

## 8-Channel, Dual 4-Channel, Triple 2-Channel Multiplexers

### DESCRIPTION

The DG9251, DG9252, and DG9253 are high precision single and dual supply CMOS analog multiplexers. DG9251 is an 8-channel multiplexer, the DG9252 is a dual 4-channel multiplexer, and the DG9253 is a triple 2-channel multiplexer or triple SPDT.

Designed to operate from a + 2.7 V to + 16 V single supply or from a  $\pm 2.7$  V to  $\pm 5$  V dual supplies, the DG9251, DG9252, and DG9253 are fully specified at + 16 V, + 5 V and  $\pm 5$  V. All control logic inputs have guaranteed 1.4 V high limit when operating from + 5 V or  $\pm 5$  V supplies and 1.65 V when operating from a + 16 V supply.

The DG9251, DG9252, and DG9253 are precision multiplexers of low leakage, low charge injection, and low parasitic capacitance. They conduct equally well in both directions, offer rail to rail analog signal handling and can be used both as multiplexers as well as de-multiplexers. The DG9251, DG9252, and DG9253 operating temperature is specified from - 40 °C to + 85 °C and are available in ultra compact 1.8 mm x 2.6 mm miniQFN16 packages.

### FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- + 2.7 V to + 16 V single supply operation  
 $\pm 2.7$  V to  $\pm 5$  V dual supply operation
- Fully specified at + 16 V, + 5 V,  $\pm 5$  V
- Low charge injection (< 4.1 pC typ.)
- High bandwidth: 314 MHz (DG9251)  
449 MHz (DG9252)  
480 MHz (DG9253)
- Low switch capacitance ( $C_{S(off)}$  2.7 pF typ.)
- Good isolation and crosstalk performance (typ. - 45 dB at 100 MHz)
- MiniQFN16 package (1.8 mm x 2.6 mm)
- **Compliant to RoHS Directive 2002/95/EC**

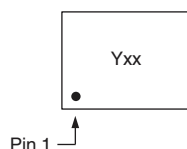
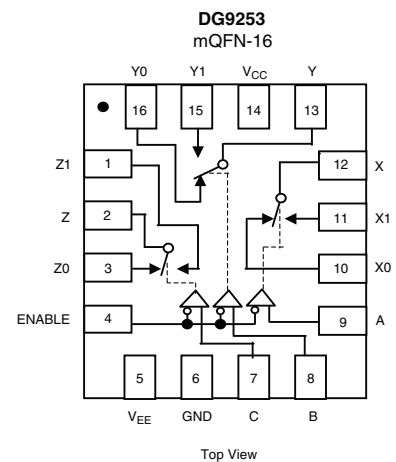
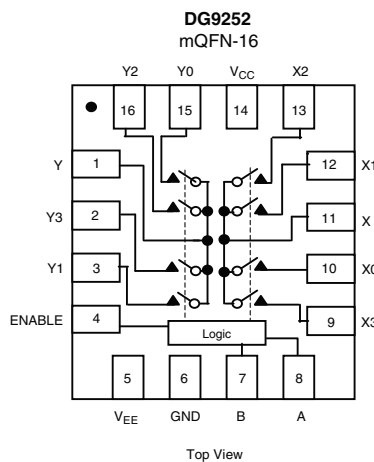
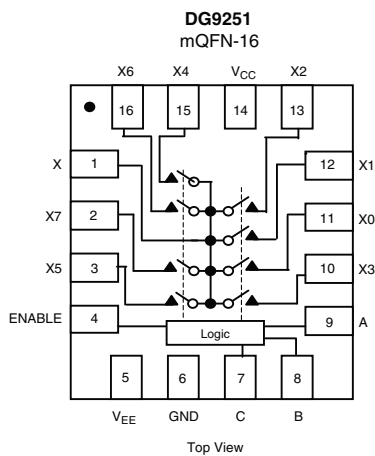


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

- Data acquisition
- Medical and healthcare devices
- Control and automation equipments
- Test instruments
- Touch panels
- Consumer

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: 8xx for DG9251  
(miniQFN16) Hxx for DG9252  
Jxx for DG9253  
xx = Date/Lot Traceability Code

TRUTH TABLE						
Enable Input	Select Inputs			On Switches		
	C	B	A	DG9251	DG9252	DG9253
H	X	X	X	All Switches Open	All Switches Open	All Switches Open
L	L	L	L	X to X0	X to X0, Y to Y0	X to X0, Y to Y0, Z to Z0
L	L	L	H	X to X1	X to X1, Y to Y1	X to X1, Y to Y0, Z to Z0
L	L	H	L	X to X2	X to X2, Y to Y2	X to X0, Y to Y1, Z to Z0
L	L	H	H	X to X3	X to X3, Y to Y3	X to X1, Y to Y1, Z to Z0
L	H	L	L	X to X4	X to X0, Y to Y0	X to X0, Y to Y0, Z to Z1
L	H	L	H	X to X5	X to X1, Y to Y1	X to X1, Y to Y0, Z to Z1
L	H	H	L	X to X6	X to X2, Y to Y2	X to X0, Y to Y1, Z to Z1
L	H	H	H	X to X7	X to X3, Y to Y3	X to X1, Y to Y1, Z to Z1

ORDERING INFORMATION		
Temp. Range	Package	Part Number
DG9251, DG9252, DG9253		
- 40 °C to 125 °C <sup>a</sup>	16-Pin miniQFN	DG9251EN-T1-E4
		DG9252EN-T1-E4
		DG9253EN-T1-E4

Notes:

a. - 40 °C to 85 °C datasheet limits apply.

ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted)			
Parameter		Limit	Unit
V <sub>CC</sub> to V <sub>EE</sub>		18	V
GND to V-		9	
Digital Inputs <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub>		(V-) - 0.3 to (V+) + 0.3 or 30 mA, whichever occurs first	
Continuous Current (Any terminal)		30	mA
Peak Current, S or D (Pulsed 1 ms, 10 % duty cycle)		100	
Storage Temperature		- 65 to 150	°C
Power Dissipation <sup>b</sup>	16-Pin miniQFN <sup>c, d</sup>	525	mW
Thermal Resistance <sup>b</sup>	16-Pin miniQFN <sup>d</sup>	152	°C/W
Latch-up (per JESD78)		> 300	mA

Notes:

a. Signals on SX, DX, or INX exceeding V+ or 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/°C above 70 °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 (for Dual Supplies)									
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_{CC} = +5\text{ V}$ , $V_{EE} = -5\text{ V}$ $V_{IN(A, B, C \text{ and } ENABLE)} = 1.4\text{ V}, 0.3\text{ V}^a$	Temp. <sup>b</sup>	Typ. <sup>c</sup>	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. <sup>d</sup>	Max. <sup>d</sup>	Min. <sup>d</sup>	Max. <sup>d</sup>	
<b>Power Supplies</b>									
Power Supply Current	$I_{CC}$		Room Full	0.05		1 10		1 10	$\mu\text{A}$
Negative Supply Current	$I_{EE}$		Room Full	- 0.05	- 1 - 10		- 1 - 10		
Ground Current	$I_{GND}$		Room Full	- 0.05	- 1 - 10		- 1 - 10		

SPECIFICATIONS (for Unipolar Supplies)									
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_{CC} = +5\text{ V}$ , $V_{EE} = 0\text{ V}$ $V_{IN(A, B, C \text{ and } ENABLE)} = 1.4\text{ V}, 0.3\text{ V}^a$	Temp. <sup>b</sup>	Typ. <sup>c</sup>	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. <sup>d</sup>	Max. <sup>d</sup>	Min. <sup>d</sup>	Max. <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full		0	5	0	5	V
On-Resistance	$R_{ON}$	$I_S = 1\text{ mA}$ , $V_D = 0\text{ V}$ , + 3.5 V	Room Full	145		482 565		482 513	$\Omega$
On-Resistance Match	$\Delta R_{ON}$	$I_S = 1\text{ mA}$ , $V_D = + 3.5\text{ V}$	Room Full	3.6		20 22		20 21	
On-Resistance Flatness	$R_{FLATNESS}$	$I_S = 1\text{ mA}$ , $V_D = 0\text{ V}$ , + 3 V	Room Full	113		151 254		151 231	
Switch Off Leakage Current	$I_{S(off)}$	$V_{CC} = +5.5\text{ V}$ , $V_{EE} = 0\text{ V}$ $V_D = 1\text{ V}/4.5\text{ V}$ , $V_S = 4.5\text{ V}/1\text{ V}$	Room Full	$\pm 0.02$	- 1 - 50	1 50	- 1 - 5	1 5	nA
	$I_{D(off)}$		Room Full	$\pm 0.02$	- 1 - 50	1 50	- 1 - 5	1 5	
Channel On Leakage Current	$I_{D(on)}$	$V_{CC} = +5.5\text{ V}$ , $V_{EE} = 0\text{ V}$ $V_D = V_S = 1\text{ V}/4.5\text{ V}$	Room Full	$\pm 0.02$	- 1 - 50	1 50	- 1 - 5	1 5	
<b>Digital Control</b>									
$V_{IN(A, B, C \text{ and } ENABLE)}$ Low	$V_{IL}$		Full			0.3		0.3	V
$V_{IN(A, B, C \text{ and } ENABLE)}$ High	$V_{IH}$		Full		1.4		1.4		
Input Current, $V_{IN}$ Low	$I_L$	$V_{IN(A, B, C \text{ and } ENABLE)}$ under test = 0.3 V	Full	0.01	- 1	1	- 1	1	$\mu\text{A}$
Input Current, $V_{IN}$ High	$I_H$	$V_{IN(A, B, C \text{ and } ENABLE)}$ under test = 1.4 V	Full	0.01	- 1	1	- 1	1	
<b>Dynamic Characteristics</b>									
Transition Time	$t_{TRANS}$	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ see figure 1, 2, 3	Room Full	97		230 305		230 266	ns
Enable Turn-On Time	$t_{ON}$		Room Full	229		335 652		335 545	
Enable Turn-Off Time	$t_{OFF}$		Room Full	64		150 173		150 163	
Break-Before-Make Time Delay	$t_D$		Room Full	36	20		20		
Charge Injection <sup>e</sup>	Q	$V_g = 0\text{ V}$ , $R_g = 0\ \Omega$ , $C_L = 1\text{ nF}$	Full	0.44					pC
Off Isolation <sup>e</sup>	OIRR	$R_L = 50\ \Omega$ , $C_L = 15\text{ pF}$ $f = 100\text{ kHz}$	Room	< - 90					dB
Channel-to-Channel Crosstalk <sup>e</sup>	$X_{TALK}$		Room	< - 90					



**SPECIFICATIONS (for Unipolar Supplies)**

Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_{CC} = +5\text{ V}, V_{EE} = 0\text{ V}$ $V_{IN(A, B, C \text{ and } ENABLE)} = 1.4\text{ V}, 0.3\text{ V}^a$	Temp. <sup>b</sup>	Typ. <sup>c</sup>	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. <sup>d</sup>	Max. <sup>d</sup>	Min. <sup>d</sup>	Max. <sup>d</sup>	
<b>Dynamic Characteristics</b>									
Source Off Capacitance <sup>e</sup>	$C_{S(off)}$	f = 1 MHz	DG9251	Room	2.9				pF
			DG9252	Room	2.2				
			DG9253	Room	2.1				
Drain Off Capacitance <sup>e</sup>	$C_{D(off)}$	f = 1 MHz	DG9251	Room	12.4				
			DG9252	Room	6.8				
			DG9253	Room	4.6				
Channel On Capacitance <sup>e</sup>	$C_{D(on)}$	f = 1 MHz	DG9251	Room	16				
			DG9252	Room	10.6				
			DG9253	Room	8.8				
<b>Power Supplies</b>									
Power Supply Current	$I_{CC}$	$V_{IN(A, B, C \text{ and } ENABLE)} = 0\text{ V or } 5\text{ V}$	Room Full	0.05		1 10	1 10	μA	
Negative Supply Current	$I_{EE}$		Room Full	- 0.05	- 1 - 10	- 1 - 10			
Ground Current	$I_{GND}$		Room Full	- 0.05	- 1 - 10	- 1 - 10			

