0.5 pC Charge Injection, 100 pA Leakage, Dual SPDT Analog Switch

DESCRIPTION

The DG636 is an analog CMOS, dual SPDT switch, designed to operate from a + 2.7 V to + 12 V single supply or from ± 2.7 V to ± 5.0 V, dual supplies. The DG636 is fully specified at + 3 V, + 5 V and ± 5 V. All control logic inputs have guaranteed 2 V logic high limits when operating from + 5 V or ± 5 V supplies and 1.4 V when operating from a 3 V supply.

The DG636 switches conduct equally well in both directions and offer rail to rail analog signal handling. < 1 pC low charge injection, coupled with very low switch capacitance and leakage current makes this product ideal for use in precision instrumentation applications. Operating temperature range is specified from - 40 °C to + 125 °C. The DG636 is available in 14 lead TSSOP and the space saving 1.8 x 2.6 mm miniQFN package.

FEATURES

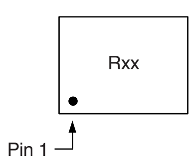
- Ultra low charge injection (± 0.5 pC, typ. over the full analog signal range)
- Leakage current < 0.5 nA max. at 85 °C
- Low switch capacitance (C_{soff}, 2 pF typ.)
- Low $r_{DS(on)}$ - 115 Ω max.
- Fully specified with single supply operation at 3.0 V, 5.0 V and dual supplies at ± 5.0 V
- Low voltage, 2.5 V CMOS/TTL compatible
- 600 MHz, - 3 dB bandwidth
- Excellent isolation and crosstalk performance (typ. > - 60 dB at 10 MHz)
- Fully specified from - 40 °C to 85 °C and - 40 °C to + 125 °C
- 14 Pin TSSOP and 16 Pin miniQFN package (1.8 x 2.6 mm)

Pb
Pb-free
RoHS
COMPLIANT

APPLICATIONS

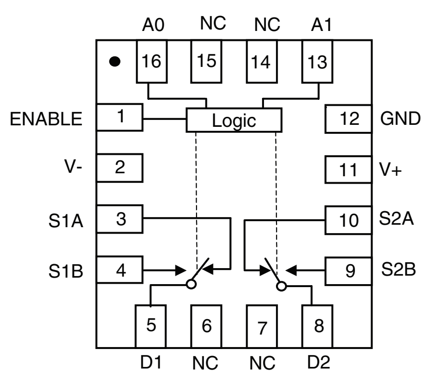
- High-end data acquisition
- Medical instruments
- Precision instruments
- High speed communications applications
- Automated test equipment
- Sample and hold applications

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



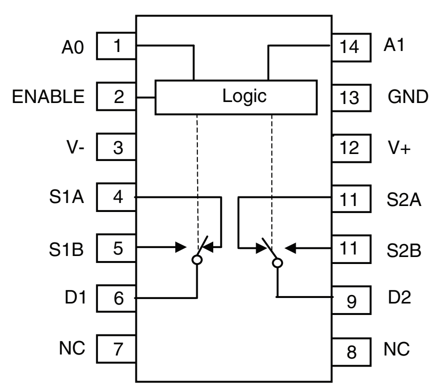
Device Marking: Rxx for DG636 (miniQFN16)
xx = Date/Lot Traceability Code

DG636
mQFN-16



Top View

DG636
TSSOP14



Top View

ENABLE = Hi, all switches are controlled by addr pins. ENABLE = Lo, all switches are off.

TRUTH TABLE

Enable Input	Selected Input		On Switches
	A1	A0	DG636
L	X	X	All Switches Open
H	L	L	D1 to S1A, D2 to S2A
H	L	H	D1 to S1B, D2 to S2A
H	H	L	D1 to S1A, D2 to S2B
H	H	H	D1 to S1B, D2 to S2B

ORDERING INFORMATION

Temp. Range	Package	Part Number
- 40 °C to 125 °C[a]	14-Pin TSSOP	DG636EQ-T1-E3
	16-Pin miniQFN	DG636EN-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 (Package)[b]	14-Pin TSSOP[c]	450	mW
	16-Pin miniQFN[d, e]	525	
Thermal Resistance (Package)[b]	14-Pin TSSOP	178	°C/W
	16-Pin miniQFN	152	

