

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 ± 2.7 V to ± 5 V dual supplies, the DG9251, DG9252, and DG9253 are fully specified at + 16 V, + 5 V and ± 5 V. All control logic inputs have guaranteed 1.4 V high limit when operating from + 5 V or ± 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
- ± 2.7 V to ± 5 V dual supply operation
- Fully specified at + 16 V, + 5 V, ± 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**

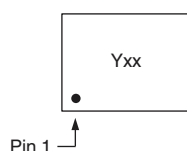
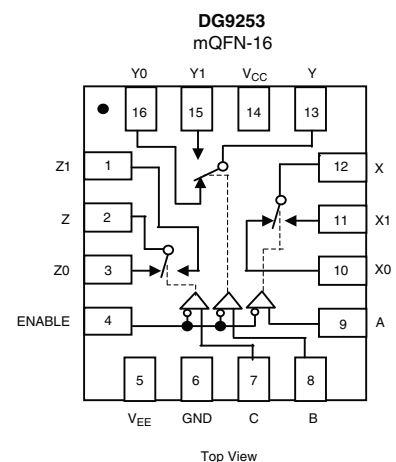
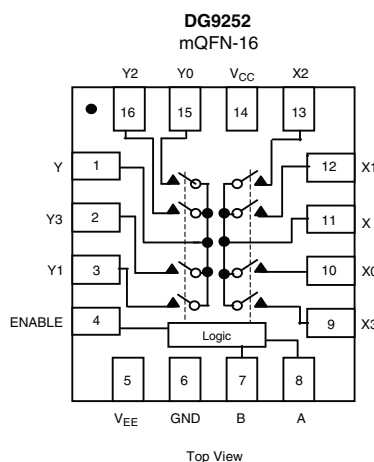
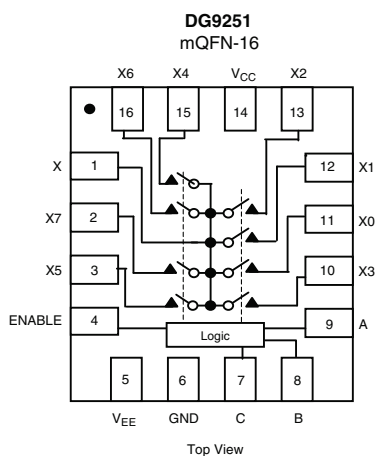


RoHS
COMPLIANT
HALOGEN
FREE

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 ^a	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 _A = 25 °C, unless otherwise noted)			
Parameter		Limit	Unit
V _{CC} to V _{EE}		18	V
GND to V-		9	
Digital Inputs ^a , V _S , V _D		(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 ^b	16-Pin miniQFN ^{c, d}	525	mW
Thermal Resistance ^b	16-Pin miniQFN ^d	152	°C/W
Latch-up (per JEDEC78)		> 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 V, V _{EE} = - 5 V V _{IN} (A, B, C and ENABLE) = 1.4 V, 0.3 V ^a		Temp. ^b	Typ. ^c	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit	
						Min. ^d	Max. ^d	Min. ^d	Max. ^d		
Analog Switch											
Analog Signal Range ^e	V _{ANALOG}			Full		- 5	5	- 5	5	V	
On-Resistance	R _{ON}	I _S = 1 mA, V _D = - 3 V, 0 V, + 3 V		Room Full	90		182 252		182 223	Ω	
On-Resistance Match	ΔR _{ON}	I _S = 1 mA, V _D = ± 3 V		Room Full	3.1		6 10		6 8		
On-Resistance Flatness	R _{FLATNESS}	I _S = 1 mA, V _D = - 3 V, 0 V, + 3 V		Room Full	32.4		44 64		44 61		
Switch Off Leakage Current	I _{S(off)}	V _{CC} = 5.5 V, V _{EE} = - 5.5 V, V _D = ± 4.5 V, V _S = ± 4.5 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} = 5.5 V, V _{EE} = - 5.5 V, V _S = V _D = ± 4.5 V		Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5		
Digital Control											
V _{IN} (A, B, C and ENABLE) Low	V _{IL}			Full			0.3		0.3	V	
V _{IN} (A, B, C and ENABLE) High	V _{IH}			Full		1.4		1.4			
Input Current, V _{IN} Low	I _{IL}	V _{IN} (A, B, C and ENABLE) under test = 0.3 V		Full	0.01	- 1	1	- 1	1	μA	
Input Current, V _{IN} High	I _{IH}	V _{IN} (A, B, C and ENABLE) under test = 1.4 V		Full	0.01	- 1	1	- 1	1		
Input Capacitance ^e	C _{IN}	f = 1 MHz		Room	2.4					pF	
Dynamic Characteristics											
Transition Time	t _{TRANS}	R _L = 300 Ω, C _L = 35 pF see figure 1, 2, 3		Room Full	88		236 281		236 251	ns	
Enable Turn-On Time	t _{ON}			Room Full	158		250 455		250 369		
Enable Turn-Off Time	t _{OFF}			Room Full	40		125 136		125 131		
Break-Before-Make Time Delay	t _D			Room Full	32	13		13			
Off Isolation ^e	OIRR	R _L = 50 Ω, C _L = 15 pF	f = 100 kHz	Room	< - 90					dB	
			f = 10 MHz	Room	- 64						
f = 100 MHz	Room		- 45								
Channel-to-Channel Crosstalk ^e	X _{TALK}		f = 100 kHz	Room	< - 90						
			f = 10 MHz	Room	- 67						
			f = 100 MHz	Room	- 48						
Bandwidth, 3 dB	BW	R _L = 50 Ω	DG9251	Room	314					MHz	
			DG9252	Room	449						
			DG9253	Room	480						
Charge Injection ^e	Q	V _g = 0 V, R _g = 0 Ω, C _L = 1 nF		Room	4.1					pC	
Source Off Capacitance ^e	C _{S(off)}	f = 1 MHz	DG9251	Room	2.7					pF	
			DG9252	Room	2.2						
			DG9253	Room	2.0						
Drain Off Capacitance ^e	C _{D(off)}	f = 1 MHz	DG9251	Room	10.7						
			DG9252	Room	6.6						
			DG9253	Room	4.6						
Channel On Capacitance ^e	C _{D(on)}	f = 1 MHz	DG9251	Room	14.6						
			DG9252	Room	9.8						
			DG9253	Room	8.6						
Total Harmonic Distortion ^e	THD	Signal = 1 V _{RMS} , 20 Hz to 20 kHz, R _L = 600 Ω		Room	0.2					%	

