

# Low-Voltage, Low $R_{ON}$ , Dual DPDT Analog Switch

## DESCRIPTION

The DG2015 is a dual double-pole/double-throw monolithic CMOS analog switch designed for high performance switching of analog signals. Combining low power, high speed, low on-resistance and small physical size, the DG2015 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG2015 is built on Vishay Siliconix's low voltage J12 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.

## FEATURES

- **Halogen-free according to IEC 61249-2-21 Definition**
- Low Voltage Operation (2.7 V to 3.3 V)
- Low On-Resistance -  $R_{ON}$ : 0.85  $\Omega$
- 3 dB Loss at 100 MHz
- Fast Switching:  $t_{ON} = 40$  ns  
 $t_{OFF} = 35$  ns
- QFN-16 Package
- **Compliant to RoHS Directive 2002/95/EC**



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

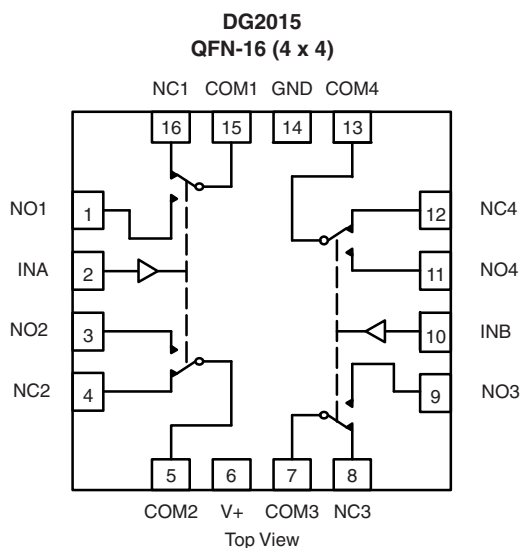
## BENEFITS

- Reduced Power Consumption
- High Accuracy
- Reduced Board Space
- Reduce Board Space
- TTL/1.8 V Logic Compatible

## APPLICATIONS

- Cellular Phones
- Speaker Headset Switching
- Audio and Video Signal Routing
- PCMCIA Cards
- Battery Operated Systems

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



## TRUTH TABLE

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

## ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 °C to 85 °C	16-pin QFN (4 mm x 4 mm)	DG2015DN-T1-E4

**ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

Parameter	Limit	Unit
Reference $V_+$ to GND	- 0.3 to + 6	V
IN, COM, NC, $\text{NO}^a$	- 0.3 to ( $V_+ + 0.3$ )	
Current (Any terminal except NO, NC or COM)	30	mA
Continuous Current (NO, NC, or COM)	$\pm 150$	
Peak Current (Pulsed at 1 ms, 10 % duty cycle)	$\pm 200$	
Storage Temperature (D Suffix)	- 65 to 150	$^{\circ}\text{C}$
Package Solder Reflow Conditions <sup>d</sup>	16-pin QFN (4 mm x 4 mm)	
Power Dissipation (Packages) <sup>b</sup>	QFN-16 <sup>c</sup>	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 23.5 mW/ $^{\circ}\text{C}$  above 70  $^{\circ}\text{C}$ .

d. Manual soldering with iron is not recommended for leadless components. The QFN 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** ( $V_+ = 3\text{ V}$ )

Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, VIN = 0.4 V or 2 Ve	Temp.a	Limits - 40 °C to 85 °C			Unit
				Min.b	Typ.c	Max.b	
Analog Switch							
Analog Signal Range <sup>d</sup>	VNO, VNC VCOM		Full	0		V+	V
On-Resistance	RON	V+ = 2.7 V, VCOM = 0.2 V/1.5 V, INO, INC = 100 mA	Room Full		0.85	1.6 1.7	Ω
RON Flatness	RON Flatness	V+ = 2.7 V, VCOM = 0 V to V+, INO, INC = 100 mA	Room		0.16		
RON Match	ΔRON		Room		0.15		
Switch Off Leakage Current	INO(off) INC(off)	V+ = 3.3 V VNO, VNC = 1 V/3 V, VCOM = 3 V/1 V	Room Full	- 1 - 10		1 10	nA
	ICOM(off)		Room Full	- 1 - 10		1 10	
Channel-On Leakage Current	ICOM(on)	V+ = 3.3 V, VNO, VNC = VCOM = 1 V/3 V	Room Full	- 1 - 10		1 10	
Digital Control							
Input High Voltage	VINH		Full	2			V
Input Low Voltage	VINL		Full			0.4	
Input Capacitance	Cin		Full		4		pF
Input Current	IINL or IINH	VIN = 0 V or V+	Full	- 1		1	μA
Dynamic Characteristics							
Turn-On Time	tON	VNO or VNC = 2 V, RL = 300 Ω, CL = 35 pF	Room Full		40	65 67	ns
Turn-Off Time	tOFF		Room Full		35	60 62	
Break-Before-Make Time	td		Full	1	3		
Charge Injection <sup>d</sup>	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room		7		pC
Off-Isolation <sup>d</sup>	OIRR	RL = 50 Ω, CL = 5 pF, f = 1 MHz	Room		- 67		dB
Crosstalk <sup>d</sup>	XTALK		Room		- 70		
NO, NC Off Capacitance <sup>d</sup>	CNO(off) CNC(off)	VIN = 0 V or V+, f = 1 MHz	Room		63		pF
			Room		67		
Channel-On Capacitance <sup>d</sup>	CNO(on) CNC(on)		Room		200		
			Room		196		

SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %, VIN = 0.4 V or 2 Ve	Temp. <sup>a</sup>	Limits - 40 °C to 85 °C			Unit
				Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
Power Supply							
Power Supply Range	V+			2.7		3.3	V
Power Supply Current	I+	VIN = 0 V or V+	Full			1	μA
Power Consumption	PC		Full			3.3	μW

Notes:

a. Room = 25 °C, full = as determined by the operating suffix.

b. Typical values are for design aid only, not guaranteed nor subject to production testing.

c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

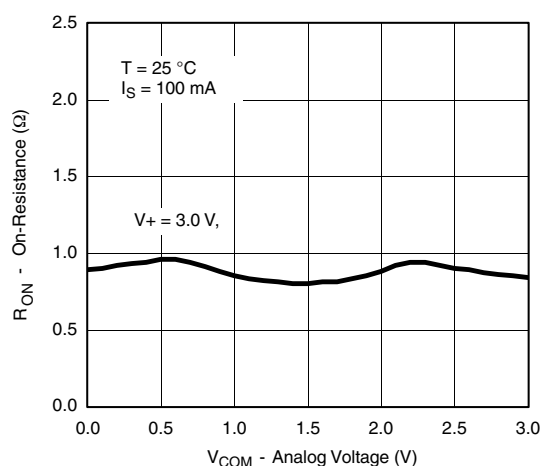
d. Guarantee by design, not subjected to production test.

e.  $V_{IN}$  = input voltage to perform proper function.

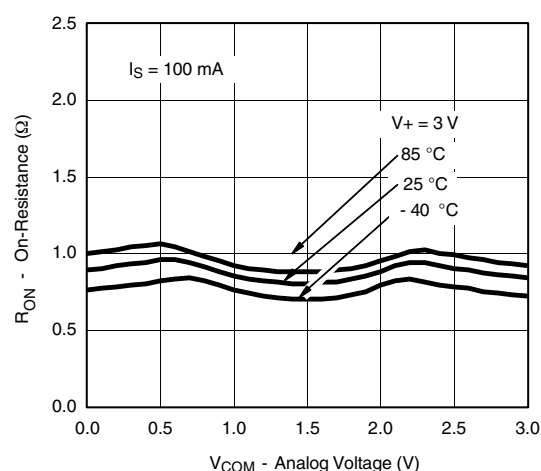
f. Guaranteed by 5 V leakage testing, not production tested.

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.

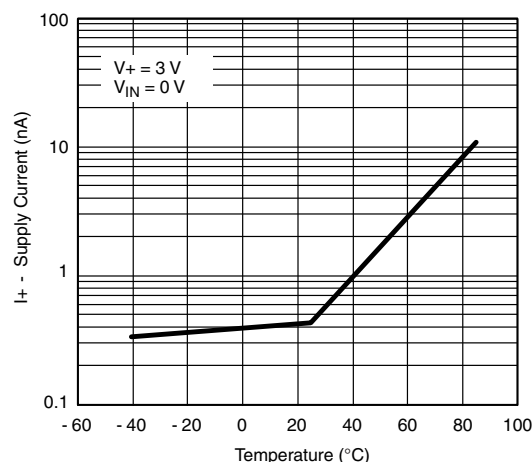
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



