LC²MOS Precision Mini-DIP Analog Switch

ADG419

FEATURES

44 V supply maximum ratings
V_{SS} to V_{DD} analog signal range
Low on resistance: <35 Ω
Ultralow power dissipation: < 35 µW
Fast transition time: 160 ns maximum
Break-before-make switching action
Plug-in replacement for DG419

FUNCTIONAL BLOCK DIAGRAM

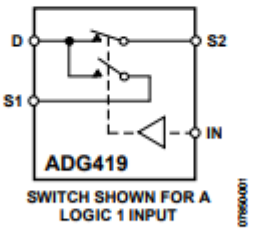

Figure 1.

APPLICATIONS

Precision test equipment
Precision instrumentation
Battery-powered systems
Sample hold systems

GENERAL DESCRIPTION

The ADG419 is a monolithic CMOS SPDT switch. This switch is designed on an enhanced LC²MOS process that provides low power dissipation yet gives high switching speed, low on resistance, and low leakage currents.

The on resistance profile of the ADG419 is very flat over the full analog input range, ensuring excellent linearity and low distortion. The part also exhibits high switching speed and high signal bandwidth. CMOS construction ensures ultralow power dissipation, making the parts ideally suited for portable and battery-powered instruments.

Each switch of the ADG419 conducts equally well in both directions when on and has an input signal range that extends to the supplies. In the off condition, signal levels up to the supplies are blocked. The ADG419 exhibits break-before-make switching action.

PRODUCT HIGHLIGHTS

1. Extended Signal Range.
   The ADG419 is fabricated on an enhanced LC²MOS process, giving an increased signal range that extends to the supply rails.
2. Ultralow Power Dissipation.
3. Low R_{ON}.
4. Single-Supply Operation.
   For applications where the analog signal is unipolar, the ADG419 can be operated from a single rail power supply. The part is fully specified with a single 12 V power supply and remains functional with single supplies as low as 5 V.

SPECIFICATIONS

DUAL SUPPLY

V_{DD} = 15 V ± 10%, V_{SS} = −15 V ± 10%, V_L = 5 V ± 10%, GND = 0 V, unless otherwise noted.

Table 1.

	B Version			T Version			
Parameter[1]	**+25°C**	**−40°C to +85°C**	**−40°C to +125°C**	**+25°C**	**−55°C to +125°C**	**Unit**	**Test Conditions/Comments**
ANALOG SWITCH							
Analog Signal Range			V_{SS} to V_{DD}		V_{SS} to V_{DD}		
R_{ON}	25			25		Ω typ	V_D = ±12.5 V, I_S = −10 mA
	35	45	45	35	45	Ω max	V_{DD} = +13.5 V, V_{SS} = −13.5 V

LEAKAGE CURRENTS							V_{DD} = +16.5 V, V_{SS} = −16.5 V
Source Off Leakage, I_S (Off)	±0.1			±0.1		nA typ	V_D = ±15.5 V, V_S = ∓15.5 V; see Figure 12
	±0.25	±5	±15	±0.25	±15	nA max	
Drain Off Leakage, I_D (Off)	±0.1			±0.1		nA typ	V_D = ±15.5 V, V_S = ∓15.5 V; see Figure 12
	±0.75	±5	±30	±0.75	±30	nA max	
Channel On Leakage, I_D, I_S (On)	±0.4			±0.4		nA typ	V_S = V_D = ±15.5 V; see Figure 13
	±0.75	±5	±30	±0.75	±30	nA max	
DIGITAL INPUTS							
Input High Voltage, V_{INH}		2.4	2.4		2.4	V min	
Input Low Voltage, V_{INL}		0.8	0.8		0.8	V max	
Input Current							
I_{INL} or I_{INH}		±0.005	±0.005		±0.005	µA typ	V_{IN} = V_{INL} or V_{INH}
		±0.5	±0.5		±0.5	µA max	
DYNAMIC CHARACTERISTICS[2]							
$t_{TRANSITION}$	160	200	200	145	200	ns max	R_L = 300 Ω, C_L = 35 pF; V_{S1} = ±10 V, V_{S2} = ∓10 V; see Figure 14
Break-Before-Make Time Delay, t_D	30			30		ns typ	R_L = 300 Ω, C_L = 35 pF; V_{S1} = V_{S2} = ±10 V; see Figure 15
	5			5		ns min	
Off Isolation	80			80		dB typ	R_L = 50 Ω, f = 1 MHz; see Figure 16
Channel-to-Channel Crosstalk	90			70		dB typ	R_L = 50 Ω, f = 1 MHz; see Figure 17
C_S (Off)	6			6		pF typ	f = 1 MHz
C_D, C_S (On)	55			55		pF typ	f = 1 MHz
POWER REQUIREMENTS							V_{DD} = +16.5 V, V_{SS} = −16.5 V
I_{DD}	0.0001			0.0001		µA typ	V_{IN} = 0 V or 5 V
	1	2.5	2.5	1	2.5	µA max	
I_{SS}	0.0001			0.0001		µA typ	
	1	2.5	2.5	1	2.5	µA max	
I_L	0.0001			0.0001		µA typ	V_L = 5.5 V
	1	2.5	2.5	1	2.5	µA max	