SPECIFICATIONS (for Dual Supplies)									
Parameter	Symbol	Test Conditions Unless Otherwise Specified V _{CC} = + 5 V, V _{EE} = - 5 V V _{IN} (A, B, C and ENABLE) = 1.4 V, 0.3 V ^a	Temp. ^b	Typ. ^c	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. ^d	Max. ^d	Min. ^d	Max. ^d	
Power Supplies									
Power Supply Current	I _{CC}	V _{CC} = + 5 V, V _{EE} = - 5 V V _{IN} (A, B, C and ENABLE) = 0 or 5 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} = + 5 V, V _{EE} = 0 V V _{IN} (A, B, C and ENABLE) = 1.4 V, 0.3 V ^a	Temp. ^b	Typ. ^c	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. ^d	Max. ^d	Min. ^d	Max. ^d	
Analog Switch									
Analog Signal Range ^e	V _{ANALOG}		Full		0	5	0	5	V
On-Resistance	R _{ON}	I _S = 1 mA, V _D = 0 V, + 3.5 V	Room Full	145		482 565		482 513	Ω
On-Resistance Match	ΔR _{ON}	I _S = 1 mA, V _D = + 3.5 V	Room Full	3.6		20 22		20 21	
On-Resistance Flatness	R _{FLATNESS}	I _S = 1 mA, V _D = 0 V, + 3 V	Room Full	113		151 254		151 231	
Switch Off Leakage Current	I _{S(off)}	V _{CC} = + 5.5 V, V _{EE} = 0 V V _D = 1 V/4.5 V, V _S = 4.5 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} = + 5.5 V, V _{EE} = 0 V V _D = V _S = 1 V/4.5 V	Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	
Digital Control									
V _{IN} (A, B, C and ENABLE) Low	V _{IL}		Full			0.3		0.3	V
V _{IN} (A, B, C and ENABLE) High	V _{IH}		Full		1.4		1.4		
Input Current, V _{IN} Low	I _L	V _{IN} (A, B, C and ENABLE) under test = 0.3 V	Full	0.01	- 1	1	- 1	1	μA
Input Current, V _{IN} High	I _H	V _{IN} (A, B, C and ENABLE) under test = 1.4 V	Full	0.01	- 1	1	- 1	1	
Dynamic Characteristics									
Transition Time	t _{TRANS}	R _L = 300 Ω, C _L = 35 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 ^e	Q	V _g = 0 V, R _g = 0 Ω, C _L = 1 nF	Full	0.44					pC
Off Isolation ^e	OIRR	R _L = 50 Ω, C _L = 15 pF f = 100 kHz	Room	< - 90					dB
Channel-to-Channel Crosstalk ^e	X _{TALK}		Room	< - 90					