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 5.6 mW/°C above 70 °C.
d. Derate 6.6 mW/°C above 70 °C.
e. 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									
		Test Conditions **Unless Otherwise Specified** V+ = 5 V, V- = - 5 V			- 40 to 125 °C		- 40 to 85 °C		
Parameter	**Symbol**	$V_{IN\ A0,\ A1\ and\ ENABLE}$ = 2.0 V, 0.8 V[a]	**Temp.**[b]	**Typ.**[c]	**Min.**[d]	**Max.**[d]	**Min.**[d]	**Max.**[d]	**Unit**
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		- 5	5	- 5	5	V
On-Resistance	$r_{DS(on)}$	I_S = 1 mA, V_D = - 3 V, 0 V, + 3 V	Room Full	70		115 160		115 140	
On-Resistance Match	Δr_{ON}	I_S = 1 mA, V_D = ± 3 V	Room Full	1		5 6.5		5 6.5	Ω
On-Resistance Flatness	$r_{FLATNESS}$	I_S = 1 mA, V_D = - 3 V, 0 V, + 3 V	Room Full	10		20 33		20 22	
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	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	
	$I_{D(off)}$		Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
Channel On Leakage Current	$I_{D(on)}$	V+ = 5.5 V, V- = - 5.5 V, V_S = V_D = ± 4.5 V	Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	
Digital Control									
Input Current, V_{IN} Low	I_{IL}	$V_{IN\ A0,\ A1\ and\ ENABLE}$ Under Test = 0.8 V	Full	0.005	- 0.1	0.1	- 0.1	0.1	µA
Input Current, V_{IN} High	I_{IH}	$V_{IN\ A0,\ A1\ and\ ENABLE}$ Under Test = 2.0 V	Full	0.005	- 0.1	0.1	- 0.1	0.1	
Input Capacitance[e]	C_{IN}	f = 1 MHz	Room	3.4					pF
Dynamic Characteristics									
Transition Time	t_{TRANS}	$V_{S(CLOSE)}$ = 3 V, $V_{S(OPEN)}$ = 0.0 V, R_L = 300 Ω, C_L = 35 pF	Room Full	20		70 105		70 80	
Turn-On Time	t_{ON}	R_L = 300 Ω, C_L = 35 pF V_S = ± 3 V	Room Full	16		60 90		60 65	ns
Turn-Off Time	t_{OFF}		Room Full	15		52 76		52 56	
Break-Before-Make Time Delay	t_D	V_S = 3 V R_L = 300 Ω, C_L = 35 pF	Room Full	15	5		5		
Charge Injection[e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	0.36					pC
Off Isolation[e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	- 58					dB
Bandwidth[e]	BW	R_L = 50 Ω	Room	610					MHz
Channel-to-Channel Crosstalk[e]	X_{TALK}	R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	- 88					dB
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	2.1					
Drain Off Capacitance[e]	$C_{D(off)}$		Room	4.2					pF
Channel On Capacitance[e]	$C_{D(on)}$		Room	11.3					
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_{IN} = 0 V, or V+	Room Full	0.001		0.5 1		0.5 1	
Negative Supply Current	I-		Room Full	- 0.001	- 0.5 - 1		- 0.5 - 1		µA
Ground Current	I_{GND}		Room Full	- 0.001	- 0.5 - 1		- 0.5 - 1		

