

Low Voltage, Low On-Resistance, Dual DPDT/Quad SPDT Analog Switch

DESCRIPTION

The DG2788, DG2789 are monolithic CMOS analog switching products designed for high performance switching of analog signals. Combining low power, high speed, low on-resistance and small physical size, the DG2788, DG2789 are ideal for portable and battery powered applications requiring high performance and efficient use of board space. The DG2788, DG2789 are built on Vishay Siliconix's low voltage process. An epitaxial layer prevents latchup. Break-before-make is guaranteed.

The switch conducts equally well in both directions when on, and blocks up to the power supply level when off. The DG2788 is configured as a dual Double Pole Double Throw switches while the DG2789 is configured as a Quad Single Pole Double Throw. The DG2789 has one control pin for all four SPDT switches and also has an enable pin that can turn all switches off.

The DG2788 and DG2789 comes in a small miniQFN-16 lead package (2.6 x 1.8 x 0.75 mm).

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations and is 100 % RoHS compliant.

FEATURES

- Low voltage operation (1.65 V to 4.3 V)
- Low on-resistance - R_{ON} : 0.4 Ω typ. at 2.7 V
- Fast switching: t_{ON} = 47 ns
 t_{OFF} = 15 ns
- miniQFN-16 package
- Latch-up current > 300 mA (JESD78)


RoHS
COMPLIANT

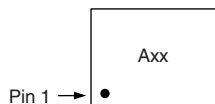
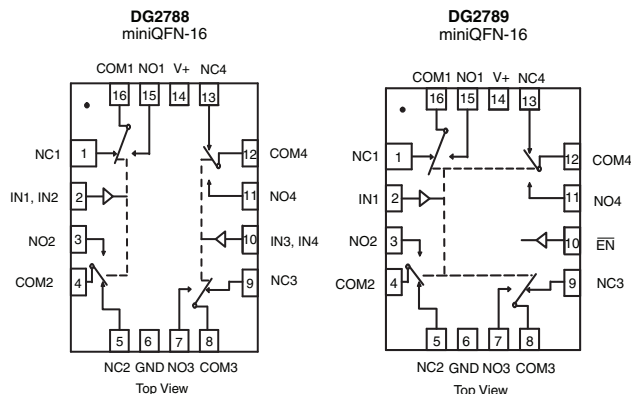
BENEFITS

- Reduced power consumption
- High accuracy
- Reduce board space
- TTL/1.8 V logic compatible
- High bandwidth

APPLICATIONS

- Cellular phones
- Speaker headset switching
- Audio and video signal routing
- PCMCIA cards
- Battery operated systems

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: Axx for DG2788
Bxx for DG2789
xx = Date/Lot Traceability Code
Note: Pin 1 has long lead

TRUTH TABLE (DG2788)

Logic	NC1, 2, 3 and 4	NO1, 2, 3 and 4
0	ON	OFF
1	OFF	ON

TRUTH TABLE (DG2789)

EN Logic	IN Logic	NC1, 2, 3 and 4	NO1, 2, 3 and 4
0	0	ON	OFF
0	1	OFF	ON
1	x	OFF	OFF

ORDERING INFORMATION

Temp. Range	Package	Part Number
- 40 °C to 85 °C	miniQFN-16	DG2788DN-T1-E4 DG2789DN-T1-E4

ABSOLUTE MAXIMUM RATINGS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)				
Parameter		Symbol	Limit	Unit
Reference to GND	V+		- 0.3 to 5.0	V
	IN, COM, NC, NO ^a		- 0.3 to (V+ + 0.3)	
Current (Any terminal except NO, NC or COM)			30	mA
Continuous Current (NO, NC, or COM)			± 300	
Peak Current (Pulsed at 1 ms, 10 % duty cycle)			± 500	
Storage Temperature (D Suffix)			- 65 to 150	$^\circ\text{C}$
Package Solder Reflow Conditions ^d	miniQFN-16		250	
Power Dissipation (Packages) ^b	miniQFN-16 ^c		525	mW

Notes:

- a. Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- b. All leads welded or soldered to PC board.
- c. Derate 6.6 mW/ $^\circ\text{C}$ above 70 $^\circ\text{C}$
- d. Manual soldering with iron is not recommended for leadless components. The miniQFN-16 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper lip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.



