Dual SPDT Analog Switch

DESCRIPTION

The DG9236 is a CMOS, dual SPDT analog switch designed to operate from V+ = 2.7 V to V+ = 16 V max. operating, single supply. All control logic inputs have a guaranteed 1.8 V logic high threshold when operation from a + 16 V power supply. This makes the DG9236 ideally suited to interface directly with low voltage micro-processor control signals.

Processed with high density CMOS technology, the DG9236 while providing ultra low parasitic capacitance of 2 pF for $CS_{(OFF)}$ and 8.4 pF for $CD_{(ON)}$. Other performance features are: 3 dB bandwidth, 800 MHz, - 70 dB crosstalk and 62 dB off isolation at 10 MHz frequency.

Key applications for the DG9236 are logic level translation, pulse generator, and high speed or low noise signal switching in precision instrumentations and portable device designs.

The operation temperature range is specified from - 40 °C to + 85 °C. The DG9236 is available in space saving 1.4 mm x 1.8 mm miniQFN10 package.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device termination. The miniQFN-10 package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-E4" suffix to the ordering part number. The nickel-palladium-gold device terminations meet all JEDEC standards for reflow and MSL rating.

FEATURES

- Leakage current < 0.5 nA max. at 85 °C
- Low switch capacitance (C_{soff}, 2 pF typ.)
- $R_{DS(on)}$ 101 Ω max. 800 MHz bandwidth
- Fully specified with single supply operation at 16 V
- Low voltage, 1.8 V CMOS/TTL compatible
- Excellent isolation and crosstalk performance (typ. > - 60 dB at 10 MHz)
- Fully specified from - 40 °C to 85 °C
- Latch-up current 300 mA per JESD78
- Lead (Pb)-free low profile miniQFN-10 (1.4 mm x 1.8 mm x 0.55 mm)
- **Compliant to RoHS Directive 2002/95/EC**

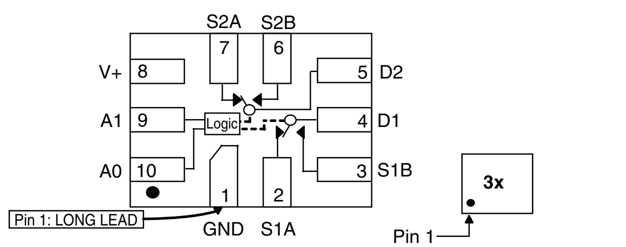
Pb-free
RoHS
COMPLIANT

APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG9236
miniQFN - 10L



Top View

Device marking: 3x for DG9236
x = Date/Lot Traceability Code

TRUTH TABLE		
Selected Input		**On Switches**
A1	**A0**	**DG9236**
X	0	D1 to S1A
X	1	D1 to S1B
0	X	D2 to S2A
1	X	D2 to S2B

ORDERING INFORMATION

Temp. Range	Package	Part Number
- 40 °C to 85 °C	10 pin miniQFN	DG9236DN-T1-E4

Notes:
• - 40 °C to 85 °C datasheet limits apply.

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)

Parameter		Limit	Unit
V+ to GND		18	V
Digital Inputs[a], V_S, V_D		(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 (Package)[b]	10 pin miniQFN[c, d]	208	mW
Thermal Resistance (Package)[b]	10 pin miniQFN	357	°C/W

Notes:
a. Signals on SX, DX, or AX exceeding V+ or GND 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 2.6 mW/°C above 70 °C.
d. Manual soldering with iron is not recommended for leadless components. The miniQFN-10 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 16 V Supply)

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 16 V, $V_{A0, A1}$ = 1.8 V, 0.5 V[a]	Temp.[b]	Typ.[c]	- 40 °C to 85 °C		Unit
					Min.[d]	Max.[d]	
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full			16	V
On-Resistance	$R_{DS(on)}$	I_S = 1 mA, V_D = 0.7 V, 2.6 V, 8 V, 11 V, 15.3 V	Room Full	101		145 160	Ω
On-Resistance Match	ΔR_{ON}	I_S = 1 mA, V_D = 0.7 V, 2.6 V, 8 V, 11 V, 15.3 V	Room Full	2		14 15	
On-Resistance Flatness	$R_{FLATNESS}$	I_S = 1 mA, V_D = 0.7 V, 2.6 V, 8 V, 11 V, 15.3 V	Room Full	38		55 60	
Switch Off Leakage Current	$I_{S(off)}$	V+ = 16 V, V_D = 1 V/15 V, V_S = 15 V/1 V	Room Full	± 0.01	- 1 - 2	1 2	nA
	$I_{D(off)}$		Room Full	± 0.01	- 1 - 2	1 2	
Channel On Leakage Current	$I_{D(on)}$	V+ = 16 V, V_D = V_S 1 V/15 V	Room Full	± 0.01	- 1 - 2	1 2	
Digital Control							
Input Current, V_{IN} Low	I_{IL}	V_{AX} = 0.5 V	Full	0.005	- 0.1	0.1	µA
Input Current, V_{IN} High	I_{IH}	V_{AX} = 1.8 V	Full	0.005	- 0.1	0.1	
Input Capacitance[e]	C_{IN}	f = 1 MHz	Room	3			pF
Dynamic Characteristics							
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF see figure 1, 2	Room Full	30		70 80	ns
Turn-Off Time	t_{OFF}		Room Full	17		55 65	
Break-Before-Make	t_{BBM}		Room Full	19 25	1 1		
Charge Injection[e]	Q_{INJ}	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	6			pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	- 62			dB
Bandwidth[e]	BW	R_L = 50 Ω	Room	800			MHz
Channel-to-Channel Crosstalk[e]	X_{TALK}	R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	- 70			dB

SPECIFICATIONS (for 16 V Supply)							
Parameter	**Symbol**	**Test Conditions Unless Otherwise Specified** $V+ = 16$ V, $V_{A0, A1} = 1.8$ V, 0.5 V[a]	**Temp.**[b]	**Typ.**[c]	**- 40 °C to 85 °C Min.**[d]	**- 40 °C to 85 °C Max.**[d]	**Unit**
Dynamic Characteristics							
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	2			pF
Channel On Capacitance[e]	$C_{D(on)}$	f = 1 MHz	Room	8.4			pF
Total Harmonic Distortion[e]	THD	Signal = 1 V_{RMS}, 20 Hz to 20 kHz, $R_L = 600\ \Omega$	Room	0.18			%
Power Supplies							
Power Supply Current	I+	$V_{IN} = 0$ V, or V+	Room Full	0.013 0.022		0.5 1.0	µA
Ground Current	I_{GND}	$V_{IN} = 0$ V, or V+	Room Full	0.01 0.021	- 0.5 - 1.0		µA

