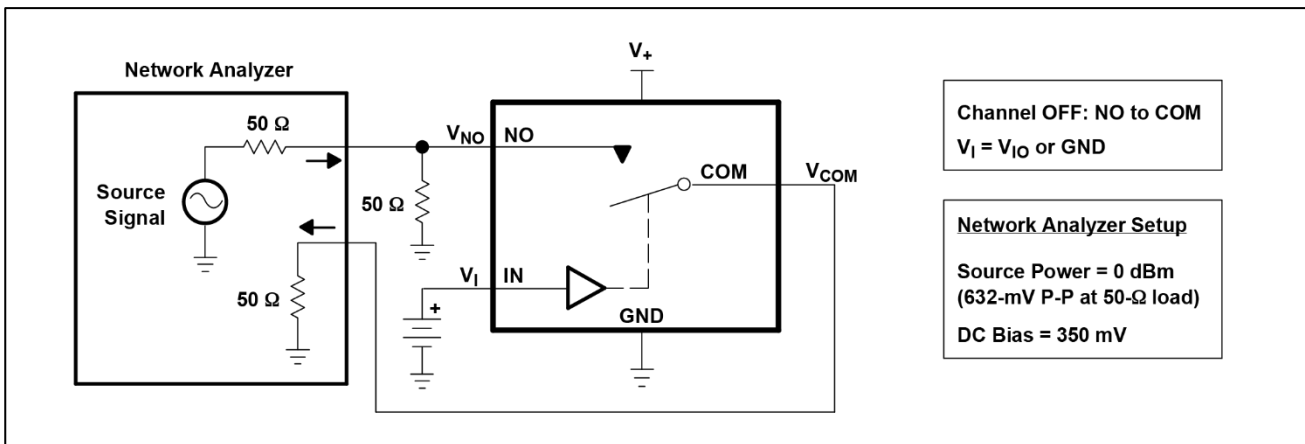


Figure 8. OFF Isolation ( $O_{iso}$ )

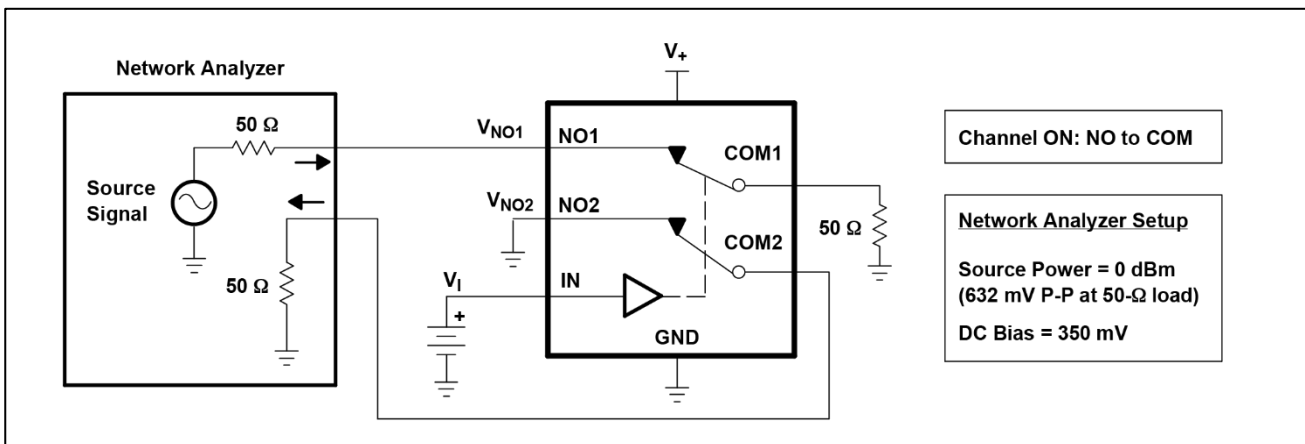


Figure 9. Crosstalk ( $X_{TALK}$ )