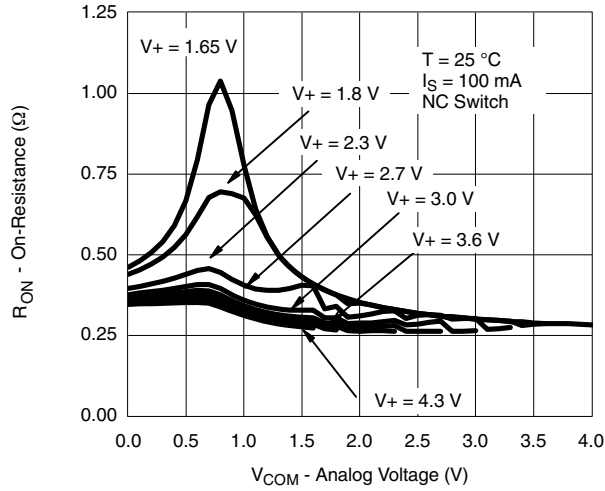
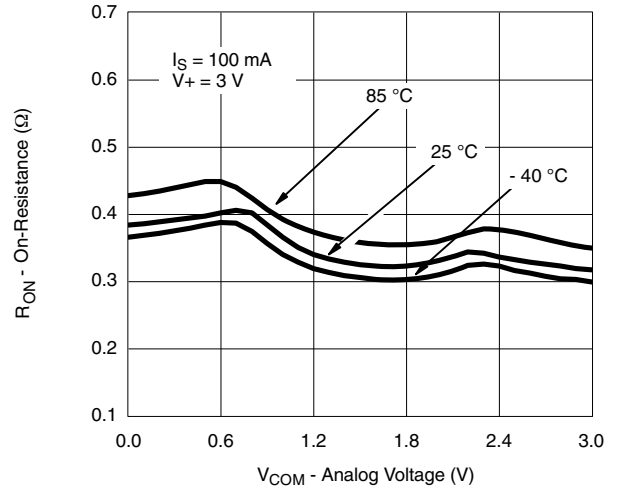
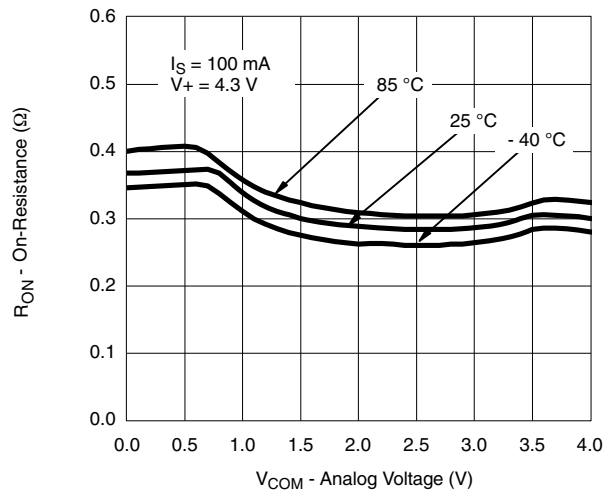
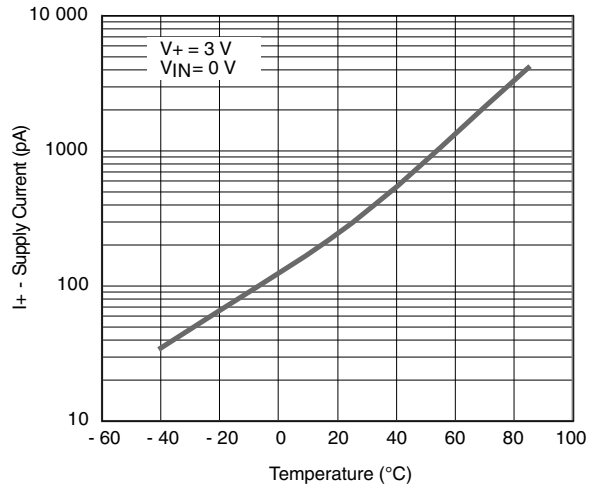
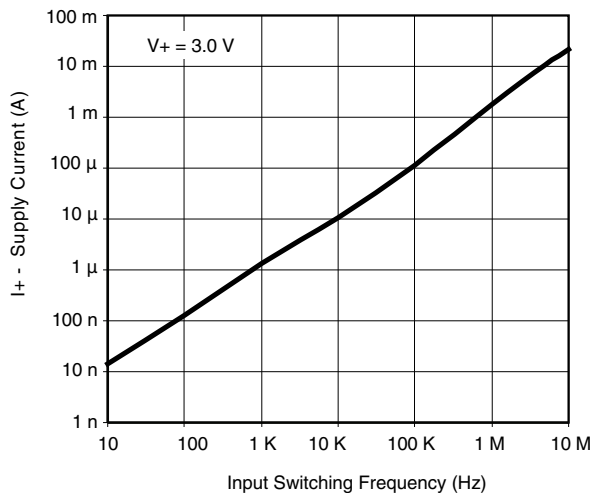
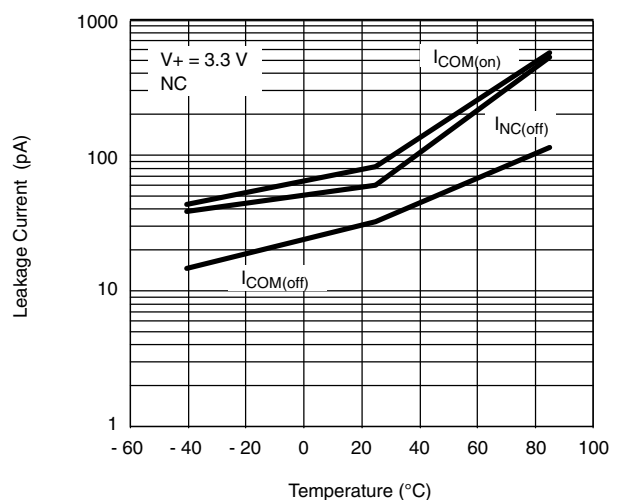
SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, VIN = 0.5 or 1.4 V ^e	Temp. ^a	Limits - 40 °C to 85 °C			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} , V _{COM}		Full	0		V+	V
On-Resistance	R _{ON}	V+ = 2.7 V, V _{COM} = 0.5 V, I _{NO} , I _{NC} = 100 mA	Room		0.4	0.5	Ω
		V+ = 2.7 V, V _{COM} = 1.5 V, I _{NO} , I _{NC} = 100 mA			0.33		
			Full			0.56	
R _{ON} Flatness ^d	R _{ON} Flatness	V+ = 2.7 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 100 mA	Room		0.1	0.15	Ω
R _{ON} Match ^d	ΔR _{ON}		Room		0.05		
Switch Off Leakage Current	I _{NO(off)} , I _{NC(off)}	V+ = 3.3 V, V _{NO} , V _{NC} = 0.3 V/3.0 V, V _{COM} = 3.0 V/0.3 V	Room	- 1		1	nA
	I _{COM(off)}		Full	- 10		10	
			Room	- 1		1	
Channel-On Leakage Current	I _{COM(on)}	V+ = 3.3 V, V _{NO} , V _{NC} = V _{COM} = 0.3 V/3.0 V	Room	- 1		1	nA
