8-Channel Multiplexer, with 0.5 pC Charge Injection

DESCRIPTION

The DG9451 is a precision low voltage, single and dual supply CMOS analog 8-channel multiplexer.

The DG9451 is designed to operate from a + 2.7 V to + 12 V single supply or from ± 5 V dual supplies and is fully specified at + 12 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 1.6 V when operating from a + 12 V supply.

The DG9451 switches 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.

< 0.5 pC low charge injection coupled with very low switch capacitance make these products ideal for precision instrumentation multiplexers.

Operating temperature is specified from - 40 °C to + 125 °C.

The DG9451 is available in the space saving 1.8 mm x 2.6 mm miniQFN package.

FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- + 2.7 V to + 12 V single supply operation ± 2.5 V to ± 5 V dual supply operation
- Fully specified at + 12 V, + 5 V, ± 5 V
- 100 Ω maximum on-resistance
- Low voltage
- Low charge injection (< 0.5 pC typ.)
- High bandwidth: 270 MHz
- Low switch capacitance ($C_{s(off)}$ 1 pF typ.)
- Excellent isolation and crosstalk performance (typ. - 44 dB at 100 MHz)
- MiniQFN package (1.8 mm x 2.6 mm)
- Fully specified from - 40 °C to + 85 °C and - 40 °C to + 125 °C
- Compliant to RoHS directive 2002/95/EC

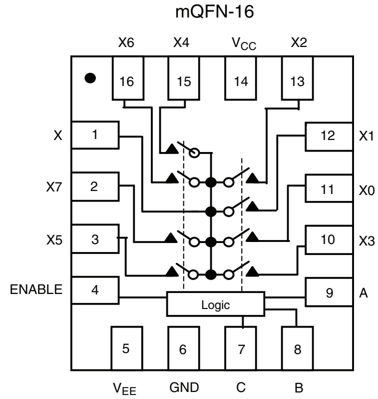
Pb-free
RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

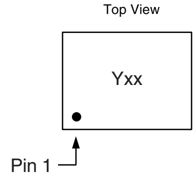
- Precision instrumentation
- Sample and hold applications
- Medical instruments
- High speed communication applications
- Automated test equipment
- High-end data acquisition

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

mQFN-16



Top View



Device Marking: Yxx for DG9451 (miniQFN16)

xx = Date/Lot Traceability Code

TRUTH TABLE

Enable Input	Select Inputs			On Switches
	C	B	A	DG9451
H	X	X	X	All Switches Open
L	L	L	L	X to X0
L	L	L	H	X to X1
L	L	H	L	X to X2
L	L	H	H	X to X3
L	H	L	L	X to X4
L	H	L	H	X to X5
L	H	H	L	X to X6
L	H	H	H	X to X7