**SPECIFICATIONS** (for Unipolar Supplies)

Parameter	Symbol	Test Conditions Unless Otherwise Specified V _{CC} = + 5 V, V _{EE} = 0 V V _{IN} (A, B, C and ENABLE) = 1.4 V, 0.3 V ^a		Temp. ^b	Typ. ^c	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
						Min. ^d	Max. ^d	Min. ^d	Max. ^d	
Dynamic Characteristics										
Source Off Capacitance ^e	C _{S(off)}	f = 1 MHz	DG9251	Room	2.9					pF
			DG9252	Room	2.2					
			DG9253	Room	2.1					
Drain Off Capacitance ^e	C _{D(off)}	f = 1 MHz	DG9251	Room	12.4					
			DG9252	Room	6.8					
			DG9253	Room	4.6					
Channel On Capacitance ^e	C _{D(on)}	f = 1 MHz	DG9251	Room	16					
			DG9252	Room	10.6					
			DG9253	Room	8.8					
Power Supplies										
Power Supply Current	I _{CC}	V _{IN} (A, B, C and ENABLE) = 0 V or 5 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 V, V _{EE} = 0 V V _{IN} (A, B, C and ENABLE) = 1.6 V, 0.5 V ^a	Temp. ^b	Typ. ^c	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
					Min. ^d	Max. ^d	Min. ^d	Max. ^d	
Analog Switch									
Analog Signal Range ^e	V _{ANALOG}		Full		0	16	0	16	V
On-Resistance	R _{ON}	I _S = 1 mA, V _D = 0.7 V, 8 V, 15.3 V	Room Full	69		152 171		152 158	Ω
On-Resistance Match	ΔR _{ON}	I _S = 1 mA, V _D = + 0.7 V	Room Full	2		7 10		7 8	
On-Resistance Flatness	R _{FLATNESS}	I _S = 1 mA, V _D = 0.7 V, + 15.3 V	Room Full	32		45 53		45 49	
Switch Off Leakage Current	I _{S(off)}	V _{CC} = + 16 V, V _{EE} = 0 V V _D = 1 V/15 V, V _S = 15 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 V, V _{EE} = 0 V V _D = V _S = 1 V/15 V	Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	
Digital Control									
V _{IN} (A, B, C and ENABLE) Low	V _{IL}		Full			0.5		0.5	V
V _{IN} (A, B, C and ENABLE) High	V _{IH}		Full		1.6		1.6		
Input Current, V _{IN} Low	I _L	V _{IN} (A, B, C 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 and ENABLE) under test = 1.6 V	Full	0.01	- 1	1	- 1	1	
Dynamic Characteristics									
Transition Time	t _{TRANS}	R _L = 300 Ω, C _L = 35 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 V^a		Temp. ^b	Typ. ^c	- 40 °C to 125 °C		- 40 °C to 85 °C		Unit
						Min. ^d	Max. ^d	Min. ^d	Max. ^d	
Charge Injection ^e	Q	$V_g = 0\text{ V}$, $R_g = 0\text{ }\Omega$, $C_L = 1\text{ nF}$		Room	4.5					pC
Dynamic Characteristics										
Off Isolation ^e	OIRR	$R_L = 50\text{ }\Omega$, $C_L = 15\text{ pF}$ $f = 100\text{ kHz}$		Room	< - 90					dB
Channel-to-Channel Crosstalk ^e	X_{TALK}			Room	< - 90					
Source Off Capacitance ^e	$C_{S(off)}$	$f = 1\text{ MHz}$	DG9251	Room	2.6					pF
			DG9252	Room	2.1					
			DG9253	Room	1.8					
Drain Off Capacitance ^e	$C_{D(off)}$	$f = 1\text{ MHz}$	DG9251	Room	10.4					
			DG9252	Room	5.8					
			DG9253	Room	4.2					
Channel On Capacitance ^e	$C_{D(on)}$	$f = 1\text{ MHz}$	DG9251	Room	15					
			DG9252	Room	9.5					
			DG9253	Room	8.2					
Power Supplies										
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	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		

Notes:

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

b. Room - 25 °C, full = as determined by the operating temperature suffix.

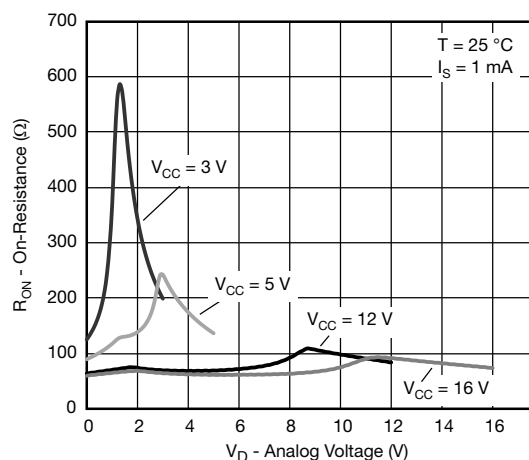
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.

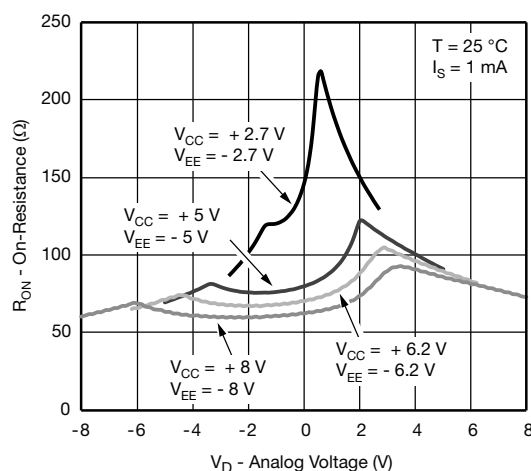
e. Guaranteed by design, not subject to production test.

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.