			Full	- 10		10	
Digital Control							
Input High Voltage	V _{INH}		Full	1.4			V
Input Low Voltage	V _{INL}		Full			0.5	
Input Capacitance	C _{in}		Full		6		pF
Input Current	I _{INL} or I _{INH}	V _{IN} = 0 or V+	Full	- 1		1	μA
Dynamic Characteristics							
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = 1.5 V, R _L = 50 Ω, C _L = 35 pF	Room		47	72	ns
Turn-Off Time	t _{OFF}		Full		15	43	
			Full			45	
Break-Before-Make Time	t _d		Full	1			
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room		87		pC
Off-Isolation ^d	OIRR	R _L = 50 Ω, C _L = 5 pF, f = 100 kHz	Room		- 69		dB
		R _L = 50 Ω, C _L = 5 pF, f = 1 MHz			- 49		
Crosstalk ^{d, f}	X _{TALK}	R _L = 50 Ω, C _L = 5 pF, f = 100 kHz			- 106		
		R _L = 50 Ω, C _L = 5 pF, f = 1 MHz			- 96		
N _O , N _C Off Capacitance ^d	C _{NO(off)}	f = 1 MHz	Room		81		pF
	C _{NC(off)}		Room		81		
Channel-On Capacitance ^d	C _{NO(on)}		Room		186		
	C _{NC(on)}		Room		186		
Power Supply							
Power Supply Range	V+			2.7		3.3	V
Power Supply Current	I+	V _{IN} = 0 or V+	Full			1.0	μA

