



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 mm x 1.8 mm 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

- Wide operation voltage range: 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)
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

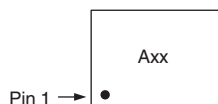
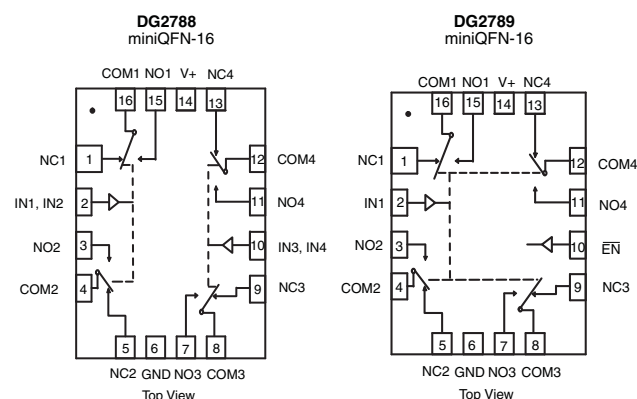
BENEFITS

- Reduced power consumption
- High accuracy
- Reduce board space
- Low voltage 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	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 UNLESS OTHERWISE 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	VNO, VNC, VCOM		Full	0	-	V+	V
On-Resistance	RON	V+ = 2.7 V, VCOM = 0.5 V, INO, INC = 100 mA	Room	-	0.4	0.5	Ω
		V+ = 2.7 V, VCOM = 1.5 V, INO, INC = 100 mA		-	0.33		
			Full	-	-	0.56	
RON Flatness ^d	RON Flatness	V+ = 2.7 V, VCOM = 0 to V+, INO, INC = 100 mA	Room	-	0.1	0.15	
RON Match ^d	ΔRON		Room	-	0.05	-	
Switch Off Leakage Current	INO(off), INC(off)	V+ = 3.3 V, VNO, VNC = 0.3 V/3 V, VCOM = 3 V/0.3 V	Room	-1	-	1	nA
	ICOM(off)		Full	-10	-	10	
			Room	-1	-	1	
			Full	-10	-	10	
Channel-On Leakage Current	ICOM(on)	V+ = 3.3 V, VNO, VNC = VCOM = 0.3 V/3 V	Room	-1	-	1	
			Full	-10	-	10	
Digital Control							
Input High Voltage	VINH		Full	1.4	-	-	V
Input Low Voltage	VINL		Full	-	-	0.5	
Input Capacitance	CIN		Full	-	6	-	pF
Input Current	IINL or IINH	VIN = 0 or V+	Full	-1	-	1	μA
Dynamic Characteristics							
Turn-On Time	tON	VNO or VNC = 1.5 V, RL = 50 Ω, CL = 35 pF	Room	-	47	72	ns
			Full	-	-	75	
Turn-Off Time	tOFF		Room	-	15	43	
			Full	-	-	45	
Break-Before-Make Time	td		Full	1	-	-	
Charge Injection ^d	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room	-	87	-	pC
Off-Isolation ^d	OIRR	RL = 50 Ω, CL = 5 pF, f = 100 kHz	Room	-	-69	-	dB
		RL = 50 Ω, CL = 5 pF, f = 1 MHz		-	-49	-	
Crosstalk ^{d, f}	XTALK	RL = 50 Ω, CL = 5 pF, f = 100 kHz		-	-106	-	
		RL = 50 Ω, CL = 5 pF, f = 1 MHz		-	-96	-	
NO, NC Off Capacitance ^d	CNO(off)	f = 1 MHz	Room	-	81	-	pF
	CNC(off)		Room	-	81	-	
Channel-On Capacitance ^d	CNO(on)		Room	-	186	-	
	CNC(on)		Room	-	186	-	
Power Supply							
Power Supply Range	V+			1.65	-	4.3	V
Power Supply Current	I+	VIN = 0 or V+	Full	-	-	1	μA