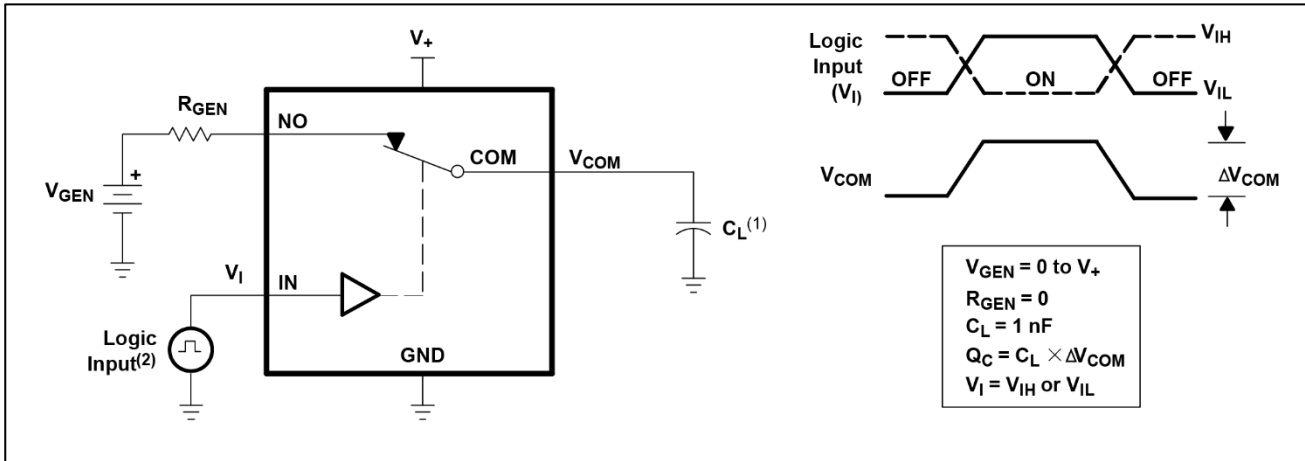


Figure 10. Charge Injection ( $Q_C$ )

