
Small Plastic Package, Quad SPDT Analog Switch**Features**

- CMOS Technology for Bus and Analog Applications
- Low On-Resistance: 0.5Ω
- Wide V_{DD} Range: 1.8V to 4.2V
- Rail-to-Rail Signal Range
- High Off Isolation: $-83\text{dB @ }100\text{kHz}$
- Channel-to-Channel Crosstalk Rejection: $-97\text{dB @ }100\text{kHz}$
- Break-Before-Make Switching
- Extended Industrial Temperature Range: -40°C to 85°C
- ESD protection: 4kV(HBM)
- Packaging (Pb-free & Green): 16-contact TQFN (ZH16)

Ordering Information

Part Number	Package
PI3A412ZHE	Lead Free and Green TQFN-16 (ZH16)

Description

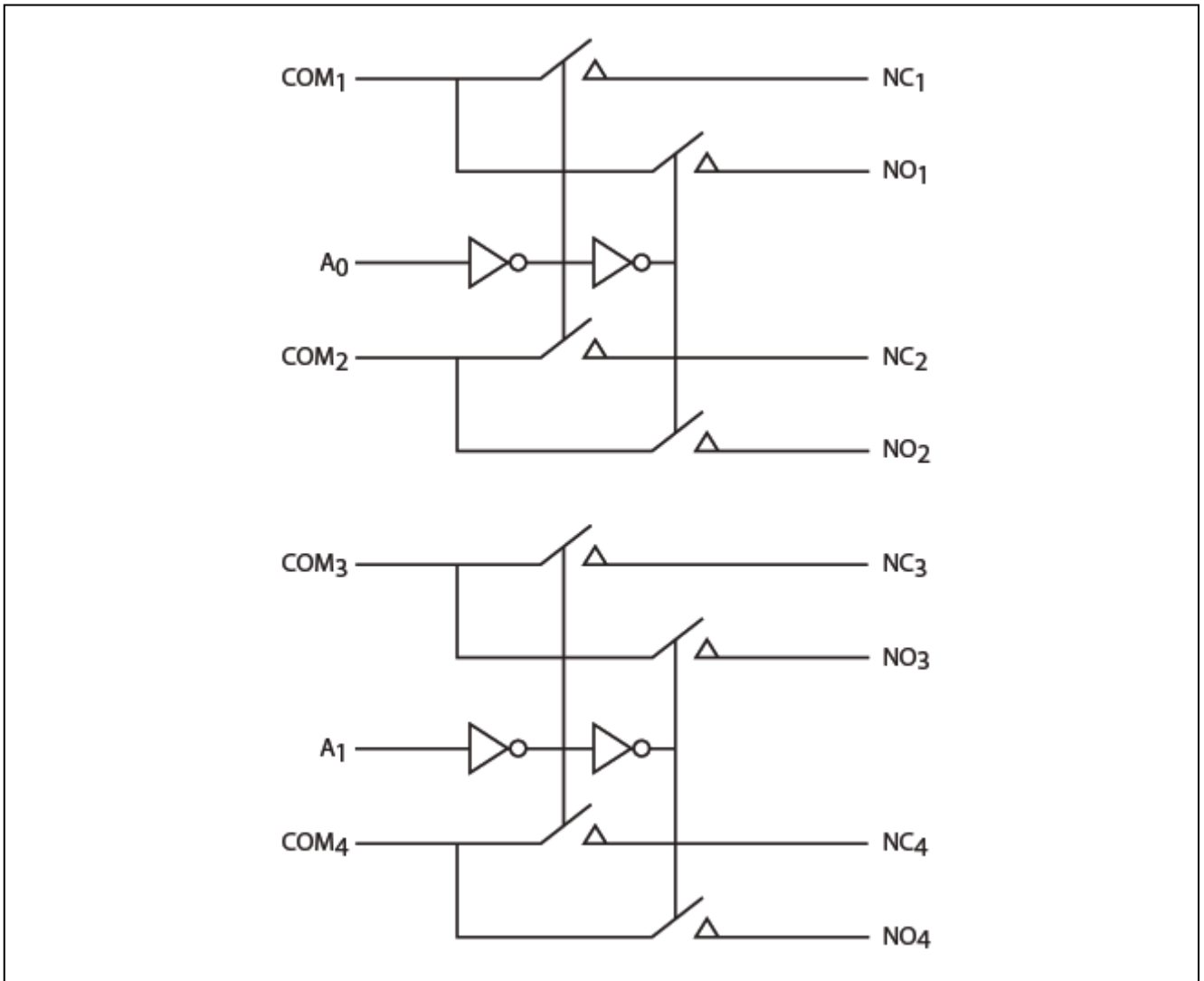
PI3A412 is a quad single-pole double throw (SPDT) CMOS switch. It can be used as an analog switch or as a low-delay bus switch. Specified over a wide operating power supply voltage, 1.8V to 4.2V, the PI3A412 has an On-Resistance of 0.5Ω at +4.2V.

Control inputs(Ax) are independent of supply voltage.