SPECIFICATIONS (for 5 V Supply)							
Parameter	**Symbol**	**Test Conditions Unless Otherwise Specified** $V+ = 5$ V, $V_{A0, A1} = 1.4$ V, 0.5 V[a]	**Temp.**[b]	**Typ.**[c]	**- 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	V
On-Resistance	$R_{DS(on)}$	$I_S = 1$ mA, $V_D = 0$ V, 3 V, 3.5 V	Room Full	301		365 380	Ω
On-Resistance Match	ΔR_{ON}	$I_S = 1$ mA, $V_D = 0$ V, 3 V, 3.5 V	Room Full	3		14 15	Ω
Switch Off Leakage Current	$I_{S(off)}$	V+ = 5.5 V, $V_D = 1$ V/4.5 V, $V_S = 4.5$ V/1 V	Room Full	± 0.01	- 1 - 1.2	1 1.2	nA
Switch Off Leakage Current	$I_{D(off)}$	V+ = 5.5 V, $V_D = 1$ V/4.5 V, $V_S = 4.5$ V/1 V	Room Full	± 0.01	- 1 - 1.2	1 1.2	nA
Channel On Leakage Current	$I_{D(on)}$	V+ = 5.5 V, $V_S = V_D = 1$ V/4.5 V	Room Full	± 0.01	- 1 - 1.2	1 1.2	nA
Digital Control							
Input Current, V_{IN} Low	I_L	$V_{AX} = 0.5$ V	Full	0.005	- 0.1	0.1	µA
Input Current, V_{IN} High	I_H	$V_{AX} = 1.4$ V	Full	0.005	- 0.1	0.1	µA
Input Capacitance	C_{IN}	f = 1 MHz	Room	3			pF
Dynamic Characteristics							
Turn-On Time	t_{ON}	$R_L = 300\ \Omega$, $C_L = 35$ pF see figure 1, 2	Room Full	70		100 110	ns
Turn-Off Time	t_{OFF}	$R_L = 300\ \Omega$, $C_L = 35$ pF see figure 1, 2	Room Full	17		70 80	ns
Break-Before-Make-Time	t_{BMM}	$R_L = 300\ \Omega$, $C_L = 35$ pF see figure 1, 2	Room Full	42	5 1		ns
Charge Injection[e]	Q_{INJ}	$C_L = 1$ nF, $R_{GEN} = 0\ \Omega$, $V_{GEN} = 0$ V	Full	2			pC
Off-Isolation[e]	OIRR	f = 10 MHz, $R_L = 50\ \Omega$, $C_L = 5$ pF	Room	- 62			dB
Crosstalk[e]	X_{TALK}	f = 10 MHz, $R_L = 50\ \Omega$, $C_L = 5$ pF	Room	- 70			dB
Bandwidth[e]	BW	$R_L = 50\ \Omega$	Room	570			MHz
Total Harmonic Distortion[e]	THD	Signal = 1 V_{RMS}, 20 Hz to 20 kHz, $R_L = 600\ \Omega$	Room	2.4			%
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	2.1			pF
Channel On Capacitance[e]	$C_{D(on)}$	f = 1 MHz	Room	8.1			pF
Power Supplies							
Power Supply Current	I+	$V_{IN} = 0$ V, or V+	Room Full	0.001		0.5 1	µA
Ground Current	I_{GND}	$V_{IN} = 0$ V, or V+	Room Full	- 0.001	- 0.5 - 1		µA

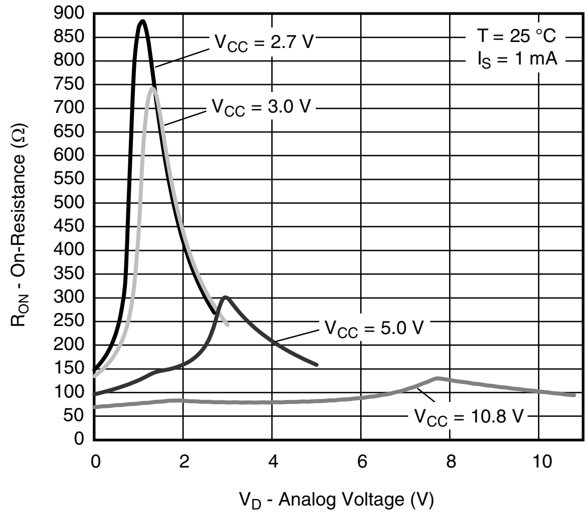
SPECIFICATIONS (for 3 V Supply)

Parameter	Symbol	Test Conditions Unless Otherwise Specified $V+ = 3$ V, $V_{A0, A1} = 1.4$ V, 0.5 V[a]	Temp.[b]	Typ.[c]	- 40 °C to + 85 °C Min.[d]	Max.[d]	Unit
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full			3	V
On-Resistance	$R_{DS(ON)}$	$I_S = 1$ mA, $V_D = + 1.5$ V	Room Full	732		795 810	Ω
On-Resistance Match	ΔR_{ON}	$I_S = 1$ mA, $V_D = + 1.5$ V	Room Full	5		16 17	Ω
Switch Off Leakage Current (for 16 pin miniQFN)	$I_{S(off)}$	$V+ = 3.3$ V, $V- = 0$ V $V_D = 1$ V/3 V, $V_S = 3$ V/1 V	Room Full	± 0.01	- 1 - 1.2	1 1.2	nA
	$I_{D(off)}$		Room Full	± 0.01	- 1 - 1.2	1 1.2	nA
Channel On Leakage Current (for 16 pin miniQFN)	$I_{D(on)}$	$V+ = 3.3$ V, $V- = 0$ V, $V_S = V_D = 1$ V/3 V	Room Full	± 0.01	- 1 - 1.2	1 1.2	nA
Digital Control							
Input Current, V_{IN} Low	I_L	$V_{AX} = 0.5$ V	Full	0.005	- 0.1	0.1	µA
Input Current, V_{IN} High	I_H	$V_{AX} = 1.4$ V	Full	0.005	- 0.1	0.1	µA
Input Capacitance	C_{IN}	f = 1 MHz	Room	3.1			pF
Dynamic Characteristics							
Enable Turn-On Time	t_{ON}	$R_L = 300$ Ω, $C_L = 35$ pF see figure 1, 2	Room Full	30		150 170	ns
Enable Turn-Off Time	t_{OFF}		Room Full	20		110 120	ns
Break-Before-Make-Time	t_{BMM}		Room Full	19 25	5 1	not limit	ns
Charge Injection[e]	Q_{INJ}	$C_L = 1$ nF, $R_{GEN} = 0$ Ω, $V_{GEN} = 0$ V	Full	1			pC
Off-Isolation[e]	OIRR	f = 10 MHz, $R_L = 50$ Ω, $C_L = 5$ pF	Room	- 63			dB
Crosstalk[e]	X_{TALK}		Room	- 70			dB
Bandwidth[e]	BW	$R_L = 50$ Ω	Room	183			MHz
Total Harmonic Distortion[e]	THD	Signal = 1 V_{RMS}, 20 Hz to 20 kHz, $R_L = 600$ Ω	Room	5.5			%
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	2.1			pF
Channel On Capacitance[e]	$C_{D(on)}$		Room	8.3			pF
Power Supplies							
Power Supply Current	I+	$V_{IN} = 0$ V, or V+	Room Full	0.001		0.5 1	µA
Ground Current	I_{GND}		Room Full	- 0.001	- 0.5 - 1		µA