SPECIFICATIONS (V+ = 3 V)							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE 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	VNO, VNC, VCOM		Full	0	-	V+	V
On-Resistance	RON	V+ = 4.3 V, VCOM = 0.9 V, INO, INC = 100 mA	Room	-	0.32	0.45	Ω
		V+ = 4.3 V, VCOM = 2.5 V, INO, INC = 100 mA		-	0.27		
			Full	-	-	0.5	
RON Flatness d	RON Flatness	V+ = 4.3 V, VCOM = 0 to V+, INO, INC = 100 mA	Room	-	0.1	0.15	
RON Match d	ΔRON		Room	-	0.03	-	
Switch-Off Leakage Current d	INO(off), INC(off)	V+ = 4.3 V, VNO, VNC = 0.3 V/4 V, VCOM = 4 V/0.3 V	Room	-10	-	10	nA
			Full	-100	-	100	
	ICOM(off)		Room	-10	-	10	
			Full	-100	-	100	
Channel-On Leakage Current d	ICOM(on)		Room	-10	-	10	
			Full	-100	-	100	
Digital Control							
Input High Voltage	VINH		Full	1.6	-	-	V
Input Low Voltage	VINL		Full	-	-	0.5	
Input Capacitance	CIN		Full	-	6	-	pF
Input Current	IINL or IINH	VIN = 0 or V+	Full	-1	-	1	μA
Dynamic Characteristics							
Charge Injection d	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room	-	105	-	pC
NO, NC Off Capacitance d	CNO(off)	f = 1 MHz	Room	-	79	-	pF
	CNC(off)		Room	-	79	-	
Channel-On Capacitance d	CNO(on)		Room	-	183	-	
	CNC(on)		Room	-	183	-	
Power Supply							
Power Supply Range	V+			1.65	-	4.3	V
Power Supply Current	I+	VIN = 0 or V+	Full	-	-	1	μA

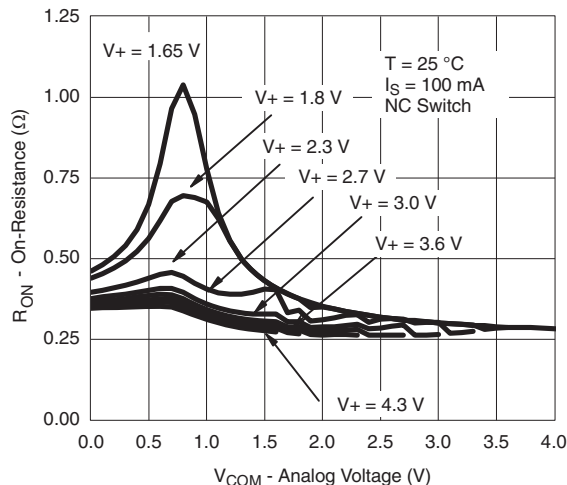
Notes

- 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.

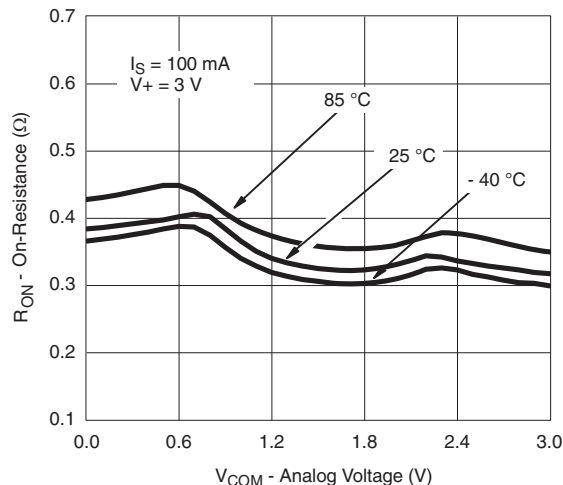
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