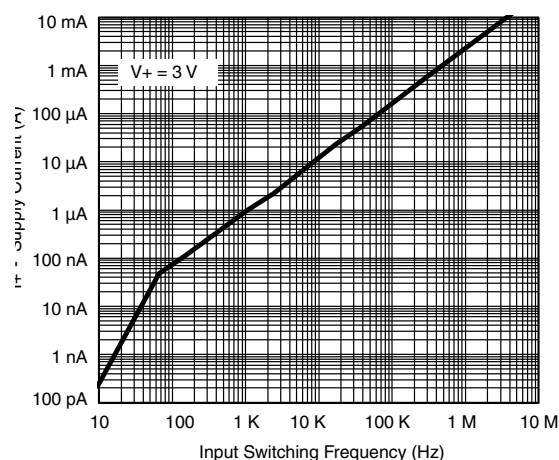
$R_{ON}$  vs.  $V_{COM}$  and Supply Voltage



$R_{ON}$  vs. Analog Voltage and Temperature

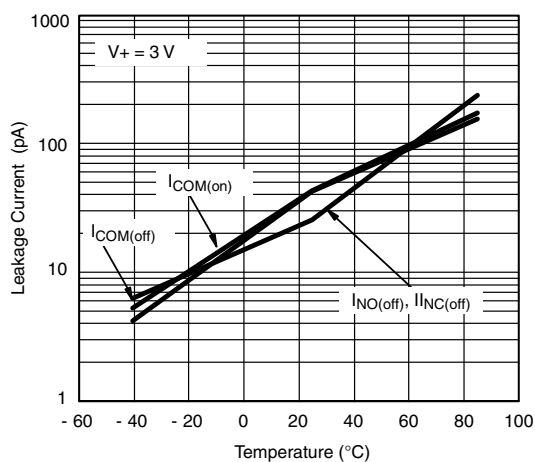


Supply Current vs. Temperature

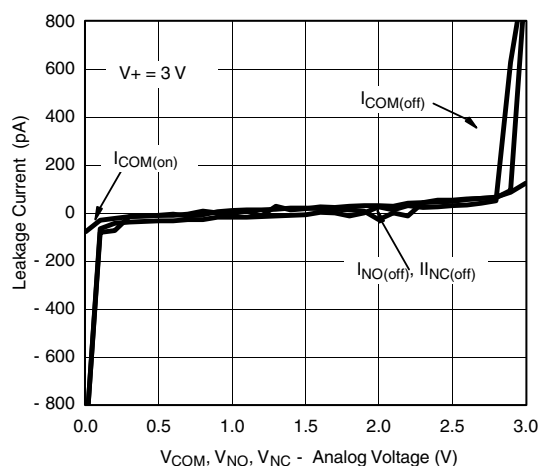


Supply Current vs. Input Switching Frequency

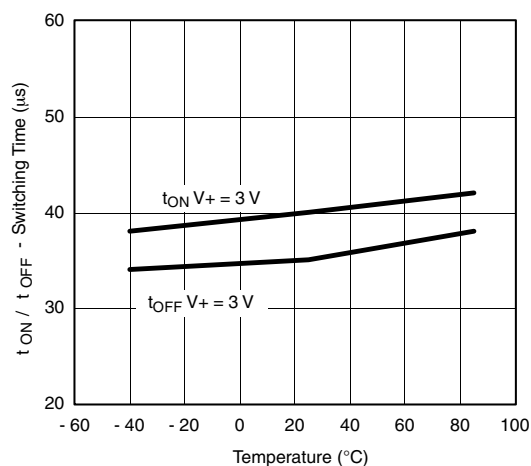
### TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