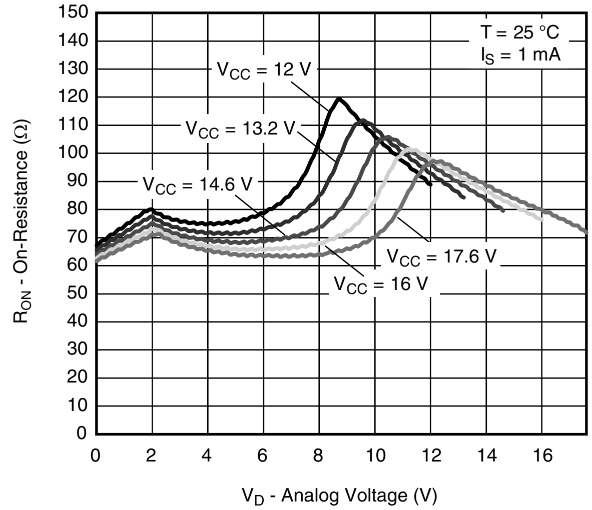
Notes:
a. V_{IN} = input voltage to perform proper function.
b. Room = 25 °C, Full = as determined by the operating temperature.
c. Typical value are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the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

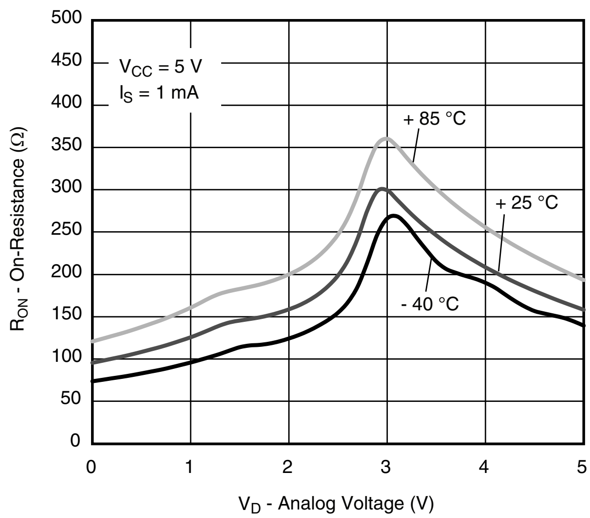
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



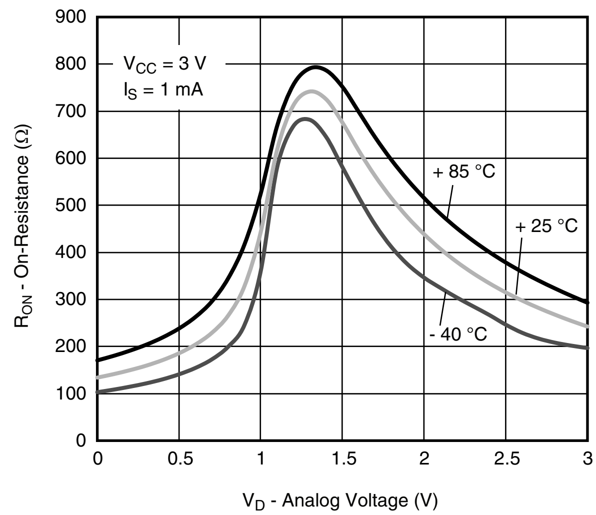
R_{ON} vs. V_D and Single Supply Voltage



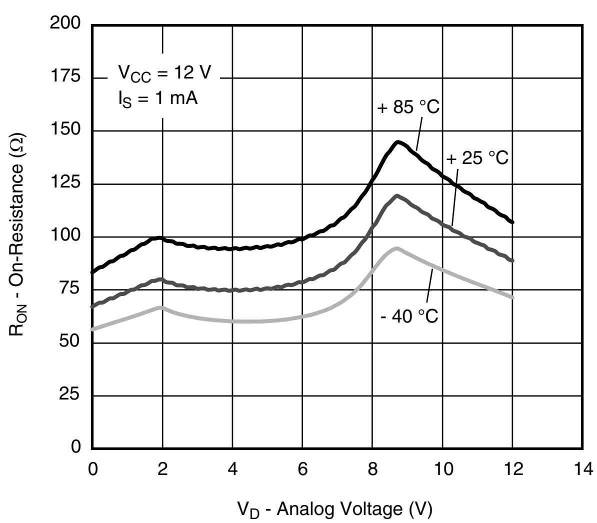
R_{ON} vs. V_D and Single Supply Voltage



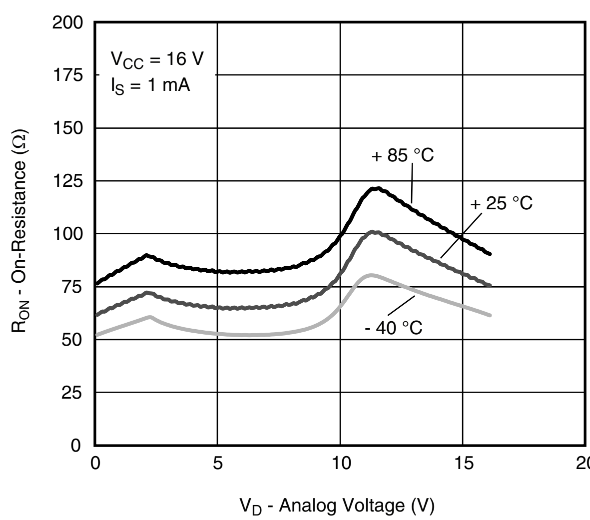
R_{ON} vs. Analog Voltage and Temperature