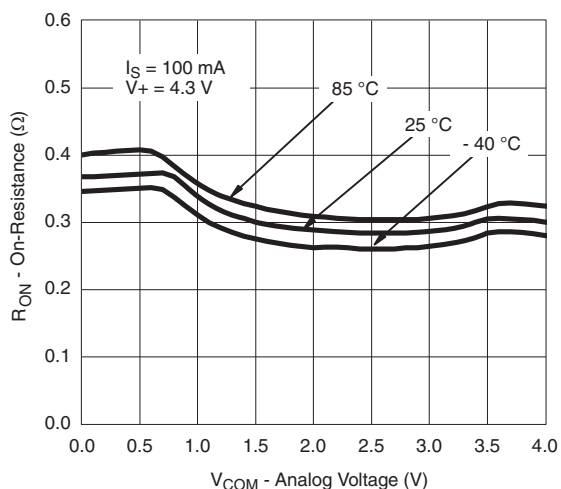
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)



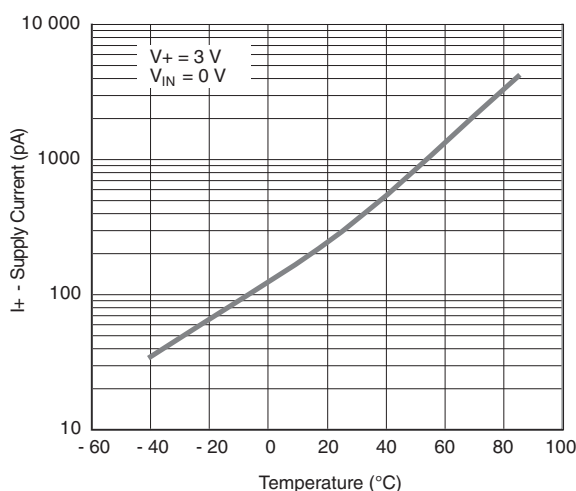
R_{ON} vs. V_{COM} and Supply Voltage



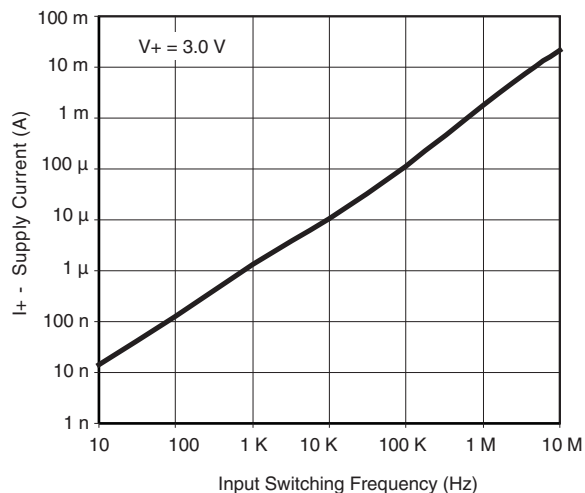
R_{ON} vs. Analog Voltage and Temperature



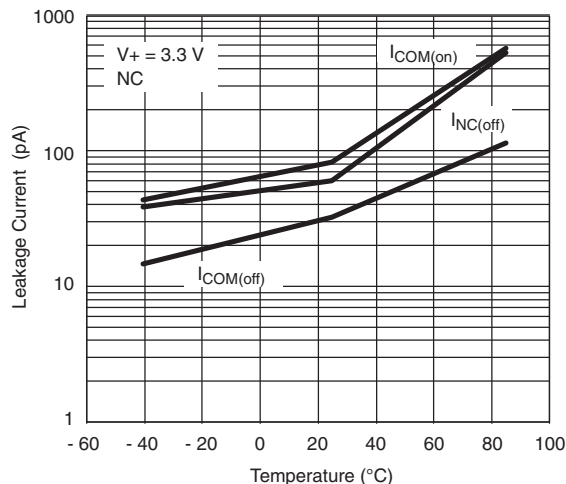
R_{ON} vs. Analog Voltage and Temperature