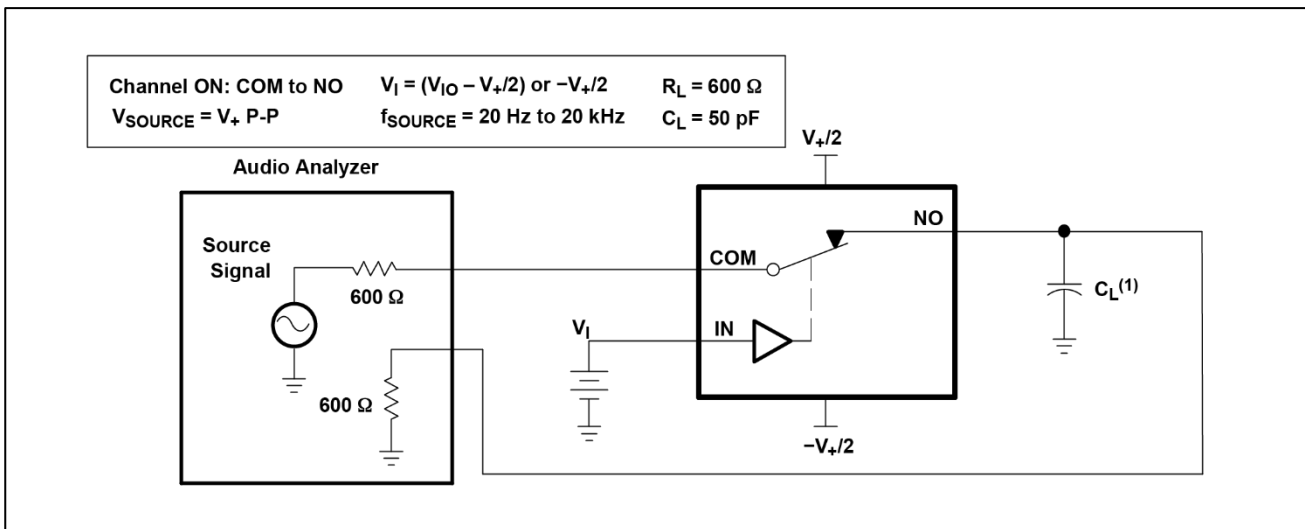


Figure11.Total Harmonic Distort

### TYPICAL APPLICATION

Analog signals that range over the entire supply voltage  $V_{CC}$  to GND can be passed with very little change in ON-state resistance. The switches are bidirectional, so the NO, NC, and COM pins can be used as either inputs or outputs. Pull the digitally controlled input select pin IN to  $V_{CC}$  or GND to avoid unwanted switch states that could result if the logic control pin is left floating.

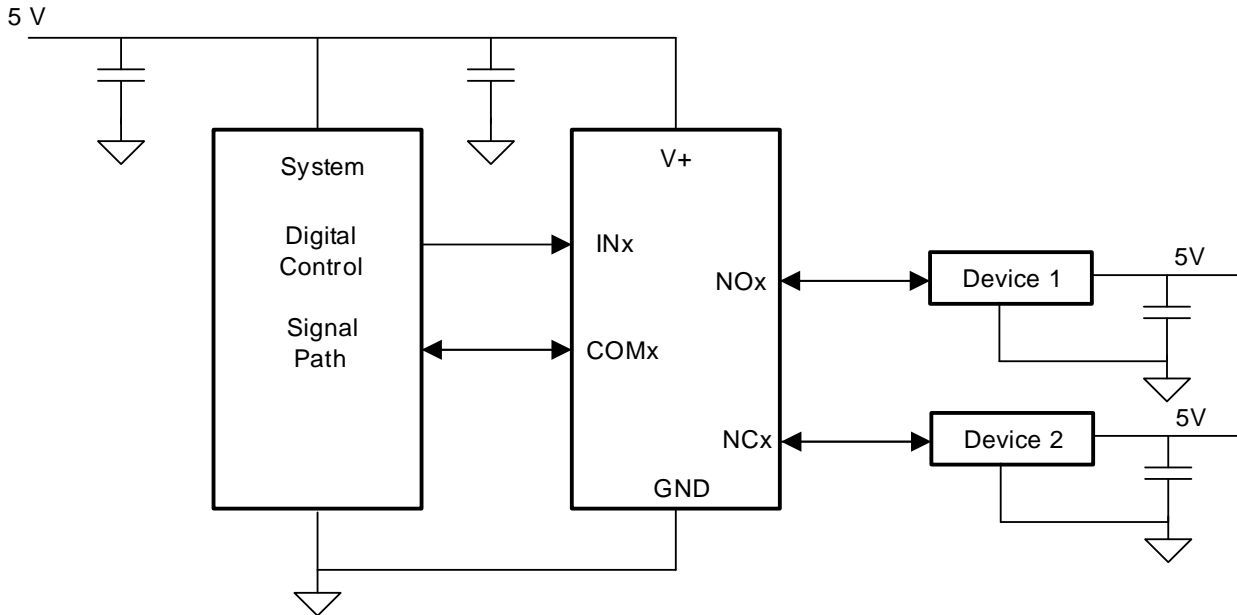
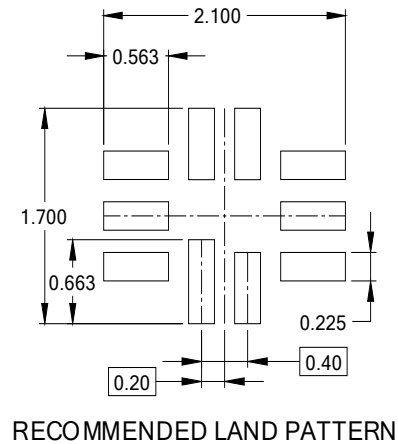
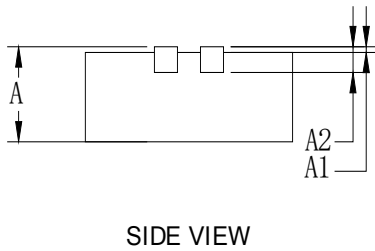
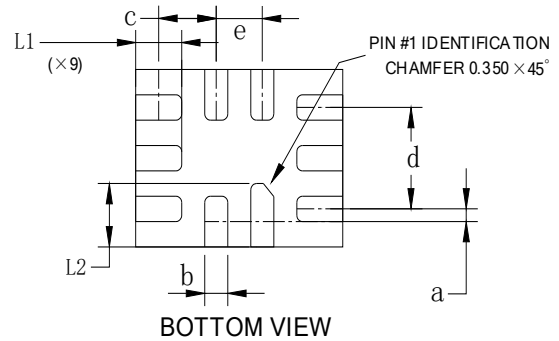
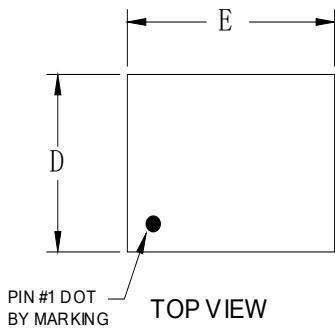