SPECIFICATIONS FOR SINGLE SUPPLY

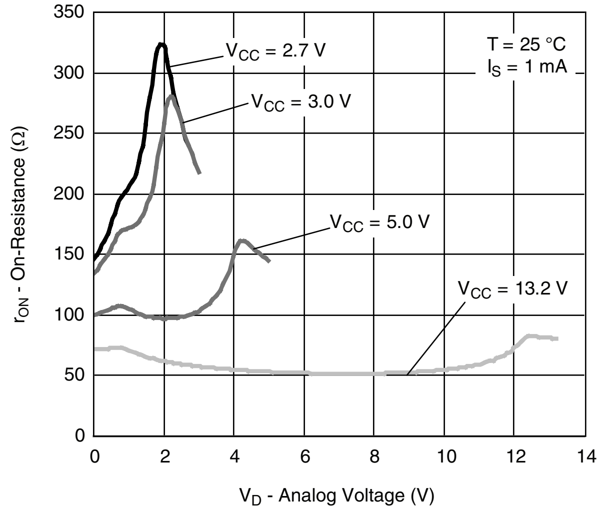
Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 5 V, V- = 0 V $V_{IN\ A0,\ A1\ and\ ENABLE}$ = 2.0 V, 0.8 V[a]	Temp.[b]	Typ.[c]	- 40 to 125 °C Min.[d]	- 40 to 125 °C Max.[d]	- 40 to 85 °C Min.[d]	- 40 to 85 °C Max.[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full			5		5	V
On-Resistance	$r_{DS(on)}$	I_S = 1 mA, V_D = + 3.5 V	Room Full	120		170 250		170 200	Ω
On-Resistance Match	Δr_{ON}	I_S = 1 mA, V_D = + 3.5 V	Room Full	3		5 12		5 10	Ω
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	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
	$I_{D(off)}$		Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
Channel On Leakage Current	$I_{D(on)}$	V+ = 5.5 V, V- = 0 V V_S = V_D = 1 V/4.5 V	Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
Digital Control									
Input Current, V_{IN} Low	I_L	$V_{IN\ A0,\ A1\ and\ ENABLE}$ Under Test = 0.8 V	Full	0.005	- 0.1	0.1	- 0.1	0.1	µA
Input Current, V_{IN} High	I_H	$V_{IN\ A0,\ A1\ and\ ENABLE}$ Under Test = 2.0 V	Full	0.005	- 0.1	0.1	- 0.1	0.1	µA
Input Capacitance	C_{IN}	f = 1 MHz	Room	4.3					pF
Dynamic Characteristics									
Transition Time	t_{TRANS}	$V_{S(CLOSE)}$ = 3 V, $V_{S(OPEN)}$ = 0.0 V, R_L = 300 Ω, C_L = 35 pF	Room Full	36		75 120		75 95	ns
Enable Turn-On Time	$t_{ON(EN)}$		Room Full	30		70 102		70 80	ns
Enable Turn-Off Time	$t_{OFF(EN)}$		Room Full	17		47 88		47 63	ns
Break-Before-Make-Time	t_{BMM}		Room Full	23	 5		 5		ns
Charge Injection	Q	C_L = 1 nF, R_{GEN} = 0 Ω, V_{GEN} = 0 V	Full	0.1					pC
Off-Isolation[e]	OIRR	f = 10 MHz, R_L = 50 Ω, C_L = 5 pF	Room	- 58					dB
Crosstalk[e]	X_{TALK}		Room	- 81					dB
Bandwidth[e]	BW	R_L = 50 Ω	Room	520					MHz
Total Harmonic Distortion	THD	Signal = 1 V_{RMS}, 20 Hz to 20 kHz, R_L = 600 Ω	Room	0.009					%
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	2.5					pF
Drain Off Capacitance[e]	$C_{D(off)}$			6.4					pF
Channel On Capacitance[e]	$C_{D(on)}$			11.3					pF
Power Supplies									
Power Supply Current	I+	V_{IN} = 0 V, or V+	Room Full	0.001		0.5 1		0.5 1	µA
Negative Supply Current	I-		Room Full	- 0.001	- 0.5 - 1		- 0.5 - 1		µA
Ground Current	I_{GND}		Room Full	- 0.001	- 0.5 - 1		- 0.5 - 1		µA