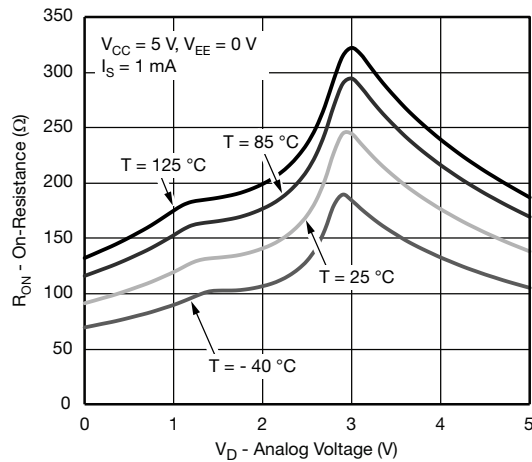
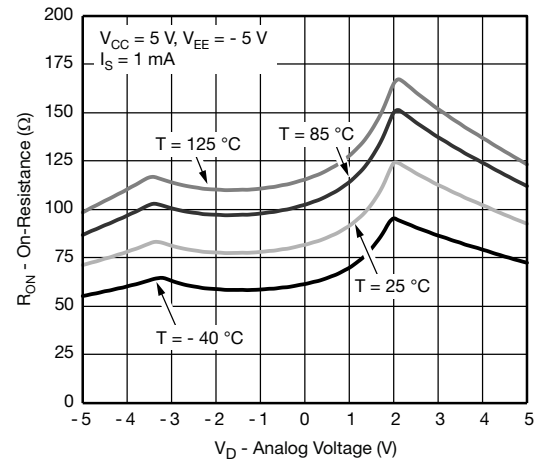
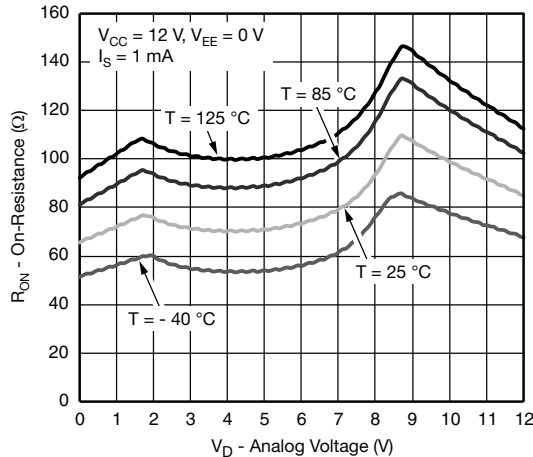
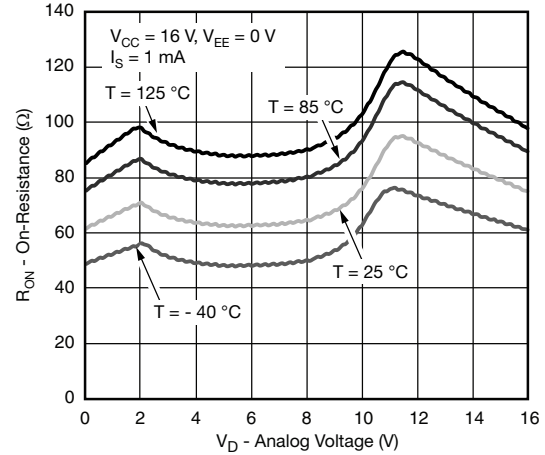
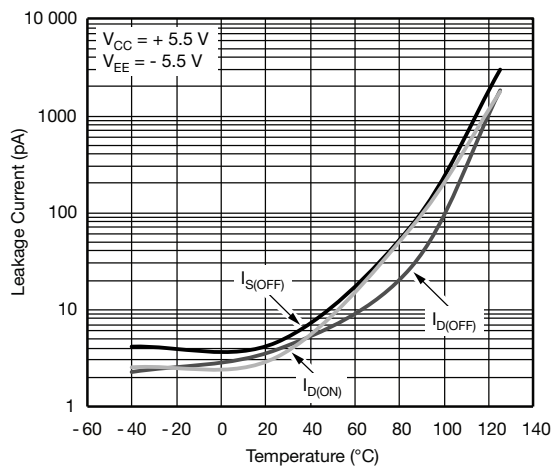
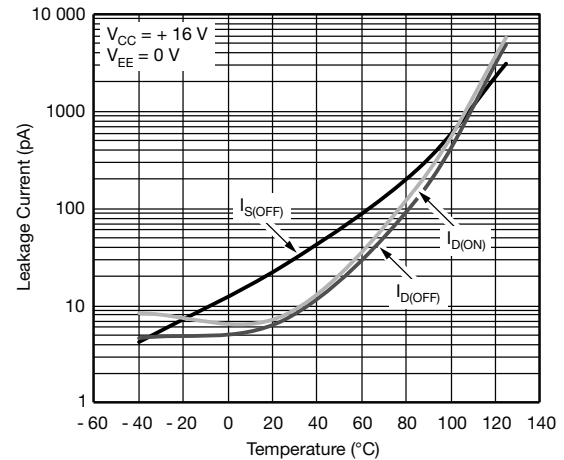
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



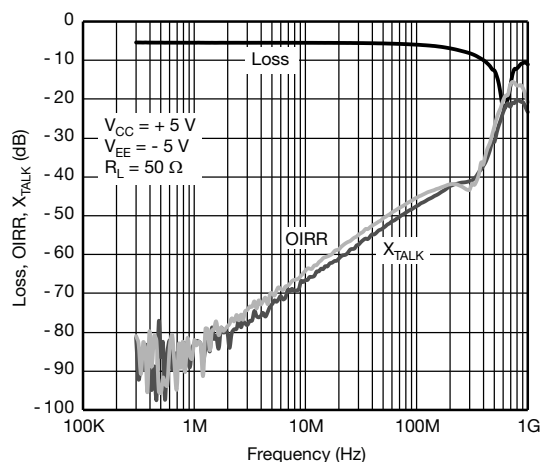
R_{ON} vs. V_D and Single Supply Voltage