R_{ON} vs. Analog Voltage and Temperature

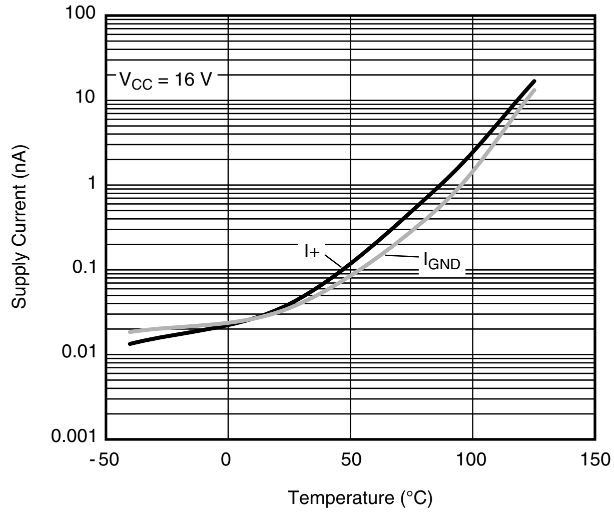


R_{ON} vs. Analog Voltage and Temperature

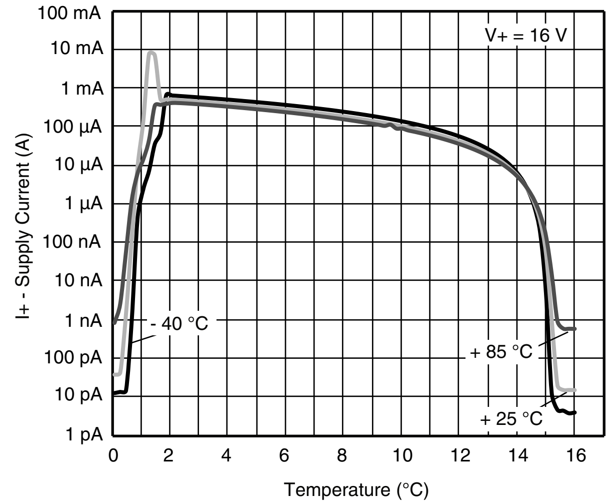


R_{ON} vs. Analog Voltage and Temperature

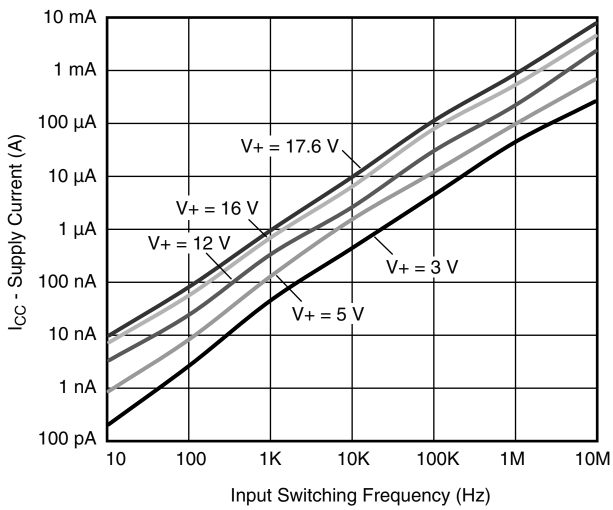
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



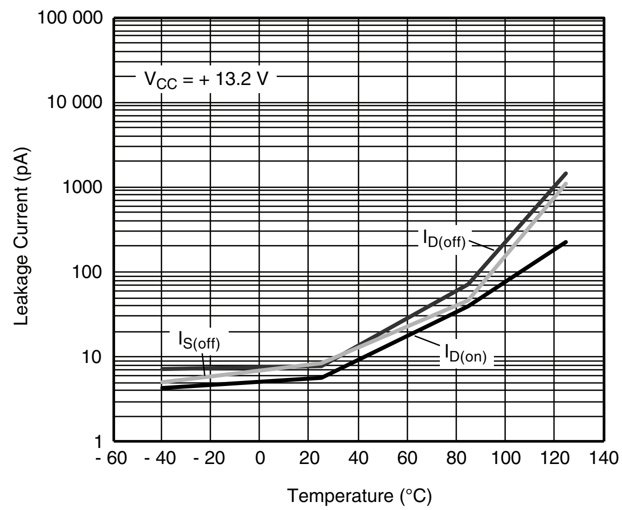
Supply Current vs. Temperature



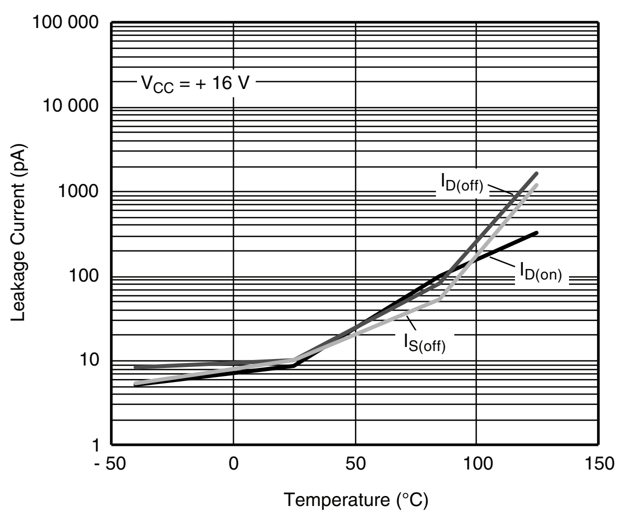
Supply Current vs. V_{IN} and Temperature