**SPECIFICATIONS (for Unipolar Supplies)**

Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_{CC} = +16\text{ V}, V_{EE} = 0\text{ V}$ $V_{IN(A, B, C \text{ and } ENABLE)} = 1.6\text{ V}, 0.5\text{ V}^a$	Temp. <sup>b</sup>	Typ. <sup>c</sup>	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. <sup>d</sup>	Max. <sup>d</sup>	Min. <sup>d</sup>	Max. <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full		0	16	0	16	V
On-Resistance	$R_{ON}$	$I_S = 1\text{ mA}, V_D = 0.7\text{ V}, 8\text{ V}, 15.3\text{ V}$	Room Full	69		152 171		152 158	Ω
On-Resistance Match	$\Delta R_{ON}$	$I_S = 1\text{ mA}, V_D = +0.7\text{ V}$	Room Full	2		7 10		7 8	
On-Resistance Flatness	$R_{FLATNESS}$	$I_S = 1\text{ mA}, V_D = 0.7\text{ V}, +15.3\text{ V}$	Room Full	32		45 53		45 49	
Switch Off Leakage Current	$I_{S(off)}$	$V_{CC} = +16\text{ V}, V_{EE} = 0\text{ V}$ $V_D = 1\text{ V/15 V}, V_S = 15\text{ V/1 V}$	Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	nA
	$I_{D(off)}$		Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	
Channel On Leakage Current	$I_{D(on)}$	$V_{CC} = +16\text{ V}, V_{EE} = 0\text{ V}$ $V_D = V_S = 1\text{ V/15 V}$	Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	
<b>Digital Control</b>									
$V_{IN(A, B, C \text{ and } ENABLE)}$ Low	$V_{IL}$		Full			0.5		0.5	V
$V_{IN(A, B, C \text{ and } ENABLE)}$ High	$V_{IH}$		Full		1.6		1.6		
Input Current, $V_{IN}$ Low	$I_L$	$V_{IN(A, B, C \text{ and } ENABLE)}$ under test = 0.5 V	Full	0.01	- 1	1	- 1	1	μA
Input Current, $V_{IN}$ High	$I_H$	$V_{IN(A, B, C \text{ and } ENABLE)}$ under test = 1.6 V	Full	0.01	- 1	1	- 1	1	
<b>Dynamic Characteristics</b>									
Transition Time	$t_{TRANS}$	$R_L = 300\ \Omega, C_L = 35\text{ pF}$ see figure 1, 2, 3	Room Full	56		130 160		130 150	ns
Enable Turn-On Time	$t_{ON}$		Room Full	98		175 256		175 221	
Enable Turn-Off Time	$t_{OFF}$		Room Full	37		120 134		120 127	
Break-Before-Make Time Delay	$t_D$		Room Full	31	12		12		

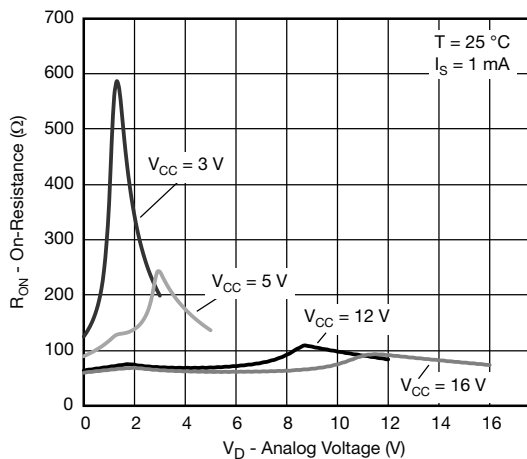
SPECIFICATIONS (for Unipolar Supplies)									
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_{CC} = +16\text{ V}$ , $V_{EE} = 0\text{ V}$ $V_{IN(A, B, C \text{ and } ENABLE)} = 1.6\text{ V}$ , $0.5\text{ V}^a$	Temp. <sup>b</sup>	Typ. <sup>c</sup>	-40 °C to 125 °C		-40 °C to 85 °C		Unit
					Min. <sup>d</sup>	Max. <sup>d</sup>	Min. <sup>d</sup>	Max. <sup>d</sup>	
Charge Injection <sup>e</sup>	Q	$V_g = 0\text{ V}$ , $R_g = 0\ \Omega$ , $C_L = 1\text{ nF}$	Room	4.5					pC
<b>Dynamic Characteristics</b>									
Off Isolation <sup>e</sup>	OIRR	$R_L = 50\ \Omega$ , $C_L = 15\text{ pF}$ $f = 100\text{ kHz}$	Room	< -90					dB
Channel-to-Channel Crosstalk <sup>e</sup>	$X_{TALK}$		Room	< -90					
Source Off Capacitance <sup>e</sup>	$C_{S(off)}$	$f = 1\text{ MHz}$	DG9251	Room	2.6				pF
			DG9252	Room	2.1				
			DG9253	Room	1.8				
Drain Off Capacitance <sup>e</sup>	$C_{D(off)}$	$f = 1\text{ MHz}$	DG9251	Room	10.4				
			DG9252	Room	5.8				
			DG9253	Room	4.2				
Channel On Capacitance <sup>e</sup>	$C_{D(on)}$	$f = 1\text{ MHz}$	DG9251	Room	15				
			DG9252	Room	9.5				
			DG9253	Room	8.2				
<b>Power Supplies</b>									
Power Supply Current	$I_{CC}$	$V_{IN(A, B, C \text{ and } ENABLE)} = 0\text{ V or } 16\text{ V}$	Room Full	0.05		1 10		1 10	$\mu\text{A}$
Negative Supply Current	$I_{EE}$		Room Full	-0.05	-1 -10		-1 -10		
Ground Current	$I_{GND}$		Room Full	-0.05	-1 -10		-1 -10		

**Notes:**

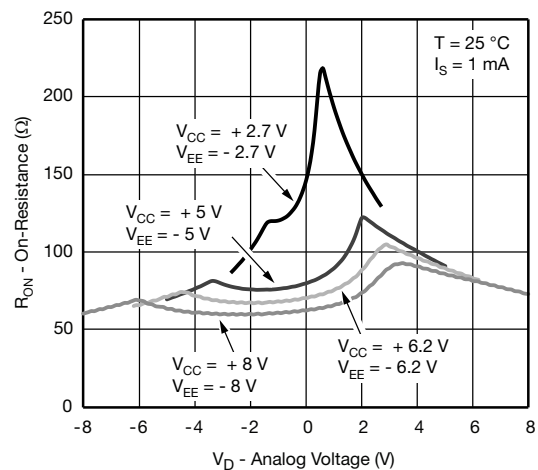
- a.  $V_{IN}$  = input voltage to perform proper function.
- b. Room - 25 °C, full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- e. Guaranteed by design, not subject to production test.