[1] Temperature ranges are as follows: B Version: −40°C to +125°C; T Version: −55°C to +125°C.
[2] Guaranteed by design, not subject to production test.

SINGLE SUPPLY

V_{DD} = 12 V ± 10%, V_{SS} = 0 V, V_L = 5 V ± 10%, GND = 0 V, unless otherwise noted.

Table 2.

	B Version			T Version			
Parameter[1]	**+25°C**	**−40°C to +85°C**	**−40°C to +125°C**	**+25°C**	**−55°C to +125°C**	**Unit**	**Test Conditions/Comments**
ANALOG SWITCH							
Analog Signal Range			0 to V_{DD}		0 to V_{DD}	V	
R_{ON}	40			40		Ω typ	V_D = 3 V, 8.5 V, I_S = −10 mA
		60	70		70	Ω max	V_{DD} = 10.8 V
LEAKAGE CURRENT							V_{DD} = 13.2 V
Source OFF Leakage, I_S (Off)	±0.1			±0.1		nA typ	V_D = 12.2 V/1 V, V_S = 1 V/12.2 V; see Figure 12
	±0.25	±5	±15	±0.25	±15	nA max	
Drain OFF Leakage, I_D (Off)	±0.1			±0.1		nA typ	V_D = 12.2 V/1 V, V_S = 1 V/12.2 V; see Figure 12
	±0.75	±5	±30	±0.75	±30	nA max	
Channel ON Leakage, I_D, I_S (On)	±0.4			±0.4		nA typ	V_S = V_D = 12.2 V/1 V; see Figure 13
	±0.75	±5	±30	±0.75	±30	nA max	

DIGITAL INPUTS							
Input High Voltage, V_{INH}		2.4	2.4		2.4	V min	
Input Low Voltage, V_{INL}		0.8	0.8		0.8	V max	
Input Current							
I_{INL} or I_{INH}		±0.005	±0.005		±0.005	µA typ	$V_{IN} = V_{INL}$ or V_{INH}
		±0.5	±0.5		±0.5	µA max	
DYNAMIC CHARACTERISTICS[2]							
$t_{TRANSITION}$	180	250	250	170	250	ns max	R_L = 300 Ω, C_L = 35 pF; V_{S1} = 0 V/8 V, V_{S2} = 8 V/0 V; see Figure 14
Break-Before-Make Time Delay, t_D	60			60		ns typ	R_L = 300 Ω, C_L = 35 pF; $V_{S1} = V_{S2}$ = 8 V; see Figure 15
Off Isolation	80			80		dB typ	R_L = 50 Ω, f = 1 MHz; see Figure 16
Channel-to-Channel Crosstalk	90			70		dB typ	R_L = 50 Ω, f = 1 MHz; see Figure 17
C_S (Off)	13			13		pF typ	f = 1 MHz
C_D, C_S (On)	65			65		pF typ	f = 1 MHz
POWER REQUIREMENTS							V_{DD} = 13.2 V
I_{DD}	0.0001			0.0001		µA typ	V_{IN} = 0 V or 5 V
	1	2.5	2.5	1	2.5	µA max	
I_L	0.0001			0.0001		µA typ	V_L = 5.5 V
	1	2.5	2.5	1	2.5	µA max	

[1] Temperature ranges are as follows: B Version: –40°C to +125°C; T Version: –55°C to +125°C.
[2] Guaranteed by design, not subject to production test.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C unless otherwise noted.