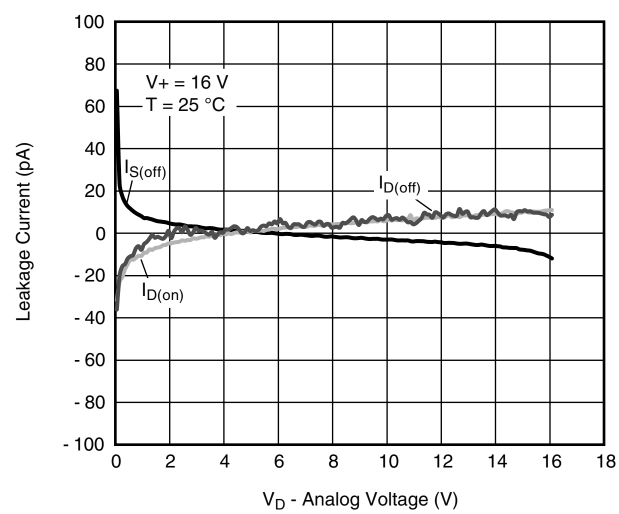
Supply Current vs. Input Switching Frequency



Leakage Current vs. Temperature

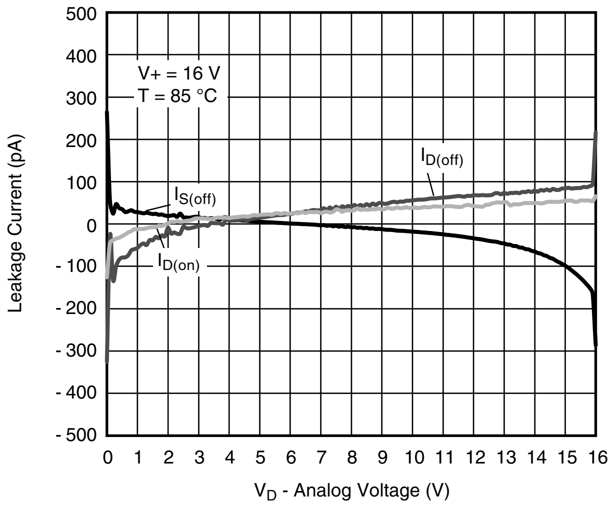


Leakage Current vs. Temperature

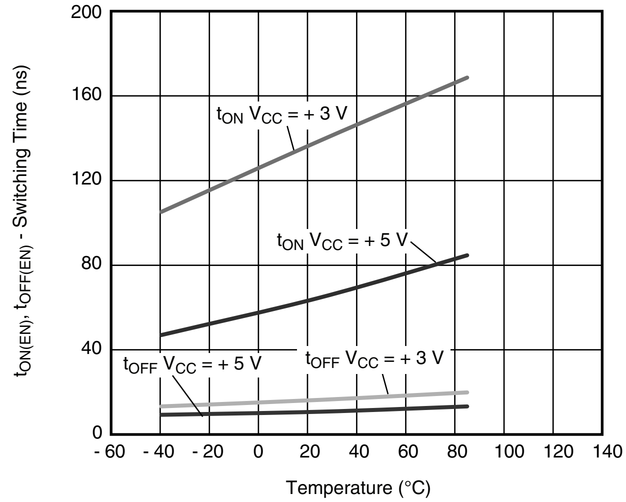


Leakage Current vs. Analog Voltage

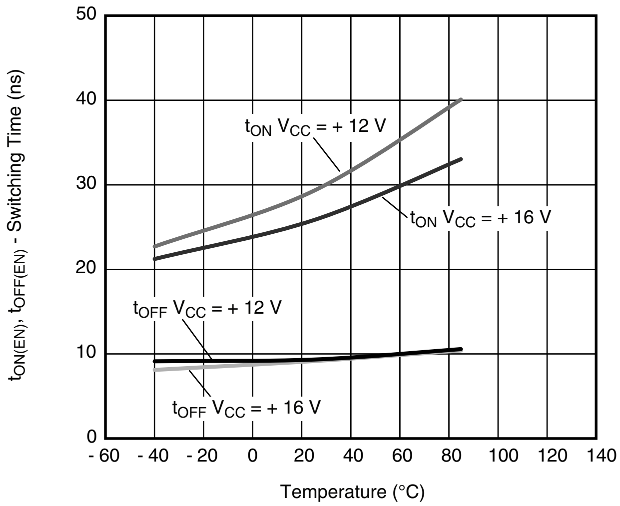
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



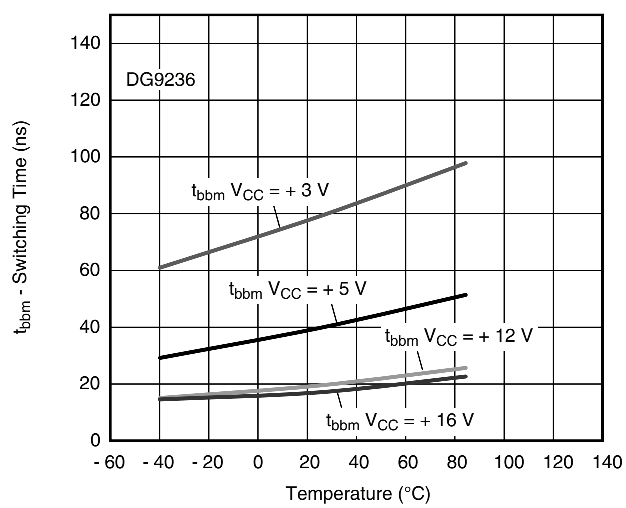
Leakage Current vs. Analog Voltage



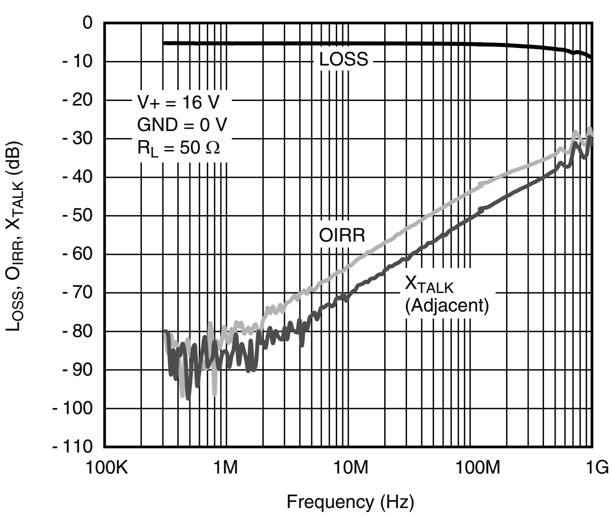
Switching Time vs. Temperature t_{ON}/t_{OFF}