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)

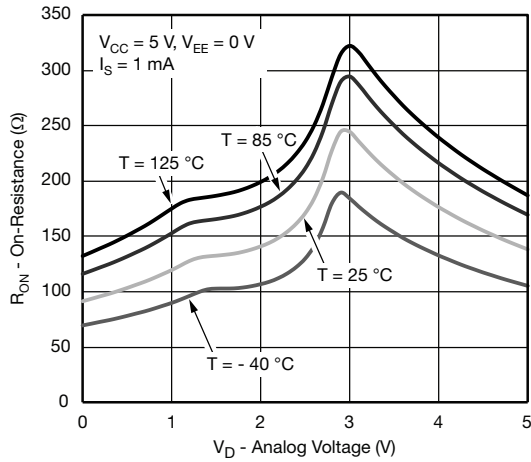


**RON vs.  $V_D$  and Single Supply Voltage**

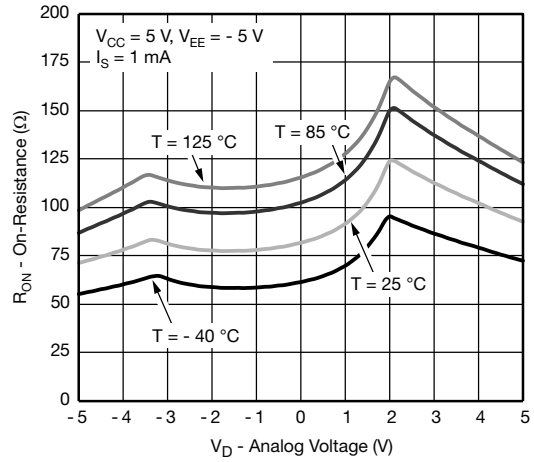


**RON vs.  $V_D$  and Dual Supply Voltage**

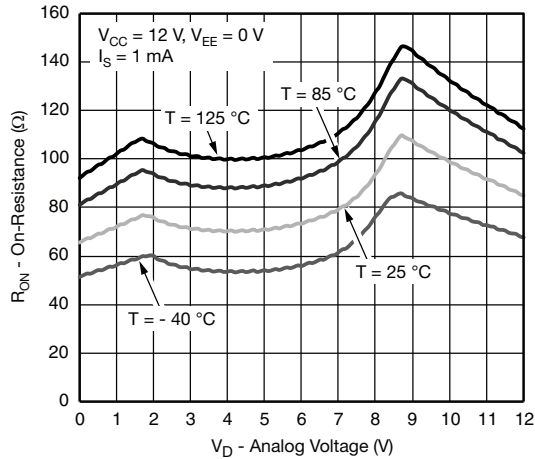
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



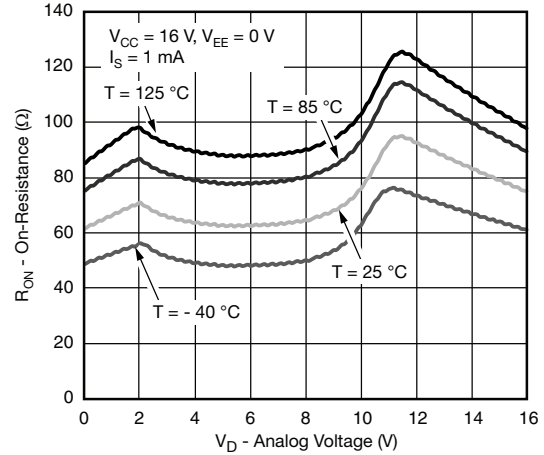
**$R_{ON}$  vs. Analog Voltage and Temperature**



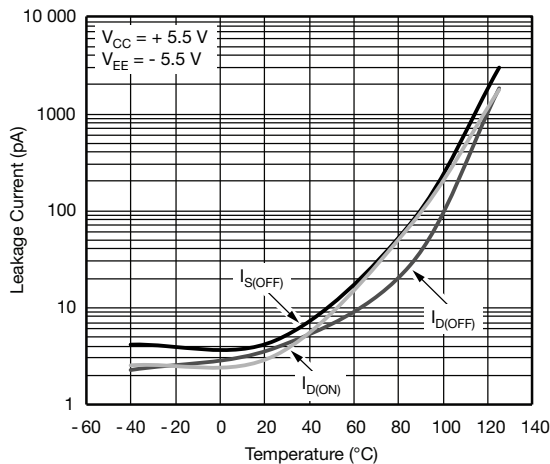
**$R_{ON}$  vs. Analog Voltage and Temperature**



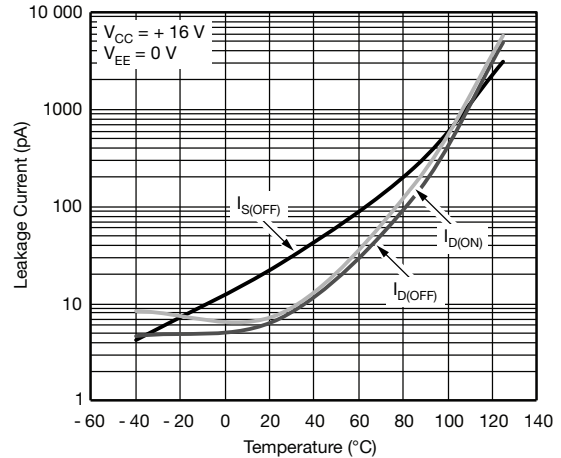
**$R_{ON}$  vs. Analog Voltage and Temperature**