SPECIFICATIONS (V+ = 4.3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 4.3 V, V _{IN} = 0.5 or 1.6 V ^e	Temp. ^a	Limits - 40 °C to 85 °C			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Analog Switch							
Analog Signal Range ^d	V _{NO} , V _{NC} , V _{COM}		Full	0		V+	V
On-Resistance	R _{ON}	V+ = 4.3 V, V _{COM} = 0.9 V, I _{NO} , I _{NC} = 100 mA	Room		0.32	0.45	Ω
		V+ = 4.3 V, V _{COM} = 2.5 V, I _{NO} , I _{NC} = 100 mA	Room		0.27		
			Full			0.5	
R _{ON} Flatness ^d	R _{ON} Flatness	V+ = 4.3 V, V _{COM} = 0 to V+, I _{NO} , I _{NC} = 100 mA	Room		0.1	0.15	Ω
R _{ON} Match ^d	ΔR _{ON}		Room		0.03		
Switch Off Leakage Current ^d	I _{NO(off)} , I _{NC(off)}	V+ = 4.3 V, V _{NO} , V _{NC} = 0.3 V/4.0 V, V _{COM} = 4.0 V/0.3 V	Room	-10		10	nA
	I _{COM(off)}		Full	- 100		100	
Channel-On Leakage Current ^d		I _{COM(on)}	Room	- 10		10	
	Full		- 100		100		
Digital Control							
Input High Voltage	V _{INH}		Full	1.6			V
Input Low Voltage	V _{INL}		Full			0.5	
Input Capacitance	C _{in}		Full		6		pF
Input Current	I _{INL} or I _{INH}	V _{IN} = 0 or V+	Full	- 1		1	μA
Dynamic Characteristics							
Charge Injection ^d	Q _{INJ}	C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω	Room		105		pC
N _O , N _C Off Capacitance ^d	C _{NO(off)}	f = 1 MHz	Room		79		pF
	C _{NC(off)}		Room		79		
Channel-On Capacitance ^d	C _{NO(on)}		Room		183		
	C _{NC(on)}		Room		183		
Power Supply							
Power Supply Range	V+					4.3	V
Power Supply Current	I+	V _{IN} = 0 or V+	Full			1.0	μA