ORDERING INFORMATION

Temp. Range	Package	Part Number
DG9451		
- 40 °C to 125 °C[a]	16-Pin miniQFN	DG9451EN-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+ to V-		14	V
GND to V-		7	
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 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 V, V_{EE} = - 5 V $V_{IN(A, B, C \text{ and } ENABLE)}$ = 1.4 V, 0.3 V[a]	Temp.[b]	Typ.[c]	- 40 °C to 125 °C Min.[d]	- 40 °C to 125 °C Max.[d]	- 40 °C to 85 °C Min.[d]	- 40 °C to 85 °C Max.[d]	Unit
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	66		100 125		100 118	Ω
On-Resistance Match	ΔR_{ON}	I_S = 1 mA, V_D = ± 3 V	Room Full	3		6 10		6 8	
On-Resistance Flatness	$R_{FLATNESS}$	I_S = 1 mA, V_D = - 3 V, 0 V, + 3 V	Room Full	10.2		16 20		16 18	
Switch Off Leakage Current	$I_{S(off)}$	V+ = 5.5 V, V- = - 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+ = 5.5 V, V- = - 5.5 V, V_S = V_D = ± 4.5 V	Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	
Digital Control									
$V_{IN(A, B, C \text{ and } ENABLE)}$ 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_{IL}	$V_{IN(A, B, C \text{ and } ENABLE)}$ under test = 0.3 V	Full	0.01	- 1	1	- 1	1	µA
Input Current, V_{IN} High	I_{IH}	$V_{IN(A, B, C \text{ and } ENABLE)}$ under test = 1.4 V	Full	0.01	- 1	1	- 1	1	
Input Capacitance[e]	C_{IN}	f = 1 MHz	Room	3.4					pF
Dynamic Characteristics									
Transition Time	t_{TRANS}	R_L = 300 Ω, C_L = 35 pF see figure 1, 2, 3	Room Full	66		180 218		180 207	ns
Enable Turn-On Time	t_{ON}		Room Full	152		250 295		250 282	
Enable Turn-Off Time	t_{OFF}		Room Full	60		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	- 65					
		f = 100 MHz	Room	- 44					
Channel-to-Channel Crosstalk[e]	X_{TALK}	f = 100 kHz	Room	< - 90					
		f = 10 MHz	Room	- 74					
		f = 100 MHz	Room	- 44					
Bandwith, 3 dB	BW	R_L = 50 Ω	Room	270					MHz
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	0.20					pC
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	1					pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room	10					
Channel On Capacitance[e]	$C_{D(on)}$		Room	16					
Total Harmonic Distortion[e]	THD	Signal = 1 V_{RMS}, 20 Hz to 20 kHz, R_L = 600 Ω	Room	0.01					%
Power Supplies									
Power Supply Current	I+	V_{CC} = + 5 V, V_{EE} = - 5 V $V_{IN(A, B, C \text{ and } ENABLE)}$ = 0 or 5 V	Room Full	0.05		1 10		1 10	µA
Negative Supply Current	I-		Room Full	- 0.05	- 1 - 10		- 1 - 10		
Ground Current	I_{GND}		Room Full	- 0.05	- 1 - 10		- 1 - 10		

SPECIFICATIONS FOR UNIPOLAR SUPPLIES									
		Test Conditions Unless Otherwise Specified V_{CC} = + 5 V, V_{EE} = 0 V $V_{IN(A, B, C \text{ and } ENABLE)}$ = 1.4 V, 0.3 V[a]			- 40 °C to 125 °C		- 40 °C to 85 °C		
Parameter	**Symbol**		**Temp.[b]**	**Typ.[c]**	**Min.[d]**	**Max.[d]**	**Min.[d]**	**Max.[d]**	**Unit**
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	105		165 205		165 194	
On-Resistance Match	ΔR_{ON}	I_S = 1 mA, V_D = + 3.5 V	Room Full	3.2		8 13		8 10	Ω
On-Resistance Flatness	$R_{FLATNESS}$	I_S = 1 mA, V_D = 0 V, + 3 V	Room Full	17		26 30		26 28	
Switch Off Leakage Current	$I_{S(off)}$	V+ = + 5.5 V, V- = 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	
	$I_{D(off)}$		Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	nA
Channel On Leakage Current	$I_{D(on)}$	V+ = + 5.5 V, V- = 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									
$V_{IN(A, B, C \text{ and } ENABLE)}$ 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	µA
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	
Dynamic Characteristics									
Transition Time	t_{TRANS}	R_L = 300 Ω, C_L = 35 pF See Figure 1, 2, 3	Room Full	79		205 295		205 285	
Enable Turn-On Time	t_{ON}		Room Full	220		335 403		335 393	ns
Enable Turn-Off Time	t_{OFF}		Room Full	93		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	0.81					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					
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	1					
Drain Off Capacitance[e]	$C_{D(off)}$		Room	11					pF
Channel On Capacitance[e]	$C_{D(on)}$		Room	17					
Power Supplies									
Power Supply Current	I+	$V_{IN(A, B, C \text{ and } ENABLE)}$ = 0 V or 5 V	Room Full	0.05		1 10		1 10	
Negative Supply Current	I-		Room Full	- 0.05	- 1 - 10		- 1 - 10		µA
Ground Current	I_{GND}		Room Full	- 0.05	- 1 - 10		- 1 - 10		