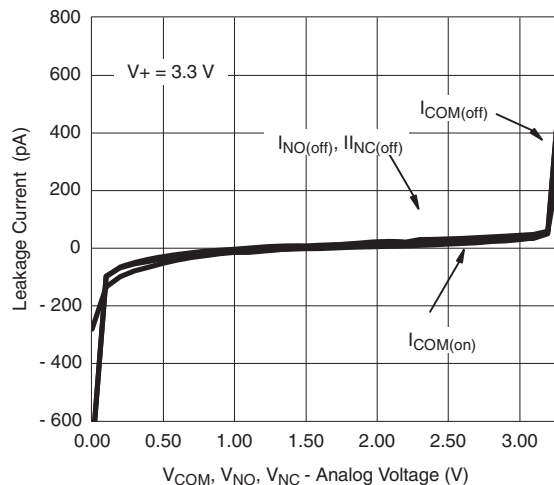
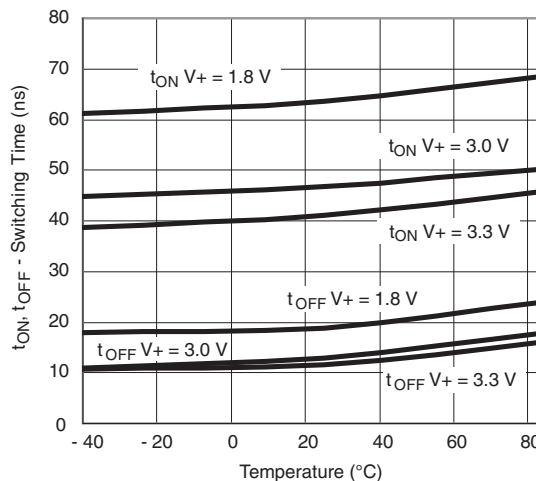
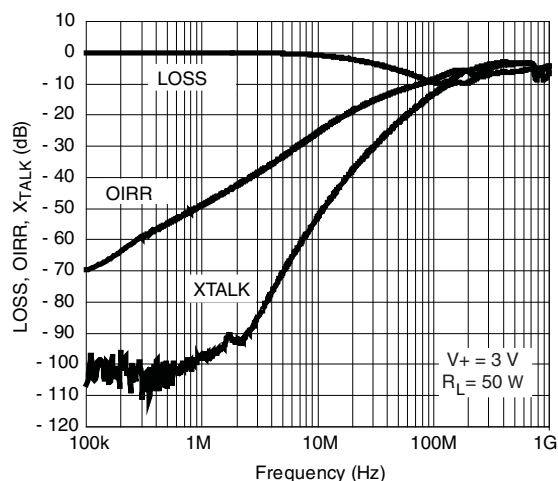
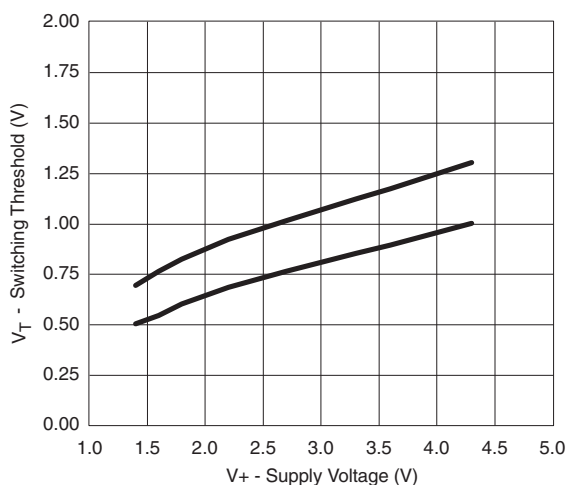
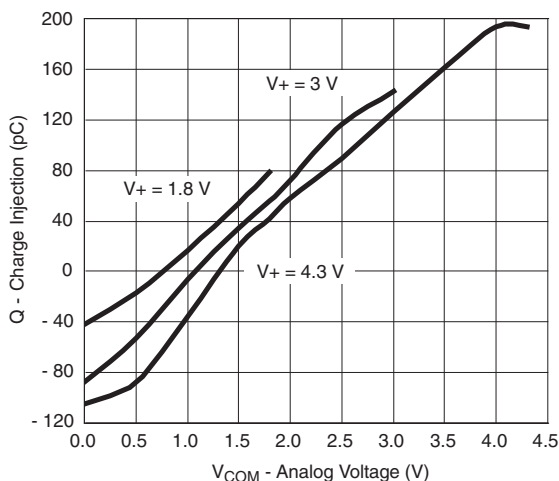
Supply Current vs. Temperature