Table 3.

Parameter	Rating
V_{DD} to V_{SS}	44 V
V_{DD} to GND	–0.3 V to +25 V
V_{SS} to GND	+0.3 V to –25 V
V_L to GND	–0.3 V to V_{DD} + 0.3 V
Analog, Digital Inputs[1]	V_{SS} – 2 V to V_{DD} + 2 V or 30 mA, whichever occurs first
Continuous Current, S or D	30 mA
Peak Current, S or D (Pulsed at 1 ms, 10% Duty-Cycle Maximum)	100 mA
Operating Temperature Range	
Industrial (B Version)	–40°C to +125°C
Extended (T Version)	–55°C to +125°C
Storage Temperature Range	–65°C to +150°C
Junction Temperature	150°C
CERDIP Package, Power Dissipation	600 mW
θ_{JA}, Thermal Impedance	110°C/W
Lead Temperature, Soldering (10 sec)	300°C
PDIP Package, Power Dissipation	400 mW
θ_{JA}, Thermal Impedance	100°C/W
Lead Temperature, Soldering (10 sec)	260°C
SOIC Package, Power Dissipation	400 mW
θ_{JA}, Thermal Impedance	155°C/W
MSOP Package, Power Dissipation	315 mW
θ_{JA}, Thermal Impedance	205°C/W
Lead Temperature, Soldering	
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C

[1]Overvoltages at IN, S or D is clamped by internal diodes. Limit current to the maximum ratings given.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

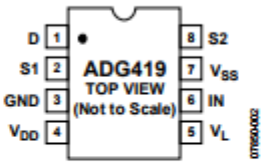

Figure 2. Pin Configuration

Table 4. Pin Function Description

Pin No.	Mnemonic	Description
1	D	Drain terminal. May be an input or an output.
2	S1	Source terminal. May be an input or an output.
3	GND	Ground (0 V) reference.
4	V_{DD}	Most positive power supply potential.
5	V_L	Logic power supply (5 V).
6	IN	Logic control input.
7	V_{SS}	Most negative power supply potential in dual-supply applications. In single-supply applications, it may be connected to GND.
8	S2	Source terminal. May be an input or an output.