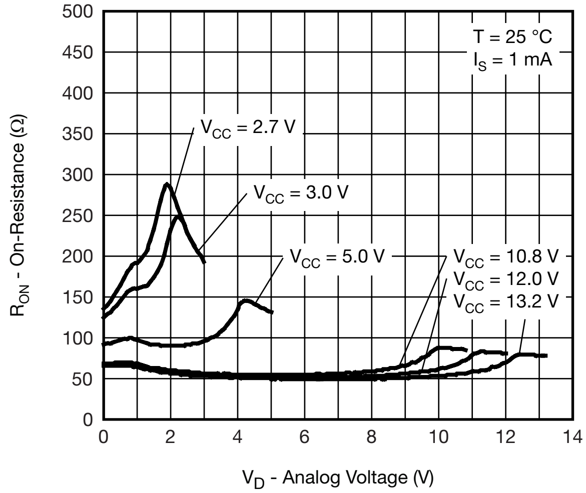
SPECIFICATIONS FOR UNIPOLAR SUPPLIES

Parameter	Symbol	Test Conditions Unless Otherwise Specified V_{CC} = + 12 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 Min.[d]	- 40 °C to 125 °C Max.[d]	- 40 °C to 85 °C Min.[d]	- 40 °C to 85 °C Max.[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		0	12	0	12	V
On-Resistance	R_{ON}	I_S = 1 mA, V_D = 0.7 V, 6.0 V, 11.3 V	Room Full	68		105 143		105 137	Ω
On-Resistance Match	ΔR_{ON}	I_S = 1 mA, V_D = + 0.7 V	Room Full	4		7 10		7 8	
On-Resistance Flatness	$R_{FLATNESS}$	I_S = 1 mA, V_D = 0.7 V, + 11.3 V	Room Full	32		45 49		45 47	
Switch Off Leakage Current	$I_{S(off)}$	V+ = + 12 V, V- = 0 V V_D = 1 V/11 V, V_S = 11 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	nA
Channel On Leakage Current	$I_{D(on)}$	V+ = + 12 V, V- = 0 V V_D = V_S = 1 V/11 V	Room Full	± 0.02	- 1 - 50	1 50	- 1 - 5	1 5	nA
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		V
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	µA
Dynamic Characteristics									
Transition Time	t_{TRANS}	R_L = 300 Ω, C_L = 35 pF see figure 1, 2, 3	Room Full	55		135 166		135 155	ns
Enable Turn-On Time	t_{ON}		Room Full	106		185 219		185 205	ns
Enable Turn-Off Time	t_{OFF}		Room Full	65		130 144		130 137	ns
Break-Before-Make Time Delay	t_D		Room Full	30		12		12	ns
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	0.79					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					dB
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	1					pF
Drain Off Capacitance[e]	$C_{D(off)}$		Room	9					pF
Channel On Capacitance[e]	$C_{D(on)}$		Room	15					pF
Power Supplies									
Power Supply Current	I+	$V_{IN(A, B, C\ and\ ENABLE)}$ = 0 V or 12 V	Room Full	0.05		1 10		1 10	µA
Negative Supply Current	I-		Room Full	- 0.05	- 1 - 10		- 1 - 10		µA
Ground Current	I_{GND}		Room Full	- 0.05	- 1 - 10		- 1 - 10		µA

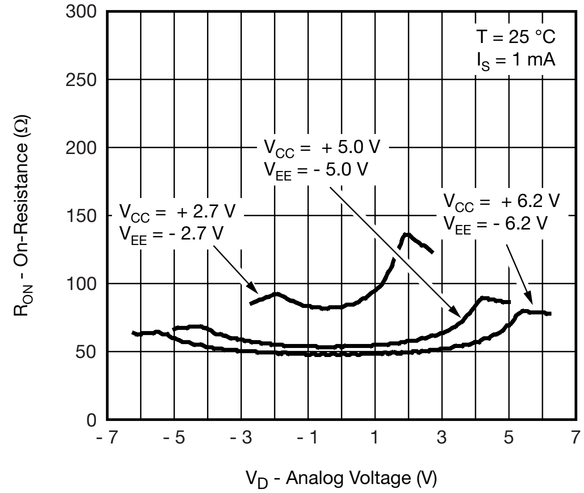
Notes:
a. V_{IN} = input voltage to perform proper function.
b. Room - 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum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