Application

- Cell Phones
- PDAs
- MP3 Players
- Portable Instrumentation
- Computer Peripherals
- Speaker Headset Switching
- Power Routing
- Relay Replacement
- Audio and Video Signal Routing
- PCMCIA Cards
- Modems

Functional Block Diagram

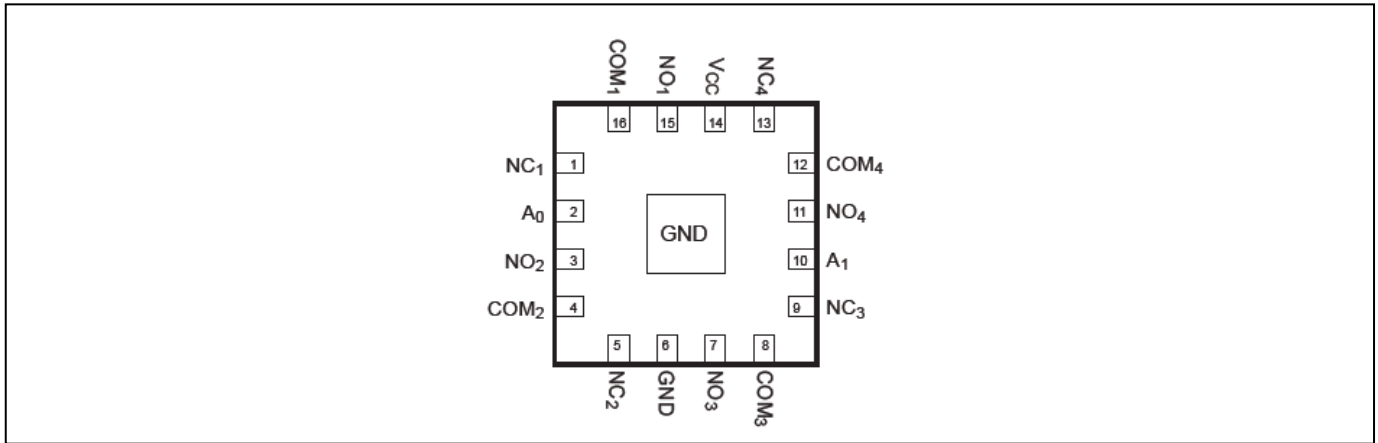


A0	Function	A1	Function
0	NCX Connected to COMX	0	NCY Connected to COMY
1	NOX Connected to COMX	1	NOY Connected to COMY

Notes:

1. X = 1 or 2
2. Y = 3 or 4

Pin Assignment



Pin Description

Pin no	Name	Description
1	NC1	Data Port (Normally connect)
2	A0	Logic Input Control
3	NO2	Data Port (Normally open)
4	COM1	Common Output / Data Port
5	NC2	Data Port (Normally connect)
6	GND	Ground
7	NO3	Data Port (Normally open)
8	COM3	Common Output / Data Port
9	NC3	Data Port (Normally connect)
10	A1	Logic Input Control
11	NO4	Data Port (Normally open)
12	COM4	Common Output / Data Port
13	NC4	Data Port (Normally connect)
14	V _{CC}	Positive Power Supply
15	NO1	Data Port (Normally open)
16	COM1	Common Output / Data Port

Logic Function Table

Logic Input (IN _x)	Function
0	NC _x Connected to COM _x
1	NO _x Connected to COM _x

Note: x = 1 or 2

Maximum Ratings

Storage Temperature.....	-65 to +150
Ambient Temperature with Power Applied.....	-40 to +85
Supply Voltage V_{DD}	-0.5V to +4.6V
Control Input Voltage V_{INx}	0V to +4.6V
DC Input Voltage V_{INPUT}	-0.5V to +4.6V
Continuous Current NO_NC_COM_.....	±400mA
Peak Current NO_NC_COM_ (pulsed at 1ms 10% duty cycle)	±500mA
ESD (HBM)	4kV

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

Control input must be held HIGH or LOW; it must not float.

Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Operating Voltage	-	1.8	-	4.2	V
V_{IN}	Control Input Voltage	-	0	-	V_{CC}	V
V_{INPUT}	Switch Input Voltage	-	-0.3	-	V_{CC}	V
T_A	Operating Temperature	-	-40	25	85	°C
t_r, t_f	Input Rise and Fall Time	-	0	-	10	ns/V

DC Electrical Characteristics

+3.0V Supply ($V_{DD} = 2.7V$ to $3.6V$, $V_{IH} = +1.6V$, $V_{IL} = +0.4V$, $T_A = -40^{\circ}C$ to $85^{\circ}C$, unless otherwise noted. Typical values are at $3.0V$ and $+25^{\circ}C$.)