SPECIFICATIONS FOR SINGLE SUPPLY

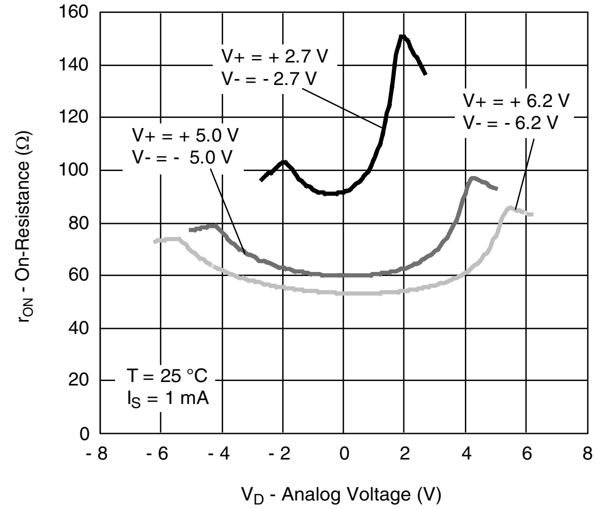
Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 3 V, V- = 0 V $V_{IN\ A0,\ A1\ and\ ENABLE}$ = 1.4 V, 0.6 V[a]	Temp.[b]	Typ.[c]	- 40 to + 125 °C Min.[d]	- 40 to + 125 °C Max.[d]	- 40 to + 85 °C Min.[d]	- 40 to + 85 °C Max.[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full			3		3	V
On-Resistance	$r_{DS(ON)}$	I_S = 1 mA, V_D = + 1.5 V	Room Full	200		245 325		245 290	Ω
On-Resistance Match	Δr_{ON}	I_S = 1 mA, V_D = + 1.5 V	Room Full	5		6 13		11 6	Ω
Switch Off Leakage Current	$I_{S(off)}$	V+ = 3.0 V, V- = 0 V V_D = 1 V/3.0 V, V_S = 3.0 V/1 V	Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
	$I_{D(off)}$		Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
Channel On Leakage Current	$I_{D(on)}$	V+ = 3.0 V, V- = 0 V $V_S = V_D$ = 1 V/3.0 V	Room Full	± 0.01	- 0.1 - 18	0.1 18	- 0.1 - 0.5	0.1 0.5	nA
Digital Control									
Input Current, V_{IN} Low	I_L	$V_{IN\ A0,\ A1\ and\ ENABLE}$ Under Test = 0.6 V	Full	0.005	- 1	1	- 1	1	µA
Input Current, V_{IN} High	I_H	$V_{IN\ A0,\ A1\ and\ ENABLE}$ Under Test = 1.4 V	Full	0.005	- 1	1	- 1	1	µA
Input Capacitance	C_{IN}	f = 1 MHz	Room	4.3					pF
Dynamic Characteristics									
Transition Time	t_{TRANS}	$V_{S(CLOSE)}$ = 3.0 V, $V_{S(OPEN)}$ = 0.0 V, R_L = 300 Ω, C_L = 35 pF	Room Full	95		130 190		130 160	ns
Enable Turn-On Time	$t_{ON(EN)}$		Room Full	77		108 161		108 131	ns
Enable Turn-Off Time	$t_{OFF(EN)}$		Room Full	35		76 112		76 88	ns
Break-Before-Make-Time	t_{BMM}		Room Full	45	 5		 5		ns
Charge Injection	Q	C_L = 1 nF, R_{GEN} = 0 Ω, V_{GEN} = 0 V	Full	1.2					pC
Off-Isolation[e]	OIRR	f = 10 MHz, R_L = 50 Ω, C_L = 5 pF	Room	- 57					dB
Crosstalk[e]	X_{TALK}		Room	- 93					dB
Bandwidth[e]	BW	R_L = 50 Ω	Room	442					MHz
Total Harmonic Distortion	THD	Signal = 1 V_{RMS}, 20 Hz to 20 kHz, R_L = 600 Ω	Room	0.09					%
Source Off Capacitance[e]	$C_{S(off)}$	f = 1 MHz	Room	2.5					pF
Drain Off Capacitance[e]	$C_{D(off)}$			6.4					pF
Channel On Capacitance[e]	$C_{D(on)}$			11.7					pF
Power Supplies									
Power Supply Current	I+	V_{IN} = 0 V, or V+	Room Full	0.001		0.5 1		0.5 1	µA
Negative Supply Current	I-		Room Full	- 0.001	- 0.5 - 1		- 0.5 - 1		µA
Ground Current	I_{GND}		Room Full	- 0.001	- 0.5 - 1		- 0.5 - 1		µA

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.

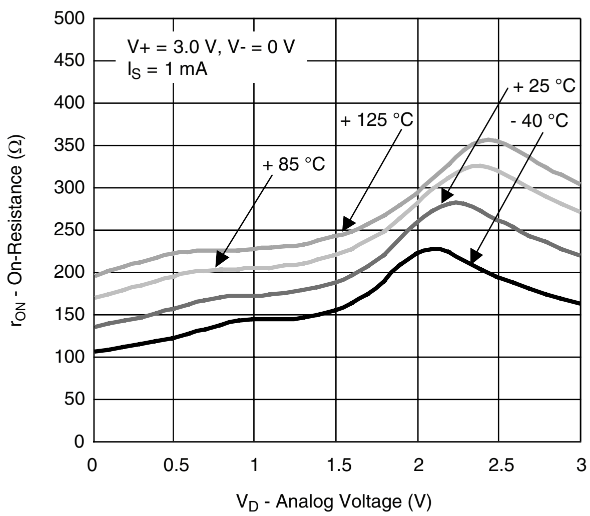
TYPICAL CHARACTERISTICS 25 °C



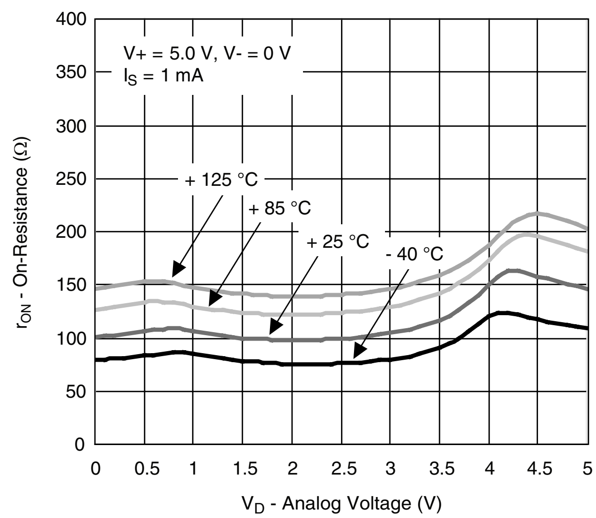
On-Resistance vs. V_D (Single Supply Voltage)