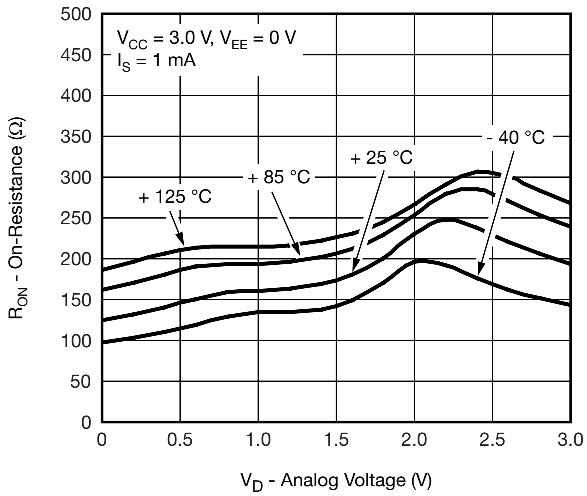
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



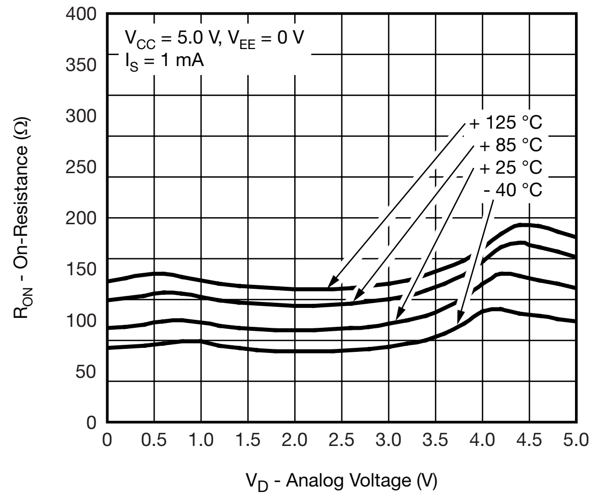
On-Resistance vs. V_D and Signal Supply Voltage



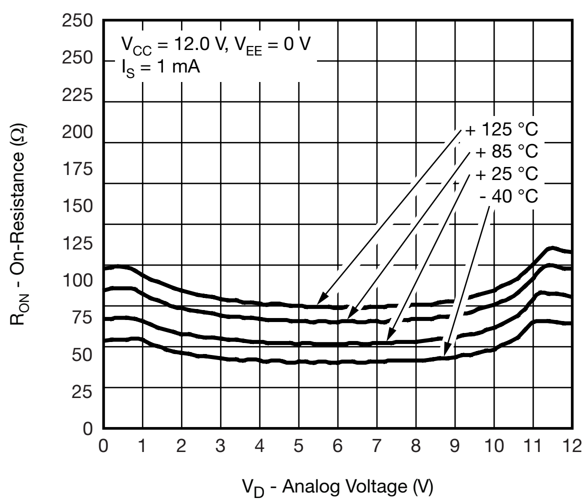
On-Resistance vs. Analog Voltage and Temperature



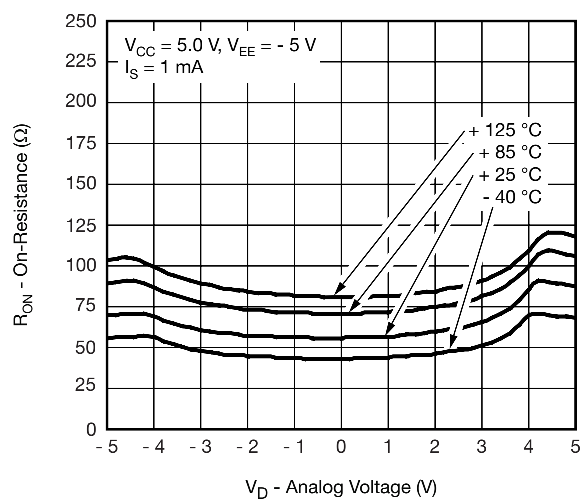
On-Resistance vs. Analog Voltage and Temperature