Table 5. Truth Table

Logic	Switch 1	Switch 2
0	On	Off
1	Off	On

TYPICAL PERFORMANCE CHARACTERISTICS

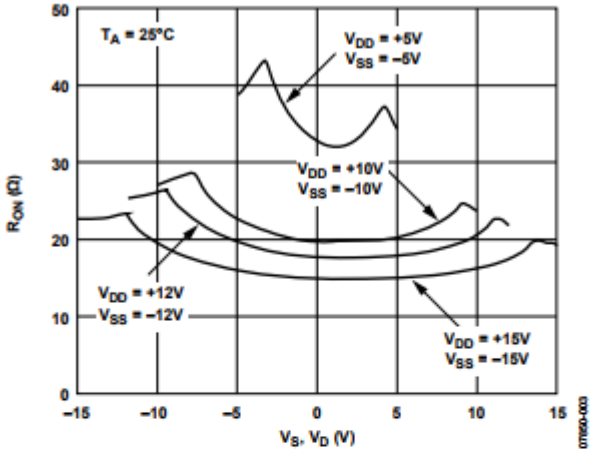

Figure 3. R_{ON} as a Function of V_D (V_S), Dual-Supply Voltage

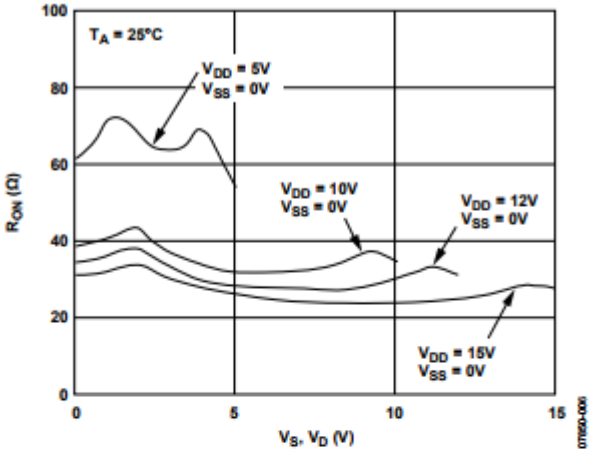

Figure 6. R_{ON} as a Function of V_D (V_S), Single-Supply Voltage

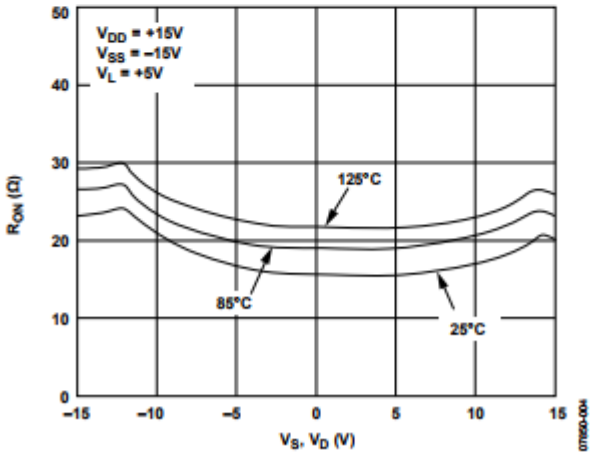

Figure 4. R_{ON} as a Function of V_D (V_S) for Different Temperatures

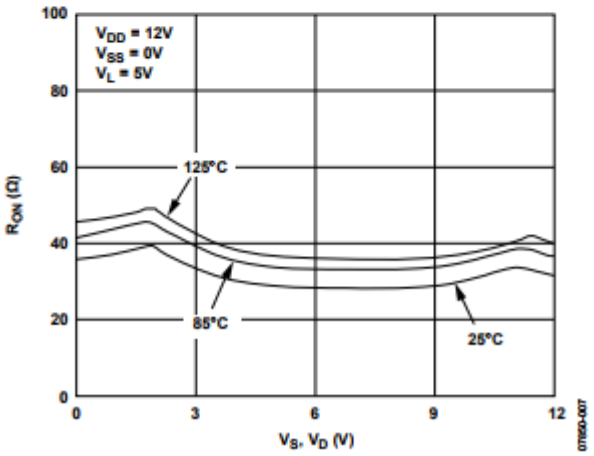

Figure 7. R_{ON} as a Function of V_D (V_S) for Different Temperatures

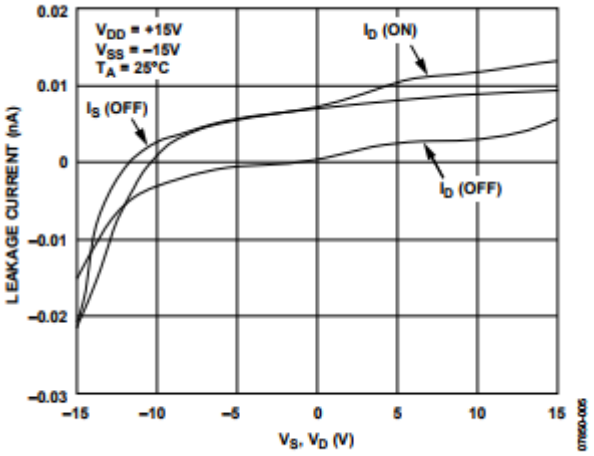

Figure 5. Leakage Currents as a Function of Vs (V_D)

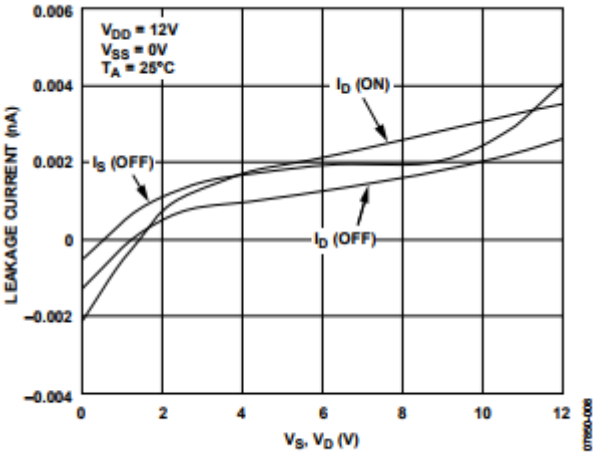

Figure 8. Leakage Currents as a Function of Vs (V_D)