Parameter	Symbol	Test Conditions	TEMP	Min.	Typ.	Max.	Units	
ANALOG SWITCH								
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}		$-40^{\circ}C$ to $85^{\circ}C$	0	-	V_{CC}	V	
On-Resistance	R_{ON}	$V_{CC} = 2.7V, I_{COM} = 100mA, V_{NO}$ or $V_{NC} = 1V, \text{Test Circuit 1}$	$+25^{\circ}C$	-	0.6	0.9	Ω	
			$-40^{\circ}C$ to $85^{\circ}C$	-	-	1		
On-Resistance Match Between Channels	ΔR_{ON}	$V_{CC} = 2.7V, I_{COM} = 100mA, V_{NO}$ or $V_{NC} = 1V, \text{Test Circuit 1}$	$+25^{\circ}C$	-	0.05	0.2	Ω	
			$-40^{\circ}C$ to $85^{\circ}C$	-	0.05	0.24		
On-Resistance Flatness	R_{ONF}	$V_{CC} = 2.7V, I_{COM} = 100mA, V_{NO}$ or $V_{NC} = 1V, 2.5V, \text{Test Circuit 1}$	$+25^{\circ}C$	-	0.05	0.15	Ω	
			$-40^{\circ}C$ to $85^{\circ}C$	-	0.1	0.2		
Source Off Leakage Current	$I_{OFF(NO)}$ or $I_{OFF(NC)}$	$V_{CC} = 3.6V, V_{NO}$ or $V_{NC} = 3.3V/0.3V, V_{COM} = 0.3V/3.3V$	$-40^{\circ}C$ to $85^{\circ}C$	-	-	1	μA	
Channel On Leakage Current	$I_{NC(ON)}, I_{NO(ON)}, I_{COM(ON)}$	$V_{CC} = 3.6V, V_{NO}$ or $V_{NC} = 3V/0.3V, V_{COM} = 3V/0.3V$, or floating	$-40^{\circ}C$ to $85^{\circ}C$	-	-	1		
DIGITAL INPUTS								
Input Logic High	V_{IH}		$-40^{\circ}C$ to $85^{\circ}C$	1.2	-	-	V	
Input Logic Low	V_{IL}		$-40^{\circ}C$ to $85^{\circ}C$	-	-	0.5		
IN Input Leakage Current	I_{IN}	$V_{CC} = 2.7V, V_{IN} = 0$ or $2.7V$	$-40^{\circ}C$ to $85^{\circ}C$	-	-	1	μA	
DYNAMIC CHARACTERISTICS								
Turn-On Time	t_{ON}	$V_{CC} = 3.3V, V_{NO}$ or $V_{NC} = 2.0V, R_L = 50\Omega, C_L = 35pF, \text{See Test Circuit Figure 2.}$	$+25^{\circ}C$	-	16	-	ns	
Turn-Off Time	t_{OFF}		$+25^{\circ}C$	-	60	-	ns	
Break-Before-Make Delay	t_D	$V_{IH} = 1.5V, V_{IL} = 0V, \text{See Test Circuit Figure 3.}$	$+25^{\circ}C$	-	10	-	ns	
NC-NO and COM-NC/NO Off-Isolation	O_{ISO}	$V_{BIAS} = 1.5V, V_{IN} = 0dBm, V_{IH} = 1.5V, V_{IL} = 0V. \text{See Test Circuit Figure 4 \& Figure 5}$	100kHz	$+25^{\circ}C$	-	-81	-	dB
			1MHz	$+25^{\circ}C$	-	-61	-	
			10MHz	$+25^{\circ}C$	-	-39	-	
Channel-to-Channel Crosstalk	X_{TALK}	$V_{BIAS} = 1.5V, V_{IN} = 0dBm, V_{IH} = 1.5V, V_{IL} = 0V \text{See Test Circuit Figure 6.}$	100kHz	$+25^{\circ}C$	-	-97	-	dB
			1MHz	$+25^{\circ}C$	-	-98	-	
			10MHz	$+25^{\circ}C$	-	-77	-	
3dB Bandwidth	f_{3dB}	$V_{BIAS} = 1.5V, V_{IN} = 0dBm, V_{IH} = 1.5V, V_{IL} = 0V. \text{See Test Circuit Figure 7.}$	$+25^{\circ}C$	-	79	-	MHz	
Charge Injection Select Input to Common I/O	Q	$V_{IN} = GND, R_S = 0, C_L = 1nF, V_{IH} = 1.5V, V_{IL} = 0V \text{See Test Circuit Figure 8.}$	$+25^{\circ}C$	-	35	-	pC	
Off Capacitance	$C_{NC(OFF)}$	$f = 1MHz, \text{See Test Circuit Figure 9}$	$+25^{\circ}C$	-	20	-	pF	
Off capacitance	$C_{NO(OFF)}$			-	20	-		
On Capacitance	C_{ON}			$f = 1MHz, \text{See Test Circuit Figure 10}$	$+25^{\circ}C$	-		55

+4.2V Supply ($V_{DD} = 4.2V$, $T_A = -40^\circ C$ to $85^\circ C$, unless otherwise noted. Typical values are at 4.2V and $+25^\circ C$.)