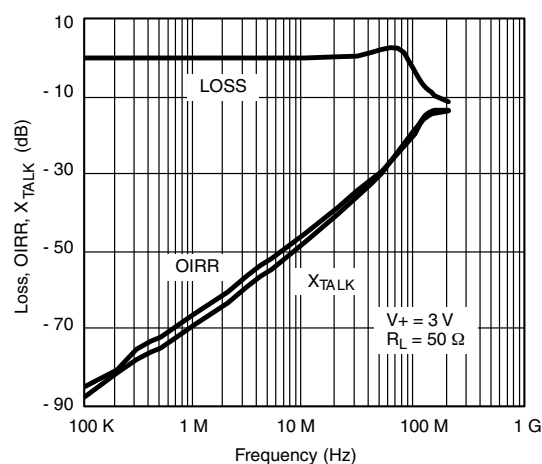
Leakage Current vs. Temperature



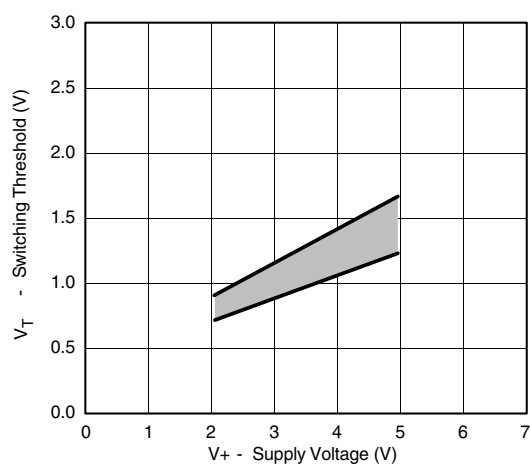
Leakage vs. Analog Voltage



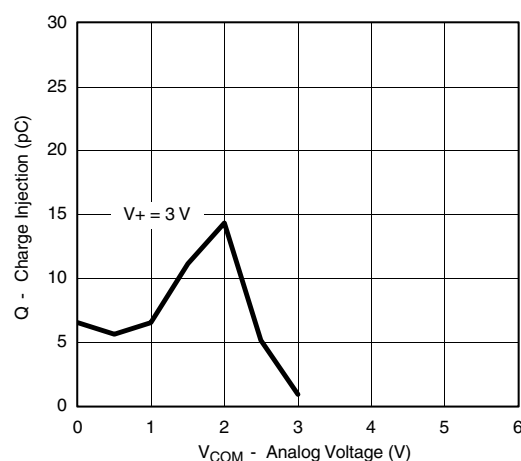
Switching Time vs. Temperature



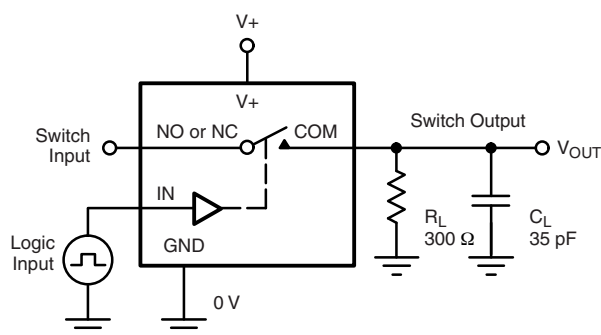
Insertion Loss, Off-Isolation Crosstalk vs. Frequency