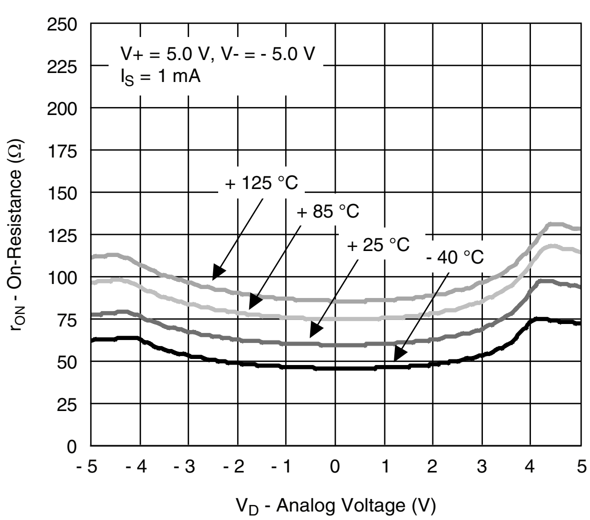
On-Resistance vs. V_D (Dual Supply Voltage)



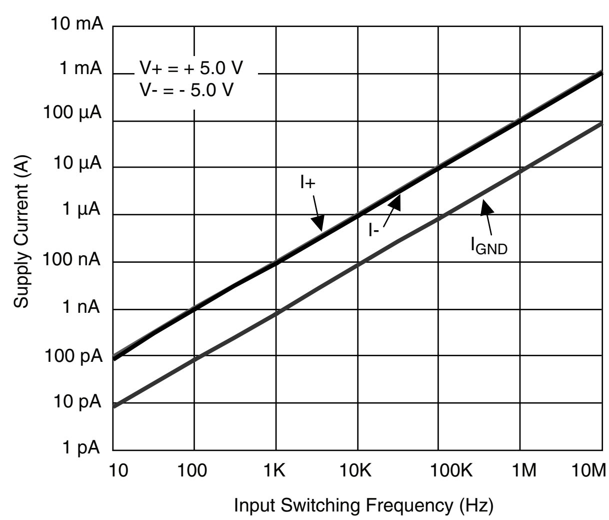
On-Resistance vs. Analog Voltage and Temperature