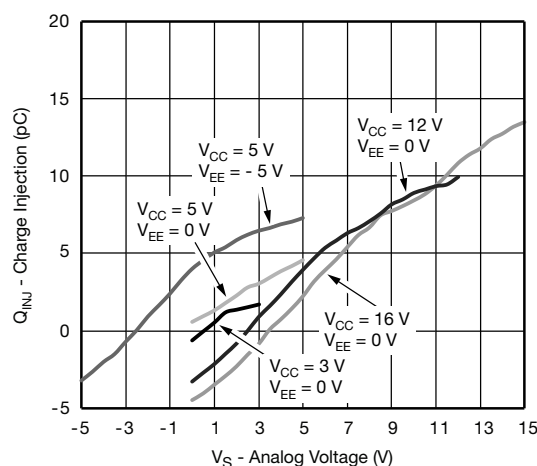
R_{ON} vs. V_D and Dual Supply Voltage

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

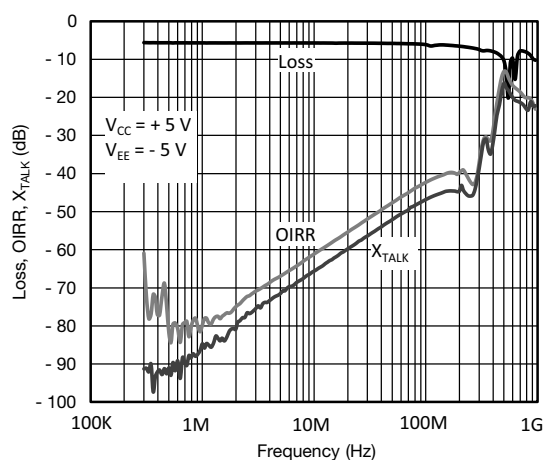
TYPICAL CHARACTERISTICS



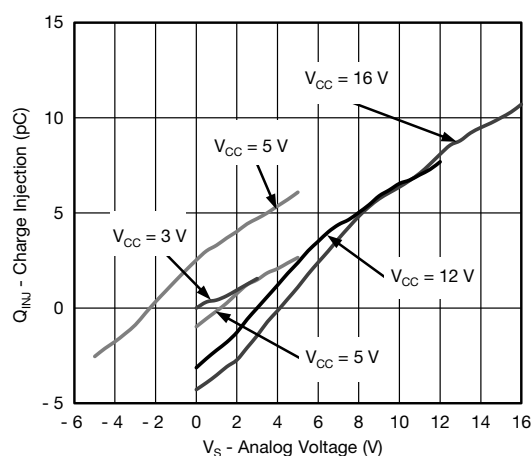
DG9251 Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



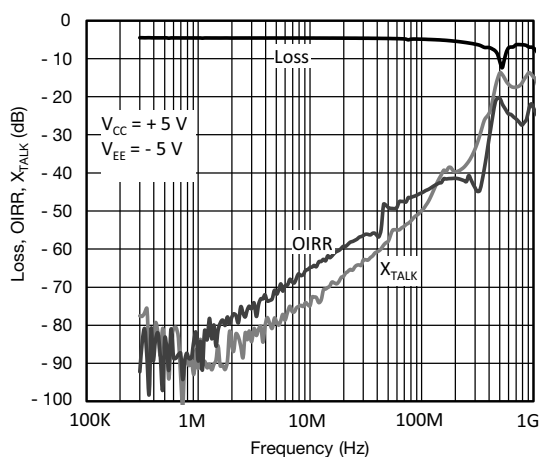
DG9251 Charge Injection vs. Analog Voltage



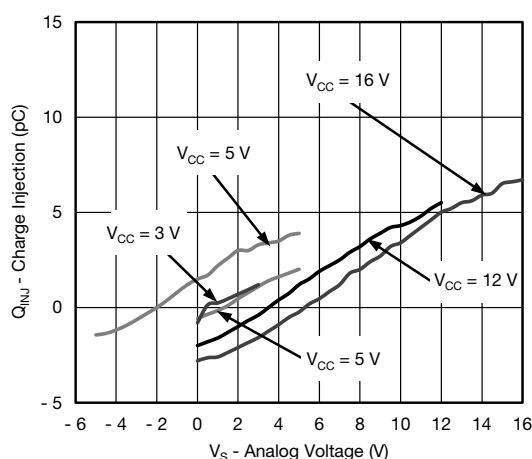
DG9252 Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