Parameter	Symbol	Test Conditions	TEMP	Min.	Typ.	Max.	Units	
Analog Switch								
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}		$-40^\circ C$ to $85^\circ C$	0	-	V_{CC}	V	
On-Resistance	R_{ON}	$V_{CC} = 4.2V, I_{COM} = 100mA, V_{NO}$ or $V_{NC} = 1V, \text{Test Circuit 1}$	$+25^\circ C$	-	0.5	0.75	Ω	
			$-40^\circ C$ to $85^\circ C$	-	-	0.85		
On-Resistance Match Between Channels	ΔR_{ON}	$V_{CC} = 4.2V, I_{COM} = 100mA, V_{NO}$ or $V_{NC} = 1V, \text{Test Circuit 1}$	$+25^\circ C$	-	0.05	0.15	Ω	
			$-40^\circ C$ to $85^\circ C$	-	0.1	0.2		
On-Resistance Flatness	R_{ONF}	$V_{CC} = 4.2V, I_{COM} = 100mA, V_{NO}$ or $V_{NC} = 1V, 2.5V, \text{Test Circuit 1}$	$+25^\circ C$	-	0.1	0.22	Ω	
			$-40^\circ C$ to $85^\circ C$	-	-	0.26		
Source Off Leakage Current	$I_{OFF(NO)}$ or $I_{OFF(NC)}$	$V_{CC} = 4.2V, V_{NO}$ or $V_{NC} = 3.3V/0.3V, V_{COM} = 0.3V/3V$	$-40^\circ C$ to $85^\circ C$	-	-	1	μA	
Channel On Leakage Current	$I_{NC(ON)}, I_{NO(ON)}, I_{COM(ON)}$	$V_{CC} = 4.2V, V_{NO}$ or $V_{NC} = 3V/0.3V, V_{COM} = 3V/0.3V, \text{or floating}$	$-40^\circ C$ to $85^\circ C$	-	-	1		
DIGITAL INPUTS								
Input Logic High	V_{IH}	-	$-40^\circ C$ to $85^\circ C$	1.2	-	-	V	
Input Logic Low	V_{IL}	-	$-40^\circ C$ to $85^\circ C$	-	-	0.5		
IN Input Leakage Current	I_{IN}	$V_{CC} = 4.2V, V_{IN} = 0$ or $4.2V$	$-40^\circ C$ to $85^\circ C$	-	-	1	μA	
DYNAMIC CHARACTERISTICS								
Turn-On Time	t_{ON}	$V_{IH} = 4.2V, V_{IL} = 2.0V, R_L = 50\Omega, C_L = 35pF, \text{See Test Circuit Figure 2.}$	$+25^\circ C$	-	13	-	ns	
Turn-Off Time	t_{OFF}		$+25^\circ C$	-	38	-	ns	
Break-Before-Make Delay	t_D	V_{NO} or $V_{NC} = 1.5V, R_L = 50\Omega, C_L = 35pF, \text{See Test Circuit Figure 3.}$	$+25^\circ C$	-	8	-	ns	
NC-NO and COM-NC/NO Off-Isolation	O_{ISO}	Signal = 0dBm, V_{NO} or V_{NC} centered between V_{CC} and GND, $R_L = 50\Omega, \text{See Test Circuit Figure 4 \& Figure 5.}$	100kHz	$+25^\circ C$	-	-83	-	dB
			1MHz	$+25^\circ C$	-	-61	-	
			10MHz	$+25^\circ C$	-	-40	-	
Channel-to-channel Crosstalk	X_{TALK}	$V_{BIAS} = 2.1V, V_{IN} = 0dBm, V_{IH} = 3V, V_{IL} = 0V, \text{See Test Circuit Figure 6.}$	100kHz	$+25^\circ C$	-	-97	-	dB
			1MHz	$+25^\circ C$	-	-97	-	
			10MHz	$+25^\circ C$	-	-77	-	
3dB Bandwidth	f_{3dB}	$V_{BIAS} = 2.1V, V_{IN} = 0dBm, V_{IH} = 3V, V_{IL} = 0V. \text{See Test Circuit Figure 7.}$	$+25^\circ C$	-	78	-	MHz	
Charge Injection Select Input to Common I/O	Q	$V_{IN} = GND, R_S = 0, C_L = 1nF, \text{See Test Circuit Figure 8.}$	$+25^\circ C$	-	50	-	pC	
Off Capacitance	$C_{NC(OFF)}$	$f = 1MHz, \text{See Test Circuit Figure 9}$	$+25^\circ C$	-	20	-	pF	
Off capacitance	$C_{NO(OFF)}$			-	20	-		
On Capacitance	C_{ON}			$f = 1MHz, \text{See Test Circuit Figure 10}$	$+25^\circ C$	-		55
POWER REQUIREMENTS								
Power Supply Range	V_{CC}	-	$-40^\circ C$ to $85^\circ C$	1.8	-	4.2	V	
Power Supply Current	I_{CC}	$V_{CC} = 4.2V, V_{IN} = 0V$ or V_{CC}	$-40^\circ C$ to $85^\circ C$	-	-	1	μA	

Test Circuits and Timing Diagrams

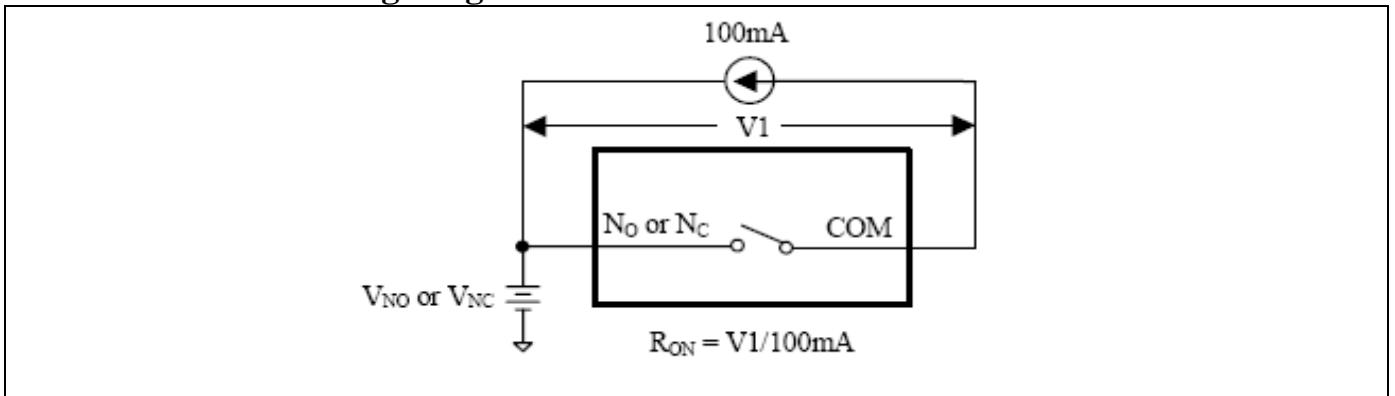


Figure 1. On Resistance

Notes:

1. Unused input (NC or NO) must be grounded.

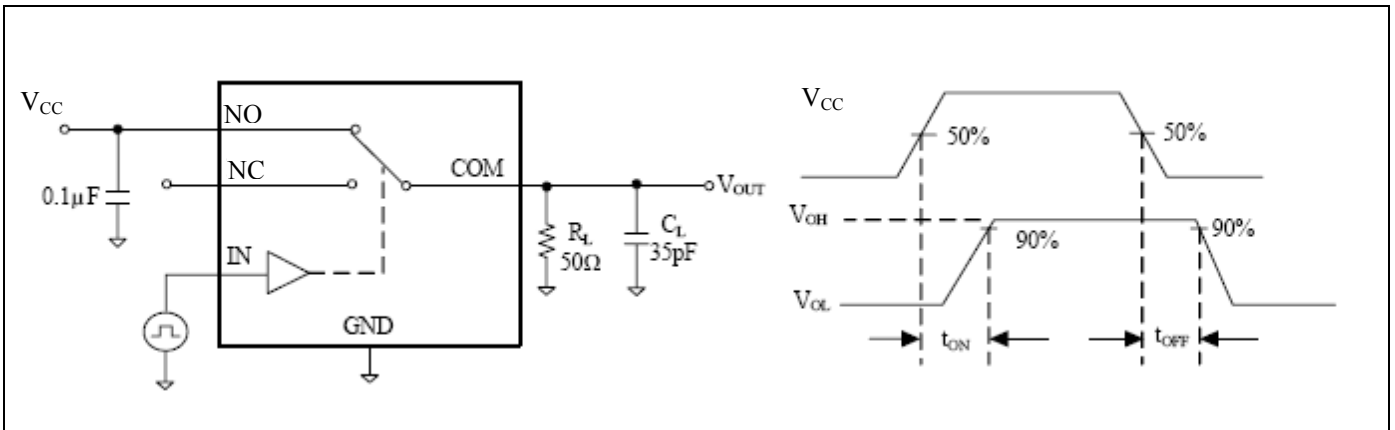


Figure 2. Switching Times

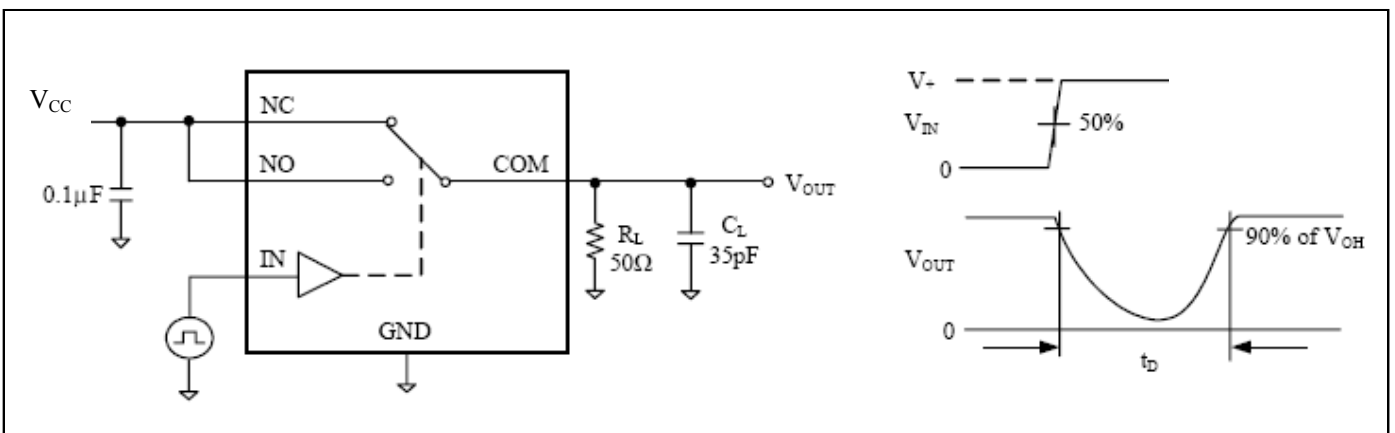


Figure 3. Break Before Make Interval Timing