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

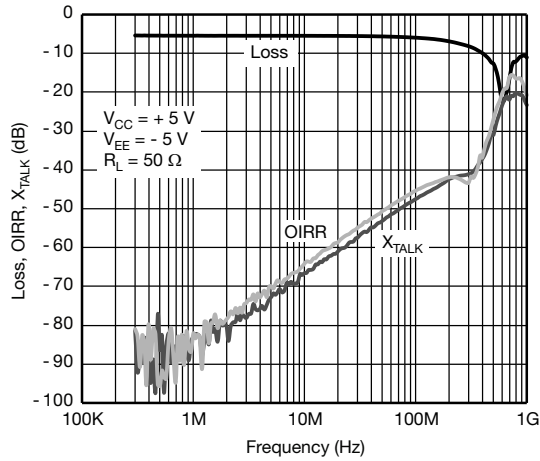


**Leakage Current vs. Temperature**

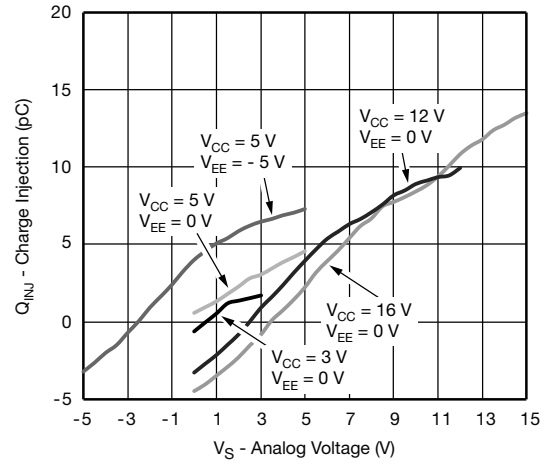


**Leakage Current vs. Temperature**

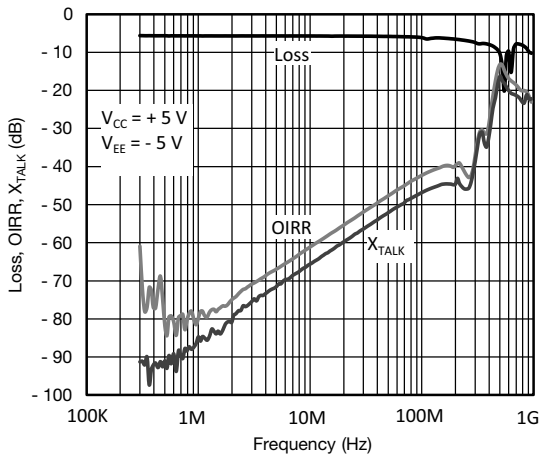
### TYPICAL CHARACTERISTICS



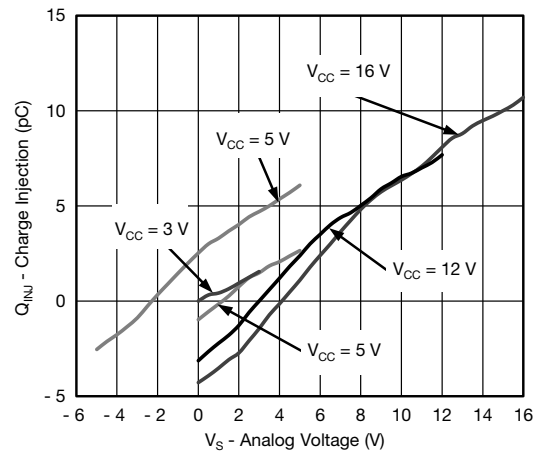
DG9251 Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



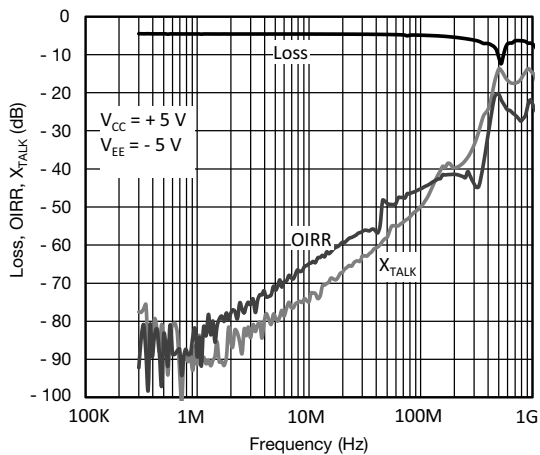
DG9251 Charge Injection vs. Analog Voltage



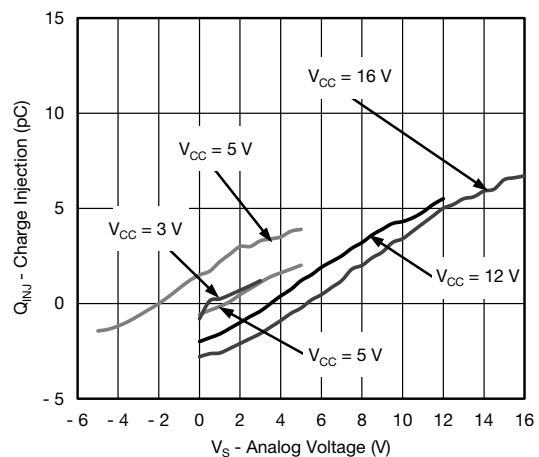
DG9252 Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