On-Resistance vs. Analog Voltage and Temperature

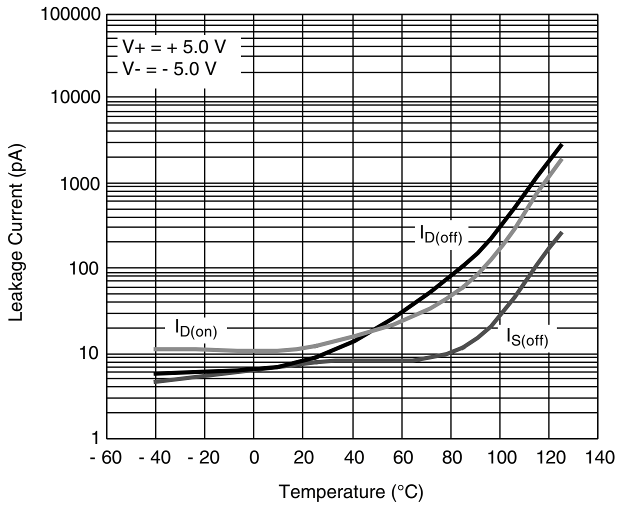


On-Resistance vs. Analog Voltage and Temperature

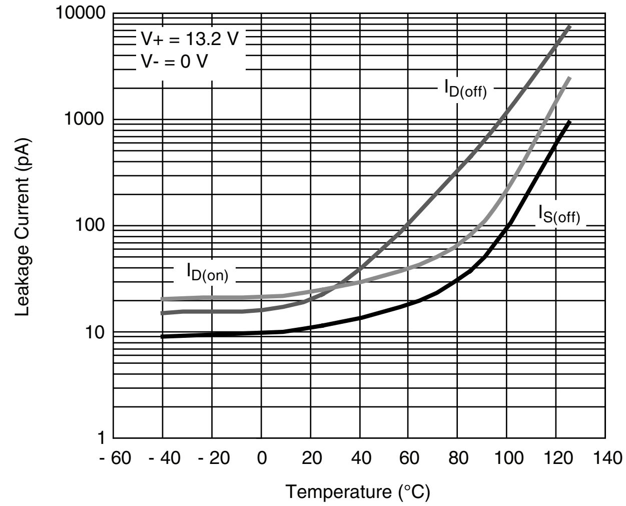


Supply Current vs. Input Switching Frequency

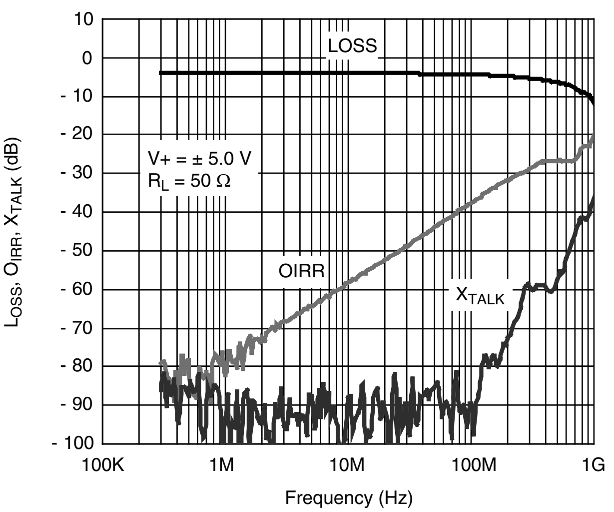
TYPICAL CHARACTERISTICS 25 °C



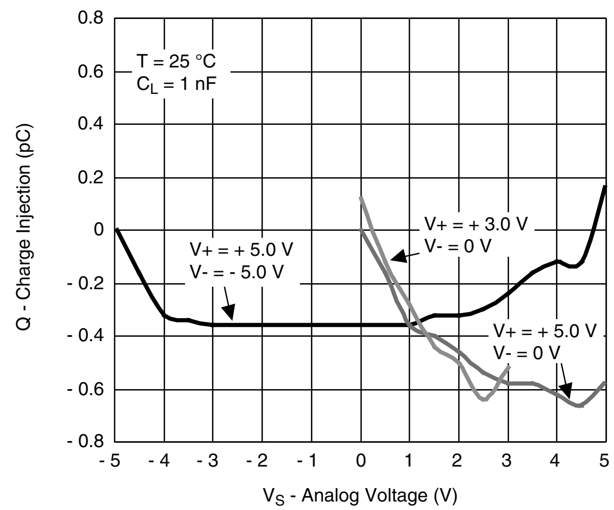
Leakage Current vs. Temperature



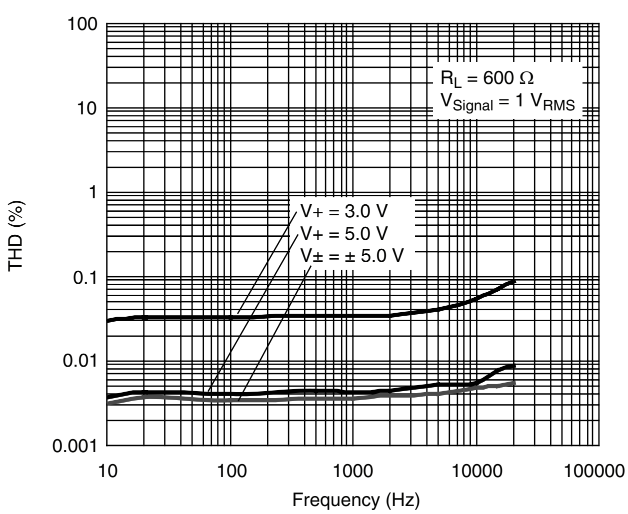
Leakage Current vs. Temperature



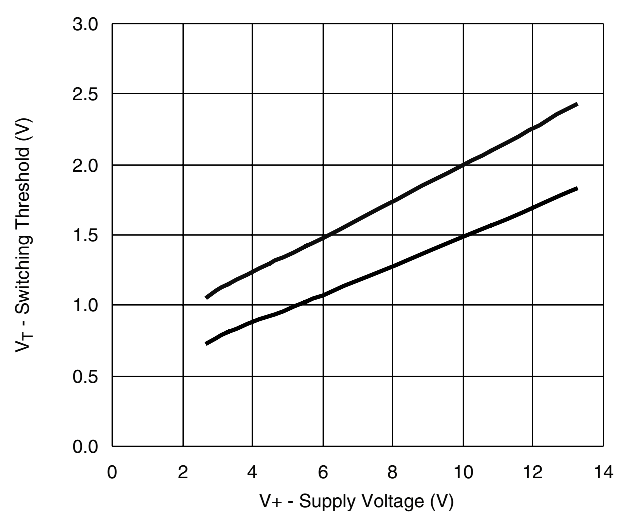
Insertion Loss, Off-Isolation, Crosstalk vs. Frequency