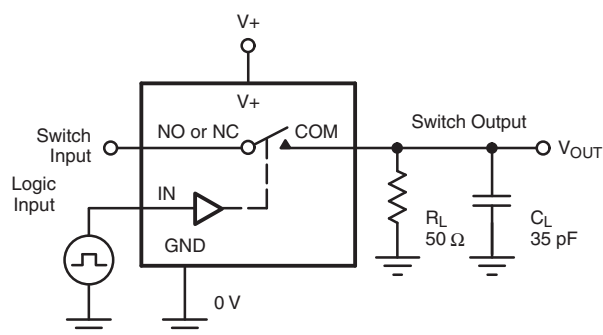


Supply Current vs. Input Switching Frequency

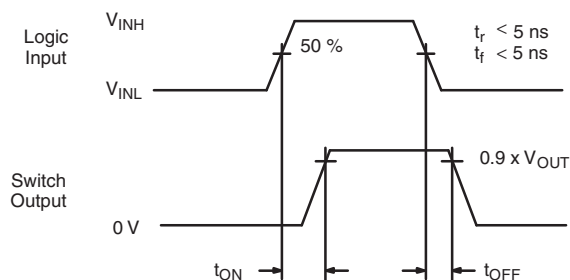


Leakage Current vs. Temperature

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

Leakage vs. Analog Voltage

Switching Time vs. Temperature

Insertion Loss, Off-Isolation Crosstalk vs. Frequency

Switching Threshold vs. Supply Voltage

Charge Injection vs. Analog Voltage

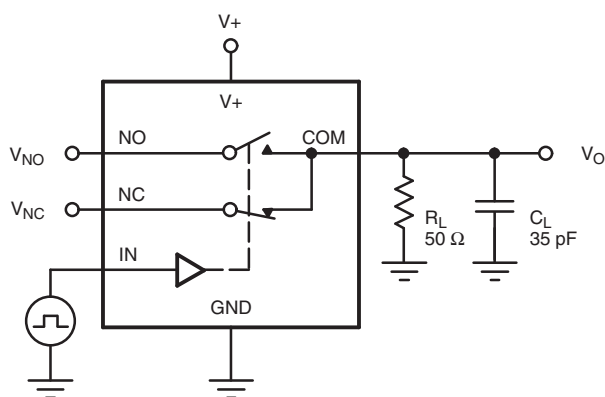
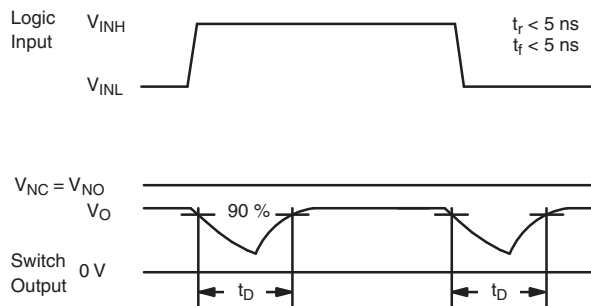
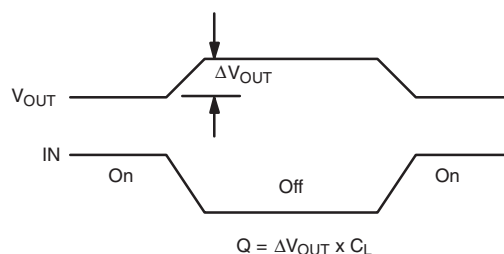
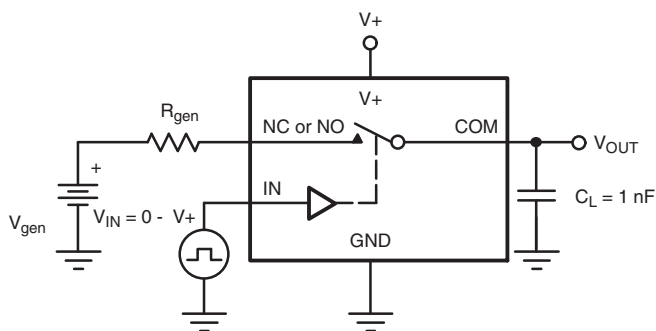
TEST CIRCUITS