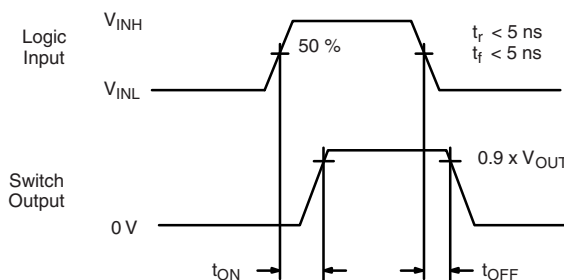
Switching Threshold vs. Supply Voltage



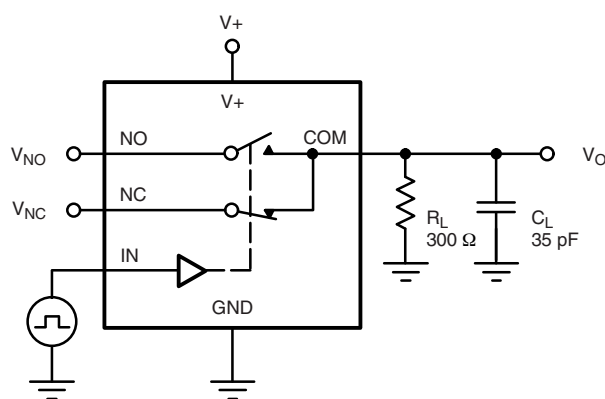
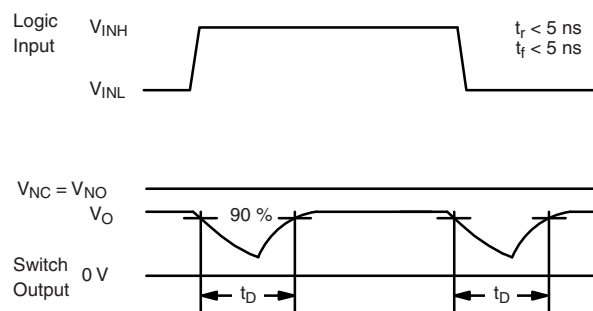
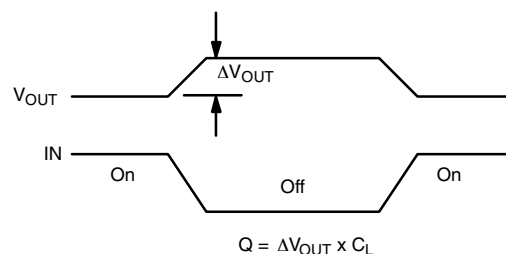
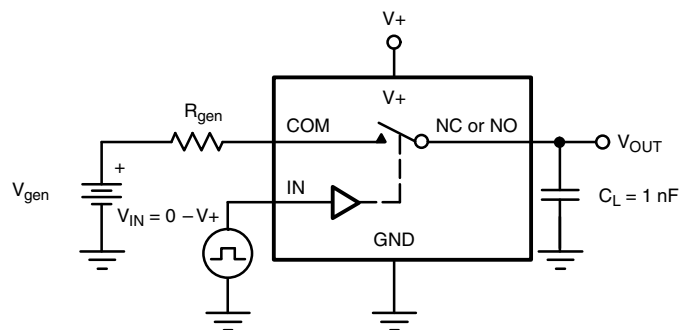
Charge Injection vs. Analog Voltage

**TEST CIRCUITS**

 $C_L$  (includes fixture and stray capacitance)

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



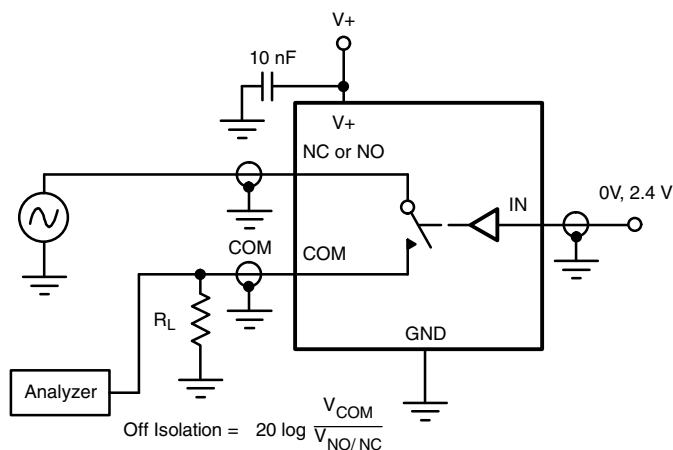
Logic "1" = Switch On  
Logic input waveforms inverted for switches that have the opposite logic sense.

**Figure 1. Switching Time**

 $C_L$  (includes fixture and stray capacitance)

**Figure 2. Break-Before-Make Interval**


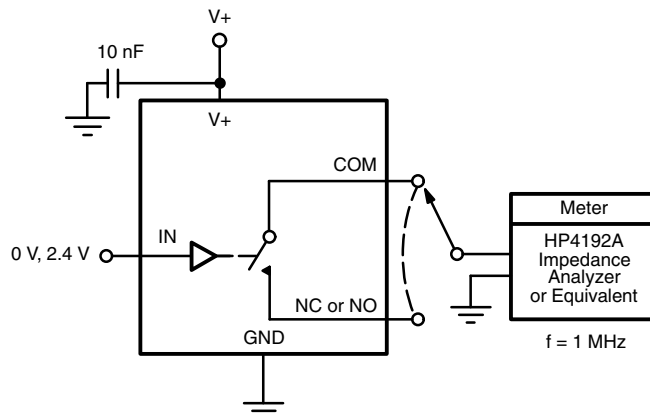
IN depends on switch configuration: input polarity determined by sense of switch.