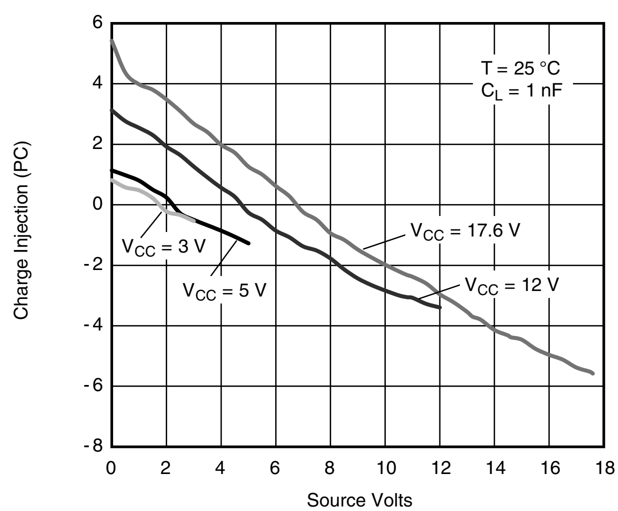
Switching Time vs. Temperature t_{ON}/t_{OFF}



Switching Time vs. Temperature

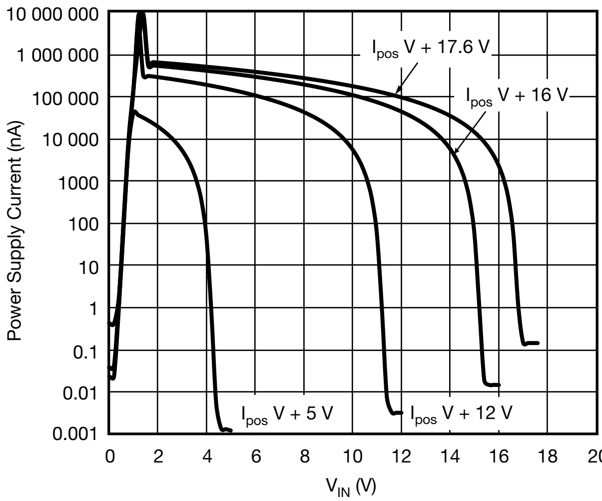


Insertion Loss, Off-Isolation, Crosstalk vs. Frequency

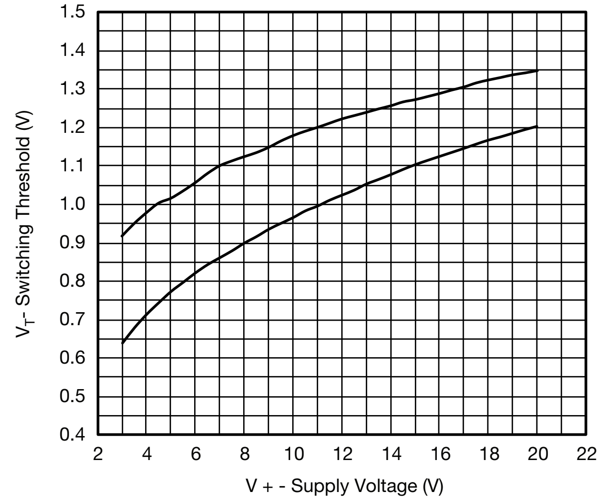


DG9236 BCFE-C Charge Injection Measured at Drain C_L = 1 nF

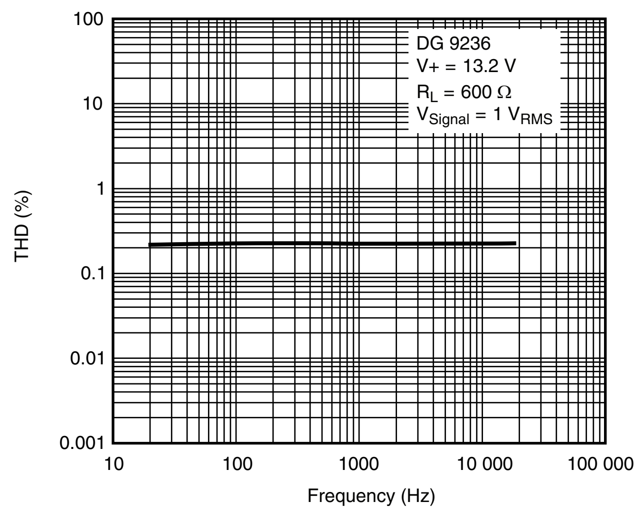
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Supply Current vs. V_{IN} and Temperature