Charge Injection vs. Analog Voltage



Total Harmonic Distortion vs. Frequency



Switching Threshold vs. Supply Voltage

TEST CIRCUITS

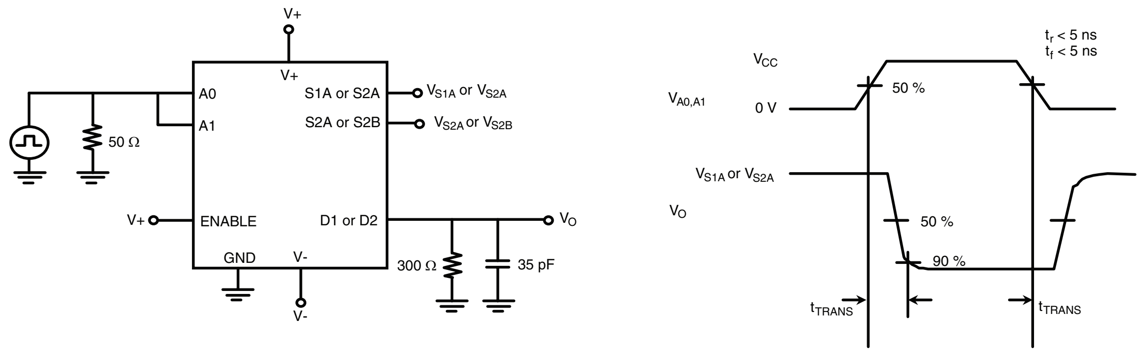


Figure 1. Transition Time

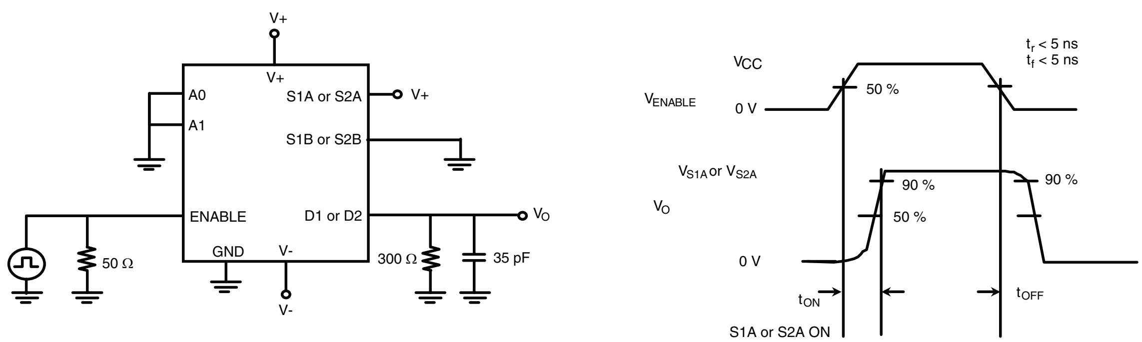


Figure 2. Enable Switching Time

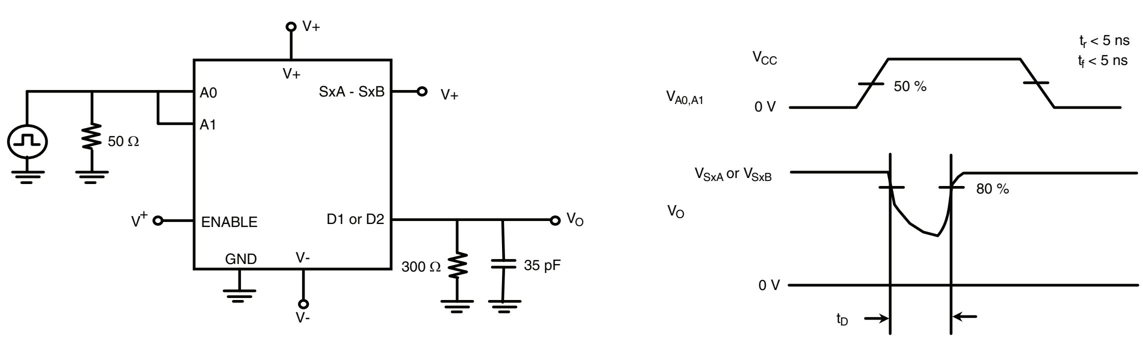


Figure 3. Break-Before-Make

TEST CIRCUITS

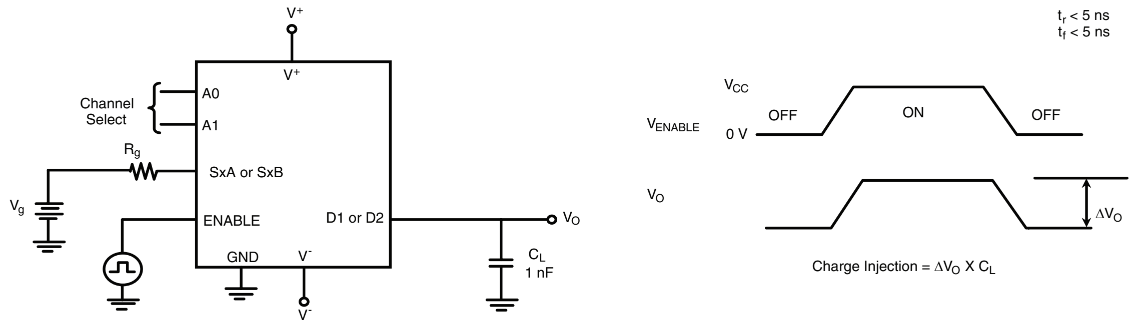
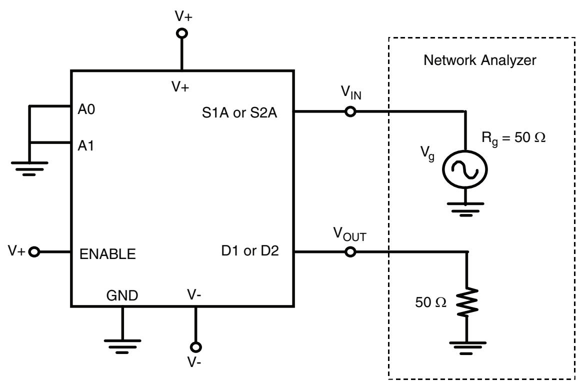
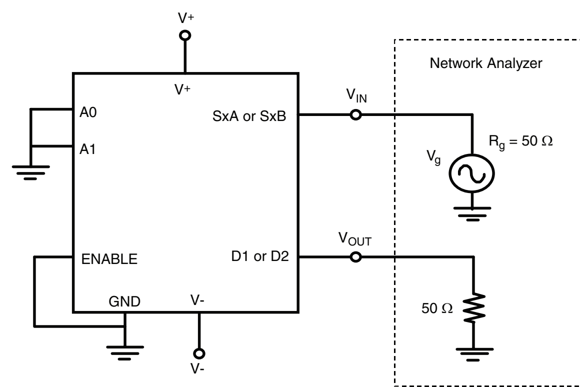