DG9252 Charge Injection vs. Analog Voltage

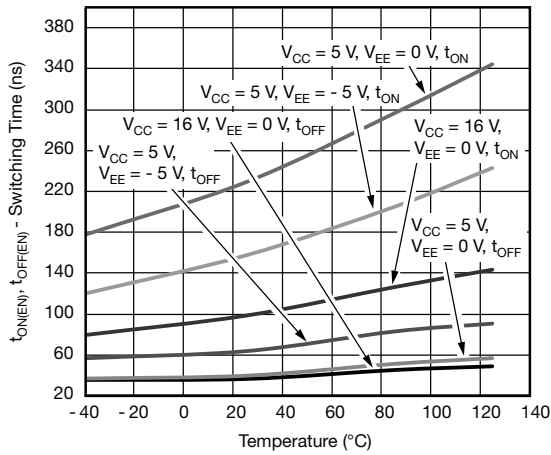


DG9253 Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

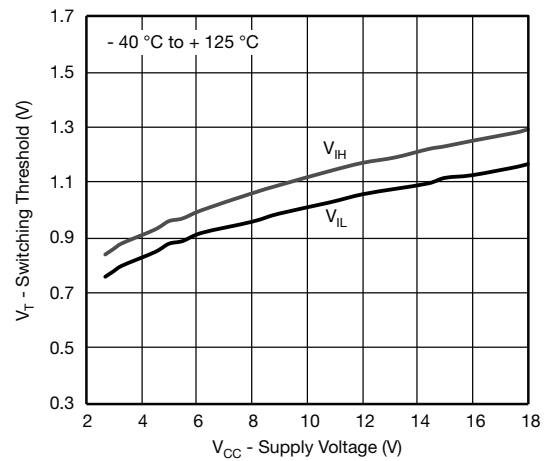


DG9253 Charge Injection vs. Analog Voltage

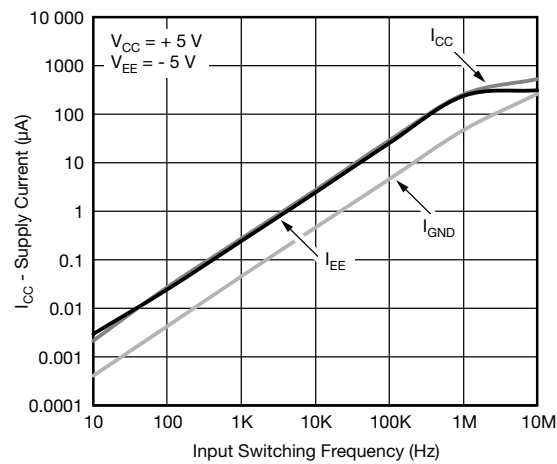
## TYPICAL CHARACTERISTICS



Switching Time vs. Temperature



Switching Threshold vs. Supply Voltage



Supply Current vs. Input Switching Frequency

## TEST CIRCUITS

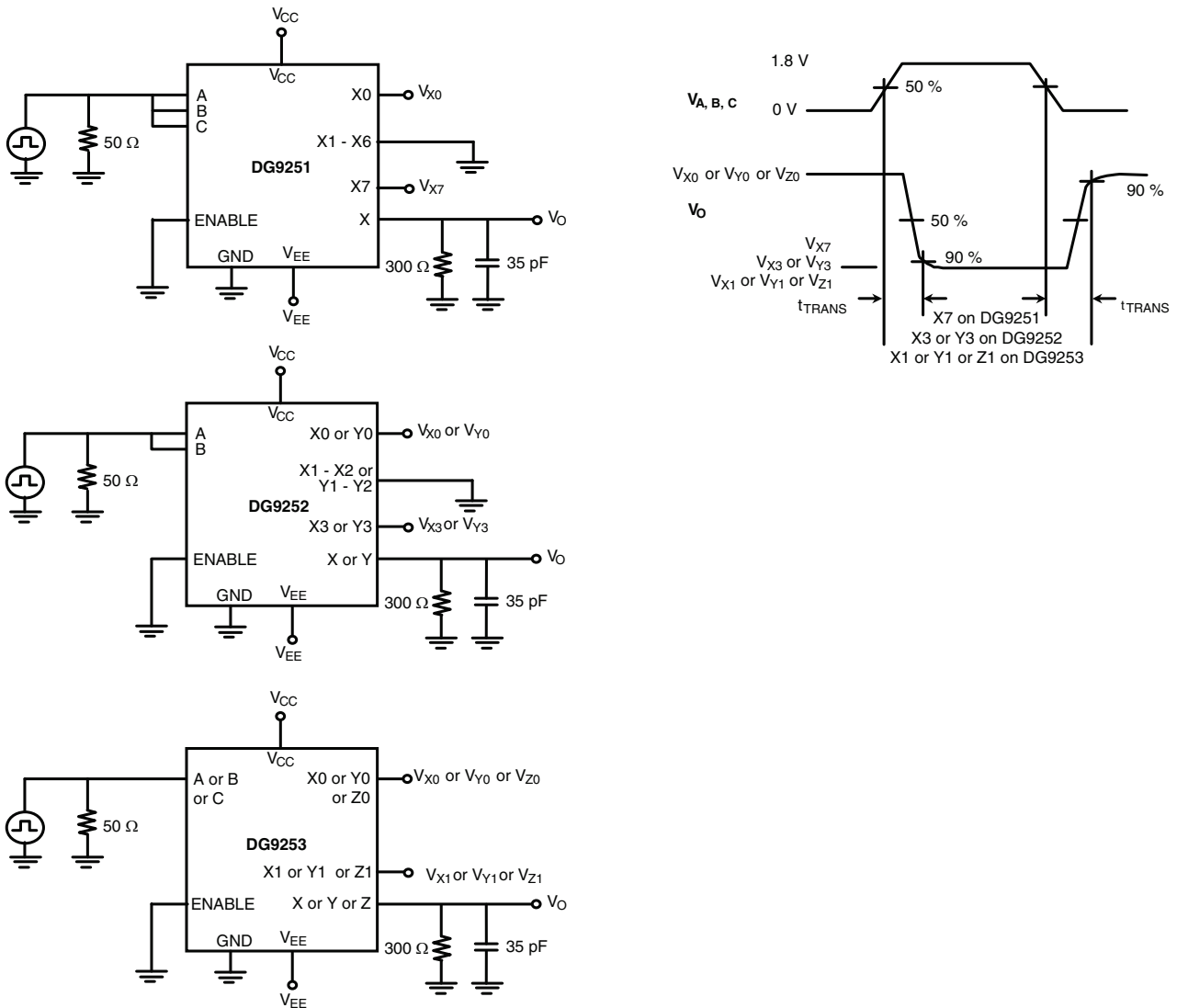


Figure 1. Transition Time

## TEST CIRCUITS

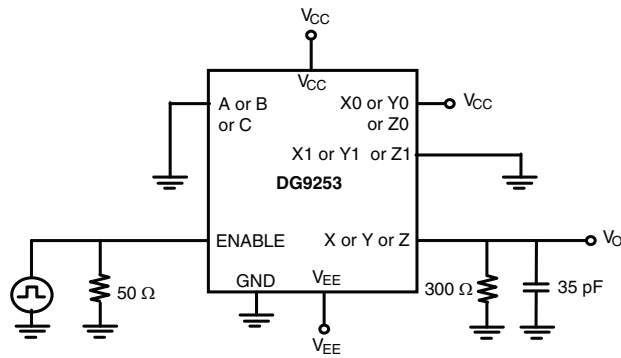
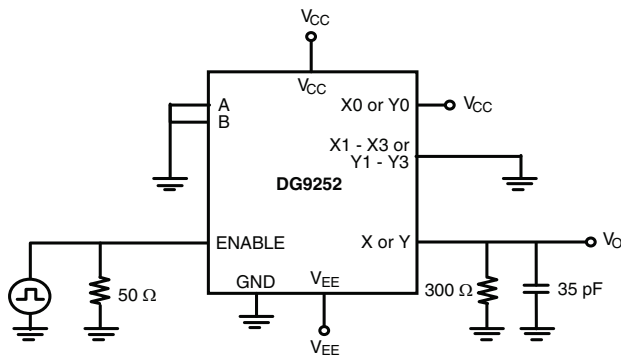
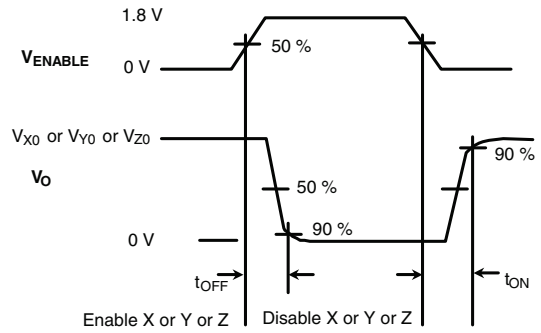
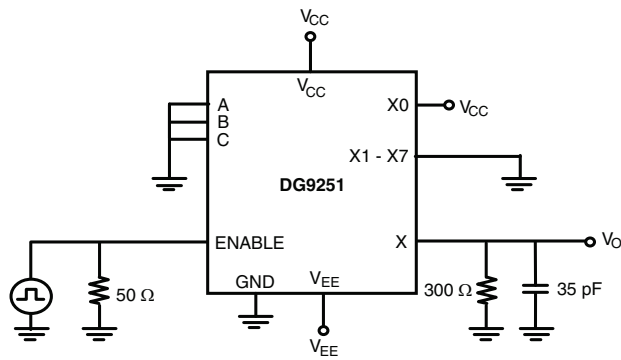