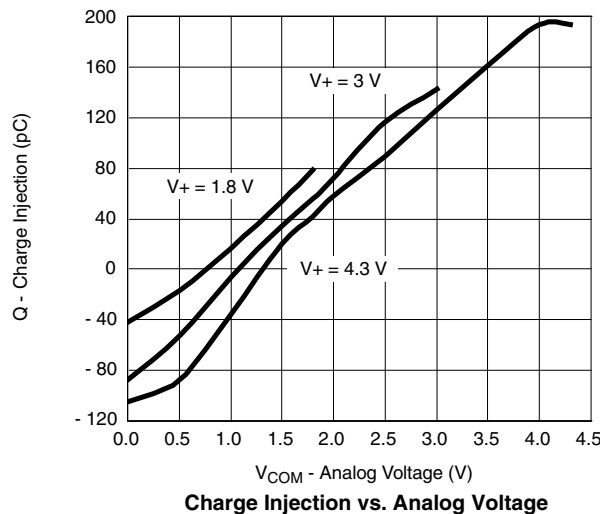
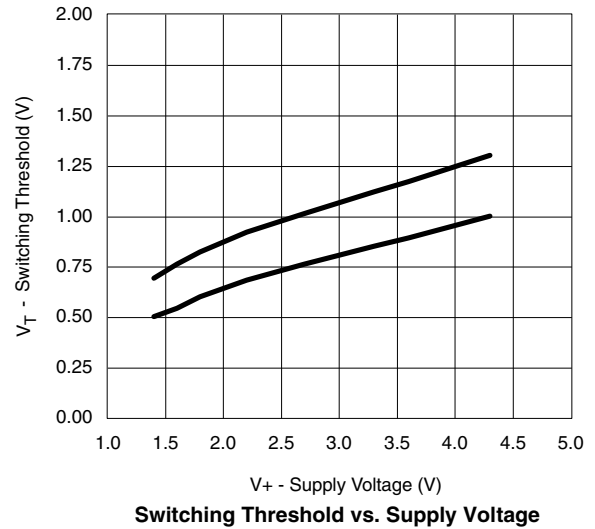
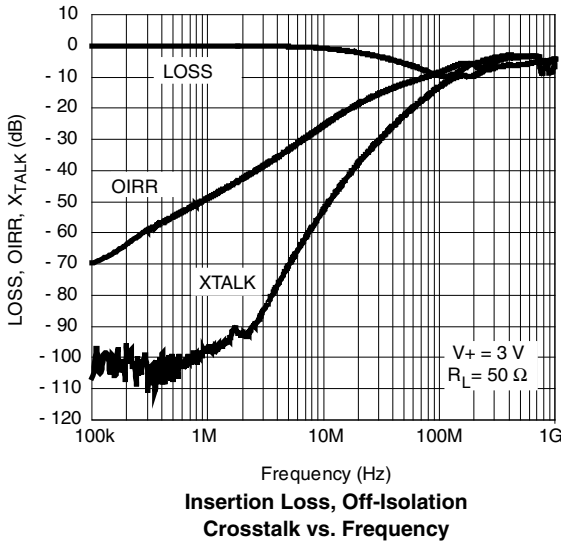
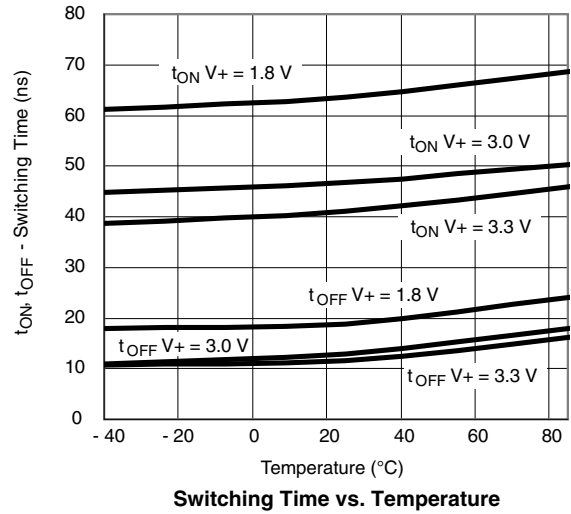
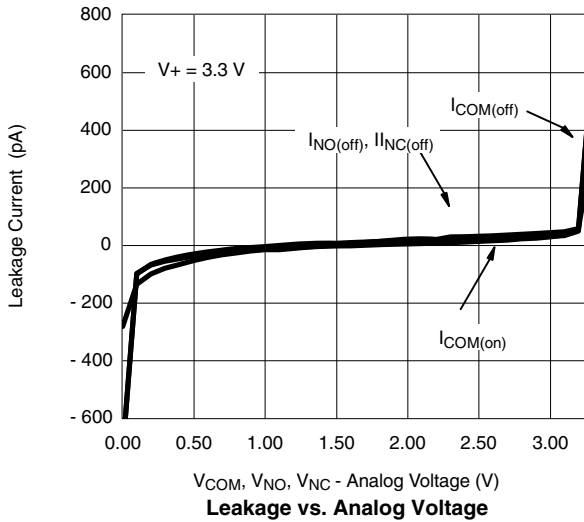
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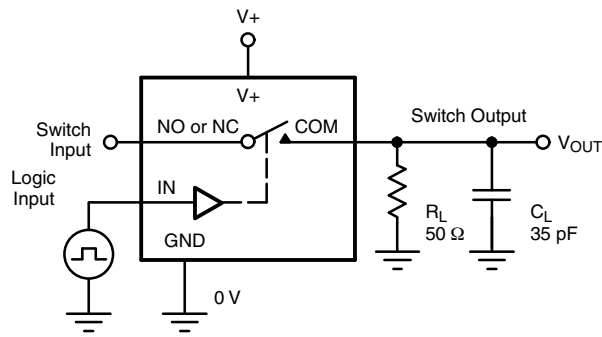
- Room = 25 °C, Full = as determined by the operating suffix.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Typical values are for design aid only, not guaranteed nor subject to production testing.
- Guarantee by design, not subjected to production test.
- V_{IN} = input voltage to perform proper function.
- Crosstalk measured between channels.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)