 C_L (includes fixture and stray capacitance)

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



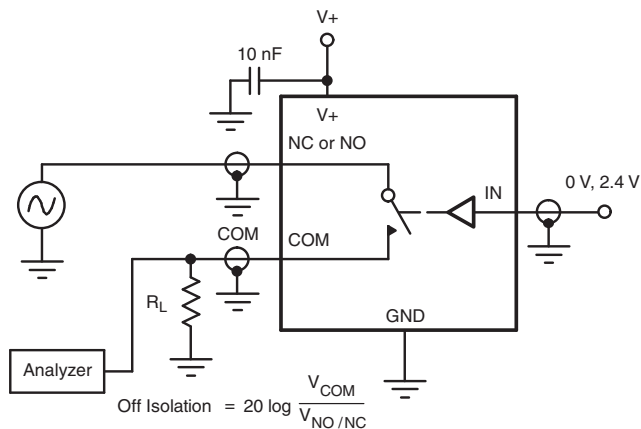
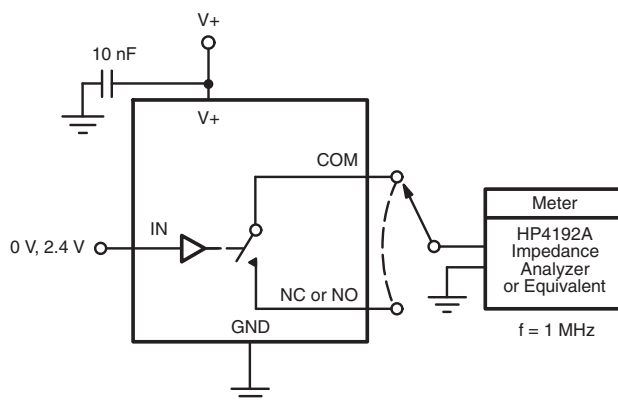
Logic "1" = Switch On

Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time

 C_L (includes fixture and stray capacitance)