DG9252 Charge Injection vs. Analog Voltage

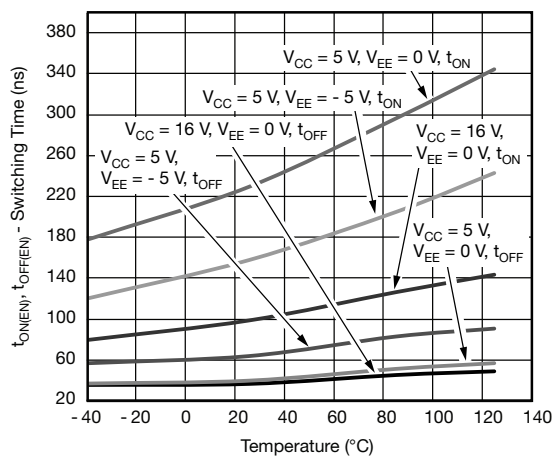


DG9253 Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

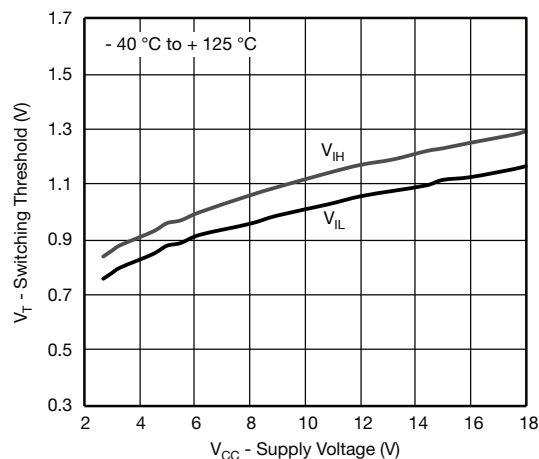


DG9253 Charge Injection vs. Analog Voltage

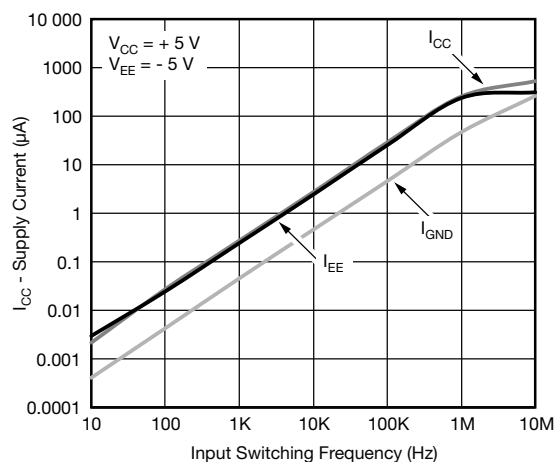
TYPICAL CHARACTERISTICS



Switching Time vs. Temperature



Switching Threshold vs. Supply Voltage



Supply Current vs. Input Switching Frequency

TEST CIRCUITS

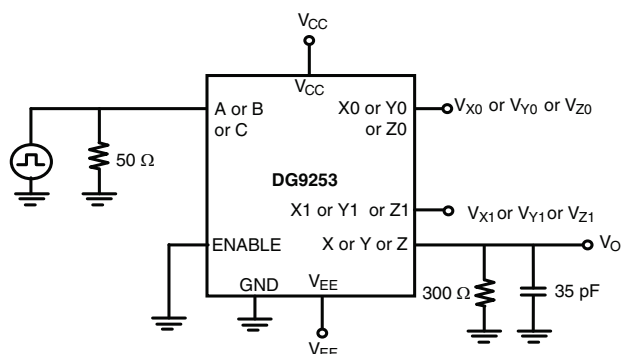
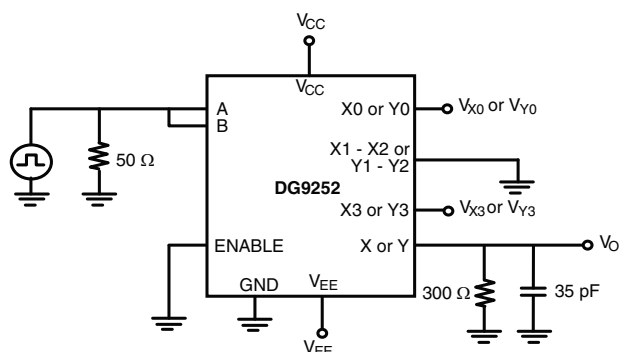
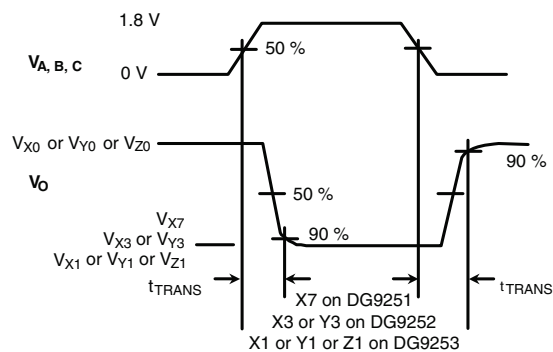
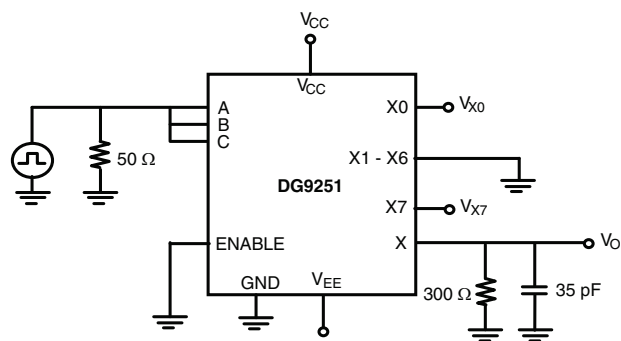
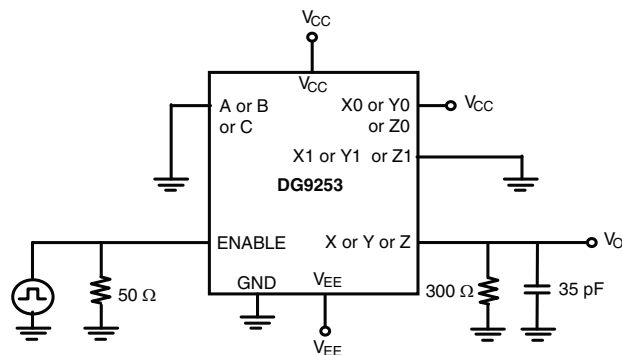
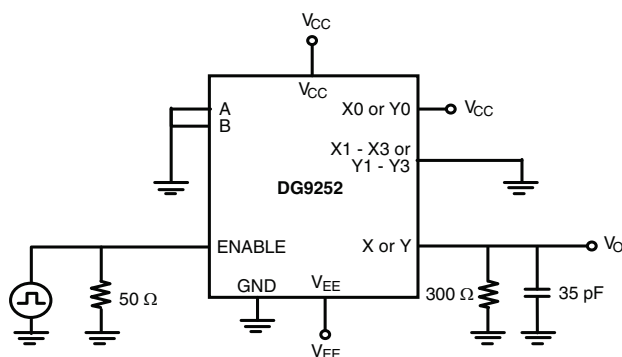
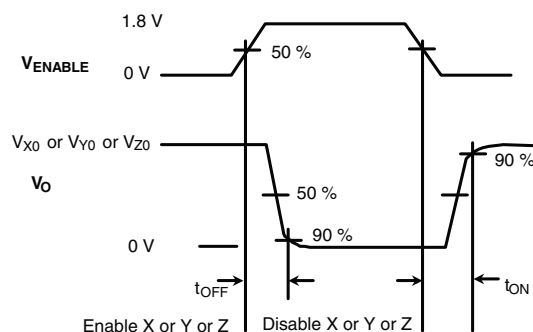
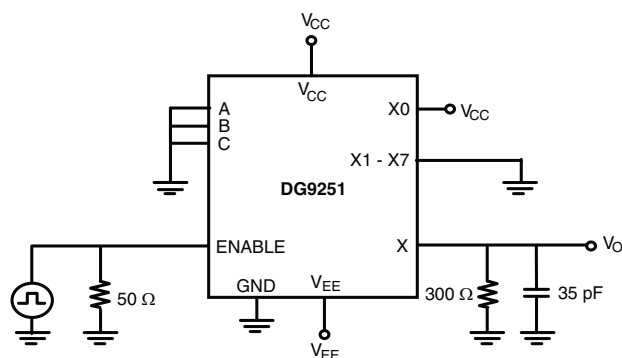