**Figure 3. Charge Injection**

## TEST CIRCUITS



### Figure 4. Off-Isolation



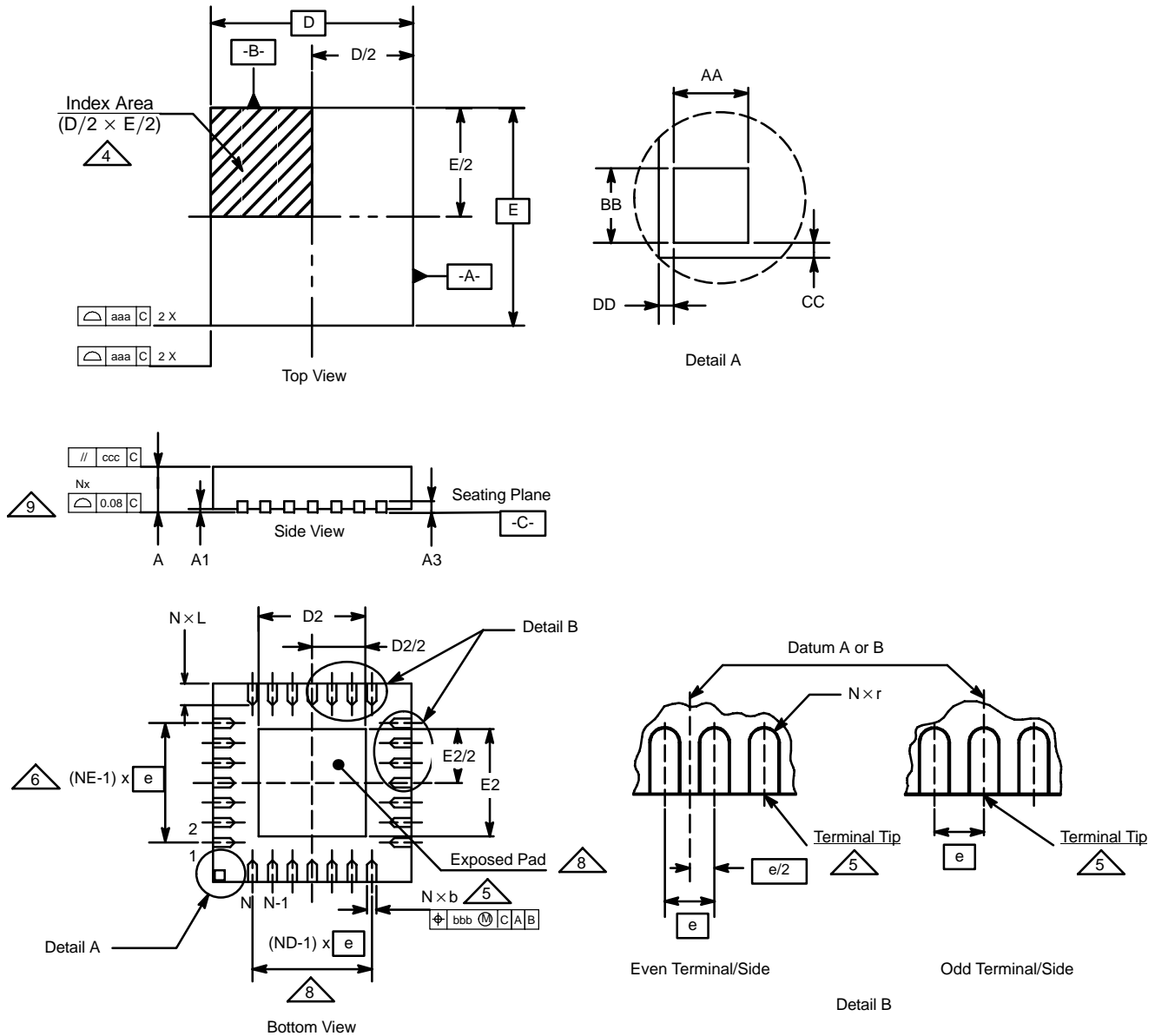
### Figure 5. Channel Off/On Capacitance

*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?71971](http://www.vishay.com/ppg?71971).*