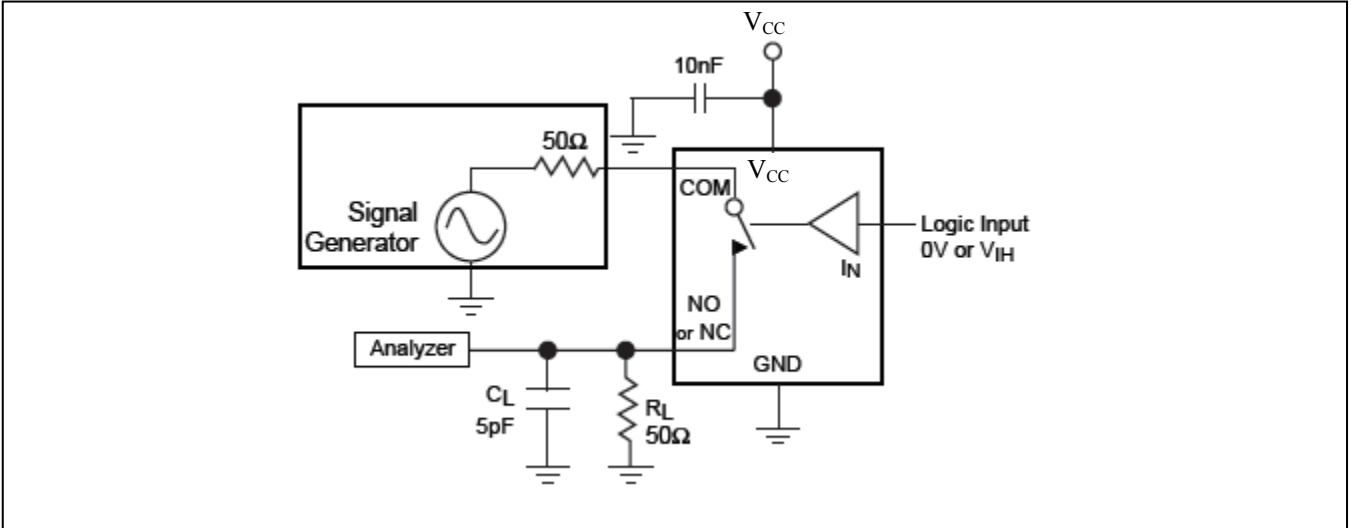


Figure 4. COM-NC/NO Isolation

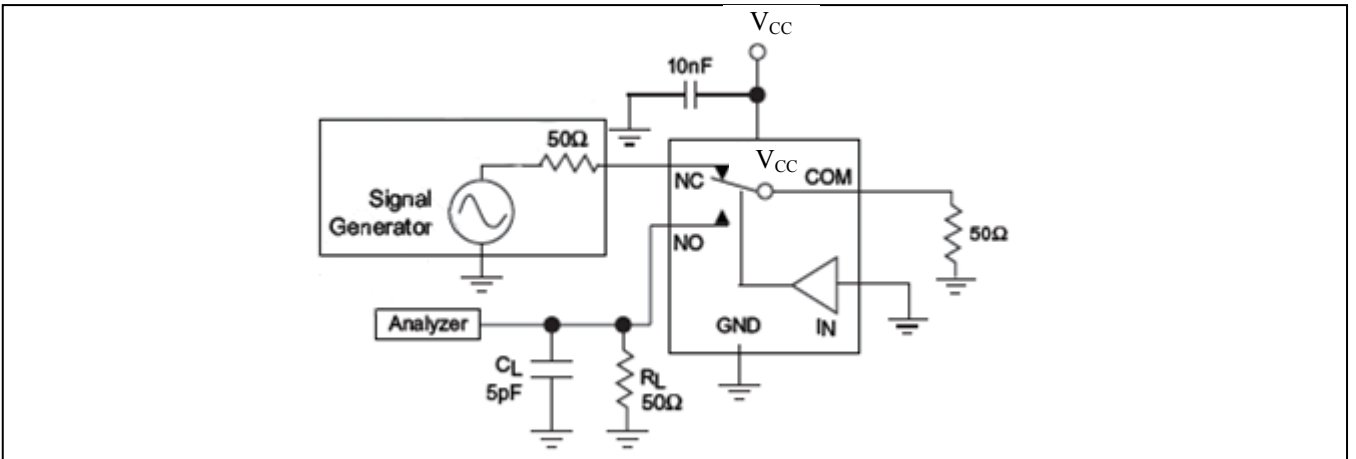


Figure 5. NC-NO Isolation

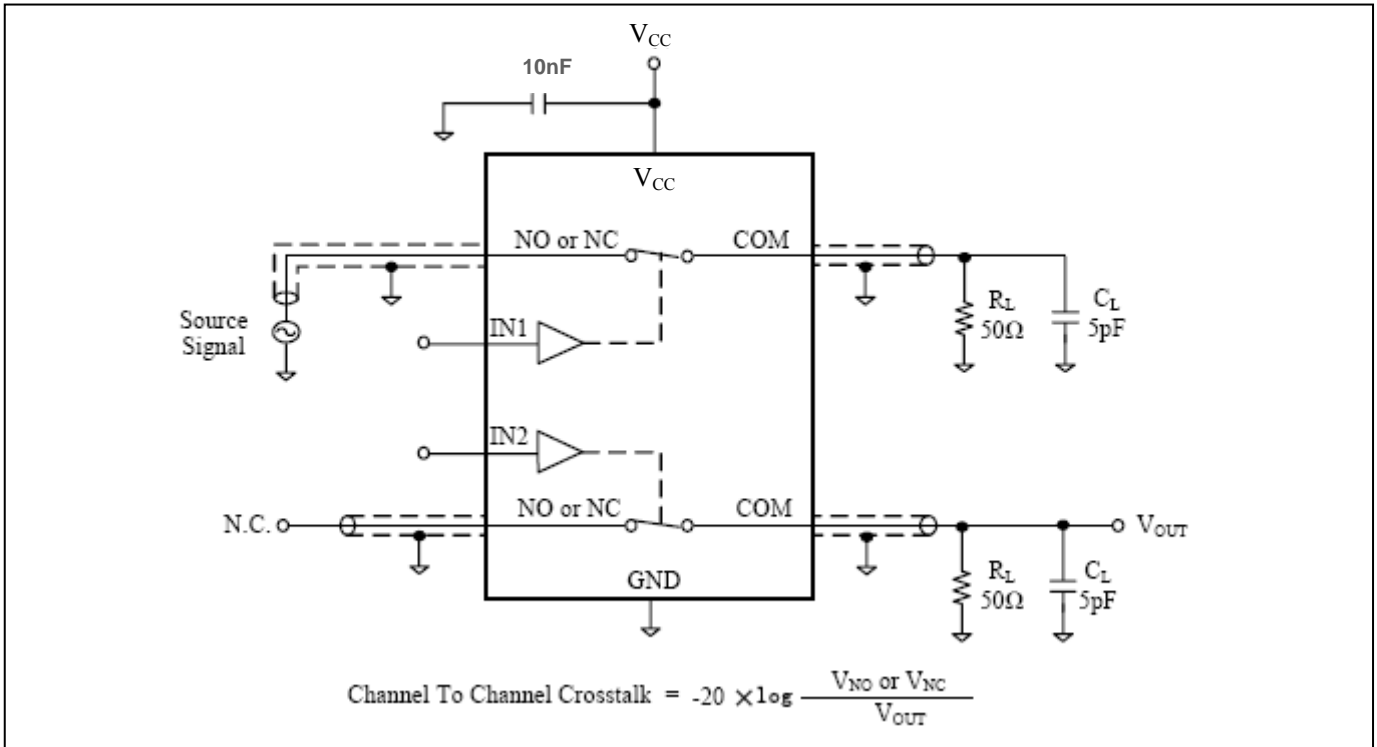


Figure 6. Channel-to-Channel Crosstalk