Figure 1. Transition Time

TEST CIRCUITS

Figure 2. Enable Switching Time

TEST CIRCUITS

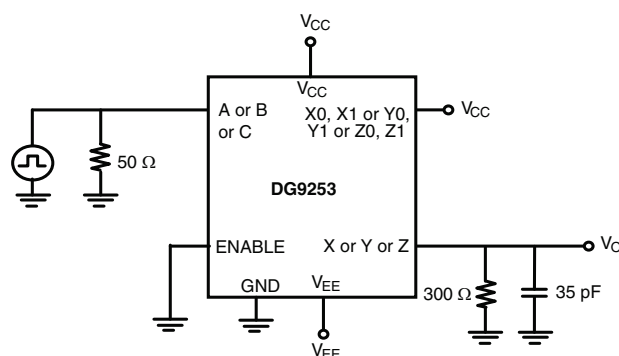
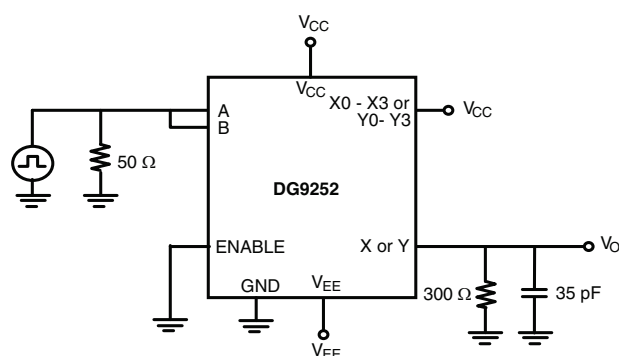
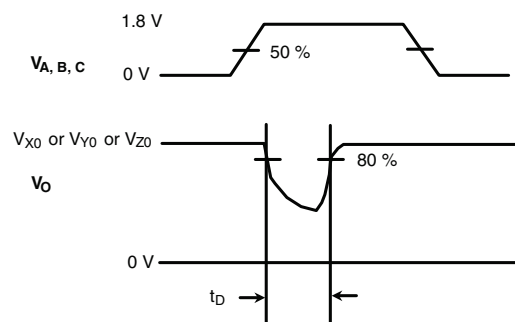
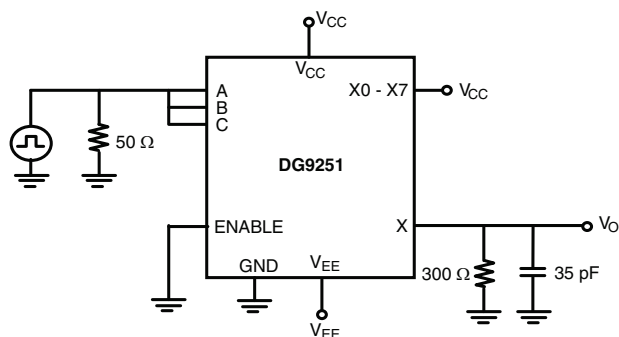


Figure 3. Break-Before-Make

TEST CIRCUITS

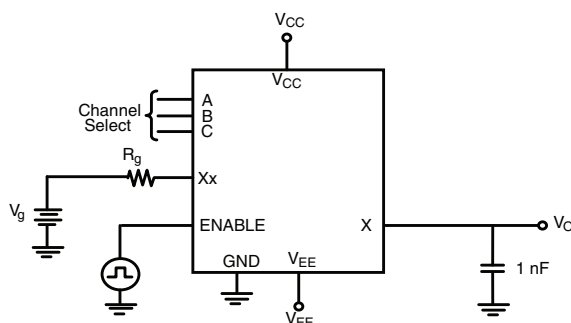


Figure 4. Charge Injection

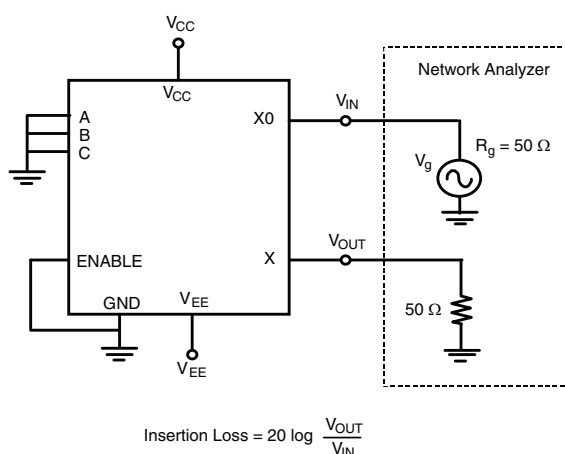
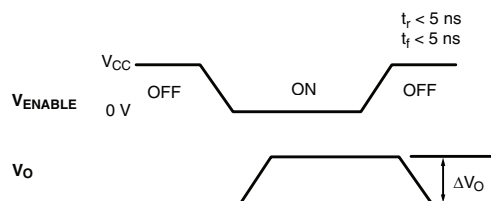