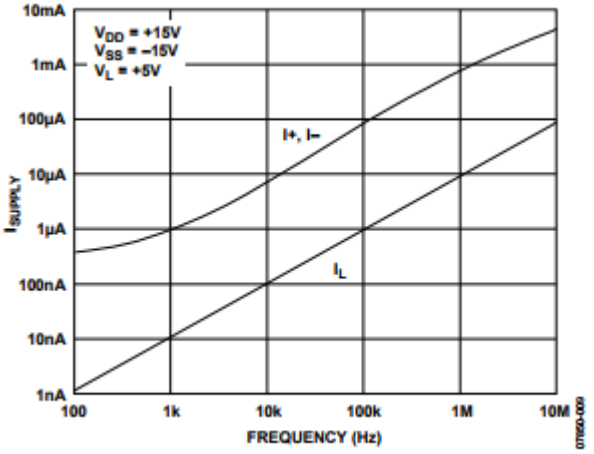

Figure 9. Supply Current (I_{SUPPLY}) vs. Input Switching Frequency

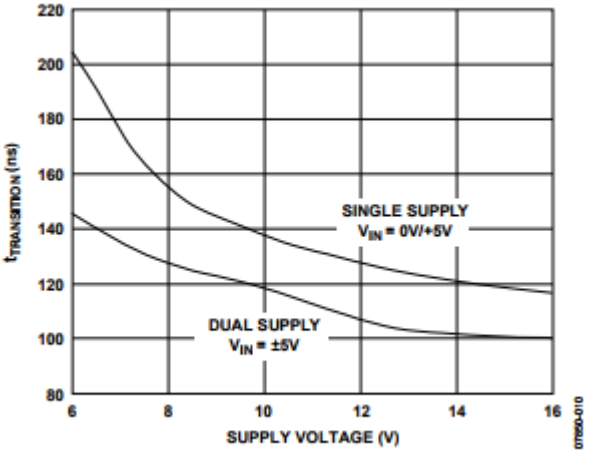

Figure 10. Transition Time ($t_{TRANSITION}$) vs. Power Supply Voltage

TEST CIRCUITS

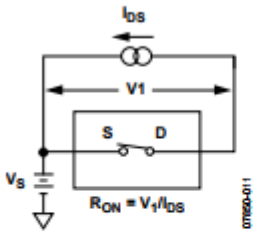

Figure 11. On Resistance

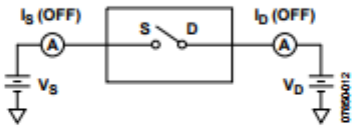

Figure 12. Off Leakage

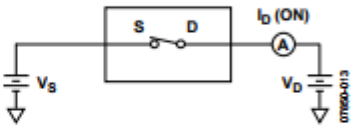

Figure 13. On Leakage

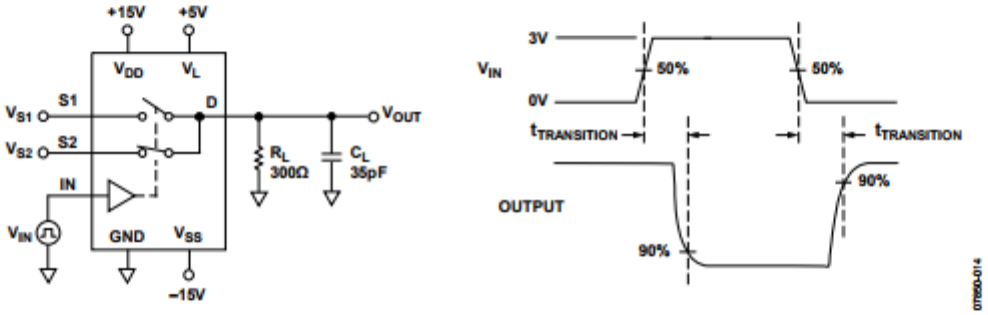

Figure 14. Transition Time, $t_{TRANSITION}$

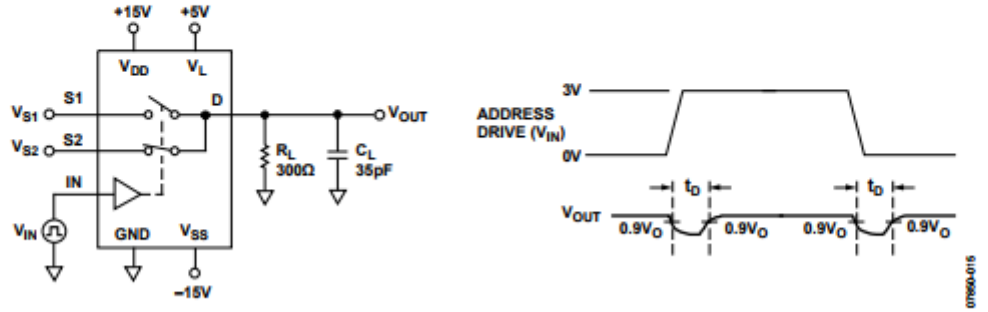

Figure 15. Break-Before-Make Time Delay, t_D

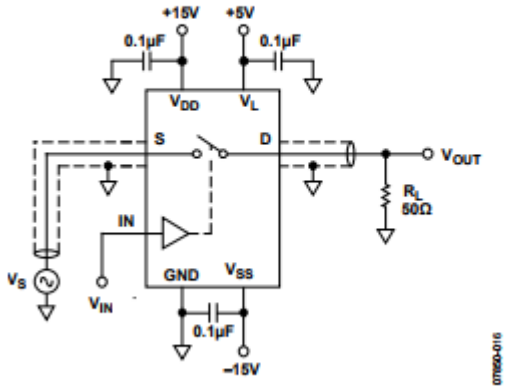

Figure 16. Off Isolation

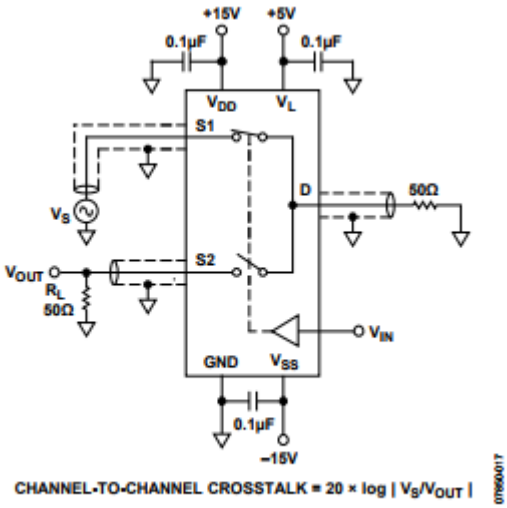

Figure 17. Crosstalk

TERMINOLOGY

V_{DD}
Most positive power supply potential.

V_{SS}
Most negative power supply potential in dual-supply applications. In single-supply applications, it may be connected to GND.

V_L
Logic power supply (5 V).

GND
Ground (0 V) reference.

S
Source terminal. May be an input or an output.

D
Drain terminal. May be an input or an output.

IN
Logic control input.

R_{ON}
Ohmic resistance between D and S.

I_S (Off)
Source leakage current with the switch off.

I_D (Off)
Drain leakage current with the switch off.

I_D, I_S (On)
Channel leakage current with the switch on.

V_D (V_S)
Analog voltage on terminals D, S.

C_S (Off)
Off switch source capacitance.

C_D, C_S (On)
On switch capacitance.

$t_{TRANSITION}$
Delay time between the 50% and 90% points of the digital inputs and the switch on condition when switching from one address state to another.

t_D
Off time or on time measured between the 90% points of both switches when switching from one address state to the other.

V_{INL}
Maximum input voltage for Logic 0.

V_{INH}
Minimum input voltage for Logic 1.

I_{INL} (I_{INH})
Input current of the digital input.

Crosstalk
A measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance.

Off Isolation
A measure of unwanted signal coupling through an off channel.

I_{DD}
Positive supply current.

I_{SS}
Negative supply current.