Figure 2. Enable Switching Time

## TEST CIRCUITS

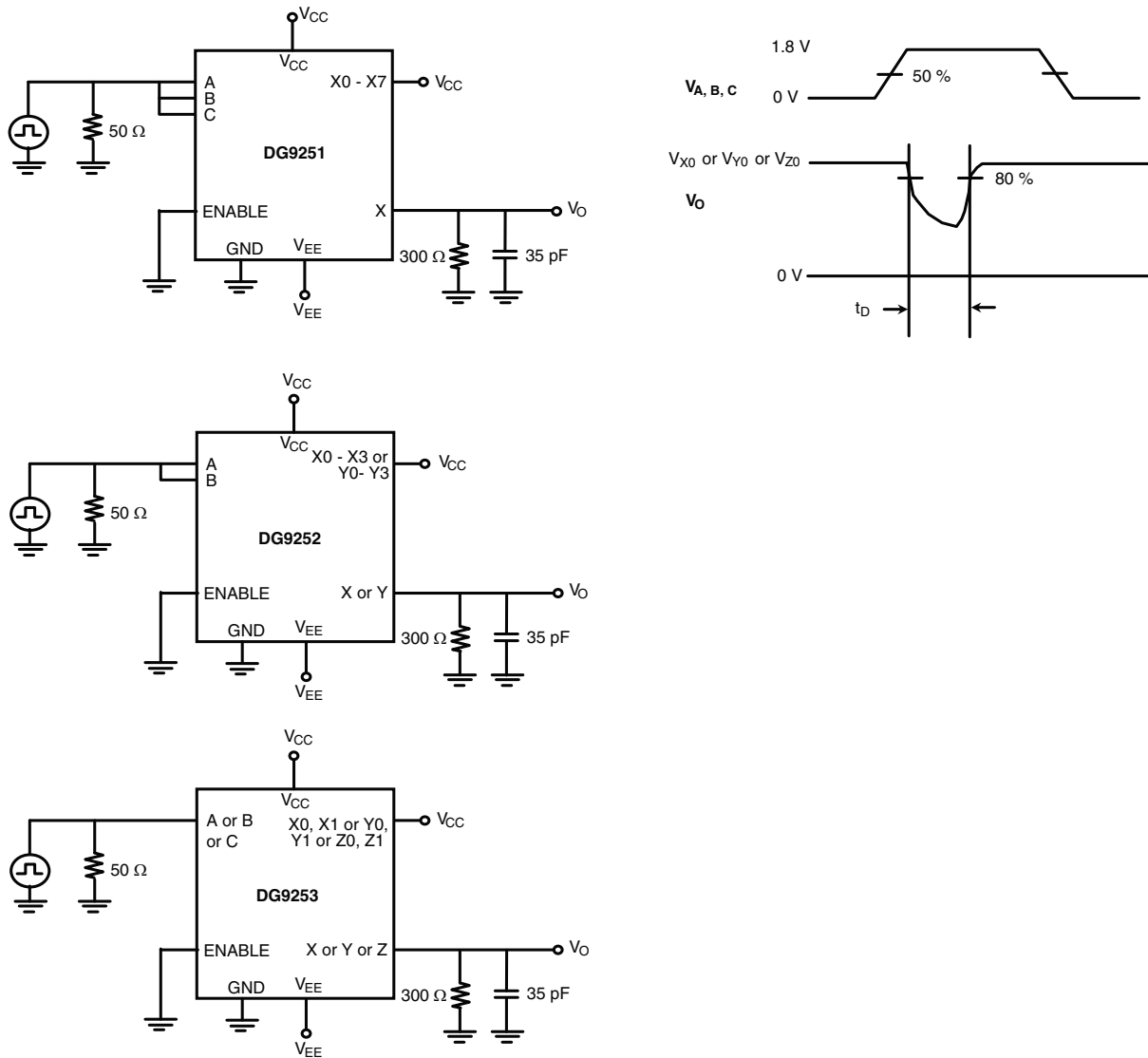


Figure 3. Break-Before-Make

## TEST CIRCUITS

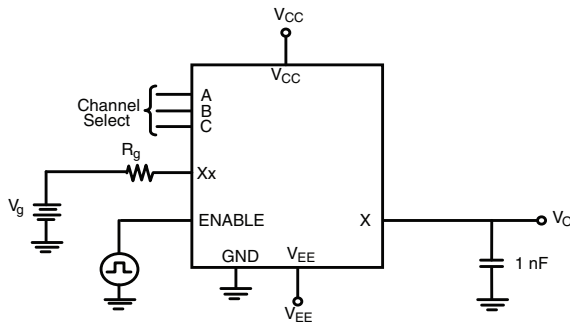
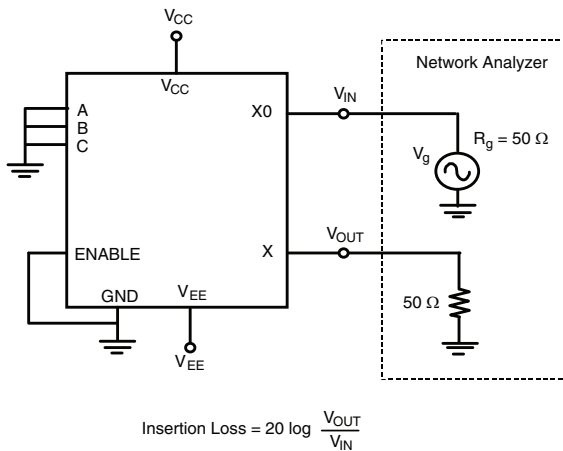
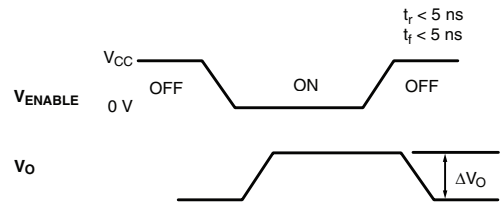
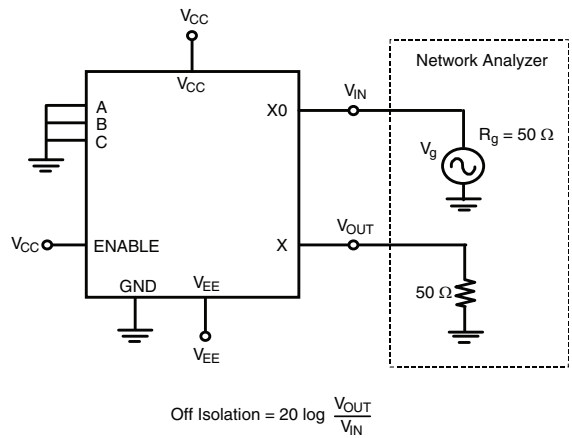