 R_{ON} vs. V_{COM} and Supply Voltage

 R_{ON} vs. Analog Voltage and Temperature

 R_{ON} vs. Analog Voltage and Temperature

Supply Current vs. Temperature

Supply Current vs. Input Switching Frequency

Leakage Current vs. Temperature

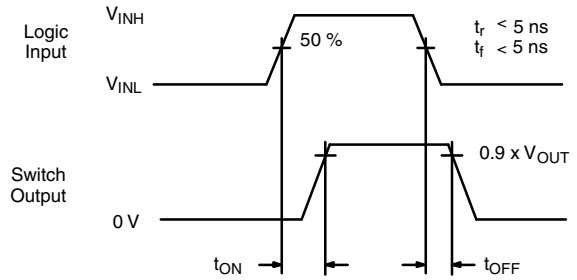
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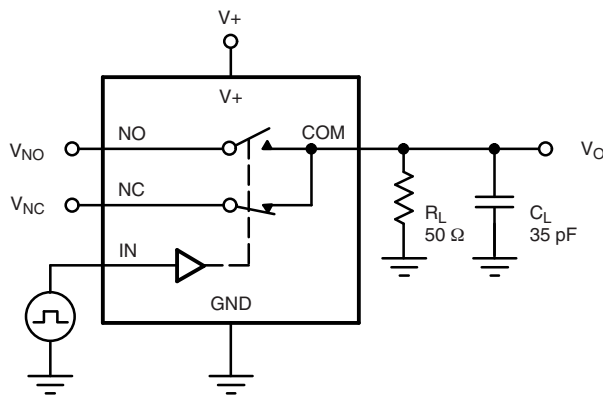
TEST CIRCUITS


C_L (includes fixture and stray capacitance)

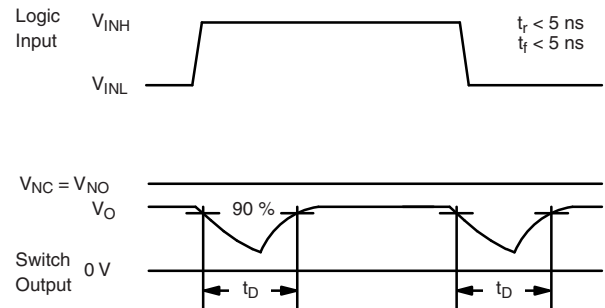
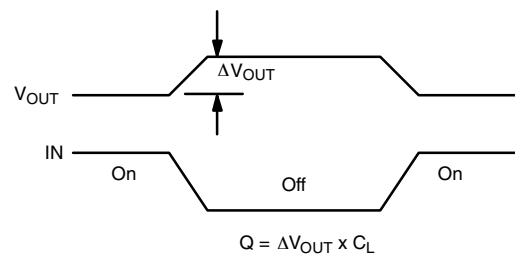
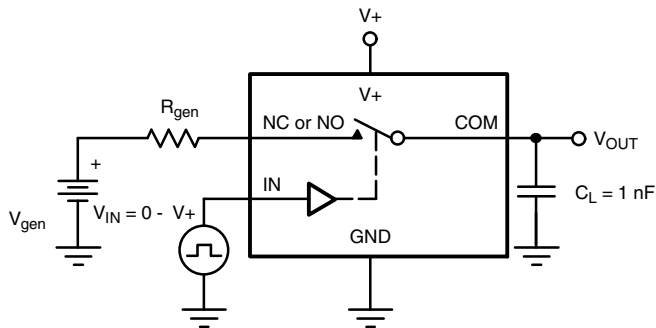
$$V_{OUT} = V_{COM} \left(\frac{R_L}{R_L + R_{ON}} \right)$$



Logic "1" = Switch On
 Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 1. Switching Time