On-Resistance vs. Analog Voltage and Temperature

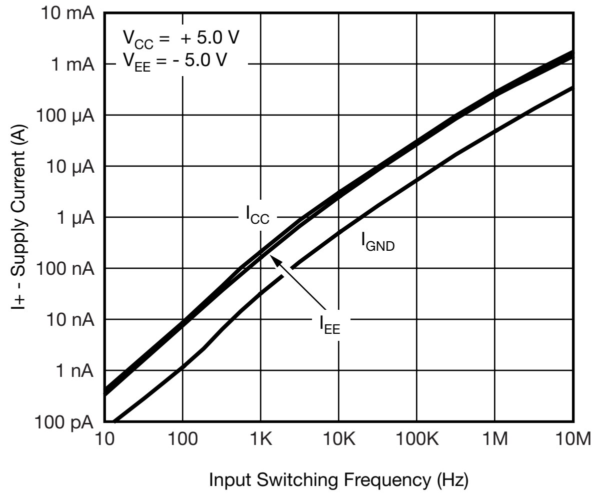


On-Resistance vs. Analog Voltage and Temperature

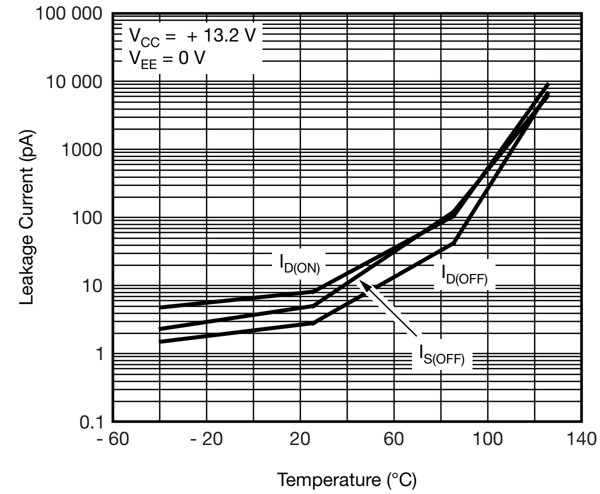


On-Resistance vs. Analog Voltage and Temperature

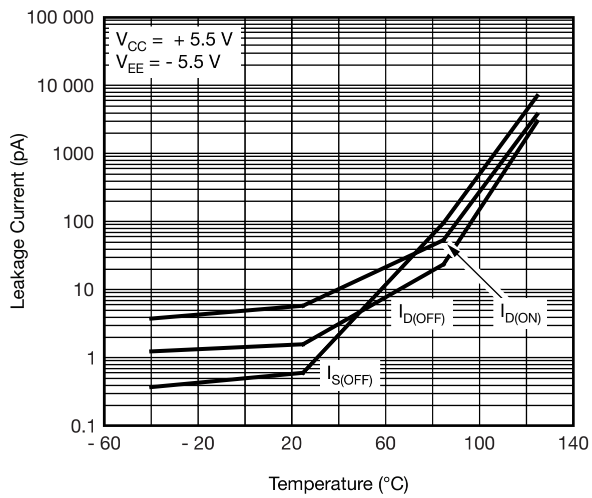
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



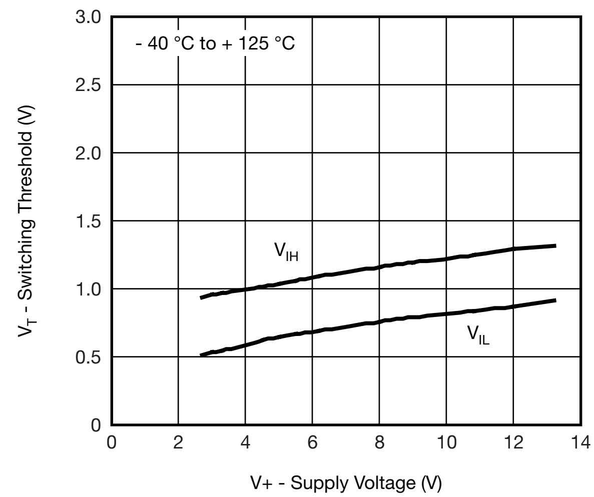
Supply Current vs. Input Switching Frequency