Switching Threshold (Lower) vs. Single Supply Voltage



THD vs. Frequency

TEST CIRCUITS

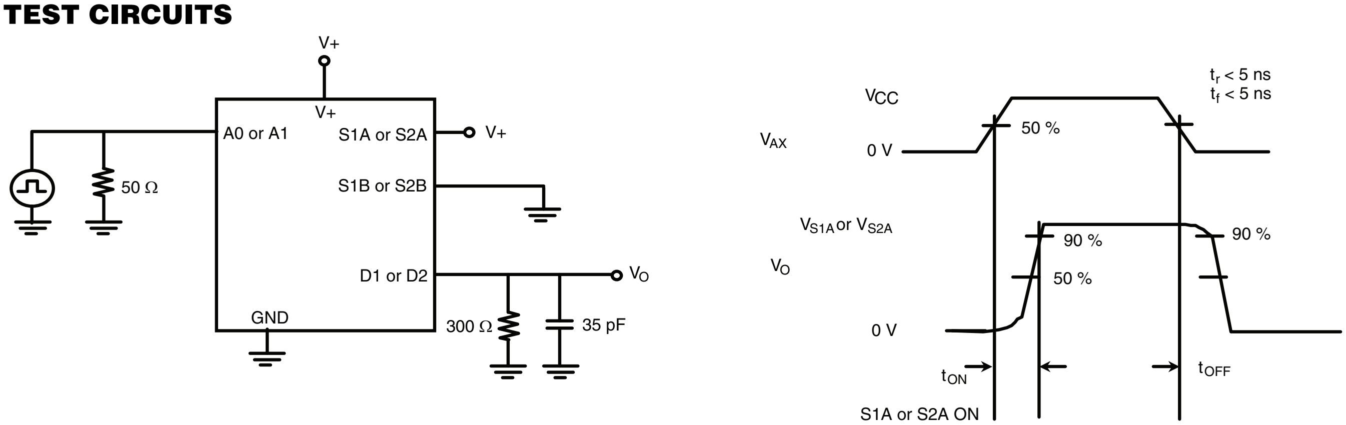


Figure 1. Enable Switching Time

TEST CIRCUITS

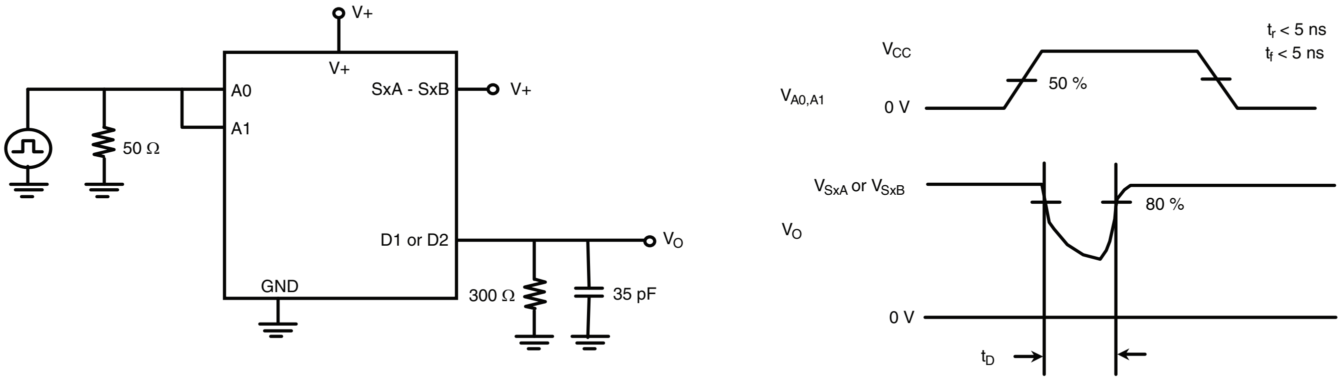


Figure 2. Break-Before-Make

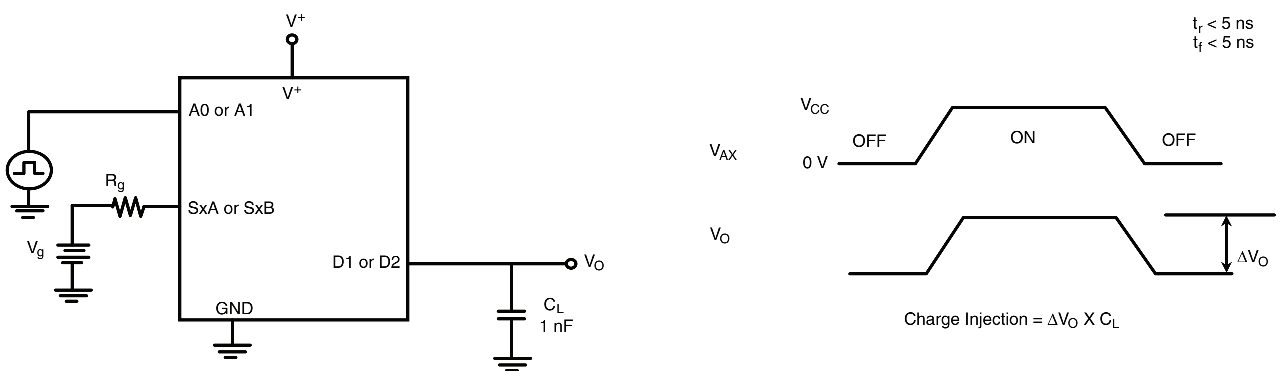
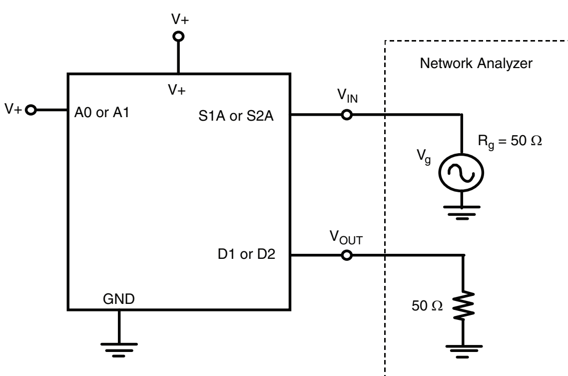
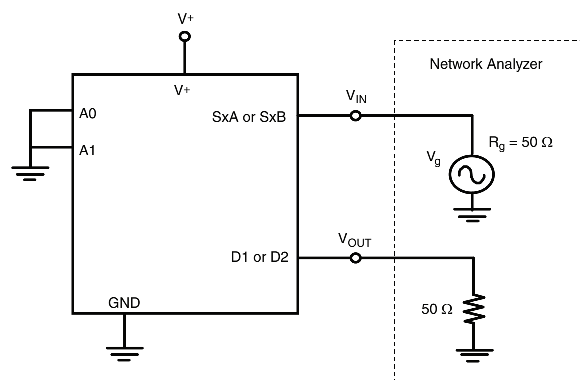