Figure 12. Typical Application Schematic

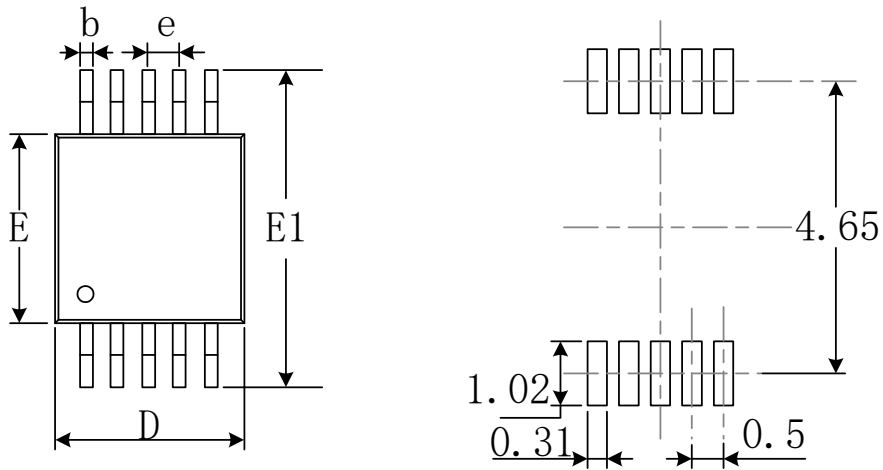
# PACKAGE OUTLINE DIMENSIONS

## QFN-1.4x1.8-10L

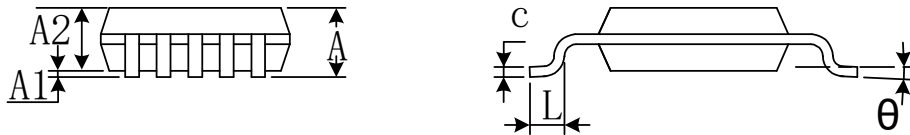


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
a	0.050	0.150	0.002	0.006
b	0.150	0.250	0.006	0.010
c	0.450	0.550	0.018	0.022
d	0.800 REF		0.031 REF	
D	1.350	1.450	0.053	0.057
E	1.750	1.850	0.069	0.073
e	0.400 TYP		0.016 TYP	
L1	0.350	0.450	0.014	0.018
L2	0.450	0.550	0.018	0.022

# MSOP-10



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°