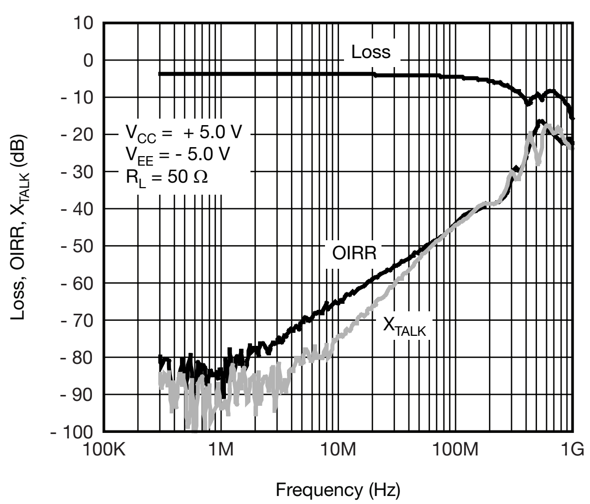
Leakage Current vs. Temperature



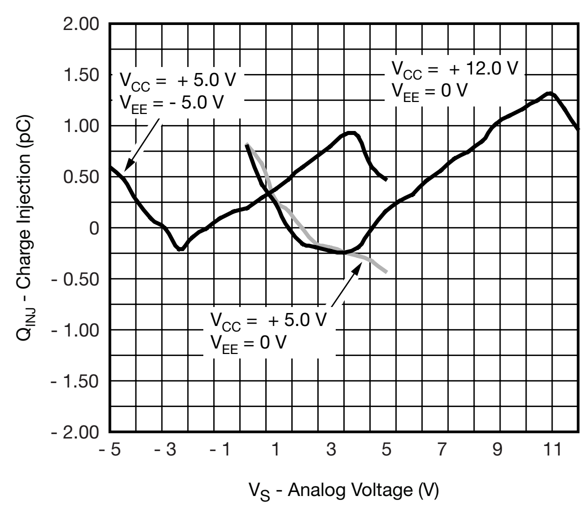
Leakage Current vs. Temperature



Switching Threshold vs. Supply Voltage

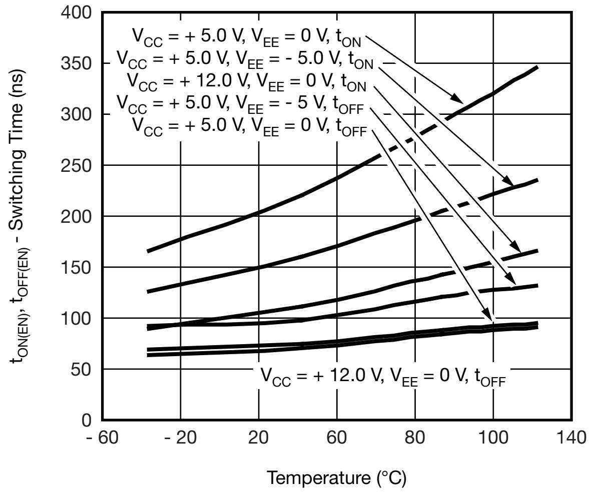


Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



Charge Injection vs. Analog Voltage

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Switching Time vs. Temperature