Figure 5. Insertion Loss

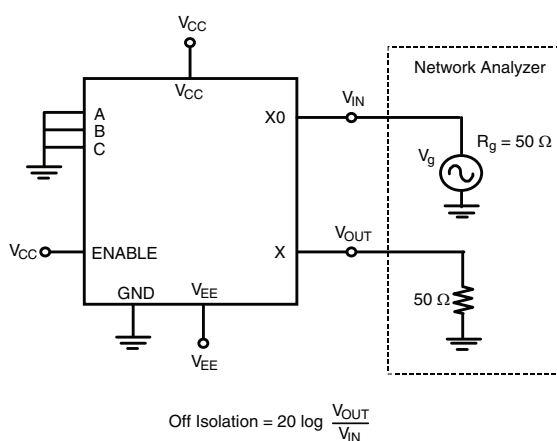


Figure 6. Off Isolation

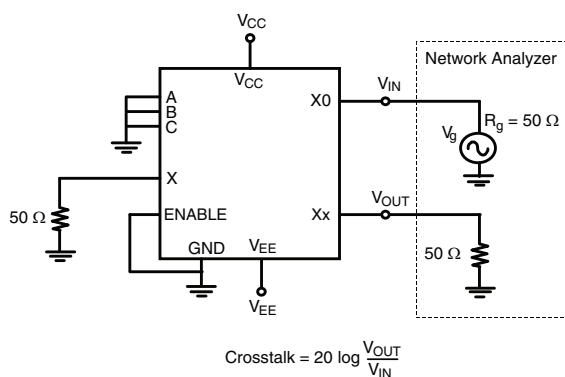


Figure 7. Crosstalk

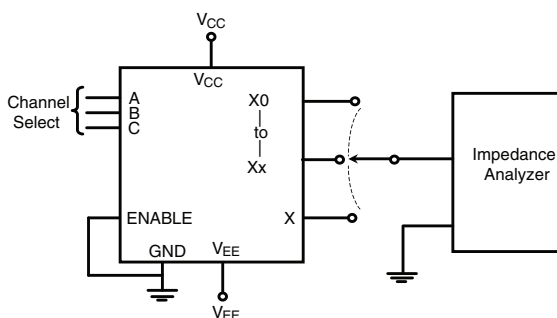
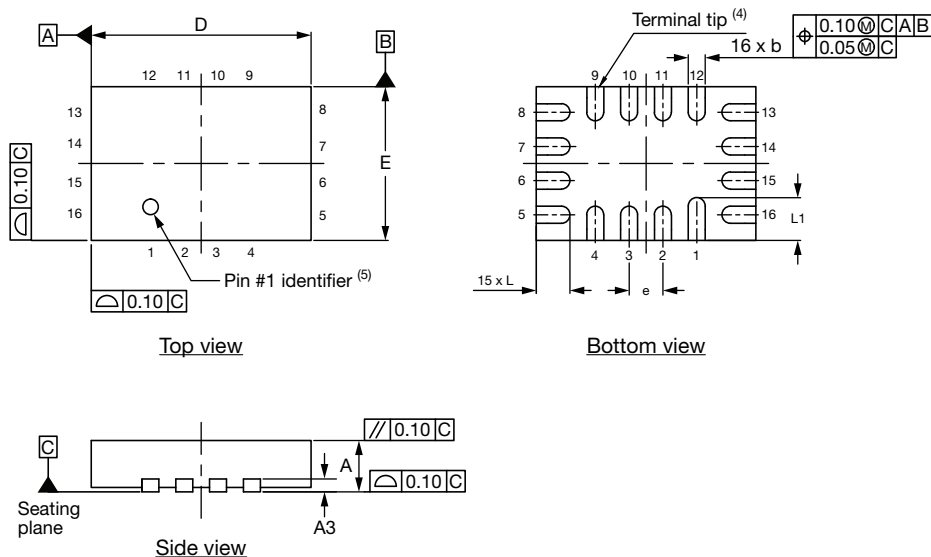


Figure 8. Source, Drain Capacitance

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Thin miniQFN16 Case Outline



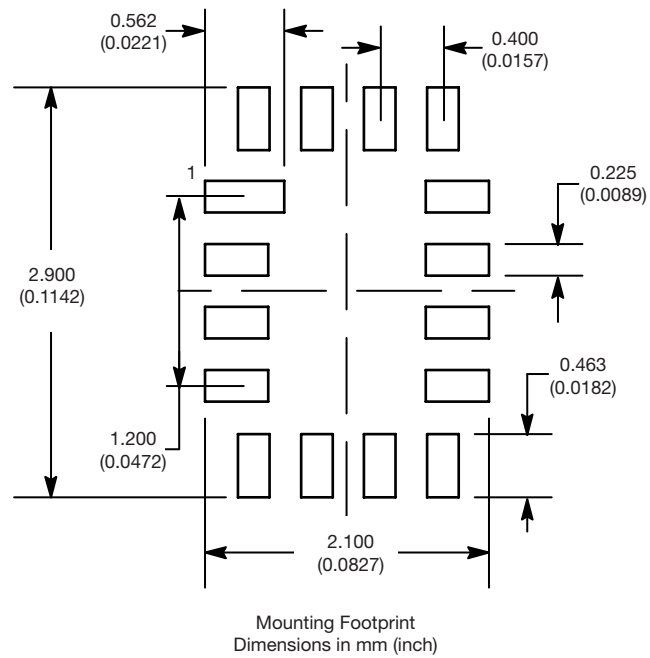
DIMENSIONS	MILLIMETERS ⁽¹⁾			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.50	0.55	0.60	0.020	0.022	0.024
A1	0	-	0.05	0	-	0.002
A3	0.15 ref.			0.006 ref.		
b	0.15	0.20	0.25	0.006	0.008	0.010
D	2.50	2.60	2.70	0.098	0.102	0.106
e	0.40 BSC			0.016 BSC		
E	1.70	1.80	1.90	0.067	0.071	0.075
L	0.35	0.40	0.45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





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