C_L (includes fixture and stray capacitance)


Figure 2. Break-Before-Make Interval


IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection

TEST CIRCUITS

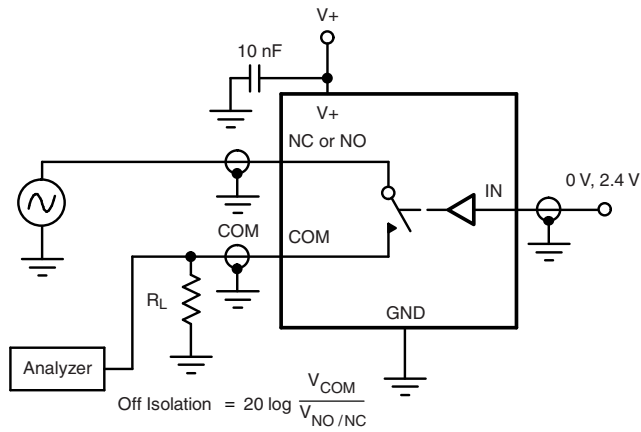


Figure 4. Off-Isolation

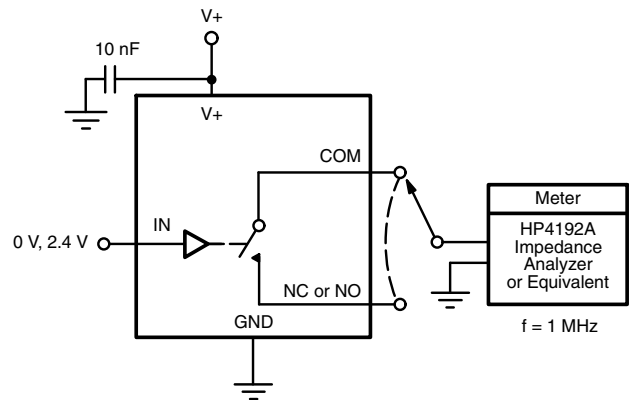
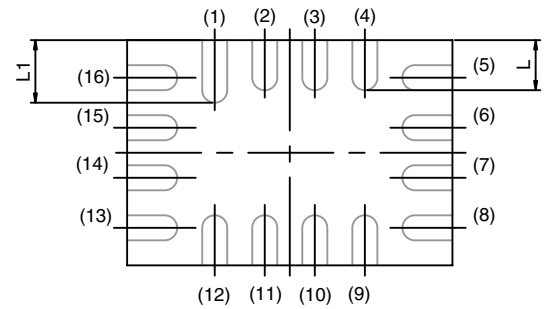
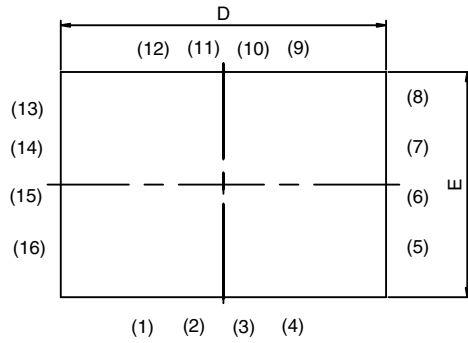


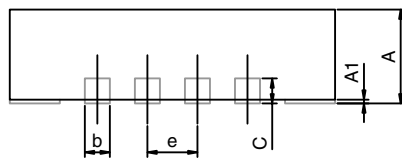
Figure 5. Channel Off/On Capacitance

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MINI QFN-16L



BACK SIDE VIEW



DIM	MILLIMETERS			INCHES		
	MIN.	NAM	MAX.	MIN.	NAM	MAX.
A	0.70	0.75	0.80	0.0275	0.0295	0.0315
A1	0	-	0.05	0	-	0.002
b	0.15	0.20	0.25	0.0059	0.0078	0.0098
C	0.15	0.20	0.25	0.0059	0.0078	0.0098
D	2.60 BSC			0.1023 BSC		
E	1.80 BSC			0.0708 BSC		
e	0.40 BSC			0.0157 BSC		
L	0.35	0.40	0.45	0.0137	0.0157	0.0177
L1	0.45	0.50	0.55	0.0177	0.0196	0.0216

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DWG: 5954



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