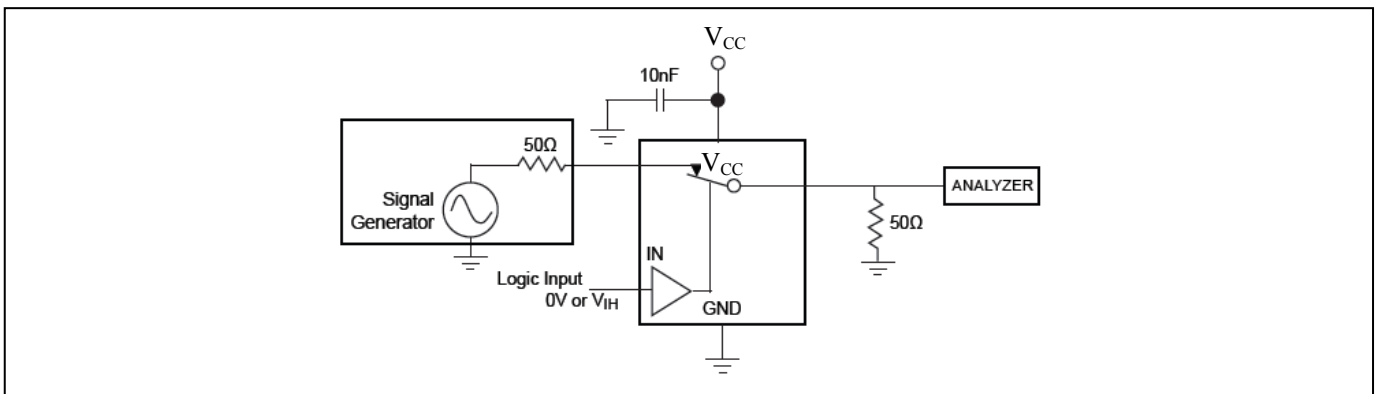


Figure 7. Bandwidth

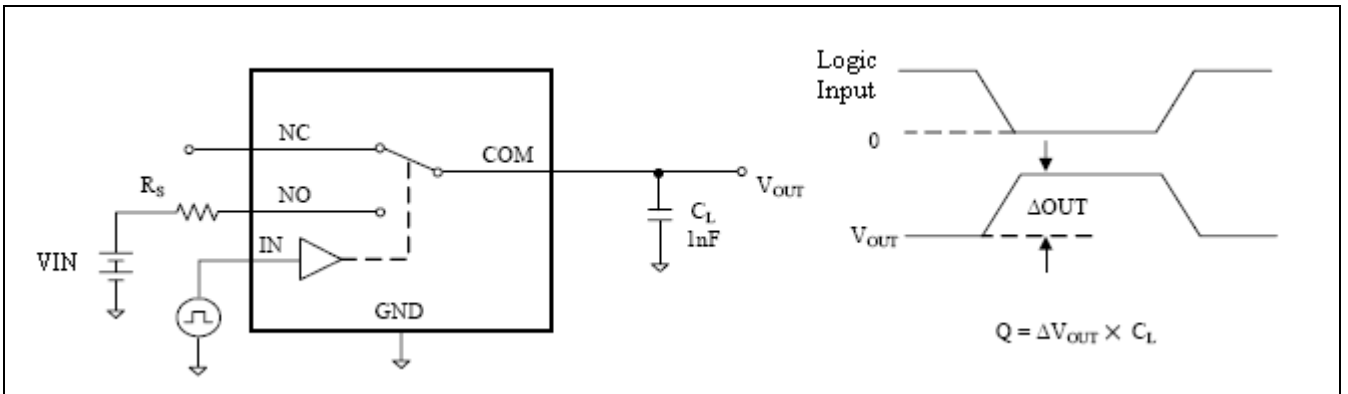


Figure 8. Charge Injection

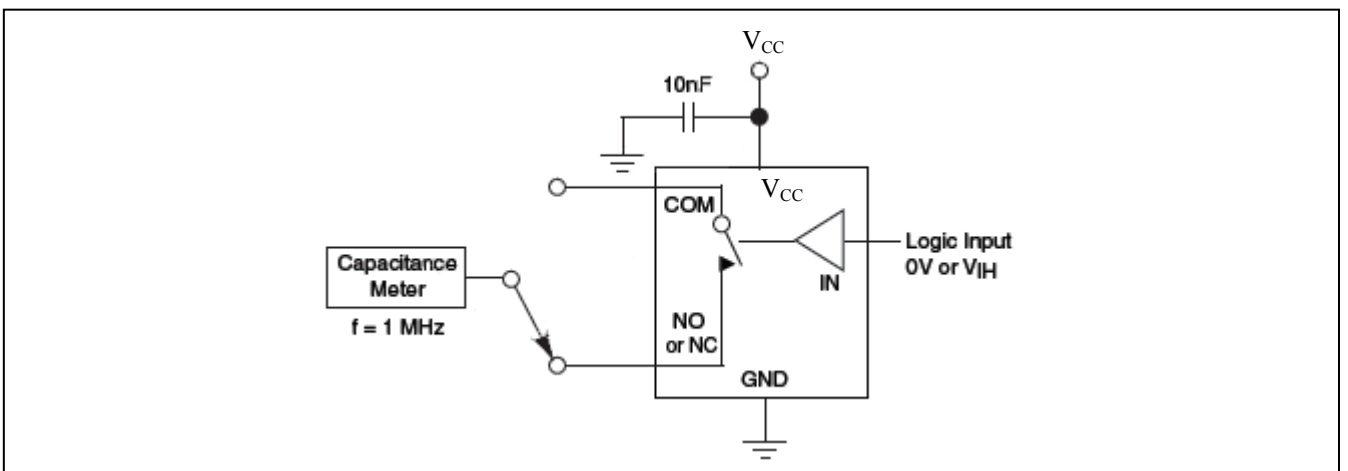


Figure 9. Channel Off Capacitance