TEST CIRCUITS

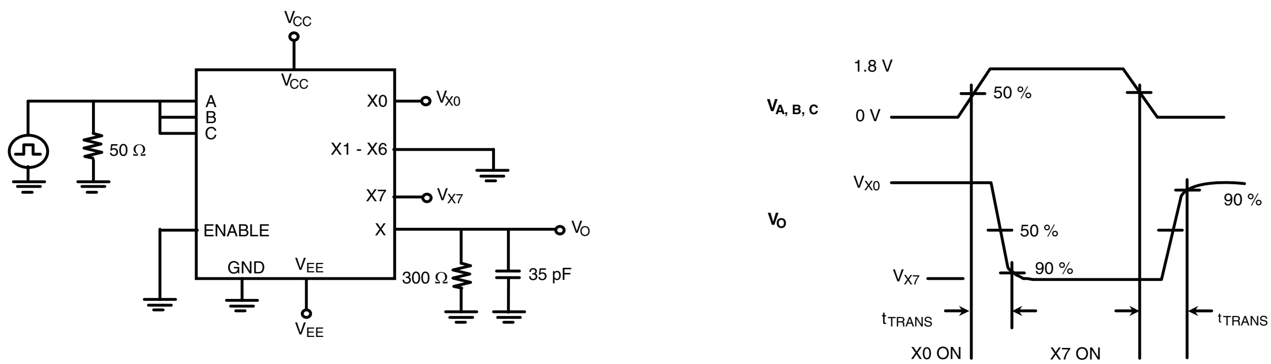


Figure 1. Transition Time

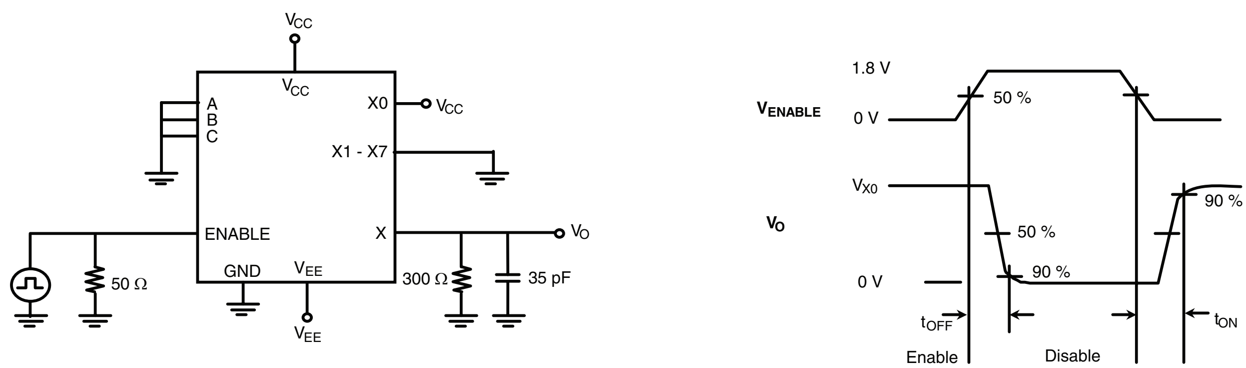


Figure 2. Enable Switching Time

TEST CIRCUITS

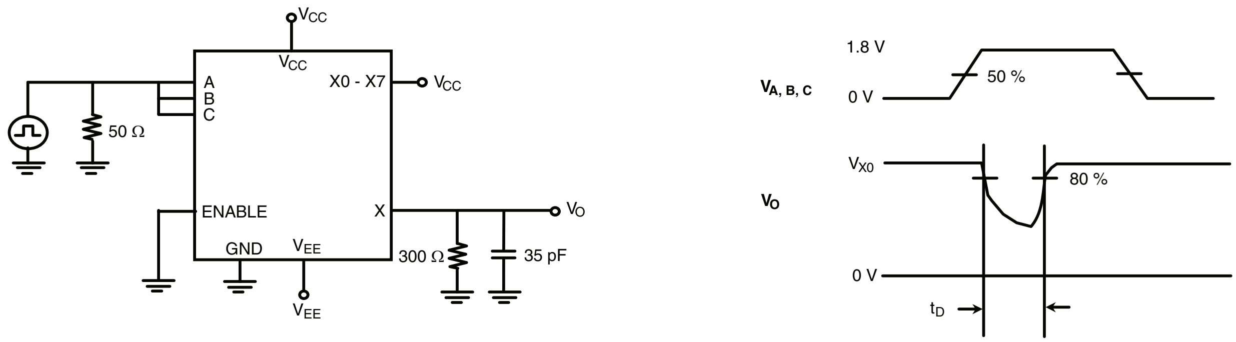
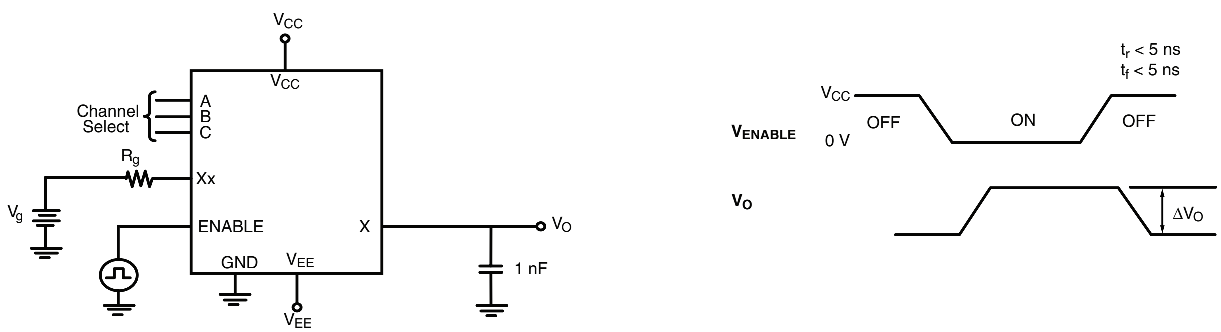
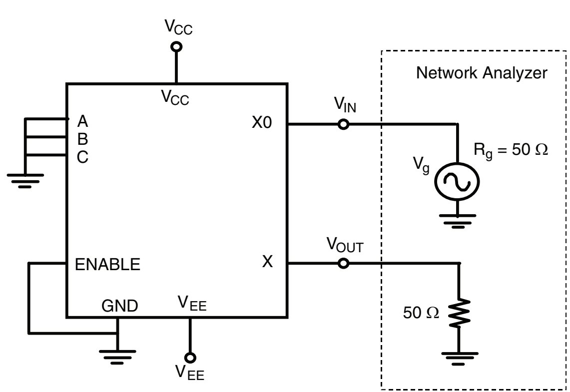


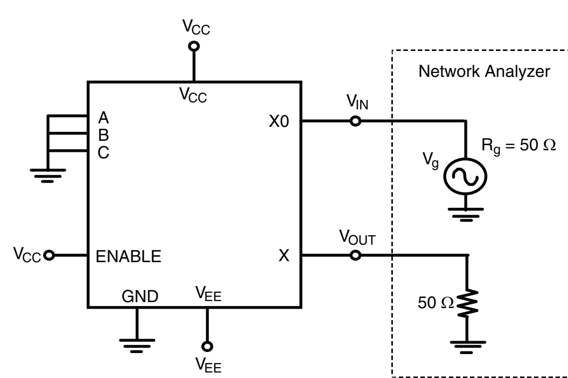
Figure 3. Break-Before-Make