Figure 3. Charge Injection



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

Figure 4. Insertion Loss



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

Figure 5. Off-Isolation

TEST CIRCUITS

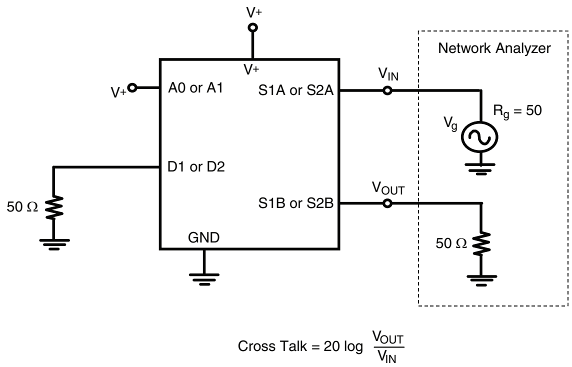


Figure 6. Crosstalk

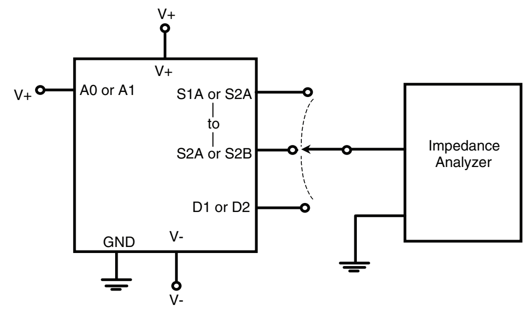
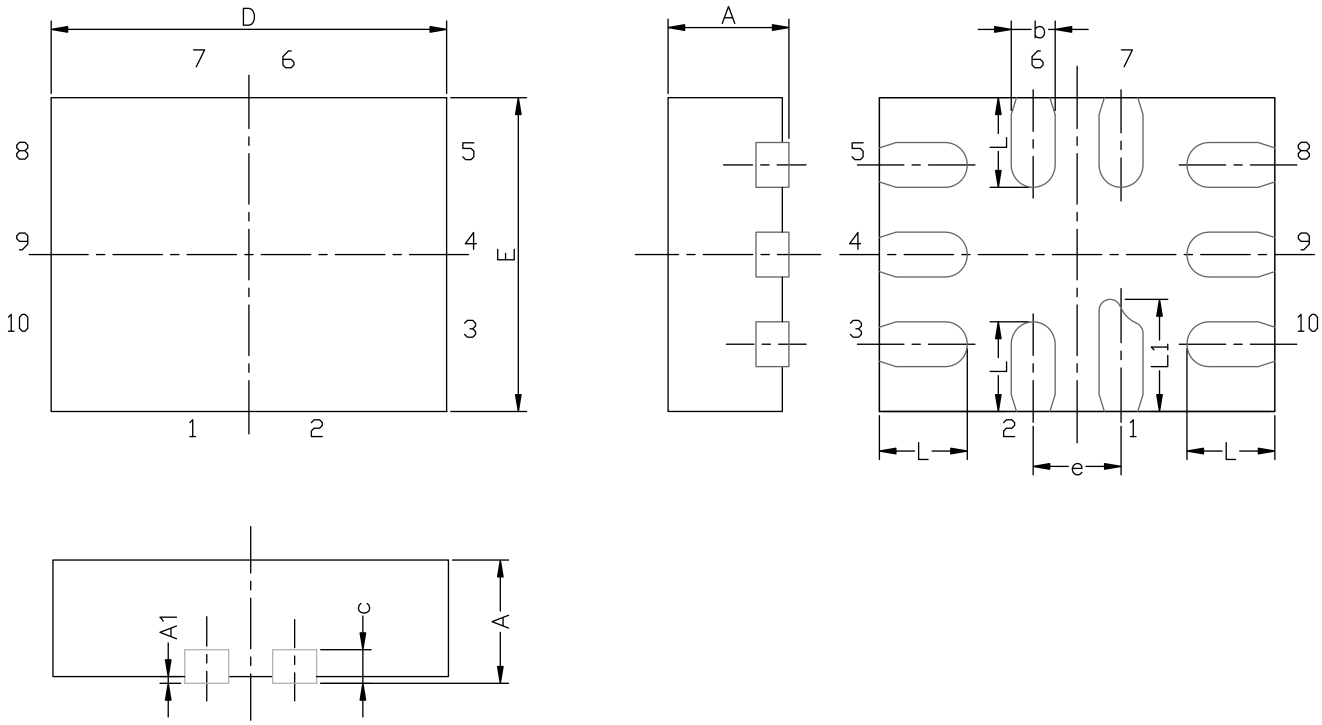


Figure 7. Source/Drain Capacitance

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?67049.

MINI QFN-10L CASE OUTLINE



DIM	MILLIMETERS			INCHES		
	MIN.	NAM.	MAX.	MIN.	NAM.	MAX.
A	0.45	0.55	0.60	0.0177	0.0217	0.0236
A1	0.00	-	0.05	0.000	-	0.002
b	0.15	0.20	0.25	0.006	0.008	0.010
c	0.150 or 0.127 REF [1]			0.006 or 0.005 REF [1]		
D	1.70	1.80	1.90	0.067	0.071	0.075
E	1.30	1.40	1.50	0.051	0.055	0.059
e	0.40 BSC			0.016 BSC		
L	0.35	0.40	0.45	0.014	0.016	0.018
L1	0.45	0.50	0.55	0.0177	0.0197	0.0217

Note

(1) The dimension depends on the leadframe that assembly house used.

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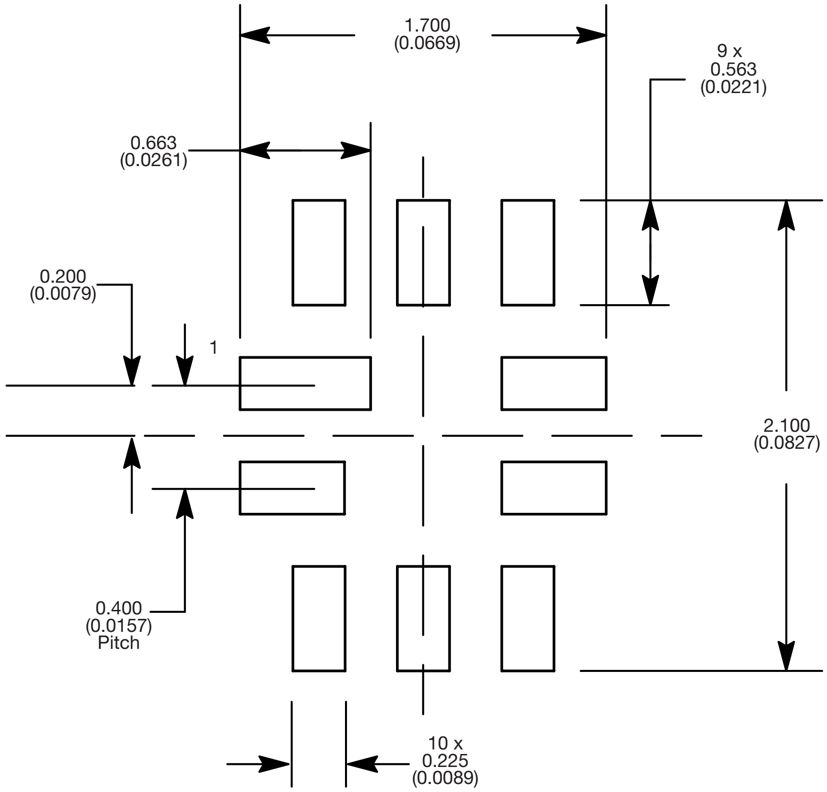
RECOMMENDED MINIMUM PADS FOR MINI QFN 10L



Mounting Footprint
Dimensions in mm (inch)

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