Figure 4. Charge Injection



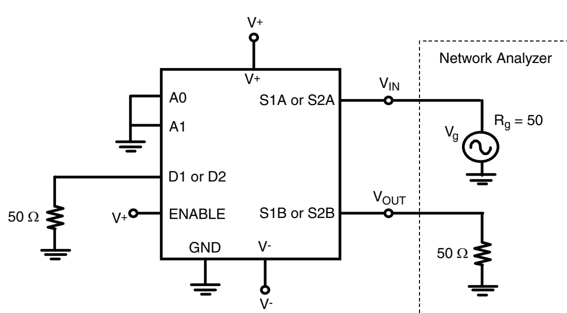
Insertion Loss = 20 log $\frac{V_{OUT}}{V_{IN}}$

Figure 5. Insertion Loss



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

Figure 6. Off-Isolation



Cross Talk = 20 log $\frac{V_{OUT}}{V_{IN}}$

Figure 7. Crosstalk

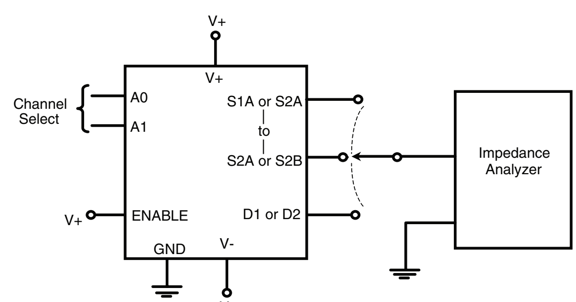


Figure 8. Source/Drain Capacitance

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 http://www.vishay.com/ppg?69901.

Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.