Fig. 2 - Break-Before-Make Interval


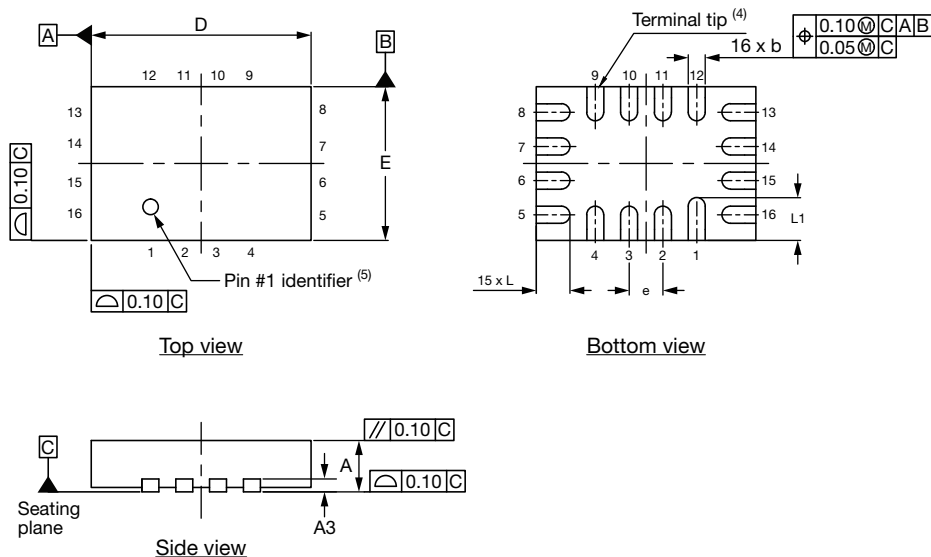
IN depends on switch configuration: input polarity determined by sense of switch.

Fig. 3 - Charge Injection

TEST CIRCUITS

Fig. 4 - Off-Isolation

Fig. 5 - Channel Off/On Capacitance

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?73863.

Thin miniQFN16 Case Outline



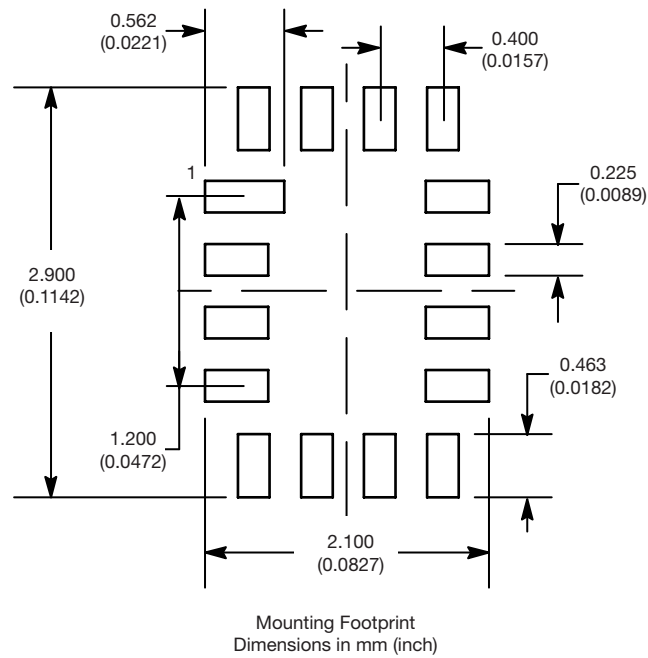
DIMENSIONS	MILLIMETERS ⁽¹⁾			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.50	0.55	0.60	0.020	0.022	0.024
A1	0	-	0.05	0	-	0.002
A3	0.15 ref.			0.006 ref.		
b	0.15	0.20	0.25	0.006	0.008	0.010
D	2.50	2.60	2.70	0.098	0.102	0.106
e	0.40 BSC			0.016 BSC		
E	1.70	1.80	1.90	0.067	0.071	0.075
L	0.35	0.40	0.45	0.014	0.016	0.018
L1	0.45	0.50	0.55	0.018	0.020	0.022
N ⁽³⁾	16			16		
Nd ⁽³⁾	4			4		
Ne ⁽³⁾	4			4		

Notes

- (1) Use millimeters as the primary measurement.
- (2) Dimensioning and tolerances conform to ASME Y14.5M. - 1994.
- (3) N is the number of terminals. Nd and Ne is the number of terminals in each D and E site respectively.
- (4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.
- (5) The pin 1 identifier must be existed on the top surface of the package by using identification mark or other feature of package body.
- (6) Package warpage max. 0.05 mm.

ECN: T16-0226-Rev. B, 09-May-16
DWG: 6023

RECOMMENDED MINIMUM PADS FOR MINI QFN 16L





Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.