Figure 4. Charge Injection



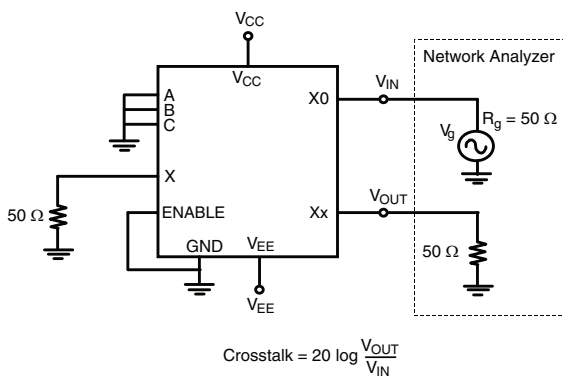
$$\text{Insertion Loss} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

Figure 5. Insertion Loss



$$\text{Off Isolation} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

Figure 6. Off Isolation



$$\text{Crosstalk} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

Figure 7. Crosstalk

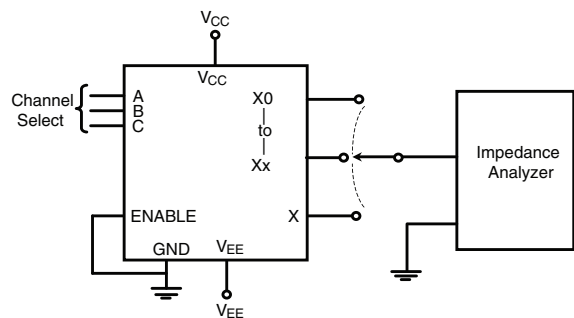
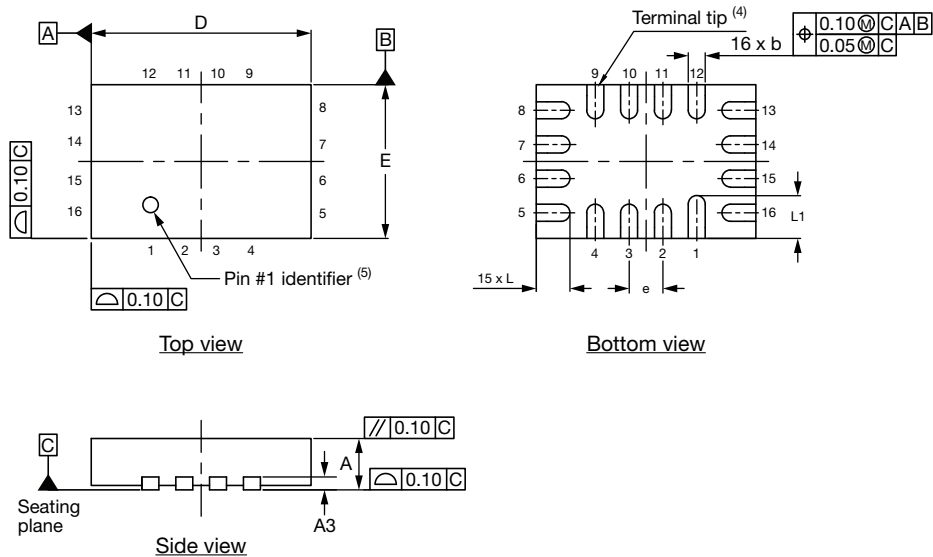


Figure 8. Source, Drain Capacitance

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?267075](http://www.vishay.com/ppg?267075).

## Thin miniQFN16 Case Outline



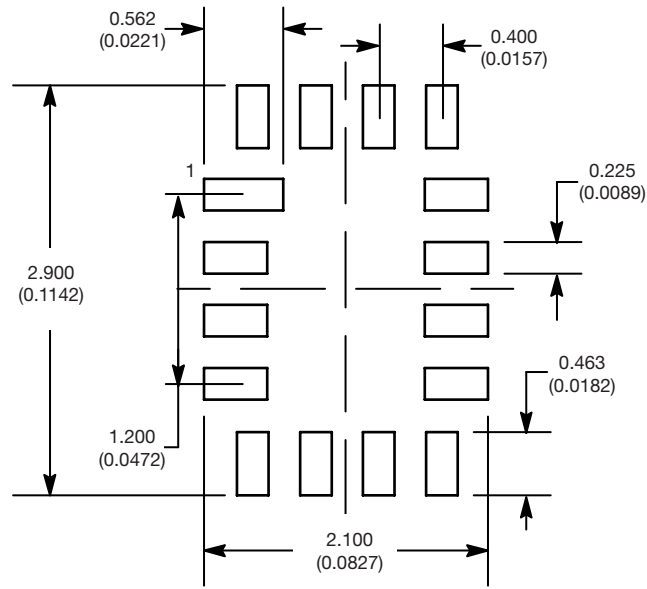
DIMENSIONS	MILLIMETERS <sup>(1)</sup>			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.50	0.55	0.60	0.020	0.022	0.024
A1	0	-	0.05	0	-	0.002
A3	0.15 ref.			0.006 ref.		
b	0.15	0.20	0.25	0.006	0.008	0.010
D	2.50	2.60	2.70	0.098	0.102	0.106
e	0.40 BSC			0.016 BSC		
E	1.70	1.80	1.90	0.067	0.071	0.075
L	0.35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

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DWG: 6023

**RECOMMENDED MINIMUM PADS FOR MINI QFN 16L**



Mounting Footprint  
Dimensions in mm (inch)



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