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

Figure 5. Insertion Loss



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

Figure 6. Off Isolation

TEST CIRCUITS

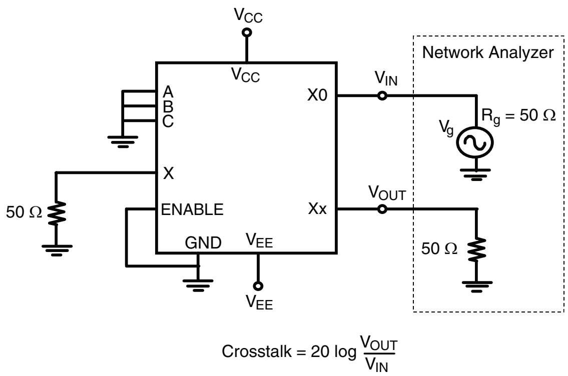


Figure 7. Crosstalk

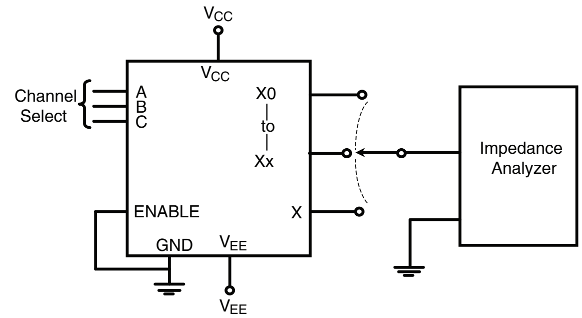


Figure 8. Source, Drain Capacitance

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