**QFN-16 (4 × 4 mm)**

JEDEC Part Number: MO-220



### QFN-16 (4 × 4 mm)

JEDEC Part Number: MO-220

Dim	MILLIMETERS*			INCHES			Notes
	Min	Nom	Max	Min	Nom	Max	
A	0.80	0.90	1.00	0.0315	0.0354	0.0394	
A1	0	0.02	0.05	0	0.0008	0.0020	
A3	-	0.20 Ref	-	-	0.0079	-	
AA	-	0.345	-	-	0.0136	-	
aaa	-	0.25	-	-	0.0098	-	
BB	-	0.345	-	-	0.0136	-	
b	0.23	0.30	0.38	0.0091	0.0118	0.0150	5
bbb	-	0.10	-	-	0.0039	-	
CC	-	0.18	-	-	0.0071	-	
ccc	-	0.10	-	-	0.0039	-	
D	4.00 BSC			0.1575 BSC			
D2	2.00	2.15	2.25	0.0787	0.0846	0.0886	
DD	-	0.18	-	-	0.0071	-	
E	4.00 BSC			0.1575 BSC			
E2	2.00	2.15	2.25	0.0787	0.0846	0.0886	
e	0.65 BSC			0.0256 BSC			
L	0.45	0.55	0.65	0.0177	0.0217	0.0256	
N	16			16			3, 7
ND	-	4	-	-	4	-	6
NE	-	4	-	-	4	-	6
r	b(min)/2	-	-	b(min)/2	-	-	

\* Use millimeters as the primary measurement.

ECN: S-21437—Rev. A, 19-Aug-02  
DWG: 5890

#### NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5M-1994.
2. All dimensions are in millimeters. All angles are in degrees.
3. N is the total number of terminals.

4. The terminal #1 identifier and terminal numbering convention shall conform to JESD 95-1 SPP-012. Details of terminal #1 identifier are optional, but must be located within the zone indicated. The terminal #1 identifier may be either a molded or marked feature. The X and Y dimension will vary according to lead counts.

5. Dimension b applies to metallized terminal and is measured between 0.25 mm and 0.30 mm from the terminal tip.

6. ND and NE refer to the number of terminals on the D and E side respectively.

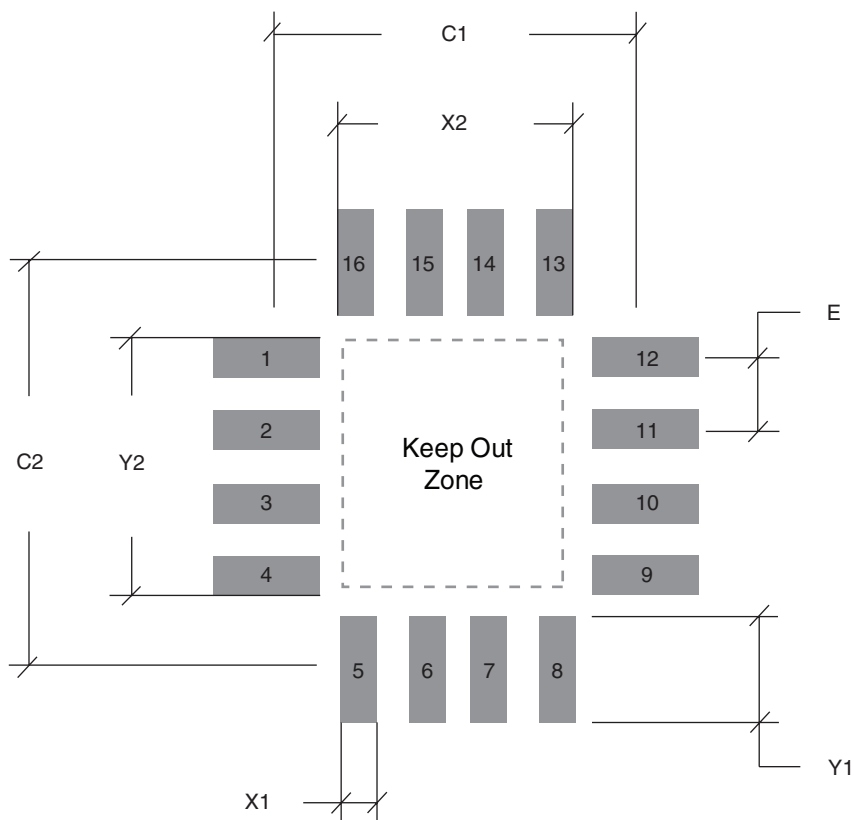
7. Depopulation is possible in a symmetrical fashion.

8. Variation HHD is shown for illustration only.

9. Coplanarity applies to the exposed heat sink slug as well as the terminals.



**RECOMMENDED MINIMUM PADS FOR QFN-16 (4 x 4 MM BODY)**



	Inches	Millimeters
C1	0.142	3.60
C2	0.142	3.60
E	0.026	0.65
X1	0.014	0.35
X2	0.089	2.25
Y1	0.037	0.95
Y2	0.089	2.25

**Note:**

QFN-16 (4 x 4) has an exposed center pad that must not come into contact with any metalized structure on the PCB. This area is considered a Keep Out Zone.



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