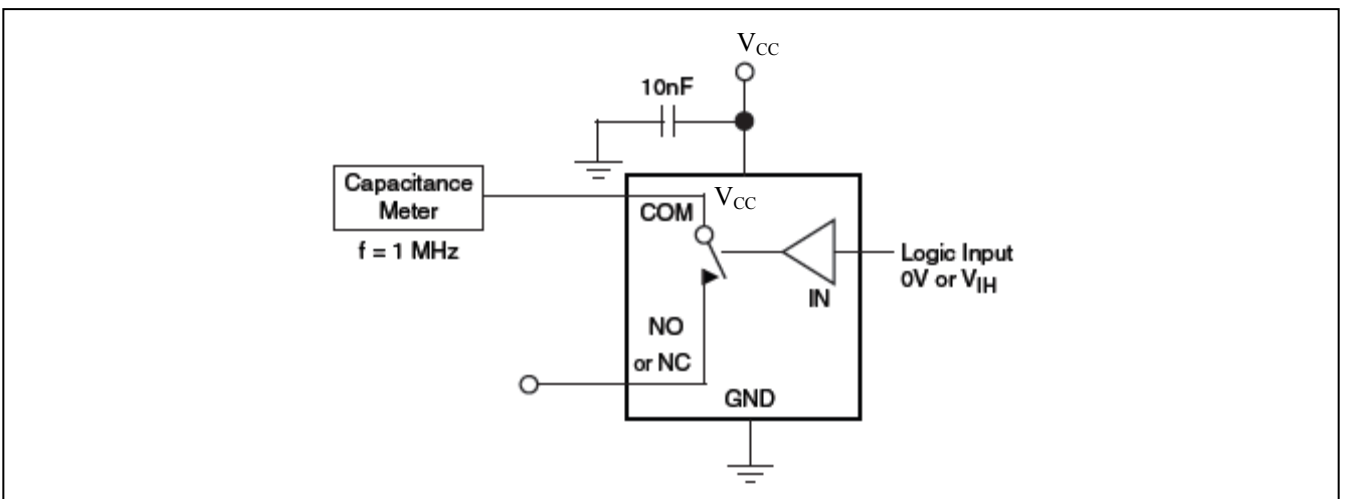
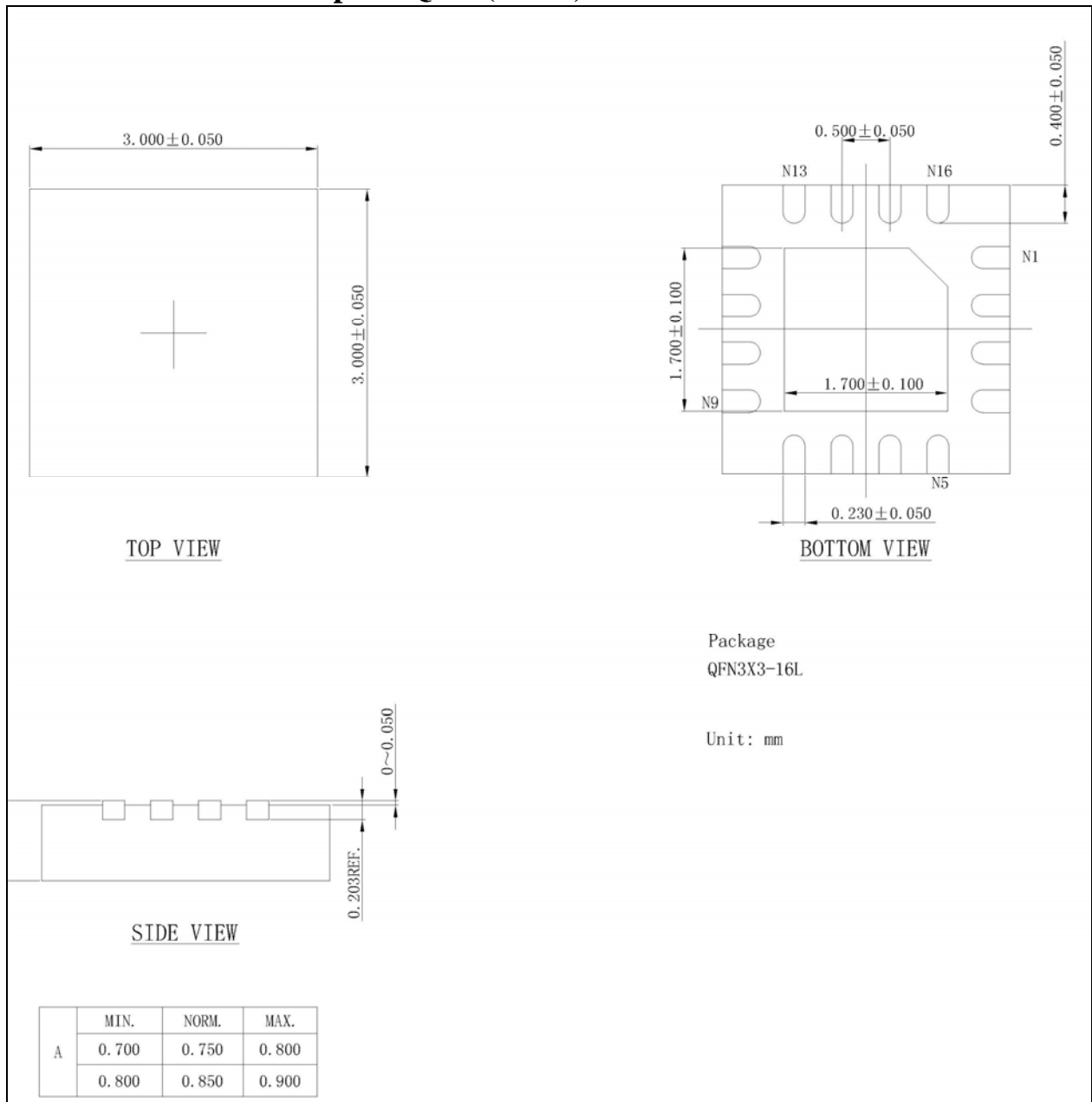


Figure 10. Channel On Capacitance

Mechanical Information 16-pin TQFN (ZH16)



Notes

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